An Investigation of Attentional Bias in Test Anxiety

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Abstract

Test anxiety is an individual personality trait, which results in elevated state anxiety in situations of performance evaluation. For school-age children, high-stakes examinations occurring at the culmination of programmes of study are where they frequently experience such evaluation. Alongside its impact on an individual’s wellbeing, heightened test anxiety has been reliably linked to deficits in performance on examinations and assessments.

Attentional bias has been shown to be an aspect of many forms of anxiety and is considered to have role in the maintenance of state anxiety, though the mechanisms underlying this are not fully clear. However, Attentional Control Theory (Eysenck, Derakshan, Santos, & Calvo, 2007) implicates preferential allocation of attention to threat in its explanation of performance deficits associated with test anxiety. The presence of attentional bias in test anxiety appears theoretically plausible with some empirical support (e.g. Putwain, Langdale, Woods and Nicholson, 2011); however, its reliability is under question.

This study aims to investigate the presence of attentional bias in test anxiety, with a view to further understanding its underlying mechanisms and informing the development of interventions to ameliorate its effects. To ensure ecological validity, this study was conducted in schools and colleges, with a sample of 16-18-year olds following high-stakes programmes of study. Full investigation of test anxiety requires individuals to experience heightened state anxiety through performance evaluation threat; hence, the Trier Social Stress Test (TSST) was modified to make it applicable to this context and population.

This study was conducted in two experimental phases, both of which adopted a mixed methodological approach to provide quantitative and qualitative data. The preliminary phase evaluated the materials and anxiety manipulation protocols. The main phase employed the modified-TSST in collaboration with a dot-probe task to investigate participants’ attentional bias when under high performance evaluation threat.

No patterns of attentional bias were uncovered to indicate a consistent relationship to either trait test anxiety or attentional control. However, there was a level of congruence between how some individuals describe themselves in evaluative situations and the attentional bias they displayed. Further investigation employing mixed methodological approaches such as Single Case Experimental Design is recommended to identify and address attentional bias in test anxiety.
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The Author

The author of this thesis holds a BSc (Hons) in Chemistry, a PGCE in Secondary Education and an MEd in Psychology of Education. Prior to undertaking this project, he was a secondary school Science teacher for 15 years and held several leadership roles in both the pastoral and academic areas of education. While in the positions of Head of Year 11 and Assistant Head of 6th Form, the author became increasingly aware of, and concerned about, the impact of the examination process on young people, and felt that the pressure and anxiety they experienced was in some way detrimental to both their wellbeing and academic performance.

In 2011, the author left the teaching profession to pursue a Master’s degree in Psychology of Education; during this he learned that the concerns he had surrounding the impact of examinations and testing on young people were investigated through research in the field of Test Anxiety. A basic level of research experience was gained completing a project for his Masters dissertation; however, the substantive research experience of this author was gained while undertaking the work for this thesis.

The author is still working in the field of education and currently holds the position of Lecturer in Secondary Education on the PGCE course at the University of Manchester.
Chapter 1 Introduction

High-stakes examinations at the culmination of compulsory education are a component of most education systems. In the English school system, these examinations take the form of the General Certificate of Secondary Education (GCSE) and Advanced Level (A-Level) qualifications, taken at the ages of 16 and 18 respectively. In preparation for these, students will sit numerous class tests, end of year assessments, and mock examinations. The outcome of GCSEs and A-Levels have long-term consequences on an individual’s access to higher education and employment opportunities. As education in the UK has become increasingly target-driven and accountable, examination such as GCSE’s and A-Levels are also used as performance indicators for schools and colleges. They are an influential measure in the formation of school league tables and are also employed to assess the performance of individual teachers. Taken together, it is unsurprising that school-age children perceive the examination and assessment process as pressurised, and that it is a source of anxiety for some.

1.1 Test Anxiety

Test Anxiety is form of anxiety that is specific to examinations and other situations of performance evaluation. It describes the tendency to appraise examinations as threatening and leaves the individual predisposed to experience elevated levels of state anxiety at times of evaluation and assessment (Putwain & Daly, 2014; Spielberger & Vagg, 1995). This brings with it a range of cognitive and physiological reactions that are experienced in a dynamic manner, which is unique to the individual and their appraisal and reappraisals of the situation they find themselves in (Whitaker Sena, Lowe, & Lee, 2007; Zeidner, 1998). Test anxiety is a complex construct that has developed over time, with the dimensions of worry, test irrelevant thinking, tension and bodily symptoms now being widely recognised in instruments designed to measure and quantify it.

Test anxiety is a phenomenon that was first recognised as separate to general anxiety in the 1950’s, leading to a field of research attempting to define and explain it. More recently, linked to the increased pressure within education, test anxiety research has been on the increase again (Putwain, 2008). Despite this large body of evidence, the prevalence of higher levels of test anxiety in school-age populations has been difficult to quantify, with estimates ranging between 10% and 40% (von der Embse, Barterian, & Segool, 2014). Even if the true figure lies at the lower end of this range, it
would still represent many tens of thousands of children and adolescents sitting high-
stakes examinations each year while vulnerable to heightened anxiety.

Test anxiety, as with any form of anxiety, poses a threat to an individual’s wellbeing, this alone should be a reason to explore ways to mitigate its impact. Additionally, test anxiety is also a cause for concern to those working in education as it has been reliably linked with deficits in academic performance (Hembree, 1988; Seipp, 1991). While these deficits are difficult to quantify, this is the area that has driven much of the research into test anxiety, in an effort to understand the mechanisms which may be responsible for the reduced attainment of test anxious students.

1.2 Attentional Bias

An attentional bias is the disproportionate allocation of attention towards stimuli perceived as threatening; this is characterised by preferentially attending to, or difficulty in disengaging attention from such stimuli (Clarke et al., 2015). Attentional bias towards threat has been reliably identified in many anxious populations; however, the mechanisms behind it are unclear (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007; Cisler & Koster, 2010). This is in part due to the practical difficulty in differentiating between the two proposed aspects of attentional bias; an inability to inhibit attending to a stimulus in the first place and subsequently shifting attention away from it. In experimental paradigms used to investigate the construct, both of these attentional patterns may be responsible for similar results.

1.2.1 The dot-probe paradigm.

Dot-probe tasks are an experimental approach commonly used to investigate attentional bias (See, MacLeod, & Bridle, 2009). Briefly, using a computer, a study participant completes multiple trials in which they are simultaneously presented with two stimuli; one threatening and one non-threatening. These are quickly followed by a probe in the location of one of the stimuli; the task is to identify an aspect of this probe, for example, the direction an arrow is pointing. The computer records the reaction time to each probe, these can then be analysed to investigate if there are patterns in the time taken to respond to each type of trial. A difference in the reaction time to threatening and non-threatening trials indicates the presence of an attentional bias; with faster responses to probes in the location of threatening stimuli considered to show a bias towards threat.
1.3 Attentional Bias in Test Anxiety

Despite being found in many forms of anxiety, attentional bias has rarely been explicitly investigated and identified in test anxiety; however, its presence in this situational specific form of anxiety would make conceptual sense. Where attentional bias in test anxious individuals has been identified (Putwain et al., 2011), the findings have proven difficult to replicate. In explaining the negative impact of test anxiety on academic performance, Attentional Control Theory (Eysenck et al., 2007) describes processes that have much in common with attentional bias; hence, there is evidence to suggest the presence of attentional bias in test anxiety is an area that warrants further investigation.

1.4 Investigating Test Anxiety

A difficulty in conducting research into test anxiety, is that it is an underlying personality trait which only impacts on individuals when they are experiencing heightened state anxiety brought on by performance evaluation threat (Spielberger & Vagg, 1995; Zeidner, 1998). Hence, investigations need to be carried out in situations where individuals perceive performance evaluation threat to be present. Laboratory simulations are frequently employed; however, naturalistic settings provide a greater level of ecological validity, which may be beneficial to the development and implementation of interventions that stem from the advancement of theory.

In the context of children and schools, high-stakes examinations would appear to be the ideal setting in which to investigate test anxiety; however, due to the possibility of any investigation having an impact on the outcome of the assessment this is a practical impossibility. From a research ethics point of view this would be questionable, practically, schools would simply not agree to it. Hence, experimental simulations are required that can be employed in educational settings to induce similar feelings of performance evaluation threat and state anxiety as real examinations. Importantly, the feelings generated by these proxies must be short-lived and proportionate to the anxiety associated with examinations and assessments.

1.5 Aims

The overarching aim of this study is to investigate the presence of attentional bias in test anxiety within an adolescent population. School-age children were of interest due to the importance of the high-stakes examinations they face. Importantly, should the findings of this work inform the development of interventions into test
anxiety, these would be implemented in schools; hence, a naturalistic study was felt to offer greater ecological validity than laboratory-based investigations. Having conducted a thorough review of the literature in the areas of test anxiety and attentional bias, the aims of the study were:

1. To establish an ethically robust protocol for the study of test anxiety in a naturalistic setting.
2. To investigate the presence of attentional bias in highly state anxious adolescents while under performance evaluation.
3. To explore how any such attentional bias is influenced by trait test anxiety and attentional control in an adolescent population.
4. To explore the relationship of attentional control to trait test anxiety and state anxiety.
5. To investigate if evidence is provided to support and refine the proposed model of impaired performance in test anxious students presented in Figure 2.2.

1.6 Summary of the Methodology

To fully address the aims of this study, it was conducted in two phases. The author developed a performance evaluation elicitation protocol based on the Trier Social Stress Test (TSST). An existing dot-probe task was also reprogrammed to present it in a manner that was practical in naturalistic settings. A preliminary study was carried out to evaluate the impact of the modified-TSST protocol and the utility of the proposed instruments including the dot-probe task. The main study collected data on the participants’ trait test anxiety and attentional control, and employed the modified-TSST protocols and attentional bias dot-probe task (ABDP) to identify and quantify any attentional bias they may experience in a state of heightened performance evaluation threat. In both phases, a semi-structured interview was conducted with all participants at the conclusion of their experimental session.

The preliminary study adopted an experimental design to evaluate the modified-TSST protocols, with participants randomly assigned to low and high performance evaluation threat conditions. The ABDP was used in this phase to ensure research integrity, no data relating to attentional bias was collected.

The main study employed a pre-experimental design in which the high-PET protocol of the modified-TSST was used to induce heightened state anxiety in all participants; in this state, participants completed the ABDP to provide data on their response times to a total of 96 threat and non-threat dot-probe trials.
Chapter 2 - Literature Review

2.1 Introduction to the Literature Review

The literature presented in this chapter is organised into four main sections. The first of these (section 2.2) provides an overview of anxiety in general, discusses the relationship between trait and state anxiety, and outlines some of the main sources of anxiety for school-age children and adolescents. Section 2.3 reviews the body of literature in the field of test anxiety, including how the construct has developed over the last 60 years, some of the theories that underpin it, its prevalence, and its impact on academic performance. Following this, section 2.4 is concerned with the phenomenon of attentional bias. This section will review the evidence for attentional bias in different forms of anxiety, the theoretical models proposed to explain them, and methods for their identification and measurement. Treatment interventions for attentional bias will be considered. The rationale for this study is presented in section 2.5, the research questions can be found in section 2.6.

2.2 Anxiety: An Overview

Anxiety has been a key topic in psychological research for many decades. It is commonly defined as a state of excessive fear, worry and apprehension accompanied by physiological symptoms relating to the arousal of the autonomic nervous system (Eysenck, 1992); describing many affective, motor or physiological responses to non-specific perceptions of danger or threat (Kaplan & Sadock, 1981). Threat can be physical, such as the anticipation or occurrence of bodily harm, or psychological, such as damage to self-esteem or risk to personal welfare (Friedman & Bendas-Jacob, 1997). Along with depression, anxiety is considered one of the psychological outcomes of stress (Searle, Newell & Bright, 2001). While there are individual differences in how anxiety manifests itself, the following components are frequently present: (a) feelings of fear and anticipation of danger without the ability to identify immediate threats accounting for these feelings, (b) physiological arousal and distress, (c) disruption of cognitive control and problem-solving, leading to difficulty in thinking clearly and coping with demands of the immediate environment (Friedman & Bendas-Jacob, 1997). Anxiety is a term that often has negative associations; however, it must be noted that there are situations where a level of anxiety can be considered beneficial. For example, Eysenck (1992) claims anxiety is crucial to survival as it provides a warning sign of threat and danger, suggesting it has a motivational effect and promotes optimal
performance. Where the process of detecting threat and danger becomes over-developed, the frequency and severity of threatening events is exaggerated, resulting in the individual experiencing feelings of anxiety in situations where no threat is present.

### 2.2.1 Trait and state anxiety.

The distinction between state and trait anxiety, established by Spielberger (1966, 1972, 1975), is an important one to clarify. Spielberger (1966, p. 13) describes trait anxiety as “stable individual differences in a unitary, relatively permanent personality characteristic.” Whereas Spielberger (1972, p. 482) defines state anxiety (A-state) as “…evoked whenever a person perceives a particular stimulus or situation as potentially harmful, dangerous or threatening. A-states vary in intensity and fluctuate over time as a function of the amount of stress that impinges on an individual.” Hence, trait anxiety is considered a stable personality trait, which refers to how prone an individual is to experience levels of increased state anxiety in situations perceived as threatening. State anxiety is characterised by the feelings of fear, tension and worry individuals experience in a given situation. Spielberger (1975) also makes clear that while state anxiety can be observed in a person’s behaviour, trait anxiety cannot; rather it’s presence may be indicated by the intensity and frequency of an individual’s episodes of elevated state anxiety.

The relationship between trait and state anxiety suggests that the level of state anxiety experienced at any given moment is impacted by a combination of trait anxiety and the situational stressors being experienced (Eysenck, 1992). Endler and Parker (1990) propose four situational dimensions of trait anxiety; social evaluation, physical danger, ambiguity, and daily routines, while recognising that others are theoretically possible. Their interactional model of anxiety suggests state anxiety is a product of the interaction between a specific dimension of trait anxiety and a situation congruent with that dimension which an individual perceives as threatening. In identical situations, individuals high in a specific dimension of trait anxiety will experience greater state anxiety than individuals lower in that dimension or high in other dimensions. Simply put, an individual with high trait anxiety of flying, will experience greater state anxiety on an aircraft than someone who has less trait anxiety of flying; they will also experience higher state anxiety than an individual with similarly high trait anxiety about examinations. Endler and Parker (1990) provides a range of empirical evidence to support this including, Kowalchuk and Endler (1985) and Endler, King and Herring (1983).
Endler (1988) proposes a framework that also encompasses stress and coping alongside anxiety; individual variables, interact with potentially stressful situations to induce the perception of threat or danger (see Figure 2.1). The perception of threat leads to increases in state anxiety; how the individual manages this state anxiety influences, through a feedback loop, the degree of state anxiety they continue to experience. For example, if they feel overwhelmed by their anxiety, their perception of anxiety will increase. Conversely, if they can deal with the anxiety in a way that allows them to remain in control of the situation, the anxiety they experience will decrease.

![Figure 2.1 Interactional model of stress, anxiety, and coping (reproduced from Endler, 1988)](image)

Research in the field of anxiety shows that the feelings of state anxiety experienced by an individual are the result of a complex interaction between their personality traits and their unique perception of a situation. Additionally, the state anxiety they experience is fluid, with continual reappraisals and feedback leading to its increase or decrease.

### 2.2.2 Sources of anxiety in schools.

As children progress through the English education system, the emphasis quickly changes from learning through exploration and play, towards a more formal and teacher-led structure. While the age at which this shift occurs varies between countries, this structure is broadly representative of most advanced education systems, for example, the United States, Australia, and Europe. With this move towards formality
and structure comes an increased frequency of testing and assessment, and expectations from parents and teachers to perform well; these expectations may become internalised in the child (McDonald, 2001). As children develop, they can understand feedback about their performance and will increasingly evaluate this against their own expectations. They will also begin to make comparisons with their peers (Nicholls, 1976); it will become clear that some children are more academically gifted than others. This has the potential to lead to further anxiety around the assessment and testing process, especially where children perceive themselves as less able than their friends, peers, and siblings. In recent years, the level of accountability in education has increased, with students’ outcomes on examinations being used to measure and even rank the effectiveness of schools and teachers. It is likely that to some extent, this pressure will filter down from school leaders, to classroom teachers, and eventually to the students themselves (McDonald, 2001). Whether intentional or not, this pressure could lead to an increase in the anxiety that these students experience (Putwain, 2008).

McDonald (2001) reviewed literature on the prevalence of anxiety, specifically test anxiety, in school-aged children; concluding that tests and examinations are a major cause of concern to many children. In exploring the sources of anxiety for children in schools, McDonald (2001) found “fear of failure and criticism”, “taking a test”, and “failing a test” to be prevalent (for example, Ollendick, 1983). In a study of over 3000 children, King et al. (1989) found that general fears decreased with age, however, “fear of failure and criticism” did not, Ollendick, King and Frary (1989) found similar patterns, with “fear of failing a test” slightly increasing in older participants. These studies were based in Australia and Australia and the United States. In UK-based research, Kyriacou and Butcher (1993) investigated the sources of stress and anxiety in 15- and 16-year-olds; examinations were the most frequently cited, followed by deadlines for assessed work then revision. Gallagher and Miller’s (1996) study into the sources of worry in Northern Irish adolescents found passing exams to be the greatest cause for concern, with worries relating to exams or schoolwork occurring commonly. McDonald (2001) was careful to present contrasting evidence in the form of Yamamoto, Whittaker and Davies (1998); in this study of children from England, Wales and Northern Ireland, poor marks in an examination was only rated as thirteenth in a list of twenty items. However, in this instance, the participants were asked about occurrences such as “being involved in an accident” and “losing a parent”; events as severe as these had not been included in the other studies cited. This illustrates the difficulty that exists in making direct comparisons between such studies; some research is focussed on
worries found only in educational settings (e.g. Kyriacou & Butcher, 1993), while others look at a far wider range of situations (e.g. Yamamoto et al., 1998). In the case of those looking at a greater range of worries, it could be expected that the loss of a parent would be of greater concern than examinations or schoolwork.

School-age children and adolescents in English schools face a highly-pressured assessment and examination regime. Whether this system has become increasingly demanding over recent years is a contentious issue; however, both in schools and society in general, there is a widely-held perception of a more challenging assessment system with long-term consequences for failure and under-achievement. It would seem unlikely that school-age children and adolescents are unaware of this perception. While it would be unwise to make direct comparisons between a child’s worries about their academic progress and the death of a loved one, it is clear that for many school-age children, concerns about examinations are source of worry and anxiety.

The following section outlines these worries and their impact, through literature in the field of a specific form of anxiety known as “test anxiety”.

2.3 Test Anxiety

2.3.1 Introduction and definition.

Examinations are an inevitable and important fact of life for students at school, college, and university, with formal assessment taking place at the culmination of the majority of programmes of study (Keogh, Bond, French, Richards, & Davis, 2004). Where the outcomes are closely linked to the individual young person’s future educational, employment, or vocational opportunities, tests and examinations are referred to as “high-stakes”. In the English education system, where this work is based, children first encounter formal tests at seven years of age and are then tested regularly at 11, 14, and 16; these are high-stakes examinations that have clear ramifications for both the individual students, their teachers, and their school. Should young people wish to enter higher education they will experience another round of statutory testing at 18, this will decide both the institutions they are able to attend and the courses they can follow. Testing and assessment, albeit in different formats, will then continue through university. Having embarked upon a career, yet more decisions are likely be based on further tests, examinations, or other forms of evaluation. For many reasons, including the importance of formal examinations to an individual’s future opportunities, comparison of performance to peers, and even the process of taking and examination itself, it is not surprising that for many students, examinations are a source of anxiety.
(see section 2.2.2). However, for some individuals, these feelings are characterised by an excessive fear known as test anxiety (e.g. Keogh et al., 2004), which, is thought by many to be detrimental to their performance and achievement (for example, Covington & Omelich, 1987; Zeidner, 1998).

Test anxiety refers to individual differences in the tendency to appraise examinations, or similar instances of performance evaluation as threatening, leading to a range of cognitive and physiological responses (Putwain & Daly, 2014; Spielberger & Vagg 1995). Where test anxiety can be differentiated from general anxiety is that it is considered specific to evaluative situations and academic assessment contexts (Friedman & Bendas-Jacob, 1997). In such situations, where their performance is being judged, test anxious individuals are predisposed to experience heightened levels of state anxiety (Stöber, 2004).

Test anxiety was first conceptualised as encompassing a number of factors associated with assessment, such as attitudes towards the learning establishment, courses, teachers and instructors, as well as tests themselves (McCarthy & Goffin, 2005); this approach is evident in early work in the field, for example, Mandler and Sarason (1952). However, the current consensus is to focus test anxiety research on the examination and assessment process that encompasses a range of current assessment contexts (Putwain, 2007). This includes statutory examinations, informal class tests, coursework and assignments, and oral presentations, all of which may be experienced across different tiers of education. The test anxiety construct could theoretically be applied to instances of testing occurring outside educational contexts, such as driving tests or other manual skills tests; however, occurrences of this in academic literature are rare. What is common throughout all these forms of assessment is what is referred to as “ego threat” (Spielberger, 1966). This occurs when an individual’s performance is evaluated by others, with a judgement made about the person’s abilities or skills; if success on these tasks is considered important to an individual’s self-esteem, it follows that failure and its consequences would be considered as threatening. Situations where the rewards for success or consequence of failure are pertinent, such as examinations to decide an individual’s place at University, could be perceived as being especially threatening. However, there need not be long-term implications for ego threat to be present.

There is no single agreed definition of test anxiety, though the majority of research in the area displays a commonality of approach, encompassing a situation causing the anxiety and the impact of this situation on the individual. For example,
Zeidner (1998, p.25) describes test anxiety as “the set of cognitive, affective and behavioural reactions that accompany concern over possible negative consequences contingent on a test or evaluative situation”, with Nicaise, (1995) and Whitaker Sena et al., (2007) considering test anxiety to be “an individual’s physiological, cognitive, and behavioural responses that stimulate negative feelings about an evaluation.” Suinn (1968, p.365) defined test anxiety in a manner that encapsulated some of its impact: “an inability to think or remember, a feeling of tension and difficulty in reading or comprehending simple sentences or directions during an examination”. Task-irrelevant behaviour was also described by Sarason (1972, p.410); “a tendency to emit personalised task-irrelevant responses when the individual experiences heightened awareness that his performance is being evaluated.”

For the purposes of this work, test anxiety is considered a personality trait, which leaves individuals predisposed to interpret examinations and tests as threatening. In situations of performance evaluation, this results in them experiencing heightened levels of state anxiety and an associated range of cognitive, physiological and behavioural responses.

2.3.2 Development of test anxiety research.

The test anxiety construct was first investigated in the 1950s, with the work of Mandler and Sarason (1952) being credited as the first to recognise it as stand-alone construct (Hembree, 1988); since then interest in the area has grown with numerous studies being documented (Zeidner, 1998). Research into test anxiety grew through the 1970’s, reaching its peak in the early 1980’s with attempts to define both a causal mechanism for its impact on academic performance and to develop interventions to counter this impact (Zeidner, 1998). Despite a drop in research volume after this time, test anxiety has reappeared in the foreground of research in recent years due to policy changes leading to increased accountability and curricular becoming ever more outcome-driven (Putwain, 2008). This approach to assessment has become prevalent in most formal education systems, including England, where this work is situated. Much of the work in the field of test anxiety has been carried out in the United States; however, there are important cultural and structural differences between the education systems of the two countries, meaning that findings from the US cannot automatically be ascribed to UK populations. Hence, detailed research into how test anxiety manifests itself in UK/English school populations is required.
The approaches taken to define the test anxiety construct have varied as a function of the theoretical perspectives of the researchers working in the area (Lowe et al., 2007). Early test anxiety research was focused around a motivational construct and psychological drives, and was reflective of general anxiety (e.g. Mandler & Sarason, 1952; Spence & Spence, 1966). Research shifted in the late-1960s towards a cognitive model of anxiety; for example, Liebert & Morris (1967), giving rise to theories of test anxiety as a cognitive-attentional phenomenon (Wine, 1971; Sarason, 1972). These theories propose an individual must divide their attention between task-relevant thoughts (e.g. addressing the requirements of a task) and task-irrelevant thoughts (e.g. worries about their performance and/or the consequences of failure). This division of attention was proposed to have a negative impact on task performance (Wine, 1971). In the 1980’s a skills deficit paradigm generated interest (e.g., Benjamin, McKeachie, Lin, & Holinger, 1981; Culler & Holahan, 1980; Kirkland & Hollandsworth, 1980). This suggests students with poor study or test-taking skills struggle encoding and organising academic material; therefore, performing poorly on tests. This proposed that test anxiety was a result of their experience of repeated failures due to a lack of the required skills, rather than being a cause of their academic difficulties.

More recently, Processing Efficiency Theory (Eysenck & Calvo, 1992) and Attentional Control Theory (Eysenck et al., 2007), have provided a promising and detailed explanation of how test anxiety impacts upon individuals in evaluative situations leading to deficits in task performance. These appear to support and extend cognitive-attentional models of test anxiety.

2.3.3 The multidimensional nature of test anxiety.

It is widely accepted that test anxiety is a multidimensional construct with distinct cognitive and physiological components (Putwain & Daly, 2014). Liebert & Morris (1967) were the first to propose a two-dimensional model of test anxiety composed of two related but independent factors: worry and emotionality, this brought with it a change from the early focus of research on psychological drives, towards a more cognitive construct of test anxiety.

Within this model, worry is conceptualised as “any cognitive expression of concern about one's own performance”; emotionality is used to encapsulate “autonomic reactions which tend to occur under examination stress” (Liebert & Morris, 1967, p. 975). McDonald (2001) characterised worry as (i) unfavourable comparisons with others (e.g. “all my friends will do better than me on this test”), (ii) doubts about ability
(e.g. “I can’t do tests, so I’m going to do badly on this one”), and (iii) negative beliefs about the consequences of poor test performance (e.g. “if I do badly on this test my friends will think I’m stupid”). McDonald (2001) also suggested emotionality, the physiological component of test anxiety, manifests itself in a range of ways, including muscle tension, increased heart rate, sweating, and nausea. Cassady and Finch (2015) associated the worry factor of test anxiety with specific beliefs and behaviours including; (i) heightened perceived threat for tests; (ii) reduced cognitive processing skills; (iii) cognitive interference and susceptibility to distraction; and (iv) task avoidance, disengagement, and acceptance of failure.

A body of work, (for example, Eysenck & Calvo, 1992) concluded, based on the findings of Liebert & Morris (1967), that worry and emotionality are related with a high degree of correlation between them; however they are considered different constructs and are triggered by different aspects of the examination situation. Worry is elicited by internal or external stimuli in situations where failure is perceived as imminent (Deffenbacher & Hazaleus, 1985; Eysenck, 1992), or where one’s coping resources are perceived as inadequate (Sarason & Sarason, 1990); these lead the individual to consider the examination as threatening to their self-esteem (i.e. ego threat). Emotionality has been proposed to be triggered by solely external cues surrounding the examination situation, such as the room itself, the presences of invigilators or the distribution of exam papers (Deffenbacher & Hazaleus, 1985).

Using a measure of state test anxiety, the Worry-Emotionality Questionnaire (WEQ), Smith and Morris (1976), and Morris and Engle (1981) provided further support for worry and emotionality being different constructs, showing they display different patterns throughout an examination; worry scores remained relatively constant, while emotionality scores decreased. Where participants were given feedback on their performance on an item by item basis as they completed an assessment, it was shown that worry scores also decreased (Morris & Fulmer, 1976). This also suggests worry is triggered by an individual’s own perception of failure and/or an inability to cope with the task; where external feedback is provided, it counters these perceptions and worry appears to decrease.

Morris and Liebert (1969) reported that worry was associated with deficits in performance on examinations, whereas there was no relationship between emotionality and performance, thus supporting Liebert and Morris’s (1967) earlier conclusion that the two are different constructs. A large body of evidence appears to confirm the worry component of test anxiety has strong negative correlations with academic performance.
(for example, Deffenbacher, Deitz, & Hazaleus, 1981; Deffenbacher & Hazaleus, 1985; Derakshan & Eysenck, 2009; Eysenck & Calvo, 1992; Keogh et al., 2004). The impact of test anxiety on performance will be discussed further in section 2.3.7.

The Reaction to Tests questionnaire (Sarason, 1984) expanded the constructs of worry and emotionality into a four-factor model of test anxiety. The cognitive (worry) component was divided into two sub-components; worry, which refers to the negative thoughts an individual may have about the examination itself, and test-irrelevant thinking, i.e. thoughts that are unrelated to the examination. Emotionality was sub-divided into tension; a sense of distress or unease, and bodily symptoms; physical symptoms such as nausea, sweating, etc. These four components were also employed by Benson, Moulin-Julian, Schwarzer, Seipp & El-Zahhar (1992) in their development of the Revised Test Anxiety Scale.

In summary, test anxiety has long been recognised as a multidimensional construct consisting of two main components; worry and emotionality, these can be further sub-divided. There is a compelling body of evidence to suggest that different aspects of the examination have a differential impact on these components. Therefore, research into test anxiety must consider this multidimensional nature when exploring the construct.

2.3.4 Trait and state test anxiety.

As noted earlier, when discussing anxiety in general (section 2.2.1), it is important to make clear distinctions between trait and state test anxiety. Trait test anxiety is an individual’s predisposition to experience higher levels of state anxiety in an examination or similar assessment situation. State anxiety refers to the individual’s feelings of fear, tension and worry, and the physiological symptoms they experience during these situations. Trait test anxiety is widely thought of as a stable personality trait and, as such, does not undergo significant change over time (Spielberger & Vagg, 1995). The level of trait test anxiety at a given point in time can be considered relatively constant for that individual barring any major developmental changes; hence, a measurement taken at time one can be applied to times two and three (Hong, 1998). Conversely, state anxiety is transient; dependent upon the individual’s trait test anxiety, present experiences, and the degree to which they perceive the examination situation as threatening. Therefore, its measurement at a point in time can only be considered relevant to that specific scenario, it cannot be applied to other situations no matter how similar. The transient nature of state test anxiety was illustrated by Hong (1998), who
found increases in state anxiety during an examination when candidates encountered
questions they found difficult, and by MacLeod and Matthews (1988), where state
anxiety was found to increase significantly as an examination approached.

According to Spielberger and Vagg (1995), state anxiety can be considered the
product of several factors, including; individual differences in trait test anxiety, the
student’s perception of their ability in the subject being tested, and the examination
questions or tasks. Unsurprisingly, those individuals higher in trait test anxiety perceive
examinations as more threatening and are more likely to experience higher levels of
state anxiety in such situations. However, due to the factors thought to play a role in the
generation and maintenance of state anxiety, the relationship between trait and state test
anxiety is more complex than it may initially appear. For example, an individual who is
low in trait test anxiety, but perceives themselves to have a poor aptitude for a subject
alongside feeling unprepared for an examination, may well find themselves
experiencing higher state anxiety than a highly trait test anxious peer who, nonetheless,
believes they are good at the subject and feels fully prepared.

Spielberger and Vagg (1995) and Zeidner (1998) both propose transactional
models, which encapsulate the trait-state test anxiety relationship well. These are
discussed below.

2.3.4.1 Spielberger and Vagg’s model (1995).

This model is a framework representing pre-existing conditions, an individual’s
reaction to an evaluative situation, their emotional and cognitive processes, and the
correlates and consequences of test anxiety. This provides “a cross-sectional analysis
of test anxiety as a situation-specific dynamic process” (Spielberger and Vagg, 1995, p.
11). The description of a dynamic process is key; the individual’s experience of the
evaluation is fluid, rather than being fixed at one time point. At the beginning of
assessment, the extent to how the individual appraises the situation as threatening will
depend on a range of factors; their trait test anxiety, their perceived ability in the
subject, and how well their study skills and attitudes lead them to believe they have
prepared.

2.3.4.2 Zeidner’s model (1998).

Zeidner’s transactional model of test anxiety (Appendix 1) also illustrates a
dynamic process and shares many features with that of Spielberger and Vagg (1995). In
Zeidner’s model, state anxiety is again the product of the interaction between trait test
anxiety and an evaluative situation, with success or failure having some relevance to the individual’s goals or values. Important characteristics of the evaluative situation include, the nature of the task and its difficulty, the time constraints, the attitude of the examiner, and the setting in which the task is taking place. How the individual perceives these factors, rather than the characteristics themselves, leads to the state anxiety they experience. The perception of the testing situation as threatening is subjective, Zeidner (1998) suggested the following factors, based upon Eysenck (1992), determine the “threat value” of an assessment situation (reproduced from Zeidner, 1998, pp. 23-24):

- Personal salience of the test (“It’s terribly important that I do well on this exam”)
- Subjective probability of negative test outcomes (“I will almost certainly flunk my organic chemistry exam”)
- Imminence of the exam (“The exam is this Thursday and I haven’t even begun studying yet”)
- Perceived aversiveness of the event (“I detest taking chemistry exams”)
- Perceived unavailability of coping strategies and skills (“I just don’t know how to go about studying for this chemistry midterm”)

2.3.4.3. Summary of trait-state anxiety models.

Due to their commonalities, it is possible to summarise the key proposals of both models together. At the start of an examination, an individual’s trait test anxiety interacts with how threatening they perceive the situation to be, resulting in an initial level of state anxiety. As the assessment progresses, further reappraisals occur, leading to changes in state anxiety levels. Positive reappraisals will lead to a reduction in state anxiety, while negative reappraisals will result in state anxiety increasing. If an individual finds themselves struggling to address the demands of the task, they are likely to reappraise the situation as more threatening than first thought, leading to increases in state anxiety. The associated feelings of tension and physiological arousal can result in further increases in state anxiety. Conversely, an individual who begins to feel successful on the task, may reappraise the situation as less threatening than initially perceived, resulting in a reduction in state anxiety, this in turn can feed into more positive thinking and ongoing lowering of state anxiety levels.
Throughout an examination, individuals are required to employ memory and other cognitive processes to formulate a response to the examination question or satisfy the demands of the task. The worries, test-irrelevant thinking, or other emotional reactions associated with the process of continual reappraisal have the potential to interfere with attention and concentration and may contribute to impaired task performance.

In relation to this study, these models demonstrate how the state anxiety experienced by an individual is due to the interaction between the situation they find themselves in, their levels of trait anxiety, and how they appraise and reappraise themselves and their performance. Hence, individuals will display a range of responses and experience different levels of state anxiety when faced with identical examinations and evaluative situations. Additionally, these models are of practical importance where instruments are being designed to manipulate anxiety; as well as ensuring they can induce state anxiety in the first place, these instruments also need to recognise the dynamic nature of the process and ensure that the feedback and information an individual receives leads them to continue to appraise the situation as challenging or threatening.

2.3.5 How test anxiety manifests itself in individuals.

Zuriff (1997) described three “symptoms” of test anxiety experienced by individuals in examination situations; (a) subjective distress, fear, tension, dizziness, nausea; (b) physical symptoms, increased heart rate, sweaty palms, muscular tension, increased breathing rate; (c) cognitive effects, difficulty in concentrating, what is referred to as “going blank”, an inability to understand the examination questions. Alongside these symptoms, the individual may also experience negative thoughts, including ‘I’m going to fail’, “I cannot do this’, or ‘I’m a failure’.

Zeidner (1998, p. 30) presents these symptoms as three facets of test anxiety; cognitive facets, concerned with worry, self-critical thoughts and test-irrelevant thinking that may interfere with task performance; affective facets, physical reactions, tension, the perception of arousal; behavioural facets, procrastination, different approaches to study and preparation, avoidance behaviours.

While the names of these symptoms, and how they are grouped may appear different, both Zuriff (1997) and Zeidner (1998) suggest there are three areas in which test anxiety manifests itself in an individual:


These manifestations of test anxiety appear congruent with aspects of the multidimensional model proposed in section 2.3.3. Cognitive manifestations encompass the worry and test irrelevant thinking domains, while physical manifestations include tension and physical symptoms.

More recent work has suggested that there is also a social facet to test anxiety, comprising an individual’s concerns about how their performance will be judged by parents, teachers and peers (Lowe et al., 2007; Lowe & Ang, 2012; Lowe, Ang, & Loke, 2011). Examples include, not living up to parents’ expectations, failing to do as well as their siblings, or letting their teachers down. While much of this work was based in the Singaporean education system, recognised to be highly competitive (Lowe et al., 2011), it seems unlikely that these concerns would be absent from the education systems of other countries employing similar high-stakes assessment regimes.

Zeidner (1998) stresses that there is no single, uniform response to examinations by test anxious students; in assessment situations they may experience all, some or none of the symptoms of test anxiety suggested above. Hence, how test anxiety manifests itself must be considered unique to both the individual and the situation they find themselves in; this manifestation, and its impact on the individual, could be argued to be more important than the individual’s absolute level of test anxiety. Therefore, the investigation of test anxiety requires more than simply measuring its levels within populations.

Most research into test anxiety has focussed on the cognitive facet, i.e. worry, as it is commonly thought of as being the most important and debilitating component (e.g. Sarason, 1984; Zeidner, 1998). This is supported by a significant body of research, which suggests that preoccupation with failure, feelings of inadequacy, rumination over the consequences of failure, and negative expectation of self, characterise highly test anxious individuals in examination and evaluative situations (Zeidner, 1998). Hence, it is important to ensure that this facet is fully explored when conducting research into test anxiety; however, the other aspects of test anxiety must not be ignored, otherwise its impact on an individual may not be fully reflected.

2.3.6 Measuring test anxiety.

Test anxiety, as with many areas of psychology and educational psychology, has shown itself to be a complex construct to accurately measure; self-report questionnaires
are by far the most common tool employed in the research field (Friedman & Bendas-
Jacob, 1997; von der Embse, Kilgus, Segool, & Putwain, 2013). A clear distinction
must be made between measures designed to quantify trait test anxiety and state test
anxiety; measures of trait test anxiety ask participants to report how they generally feel
about evaluative situations, while measures of state anxiety require individuals to
indicate how they currently feel in the present situation.

A criticism that can be levelled at the use of self-report measures in general, is
that they rely on self-awareness and honesty. Participants may provide responses which
they believe are socially desirable to give the impression they wish to convey, or they
may feel self-conscious and not provide information that could result in embarrassment
(Paulhus & Vazire, 2009). Where individuals are attempting to present an unbiased
picture of themselves, they may lack the introspection required to give an accurate
reflection of themselves, or may inadvertently hide their true feelings. In the case of
complex concepts, individuals may not have the knowledge or understanding to respond
accurately (Paulhus & Vazire, 2009).

Self-report measures frequently employ rating scales to categorise responses;
while guidance can be given how to interpret these, there will always be a level of
subjectivity; for example, what one person considers often could mean sometimes to
someone else. Hence, clarity of instruction is vital to successfully collecting data using
these instruments.

A solution to these issues is to combine data from self-report questionnaires with
that collected using other methods (von der Embse et al., 2013). Examples include,
studying behaviour in situations similar to that which they are being asked about, or
conducting interviews designed to provide greater depth and context to their
questionnaire responses.

In the field of anxiety research, an alternative to self-report questionnaires is to
employ techniques to measure physiological arousal such as heat rate, respiration, or
even biological markers (for example, Harkness, Stewart, & Wynne-Edwards, 2011;
Hellhammer & Schubert, 2012; von Dawans, Kirschbaum, & Heinrichs, 2011). While
these approaches are not sensitive to the issues of honesty and self-awareness, they are
constrained by individuals having their own physiology. In other words, two
individuals experiencing the same feelings of anxiety or worry may display very
different changes in heart or respiration rate due to numerous other physiological
variables; these are challenging to control and account for.
Due to the sheer number of self-report instruments purported to measure test anxiety, the following sections are not intended to be a comprehensive review of the field; rather they provide a brief overview of the development of what the author considers are the key measures employed in research in this area.

2.3.6.1 Measurement in adults.

Mandler and Sarason (1952) produced the Test Anxiety Questionnaire (TAQ), the first self-report questionnaire specific to test anxiety. This employed a graphical scale upon which participants could indicate their experience of several self-orientated thoughts and physiological reactions immediately before or after an examination. The TAQ was further developed by Sarason (1958) into the Test Anxiety Scale (TAS) by re-writing the statements to facilitate true-false answers; this in turn has undergone further revisions (e.g. Sarason 1978; Sarason & Glanzer, 1962). These early measures were developed before a clear distinction was made between trait and state anxiety and ask respondents about their general feelings towards examinations and assessments as opposed to specific situations (Zeidner, 1998). Hence, they are considered to better encapsulate trait anxiety.

The seminal work of Liebert and Morris (1967) identified questions on the TAQ that were considered to address the two main components of test anxiety; worry and emotionality. This led to the development of the 10-item Worry-Emotionality Questionnaire (WEQ). Instructions for responding to these items state, “indicate how you feel right now”; therefore, the WEQ is considered to measure state test anxiety. Based upon the WEQ, the Revised Worry-Emotionality Questionnaire (Morris, Davies & Hutchings, 1981) was developed, later extended by Meijer (2001) by introducing items relating to self-confidence to form the Revised Worry-Emotionality Scale (RWES).

Spielberger et al. (1978) produced the Test Anxiety Inventory (TAI), a 20-item measure based upon the TAS, this employed a four-point scale to measure the individual differences in trait test anxiety conceptualised as a situation-specific personality trait (Spielberger & Vagg, 1995). The two key goals guiding the development of the TAI were (i) to produce a brief and objective scale to generate a total score that would correlate with other common measures of test anxiety and (ii) to derive sub-scales to measure worry and emotionality. The TAI has been identified as one of the most frequently used measures of test anxiety (Benson et al., 1992) and has been translated in to multiple languages.
The Reactions to Tests scale (RTT: Sarason, 1984) is a 40-item scale that measures the four components of test anxiety proposed by Sarason (1984, 1988); worry, test-irrelevant thinking, tension and bodily symptoms. Based upon these components, Benson et al. (1992) used the TAI and RTT to develop the Revised Test Anxiety Scale (RTA). The RTA comprises 20 items making up four sub-scales; worry (6 items), tension (5 items), test-irrelevant thinking (4 items) and bodily symptoms (5 items), these can be scored individually and combined to generate a total scale score. The RTA was initially successfully cross-validated with independent American and Egyptian samples (Benson & El-Zahhar, 1994), correlations between sub-scales were found to be considerable among tension, worry and bodily symptoms (from .70 to .75); however, test-irrelevant thinking correlated less well (from .26 to .34) (Benson et al., 1992; Benson & El-Zahhar, 1994). This raised the question if test-irrelevant thinking belongs in the test anxiety domain, or if this is capturing thoughts unrelated to worry about test performance (e.g. Hagtvet & Benson, 1997; Spielberger & Vagg, 1995). Despite this question, the RTA has been successfully employed in a number of studies and demonstrated excellent psychometric properties (Keogh et al., 2004; McIlroy, Bunting, & Adamson, 2000; Putwain & Symes, 2011; Putwain et al., 2011). Reliability coefficients for worry ($\alpha = .75$), test-irrelevant thinking ($\alpha = .84$), tension ($\alpha = .79$), and bodily symptoms ($\alpha = .80$) have been shown to be good (Putwain, Woods, & Symes, 2010).

2.3.6.2 Measurement in children.

A large proportion of test anxiety research is carried out with children in schools; however, the majority of measures have been designed for use with, and validated in, adult populations (Anderson & Sauser, 1995; Wren & Benson, 2004). While these instruments may still capture children’s feelings about assessment situations, this raise questions concerning reliability and validity especially in younger children who may have had very different experiences, and be at different stages in their development than adults (Wren & Benson, 2004).

The Test Anxiety Scale for Children (TASC; Sarason et al., 1960) was developed for school-aged children in grades 1-6 (broadly equivalent to the English primary school years), and has been widely used for the investigation of children’s test anxiety. However, Wigfield and Eccles (1989) and Wren and Benson (2004), questioned its continued use, highlighting areas that suggest the TASC is now no longer appropriate, including outdated and/or overly complex wording of some items and
outdated domain definitions (Wren & Benson, 2004). This is particularly important considering the multidimensional nature of test anxiety; the TASC very much reflects the position at the time it was written, of a one-dimensional construct. To address this, Wren and Benson (2004) developed the Children’s Test Anxiety Scale (CTAS), a 30-item self-report instrument with three sub-scales; thoughts, off-task behaviours and autonomic reactions. Von der Embse et al., (2013) reported the CTAS as demonstrating satisfactory internal consistency and commented that the instrument was “promising”.

Recently developed questionnaires, for example the Test Anxiety Scale for Elementary Students (TAS-E: Lowe et al., 2011), the Test Anxiety Inventory for Children and Adolescents (TAICA: (Lowe et al., 2007) and the Test Anxiety Measure for Adolescents (TAMA: Lowe, 2014), have included items relating to the social component of test anxiety to reflect fears about how performance may be judged by others such as peers, parents and teachers (Putwain & Daly, 2014). These instruments are not as widely used as measures such as the RTA; however, an approach from some researchers is to employ sections of these alongside other measures of test anxiety (e.g. Putwain & Daly, 2014).

While these instruments indicate a promising move forward in the measurement of test anxiety in children, they are designed to address a wide range of ages. This is problematical, as the life-experiences and emotional development that will occur throughout the secondary school years (11 to 18 in England) make it very difficult to design an instrument that will be suitable for both younger children and older adolescents. Additionally, the tools mentioned above have often been validated with those at the younger end of their intended audience; hence, while they may be suitable for children and those in their early teenage years, instruments designed for adult populations may well be appropriate for older adolescents.

2.3.6.3 Measurement of test anxiety in this study.

Despite the criticisms of self-report measures, they are advantageous in many ways; they are efficient in collecting large amounts of data, they are relatively easy to administer, and appropriately designed questions facilitate the investigation of complex constructs. Physiological measures, while appearing objective, are complex to use, time consuming, and intrusive; while appropriate in certain circumstances, they would not be feasible for use in a study such as this.

Where self-report measures are employed, care must be taken to ensure that the instruments chosen are suitable for the population under investigation, their reliability
and validity must also be considered. As the population of interest in this study was aged between 16-18 years old, it was felt that a scale designed for adults would be more appropriate in terms of its wording. Having reviewed several options, the Revised Test Anxiety Scale was considered the most suitable choice for use in this study. To address some of the issues highlighted, the author made contemporaneous notes on the behaviour of participants in an evaluation situation, further information was also collected from participants in the form of a short semi structured interview (see section 3.4.2).

2.3.7 Prevalence of test anxiety, demographic variations, and academic performance.

2.3.7.1 Prevalence of test anxiety.

King and Ollendick (1989) observed that while a large amount of research had been done to establish the nature and impact of test anxiety, few studies had attempted to establish the proportion of school children and adolescents who experience high levels of test anxiety. Despite this being written almost 30 years ago, there is still work to be done to clearly establish the proportion of school-age children experiencing test anxiety at times of examinations and assessments.

One difficulty in clarifying this proportion lies in defining the point at which self-reported test anxiety scores could be considered problematical, as assigning variables from a continuous distribution into distinct categories is a challenging procedure (DeCoster, Iselin, and Gallucci, 2009; MacCallum et al. 2002). Categorising responses in this way can limit individual differences and suggest a level of homogeneity between values that have been grouped together that does not exist. Additionally, this can imply that categories are discrete from one another, when in fact they may be similar constructs expressed to a greater or lesser extent (Putwain & Daly, 2014). Hence, the practice of categorising responses from continuous distributions is not generally encouraged; however, there may be conditions where it may be possible to justify this (Putwain & Daly, 2014). There is considerable evidence to suggest that individuals scoring highly on measures of test anxiety perform less well when their academic performance is assessed compared to those demonstrating lower levels of test anxiety (e.g. Hembree, 1988; Seipp, 1991), see sections 2.3.7.3 to 2.3.7.6. Hence, with appropriate caution, it may be beneficial to establish the proportion of school-age students who fall into the range of what is considered “high” test anxiety.
Attempts to quantify the prevalence of detrimental test anxiety have frequently proved inconclusive; rates in the region of 10-40% of school-age students have been proposed (von der Embse et al., 2014). Such a broad estimation could be an artefact of two linked factors: a) prevalence rates are frequently identified from studies where this was not the principal aim, and b) sample sizes are smaller than would be required to reliably identify prevalence rates (Putwain & Daly, 2014).

In a recent large-scale study into the prevalence of test anxiety, Putwain and Daly (2014) collected data from a large sample of 14-16-year-olds from 11 schools in England; 16.4% of the sample reported themselves to be highly test anxious, with female students (22.5%) reporting a significantly higher proportion than male students (10.3%). Currently this is the most comprehensive indication of the prevalence rates of test anxiety in school-age children; however, this sample was taken from a narrow geographic and demographic range, further research into this area would be beneficial. In England over 600,000 students sit their GCSE examinations each year, the figures from Putwain and Daly (2014) suggest approximately 100,000 of these may be experiencing high levels of test anxiety.

Regardless of definitive information into the numbers of children affected by test anxiety, few would contest that the negative emotional responses experienced by many students in relation the testing and evaluation process has an impact on their academic achievement (Cassady & Johnson, 2002; McIlroy et al., 2000), with Covington and Omelich (1987, p. 393) claiming “The fact that anxiety arousal is associated with decrements in performance is incontestable.” Therefore, anxiety induced by the examination process is of interest to those working in both research and education as it is thought to have a detrimental impact on academic success, self-esteem and wellbeing (Hembree, 1988; Seipp, 1991).

2.3.7.2 Demographic factors associated with test anxiety.

Demographic factors such as age, gender, ethnicity and socio-economic status have been considered significant predictors of test anxiety scores (Hembree, 1988; McDonald, 2001; Zeidner, 1998). Female participants have frequently been shown to score more highly on self-report measures of test anxiety (e.g. Hembree, 1988; Putwain & Daly, 2014; Seipp & Schwarzer, 1996), though exceptions to this pattern have been reported (Seipp, 1991). These gender differences have been found to be greater in the emotionality component than in the worry component of test anxiety (e.g. Putwain 2007; Zeidner 1990; Zeidner and Schleyer 1999). The gender differences observed in
test anxiety reflect those found in other areas of self-reported anxiety; however, it is not clear if this is due to constructs underpinning anxiety, or an indication that females are more willing to report their anxious thoughts and feelings (Egloff & Schmukle, 2004). Stöber (2004) suggests there are differences in how male and female students prepare for examinations; reporting that male students were more likely to use avoidance tactics, while female students approached the examination in a more productive and focused manner. Putwain and Daly (2014) highlight the contradictory nature of findings in this area; female students employed more effective coping strategies, yet experienced greater examination-related anxiety than males. It is proposed this shows males to be less aware of the threats posed by formal high-stakes examinations due to their greater reliance on avoidance than females.

There are clearly gender differences in self-reported test anxiety, though it is less clear if there are gender differences in the state anxiety experienced by individuals, or merely differences in how students respond to attempts to measure the construct.

The levels of test anxiety associated with age have been shown to increase gradually as children progress through primary school, in late childhood or early adolescence they then appear to stabilise (Hembree, 1988; Wigfield & Eccles, 1989). When this stabilisation occurs is a matter of debate; Hembree (1988) observed it to remain static from ages 10-11, while Wigfield and Eccles (1989) suggested test anxiety levels continue to increase throughout the high school years up to the age of 14. Clearly, by the ages of 16-18, when students in the English education system take their high-stakes GCSE and A-level examinations, their levels of test anxiety will have reached stability.

In summary, considering the lack of consistent and clear evidence on the impact of factors such as gender and age on levels of test anxiety, studies into the phenomenon should attempt to draw participants from as diverse a range of backgrounds as possible, this will serve to ensure findings are increasingly generalisable to wider populations.

2.3.7.3 Test anxiety and academic performance - introduction.

The negative appraisals of the examination process associated with test anxiety have been shown to have a detrimental impact on academic success (Bonaccio & Reeve, 2010; Hembree, 1988; Owens, Stevenson, Hadwin, & Norgate, 2014; Seipp, 1991; Von der Embse & Hasson, 2012) While this impact has not been straightforward to quantify, meta-analyses uncovering correlations in the region of $r = -0.25$ between test anxiety and academic achievement are broadly representative of the research in the
field (Hembree, 1988; Seipp, 1991). Alongside deficits in performance, Lowe (2014) also identified where test anxiety has been linked to emotional distress (Jackson, 2010; Lobman, 2013), lower self-esteem (Pekrun, 2000), and an increase in mental health issues (King, Mietz, Tinney, & Ollendick, 1995).

Research into the impact of test anxiety on academic performance is reflective of the view that is widely held both inside and outside the research community; that anxiety is considered counter-productive to an individual’s performance on any form of task or assessment. Hence the focus of test anxiety research has been to ascertain the negative impact test anxiety may have on attainment in examinations. However, this automatic assumption is one that must be cautioned against and the relationship between test anxiety and assessment performance must be explored alongside factors that may influence the relationship between the two.

2.3.7.4 Debilitating and facilitating effects of test anxiety.

While the negative impact of test anxiety is an important area of research, it must be recognised that a level of anxiety is considered facilitative for some individuals in certain circumstances (e.g. Hembree, 1988; Zeidner, 1998). The inverted-U shaped relationship between anxiety and performance, the so-called Yerkes-Dodson Law (Yerkes-Dodson, 1908), has been in existence for many years. To simplify, it states that the optimum level of arousal in a situation lies somewhere towards the middle of the scale on which it is being measured rather than at the extremes. In the case of test anxiety, McDonald (2001) suggests that in a situation where an individual perceived there were no consequences of failure nor reward for doing well, they would not be sufficiently motivated to perform to their potential. However, if the level of anxiety experienced exceeds the optimum level, it will lead to performance being compromised. The practical difficulty with this, while theoretically sound, is that the optimum level of arousal is unique to the individual; a situation that may results in one person feeling well-motivated to perform, could result in debilitating levels of anxiety in another.

Despite early theories discussing the possibility of a facilitating effect of test anxiety, the clear majority of research has focussed on its negative aspects and assumed a relationship in which, as test anxiety increases, examination performance falls.

2.3.7.5 The relationship between test anxiety and academic performance.

There have been a vast number of studies over the past 60 years investigating the relationship between test anxiety and performance in evaluative situations, with a
wide range of sources showing a negative relationship between test anxiety and academic performance in both adults and children (e.g. Cassady & Johnson, 2002; Hembree, 1988; Seipp, 1991; Smith & Smith, 2002; Zeidner, 1998). While it cannot be considered a fact, there is a consensus, that for many individuals test anxiety is detrimental to academic and task performance; however, there is some disagreement on the magnitude of this impact. Such a large body of evidence can be challenging to analyse; though, two comprehensive meta-analyses by Hembree (1988) and Seipp (1991) provide compelling evidence. While relatively dated, there is nothing in the current literature to compare with their scope; hence, their findings are still considered relevant today (e.g. Steinmayr, Crede, McElvany, & Wirthwein, 2016).

2.3.7.6 Meta-analysis evidence for the TA/performance relationship.

Hembree (1988) collected data from 562 studies conducted between 1952 and 1986 and used performance measures such as IQ scores, achievement measures, grade point average (GPA), and laboratory tasks (e.g. memory and problem solving tasks). While the geographical location of the studies was not included, given that institutions in the United States dominated the field of test anxiety research during this time, it would be likely most of the data originated in the USA. Overall, this study found a negative correlation ($r = -0.29$) between test anxiety and academic performance. As reductions in test anxiety were also found to be associated with improvements in performance, Hembree (1988) claimed that there was evidence to indicate test anxiety was a cause of poor academic performance. While this causal relationship makes conceptual sense, caution must be taken when inferring causal relationships from non-directional analyses.

Table 2.1 A summary of correlations between test anxiety and academic performance (adapted from Hembree, 1988)

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Mean effect size*</th>
<th>US school grade**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement</td>
<td>-0.29</td>
<td>4 - 6, 8 - PS</td>
</tr>
<tr>
<td>Worry component</td>
<td>-0.31</td>
<td>9 - PS</td>
</tr>
<tr>
<td>Emotionality component</td>
<td>-0.15</td>
<td>9 - PS</td>
</tr>
</tbody>
</table>

* All effect sizes are significant, $p < .01$  **PS = post-secondary education
Table 2.1 shows that significant negative associations between test anxiety and performance were found from grade 4 upwards; as test anxiety increased, performance fell. The magnitude of the relationship is larger for the worry component of test anxiety when compared to the emotionality component.

Hembree (1988) also identified several variables that moderate the relationship between test anxiety and performance, leading to following conclusions:

- There was a significant inverse relationship between test anxiety and performance from grade 3 upwards; as test anxiety increased, performance fell.
- There was a stronger relationship between worry and performance than between emotionality and performance.
- Gender did not moderate the test anxiety/performance relationship.
- The relationship between test anxiety and performance was stronger for students of an average ability than for those of higher or lower abilities.

Seipp (1991) carried out a meta-analysis of 126 studies from between 1975 to 1988, focussing on the relationship between anxiety and academic performance. Both US and European based studies were included; however, information on the participants’ ages, ability, and school year were lacking. In agreement with Hembree (1988), this meta-analysis found a negative relationship between test anxiety and performance (overall $r = -.21$), with a stronger relationship for the worry component of test anxiety than the emotionality component. The relationship between test anxiety and performance was marginally stronger in females, though it was not concluded to be significant. The country in which the data were collected also showed no effect; however, when examining gender differences alongside the country an interaction was shown for that data which originated in the United States. Hence, the frequently reported gender differences in test anxiety were concluded to be “an over generalisation from USA findings” (Siepp, 1991, p. 31). Seipp (1991) also explored the nature of the test anxiety-performance relationship in terms of the timing of when measurements were taken; a slightly stronger negative relationship was found when test anxiety was measured in advance of the assessment. Hence, the timing of the measurement of test anxiety needs to be a consideration when investigating this relationship in future.

To summarise the findings of Seipp (1991):

- There was a negative relationship between test anxiety and academic performance.
- Worry demonstrated a stronger relationship with test anxiety than emotionality.
• Gender differences were found; however, these were only significant when considered alongside the nationality of the students.
• Both trait and state test anxiety were found to negatively impact performance.

Both Hembree (1988) and Seipp (1991) have produced meta-analyses supporting the findings from a wide body of work that higher levels of test anxiety are associated with lower levels of task performance. They also show it is the worry component of test anxiety that is more strongly associated with these deficits than the emotionality component. The reported effect sizes of -.29 and -.21 respectively may be considered small, accounting for around 4% of the variance in performance seen within the sample populations (Zeidner, 1998). However, this has been interpreted by Seipp (1991) as potentially leading to highly test anxious individuals scoring approximately half a standard deviation lower than their peers on a typical achievement scale. This could have greater impact than the figures alone may suggest as exams are commonly graded based on pre-determined boundaries; hence, a relatively small decrease in the score on an examination could have a disproportionate impact on performance if it causes an individual to drop into a lower grade boundary or from a pass to a fail grade.

It is clear a negative relationship exists between test anxiety and performance on assessed tasks; the widely accepted view in the field is that test anxiety is responsible for deficits in performance. However, the presence of this correlation does not confirm causality and it must be recognised that the relationship between test anxiety and performance is a complex one in which multiple factors may play a role. Greater understanding of the underlying mechanisms which maintain anxiety in evaluative situations may provide further insights into how test anxiety appears to result in deficits in academic performance. This would also facilitate the development of interventions to mitigate the impact of test anxiety with the potential to improve the academic outcomes of test anxious children.

2.4 Attentional Bias: Introduction

Individuals experience countless situations which bring with them a range of positive and negative emotional meanings. Research suggests an individual’s current mood, coupled with longer-term tendencies (such as anxiety), are associated with the emotional aspects of an event that are attended to; additionally, these can lead to a predisposition to interpret emotionally ambiguous events as positive or negative (Matthews & MacLeod, 1994; Mathews & MacLeod, 2002). Where two or more
stimuli are competing for processing resources, individuals with higher levels of trait anxiety are considered more likely to attend to the stimulus they perceive as threatening; they are also more likely to interpret ambiguous information as threatening (Clarke, MacLeod, & Guastella, 2013; Mathews & MacLeod, 2002). This situation is exacerbated when the individual is under stress or pressure resulting in heightened state anxiety. The term commonly used to describe this process is attentional bias; an attentional bias is considered to exist when disproportionate attentional resources are allocated towards stimuli perceived as threatening rather than towards neutral stimuli, including where ambiguous stimuli are processed as threatening (Putwain et al., 2011; Van Bockstaele et al., 2014).

2.4.1 Evidence for attentional bias in anxious populations.

Attentional bias towards threat in anxious populations is a well-established phenomenon (e.g. Bar-Haim et al., 2007; Macleod & Clarke, 2015; MacLeod, Mathews, & Tata, 1986; MacLeod & Mathews, 1988), this bias is either less consistent or not observed at all in non-anxious individuals (Cisler & Koster, 2010). Once established, this bias then appears to persist while the person continues to experience feelings of stress and anxiety (Fox, Russo, & Dutton, 2002). While a causal link between attentional bias and anxiety has been proposed (e.g. Beck & Clark, 1997), more recent evidence would suggest a bidirectional and mutually reinforcing relationship is more likely (Van Bockstaele et al., 2014).

Attentional bias has been observed in many forms of anxiety; however, there is a lack of clarity in the underlying mechanisms that leads to it. Specifically, where bias is observed, it is proposed to be due to either preferential attentional engagement to stimuli considered threatening, or a difficulty in disengaging attention from threatening stimuli. While interesting in the advancement of attentional bias research, this distinction is beyond the scope of this work.

Bar-Haim et al's. (2007) meta-analysis collected data from 172 studies, involving over 4000 anxious and non-anxious participants across a variety of experimental paradigms and conditions. This work concluded that threat-related bias was a robust phenomenon in anxious individuals, which was not present in non-anxious individuals; an aggregate moderate effect size of threat-related bias of $d = .45$ was uncovered. The findings were such that Bar-Haim et al. (2007, p. 15) stated “The meta-analytic finding for the anxious participants cannot be reduced to insignificance in the next 11,339 studies, even if those studies yielded only null results”. Hence, the role of
Attentional bias towards threat in anxious populations is considered a robust facet of the maintenance of heightened levels of state anxiety; though Bar-Haim et al. (2007) recognise that while the association between attentional bias and anxiety is clear, evidence for the causal role of selective attention is still scarce. Work to develop interventions to modify threat bias (e.g. Clarke et al., 2013; Hakamata et al., 2010) appears to support the presence of attentional bias in anxious populations.

Observable characteristics of attentional bias includes threatening stimuli being detected faster than non-threatening stimuli and difficulty in disengaging from threatening stimuli (Cisler & Koster, 2010), these can be investigated using a number of experimental approaches (see section 2.4.4). Techniques employed to indicate the presence of attentional bias may not discriminate between preferential detection and difficulty in disengagement; effectively, what is observed by the researcher in terms of the participant’s reaction times to stimuli (frequently used to indicate the presence of attentional bias) may appear similar, despite the underlying mechanisms responsible for them being different.

2.4.2 Summary of attentional bias in anxious populations.

Models of cognitive interference have long been proposed to explain the negative impact of test anxiety on task performance (for example Wine, 1971; Sarason, 1980). Briefly, these influential models suggest that when experiencing high state anxiety, highly-test anxious individuals must divide their attention between their negative thoughts and worries, and task-related thoughts. This reduces the cognitive resources available to the task, leading to reductions in performance and attainment. Low-test anxious individuals are thought to experience these worries to a far lesser extent, thus leaving greater attentional resources available for the task on which they are being evaluated. These models were conceived long before the term attentional bias was used; however, it could be argued that the division of attention they describe is similar in many ways to current models of attentional bias in anxiety.

Attentional bias has been uncovered in many anxious populations, these include: Generalised Anxiety Disorder, social phobia, Post-Traumatic Stress Disorder, panic disorder, Obsessive Compulsive Disorder, and other specific phobias (for a full review, see Cisler & Koster, 2010). While there are some exceptions, for example Moritz and von Muhlenen (2008) and Moritz et al. (2008), the majority of evidence suggests that attentional bias occurs in equal magnitude across a range of anxiety disorders (Bar-Haim et al., 2007; Cisler & Koster, 2010); therefore, attentional bias does not appear to
be a feature of any specific anxiety disorders, but seems likely to be a component of elevated anxiety (Cisler & Koster, 2010). The association between attentional bias and anxiety is clear; however, evidence suggesting a causal relationship between bias towards threat and state anxiety is not robust and a bidirectional relationship, with attentional bias and state anxiety influencing each other appears more likely (Van Bockstaele et al., 2014).

The broad body of evidence for the presence of attentional bias in a range of anxieties, would suggest it is present in forms of anxiety in which it has not been extensively identified, for example, test anxiety. The identification of attentional bias in test anxiety could further the understanding of the underlying mechanisms that play a role in the maintenance of anxiety in evaluative situations and the deficits in test performance associated with high test anxiety individuals. This could also serve to facilitate the development of interventions to address this bias.

2.4.3 Theories underpinning attentional bias.

Over the last 30 years several models have been proposed to account for the underlying mechanisms of attentional bias seen in anxiety, focusing on individual differences in trait anxiety.

2.4.3.1 Beck and Clark's (1997) cognitive model.

Beck and Clark's (1997) model of anxiety proposes it is characterised by biases at three points; (1) the initial registration of a threat stimulus and assessment of personal relevance, (2) the activation of a primal threat mode, and (3) the secondary activation of more elaborative and reflective modes of thinking (Cisler & Koster, 2010). The first of these is responsible for the stimulus-driven automatic orienting to threat, leading to the activation of innate responses concerned with minimising threat and securing safety. These “primal” responses appear to be relatively inflexible. Once the individual’s attention has been captured, the final stage in the process involves a slower processing of the threat requiring effort by the individual. This model explains the observations seen in the experimental investigation of attentional bias, but does not differentiate between preferential attention to threat and difficulty in disengagement.

2.4.3.2 Williams, Watts, MacLeod, and Mathews' (1988) model.

The influential model of Williams et al. (1988) proposes that information processing bias occurs at the preconscious level with an affective decision making
mechanism interpreting whether information is threatening or not. Information considered to be threatening has attentional resources allocated towards it; low-threat information is not attended to, with resources maintained on the task at hand. Williams et al. (1988) claim trait anxiety modulates the allocation of resources; high trait anxious individuals will allocate their attention to threat, resulting in an attentional bias, while low trait anxious individuals will be more likely to ignore threatening information, effectively directing attention away from the stimulus. This process is moderated by levels of state anxiety, altering the threshold at which stimuli are considered threatening. As this model predicts higher levels of trait anxiety effectively lower the threshold for the detection of threatening stimuli, it indirectly suggests that attentional bias is due to preferential attention rather than prolonged engagement with stimuli.

This model has been influential in further models of attentional bias; however, it is not without its limitations, specifically in low-trait anxious individuals. For example, Cisler and Koster (2010) suggest the model proposed by Williams et al. (1988) may well hold for information that poses a low-level of threat, but it would seem unlikely that severe threat will not attract an individual’s attention regardless of trait anxiety levels, as this could result in an inadequate response to genuine threat. Wilson and MacLeod (2003) investigated this, finding that high trait anxious individuals display an attentional bias when presented with both severely and moderately threatening stimuli, in contrast, low trait anxious individuals only displayed a bias when presented with severely threatening stimuli.

2.4.3.3 Mogg and Bradley's (1998) cognitive-motivational model.

Mogg and Bradley's (1998) cognitive-motivational model of anxiety considers attention to threat as a normal and adaptive mechanism, with an individual’s attention to threat determined by two systems; (1) an evaluation system responsible for the initial, preconscious appraisal of stimuli, and (2) a goal engagement system which determines the allocation of processing resources. A stimulus interpreted as highly threatening will result in an interruption in behaviour as attention is allocated to the stimulus. High trait anxious individuals are considered more sensitive to threat; hence, mildly threatening stimuli are more readily interpreted as highly threatening than in low trait anxious individuals. This would suggest the high and low trait anxious individuals would display different patterns of attention when experiencing mildly threatening stimuli; however, severely threatening stimuli would not elicit different responses.
2.4.3.4 Matthews and Mackintosh's (1998) model.

Mathews and Mackintosh's (1998) model proposes a threat evaluation system that has much in common with Williams et al. (1998); here, a stimulus is automatically evaluated and feeds into a distracter/threat representation system. Up to a point the interference caused by this distraction representation can be countered by effortful attending to the task at hand. This model proposes that the input stimulus is required to cross a threshold level before eliciting an output; high anxiety lowers this threshold leading to increased output. Hence, providing an explanation of an attentional bias in high trait anxious individuals. This model also suggests that highly threatening stimuli will capture the attention of everyone, while mildly threatening stimuli will only do so in individuals with higher anxiety levels.

2.4.3.5 Eysenck et al.'s (2007) Attentional Control Theory.

Eysenck et al., (2007) initially proposed Attentional Control Theory to explain the performance deficits associated with anxiety by suggesting state anxiety impacts the Central Executive of the Working Memory System (Baddely, 1986) and impairs attentional control by disrupting the balance between two attentional systems; the goal-directed system and the stimulus-driven system. This theory proposes anxiety leads to an increased influence of the stimulus-driven system, while decreasing the influence of the goal-directed system, resulting in impairment in two functions of the central executive considered important to attentional control: inhibition and shifting. Inhibition refers to the ability to inhibit or regulate dominant or automatic responses (Miyake et al., 2000), shifting refers to the adaptive ability to shift attention between tasks depending on context (Cisler & Koster, 2010). This may manifest itself in difficulties in preventing threatening stimuli from initially capturing attentional and/or disengaging attention from these stimuli. Prior to the development of Attentional Control Theory, Derryberry and Reed (2002) found individuals with lower levels of self-reported attentional control, measured using the Attentional Control Scale (ACS: Derryberry and Reed, 2002), displayed a greater bias towards threatening stimuli than those able to better control their attention. Berggren and Derakshan (2013) examined evidence from neuroscientific studies to conclude that there is a growing evidence base to support the predictions of Attentional Control Theory, suggesting this is a direction of research that requires further investigation.
2.4.3.6 Summary of models underpinning attentional bias.

In summary, there is commonality between models of attentional bias in the context of anxiety, for example the component of vigilance/preferential attention towards threat. However, there is also disagreement, e.g. only Eysenck et al. (2007) present an explanation for the difficulty in disengaging attention from threat. The avoidance of threat is another area not addressed in all models, with only Williams et al., (1988) attempting to account for it. Where these theories are consistent is in the assumption that the appraisal of stimuli as threatening (or not), and the facilitation of attention towards them occurs at a preconscious level.

Attentional Control Theory (Eysenck et al., 2007) suggests that anxiety disrupts the balance between the goal-directed and stimulus-driven attentional systems in working memory, leading to a more stimulus-driven type of response; this is proposed to impair the inhibition and shifting functions of the central executive. Impaired inhibition results in a reduction in an individual’s ability to direct their attention between competing stimuli, impaired shifting leads to difficulties in disengaging their attention from task-irrelevant stimuli. Despite the origin of Attentional Control Theory being in relation to performance deficits associated with anxiety, the reduced ability to both inhibit and shift attention in the presence of threatening stimuli could be considered consistent with patterns of behaviour observed in attentional bias research; impaired inhibition seems congruent with preferential attention to threatening stimuli, impaired shifting is consistent with difficulties in disengaging attention from threatening stimuli. This link between attentional bias and attentional control has been previously proposed by others including Derryberry and Reed (2002), Helzer, Connor-Smith, and Reed (2009), and Lonigan and Vasey (2009); suggesting a complex relationship in which attentional bias is moderated by voluntary attentional control.

Other theories of attentional bias also discuss the effortful processing of information when proposing models leading to attentional bias (e.g. Beck & Clark, 1997; Matthews & Mackintosh, 1998).

The work of Owens et al., (2014) is pertinent to Attentional Control Theory and its key proposal that anxiety disrupts certain working memory processes, resulting in a reduction of performance on complex tasks. Owens et al., (2014) investigated the interaction between trait anxiety and working memory capacity in an adolescent population; findings that in those with lower working memory capacity, increases in trait anxiety were associated with lower performance. The opposite was true for those with high working memory capacity. Hence, it was suggested that working memory
capacity has a moderating role in the relationship between trait anxiety and test performance; this is consistent with the results of Ashcraft and Krause (2007). The mediating role of working memory capacity may also explain Attentional Control Theory’s inability to account for instances where individuals with high levels of trait anxiety still perform well on examinations and other cognitive tasks. Those with higher working memory capacities may be able to cope better with the processing impairments put forward in the theory; hence, their anxiety may have a motivational impact to avoid negative evaluation or task failure (Owens et al., 2014).

There is a body of literature that raises questions surrounding the possibility that an individual may be able to negate or reduce their attentional bias through effortful management of their attentional resources if they have sufficient attention control; Cisler & Koster (2010) propose this in their review of the field of attentional bias. While research in this area is still sparse, there appears to be growing evidence which suggests further investigation of the role of an individual’s ability to maintain and control their attention is warranted in anxiety-related attentional bias research.

2.4.4 Identifying attentional bias - experimental tasks.

The overarching theory in attentional bias research is that attention will be allocated towards threatening stimuli over neutral stimuli in anxious individuals, this has been observed through several experimental approaches, demonstrating the phenomenon is not simply an artefact of particular experimental procedures (Cisler & Koster, 2010). The most common experimental paradigms employed to investigate attentional bias is the Modified Stroop task (Stroop, 1935), the Dot-Probe task (MacLeod et al., 1986), and the Spatial Cueing task (Fox, Russo, Bowles and Dutton, 2001), these are summarised below.

2.4.4.1 Modified Stroop task.

The modified Stroop task (Stroop, 1935) displays threatening and neutral words in different colours; participants are required to identify the colour of the word while ignoring its meaning. For example, if the word red were shown in a blue font, the correct response would be blue. Faster response times when reporting the colour of words with a threatening semantic content are an indication of attentional bias towards threat. Several studies have demonstrated attentional bias using the Stroop task in anxious populations (e.g. Bar-Haim et al., 2007; Mogg & Bradley, 1998; Williams et al., 1996).
The modified Stroop task was initially the most widely used tool to investigate threat-related attentional bias in anxiety (Bar-Haim et al., 2007); however, as the Stroop presents only a single threat or neutral stimulus in each trial, it has been suggested that responses to threat-related stimuli may be delayed as a result of processes not involving attention. For example, Mogg, Holmes, Garner, and Bradley (2008) found that when no movement of attention was required, high trait anxious participants still demonstrated significantly slower reaction times than those with lower trait anxiety, when presented with threatening stimuli at a location they were already attending to. For this reason, the use of a Stroop task was rejected early in the development of this study.

2.4.4.2 Dot-probe tasks.

The dot-probe task (MacLeod et al., 1986) was designed to address the limitations of the modified Stroop task highlighted above. Dot-probe tasks display two stimuli, frequently words, on a computer screen, either arranged one above the other or to the left and right of each other. Word pairs consist of one that is emotionally threatening and pertinent to the concerns of the participants (threat congruent trials), and another that is emotionally neutral (threat non-congruent trials) (See et al., 2009). The stimuli are presented for a short period of time (e.g. 500ms), they then disappear and a probe (e.g. an arrow) appears in the location previously occupied by one of the stimuli. The participant presses a key to indicate which of the stimuli the probe has replaced. Alternatively, in the case of an arrow, the key press can be used to indicate the direction of the probe (for example, Putwain et al., 2011). Attentional bias is indicated when the response times towards probes that replace threatening stimuli are different to the response times when the probes replace neutral stimuli. Where an individual's attention is directed towards the threat stimulus, response times will be shorter for probes that replace threatening stimuli compared with probes that replace neutral stimuli. A significant body of research has demonstrated attentional bias when employing the dot-probe task (e.g. Bar-Haim et al., 2007; Mogg & Bradley, 1998).

Dot-probe tasks provide a wealth of evidence that anxious individuals show attentional bias towards threatening stimuli. If an individual’s attention is preferentially allocated towards threatening stimuli, this will result in faster response times to probes associated with these stimuli. If the bias is a result of delayed disengagement with threatening stimuli, this will similarly lead to faster reaction times to probes appearing in the same location. Hence, while the dot-probe paradigm has shown itself able to
identify the presence of attentional bias, it is unable to discriminate between preferential attention towards, and delayed disengagement from threatening stimuli.

2.4.4.3 Spatial cueing tasks.

In spatial cueing tasks (Fox et al, 2001) participants focus on a fixation point located between two rectangles, a cue is then presented (a threatening or neutral stimulus) in one of the rectangles, followed by a target in either of the rectangles. A valid cue predicts the location of the target and is designed to draw attention towards it, while an invalid cue draws attention away from the target; the task is to press a key indicating which rectangle contains the target. A faster response to valid threat-cued trials compared to valid neutral-cued trials is an indication of attentional bias towards threatening stimuli. Fox et al. (2001) claim that findings gathered when employing spatial cueing tasks show that threatening stimuli result in difficulties in disengaging attention rather than preferential attention towards threat. As with the other experimental paradigms, there is evidence identifying attentional bias using spatial cueing tasks (Cisler & Koster, 2010; Clarke et al., 2013).

2.4.4.4 Summary of experimental tasks.

The competition for attention between neutral and threat-related stimuli is considered by many to be a prerequisite for the emergence of threat-related attentional bias (Bar-Haim et al., 2007); hence, the dot-probe paradigm may be a more appropriate approach to their investigation than spatial cueing tasks. Additionally, in the dot-probe paradigm, the cue stimuli are task irrelevant, whereas in the emotional spatial cuing paradigm participants are instructed to attend to the cue. This may reduce the potential to generalise findings from the spatial cuing paradigm as they could be dependent on the use of a task-relevant stimulus (Bar-Haim et al., 2007). Therefore, after reviewing the evidence available, the dot-probe paradigm was considered the most appropriate experimental paradigm through which to investigate attentional bias in this study.

2.4.5 Evidence for attentional bias in test anxiety.

MacLeod et al., (1986) employed a dot-probe task to demonstrate that clinically anxious participants shifted their attention towards emotionally threatening stimuli while non-anxious controls shifted their attention away from such material. This was expanded upon to explore the impact of state and trait anxiety in MacLeod and Mathews (1988). Participants were undergraduate students who were facing their end
of year examinations; testing at twelve weeks prior to the examination was considered a low state anxiety situation, while further testing one week before the examination was considered the high state anxiety condition. Both exam-specific and generally threatening stimuli were used in the dot-probe task employed in this study. Highly-trait anxious individuals shifted their attention towards the generally threatening material in both low and high state anxiety situations; however, results for examination specific stimuli were more complex. In the high state anxiety testing period, highly-trait anxious individuals demonstrated an attentional bias towards examination specific stimuli whereas low-trait anxiety participants shifted their attention away from such stimuli. Hence, it was suggested that the attentional response to the relevant stress-related stimuli was the result of an interaction of both trait and state anxiety.

The above study employed participants categorised as high or low in trait anxiety in an examination situation; however, it was not investigating the presence of attentional bias in test anxiety per se. The identification of attentional bias in many other forms of anxiety suggests it could also be expected to be present in test anxiety; however, there is little direct evidence to support this, requiring further work in this specific field.


Putwain et al. (2011) carried out a study directly investigating the presence of attentional bias towards threatening stimuli in high trait test anxious individuals. This employed undergraduate participants in a situation where performance evaluation threat was salient; a dot-probe task was used to measure attentional bias. Trait test anxiety was measured using the Revised Test Anxiety Scale, identifying 31 participants as low or high in trait test anxiety; low trait test anxiety was defined as a score of -1SD from the population mean, while high trait test anxiety was defined as +1SD. Participants were randomised into high or low performance evaluation threat conditions and given a non-verbal cognitive ability task comprising sets D and E of the Standard Progressive Matrices (Raven, Raven, & Court, 2004).

Performance evaluation threat was manipulated by the instructions the participants received. In the high threat condition, participants were told the aim of the project was to measure cognitive ability, that the task related to levels of intelligence and could be used to predict degree outcomes, and that results would be evaluated by members of the departmental teaching staff and compared with the results of other students. In the low threat condition, participants were instructed that the aim of the
study was to measure their individual reaction times, which were unrelated to academic ability, and that results would not be compared to those of other students.

Highly test anxious participants displayed an attentional bias towards threatening stimuli under high performance evaluation threat conditions only. The authors suggest this is consistent with a vigilant mode of processing stimuli, however, they also recognise the findings could be due to a difficulty in disengaging from the threatening stimuli. In the low performance evaluation threat condition, both high and low test anxious participants showed a bias away from threatening stimuli. Putwain et al. (2011) claim these findings demonstrate, there is an attentional bias towards threatening stimuli in highly test anxious individuals when experiencing heightened levels of performance evaluation. This is consistent with the findings from other forms of anxiety.

The authors of Putwain et al. (2011) recognise the sample size was small; however, it was considered sufficient for the pilot nature of the study. They also suggest that the approach adopted to manipulate the participants’ state anxiety, through different levels of performance evaluation, may not have sufficiently replicated the levels of threat posed by real high-stakes examinations; hence, they questioned the ecological validity of the findings.

Personal communication with two of the authors of Putwain et al. (2011) between September 2013 and November 2014, provided information on several unsuccessful attempts to replicate the initial findings and the approach adopted in the study to manipulate anxiety has been questioned. The use of Raven’s Matrices and the scenario in which they were presented, may have been unable to induce the level of performance evaluation threat and associated state anxiety experienced in high-stakes examinations. Not only is this a limitation to the ecological validity and generalisability of the findings of Putwain et al. (2011), it also raises questions if the results are truly indicative of those that may be found in high-stakes examinations.

Despite the limitations and the authors’ reports of problems with replicating the findings, the work of Putwain et al. (2011) offers a promising direction in test anxiety research. Larger-scale studies are required, employing the dot-probe paradigm alongside ecologically valid anxiety manipulation techniques, to investigate the presence of attentional bias towards threatening stimuli in highly test anxious individuals. This would advance the understanding of how test anxious individuals experience anxiety in evaluative situations, and has the potential to provide evidence to
inform the development of Attentional Bias Modification Treatments (see section 2.4.6) to support such individuals.

**2.4.6 Attentional Bias Modification Treatment.**

In-keeping with the premise that attentional bias towards threatening stimuli has a role in the maintenance of state anxiety, experimental procedures designed to manipulate attentional processing were developed to explore this relationship further. These attention manipulation tasks have also shown promise in reducing attention to threat and vulnerability to anxiety (Hakamata et al., 2010; Macleod & Clarke, 2015), leading to a growing body of research into Attentional Bias Modification Treatment (ABMT).

ABMT employs techniques that were originally designed to identify attentional bias, and adapts them to encourage the selective processing of neutral stimuli over threatening stimuli with the aim of reducing symptoms of anxiety. A key principle behind ABMT is that participants complete these modified tasks multiple times over extended periods ranging from a number of days to several weeks (Macleod & Clarke, 2015).

The most common training procedure used in ABMT has been a modified version of the dot-probe task (Macleod & Clarke, 2015). In dot-probe tasks employed to identify attentional bias, the probes are equally associated with both threatening and non-threatening stimuli. In ABMT this equality in the probe location is removed; training designed to reduce bias towards threat consistently presents probes in the location not congruent with the threatening stimulus, i.e. congruent with the non-threatening or neutral stimulus, the opposite is true of training intended to increase selective attention towards threat.

ABMT is a relatively new and growing field; hence, evidence to support the use of such interventions is limited. However, three reviews have reported promising findings. Hakamata et al. (2010) investigated 12 studies, collectively indicating ABMT was responsible for significantly greater reductions in attentional bias and anxiety than control conditions, these reductions were associated with large ($d = 1.16$) and medium size effects ($d = .61$). Further analysis revealed that larger effect sizes were associated with stimuli presented as words rather than faces, along with those located top/bottom as opposed to left/right on the screen. Hallion & Ruscio (2011) conducted a larger review, based on 45 studies, investigating the impact of ABMT on both anxiety and depression. This found ABMT had significant but small effects on attentional bias ($g =$...
.29) and anxiety (g = .23); the effect on depression was not significant. Beard, Sawyer and Hofmann (2012) carried out a review covering a range of psychological conditions in which ABMT had been employed, resulting in the inclusion of 37 studies. A significant large effect was reported on attentional bias (g = 1.06), leading to the conclusion that ABMT has a reliable effect in modifying attentional bias. Additionally, in common with Hakamata et al. (2010), larger effect sizes were associated with studies involving stimuli presented in a top/bottom manner. Both Hakamata et al. (2010) and Beard et al. (2012) concluded that increased numbers of ABMT sessions resulted in larger effect sizes.

Clearly, these reviews are limited due to their relatively small numbers of studies and participants, they also contrast in the magnitude of the effect they uncovered. However, they indicate that ABMT has the potential to impact on both attentional bias and anxiety across a range of populations; MacLeod and Clarke (2015) concluded that where ABMT has reduced attention to threat it has also reduced vulnerability to anxiety with a high degree of reliability. Additionally, MacLeod and Clarke (2015) suggest that where ABMT has not resulted in reductions in anxiety, it is due to a failure of the task to modify attention in the desired manner. While conflicting findings have been presented, for example Mogoașe, David and Koster (2014), ABMT does appear to have potential for use in the treatment of anxiety and warrants further investigation.

2.4.6.1 Relevance of ABMT to test anxiety research.

ABMT offers an approach to ameliorate the impact of test anxiety and potentially address some of the deficits in performance that test anxious individuals display in examination situations. Before this can happen, further evidence is required to confirm the presence of attentional bias in test anxious individuals, to ascertain how it manifests itself, and its relationship to both trait test anxiety and state anxiety. Addressing these issues has the potential to inform the development of ABMT specific to test anxiety and may suggest methods of identifying individuals for whom such training may be beneficial.

2.4.7 Summary of attentional bias and relevance to this study.

For the purposes of this work, an attentional bias is considered to occur when an individual has to divide their attention between two competing stimuli and, due to the threatening nature of one of these stimuli, disproportionate resources are allocated to it.
For example, in an assessment situation, an individual experiencing an attentional bias towards the threat posed by the assessment will have their attention drawn to their fear of failure and the consequences of this, rather than being able to focus on the task itself.

Attentional bias towards threatening stimuli is a robust phenomenon in a range of forms of anxiety. Whether such bias is due to preferentially attending to, or difficulty in disengaging attention from threatening stimuli is unclear. However, it could be argued that the impact on the individual is the same; attention is disproportionately allocated towards stimuli appraised as threatening, reducing the attentional resources available for other tasks. Evidence suggests attentional bias plays a role in the maintenance of state anxiety, though the causal nature of this association is not fully clear; a bidirectional relationship appears likely. While some studies have explored attentional bias in relation to examinations and other evaluative situations, only Putwain et al. (2011) specifically set out to investigate the presence of attentional bias in the context of test anxious individuals; finding a bias towards threatening stimuli in highly test anxious individuals when experiencing heightened levels of performance evaluation. Despite its limitations (see section 2.4.5.1), this represented a promising development in the field of test anxiety research.

Several models have been proposed to explain the processes underpinning the observations made in attentional bias research; these agree on many levels, though differences between them result in a lack of consensus regarding the mechanisms leading to attentional bias in anxious individuals and the direction of the relationship with state anxiety. In attempting to explain the impact of anxiety on performance, Attentional Control Theory (Eysenck et al., 2007) (see 3.4.3.5/6), addresses some of the points lacking in earlier theories on attentional bias. For example, accounting for both preferential allocation of attention towards, and delayed disengagement from, threatening stimuli. Hence, how an individual’s ability to control their attention when experiencing heightened state anxiety is of interest in this study.

Along with being of interest from the point of view of furthering knowledge in the field of test anxiety, the investigation of attentional bias and its role in the experiences of test anxious individuals has a practical aspect. Attentional Bias Modification Training (ABMT) has been shown to have a beneficial impact on vulnerability to anxiety; hence, identification of attentional bias in test anxiety may further the development of interventions to support test anxious individuals throughout the examination process and positively impact upon the deficits in examination performance they demonstrate.
2.5 Rationale for the Current Study

Worry associated with assessments, tests, and examinations is a common source of anxiety for school-age children. For many this is simply a fact of life and does not significantly impinge upon their education, academic progress, and wellbeing; however, for a sizeable number of students these concerns are excessive and are referred to as test anxiety. Test anxiety is a personality trait, which leads individuals to consider exams as threatening; in evaluative situations, this results in increased levels of state anxiety. High-stakes examinations such as GCSEs and A-levels are examples of such situations.

In terms of wellbeing and quality of life alone, test anxiety is an issue that requires investigation with a view to developing interventions to alleviate it. However, there is also a compelling body of evidence which shows that heightened levels of test anxiety are associated with deficits in academic performance; while it is commonly assumed that test anxiety is the cause of these deficits, there is still debate about how this occurs. Hence, greater understanding of how state anxiety is generated and maintained in highly test anxious individuals may provide avenues for addressing these performance deficits as well as being beneficial to the wellbeing of a large proportion of school-age children and adolescents.

Of interest to the current study is attentional bias; the preferential attending to, or difficulty in disengaging from, stimuli perceived as threatening. Attentional bias has been identified in many forms of anxiety, where it has been linked to the maintenance of state anxiety and deficits in task performance; however, while its presence in test anxious individuals makes conceptual sense, identification has proved challenging. Putwain et al. (2011) uncovered attentional bias towards threat in highly test anxious undergraduates, but further replication of these results has been difficult.

Attentional bias modification treatments have shown promise in reducing attentional bias towards threat in anxious populations. Hence, with a view to the development of future interventions, a key aim of this study is to investigate the presence and role of attentional bias in test anxious individuals.

Undergraduate volunteers are commonly employed in test anxiety research (e.g. Putwain et al. 2011); however, findings from participants in early adulthood cannot automatically be extrapolated to adolescents. Additionally, the assessment and examination process for undergraduates is increasingly different to that experienced by high-school students. Many undergraduate degrees are assessed over the final two years of the course, with the students gaining credits towards their final degree through a series of assignments and examinations; there is also the possibility of re-submitting
assignments and resitting examinations. In contrast, school students in England are assessed for high-stakes GCSE and A-level qualifications through terminal examinations following two-year programmes of study with no option to attempt the examination again within the same assessment period. Clear differences between the assessment of undergraduate and high-school students lead to the conclusion that studies investigating the impact of test anxiety on school-age children, require participants of school-age who are following appropriately assessed high-stakes programmes of study.

Based on the current review of literature, the following model of impaired performance in test anxious students is proposed (see Fig. 2.2 below); this shows the hypothesised relationships between trait test anxiety, state anxiety, attentional bias, and attentional control, and how they may interact, leading to impaired performance. These relationships will be investigated during the current study. However, the inclusion of “Impaired Performance” on the model is there for clarity, no measurement of the participants’ performance will be made.

![Diagram](image)

**Figure 2.2.** Proposed test anxiety process model, adapted from Sarason (1972), Wine (1971) and Zeidner (1998).
Alongside greater understanding of the phenomenon itself, research into test anxiety has the potential to inform the development of interventions to support students through the examination process. Such interventions would most likely occur in students’ schools and colleges; hence, conducting test anxiety research in a naturalistic rather than a laboratory-based setting ensures improved ecological validity of both the investigation itself and interventions developed from it. When done in collaboration with teachers, recruitment is more rigorous; improving access to students and, by employing the school’s knowledge of potential participants, reduces the likelihood of those participating for whom the process would be inappropriate. Additionally, this approach allows access to the school’s internal support networks for students should issues arise post-procedure.

2.5.1 Investigating attentional bias in test anxiety.

An individual’s beliefs of, and experiences and appraisals towards the testing and the examination process can be explored using self-report measures. However, to fully investigate attentional bias and other mechanisms underlying the maintenance of test anxiety, and to gather evidence to inform the development of interventions aimed at alleviating it, requires greater depth than questionnaires alone may be able to provide. Key to this is that while test anxiety is considered a trait phenomenon, the state anxiety it generates is only present in a situation where an individual perceives the evaluation of their performance to be a threat. Hence, to fully investigate the impact of test anxiety and its associated elevated state anxiety, requires individuals to be in a position where they perceive the evaluation of their performance to be personally threatening.

This requirement brings with it the challenge of reliably inducing similar worries and anxieties to those occurring during examinations and testing situations. The obvious solution to this would be to study individuals in the evaluative situations they encounter in everyday life. High-stakes examinations would appear the ideal context in which to study test anxiety; however, as the outcome of an examination has serious implications for the individual student, their teachers, and their school, conducting research in this environment, while theoretically feasible, is practically impossible. Therefore, experimental protocols are required to manipulate anxiety by generating similar feelings of performance evaluation as high-stakes examinations, importantly, these must have no long-term impact on the participant or their academic outcomes.
2.5.2 Manipulating anxiety.

The worry component of anxiety is triggered by stimuli which suggest failure is imminent (Deffenbacher & Hazaleus, 1985; Eysenck, 1992), or when an individual perceives their coping resources to be inadequate for the situation (Sarason & Sarason, 1990). When this occurs, the individual is considered to feel ego-threat and that their self-esteem is at risk. Hence, tasks designed to manipulate anxiety should aim to induce these feelings.

Dickerson and Kemeny (2004) conducted a review of acute psychological stressors; identifying 208 laboratory studies that had employed a range of tasks designed to induce psychological stress with pre- and post-test cortisol levels used as the indicator of increased stress. It is important to recognise that the conclusions of Dickerson and Kemeny (2004) are based upon physiological markers; hence, they cannot automatically be applied to psychological responses. However, correlations between physiological and psychological responses have been reported under both experimental (Cohen et al., 2000) and non-experimental conditions (Schlotz, Schulz, Hellhammer, Stone and Hellhammer, 2006; van Eck, Berkhof, Nicolson and Sulon, 1996). Hence, they can be considered a suitable indicator of the impact of protocols designed to manipulate stress and anxiety; relating to this, Al’Absi et al. (1997) reported correlations between increased cortisol levels and negative mood states produced by a public speaking and mental arithmetic tasks.

Dickerson and Kemeny's (2004) review of psychological stressors was specifically concerned with two aspects of these protocols: social-evaluative threat and uncontrollability/forced failure. Social-evaluative threat was proposed to occur when poor task performance could uncover the lack of a valued ability or trait, leading to the perception of the negative evaluation of others, i.e. ego-threat. Uncontrollability was considered a stressor by creating a context of forced failure; an individual is unable to alter the outcome of a situation, leading to negative consequences regardless of the effort they employ. In other words, their resources are inadequate to deal with the demands of the task no matter how hard they try. Dickerson and Kemeny’s review (2004), found the largest increases in cortisol levels were associated with tasks that included elements of both social-evaluative threat and uncontrollability; tasks that were difficult to complete successfully but lacked these components were not found to elevate cortisol levels.

Dickerson and Kemeny (2004) identified a range of psychological tasks employed to induce physiological stress and categorised them as cognitive tasks, public
speaking tasks, public speaking/cognitive task combinations, emotion-inducing procedures, or noise exposure. Of these, cognitive tasks, public speaking and public speaking/cognitive combinations elicited significant post-test cortisol responses \((p < .01)\). Forty-eight of the studies employed a combination of public speaking (such as oral presentations) and cognitive tasks (such as mental arithmetic); when analysed together these studies demonstrated an effect size of \(d = 0.87\), more than twice as large as the other categories of task studied.

The findings of this wide-reaching review provide theoretical and empirical evidence to indicate that tasks employing social-evaluative threat, uncontrollability and forced failure reliably elicited the largest cortisol responses.

2.5.3 The Trier Social Stress Test.

The Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) is an experimental protocol designed to induce moderate to intense levels of psychological stress through the use of public speaking and mental arithmetic tasks. Participants are required to give a five-minute presentation to a formal interview panel followed by a complex mental arithmetic task to be performed verbally. Importantly, participants believe they are being video and audio recorded for later analysis. As a control, a placebo stress test is often used, such as that developed by Het, Rohleder, Schoofs, Kirschbaum and Wolf (2009). This requires a similar cognitive load as the TSST without the social-evaluative and uncontrollable components. From 1993 to 2007 over 4000 individual TSST sessions were identified (Kudielka, Hellhammer & Kirschbaum, 2007) and the TSST is claimed to be the most widely used and standard protocol for the induction of experimental psychosocial stress (Kirschbaum, 2010; Kudielka et al., 2007). Data from Dickerson and Kemeny's (2004) review was used to identify the impact of the TSST; 28 studies employed either the TSST itself or a similar combination of an oral presentation followed by mental arithmetic. Collectively, these studies demonstrated a significant increase in cortisol levels \((p < .01)\) with a large effect size \(d = 1.04\). The background scenario to the public speaking task was often modified to ensure its relevance and validity to the specific participant group; however, the timing, apparent video/audio recording the participants, and the presence of two white-coated, uncommunicative observers remained consistent.

The key components of the TSST are those identified by Dickerson and Kemeny (2004); social-evaluative threat, uncontrollability, and forced failure despite effort. The TSST achieves these key components by setting tasks that are unrealistic within the
timeframe and by leading the participants to believe that the research panel and unknown others will judge their performance. These components appear to display a level of congruence with the proposed concerns of test anxious students; namely, fear of failure and the perceived negative evaluation of others. Forced failure is component of examinations which allows them to discriminate between candidates; very few individuals are intended to achieve the maximum mark on an examination, individuals will be unable to answer, or provide insufficient or erroneous responses at different points. The level of demand at which this failure occurs is reflected in the grading criteria.

Dickerson and Kemeny (2004) found that cortisol levels only remained elevated for a short period of time following completion of the TSST, returning to baseline levels after between 20 and 40 minutes. This is important as it suggests that the effects of the TSST are short-lived and have no longer-term impact on those individuals who experience it.

The TSST is a protocol designed for use in adult populations and uses scenarios and tasks based upon an interview for a job. With scenarios more appropriate to the educational context of adolescent participants, the TSST has the potential to provide a proxy capable of inducing the anxiety required to facilitate in-depth test anxiety research in schools and colleges.

2.5.4 Aims of this research.

High-stakes examinations in the English education system occur with school-age students; therefore, test anxiety and attentional bias in this population is of interest to this study. Additionally, should interventions be designed to address test anxiety, they would most likely be implemented in schools and colleges. Conducting research with school-age students in a naturalistic setting provides greater ecological validity than recruiting undergraduates to take part in a laboratory-based study. Hence, despite the challenges of conducting this type of research in schools and colleges, it was decided that a sample of 16-18-year-olds following high-stakes, terminally examined programmes of study would be employed.

As discussed in section 2.4.5.1, the work of Putwain et al. (2011) has yielded promising results in identifying patterns of attentional bias in test anxious students; however, replication of the initial findings has proven difficult. Methodological issues have been identified that may have contributed to these difficulties; hence, an implicit
focus of this work is to address these issues and investigate the presence of attentional biases in test anxious students.

Against this background, the aims of the study were:

1. To establish an ethically robust protocol for the study of test anxiety in a naturalistic setting.
2. To investigate the presence of attentional bias in highly state anxious adolescents while under performance evaluation.
3. To explore how any such attentional bias is influenced by trait test anxiety and attentional control in an adolescent population.
4. To explore the relationship of attentional control to trait test anxiety and state anxiety.
5. To investigate if evidence is provided to support and refine the proposed model of impaired performance in test anxious students presented in Figure 2.2 above.

2.5.5 Phases of this study.

To fully address the aims, this study was conducted in two phases - a preliminary study (see chapter 4) and a main study (chapter 5). The purpose of the preliminary study was to evaluate the impact of the modified-TSST protocols and the utility of the proposed instruments.

The main study was carried out to:

i. Assess trait test anxiety and trait attentional control by means of questionnaires.
ii. Determine the development and level of participants’ state anxiety by use of a questionnaire completed immediately before and after following the stress test protocols.
iii. Complete a dot-probe task to assess participants’ levels of attentional bias.
iv. Analyse the relationship between the degree of attentional bias and the levels of state anxiety.
2.6 Research Questions

Considering the preceding literature and progress to date, the proposed research questions (labeled numerically), and associated analytic sub-questions (labeled alphabetically), are:

1. Can the modified-TSST\(^1\) protocols be successfully implemented in a school-based setting with highly-test anxious adolescents (Preliminary study\(^2\)) and with adolescents heterogeneous in their levels of trait test anxiety (Main study)?

2. How do the modified TSST protocols impact on state anxiety in a highly test anxious population? (Preliminary study)
   a) Were there differences in self-reported trait test anxiety between the low- and high-PET conditions of the TSST?
   b) Were there differences in measured pre-TSST state anxiety between the low- and high-PET conditions of the TSST?
   c) How does measured state anxiety change during the high- and low-PET TSST procedures?

3. How does the high performance evaluation threat protocol of the TSST impact on state anxiety in population that is heterogeneous in terms of trait test anxiety? (Main study)
   a) How does measured state anxiety change during the TSST procedure?
   b) How does self-reported trait test anxiety interact with changes in state anxiety during the TSST process?
   c) How does self-reported attentional control interact with changes in state anxiety during the TSST process?
   d) How does self-reported trait test anxiety (worry) interact with changes in state anxiety during the TSST process?
   e) How does self-reported trait test anxiety (test irrelevant thinking) interact with changes in state anxiety during the TSST process?

4. What measurement evidence can be provided to support the hypothesised relationships (see Figure 2.2) between self-reported trait anxiety, attentional control,

\(^1\) Trier Social Stress Test - see section 3.5.1.
\(^2\) The information in brackets indicates the phase in which the relevant data were collected.
state anxiety and attentional bias in 16-18-year-olds undertaking a high-stakes program of study? (Main study)

a) What is the relationship between self-reported trait test anxiety and attentional control?

b) What is the relationship between self-reported trait test anxiety and state anxiety (baseline, pre-TSST, post-TSST, change pre- to post-TSST)?

c) What is the relationship between self-reported attentional control and state anxiety (baseline, pre-TSST, and post-TSST, change pre- to post-TSST)?

d) What is the relationship between pre-TSST state anxiety and post-TSST state anxiety?

e) What is the relationship between pre-TSST state anxiety and the change in state anxiety?

f) What is the relationship between post-TSST state anxiety and the change in state anxiety?

g) What is the relationship between self-reported trait test anxiety and attentional bias?

h) What is the relationship between self-reported attentional control and attentional bias?

i) What is the relationship between state anxiety (baseline, pre-TSST, and post-TSST) and attentional bias?

j) What is the relationship between the change in state anxiety (pre- to post-TSST) and attentional bias?

5. What is the difference, if any, between participants’ response times to threat congruent and non-threat congruent trials measured by a dot-probe task (ABDP3)?

(Main study)

6. How do trait test anxiety, attentional control and state anxiety predict attentional bias in 16-18-year-old students undertaking a high-stakes program of study? (Main study)

a) How do measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

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3 ABDP - Attentional Bias Dot-Probe Task. See section 3.5.2.
b) How do measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

c) How do the worry component of measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

d) How do the worry component of measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

7. What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)? (Main study)

a) How do the clusters differ from one another in terms of the worry component of trait test anxiety?

b) How do the clusters differ from one another in terms of self-reported attentional control?

c) How do the clusters differ from one another in terms of the calculated attentional bias index?

d) How do the clusters differ from one another in terms of pre-TSST state anxiety?

e) How do the clusters differ from one another in terms of post-TSST state anxiety?

f) How do the clusters differ from one another in terms of the change in state anxiety (pre- to post-TSST)?
Chapter 3 - General Methodology

3.1 Introduction to the Methodology Chapter

This chapter, divided into five main sections will provide an overview of the methodology employed throughout the preliminary and main phases of this study. Section 3.2 will discuss the research paradigm in which this work is positioned; section 3.3 will summarise the aims and research questions that were addressed. The rationale behind a mixed methods research design and the approach to integrating quantitative and qualitative data collection is explained in section 3.4. The experimental protocols employed for data gathering in both the preliminary and main studies can be found in section 3.5. Section 3.6 details the ethical considerations pertaining to this study.

The specific details of the preliminary and main studies will be outlined separately in chapters four and five (respectively). These will include the specific aims, participant recruitment, materials employed, procedures, and analytical strategies.

3.2 Research Paradigms

The basic beliefs or worldview which govern how researchers approach a given field are referred to as a paradigm (Guba & Lincoln, 1994), this defines and determines the philosophical assumptions that guide their actions and methods of data collection and analysis they employ (Mertens, 2005). A paradigm is a set of beliefs and concepts that form the framework within which researchers think about the given field. However, the framework of the paradigm is variable depending on the evidence and knowledge that is incorporated into setting it out. Hence, it is possible for different paradigms to be applied to a research field, which can generate debate regarding their relative merits and value. This is the situation in relation to the field of educational research, the following sections will discuss three paradigms widely found in this area; positivism, constructivism and critical realism. The position of the present research in relation to these paradigms will then be clarified.

3.2.1 The Positivist paradigm.

The term Positivism was first coined by Auguste Comte in the mid-nineteenth century, although the positivist approach to research had been present since the time of the Ancient Greeks (Cohen, Manion & Morrison, 2011). The positivist view of the world is that it is ordered, predictable and stable, and governed by a series of universal laws and patterns of behaviour.
Comte’s position was that genuine knowledge is based on personal experience; hence, multiple observers of an event will see the same thing (Robson, 2011). Therefore, this single reality can be studied relatively easily through observation and experimentation (Cohen et al., 2011). The positivist paradigm requires that researchers’ preconceptions be set aside in order to identify objective facts based on empirical observations (McEvoy & Richards, 2006). The paradigm also suggests the social world can be studied in a similar way to the natural world, with laws and theories that are widely generalisable (Cohen et al., 2011). Hence, the positivist paradigm focuses on quantitative methods for collecting and analysing data.

One criticism of the positivist paradigm as it applies to the social world, is that to maintain objectivity, studies are carried out from the perspective of an outsider; ignoring characteristics and perspectives of the observer that effect their observations (Lincoln & Guba, 1985; Robson, 2011). Additionally, unquantifiable variables are ignored, reducing context; while the focus on generalising findings to wider populations means individual variables are overlooked (Guba & Lincoln, 1994). These criticisms are pertinent to studying human behaviour, as positivism ignores complexities of human nature; for example, individuality or morality, as they contrast with the order and regularity of the world of natural science (Cohen et al., 2011).

The recognition of these flaws in the positivist paradigm led to the evolution of post-positivism, where knowledge of a singular, fixed reality is replaced by a more tentative speculation and the recognition of multiple perspectives; knowledge is considered more subjective in nature as opposed to objective (Cohen et al, 2011). Importantly, post-positivism recognises it is all but impossible to prevent a researcher’s prior knowledge and experiences from influencing their work (Reichart & Rallis, 1994) and this must be considered within a framework of objectivity and the adherence to strictly prescribed procedures (Mertens, 2005). The post-positivist paradigm believes in a single reality, while recognising knowledge of this will never be perfect due, in some part, to the limitations of the researcher (Robson, 2011). Therefore, post-positivist research focuses not simply on the findings of research, but also the confidence of these findings. This paradigm is still heavily reliant upon quantitative methods (Robson, 2011), employing hypothesis testing, incorporating standardised measures and statistical techniques (McEvoy & Richards, 2006), with approaches to sampling designed to allow results to be generalised to wider populations.
3.2.2 The Interpretivist/Constructivist paradigm.

The interpretivist (or social constructivist) paradigm rejects the positivist approach of universal laws, instead placing the emphasis on understanding how reality and knowledge are socially constructed (Blaikie, 2000). Interpretivism has a central belief that human behaviour and the social world can only be understood by considering the viewpoint of those engaged in the phenomenon being observed (Cohen et al., 2011). Hence, facts are subjective and intangible rather than absolute truths, with multiple realities being possible. Data generated is therefore not judged against external standards, rendering the concepts of reliability and validity largely irrelevant; rather, the use of data for interpretation and description is the focus of this research (Breakwell & Rose, 2006). However, this leaves such research open to criticism, as both observer and participants bring their own biases and preconceptions, and may misinterpret the factors underlying observed behaviours. Due to the complexity of research approaches in the interpretivist paradigm it is associated with qualitative methods; in-depth fieldwork, interviews (unstructured and semi-structured), focus groups and case studies. This often leads to small-scale but intense research, where the interaction between the researcher and participants is a vital part of the process (McEvoy & Richards, 2006; Philip, 1998). In direct contrast to positivism, recruitment and selection of participants may be on the basis of their usefulness for the specific project, with those participants who are not representative of a general population being actively sought out (McEvoy & Richards, 2006); clearly, this limits how the findings are generalised.

3.2.3 Critical Realism.

Critical realism is a paradigm offering an alternative to both positivism and interpretivism, adopting the perspective that the world is multi-dimensional (Houston, 2001; McEvoy and Richards, 2003; McEvoy & Richards, 2006). Rather than following a set order, observed events arise as a result of the interaction between social structures and mechanisms that may be unobserved (McEvoy & Richards, 2006). Critical realism is a scientific philosophy in which structures and processes provide a reference point for the testing of theories (Bhaskar, 1978); however, this “reality” will always be dependent upon an individual’s own perspective. Hence, knowledge of the world is limited by the information available (McEvoy & Richards, 2006). From a critical realist perspective, reality can never be fully characterised, as a researcher’s own interests and theories will shape their perceptions; hence, the fallibility of findings is recognised. From this perspective, two issues arise with a positivist approach (McEvoy & Richards, 2006);
Firstly, the focus on observable events does not consider the extent to which these observations are influenced by preconceptions and prior theoretical frameworks (McEvoy & Richards, 2006). Secondly, relationships between the different elements of social systems are dealt with in isolation without accounting for external influences (Collier, 1994; McEvoy & Richards, 2006). The value of interpretivist methodologies focusing upon discourse, human perception and motivation is recognised within critical realism (Bhaskar, 1989). However, criticisms arise of such methodologies when they fail to acknowledge the underlying social structures pertaining to the individuals or to the social networks being studied (McEvoy & Richards, 2006).

According to McEvoy and Richards (2006), critical realists argue that the choice of methods should be dictated by the nature of the research problem and that a combination of quantitative and qualitative methods is commonly most appropriate. Quantitative methods can provide information on the relationships between several variables, and potentially causal mechanisms. The strength of qualitative methods is the elaboration they can provide to relationships that it would be difficult to discover using instruments in which the responses are limited to predetermined categories.

3.2.4 Position of this Research.

Research into test anxiety, has historically been concerned with quantifying and measuring the construct; hence, it has generally been investigated from a positivist perspective with the testing of hypotheses as the objective (for example, Sommer & Arendasy, 2014). This study explored individuals’ experiences of test anxiety and employed both quantitative and qualitative techniques within a critical realist framework. Hence, there is recognition of the existence of a reality that is independent of the researcher (Oltmann & Boughey, 2012) and that absolute knowledge of the workings of this reality may not be possible (Scott, 2005). This standpoint provides a framework to observe events and generate empirical data whilst recognising this work is fallible; hence, theories proposed will be flexible and revisable.

3.3 Aims of this Research

The highest-stakes examinations in the English education system occur with school-age students; therefore, test anxiety and attentional bias in a population of this age is of interest to this study. Additionally, should interventions be designed to address test anxiety, they would most likely be implemented in schools and colleges. Conducting research with school-age students in a naturalistic setting provides greater
ecological validity than recruiting undergraduates to take part in laboratory-based studies. Hence, despite the challenges of conducting this type of research in schools and colleges, it was decided that a sample of 16-18-year-olds following high-stakes, terminally examined programmes of study would be employed.

As discussed in section 2.4.5.1, the work of Putwain et al. (2011) has yielded promising results in identifying patterns of attentional bias in test anxious students; however, replication of the initial findings has proven difficult. Methodological issues have been identified that may have contributed to these difficulties; hence, an implicit focus of this work is to address these issues and investigate the presence of attentional bias in test anxious students. Against this background, the aims of the study were:

1. To establish an ethically robust protocol for the study of test anxiety in a naturalistic setting.
2. To investigate the presence of attentional bias in highly state anxious adolescents while under performance evaluation.
3. To explore how any such attentional bias is influenced by trait test anxiety and attentional control in an adolescent population.
4. To explore the relationship of attentional control to trait test anxiety and state anxiety.
5. To investigate if evidence is provided to support and refine the proposed model of impaired performance in test anxious students presented in Figure 2.2.

To fully address the aims, the study was conducted in two phases - a preliminary study (see chapter 4) and a main study (chapter 5). The purpose of the preliminary study was to evaluate the impact of the modified-TSST protocols and the utility of the proposed instruments. The main study was carried out to:

i. Assess trait test anxiety and trait attentional control by means of questionnaires.
ii. Determine the development and level of participants’ state anxiety by use of a questionnaire completed immediately before and after undertaking the modified-TSST protocols.
iii. Complete a dot-probe task to assess participants’ levels of attentional bias.
iv. Analyse the relationship between the degree of attentional bias and the levels of state anxiety.

The specific aims of each phase are outlined in detail in the relevant chapters.
3.3.1 Research Questions

The research questions addressed in this study, including associated analytic sub-questions, can be found in section 2.6. The overarching questions are:

1) Can the modified-TSST protocols be successfully implemented in a school-based setting with highly-test anxious adolescents (Preliminary study\(^4\)) and with adolescents heterogeneous in their levels of trait test anxiety (Main study)?

2) How do the modified TSST protocols impact on state anxiety in a highly test anxious population? (Preliminary study)

3) How does the high performance evaluation threat protocol of the TSST impact on state anxiety in population that is heterogeneous in terms of trait test anxiety? (Main study)

4) What measurement evidence can be provided to support the hypothesised relationships (see Figure 2.2) between self-reported trait anxiety, attentional control, state anxiety and attentional bias in 16-18-year-olds undertaking a high-stakes program of study? (Main study)

5) What is the difference, if any, between participants’ response times to threat congruent and non-threat congruent trials measured by a dot-probe task (ABDP)? (Main study)

6) How do trait test anxiety, attentional control and state anxiety predict attentional bias in 16-18-year-old students undertaking a high-stakes program of study? (Main study)

7) What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)? (Main study)

\(^4\) The information in brackets indicates the phase in which the relevant data were collected.
3.4 Research Design

This study adopted a mixed methods approach involving the collection of quantitative and qualitative data; hence, it is important to define what is understood by these terms.

Quantitative data includes standardised measures, for example questionnaires and rating scales, providing closed answers to questions or statements. This approach has traditionally been associated with a positivist paradigm, primarily concerned with the identification of statistical relationships between variables to inform laws generalisable in a wider context. Quantitative data provides large amounts of information; however, it does little to provide context. Also, responses of individuals are masked by the population as a whole.

Qualitative data is concerned with the collection of non-numerical, open-ended information, such as semi- or unstructured interviews, which encourage participants to answer questions in their own words. Rather than analysing this data using techniques that assign value, the aim is to provide context and meaning with less concern for the generalisation of findings. Due to the researcher’s role in interpreting qualitative data, there is a possibility of bias; combined with smaller sample sizes, this limits the application of findings to wider populations. The key differences between the two methodological approaches are summarised in Table 3.1 below.

Table 3.1. A Comparison of Quantitative and Qualitative Methodologies, reproduced from (McEvoy & Richards, 2006).

<table>
<thead>
<tr>
<th></th>
<th>Quantitative methods</th>
<th>Qualitative methods</th>
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<tbody>
<tr>
<td>Ontology</td>
<td>Tangible reality</td>
<td>Intangible reality</td>
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<tr>
<td>Epistemology</td>
<td>Regularities established</td>
<td>Knowledge constructed</td>
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<td>via empirical research and</td>
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<td></td>
<td>deductive/inductive reasoning</td>
<td>interaction/hermeneutic understanding</td>
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<tr>
<td>Methodology</td>
<td>Hypothesis testing</td>
<td>In-depth fieldwork</td>
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<tr>
<td>Data Analysis</td>
<td>Verification/falsification</td>
<td>Interpretation of meaning</td>
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</table>

Due to the different paradigms in which quantitative and qualitative methods are based, some have claimed they are incompatible, and that mixed methods research is therefore impossible (e.g. Guba, 1987; Sale, Lohfield & Brazil, 2002). This view may hold if paradigms are employed to determine research methods in an overly simplistic
fashion. Others (e.g. Creswell & Plano Clarke, 2007; Howe, 1988; Robson, 2011) claim that there is a far more complex relationship between research methods and paradigms, with quantitative and qualitative methods complementing each other. Robson (2011), rather bluntly suggests that if researchers are successfully carrying out mixed methods research, then the argument that they are incompatible is clearly refuted. The shift away from positivist approaches towards a post-positivist paradigm and critical realism has brought it with is greater recognition and acceptance of the value of mixed methods approaches.

The premise underpinning the mixed methods approach employed in this study is that combining both qualitative and quantitative methods would provide a better understanding of the issues being investigated than using either in isolation. The benefits of this, as they apply to this study, are summarised below (adapted from Creswell & Plano Clark, 2007):

- As discussed above, both quantitative and qualitative data have their weaknesses. The combination of both approaches can go some way to offsetting these shortcomings.
- As the researcher has a wider range of techniques at their disposal, they can gather more comprehensive evidence than by employing quantitative or qualitative techniques alone.
- Mixed methods research has the potential to answer questions that quantitative or qualitative methods alone cannot. For example, in this study, research question 7; “What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)?” could not be addressed satisfactorily using quantitative or qualitative methodologies alone.
- A mixed methods approach is considered practical as it mirrors the way problems are solved in the real-world, i.e. using both numbers and words to provide greater understanding.

3.4.1 Mixed Methods Designs.

There are four main types of mixed methods designs, the Triangulation Design, the Embedded Design, the Explanatory Design, and the Exploratory Design (Creswell & Plano Clark, 2007), these are discussed below with justification for the chosen design.
3.4.1.1 The Triangulation Design.

Triangulation is the most well-known mixed methods design (Creswell, Plano Clark, Gutmann & Hanson, 2003) and is employed when different data sets are required to complement each other. The intention of this design is to bring together the different strengths of quantitative and qualitative data, to compare and contrast statistical results with qualitative findings, or to expand quantitative results with qualitative information (Creswell & Plano Clark, 2007). This method involves a single-phase procedure where quantitative and qualitative data are collected at the same time and have equal importance, the two sets of data are then merged. This is a very efficient approach to data collection as both quantitative and qualitative data is collected concurrently, while still allowing them to be analysed separately using traditional methods. However, a high-level of experience in each method is required and may require a team of researchers rather than an individual. If the quantitative and qualitative results do not agree it can be a difficult problem to resolve and may require the collection of further data.

3.4.1.2 The Embedded Design.

In the Embedded Design, one set of data provides a secondary and supportive role to a study based primarily in the other (Creswell et al., 2003), with the premise that a single type of data will not fully address the research questions. The most common Embedded Design is the Embedded Experimental Model (Creswell & Plano Clark, 2007); this has an experimental or quasi-experimental design with the collection of qualitative data embedded within the procedure. In a single-phase approach, the qualitative data is collected during the experiment; in a two-phase design, it can be collected either before or after depending on how it is to be used. This second approach is more applicable when the qualitative data is required to inform the experiment itself (before), or to follow-up on participants’ experiences (after) (Creswell & Plano Clark, 2007). As all data can be collected at the same time this design is very resource-efficient and logistically straightforward; this can make it attractive to researchers working alone. Integrating results can be challenging; however, they do not need to be merged and can be reported separately. The timing of when to collect the qualitative data is important and must be based upon the intention for including it in the first place.
3.4.1.3 The Explanatory Design.

The Explanatory Design is a two-phase approach in which qualitative data is employed to explain quantitative results, for example significant or non-significant findings, and outliers from the main dataset (Creswell et al., 2003). This method can also be employed to form groups for follow-up interviews (Morgan, 1998; Tashakkori & Teddlie, 1998) or to guide further investigation using purposeful sampling (Creswell & Plano Clark, 2007). Quantitative data is initially collected and analysed, followed by the collection of qualitative data. Given sufficient time, this is a method that is straightforward to implement and write-up, it is also appealing for both single and multi-phase studies. However, this is a lengthy process that may not lend itself well to situations where there are time-pressures or constraints beyond the control of the researcher. While the qualitative phase is likely to require fewer participants, this method carries with it a risk that those participants identified by the qualitative data may be unavailable for the qualitative collection.

3.4.1.4 The Exploratory Design.

This is another two-phase design, with qualitative data being used to inform the collection of quantitative data. This design is particularly applicable for the development of instruments where none exist, or to identify variables to study further; hence, this was not considered appropriate to the current study and was discounted.

3.4.2 The Embedded Design in the current study.

The collection of quantitative data is more amenable to school-based research; however, it was felt that the collection of qualitative data would provide essential information about the detail, context and potential mechanisms of participants’ test anxiety and attentional bias experienced during the experiment. Hence, an Embedded Design was employed in this study (see figure 3.1).

An embedded experimental model was employed with the collection of qualitative data built in to a primarily quantitative experimental design (Creswell & Plano Clark, 2007). This design was driven by the focus of the study being an experimental process; however, it was felt that a single quantitative dataset was not sufficient to answer the range of research questions being posed and that qualitative data would benefit the study through its ability to provide further description or explanation of the variation between participants (Sandelowski, 1996). Hence, qualitative data was collected to provide information on the participants’ experiences of examinations and
the TSST protocols. Quantitative analysis provided an understanding of how the variables were related, while the qualitative data explored the participants’ experiences in greater depth, complementing the quantitative information and addressing related research questions.

![Figure 3.1. Embedded Design employed in this study.](image)

The preliminary study adopted an experimental design with two groups of participants: high performance evaluation threat and low performance evaluation threat (acting as a control group). The collection of qualitative data was embedded into both experimental conditions.

The main study addressed the research questions by adopting a pre-experimental approach that facilitated the generation of both quantitative and qualitative data concurrently; in the main study a single group of individuals were observed before and after an intervention, no control group was employed during this phase. A pre-experimental design was employed with three predictor variables; trait test anxiety, state anxiety (measured at three time-points), and attentional control, the participants’ attentional bias was the response variable. The modified-TSST protocol (section 3.5.1) was used to induce state anxiety as a proxy for an examination situation. Quantitative data relating to trait test anxiety, attentional control, state anxiety, and attentional bias was collected. Qualitative methods were employed to gather information regarding the participants’ anxieties and strategies during the TSST protocol, evidence of attentional bias, and links to trait test anxiety.
3.5 Experimental Protocols

3.5.1 Modified Trier Social Stress Test Procedure.

The Trier Social Stress Test (TSST) (see section 2.5.3) is an experimental protocol designed to induce moderate to intense levels of psychological stress through tasks involving public speaking and mental arithmetic. The TSST achieves this through setting tasks which are unrealistic within their timeframe and by informing participants their performance will be judged. Dickerson and Kemeny (2004) identified social-evaluative threat, uncontrollability, and forced failure as central to the effectiveness of the TSST. These appear congruent with the concerns of students regarding examinations, hence it was considered suitable as an instrument to manipulate state anxiety in this study.

The TSST is mainly used to study adults, employing the scenario of a job interview; this is too remote from the life experiences of adolescents, therefore, in its unmodified form the TSST was not considered appropriate for use in this study. Modifications were made to make the protocol relevant to educational settings and the stage of education of the participants; these did not alter the purpose of the protocol itself.

Two versions of the modified-TSST were employed during the experimental sessions in the preliminary study; a condition of high performance evaluation threat (high-PET), while a placebo protocol, modified from Het et al. (2009), was employed in the low threat condition (low-PET). Only the high-PET protocol was employed in the main study. These conditions are described in detail in the following sections.

3.5.1.1 High performance evaluation threat condition.

Upon arrival, the participant was greeted by the experimenter and invited to sit at a table. The two members of the interview panel, wearing lab coats, were seated behind a second desk; they were visible, but not introduced to the participant. They maintained a courteous but serious attitude, offering no support or reassurance at any stage. A microphone and stand were visible in front of the interview panel’s desk, with a video camera clearly facing the microphone. Both devices remained switched off and inactive throughout, although this was not apparent to the participants. The participant was reminded of their right to withdraw at any time then asked to complete the State-Trait Anxiety Inventory Form Y-1 (STAI: Spielberger, 1983). Following this the experimenter briefed the participant on their first task; they were given three minutes to prepare a five-minute presentation on the topic of their chosen University course or
career pathway, how they were suited to it, and how they would stand out from other candidates in their field. They were told the process was being recorded for subsequent behavioural analysis and comparison to other presentations. During these three minutes, a stopwatch counting down the time was visible to the participants. They could make notes at this stage; however, the notes could not be used during the presentation. After three minutes, the participant was invited by an interviewer, who made a point of appearing to start the camera recording, to step up to the microphone; the participant was asked to begin their presentation. In the event of the participant pausing during the presentation they were left in silence for 20 seconds before being prompted to continue by one of the interviewers. If it became apparent that the participant was unable to carry on, the interviewers asked questions for the remainder of the five minutes. The interviewers could base their questions on the participant’s presentation, generic questions also included; (i) Why do you think you are suited to this career pathway? (ii) Why do you think you are better qualified than others? (iii) What strengths would others say you have? Five minutes from the start, the presentation was abruptly ended, even if the participant was still speaking. The second task was immediately introduced; an interviewer instructed the participant to count aloud backwards from 2015 subtracting 13 each time. In the event of a mistake, the instruction given was, "Error, start again at 2015."; the participant was required to repeat the task from the beginning with no indication of what the mistake had been. This continued for five minutes, at which point the task was ended. The STAI was completed again.

3.5.1.2 Low performance evaluation threat condition.

As in the high-PET condition, the participant was greeted by the experimenter, reminded of their right to withdraw and they completed the STAI. The two members of the interview panel were present; however, they were dressed normally, were introduced to the participant, adopted a friendly and relaxed attitude, and offered support and reassurance throughout the process. Neither a microphone nor video camera was set up. The participant was briefed on their first task; three minutes to prepare an informal talk on a topic of their choice, they were prompted that it could be about their favourite book or film, or anything else they felt confident talking about. They could use any notes they made during their talk. No time was set for the duration of the talk, the participant could choose which of the interviewers they wished to remain present and they were given the option of standing or sitting. During the participant’s
talk the researchers appeared interested and encouraging, if the participant paused they were told they could stop at any time. Following the talk the participant was congratulated on their performance and the mental arithmetic task was introduced. They were required to count aloud from zero to 300 in steps of 15, if they made a mistake they carried on and could ask for help if needed. The task was completed when the participant reached 300.

3.5.2 Attentional bias dot-probe task (ABDP).

The predominant investigative method for research into attentional bias is the dot-probe paradigm, for example MacLeod et al. (1986), MacLeod, Rutherford, Campbell, Ebsworthy, and Holker (2002), Putwain et al. (2011) and See et al., (2009) (section 2.4.4.2).

The attentional bias dot-probe task (ABDP) used in this study was based on a dot-probe task designed by Putwain et al. (2011), see section 2.4.5.1. In its initial form, the ABDP was an internet based software application requiring access to the University of Manchester’s network to load each page. This presented limitations for using the software in schools and colleges with restrictions on network access. The author re-wrote the ABDP using the E-Prime 2.0 software package, allowing it to be run remotely on a laptop without internet access. This also brought the advantage of being able to present the trials in a randomised fashion, something the online-based system was unable to do. This rewrite altered the underlying platform on which the ABDP was implemented; however, there were no modifications to its processes or rationale.

The ABDP consists of 96 trials; 48 threat congruent trials and 48 non-threat congruent trials, employing words as stimuli. Putwain et al. (2011), trialled potential words for their dot-probe task with five highly test anxious undergraduate volunteers, who rated the words from 1 (not threatening to someone who was test anxious) to 5 (highly threatening to someone who was test anxious); 30 threat words (median score of ≥4) and 37 neutral words (median score =1) were retained for creating the trial word pairs (see Appendix 2). The same words were employed in this study.

Ninety-six unique word pairs were created with threat and neutral words being matched for syllable length, this facilitated the use of phrases made of two and three word combinations (e.g. “letting myself down”). Trials began with a fixation cue (+++) presented in the middle of the screen for 500ms, this was replaced with a word pair consisting of one threatening and one neutral word presented one above the other separated vertically by five cm. After a further 500ms, the words disappeared and an
arrow appeared in the location previously occupied by one of the stimuli. The participant was required to press one of two possible keys to indicate the direction of the arrow. This sequence is represented in Figure 3.2. below.

![Figure 3.2. An example of an ABDP trial.](image)

The delay time of 500ms was based upon previous work in the dot-probe paradigm (MacLeod et al., 1986; MacLeod et al., 2002; Putwain et al., 2011; See et al., 2009). All text was black, presented on a white background in Arial font, size 14. The trials were presented in four blocks of 24 trials, the order of trials in each block was randomised. Upon completion of each block a screen displaying the instruction “Press Space” was displayed, following this prompt the number of trials completed was shown before the next block commenced. The participants’ response times (RT) for each of the 96 trials were used to calculate the mean response time to threat congruent trials and the mean response time to non-threat congruent trials. The difference in response times, known as the *attentional bias index*, was calculated as follows:

\[
\text{Mean RT(ms) congruent trials} - \text{Mean RT(ms) non-congruent trials}
\]

### 3.6 Ethical Considerations

Ethical sensitivity is required in school-based research to balance the needs of the project with the context of the schools in which they are taking place. Due to the
nature of this study, liaison with the teachers involved was vital to ensure the success of the project, with the design and aims of the modified-TSST procedure made explicit from the outset. School leadership teams were also consulted, allowing them to make informed decisions regarding their establishment’s involvement. It was a concern for some institutions that the students would be required to miss lesson time to take part; therefore, where required, experimental sessions were scheduled during the students’ non-contact time. Teachers familiar with potential participants were consulted regarding their suitability to participate and could withdraw them if necessary.

The TSST procedures and the debriefing and distress protocols (see Appendix 3) were devised in collaboration between the author (an experienced teacher), a practising educational psychologist and an academic specialising in education research. This ensured that the demands of the study were met while providing the ethical sensitivity required to secure the cooperation of schools. The University of Manchester’s Research Ethics Committee identified the debriefing and distress protocols as exemplary and a model of good practice. The research assistants who made up the interview panel had an educational background and were experienced in working with adolescents in a school context.

The high-PET protocol of the modified-TSST involves a level of deception regarding the evaluative nature of the tasks and the apparent use of audio-visual recoding equipment. This was considered necessary to the elicitation of the desired state anxiety response, both the ethical approval committee and the teachers involved agreed with this decision. However, to minimise the length of this deception, those in the high-PET condition were informed during the debrief that the microphone and video camera had not been recording and that their presentation would not be scored or assessed. While this brought with it a level of risk to the integrity of the process, it was not felt compatible with the ethical framework of the study to maintain the deception for longer than was necessary. Participants were asked not to reveal details of the procedure to their peers and to discuss any concerns they may have had with either the author or their teachers. Spot checks with subsequent participants and teaching staff revealed that this request had been complied with, suggesting the process had not been compromised.

Ethical approval was formally granted for the preliminary study on the 20th of November 2013 (ref.13228) and then for the main study on the 9th of September 2014. The following steps were taken to ensure the ethical integrity of the current study:
i. All participants were recruited on the basis of informed consent and chose to take part only if they wished.

ii. Participants were made aware of their right to withdraw at any time with no reason required.

iii. Anonymity and confidentiality were ensured. Data was stored in a locked cabinet or on a password protected laptop. Access was limited to the author and supervisors.

iv. Protection from harm - as some participants were highly test anxious and the nature of the activity involved performance evaluation threat, the remote possibility that participants may become distressed could not be ruled out. However, previous research (e.g. Kirschbaum, 2010) suggested the physiological changes that occur as a result of taking part in the TSST are short-lived and return to normal within approximately 30 minutes of the end of the process. Participants were given time to rest after taking part in the TSST, only leaving once they felt ready to do so and returning to a familiar staff member. A participant distress protocol was prepared (Appendix 3) for use in the event of a participant becoming distressed by the process. The dot-probe task was based on a paradigm widely used without adverse reactions being documented.

v. Debriefing and feedback - all participants were debriefed after participating in the study (Appendix 3). They were offered anonymous feedback about the findings; individual data was not provided.

vi. Deception - the study involved a degree of deception of the participants as the information they received about the tasks (evaluative nature, video/audio recording, observation of behaviour) was inaccurate and was designed to induce performance evaluation threat. The participant debriefing was employed to remediate the deception in such a way that it entirely removed the perceived threat and maintained faith in psychological research.

3.7 Summary of the Methodology chapter

This chapter has outlined the paradigm in which the work is situated, provided justification for the research design that was employed, and outlined the experimental protocols that were used. The following chapters will address the specific methodologies and procedures employed in the preliminary phase of the study (chapter 4) and the main phase of the study (chapter 5).
Chapter 4 Preliminary Study

4.1 Aims of the Preliminary Study

As already illustrated (in section 2.5), there is a need to conduct test anxiety research with school-age children in naturalistic settings such as schools and colleges. Test anxiety is a personality trait, predisposing highly test anxious individuals to develop higher levels of state anxiety in situations where performance evaluation is salient (section 2.3.4). To fully study the impact of test anxiety, participants need to be in a position where their levels of state anxiety are elevated in a similar way to that which occurs in an examination or test situation. However, the study of school-age children in real high-stakes examinations is neither practically nor ethically feasible; therefore, rigorous experimental simulations acting as a proxy for examinations are required to manipulate anxiety.

The author has modified the Trier Social Stress Test (TSST: sections 2.5.3 & 3.5.1) to ensure the protocols are relevant to adolescents in educational settings. Before this could be employed in a full research study, an evaluation was required of its impact on the state anxiety levels of adolescents. This would also serve to confirm that it was practically and ethically feasible to implement the protocol in school contexts and ensure the impact on participants was limited to the period of participation and immediately after.

The dot-probe task employed by Putwain et al. (2011) showed encouraging results in investigating attentional bias in undergraduate students, but its utility with adolescents required investigation. Therefore, in this preliminary study, the attentional bias dot-probe task (ABDP) was employed in conjunction with the modified-TSST; however, at this stage it was not used to investigate the presence of an attentional bias in any of the participants.

In summary, the aims of this preliminary phase of the study were:

i) To develop an ethical and feasible version of the TSST and placebo TSST for use in educational settings.

ii) To evaluate the effectiveness of these protocols in manipulating state anxiety.

iii) To explore the feasible use of the ABDP allied with the modified-TSST in a school and college contexts.
4.2 Research Questions

1) Can the modified TSST protocols be successfully implemented in a school-based setting with a high test anxiety adolescent population?

2) How do the modified TSST protocols impact on state anxiety in a highly test anxious population?
   a) Were there differences in self-reported trait test anxiety between the low- and high-PET conditions of the TSST?
   b) Were there differences in measured pre-TSST state anxiety between the low- and high-PET conditions of the TSST?
   c) How does measured state anxiety change during the high- and low-PET TSST procedures?

4.3 Methodology

4.3.1 Research design.

A between-participants experimental design was employed with performance evaluation threat as the independent variable, this was manipulated by random allocation of participants to high or low threat conditions and their associated TSST protocols. The dependent variable was state anxiety; to explore how this changed during the TSST process, in both conditions state anxiety was measured immediately before and after the TSST using Form Y-1 from the State-Trait Anxiety Inventory (STAI: Spielberger, 1983).

4.3.2 Sampling and Recruitment.

Schools and colleges in the Greater Manchester area offering A-Level courses in Psychology were identified and initial contact was made with the subject leader in that area, seven schools and colleges initially agreed to take part. Subject leaders of Psychology were contacted as they were best placed to understand the nature of the study, the benefit to their students of taking part, and to decide on how they used their curriculum time. An initial meeting with subject leaders addressed the following: (i) a detailed explanation of the procedure, including requirements of teachers and students, (ii) collection of information regarding the organisational practices of the school/college, and (iii) discussion of ethical issues and the timing of data collection. At this stage, three subject leaders agreed to take part, four consulted the school leadership team; of the latter, three agreed to take part. However, a senior teacher at
one institution expressed a lack of confidence in the process and withdrew from the study. Two of the institutions requested participation was an option for students in all A-level subjects, this was agreed to.

Meeting with subject leaders also identified ways to ensure participants benefitted from taking part. The research design, methodology, and ethics of the study were relevant to the participants’ A-level psychology programmes; hence, the author agreed to deliver a lesson following the data collection to the students on how these factors had been addressed. Clearly, this was not relevant to those not studying Psychology; for these students, participation in the study provided them with a topic for an Extended Project Qualification (EPQ).

To recruit participants, the author delivered assemblies to the relevant year-groups; during this they were provided with an information sheet outlining what the study entailed; they chose to participate on an opt-in basis. Inclusion criteria were (a) aged 16-18 years of age and (b) following A-level courses assessed by a terminal examination. A-levels are a tier of post-compulsory English education that is equivalent to senior high school in other countries. There were no formal exclusion criteria, however, the teachers were given the option to withdraw students where they felt that participation would be inappropriate.

4.3.3 Materials.

4.3.3.1 Questionnaires.

Trait levels of test anxiety were measured using the Revised Test Anxiety Scale (RTA: Hagtvet & Benson, 1997). (Appendix 4). Participants responded to twenty items (e.g. ‘During exams I feel very tense’) on a four-point Likert scale (1 = never to 4 = always), higher scores indicate higher levels of test anxiety. The RTA has been widely used in test anxiety research (e.g. Keogh et al, 2004; Putwain & Daly, 2014; Putwain & Symes, 2012), displaying good reliability (Putwain, Woods, & Symes, 2010). State anxiety was measured using form Y-1 from the State-Trait Anxiety Inventory (STAI: Spielberger, 1983) (Appendix 4). Participants respond to twenty statements (e.g. ‘I feel calm’ or ‘I am worried’) on a four-point scale (1 = not at all, 4 = very much so). Statements have both positive and negative connotations so reverse scoring is employed for ten items; a higher score on the STAI indicates higher state anxiety. The STAI is a widely used measure that appears in numerous studies in over thirty languages (Grös, Antony, Simms, & McCabe, 2007), it demonstrates excellent internal reliability (Cronbach’s $\alpha > .89$) (Barnes, Harp, & Jung, 2002).
4.3.3.2 Modified Trier Social Stress Test.

Both high- and low-PET protocols of the modified-TSST were used during the experimental sessions (see 3.5.1). These sessions consisted of an introduction, the experiment, and an interview/debrief. Both conditions required a team of three researchers; one, the experimenter, had overall responsibility for the process and conducted the introduction and debriefing phases; this role was always taken by the author. The other members of the team comprised an interview panel. Prior to these sessions, all team members had been trained in their roles by the author and were familiar with the script for the entire procedure (Appendix 5). This training had taken the form of sessions where both high- and low-PET conditions had been practised on members of the research and supervisory team, and with postgraduate research colleagues not involved in the study.

4.3.3.3 Attentional bias dot-probe task.

As the main research study would employ the ABDP to investigate attentional bias, it was included in the preliminary study to ensure research integrity; however, it was not used to capture data for analysis. Following the completion of the TSST procedure, participants in both low- and high-PET conditions joined the experimenter to complete the ABDP, delivered on a 38cm Windows laptop. All received the same instructions delivered by the experimenter, with on-screen prompts to ensure fidelity. Following a series of practice trials, the participants worked unaided following the on-screen instructions.

4.3.3.4 Participant interviews.

Upon completion of the dot-probe task, participants took part in a semi-structured interview relating to their experiences of the TSST protocols and exploring its use as a proxy for evaluative situations. This interview was designed to address the following areas; (i) the participants feelings and attitudes towards the modified-TSST tasks and the interview panel, (ii) the participants feelings while they were completing the tasks, including any anxieties and distracting thoughts, (iii) to explore the participants coping strategies in evaluative situations, and (iv) whether the instructions provided for the ABDP and the on-screen prompts were sufficient for it to be completed independently. The transcript of this interview can be found in Appendix 6. The experimenter conducted this interview in a supportive yet formal fashion; where participants were visibly concerned, they were reassured the process would be fully
explained to them at the end of the interview. As the interview was semi-structured, the experimenter generally followed the schedule; however, supplementary questions were asked of the participants based upon their answers, and clarification sought where required.

4.3.4 Procedure.

This preliminary study received ethical approval from the University of Manchester’s Research Ethics Committee on the 20th of November 2013. Schools and colleges were selected for inclusion in the study by identifying institutions in the Greater Manchester area that offered post-16 education. Potential participants were briefed regarding the nature of the study and chose to opt-in based on the information provided.

Initially, 543 students expressed an interest in participating and were screened for levels of self-reported test anxiety using the RTA; all participants had completed GCSE examinations in the year preceding this study. At the time of participation they were following a minimum of three A-level courses from across the full range of subjects available. No participants had previously received specific interventions to support them with test anxiety. Following this screening, participants scoring in the top 15% of the sample \((n = 30)\), were selected for the experimental phase of the study. This sample comprised 28 female and two male participants, 15 from school Year 12 and 15 from Year 13 (mean age 17 years 2 months). The figure of 15% was based on the findings of Putwain and Daly (2014) and aimed to include those participants who could be considered highly test anxious. A random number generator was used to assign these participants into high and low performance evaluation threat conditions.

Participants selected for the experimental session were contacted via their school a week before participation to ensure the date was convenient; the sessions were conducted in their school with the agreement of their teachers. At the beginning of the experimental session, the experimenter greeted each participant, verified their identity, confirmed their participation, and assigned them a participant number. The participant was guided through the relevant low- or high-PET procedure (section 3.5.1).

Following the TSST, participants completed STAI again, then undertook the ABDP. The interview was then conducted, after which participants were fully debriefed regarding the nature of the entire process they had just completed. Those in the high-PET condition were informed that the microphone and video camera had not been recording and their presentation would not be scored or assessed in any way. All
participants were informed that they had the right to have their data withdrawn from the study, although none took up this option.

4.3.5 Analytical Strategy.

4.3.5.1 Independent samples t-tests.

To explore baseline equivalence of the low- and high-PET conditions, quantitative data on trait test anxiety and state anxiety collected pre-TSST were analysed using independent samples t-tests. To ensure this was the appropriate statistical technique, the following assumptions needed to be satisfied:

1. One continuous dependent variable.
2. One independent dichotomous variable.
3. Independence of observations; no participants can be in both conditions of the independent variable.
4. No significant outliers in either condition.
5. The dependent variable should be normally distributed.
6. Homogeneity of variance in each condition of the independent variable.

4.3.5.2 Analysis of covariance, ANCOVA.

To determine the impact of condition on changes in state anxiety, while adjusting for pre-TSST state anxiety levels, an ANCOVA was run on state anxiety data collected pre- and post-TSST. Change in state anxiety was the dependent variable, while pre-TSST state anxiety was the covariate. The following assumptions needed to be met to run the ANCOVA:

1. One continuous dependent variable.
2. One independent variable with at least two independent groups.
3. A continuous covariate.
4. Independence of observations; no participants can be in both conditions of the independent variable.
5. A linear relationship between the dependent variable and the covariate.
6. Homogeneity of regression slopes to ensure there is no interaction between the covariate and the independent variable.
7. The dependent variable should be normally distributed.
8. There should be homoscedasticity.
9. Homogeneity of variance in each condition of the independent variable.
10. No significant outliers in either condition.
4.3.5.3 Repeated measures t-tests.
A repeated measures t-test was used to investigate the mean differences between pre- and post-TSST state anxiety within each condition. To perform a repeated measures t-test the following assumptions must be met:
1. One continuous dependent variable.
2. One independent variable, consisting of two related groups (i.e. the same participants under different conditions).
3. No significant outliers in the differences in the dependent variable between the two related groups.
4. The differences in the dependent variable between the two related groups should be normally distributed.

4.3.5.4 Directed content analysis.
The participant interviews were analysed using a technique known as Directed Content Analysis. See section 5.5 for a full explanation of this data analysis technique.

4.4 Results
Data were analysed using independent samples t-tests and an ANCOVA to explore equivalence at baseline between low-PET and high-PET conditions and the impact of the TSST on participants’ state anxiety levels, across two time periods (pre-TSST and post-TSST).

Table 4.1. Descriptive data for gender and test anxiety scores by condition

<table>
<thead>
<tr>
<th></th>
<th>Low-PET</th>
<th></th>
<th>High-PET</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>0</td>
<td>15</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Mean</td>
<td>62.07</td>
<td>3.79</td>
<td>64.13</td>
<td>6.08</td>
</tr>
</tbody>
</table>

Descriptive statistics regarding the gender balance and self-reported test anxiety scores (presented in Table 4.1 above) show the sample was predominantly female.
4.4.1 Were there differences in self-reported trait test anxiety between the low- and high-PET conditions of the TSST?

An independent samples t-test was run to determine differences in the self-reported trait test anxiety between the participants assigned to the high- and low-PET conditions.

Table 4.2. Descriptive data for pre/post-TSST state anxiety scores by condition.

<table>
<thead>
<tr>
<th></th>
<th>Low-PET</th>
<th></th>
<th>High-PET</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Pre-TSST STAI</td>
<td>43.47</td>
<td>12.06</td>
<td>38.27</td>
<td>12.97</td>
</tr>
<tr>
<td>Post-TSST STAI</td>
<td>32.80</td>
<td>9.39</td>
<td>47.67</td>
<td>15.45</td>
</tr>
<tr>
<td>STAI Difference</td>
<td>-10.67</td>
<td>11.57</td>
<td>9.40</td>
<td>11.78</td>
</tr>
</tbody>
</table>

**Screening**

There was one outlier in the high-PET condition (participant no. 35) this was checked for measurement accuracy and as this appeared a genuine value it was kept in the dataset; to check the impact of this, the analysis was repeated this value removed, no substantive differences were uncovered. Trait test anxiety scores for both conditions were normally distributed as assessed by Shapiro-Wilk’s test ($p > .05$), Levene’s test of homogeneity of variance indicated this assumption had not been violated ($p = .151$).

**Analysis**

No significant difference was found between the self-reported test anxiety scores of participants in the low-PET and high-PET conditions, $t(28) = 1.117$, $p = .273$, $d = 0.41$.

**Summary**

No differences were uncovered between the conditions in terms of the participants’ trait test anxiety, hence, they can be considered equivalent.

4.4.2 Were there differences in measured pre-TSST state anxiety between the low- and high-PET conditions of the TSST?

An independent samples t-test was run to determine if there were differences in the measured pre-TSST state anxiety between the participants assigned to the high- and low-PET conditions.
Screening

There were no outliers in either condition. Pre-TSST state anxiety scores for both conditions were normally distributed as assessed by Shapiro-Wilk’s test \((p > .05)\), Levene’s test of homogeneity of variance indicated this assumption had not been violated \((p = .617)\).

Analysis

No significant difference was found between the measured pre-TSST state anxiety scores of participants in the low-PET and high-PET conditions, \(t(28) = -1.137, p = .265, d = 0.42\).

Summary

No differences were uncovered between the conditions in terms of the participants’ pre-TSST state anxiety, hence, they can be considered equivalent.

4.4.3 How does measured state anxiety change during the low- and high-PET TSST procedures?

An ANCOVA was run to determine the effect of performance evaluation threat condition on the change in state anxiety measured pre- and post-TSST. While no significant difference was uncovered between the conditions in terms of the participant’s pre-TSST state anxiety, the non-significant differences demonstrated a medium effect size \((d = 0.42)\); hence, an ANCOVA was considered the most appropriate test to use to allow the mean changes in state anxiety to be explored after adjusting for levels of pre-TSST state anxiety.

Screening

There was a linear relationship between pre-TSST state anxiety and the change in state anxiety for each performance evaluation threat condition, as assessed by visual inspection of a scatterplot. There was homogeneity of regression slopes as the interaction between the independent variable and the covariate was not statistically significant \(F(1,26) = 2.077, p = .161\). Studentized residuals for the performance evaluation threat conditions and the overall model were normally distributed, as assessed by Shapiro-Wilk’s test \((p > .05)\). There was homoscedasticity of variances, as assessed by visual inspection of a scatterplot, Levene’s test of homogeneity of variance
indicated this assumption had not been violated \( (p = .164) \). There were no outliers in the data, with no standardized residuals greater than +/-3 standard deviations.

**Analysis**

The unadjusted data showed an increase in state anxiety for those in the high-PET condition \((M = 9.40, SD = 11.76)\) and a decrease in state anxiety for those in the low-PET condition \((M = -10.67, SD = 11.57)\). After adjusting for pre-TSST state anxiety, the change in state anxiety showed an increase for those in the high-PET condition, \(M = 8.33, 95\% \text{ CI}[2.62, 14.03]\), and a decrease for those in the low-PET condition, \(M = -9.59, 95\% \text{ CI}[-3.89, -15.30]\). There was a statistically significant difference in the change in state anxiety (pre- to post-TSST) between the high- and low-performance evaluation threat conditions, \(F(1,27) = 20.31, p < .001, \eta^2_p = .43\).

The changes in state anxiety within each condition observed during the TSST process were analysed using repeated measures t-tests.

**Screening**

There were no outliers in the difference in state anxiety pre- to post-TSST in either condition. The assumption of normality in the distribution in the changes in state anxiety were met in both the high-PET \((p = .466)\) and low-PET \((p = .617)\) conditions.

**Analysis**

Participants in the high-PET condition reported a significant increase in state anxiety, \(M = 9.40 \text{ CI}[2.89, 15.91], t(14) = 3.096, p = .008, d = 0.72\). Those in the low-PET condition reported a significant decrease in state anxiety, \(M = -10.67, 95\% \text{ CI}[-4.26, -17.07], t(14) = -3.571, p = .003, d = 0.89\).

**Summary**

These results indicate the modified TSST was successful in inducing significant differences in post-test levels of state anxiety between the low-PET and high-PET conditions. It was also revealed that the two conditions also had the opposite impact to each other on state anxiety.
4.4.4 How did the participants describe their experiences of the TSST procedure?

Data from the semi-structured interviews were transcribed, coded and analysed using directed content analysis. Comments pertaining to the participants’ state anxiety and the evaluative situation were identified. Participants in the high-PET condition frequently described their feelings during the procedure using words associated with a heightened state of anxiety, for example, “nervous” (12, 15, 40, 38, 52), “tense/stressed” (35), “anxious” (38, 42) and “uncomfortable” (11). They reported feeling “out of control” (35, 38, 43, 55, 62) during the process, while their perceived poor performance on the tasks led to “embarrassment” (12, 35, 42, 52, 62) and “frustration” (12, 15, 38, 45), with several commenting that the situation contributed to them going blank or forgetting what to say (25, 35, 40, 52 53). When asked about the procedure itself it was described as “intimidating” (15, 25, 53, 55), “cruel” (25) and “harsh” (12), time pressures were also mentioned (42, 62). Many comments were made regarding the interview panel, for example, a lack of reassurance/support (15, 35, 42, 43), “unfriendly” and “unhelpful” (38, 43, 52), “stern” (15) and “scary” (45); this led to participants feeling “judged” (11, 12, 38, 43, 55). The interview panel wearing lab coats was also mentioned as contributing to the difficulty of the situation (22, 35, 53). One participant (67) in the high-PET condition reported themselves to have been relaxed throughout (67). Participants in the low-PET condition also described feelings of anxiety or nervousness at the start of the protocol (14, 20, 34, 41, 54, 61) and being “under pressure” (14, 54, 61), others reported being “relaxed” (39, 65) or not perceiving any pressure (22, 28). During the process, many of the participants described their feelings changing and becoming “calmer” (20, 49), “comfortable” (19, 37, 41) or “more confident” (14, 22, 28, 37, 41). The interview panel were described as “positive” (14, 49), “supportive” (14, 28), “helpful” (19, 22, 41) and “nice people” (19, 34, 66). The ability to choose the topic was also mentioned as having a positive impact on the participants’ perceptions of the task (19, 28, 37, 41, 65, 90).

4.5 Summary of Findings

The rationale behind this preliminary study was to develop and evaluate a protocol to induce state anxiety through performance evaluation threat in school-age students. Achieving this within an ethical and experimentally controlled framework, which was also acceptable to teachers, would facilitate further research into test anxiety in ecologically valid contexts. A review of the literature found the key components of
high performance evaluative threat to be social-evaluative threat, uncontrollability, and forced failure (Dickerson & Kemeny, 2004), with procedures employing a combination of public speaking and cognitive tasks shown to be the most effective. From this review, the Trier Social Stress Test was chosen as the most appropriate protocol to deliver these key components and was modified to be appropriate to school-age students. Hence, the aims of the preliminary study were:

1. To develop an ethical and feasible version of the TSST and placebo TSST for use in an educational setting.
2. To evaluate the effectiveness of this protocol in evaluating self-reported state anxiety.
3. To explore the feasible use of the ABDP allied with the modified TSST in a school and college context.

The TSST is designed for use in adult populations; therefore, it was considered necessary to modify the scenarios to make them relevant to the participants’ experiences of education. The high-PET scenario was adapted from that of a job interview to being focussed on the participant’s choice of University course or career pathway; within this, the participant was required to both explain and justify their choices, with an emphasis on their strengths and suitability. A control or placebo TSST protocol based on Het et al. (2009) was also developed which was appropriate and relevant.

It was both ethically and practically feasible to implement the modified-TSST in an educational setting. Key to this was the development of the protocols by combining the skills and experience of a teacher, an educational psychologist and an academic; ensuring the process was sufficiently robust, that the wellbeing of participants was carefully considered, and that the procedures employed were acceptable to teachers in regard of their safeguarding responsibilities. The implementation of the TSST in educational contexts is discussed in greater detail in section 8.2.1.

Prior to undergoing the modified-TSST, no significant differences were found between the low-PET and high-PET participant groups in terms of their self-reported test anxiety and measured state anxiety; hence, the groups were considered equivalent at baseline. Post-TSST state anxiety scores showed those in the high-PET condition yielded a significant increase in state anxiety while the low-PET condition resulted in a significant decrease in state anxiety; both groups displayed effect sizes commensurate with those found in the adult TSST (e.g. Hellhammer & Schubert, 2012). Additionally,
the change in state anxiety scores pre- to post-TSST showed a significant difference between the two conditions after controlling for the covariate of pre-TSST state anxiety scores, again the magnitude of this effect ($\eta_p^2 = 0.43$) was similar to those observed within adults (Hellhammer & Schubert, 2012). The increase in state anxiety levels for the participants in the high-PET condition had been anticipated; however, an unexpected finding was the significant fall in the state anxiety scores of the participants in the low-PET group. It is proposed that this effect was seen on account of the experimental situation being unfamiliar to all participants, which is likely to have somewhat elevated state anxiety even for participants within the placebo condition. The encouraging and supportive nature of the low-PET protocol allowed participants’ state anxiety to return to their usual levels as the tasks progressed.

The collection of qualitative data provided insight into participants’ emotions during the process and allowed in-depth exploration of the ability of the modified-TSST to generate and maintain state anxiety. Participants’ comments indicate that the high-PET condition, through a combination of the tasks set and the scenario presented, not only generated feelings of state anxiety, but also maintained these feelings for the duration of the procedure. The low-PET condition also generated feelings of anxiety on its initial introduction; however, in contrast to the high-PET condition, the supportive and encouraging nature of the situation, and the relative simplicity of the tasks, quickly attenuated the potential threat leading to decreases in state anxiety and to the participants’ reporting they became increasingly comfortable and relaxed.

A key rationale for employing the TSST lay in its capacity to deliver social evaluative threat, uncontrollability, and forced failure. Evidence from the participant interviews leads to the conclusion that it is indeed these elements of the high-PET modified-TSST protocol that were instrumental in the genesis and maintenance of heightened state anxiety. Additionally, in the low-PET condition, where the elements of social-evaluation, uncontrollability, and failure were not present, there is evidence that state anxiety was initially generated but not maintained.

4.5.1 Limitations.

It must be recognised that the small sample size ($n = 30$) is a limitation of this study. To reliably detect effects sizes of the magnitude found in this study would require a sample in excess of one hundred and twenty participants (Cohen, 1992). This was beyond the scope of this preliminary study; hence, employing larger sample sizes should be a consideration for future work in this area.
To further explore the utility of the modified-TSST, it would have been informative to investigate whether the protocol generated the same worries as experienced during an examination or similar evaluative situation. While this was alluded to by some participants, the explicit collection of such data would be a recommendation for future studies.

4.5.2 Implications for future research and intervention using the modified-TSST.

This study has also shown the advantage and feasibility of implementing the modified-TSST protocols with adolescents within educational settings. This provides a context for ecological validity, maximises efficient use of research resources, and provides an ethical framework for experimentation. However, implementation of the modified-TSST is a resource-intensive procedure; hence, it is vital to consider ways to ensure efficient and successful implementation in the future. In addition, a key observation during implementation was that participant attrition was far less when the experimental sessions took place during participants’ lesson times as opposed to times scheduled for free-study. Unfortunately, this is a decision that will be made by the participating teachers; however, this observation does caution against scheduling experimental trials outside of regular lesson times. Furthermore, in order to maintain the unfamiliar nature of the TSST protocol, it is recommended that the researcher who performs the participant recruitment and initial screening does not sit on the interview panel in the experimental session; in this study, the author, in charge of participant recruitment, assumed the role of the experimenter.

4.6 Summary of Preliminary Study

In summary, this modified version of the TSST has the capacity to manipulate state anxiety in an adolescent population. It presents a controlled and ethically acceptable method for generating performance evaluation threat and has utility in research into the underlying causes of test anxiety and interventions reduce its negative effects; hence, it was employed in the main study of this thesis (see chapter 5).
Chapter 5 Main Research Study

5.1 Aims

Having established the modified-TSST protocols as able to reliably and safely manipulate state anxiety in a school-age population (see chapter 4), the main phase of this study employed the high-PET protocol in a wider investigation into test anxiety in educational contexts.

As previously discussed, attentional bias has been associated with many forms of anxiety (section 2.4), with empirical evidence demonstrating that when in a condition of state anxiety both clinically and highly trait-anxious participants respond more quickly to threat stimuli than to neutral stimuli (Bar-Haim et al, 2007; Cisler & Koster, 2010; Mathews & MacLeod, 2002). Hence, it is hypothesised that the attentional bias identified in other forms of clinical and trait anxiety will also be present in test anxiety; this study will investigate this further. Relationships between trait test anxiety, attentional control, and state anxiety will be explored, alongside how these factors can be used to predict an individual’s attentional bias in a situation of high performance evaluation.

Section 2.4.5.1 outlines the promising work of Putwain et al. (2011) in attempting to identify patterns of attentional bias in test anxious students, though replication of their initial results has been unsuccessful. Limitations in the elicitation of anxiety were considered to contribute to these difficulties and have been addressed by the modified-TSST protocols. Hence, implicit in this study will be an attempt to replicate the key findings of Putwain et al. (2011), albeit in a different population.

In summary, the aims of the main phase of the study were:

1. To establish an ethically robust protocol for the study of test anxiety in a naturalistic setting.
2. To investigate the presence of attentional bias in highly state anxious adolescents while under performance evaluation.
3. To explore how any such attentional bias is influenced by trait test anxiety and attentional control in an adolescent population.
4. To explore the relationship of attentional control to trait test anxiety and state anxiety.
5. To investigate if evidence is provided to support and refine the proposed model of impaired performance in test anxious students presented in Figure 2.2.
5.2 Research Questions

1) Can the high performance evaluation threat protocol of the modified-TSST be successfully implemented in a school-based setting with adolescents heterogeneous in their levels of trait test anxiety?

2) How does the high performance evaluation threat protocol of the TSST impact on state anxiety in population that is heterogeneous in terms of trait test anxiety?
   a) How does measured state anxiety change during the TSST procedure?
   b) How does self-reported trait test anxiety interact with changes in state anxiety during the TSST process?
   c) How does self-reported attentional control interact with changes in state anxiety during the TSST process?
   d) How does self-reported trait test anxiety (worry) interact with changes in state anxiety during the TSST process?
   e) How does self-reported trait test anxiety (test irrelevant thinking) interact with changes in state anxiety during the TSST process?

3) What measurement evidence can be provided to support the hypothesised relationships (Figure 2.2) between self-reported trait anxiety, attentional control, state anxiety and attentional bias in 16-18-year-olds undertaking a high-stakes program of study?
   a) What is the relationship between self-reported trait test anxiety and attentional control?
   b) What is the relationship between self-reported trait test anxiety and state anxiety (baseline, pre-TSST, post-TSST, change pre- to post-TSST)?
   c) What is the relationship between self-reported attentional control and state anxiety (baseline, pre-TSST, and post-TSST, change pre- to post-TSST)?
   d) What is the relationship between pre-TSST state anxiety and post-TSST state anxiety?
   e) What is the relationship between pre-TSST state anxiety and the change in state anxiety?
   f) What is the relationship between post-TSST state anxiety and the change in state anxiety?
   g) What is the relationship between self-reported trait test anxiety and attentional bias?
h) What is the relationship between self-reported attentional control and attentional bias?

i) What is the relationship between state anxiety (baseline, pre-TSST, and post-TSST) and attentional bias?

j) What is the relationship between the change in state anxiety (pre- to post-TSST) and attentional bias?

4) What is the difference, if any, between participants’ response times to threat congruent and non-threat congruent trials measured by the ABDP?

5) How do trait test anxiety, attentional control and state anxiety predict attentional bias in 16-18-year-old students undertaking a high-stakes program of study?
   a) How do measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?
   b) How do measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?
   c) How do the worry component of measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?
   d) How do the worry component of measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

6) What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)?
   a) How do the clusters differ from one another in terms of the worry component of trait test anxiety?
   b) How do the clusters differ from one another in terms of self-reported attentional control?
   c) How do the clusters differ from one another in terms of the calculated attentional bias index?
   d) How do the clusters differ from one another in terms of pre-TSST state anxiety?
   e) How do the clusters differ from one another in terms of post-TSST state anxiety?
   f) How do the clusters differ from one another in terms of the change in state anxiety (pre- to post-TSST)?
5.3 Methodology

5.3.1 Research design.

A pre-experimental research design was employed with three predictor variables; trait test anxiety, state anxiety (measured at three time-points), and attentional control. The participants’ attentional bias was the response variable. The high-PET modified-TSST protocol (section 3.5.1) was used to induce state anxiety as a proxy for an examination situation. Quantitative data relating to trait test anxiety, attentional control, state anxiety, and attentional bias was collected alongside qualitative data regarding the participants’ anxieties and strategies during the TSST protocol (see Fig. 5.1).

![Figure 5.1. Embedded Design employed in this study.](image)

5.3.2 Sampling and Recruitment.

Schools and colleges which had taken part in the preliminary study were invited to participate in the main research study, the teachers from five of the six agreed and two additional schools also agreed to take part; all schools and colleges were located in the Greater Manchester area. One establishment that had been involved in the preliminary study did not participate in this phase, this was due to the member of staff leaving and their replacement feeling that they would be unable to commit their time to the study as they were new to the subject leader role; there was no issue with the study or its impact. Students who had taken part in the preliminary phase of the study were excluded from this main phase.

As in the preliminary study, initial meetings with teachers addressed the following; (i) a detailed explanation of the procedure, including requirements of teachers and students, (ii) collection of information regarding the organisational practices of the school/college, and (iii) discussion of ethical issues and the timing of
data collection. Again, it was decided that following the conclusion of data collection the author would visit the establishments to deliver a lesson on the study’s design and how the ethical issues had been addressed.

Participants were recruited and briefed during their regular lesson times regarding the nature of the study, what their participation would involve, and their rights should they choose to take part. At this point, they were provided with the participant information sheet (Appendix 7) and had a minimum of two weeks to consider participating. Inclusion criteria were; (a) aged 16-18, (b) following A-level courses assessed by a terminal examination, and (c) did not participate in the preliminary phase of the study. A power calculation was performed using G*Power (version 3.1.3) for a multiple regression analysis with four predictor variables (trait test anxiety, state anxiety, attentional control, and gender5), powered for an effect size ($f^2 = 0.15$). This indicated the study required 77 participants; however, the recruitment strategy aimed for in excess of 100 participants to allow for the levels of participant attrition observed during the preliminary study.

5.3.3 Materials

5.3.3.1 Questionnaires.

The instruments employed in the preliminary study were used again during this phase; trait test anxiety was measured using the Revised Test Anxiety Scale (RTA: Hagtvet & Benson, 1997), state anxiety was measured using form Y-1 from the State-Trait Anxiety Inventory (STAI: Spielberger, 1983) (Appendix 4). Attentional control was measured using the Attentional Control Scale (ACS: Derryberry & Reed, 2002) (Appendix 4). Participants responded to twenty statements (e.g. ‘I can quickly switch from one task to another’) using a four-point scale (1 = almost never, 4 = always). Reverse scoring was employed to account for the wording of statements, the ACS demonstrates high internal reliability (Cronbach’s $\alpha = .88$) (Fajkowska & Derryberry, 2010).

5.3.3.2 Modified Trier Social Stress Test.

The high-PET version of the modified-TSST (see 3.5.1) was used during the experimental sessions and employed exactly as in the preliminary study (section 4.3.3.2). Again, the author always took on the role of the experimenter.

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5 Gender was not eventually employed as a predictor variable due to the predominantly female nature of the final population.
5.3.3.3 Attentional bias dot-probe task.
Following the completion of the TSST procedure participants joined the experimenter to complete the ABDP (see 3.5.2), all received identical instructions from the experimenter using on-screen prompts to ensure fidelity. Following a series of practice trials to ensure they were familiar with how to complete the task, participants worked unaided following the on-screen instructions. Unlike in the preliminary study, the ABDP was used to collect data on participants’ reaction times to each trial.

5.3.3.4 Participant Interviews.
Participants took part in a semi-structured interview relating to their experiences of the TSST protocols and exploring its use as a proxy for evaluative situations. The transcript of this interview can be found in Appendix 6.

5.3.4 Procedure.
This study received ethical approval from the University of Manchester’s Research Ethics Committee on the 9th of September 2014. All participants completed two research sessions that took place during their regular lesson times; session one lasted approximately fifteen minutes, session two took thirty minutes.

5.3.4.1 Session one.
The experimenter reminded the participants of the nature of the study and provided the opportunity for them to ask any questions about the process, it was also reiterated that their participation was voluntary and they could withdraw at any time. Participants completed the Revised Test Anxiety Scale, the Attentional Control Scale, the ABDP software and the State-Trait Anxiety Inventory. The order in which they were completed was counterbalanced to prevent fatigue impacting one instrument disproportionately; however, the STAI was always administered immediately prior to the ABDP as this order would occur in session two. The use of the ABDP in this session was solely to familiarise the participants with the software, the instructions, and its requirements; no data was collected until session two.

5.3.4.2 Session two.
Session two occurred approximately four weeks after session one. The experimenter welcomed each participant at the start of the session, verified their identity, and confirmed that they still wished to take part; participants were assigned an
identification number that would be used during the session. Participants’ completed the STAI immediately pre-TSST then were guided through the high-PET procedure (as outlined in 3.5.1.1). Immediately post-TSST, participants again completed the STAI, then undertook the ABDP. The instructions given were the same as in session one; however, it was indicated that performance on the task would be judged. Following this the experimenter led the participants through a semi-structured interview (Appendix 6). To conclude the session, participants were fully debriefed; they were informed that the microphone and video camera had not been recording and that their presentation would not be scored or assessed in any way. All participants were informed that they had the right to have their data withdrawn from the study, although none took up this option.

5.3.5 Data collected.

In summary, the following data were collected:

Session 1 (baseline session):
- State anxiety using the State-Trait Anxiety Inventory Form Y-1.
- Self-reported test anxiety using the Revised Test Anxiety Scale.
- Self-reported attentional control using the Attentional Control Scale.

Session 2 (experimental session):
- Pre-TSST state anxiety using the State-Trait Anxiety Inventory Form Y-1.
- Post-TSST state anxiety using the State-Trait Anxiety Inventory Form Y-1.
- Response times (in milliseconds) to the 96 ABDP trials.

5.4 Quantitative Analytical Strategy

The impact of the modified Trier Social Stress Test on the state anxiety levels of the participants was examined using both one-way and 3x3 analyses of variance (ANOVAS). A one-way repeated measures ANOVA allowed the identification of statistically significant differences between the participants’ state anxiety at three time-points; baseline, pre-TSST and post-TSST. The 3x3 ANOVAs allowed the exploration of the possible interactions between the changes in the participants’ state anxiety during the TSST and their self-reported levels of trait test anxiety, attentional control, and the worry and test irrelevant thinking components of test anxiety. The worry dimension of test anxiety is considered to have a greater impact on performance in evaluative situations (see section 2.3.7.6); this is represented on the RTA by the domains of worry and test irrelevant thinking. Hence, these were considered of greater interest to this
study than the domains relating to emotionality.

The strength and direction of the relationships between the participants’ trait test anxiety attentional control, state anxiety, and attentional bias index were determined by Pearson product-moment correlations.

The statistically significant differences between the participants’ response times to threat congruent and non-threat congruent trials completed during the ABDP process, represented by the calculated attentional bias index, were investigated using a repeated measures t-test.

A series of hierarchical multiple regressions was carried out to investigate whether the factors of trait test anxiety, attentional control, and pre- or post-TSST state anxiety could be used to predict an individual’s attentional bias index.

A cluster analysis was carried out to place the heterogeneous population of this study, into relatively homogenous groups based on the worry component of trait test anxiety, attentional control, and the attentional bias index. This facilitated the in-depth analysis of the interview data, exploring the qualitative responses of participants identified as similar to each other by the quantitative data; hence, the cluster analysis acted as a bridge between the two data sets.

5.4.1 One-way repeated measures ANOVA.

A one-way repeated measures ANOVA is used to investigate statistically significant differences between levels of a within-subjects factor; however, this alone does not identify the specific differences between each of the levels and whether these are significant. Hence, an ANOVA is often referred to as an omnibus test (Field, 2013 p.442). In most cases, it is where the differences between the levels lie that is of interest; therefore, to identify this, post hoc tests are carried out in conjunction with an ANOVA. The most common of these, Tukey’s test or Bonferroni’s procedure, examine all possible pairwise comparisons and are appropriate when there is not previous knowledge of where the group differences may occur. An alternative post hoc procedure is to employ planned contrasts where only specific combinations are explored. Planned contrasts are used where the pairwise combinations to be investigated have been determined prior to the data collection. The significance of group differences does not indicate the magnitude of any differences that are uncovered; this is addressed by the calculation of an effect size, known as partial eta squared ($\eta^2_p$).

A one-way repeated measures ANOVA was considered the most appropriate statistical test with which to investigate differences in the participants’ state anxiety at
the three points it was measured. Results from the preliminary phase of this study, and literature in the field of anxiety manipulation, suggested that the modified-TSST procedure would be responsible for significant increases in state anxiety. However, as there was a possibility that the very nature of dealing with strangers in an unfamiliar situation may be responsible for elevated levels of state anxiety, it was decided that a post hoc test would be carried out alongside the ANOVA to explore all possible pairwise combinations. Both Tukey and Bonferroni tests were considered the most appropriate as they control the Type I error rate; however, they lack statistical power (Field, 2013, p.459). The Bonferroni test has greater statistical power when the number of comparisons is small as is the case in this study; hence, it was considered the most appropriate post hoc test to employ.

To perform a one-way ANOVA, the following assumptions need to be satisfied:

1. One continuous dependent variable.
2. One within-subject factor (or independent variable) with three, or more levels.
3. No significant outliers at any level of the within subject factor.
4. The dependent variable should be normally distributed at each level.
5. The variances of the differences between all combinations of the levels of the within-subject factor must be equal. This is known as Sphericity.

### 5.4.2 3x3 ANOVA.

A 3x3 ANOVA is used to investigate the mean differences between groups based on two independent variables, and to uncover if there is an interaction between the between-subjects and within-subjects variables. The groups of the between-subjects variable are independent (e.g. experimental condition); hence, participants can only exist in one of these. A within-subjects variable has conditions that are related (for example, pre/post-intervention).

To perform a 3x3 ANOVA, the following assumptions need to be satisfied:

1. One continuous dependent variable.
2. One between-subjects variable with three categories.
3. One within-subjects factor with three levels.
4. No significant outliers.
5. The dependent variable should be normally distributed.
6. The variance of the dependent variable should be equal between groups of the between-subjects variable (Levene’s test).
7. Homogeneity of covariance.
8. The variances of the differences between all groups must be equal. This is known as Sphericity.

5.4.3 Pearson’s correlations.

A Pearson’s product-moment correlation measures the strength and direction of a linear relationship between two continuous variables and generates a Pearson correlation coefficient, denoted $r$. The value of $r$ can range from -1 to +1; -1 indicates a perfect negative relationship, +1 a perfect positive relationship, and 0 represents no relationship. It is important to note that a Pearson product-moment correlation only shows the existence of a relationship between variables, it cannot be used to infer causation on that relationship.

The strength and direction of the relationships in the proposed test anxiety process model (Figure 2.2) were determined by Pearson product-moment correlations. To perform a Pearson product-moment correlation the following assumptions must be met:

1. The variables being investigated must be measured on a continuous scale.
2. There should be a linear relationship between the variables or no evidence of a non-linear relationship.
3. There should be no significant outliers.
4. Both variables should be normally distributed.

5.4.4 Repeated measures t-tests.

A repeated measures t-test is used to investigate the mean differences between the same participants tested under different conditions; this was employed to uncover differences between the participants’ response times during the ABDP.

To perform a repeated measures t-test the following assumptions must be met:

1. One continuous dependent variable.
2. One independent variable, consisting of two related groups (i.e. the same participants under different conditions).
3. No significant outliers in the differences in the dependent variable between the two related groups.
4. The differences in the dependent variable between the two related groups should be normally distributed.
5.4.5 Multiple regressions.

Multiple regressions model the relationship between multiple independent variables and a single dependent variable, with the independent variables used to predict values of the dependent variable. This determines the total variance explained by the model and the relative contribution of each of the independent variables. This model can be represented as follows, where $X_1$ to $X_4$ represent four independent variables, $\beta_0$ is the intercept (or constant), $\beta_1$ is the slope coefficient (the gradient) for $X_1$, etc., $\varepsilon$ is used to represent the errors:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon.$$ 

Several methods of entering the independent variables into a regression model were considered. A forced entry (or enter) method places all the independent variables into the model simultaneously with no input regarding the order from the researcher. This is considered the best model for theory testing (Studenmund & Cassidy, 1987); however, a drawback is that it provides no information regarding the individual contribution to the variance from each predictor. An alternative is to carry out a stepwise regression; here, the software being used calculates the predictor that explains the greatest proportion of the variance followed by the second, then the third, etc. The predictors are then added to the model in this order. The main failing of this method is that random variations in the data can influence the order of the predictors making replication difficult (Field, 2013, p322). A third model, hierarchical entry, involves the researcher building the model up in layers, specifying the order in which the predictors are added to the model.

It was considered that neither the forced nor stepwise approaches would satisfy the requirements of this study. Hence, hierarchical multiple regressions were used to model the relationship between the independent variables of trait test anxiety, attentional control, and state anxiety (both pre- and post-TSST) to predict the dependent variable of attentional bias (using the attentional bias index). This approach allowed a model to be built up that uncovered the individual variance explained by the trait and state factors. First trait test anxiety was entered into the regression (model 1), followed by attentional control (model 2), finally the state anxiety was added (model 3).

To perform a Hierarchical Multiple Regression the following assumptions must be met:

1. One dependent variable measured at the continuous level.
2. Two or more independent variables measured at the continuous or nominal level.

3. There should be independence of observations, with the assumption that errors are independent and uncorrelated. A Durbin-Watson test (Watson & Durbin, 1951) is a test for serial correlations between errors and will result in a value between 0 (positive correlation between errors) and 4 (negative correlation). A general rule is that a value of 2 is optimal, while values of less than 1 or greater than 3 are causes for concern (Field, 2013, p311).

4. There should be a linear relationship between the dependent variable and the independent variables collectively, and between the dependent variable and each independent variable individually.

5. The variance of the predicted dependant variable is similar across the range of independent variables, this is known as Homoscedasticity.

6. Multicollinearity occurs when there is a strong correlation between the predictors in a regression model; if it exists it becomes challenging to interpret how each predictor impacts upon the model. A Variance Inflation Factor (VIF) and its tolerance (1/VIF) indicate linear relationships between variables (Field, 2013, p325). The following guidelines can be used to interpret these values and indicate a level of multicollinearity that gives rise to concern that the assumptions have not been met (Bowerman & O’Connell, 1990; Myers, 1990; Menard, 1995):
   a) Largest VIF greater than 10.
   b) Average VIF substantially greater than 1.
   c) Tolerance less than 0.2

7. Multivariate extreme values must be identified as they can exert influence or bias on the regression model and reduce its stability across the range of cases (Field, 2013, p306).
   a) Outliers can be identified by examining the studentized deleted residuals, values great than +/-3 standard deviations could be considered as outliers and its influence explored further.
   b) To determine whether any values exhibit high leverage, the following guidelines can be employed; less than 0.2 can be considered safe, 0.2 to 0.5 as risky, and above 0.5 as dangerous (Laerd Statistics, 2015).
   c) The Cook’s distance (Cook & Weisberg, 1982) is a measure of the influence a value exerts; a value greater than one indicates that a value is having an
undue effect on the model.

8. The errors in the prediction (residuals) should be approximately normally distributed. This can be examined by visual inspection of a Q-Q Plot of the studentized residuals.

**5.4.6 Cluster analysis.**

A cluster analysis is an exploratory multivariate data reduction technique (Putwain & Daly, 2013), which allows individuals to be organised into relatively homogeneous groups, or clusters, based upon combinations of independent variables and maximising the similarities of individual cases within each cluster (Burns, 2008). While the goal of grouping cases into homogeneous clusters may appear simple, the process of successive merging of similar cases into different clusters is a complex process (Yim & Ramdeen, 2015), importantly, the cluster analysis does not analyse the group differences in any way.

Due to the heterogeneous nature of the population employed in this study, a cluster analysis was used to place participants into relatively homogenous groups based on the worry component of trait test anxiety, attentional control, and the attentional bias index. A Ward’s method hierarchical cluster analysis was carried out; this approach is considered to be efficient and is based on an analysis of variance to calculate the sum of squared deviations from the mean of a cluster (Burns, 2008; Putwain & Daly, 2013). Each participant is initially treated as an individual cluster, i.e. at first there are as many clusters as participants. The clusters are then sequentially merged until only one remains; the criteria applied when merging clusters is to produce the smallest increase in the error sum of squares (Burns, 2008). A summary of the cluster solution, known as the *agglomeration schedule*, is analysed to calculate the change in the coefficients as the number of solutions is increased; this facilitates identification of the number of clusters considered to provide the optimum balance between parsimony and explanatory power.

**5.5 Qualitative Data Analysis**

Data from the semi-structured interviews were transcribed by the author and analysed using content analysis techniques. The purpose of this was to address how the participants’ reported experiences of the TSST related to patterns of trait test anxiety, attentional control, state anxiety, and attentional bias.

Content analysis is a systematic process through which valid inferences are made from data presented as text. The key aim of content analysis is to summarise and
report the contents of written data by classifying large numbers of words into fewer categories based on their content (Cohen et al., 2011). The process of content analysis involves coding raw data according to a classification scheme, allowing for the identification, indexing, and retrieval of content (Kondracki, Wellman, & Amundson, 2002). Content analysis can be used to analyse information collected through a wide range of techniques including participant interviews and observations; where interview transcripts are employed, coded items can be individual words or more complexes phrases and statements. Content analysis is applicable to experimental, quasi-experimental and non-experimental research designs.

5.5.1 Approaches to content analysis.

Hsieh and Shannon (2005) identified three approaches to content analysis; conventional, directed or summative. All three are intended to extract meaning from text; however, they differ in their applications and approaches to coding the data.

5.5.1.1 Conventional Content Analysis.

Conventional content analysis is commonly employed within studies that have the aim of describing a phenomenon, especially when existing theory or research literature is limited (Hsieh & Shannon, 2005). In this type of analysis, the researcher avoids using preconceived categories, instead having the categories emerge from the data in a step-by-step process (Kondracki et al., 2002). A key benefit of this approach is that information is gained from the study participants without the imposition of preconceived categories or perspectives (Hsieh & Shannon, 2005). However, a disadvantage of this is that as the researcher is driven purely by the data to hand, with little or no theoretical perspective they may fail to identify key categories, resulting in an incomplete understanding of the phenomenon being studied.

5.5.1.2 Directed Content Analysis.

Directed content analysis is considered an appropriate technique when aiming to further describe an existing theory or phenomenon where the current research is incomplete (Hsieh & Shannon, 2005). The process begins by using the existing theory or prior research to identify key variables as initial coding categories; items of text are then coded against this scheme. Data which cannot be coded in this manner can be analysed to identify further categories or sub-categories, these are then added to the scheme. A strength of this approach is it facilitates the extension and development of
existing theories. Additionally, it is explicit in its position that the researcher is not working from a naïve perspective, but is bringing their own biases and preconceptions to the work - this is essential to the critical realist paradigm within which this work is situated. Researchers employing this approach must be aware of the challenges associated with it; first, as they are bringing their own biases to the work they must be aware of, and guard against, favouring evidence that supports the theory they are investigating; second, the researcher must not probe interviewees in a manner that leads them to answer questions in a way that satisfies their theories.

5.5.1.3 Summative content analysis.

Summative content analysis identifies words or phrases within a body of text and quantifies their usage with the aim of exploring their context (Hsieh & Shannon, 2005). Further analysis is then carried out to uncover the underlying meaning of these words and the content of where they are used. While this approach is useful in illustrating how words are used in association with a phenomenon or theory, there is little attention paid to the broader meanings that may be present in the data (Hsieh & Shannon, 2005).

5.5.2 Content analysis in this study.

Directed content analysis was considered the most appropriate method to employ in this study as it was aiming to further explain test anxiety. Individual participant interviews were transcribed by the author and the text data generated was imported to NVivo for Mac (version 11.1.1) for detailed analysis. Initial coding categories were based on the key areas of the theoretical model employed in the study: trait test anxiety, state anxiety, attentional control, and attentional bias; participants’ attitudes to the TSST process were also coded. Several sub-categories were identified at this stage (identified in NVivo as a priori categories, AP). Each transcript was initially coded by the author using the main and sub-categories; at this stage, further sub-categories were also identified and added to the coding schedule (identified as emerging categories, E). Following this, all transcripts were revisited by the author and coded again using the full coding schedule (see Appendix 8).

5.5.3 Inter-rater reliability.

A vital component of content analysis is ensuring that the analysis carried out by an individual researcher is reliable; it is not sufficient to simply claim that items could
be coded a certain way without a procedure to check that others would make similar inferences. Inter-rater reliability is the term used to describe the extent to which two (or more) independent coders reach similar conclusions when evaluating transcripts; without this process, the data, and interpretations from it, may not be considered valid. The inter-rater reliability can be expressed as a percentage agreement or correlation coefficient (Breakwell et al., 2012); given the nature of this study, it was felt that the percentage agreement would be a suitable indicator to use.

Following the second round of coding by the author, twenty transcripts were randomly selected (using a random number generator) to be independently coded by an individual not previously involved in the project. As it was important that the second coder had a clear understanding of the theories upon which the coding schedule was based, an experienced child psychologist was approached to complete this task. This individual was a registered clinical psychologist, educated to doctoral level, with full knowledge and understanding of the project and the research questions. They were provided with the proposed theoretical model employed in the study, the definitions of each of the variables in this model, and the proposed coding schedule including the a priori and emerging sub-categories. They used this information to fully code the randomly selected transcripts. Once this coding was complete, the words and phrases they had selected for coding, along with how they coded them, were compared to the second round of full coding completed by the author. Following an analysis of both sets of coding, the author and the independent coder discussed how they had decided upon the items to code and how these codes had been assigned; emphasis was placed upon the discrepancies which emerged to identify poorly-defined categories and where there was not initial agreement that the inferences made were supported by the data. There was a high level of agreement between both coders (>80%), both on which items to code and how to code them; however, there were several additional emerging sub-codes that the independent coder suggested were appropriate. Following this process, the author made the suggested modifications to the coding schedule and carried out a final round of coding on all interview transcripts with a view to addressing the variance previously noted.
Chapter 6 - Quantitative Results (Main Study)

The aim of this chapter, organised into eight sections, is to present the quantitative findings of the main study of this thesis. Section 6.1 will outline the data screening process, section 6.2 will explain how data collected from the experimental sessions were constructed to facilitate a detailed analysis and section 6.3 will summarise the reliability of the measures used. Sections 6.4 through to 6.8 are concerned with the different analytical techniques employed in this study. Section 6.4 deals with how a range of ANOVAs were employed to explore how the modified TSST could manipulate state anxiety. Section 6.5 uses correlational techniques to show how the variables of the theoretical model employed in this study (see section 2.5) were related to each other and to inform further refinement of this model. Section 6.6 investigates the participants’ reaction times to threat and non-threat congruent trials on the ABDP. Section 6.7 employs a series of hierarchical multiple regressions to investigate whether the trait factors of self-reported test anxiety and attentional control, along with pre- or post-TSST state anxiety, could be used to predict an individual’s attentional bias. Finally, section 6.8 deals with how a cluster analysis was used to identify relatively homogenous groups, within the study’s heterogeneous sample, to inform the qualitative analysis (chapter 7).

6.1 Data Screening

Prior to analysis, all data were screened to identify errors in data entry that had resulted in values falling outside the range of those that were possible on the scales employed. This also facilitated the identification of extreme values; the procedure is dealt with below for baseline and experimental data.

6.1.1 Baseline data.

Eighty participants completed all aspects of the baseline data collection, one participant was unable to complete the state anxiety measure at this point; hence, the total number of participants was 81. All participants had completed GCSE examinations in the year preceding this study. At the time of participation they were all studying A-level Psychology plus a minimum of two other subjects from across the full range of those available. No participants had previously received specific interventions to support them with test anxiety. There were 62 female and 19 male participants; the gender bias was due to the context of the schools and colleges which agreed to take part.
in the study and the subject choices of the participants; A-level Psychology is heavily female biased in English schools. The mean age of the participants was 204.58 months or 17 years 1 month; this corresponds to the first year of post-16 education in the UK.

Baseline test anxiety score (Min 20, Max 80): Values ranged from 25 to 78; hence no values outside the range of possible scores were identified. Eighty-one participants completed this measure. One extreme value was identified, with the participant (no. 72) scoring towards the top of the possible range. This value was checked for measurement accuracy and was considered a genuine value; hence, this was left in the dataset.

Table 6.1. Summary of baseline data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (months)</td>
<td>81</td>
<td>204.69</td>
<td>7.703</td>
<td>.000</td>
<td>194</td>
<td>229</td>
<td>35</td>
</tr>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td></td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>Trait TA (Worry) min = 6, max = 24</td>
<td></td>
<td>14.89</td>
<td>4.056</td>
<td>.135</td>
<td>7</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Trait TA (Test irrelevant thinking) min = 6, max = 24</td>
<td></td>
<td>8.30</td>
<td>3.100</td>
<td>.001</td>
<td>4</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Trait TA (Tension) min = 5, max = 20</td>
<td></td>
<td>14.77</td>
<td>3.792</td>
<td>.001</td>
<td>5</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Trait TA (Bodily symptoms) min = 5, max = 20</td>
<td></td>
<td>8.91</td>
<td>3.603</td>
<td>.000</td>
<td>5</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Trait Attentional Control (Total) min = 20, max = 80</td>
<td></td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>State Anxiety (Baseline) min = 20, max = 80</td>
<td>80</td>
<td>34.98</td>
<td>8.712</td>
<td>.002</td>
<td>20</td>
<td>58</td>
<td>38</td>
</tr>
</tbody>
</table>

Baseline worry score (Min 6, Max 24): Values ranged from 7 to 23; hence no values outside the range of possible scores were identified. Baseline test irrelevant thinking score (Min 4, Max 16): Values ranged from 4 to 15; hence no values outside the range of possible scores were identified. Baseline tension score (Min 5, Max 20): Values ranged from 5 to 20; hence no values outside the range of possible scores were identified. Baseline bodily symptoms score (Min 5, Max 20): Values ranged from 5 to 20; hence no values outside the range of possible scores were identified. Eighty-one participants completed these measures.
Baseline attentional control score (Min 20, Max 80): Values ranged from 35 to 66; hence no values outside the range of possible scores were identified. Eighty-one participants completed this measure.

Baseline state anxiety total score (Min 20, Max 80): Values ranged from 20 to 58; hence no values outside the range of possible scores were identified. Eighty-one participants completed this measure, one participant, number 70, was unable to complete this baseline measure due to absence.

6.1.2 Experimental data.

6.1.2.1 Questionnaire data.

Eighty-one participants completed the experimental phase of the study, these were the same individuals as those who completed the baseline data collection. Therefore, the gender and age details are the same as in section 6.1.1.

Table 6.2. Summary of experimental questionnaire data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>20</td>
<td>59</td>
<td>39</td>
</tr>
<tr>
<td>(min = 20, max = 80)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety (post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td>(min = 20, max = 80)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety Change</td>
<td>80</td>
<td>17.15</td>
<td>10.250</td>
<td>.438</td>
<td>-2</td>
<td>44</td>
<td>46</td>
</tr>
<tr>
<td>(Baseline to Post-TSST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety Change</td>
<td>81</td>
<td>14.52</td>
<td>10.061</td>
<td>.267</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
<tr>
<td>(Pre- to Post-TSST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

STAI pre-TSST score (Min 20, Max 80): Values ranged from 20 to 59; hence no values outside the range of possible scores were identified. STAI post-TSST score (Min 20, Max 80): Values ranged from 27 to 75; hence no values outside the range of possible scores were identified. Eighty-one participants completed both measures.

6.1.2.2 Dot-probe trial data.

In keeping with the approach adopted by previous work in this field (for example, See, MacLeod, & Bridle, 2009), to minimise the influence of extreme data points, the reaction time data from the dot-probe trials was screened to remove times that were < 200ms or > 2000ms. The responses to nine individual trials were removed
for being < 200ms; two were removed for > 2000ms. Eighty-one participants completed the dot-probe task.

Table 6.3. Summary of dot-probe trial data.

<table>
<thead>
<tr>
<th>Measured response time (ms)</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All trials</td>
<td>81</td>
<td>439.85</td>
<td>68.081</td>
<td>.000</td>
<td>333</td>
<td>835</td>
<td>502</td>
</tr>
<tr>
<td>Neutral Trials</td>
<td>81</td>
<td>441.51</td>
<td>69.563</td>
<td>.000</td>
<td>336</td>
<td>838</td>
<td>502</td>
</tr>
<tr>
<td>Threat trials</td>
<td>81</td>
<td>438.19</td>
<td>67.837</td>
<td>.000</td>
<td>330</td>
<td>832</td>
<td>502</td>
</tr>
<tr>
<td>Top Trials</td>
<td>81</td>
<td>441.72</td>
<td>68.874</td>
<td>.000</td>
<td>321</td>
<td>814</td>
<td>493</td>
</tr>
<tr>
<td>Bottom Trials</td>
<td>81</td>
<td>437.98</td>
<td>70.060</td>
<td>.000</td>
<td>333</td>
<td>856</td>
<td>523</td>
</tr>
<tr>
<td>Left Trials</td>
<td>81</td>
<td>440.02</td>
<td>64.940</td>
<td>.000</td>
<td>338</td>
<td>805</td>
<td>467</td>
</tr>
<tr>
<td>Right Trials</td>
<td>81</td>
<td>439.67</td>
<td>73.125</td>
<td>.000</td>
<td>328</td>
<td>865</td>
<td>536</td>
</tr>
</tbody>
</table>

6.2 Categorisation of Variables

To allow a more detailed analysis, the participants’ scores for trait test anxiety, attentional control, worry, and test irrelevant thinking were categorised, based on each variable’s mean and standard deviation, into responses considered high (> +1SD), mid (from -1SD to +1SD), or low (< -1SD). This facilitated the exploration of relationships between all aspects of the data. It is recognised that the categorisation of data from a continuous distribution is an imperfect procedure (see section 2.3.7.1); however, as discussed in Putwain and Daly (2014), due to the robust evidence to show individuals scoring highly on measures of test anxiety perform differently in evaluative situations (Hembree, 1988; Seipp, 1991), it is empirically meaningful to characterise responses in this way. Upon examining the data, categorising trait test anxiety based on the mean and standard deviation resulted in 17.2% of the sample population being classified as high trait test anxiety. This was similar to the most recent estimate of 16.4% of school-age children and adolescents being highly test anxious (Putwain & Daly, 2014), hence it was considered a suitable approach to adopt. It must be made clear that this process was purely a statistical technique, it was not intended to suggest that those categorised
as high, mid, or low are a homogeneous category, individual differences were still present between participants.

### 6.2.1 Trait test anxiety.

High, medium, low categories of trait test anxiety based on a mean of 46.86 and a standard deviation of 11.84.

- **Low** = 20 - 35.02. Values below -1SD from the mean
- **Mid** = 35.03 - 58.69. Values between -1SD and +1SD from the mean.
- **High** = 58.70 - 80. Values above +1SD from the mean.

Table 6.4. Summary of categories of trait test anxiety.

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTA High</td>
<td>14</td>
<td>65.36</td>
<td>5.679</td>
<td>.138</td>
<td>59</td>
<td>78</td>
<td>19</td>
</tr>
<tr>
<td>RTA Mid</td>
<td>51</td>
<td>46.82</td>
<td>5.898</td>
<td>.055</td>
<td>36</td>
<td>58</td>
<td>22</td>
</tr>
<tr>
<td>RTA Low</td>
<td>16</td>
<td>30.81</td>
<td>3.016</td>
<td>.522</td>
<td>25</td>
<td>35</td>
<td>10</td>
</tr>
</tbody>
</table>

### 6.2.2 Attentional control.

High, mid and low categories of self-reported attentional control based on mean of 48.38 and standard deviation of 6.61.

- **Low** = 20 - 41.76. Values below -1SD from the mean.
- **Mid** = 41.77 – 54.99. Values between -1SD and +1SD from the mean.
- **High** = 55.00 – 80. Values above +1SD from the mean.

Table 6.5. Summary of categories of attentional control.

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS High</td>
<td>16</td>
<td>58.44</td>
<td>3.076</td>
<td>.013</td>
<td>55</td>
<td>66</td>
<td>11</td>
</tr>
<tr>
<td>ACS Mid</td>
<td>54</td>
<td>47.37</td>
<td>3.394</td>
<td>.028</td>
<td>42</td>
<td>54</td>
<td>12</td>
</tr>
<tr>
<td>ACS Low</td>
<td>11</td>
<td>38.73</td>
<td>2.102</td>
<td>.018</td>
<td>35</td>
<td>41</td>
<td>6</td>
</tr>
</tbody>
</table>
6.2.3 The worry domain of test anxiety.

High, mid and low categories of the worry component of trait test anxiety based on mean of 14.89 and standard deviation of 4.06

- Low = 6 - 10.83. Values below -1SD from the mean.
- Mid = 10.84 - 18.95. Values between -1SD and +1SD from the mean.
- High = 18.96 – 24. Values above +1SD from the mean.

Table 6.6. Summary of categories of worry.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worry High</td>
<td>15</td>
<td>20.80</td>
<td>1.568</td>
<td>.016</td>
<td>19</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>Worry Mid</td>
<td>53</td>
<td>14.70</td>
<td>2.267</td>
<td>.002</td>
<td>11</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>Worry Low</td>
<td>13</td>
<td>8.85</td>
<td>1.068</td>
<td>.016</td>
<td>7</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>

6.2.4 The test irrelevant thinking domain of test anxiety.

High, mid and low categories of the test irrelevant thinking domain of trait test anxiety based on mean of 8.30 and standard deviation of 3.10

- Low = 4 - 5.20. Values below -1SD from the mean.
- Med = 5.20 - 11.40. Values between -1SD and +1SD from the mean.
- High = 11.41 – 16. Values above +1SD from the mean.

Table 6.7. Summary of categories of test irrelevant thinking.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Irrelevant Thinking High</td>
<td>13</td>
<td>13.38</td>
<td>1.193</td>
<td>.039</td>
<td>12</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Test Irrelevant Thinking Mid</td>
<td>48</td>
<td>8.42</td>
<td>1.796</td>
<td>.000</td>
<td>6</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Test Irrelevant Thinking Low</td>
<td>20</td>
<td>4.70</td>
<td>0.470</td>
<td>.000</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

6.3 Reliability of Measures

6.3.1 Revised test anxiety scale.

The Revised Test Anxiety Scale was employed to measure participants’ trait test anxiety levels. This consisted of 20 questions and had an excellent level of internal consistency, as determined by a Cronbach’s alpha of .915. This measure was also used
to measure the components of trait test anxiety; worry (6 items, \( \alpha = .796 \)), test irrelevant thinking (4 items, \( \alpha = .853 \)), tension (5 items, \( \alpha = .864 \)) and bodily symptoms (5 items, \( \alpha = .787 \)). All values demonstrate a level of reliability that is acceptable to good (Field, 2013, p. 715).

Table 6.8. Summary of reliability data.

<table>
<thead>
<tr>
<th>Scale</th>
<th>n</th>
<th>No. items</th>
<th>Cronbach's ( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised Test Anxiety Scale (RTA)</td>
<td>81</td>
<td>20</td>
<td>0.916</td>
</tr>
<tr>
<td>RTA Worry</td>
<td>81</td>
<td>6</td>
<td>0.796</td>
</tr>
<tr>
<td>RTA Test Irrelevant Thinking</td>
<td>81</td>
<td>4</td>
<td>0.853</td>
</tr>
<tr>
<td>RTA Tension</td>
<td>81</td>
<td>5</td>
<td>0.864</td>
</tr>
<tr>
<td>RTA Bodily Symptoms</td>
<td>81</td>
<td>5</td>
<td>0.787</td>
</tr>
<tr>
<td>Attentional Control Scale</td>
<td>81</td>
<td>20</td>
<td>0.709</td>
</tr>
<tr>
<td>State-Trait Anxiety Inventory (Baseline)</td>
<td>80</td>
<td>20</td>
<td>0.887</td>
</tr>
<tr>
<td>State-Trait Anxiety Inventory (pre-TSST)</td>
<td>81</td>
<td>20</td>
<td>0.918</td>
</tr>
<tr>
<td>State-Trait Anxiety Inventory (post-TSST)</td>
<td>81</td>
<td>20</td>
<td>0.922</td>
</tr>
</tbody>
</table>

**6.3.2 Attentional control scale.**

The Attentional Control Scale was employed to measure participants’ levels of attentional control; this consisted of 20 items and demonstrated an acceptable level of internal consistency (\( \alpha = .709 \)).

**6.3.3 State-trait anxiety scale.**

The State-Trait Anxiety Inventory Form Y-1 was employed to measure participants’ state anxiety levels at baseline, immediately pre-TSST and immediately post-TSST. This consisted of 20 items and demonstrated good to excellent levels of internal consistency; baseline \( \alpha = .887 \), pre-TSST \( \alpha = .918 \), post-TSST \( \alpha = .922 \).
6.4 Anxiety Manipulation using the Modified-TSST Protocol

A series of one-way and 3x3 mixed ANOVAs was carried out to investigate the impact of the modified Trier Social Stress Test on the participants’ measured state anxiety, and how this interacted with self-reported trait test anxiety and attentional control.

6.4.1 How does measured state anxiety change during the TSST procedure?

The participants’ state anxiety was measured at three time-points during the TSST process; two weeks before the experimental session (baseline), immediately before the TSST was administered (pre-TSST) and immediately after the TSST was completed (post-TSST). A one-way repeated measures ANOVA was conducted to determine whether there were statistically significant differences in the participant’s state anxiety at these three times.

Table 6.9. State anxiety data during the TSST.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Baseline)</td>
<td>80</td>
<td>34.98</td>
<td>8.712</td>
<td>.002</td>
<td>20</td>
<td>58</td>
<td>38</td>
</tr>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>80</td>
<td>37.84</td>
<td>9.395</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>80</td>
<td>52.13</td>
<td>11.178</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
</tbody>
</table>

Screening

There were no outliers in the data, as assessed by inspection of a boxplot. State Anxiety, as assessed by Shapiro-Wilk’s test, was not normally distributed at Baseline ($p = .002$) and pre-TSST ($p = .013$) with both demonstrating positive skew towards lower values, this could be expected from an instrument used to measure the whole spectrum of state anxiety. Post-TSST State Anxiety was normally distributed ($p = .409$). As the one-way repeated measures ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112) it was still considered the most appropriate test. Mauchly’s test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.641, p = .162$. 

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**Analysis**

The TSST elicited statistically significant changes in state anxiety over time $F(2,158) = 146.823, p < .001, \eta^2_p = .650$, with state anxiety increasing from baseline ($M = 34.98, SD = 8.71$) to pre-TSST ($M = 37.84, SD = 9.40$) to post-TSST ($M = 52.12, SD = 11.18$). This is illustrated in Figure 6.1.

![Figure 6.1. Change in state anxiety during the TSST process.](image)

Post-hoc analysis with a Bonferroni adjustment revealed that state anxiety was significantly increased from baseline to pre-TSST ($M = 2.86, 95\% CI[0.53, 5.20], p = .011, d = 0.33$), and from pre-TSST to post-TSST ($M = 14.29, 95\% CI[11.58, 17.0], p < .001, d = 1.52$). These results indicate that the modified version of the TSST could significantly increase the state anxiety levels of the sample population.

**6.4.2 Interactions with changes in state anxiety.**

**6.4.2.1 How does self-reported trait test anxiety interact with changes in state anxiety during the TSST process?**

A 3x3 ANOVA was conducted to determine whether there was a statistically significant interaction between differences observed in state anxiety during the TSST and participants’ levels of trait test anxiety. The within participants variable was the individual’s state anxiety levels two weeks before the experimental session (baseline), immediately before the TSST was administered (pre-TSST) and immediately after the TSST was completed (post-TSST). The between participants variable was their self-
reported test anxiety, recoded as low (< $M-1SD$), mid ($M-1SD$ to $M+1SD$) and high ($>M+1SD$).

Table 6.10. State anxiety data for each level of trait anxiety.

<table>
<thead>
<tr>
<th></th>
<th>Baseline State Anxiety</th>
<th>pre-TSST state Anxiety</th>
<th>post-TSST State Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>High TA</td>
<td>14</td>
<td>44.71</td>
<td>7.342</td>
</tr>
<tr>
<td>Mid TA</td>
<td>50</td>
<td>34.04</td>
<td>7.830</td>
</tr>
<tr>
<td>Low TA</td>
<td>16</td>
<td>29.38</td>
<td>5.277</td>
</tr>
</tbody>
</table>

**Screening**

There was one outlier, which had a studentized residual value of 3.26 (participant no.60). This was checked for measurement accuracy and as this appeared a genuine value it was kept in the dataset; to check the impact of this the analysis was also run with this value removed, no substantive differences were uncovered. State Anxiety, as assessed by Shapiro-Wilk’s test, was not normally distributed at Baseline ($p = .004$) and pre-TSST ($p = .030$) for those participants demonstrating mid-levels of trait test anxiety, with both showing positive skew. All other conditions were normally distributed ($p < .05$). As the ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112) it was still considered the most appropriate test. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance (all values of $p > .05$), and homogeneity of covariance, as assessed by Box's test of equality of covariance matrices ($p = .237$). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 2.944$, $p = .230$.

**Analysis**

There was no statistically significant interaction between differences in state anxiety levels during the TSST and the participants’ trait test anxiety, $F(4,154) = .962$, $p = .430$, $\eta^2_p = .024$, this suggests that the impact of the TSST on participants’ levels of state anxiety was independent of their level of trait test anxiety.
6.4.2.2 How does self-reported attentional control interact with changes in state anxiety during the TSST process?

A 3x3 mixed ANOVA was conducted to determine whether there was a statistically significant interaction between differences observed in state anxiety during the TSST and participants’ self-reported levels of attentional control. The within participants variable was the individual’s state anxiety levels two weeks before the experimental session (baseline), immediately before the TSST was administered (pre-TSST) and immediately after the TSST was completed (post-TSST). The between participants variable was their self-reported attentional control, recoded as low (<$M-1SD$), mid ($M-1SD$ to $M+1SD$) and high ($>M+1SD$).

Table 6.11. State anxiety data for each level of attentional control.

<table>
<thead>
<tr>
<th></th>
<th>Baseline State Anxiety</th>
<th>pre-TSST state Anxiety</th>
<th>post-TSST State Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>High AC</td>
<td>16</td>
<td>34.81</td>
<td>7.644</td>
</tr>
<tr>
<td>Mid AC</td>
<td>54</td>
<td>34.19</td>
<td>9.194</td>
</tr>
<tr>
<td>Low AC</td>
<td>10</td>
<td>39.50</td>
<td>6.671</td>
</tr>
</tbody>
</table>

Screening

There were no outliers, which had a studentized residual value of greater than +/-3. State Anxiety, as assessed by Shapiro-Wilk’s test, was not normally distributed at Baseline ($p = .001$) and pre-TSST ($p = .013$) for those participants demonstrating mid-levels of attentional control with both showing positive skew. All other conditions were normally distributed ($p < .05$). As the ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112), it was still considered the most appropriate test. At the pre-TSST time point, there was not homogeneity of variances between the groups of participants, as assessed by Levene's test of homogeneity of variance ($p = .049$), however as this was marginally significant the ANOVA is considered robust enough to still be performed (Maxwell & Delaney, 2004, p. 113); however, a note was made of the increased likelihood of Type I errors occurring (i.e. a false positive). Homogeneity of covariance, as assessed by Box's test of equality of covariance matrices, was demonstrated ($p = .680$). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.246$, $p = .197$. 

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Analysis

There was no statistically significant interaction between differences in state anxiety levels during the TSST and the participants’ trait attentional control, $F(4,154) = 1.155, p = .333, \eta^2_p = .024$, indicating that the impact of the TSST on participants’ levels of state anxiety was independent of their level of attentional control.

6.4.3 Interactions between components of trait test anxiety and changes in state anxiety.

The worry components of trait test anxiety are considered more influential than the emotionality components in terms of their relationship to test performance (see section 2.3.3); hence, the interaction between the worry and test irrelevant thinking components of trait test anxiety and changes in state anxiety were also explored.

6.4.3.1 How does self-reported trait test anxiety (worry) interact with changes in state anxiety during the TSST process?

A 3x3 mixed ANOVA was conducted to determine whether there was a statistically significant interaction between differences observed in state anxiety during the TSST and participants’ levels of the worry component trait test anxiety. The within participants variable was the individual’s state anxiety levels two weeks before the experimental session (baseline), immediately before the TSST was administered (pre-TSST) and immediately after the TSST was completed (post-TSST). The between participants variable was their self-reported worry component of test anxiety, recoded as low ($<M-1SD$), mid ($M-1SD$ to $M+1SD$) and high ($>M+1SD$).

Table 6.12. State anxiety data for each level of worry.

<table>
<thead>
<tr>
<th>Worry Level</th>
<th>Baseline State Anxiety</th>
<th>pre-TSST state Anxiety</th>
<th>post-TSST State Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Mid</td>
<td>52</td>
<td>34.56</td>
<td>7.863</td>
</tr>
<tr>
<td>Low</td>
<td>13</td>
<td>31.00</td>
<td>8.954</td>
</tr>
</tbody>
</table>

Screening

There was one outlier, which had a studentized residual value of 3.10 (participant no. 60); this was checked for measurement accuracy and as this appeared a
genuine value it was kept in the dataset. To check the impact of this, an analysis was also run with this value removed (see 6.4.3.1.1 below). State anxiety, as assessed by Shapiro-Wilk’s test, was not normally distributed at baseline ($p = .011$) and pre-TSST ($p = .020$) for those participants demonstrating mid-levels of worry. All other conditions were normally distributed ($p < .05$). As the ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112), it was still considered the most appropriate test. At the post-TSST time point, there was not homogeneity of variances between the groups, as assessed by Levene's test of homogeneity of variance ($p = .021$), however, the ANOVA is considered robust enough to still be performed (Maxwell & Delaney, 2004, p. 113); however, a note was made of the increased likelihood of Type I errors occurring. Homogeneity of covariance, as assessed by Box's test of equality of covariance matrices, was demonstrated ($p = .488$). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.233$, $p = .199$.

*Analysis*

There was no statistically significant interaction between differences in state anxiety levels during the TSST and the participants’ levels of the worry domain of trait test anxiety, $F(4,154) = 1.833$, $p = .125$, $\eta_p^2 = .045$.

**6.4.3.1.1 How does self-reported trait test anxiety (worry) interact with changes in state anxiety during the TSST process (outlier removed)?**

Having removed the outlier from the dataset employed in 6.4.3.1 (participant no.60), the data is summarised as follows:

<table>
<thead>
<tr>
<th>Table 6.13. State anxiety data for each level of worry (outlier removed).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline State Anxiety</td>
</tr>
<tr>
<td>$n$ $M$ $SD$</td>
</tr>
<tr>
<td>Mid Worry</td>
</tr>
<tr>
<td>Low Worry</td>
</tr>
</tbody>
</table>

133
Screening

There were no outliers, which had a studentized residual value of greater than +/-3. State Anxiety, as assessed by Shapiro-Wilk’s test, was not normally distributed at Baseline ($p = .011$) and pre-TSST ($p = .020$) for those participants demonstrating mid-levels of worry. All other conditions were normally distributed ($p < .05$). As the ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112), it was still considered the most appropriate test. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance (all values of $p > .05$), and homogeneity of covariance, as assessed by Box's test of equality of covariance matrices ($p = .762$). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.023$ $p = .221$.

Analysis

There was a statistically significant interaction between differences in state anxiety levels during the TSST and the participants’ levels of the worry domain of trait test anxiety, $F(4,152) = 3.023$, $p = .015$, $\eta^2_p = .077$; however, the effect size was small. This is illustrated in Figure 6.2.

Post-hoc tests revealed that at baseline the state anxiety of the high-worry group was significantly greater than the low-worry group ($M = 8.70$, 95% CI[0.88, 16.52], $p = .025$), but was not significantly different to the mid-worry group ($M = 5.31$, 95% CI[-

Figure 6.2. Interaction between trait worry and state anxiety during the TSST.
The mid- and low-worry groups were not statistically different at this measurement point ($M = 3.39, 95\% \text{CI}[3.07, 9.86], p = .425$).

The pre-TSST state anxiety of the high-worry group was significantly greater than the low-worry group ($M = 11.62, 95\% \text{CI}[3.32, 19.92], p = .004$), but was not significantly different to mid-worry group ($M = 2.97, 95\% \text{CI}[3.29, 9.24], p = .496$). Pre-TSST, the state anxiety of the mid- and low-worry groups was also significantly different ($M = 8.64, 95\% \text{CI}[1.79, 15.49], p = .010$).

Post-TSST, the state anxiety of the high-worry group was significantly greater than the low-worry group ($M = 18.97, 95\% \text{CI}[10.16, 27.78], p < .001$), and the mid-worry group ($M = 6.66, 95\% \text{CI}[0.01, 13.31], p = .050$); the magnitude of difference between the high- and mid-worry groups is less meaningful that that between the high- and low-worry groups. At this time, the state anxiety of the mid-worry group was significantly greater than the low-worry group ($M = 12.31, 95\% \text{CI}[5.03, 19.58], p < .001$).

### 6.4.3.2 How does self-reported trait test anxiety (test irrelevant thinking) interact with changes in state anxiety during the TSST process?

A 3x3 mixed ANOVA was conducted to determine whether there was a statistically significant interaction between differences observed in state anxiety during the TSST and participants’ levels of the test irrelevant thinking component of trait test anxiety. The within participants variable was the individual’s state anxiety levels two weeks before the experimental session (baseline), immediately before the TSST was administered (pre-TSST) and immediately after the TSST was completed (post-TSST). The between participants variable was their self-reported worry component of test anxiety, recoded as low ($< M-1SD$), mid ($M-1SD$ to $M+1SD$) and high ($> M+1SD$).

<table>
<thead>
<tr>
<th>Test Irrelevant Thinking</th>
<th>Baseline State Anxiety</th>
<th>pre-TSST State Anxiety</th>
<th>post-TSST State Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>High TI</td>
<td>12</td>
<td>38.83</td>
<td>10.321</td>
</tr>
<tr>
<td>Mid TI</td>
<td>48</td>
<td>35.46</td>
<td>8.735</td>
</tr>
<tr>
<td>Low TI</td>
<td>20</td>
<td>31.50</td>
<td>6.517</td>
</tr>
</tbody>
</table>
Screening

There were no outliers, which had a studentized residual value of +/-3. State Anxiety, as assessed by Shapiro-Wilk’s test, was normally distributed for all conditions ($p < .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > .05$), and homogeneity of covariance, as assessed by Box's test of equality of covariance matrices ($p = .409$). Mauchly's test of sphericity indicated that the assumption of sphericity had not been violated, $\chi^2(2) = 3.624, p = .163$.

Analysis

There was no statistically significant interaction between state anxiety levels during the TSST and the participants’ levels of the test irrelevant thinking domain of trait test anxiety, $F(4,154) = .522, p = .698, \eta^2_p = .014$.

6.4.4 Summary of anxiety manipulation using the modified TSST.

This battery of tests indicates that the modified-TSST reliably induced significant increases in the levels of participants’ state anxiety. There was no interaction between changes in state anxiety and levels of total trait test anxiety, attentional control, or test irrelevant thinking. There was a small but significant interaction when considering the participants’ levels of worry; hence, the modified TSST may differentially influence the state anxiety of high versus mid/low worry participants.

6.5 Correlations between variables in the theoretical model

A series of correlational analyses was run to investigate the relationships that existed between the information provided by the participants on their self-reported trait test anxiety, self-reported attentional control, and their state anxiety during the TSST process. Correlations were defined as strong ($r > .70$), moderate ($r = .40$ to .69), and weak ($r < .39$) (Dancey & Reidy, 2007, p. 176).

6.5.1 Trait test anxiety

6.5.1.1 What is the relationship between self-reported trait test anxiety and attentional control?

A Pearson's product-moment correlation was run to assess the relationship between trait test anxiety and attentional control.
Table 6.15. Trait test anxiety and trait attentional control data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>Trait Attentional Control (Total)</td>
<td>81</td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
</tbody>
</table>

Screening

Preliminary analysis of a scatterplot showed a negative linear relationship. Both variables were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$).

Analysis

There was a moderate negative correlation between trait test anxiety and attentional control, $r(79) = -.420$, $p < .001$, with trait test anxiety explaining approximately 17.6% of the variance in attentional control.

6.5.1.2 What is the relationship between self-reported trait test anxiety and baseline state anxiety?

A Pearson's product-moment correlation was run to assess the relationship between trait test anxiety and baseline state anxiety.

Table 6.16. Trait test anxiety and baseline state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>State Anxiety (Baseline)</td>
<td>80</td>
<td>34.98</td>
<td>8.712</td>
<td>.002</td>
<td>20</td>
<td>58</td>
<td>38</td>
</tr>
</tbody>
</table>

Screening

Preliminary analysis of a scatterplot showed a positive linear relationship, trait test anxiety was normally distributed, as assessed by Shapiro-Wilk's test ($p = .258$), however baseline state anxiety was not normally distributed ($p = .002$). As a Pearson’s correlation is robust to deviations from normality it was decide to note this and continue (Laerd Statistics, 2015).
Analysis

There was a strong positive correlation between trait test anxiety and baseline state anxiety, \( r(78) = .519, p < .001 \), with trait test anxiety explaining approximately 26.9% of the variation in baseline state anxiety.

6.5.1.3 What is the relationship between self-reported trait test anxiety and pre-TSST state anxiety?

A Pearson's product-moment correlation was run to assess the relationship between trait test anxiety and pre-TSST state anxiety.

Table 6.17. Trait test anxiety and pre-TSST state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
</tbody>
</table>

Screening

Preliminary analysis of a scatterplot showed a weak linear relationship, trait test anxiety was normally distributed, as assessed by Shapiro-Wilk's test \( (p = .301) \), however pre-TSST state anxiety was not normally distributed \( (p = .020) \). As a Pearson’s correlation is robust to deviations from normality it was decide to note this and continue (Laerd Statistics, 2015).

Analysis

There was a moderate positive correlation between trait test anxiety and pre-TSST state anxiety, \( r(79) = .396, p < .001 \), with trait test anxiety explaining approximately 15.7% of the variation in pre-TSST state anxiety.

6.5.1.4 What is the relationship between self-reported trait test anxiety and post-TSST state anxiety?

A Pearson's product-moment correlation was run to assess the relationship between trait test anxiety and post-TSST state anxiety.
Table 6.18. Trait test anxiety and post-TSST state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
</tbody>
</table>

**Screening**

Preliminary analysis showed a positive linear relationship, as assessed by a scatterplot. Both variables were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$).

**Analysis**

There was a moderate positive correlation between trait test anxiety and post-TSST state anxiety, $r(79) = .447, p < .001$, with trait test anxiety explaining approximately 20.0% of the variation in post-TSST state anxiety.

6.5.1.5 What is the relationship between self-reported trait test anxiety and the change in state anxiety?

A Pearson’s product moment correlation was run to assess the relationship between the self-reported trait test anxiety and the difference in participants’ state anxiety (pre- to post-TSST).

Table 6.19. Trait test anxiety and the change in state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety (Total)</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>State Anxiety (Pre- to Post-TSST)</td>
<td>81</td>
<td>14.52</td>
<td>10.061</td>
<td>.267</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
</tbody>
</table>

**Screening**

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Both variables were normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$).
**Analysis**

There was no statistically significant correlation between self-reported trait test anxiety and the difference in participants’ state anxiety (pre- to post-TSST), $r(79) = .118$, $p = .294$. In other words, those individuals high in trait test anxiety did not get significantly more or less anxious than their colleagues lower in test anxiety.

**6.5.1.6 Summary of correlations involving trait test anxiety.**

These tests show participants who reported higher levels of test anxiety were more likely to report higher levels of state anxiety at baseline, pre-TSST, and post-TSST. However, there was no relationship between trait test anxiety and how participants’ anxiety changed during the TSST process. As participants’ trait test anxiety increased their attentional control fell.

**6.5.2 Attentional Control.**

**6.5.2.1 What is the relationship between self-reported attentional control and pre-TSST state anxiety?**

A Pearson's product-moment correlation was run to assess the relationship between attentional control and pre-TSST state anxiety.

Table 6.20. Trait attentional control and pre-TSST state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Attentional Control (Total)</td>
<td>81</td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
</tbody>
</table>

**Screening**

Preliminary analysis of a scatterplot showed a weak linear relationship existed. Attentional control was normally distributed, as assessed by Shapiro-Wilk's test ($p = .331$), however, pre-TSST state anxiety was not normally distributed ($p = .023$). As a Pearson’s correlation is robust to deviations from normality it was decide to note this and continue (Laerd Statistics, 2015).

**Analysis**

There was a significant weak negative correlation between attentional control and pre-TSST state anxiety, $r(79) = -.247$, $p = .026$, with attentional control explaining approximately 6.1% of the variance of pre-TSST state anxiety.
6.5.2.2 What is the relationship between self-reported attentional control and post-TSST state anxiety?

A Pearson's product-moment correlation was run to assess the relationship between attentional control and post-TSST state anxiety.

Table 6.21. Trait attentional control and post-TSST state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Attentional Control (Total)</td>
<td>81</td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
</tbody>
</table>

Screening

Preliminary analysis of a scatterplot suggested a weak linear relationship existed. Attentional control and post-TSST state anxiety were both normally distributed, as assessed by Shapiro-Wilk's test ($p > .05$).

Analysis

There was a significant weak correlation between attentional control and post-TSST state anxiety, $r(79) = -.283$, $p = .011$, with attentional control explaining approximately 8.0% of the variance of post-TSST state anxiety.

6.5.2.3 Summary of correlations involving attentional control

These tests indicate weak negative correlations between a participant’s attentional control and their levels of their state anxiety immediately pre- and post-TSST; the lower a participants attentional control, the higher their state anxiety pre- and post-TSST was likely to be.

Pearson’s correlations run to assess the relationship between self-reported attentional control and baseline state anxiety and the change in state anxiety (pre- to post-TSST) were both non-significant ($p > .05$); in the interest of parsimony these have not been reported in detail.

6.5.3 State anxiety.

6.5.3.1 What is the relationship between pre-TSST state anxiety and post-TSST state anxiety?

A Pearson’s product-moment correlation was run to assess the relationship between pre-TSST state anxiety and post-TSST state anxiety.
Screening

Preliminary inspection of a scatterplot showed a positive linear relationship. Pre-TSST state anxiety, assessed by Shapiro-Wilk’s test was not normally distributed ($p = .023$); however, post-TSST state anxiety was normally distributed as ($p = .441$). As a Pearson’s correlation is robust to deviations from normality it was decided to note this and continue (Laerd Statistics, 2015).

Table 6.22. Pre- and post-TSST state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
</tbody>
</table>

Analysis

There was a significant strong positive correlation between pre- and post-TSST state anxiety, $r(79) = .534, p < .001$, with pre-TSST state anxiety explaining approximately 28.5% of the variance of post-TSST state anxiety.

6.5.3.2 What is the relationship between pre-TSST state anxiety and the difference in state anxiety?

A Pearson’s product-moment correlation was run to assess the relationship between pre-TSST state anxiety and the difference in state anxiety (pre- to post-TSST).

Table 6.23. Pre-TSST state anxiety and the change in state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
<tr>
<td>State Anxiety (Pre- to Post-TSST)</td>
<td>81</td>
<td>14.52</td>
<td>10.061</td>
<td>.267</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
</tbody>
</table>

Screening

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Pre-TSST state anxiety, assessed by Shapiro-Wilk’s test was not normally distributed ($p = .023$); however, the difference in state anxiety was normally distributed as ($p = .244$).
As a Pearson’s correlation is robust to deviations from normality it was decided to note this and continue (Laerd Statistics, 2015).

*Analysis*

There was a significant moderate negative correlation between pre-TSST state anxiety and the difference in state anxiety (pre- to post-TSST), \( r(79) = -.359, p = .001 \), with pre-TSST state anxiety explaining approximately 12.9% of the variance of the difference in state anxiety.

6.5.3.3 *What is the relationship between post-TSST state anxiety and the difference in state anxiety?*

A Pearson’s product-moment correlation was run to assess the relationship between post-TSST state anxiety and the difference in state anxiety (pre- to post-TSST).

Table 6.24. Post-TSST state anxiety and the change in state anxiety data.

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td>State Anxiety (Pre- to Post-TSST)</td>
<td>81</td>
<td>14.52</td>
<td>10.061</td>
<td>.267</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
</tbody>
</table>

*Screening*

Preliminary inspection of a scatterplot showed a positive linear relationship. Both post-TSST state anxiety and the difference in state anxiety were normally distributed (\( p > .05 \)) as assessed by Shapiro-Wilk’s test.

*Analysis*

There was a significant strong positive correlation between post-TSST state anxiety and state anxiety difference, \( r(79) = .597, p < .001 \), with post-TSST state anxiety explaining approximately 35.6% of the variance of the difference in state anxiety (pre-to post-TSST).

6.5.3.4 *Summary of correlations involving state anxiety.*

These tests indicate that there was a strong correlation between pre- and post-TSST state anxiety; participants reporting higher levels of state anxiety immediately prior to the TSST were likely to report higher levels of state anxiety upon its
completion. Individuals reporting higher levels of state anxiety immediately prior to the TSST process were likely to report smaller increases in state anxiety than those who had claimed to be experiencing lower levels of state anxiety at the start. Participants reporting higher levels of state anxiety immediately after completing the TSST process were likely to have shown larger increases in state anxiety.

6.5.4 **Attentional Bias.**

In the following calculations, the attentional bias index (ABI) is employed to represent the participants’ attentional bias.

6.5.4.1 *What is the relationship between trait test anxiety and attentional bias?*

A Pearson's product-moment correlation was run to assess the relationship between trait test anxiety and the attentional bias index.

Table 6.25. Trait test anxiety and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety</td>
<td>81</td>
<td>46.86</td>
<td>11.83</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>(Total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

**Screening**

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Both variables were normally distributed, as assessed by Shapiro-Wilk's test (p > .05).

**Analysis**

There was no significant correlation between trait test anxiety and the attentional bias index, $r(79) = .090$, $p = .422$.

6.5.4.2 *What is the relationship between attentional control and attentional bias?*

A Pearson's product-moment correlation was run to assess the relationship between attentional control and the attentional bias index.
Screening

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Both variables were normally distributed, as assessed by Shapiro-Wilk’s test ($p > .05$).

Table 6.26. Attentional control and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Attentional Control (Total)</td>
<td>81</td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

Analysis

There was no significant correlation between attentional control and the attentional bias index, $r(79) = -.148$, $p = .186$.

6.5.4.3 What is the relationship between baseline state anxiety and attentional bias?

A Pearson’s product-moment correlation was run to assess the relationship between baseline state anxiety and the attentional bias index.

Table 6.27. Baseline state anxiety and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Baseline)</td>
<td>80</td>
<td>34.98</td>
<td>8.712</td>
<td>.002</td>
<td>20</td>
<td>58</td>
<td>38</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

Screening

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Baseline state anxiety, assessed by Shapiro-Wilk’s test, was not normally distributed ($p = .002$); however, the attentional bias index was normally distributed ($p = .094$). As a Pearson’s correlation is robust to deviations from normality it was decided to note this and continue (Laerd Statistics, 2015).
Analysis

There was no significant correlation between baseline state anxiety and the attentional bias index, $r(78) = -.006, p = .955$.

6.5.4.4 What is the relationship between pre-TSST state anxiety and attentional bias?

A Pearson’s product-moment correlation was run to assess the relationship between pre-TSST state anxiety and the attentional bias index.

Table 6.28. Pre-TSST state anxiety and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Pre-TSST)</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>22</td>
<td>59</td>
<td>37</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

Screening

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Pre-TSST state anxiety, assessed by Shapiro-Wilk’s test was not normally distributed ($p = .023$); however, the attentional bias index was normally distributed as ($p = .083$). As a Pearson’s correlation is robust to deviations from normality it was decided to note this and continue (Laerd Statistics, 2015).

Analysis

There was no significant correlation between pre-TSST state anxiety and the attentional bias index, $r(79) = -.100, p = .374$.

6.5.4.5 What is the relationship between post-TSST state anxiety and attentional bias?

A Pearson’s product-moment correlation was run to assess the relationship between post-TSST state anxiety and the attentional bias index.

Screening

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship.
Both post-TSST state anxiety and the attentional bias index were normally distributed ($p > .05$) as assessed by Shapiro-Wilk’s test.

### Table 6.29. Post-TSST state anxiety and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Post-TSST)</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

**Analysis**

There was no significant correlation between post-TSST state anxiety and attentional bias index, $r(79) = -.035$, $p = .757$.

**6.5.4.6 What is the relationship between the change in state anxiety and attentional bias?**

A Pearson’s product-moment correlation was run to assess the relationship between the change in state anxiety (pre- to post-TSST) the attentional bias index.

### Table 6.30. Change in state anxiety and attentional bias data.

<table>
<thead>
<tr>
<th></th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety (Pre- to Post-TSST)</td>
<td>81</td>
<td>14.52</td>
<td>10.061</td>
<td>.267</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

**Screening**

Preliminary inspection of a scatterplot was unclear regarding the existence of a linear relationship; however, it did not show the presence of any non-linear relationship. Both the difference in state anxiety and the attentional bias index were normally distributed ($p > .05$) as assessed by Shapiro-Wilk’s test.

**Analysis**

There was no significant correlation between the difference in state anxiety (pre-to post-TSST) and the attentional bias index, $r(79) = .056$, $p = .617$. 

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6.5.4.7 **Summary of correlations involving attentional bias.**

No significant correlations were uncovered between attentional bias, indicated by the attentional bias index, and either trait test anxiety, attentional control, or state anxiety.

6.6 **Response Times and the Attentional Bias Index**

The ABDP recorded the participants’ response times (in milliseconds), these were used to calculate the mean response time to threat congruent trials and the mean response time to non-threat congruent trials. The difference in mean response times, the attentional bias index, was calculated as follows:

$$\text{Mean RT(ms) congruent trials - Mean RT(ms) non-congruent trials}$$

A negative value indicates a bias towards threatening stimuli, a positive value indicates a bias away from threatening stimuli.

Table 6.31. Summary of response time data.

<table>
<thead>
<tr>
<th>Response time (ms)</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All trials</td>
<td>81</td>
<td>439.85</td>
<td>68.081</td>
<td>.000</td>
<td>333</td>
<td>835</td>
<td>502</td>
</tr>
<tr>
<td>Non-threat Trials</td>
<td>81</td>
<td>441.51</td>
<td>69.563</td>
<td>.000</td>
<td>336</td>
<td>838</td>
<td>502</td>
</tr>
<tr>
<td>Threat trials</td>
<td>81</td>
<td>438.19</td>
<td>67.837</td>
<td>.000</td>
<td>330</td>
<td>832</td>
<td>502</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>

6.6.1 **What is the difference between participants’ response times to threat congruent trials and non-threat congruent trials as measured by a dot-probe task?**

A repeated measures t-test was carried out to investigate the differences between the participants’ response times to threat congruent and non-threat congruent trials completed during the ABDP process. These differences were represented by the attentional bias index, ABI.
Screening

There were three outliers in the attentional bias index, these were checked for measurement accuracy and, as they appeared genuine values, they were kept in the dataset. To check the impact of this, the analysis was run again with these values removed; substantive differences were uncovered and both analyses have been presented (see 6.6.1.1). The assumption of normality in the distribution of differences in response times to threat and non-threat congruent trials was not violated, as assessed by Shapiro-Wilk’s test ($p = .083$).

Analysis

Participants responded marginally quicker to threat congruent trials ($M = 438.19, SD = 67.837$) than to non-threat congruent trials ($M = 441.51, SD = 69.563$). However, this mean difference, $M = 3.32$ms, 95% CI[-0.77, 7.40], was not statistically significant, $t(80) = -1.613, p = .111, d = .180$.

6.6.1.1 What is the difference between participants’ response times to threat congruent trial and non-threat congruent trials (outliers removed)?

Having removed the three outliers from the dataset used in 6.6.1 (nos. 6, 33 and 69), the analysis was repeated.

Screening

There were no outliers in the attentional bias index. The assumption of normality in the distribution of differences in response times to threat and non-threat congruent trials was not violated, as assessed by Shapiro-Wilk’s test ($p = .687$).

Table 6.32. Summary of response time data (outliers removed).

<table>
<thead>
<tr>
<th>Response time (ms)</th>
<th>$n$</th>
<th>$M$</th>
<th>$SD$</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>All trials</td>
<td>78</td>
<td>437.67</td>
<td>68.257</td>
<td>.000</td>
<td>333</td>
<td>835</td>
<td>502</td>
</tr>
<tr>
<td>Non-threat Trials</td>
<td>78</td>
<td>439.62</td>
<td>69.489</td>
<td>.000</td>
<td>336</td>
<td>838</td>
<td>502</td>
</tr>
<tr>
<td>Threat trials</td>
<td>78</td>
<td>435.72</td>
<td>67.852</td>
<td>.000</td>
<td>330</td>
<td>832</td>
<td>502</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td>78</td>
<td>-3.90</td>
<td>15.141</td>
<td>.687</td>
<td>-44</td>
<td>29</td>
<td>72</td>
</tr>
</tbody>
</table>
Analysis

Having removed the outliers, participants responded marginally quicker to threat congruent trials \( (M = 435.72, SD = 67.852) \) than to non-threat congruent trials \( (M = 439.62, SD = 69.489) \). This mean difference, \( M = 3.90 \text{ms}, 95\% \text{ CI}[-0.49, 7.31] \), was statistically significant, \( t(77) = -2.274, p = .026, d = .259 \).

6.6.2 Summary of differences in response times.

The attentional bias index was used as a measure of the participants’ attentional bias. Initially, there were no significant differences between the response times to threat congruent and non-threat congruent trials; hence, it does not appear that this population, considered as a whole, displayed an attentional bias towards or away from threat congruent trials. After extreme values in the ABI were removed, a significant difference was uncovered between the response times to threat congruent and non-threat congruent trials. However, the small effect size associated with this difference \( (d = .259) \) could indicate that this difference is not practically meaningful.

The differences found in the attentional bias index scores are considered in greater detail below, employing both quantitative approaches (hierarchical multiple regressions – see section 6.7 below), and qualitative (directed content analysis) approaches (see chapter 7 below).

6.7 How do trait test anxiety, attentional control and state anxiety predict attentional bias?

Table 6.33. Summary of data employed in the regression models.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Test Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Total) ( \text{min} = 20, \text{max} = 80 )</td>
<td>81</td>
<td>46.86</td>
<td>11.835</td>
<td>.301</td>
<td>25</td>
<td>78</td>
<td>53</td>
</tr>
<tr>
<td>Trait TA (Worry)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{min} = 6, \text{max} = 24 )</td>
<td>81</td>
<td>14.89</td>
<td>4.056</td>
<td>.135</td>
<td>7</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>Trait Attentional Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Total) ( \text{min} = 20, \text{max} = 80 )</td>
<td>81</td>
<td>48.38</td>
<td>6.610</td>
<td>.331</td>
<td>35</td>
<td>66</td>
<td>31</td>
</tr>
<tr>
<td>State Anxiety (pre-TSST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{min} = 20, \text{max} = 80 )</td>
<td>81</td>
<td>37.62</td>
<td>9.544</td>
<td>.013</td>
<td>20</td>
<td>59</td>
<td>39</td>
</tr>
<tr>
<td>State Anxiety (post-TSST)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \text{min} = 20, \text{max} = 80 )</td>
<td>81</td>
<td>52.14</td>
<td>11.108</td>
<td>.409</td>
<td>27</td>
<td>75</td>
<td>48</td>
</tr>
<tr>
<td>ABI (Threat - Neutral)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>81</td>
<td>-3.32</td>
<td>18.493</td>
<td>.083</td>
<td>-65</td>
<td>56</td>
<td>121</td>
</tr>
</tbody>
</table>
6.7.1 Regression analyses investigating the attentional bias index.

A series of multiple regressions was carried out to investigate whether the trait factors of self-reported test anxiety and attentional control, along with pre- or post-TSST state anxiety, could be used to predict an individual’s attentional bias index.

6.7.1.1 How do measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

A hierarchical multiple regression was run to determine if trait test anxiety, trait attentional control, and pre-TSST state anxiety predicted the attentional bias index. In the first step trait test anxiety was entered into the model (model 1), in the second step attentional control was entered (model 2), finally the pre-TSST state anxiety was entered into the model (model 3).

Screening

There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.727. There was no linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values; however, as these plots did not show evidence of any non-linear relationship either, the assumption of linearity was not violated. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity; none of the independent variables displayed a correlation of greater than +/-0.420, there were no tolerance values less than 0.733. There was one studentized deleted residual greater than +/-3 standard deviations (participant no. 33); however, as this represents a genuine value and this participant is considered important to the analysis they remained in the dataset. There were no leverage values greater than 0.149, nor values for Cook's distance above 0.264; hence none of the points were considered to be unduly influential on the regression analysis. The assumption of normality was met, as assessed by a histogram of regression standardised residuals and a P-P plot.

Analysis

The first model, using trait test anxiety, to predict attentional bias index was not statistically significant, \( R^2 = .008, F(1, 79) = 0.651, p = .422 \). The addition of attentional control (model 2) led to a non-significant increase in \( R^2 \) of .015, \( F(2, 78) = 1.182, p = .280 \). The addition of pre-TSST state anxiety (model 3) led to a further non-
significant increase in $R^2$ of .026, $F(3, 77) = 2.089, p = .152$. The full regression model using all three independent variables was not statistically significant, $R^2 = .049, F(3, 77) = 1.317, p = .275$.

Table 6.34. Summary of regression model 6.7.1.1.

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised Coefficients</th>
<th>Standardised Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$B$</td>
<td>$SE$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>Constant</td>
<td>22.93</td>
<td>23.19</td>
<td>.326</td>
</tr>
<tr>
<td>Trait Test Anxiety</td>
<td>.151</td>
<td>.203</td>
<td>.096</td>
</tr>
<tr>
<td>Attentional Control</td>
<td>-.424</td>
<td>.344</td>
<td>-.151</td>
</tr>
<tr>
<td>Pre-TSST State Anxiety</td>
<td>-.341</td>
<td>.236</td>
<td>-.176</td>
</tr>
</tbody>
</table>

$R^2$ .049  
$F$ 1.317  
$p$ .275

**Summary**

The full regression model shows that an individual’s trait test anxiety, attentional control, and state anxiety immediately prior to the TSST protocol do not predict their attentional bias index as measured by the ABDP.

6.7.1.2 How do measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

A hierarchical multiple regression was run to determine if trait test anxiety, trait attentional control, and post-TSST state anxiety predicted the attentional bias index. In the first step trait test anxiety was entered into the model (model 1), in the second step attentional control was entered (model 2), finally the post-TSST state anxiety was entered into the model (model 3).

**Screening**

There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.732. There was no linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values; however, as these plots did not show evidence of any non-linear relationship either, the assumption of linearity was not violated. There was homoscedasticity, as assessed by visual inspection of a plot of
studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity; none of the independent variables displayed a correlation of greater than +/-0.447, there were no tolerance values less than 0.789. There was one studentized deleted residual greater than +/-3 standard deviations (participant no. 33); however, as this represents a genuine value and this participant is considered important to the analysis they remained in the dataset. There were no leverage values greater than 0.157, nor values for Cook's distance above 0.215; hence none of the points were considered to be unduly influential on the regression analysis. The assumption of normality was met, as assessed by a histogram of regression standardised residuals and a P-P plot.

Table 6.35. Summary of regression model 6.7.1.2.

<table>
<thead>
<tr>
<th>Unstandardised Coefficients</th>
<th>Standardised Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td><strong>SE</strong></td>
<td><strong>β</strong></td>
</tr>
<tr>
<td>Constant</td>
<td>20.51</td>
<td>24.03</td>
</tr>
<tr>
<td>Trait Test Anxiety</td>
<td>.123</td>
<td>.208</td>
</tr>
<tr>
<td>Attentional Control</td>
<td>-.411</td>
<td>.348</td>
</tr>
<tr>
<td>Post-TSST State Anxiety</td>
<td>-.186</td>
<td>.210</td>
</tr>
</tbody>
</table>

| $R^2$                        | .033                      |
| $F$                          | .871                      |
| $p$                          | .460                      |

**Analysis**

The first model, using trait test anxiety, to predict attentional bias index was not statistically significant, $R^2 = .008$, $F(1, 79) = 0.651$, $p = .422$. The addition of attentional control (model 2) led to a non-significant increase in $R^2$ of .015, $F(2, 78) = 1.182$, $p = .280$. The addition of post-TSST state anxiety (model 3) led to a further non-significant increase in $R^2$ of .010, $F(3, 77) = 0.783$, $p = .379$. The full regression model using all three independent variables was not statistically significant, $R^2 = .033$, $F(3, 77) = 0.871$, $p = .460$.

**Summary**

The full regression model shows that an individual’s trait test anxiety, attentional control, and state anxiety immediately after the TSST protocol do not predict their attentional bias index as measured by the ABDP.
6.7.1.3 How do the worry component of measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

A hierarchical multiple regression was run to determine if the worry component of trait test anxiety, trait attentional control and pre-TSST state anxiety predicted the attentional bias index. In the first step the worry component of trait test anxiety was entered into the model (model 1), in the second step attentional control was entered (model 2), finally the pre-TSST state anxiety was entered into the model (model 3).

Screening

There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.725. There was no linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values; however, as these plots did not show evidence of any non-linear relationship either, the assumption of linearity was not violated. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity; none of the independent variables displayed a correlation of greater than +/-0.447, there were no tolerance values less than 0.800. There was one studentized deleted residual greater than +/-3 standard deviations (participant no. 33); however, as this represents a genuine value and this participant is considered important to the analysis they remained in the dataset. There were no leverage values greater than 0.117, nor values for Cook's distance above 0.217; hence none of the points were considered to be unduly influential on the regression analysis. The assumption of normality was met, as assessed by a histogram of regression standardised residuals and a P-P plot.

Analysis

The first model, using the worry component of trait test anxiety, to predict attentional bias index was not statistically significant, $R^2 = .005, F(1, 79) = 0.407, p = .525$. The addition of attentional control (model 2) led to a non-significant increase in $R^2$ of .017, $F(2, 78) = 1.350, p = .249$. The addition of pre-TSST state anxiety (model 3) led to a further non-significant increase in $R^2$ of .022, $F(3, 77) = 1.746, p = .190$. The full regression model using all three independent variables was not statistically significant, $R^2 = .044, F(3, 77) = 1.174, p = .325$. 
Table 6.36. Summary of regression model 6.7.1.3.

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised Coefficients</th>
<th>Standardised Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
</tr>
<tr>
<td>Constant</td>
<td>27.22</td>
<td>23.68</td>
<td>.254</td>
</tr>
<tr>
<td>Trait Test Anxiety (Worry)</td>
<td>.222</td>
<td>.586</td>
<td>.049</td>
</tr>
<tr>
<td>Attentional Control</td>
<td>-.463</td>
<td>.351</td>
<td>-.165</td>
</tr>
<tr>
<td>Pre-TSST State Anxiety</td>
<td>-.304</td>
<td>.230</td>
<td>-.157</td>
</tr>
<tr>
<td>R2</td>
<td></td>
<td></td>
<td>.044</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td>1.174</td>
</tr>
<tr>
<td>p</td>
<td></td>
<td></td>
<td>.325</td>
</tr>
</tbody>
</table>

**Summary**

The full regression model shows that the worry component of an individual’s trait test anxiety, attentional control, and state anxiety immediately prior to the TSST protocol do not reliably predict their attentional bias index as measured by the ABDP.

6.7.1.4 *How do the worry component of measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?*

A hierarchical multiple regression was run to determine if the worry component of trait test anxiety, trait attentional control and post-TSST state anxiety predicted the attentional bias index. In the first step the worry component of trait test anxiety was entered into the model (model 1), in the second step attentional control was entered (model 2), finally the post-TSST state anxiety was entered into the model (model 3).

**Screening**

There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.730. There was no linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values; however, as these plots did not show evidence of any non-linear relationship either, the assumption of linearity was not violated. There was homoscedasticity, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity; none of the independent variables displayed a correlation of greater than +/-0.447, there were no tolerance values less than 0.800. There was one
studentized deleted residual greater than +/-3 standard deviations (participant no. 33); however, as this represents a genuine value and this participant is considered important to the analysis they remained in the dataset. There were no leverage values greater than 0.140, nor values for Cook's distance above 0.168; hence none of the points were considered to be unduly influential on the regression analysis. The assumption of normality was met, as assessed by a histogram of regression standardised residuals and a P-P plot.

Table 6.37. Summary of regression model 6.7.1.4.

<table>
<thead>
<tr>
<th></th>
<th>Unstandardised Coefficients</th>
<th>Standardised Coefficients</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE</td>
<td>β</td>
</tr>
<tr>
<td>Constant</td>
<td>23.42</td>
<td>24.22</td>
<td>.336</td>
</tr>
<tr>
<td>Trait Test Anxiety</td>
<td>.199</td>
<td>.611</td>
<td>.044</td>
</tr>
<tr>
<td>(Worry)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>-.438</td>
<td>.353</td>
<td>-.157</td>
</tr>
<tr>
<td>Post-TSST State</td>
<td>-.163</td>
<td>.208</td>
<td>-.098</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ R^2 = .030 \]
\[ F = .788 \]
\[ p = .504 \]

Analysis

The first model, using the worry component of trait test anxiety, to predict attentional bias index was not statistically significant, \( R^2 = .005, F(1, 79) = 0.407, p = .525 \). The addition of attentional control (model 2) led to a non-significant increase in \( R^2 \) of .017, \( F(2, 78) = 1.350, p = .249 \). The addition of post-TSST state anxiety (model 3) led to a further non-significant increase in \( R^2 \) of .008, \( F(3, 77) = 0.613, p = .436 \). The full regression model using all three independent variables was not statistically significant, \( R^2 = .030, F(3, 77) = 0.788, p = .504 \).

Summary

The full regression model shows that the worry component of an individual’s trait test anxiety, attentional control, and state anxiety immediately after the TSST protocol do not predict their attentional bias index as measured by the ABDP.
6.8 Identification of Homogeneous Groups of Participants using a Cluster Analysis

A cluster analysis was carried out to place the participants in relatively homogeneous groups, using their worry component of trait test anxiety, their attentional control score and their attentional bias index. The worry component was used as this is widely considered to be one of the individual domains of test anxiety associated with the greatest impact on individuals in evaluative situations (section 2.3.3). Additionally, there is evidence in this study to suggest those reporting the highest levels of trait worry had been impacted more by the TSST procedure than those reporting mid or low levels (section 6.4.3.1).

A hierarchical cluster analysis using Ward’s method was used to generate the clusters. Analysis of the agglomeration schedule was carried out to identify the change in the coefficients as the number of solutions increased; the largest change was observed when moving from a one- to a two-cluster solution, relatively large changes were also observed when moving from two- to three-, three- to four-, and four- to five-cluster solutions. After this, there was drop in the coefficients, indicating that beyond this point the clusters were becoming increasingly homogeneous and that a meaningful difference between them was considered less likely; hence a five-cluster solution was considered to provide the optimum balance between parsimony and explanatory power. Despite not being a clustering variable, the participants’ state anxiety is also of interest; therefore, how this was represented by the five clusters was also analysed.

Participants were classified into the following five clusters:

- Cluster 1 \((n=18)\)
- Cluster 2 \((n=28)\)
- Cluster 3 \((n=30)\)
- Cluster 4 \((n=2)\)
- Cluster 5 \((n=3)\)

6.8.1 Analysis of differences between the participant clusters.

An initial inspection of the mean values did not indicate any differences between the clusters in terms of the worry component of trait anxiety. The differences in terms of attentional control were also not clear; though clusters 1 and 5 appeared higher in this aspect than the other clusters. More obvious differences between the clusters were apparent in the attentional bias index, especially between clusters 4 and 5. These differences can be seen in Figure 6.3 below.
**6.8.1.1 How do the clusters differ from one another in terms of the worry component of trait test anxiety?**

A one-way ANOVA was conducted to determine if the worry component of test anxiety was different between the clusters generated by the cluster analysis.

<table>
<thead>
<tr>
<th>Trait Anxiety (Worry)</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>14.11</td>
<td>4.874</td>
<td>.109</td>
<td>8</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>14.93</td>
<td>3.711</td>
<td>.419</td>
<td>8</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>15.10</td>
<td>4.130</td>
<td>.153</td>
<td>7</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>17.50</td>
<td>0.707</td>
<td></td>
<td>17</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>15.33</td>
<td>3.055</td>
<td>.637</td>
<td>12</td>
<td>18</td>
<td>6</td>
</tr>
</tbody>
</table>

**Screening**

There were no outliers in any of the clusters, as assessed by boxplots; data was normally distributed for each group, as assessed by the Shapiro-Wilk test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .176$).
Analysis

The difference in the worry component of test anxiety was not statistically significant between the clusters, $F(4,76) = 0.390, p = .815, \eta^2_p = .020$. A Tukey post hoc analysis revealed none of the cluster differences were significant.

6.8.1.2 How do the clusters differ from one another in terms of self-reported attentional control?

A one-way ANOVA was conducted to determine if the attentional control scores were different between the clusters generated by the cluster analysis.

Table 6.39. Attentional control data by cluster.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>55.28</td>
<td>5.613</td>
<td>.823</td>
<td>46</td>
<td>66</td>
<td>20</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>46.14</td>
<td>4.461</td>
<td>.612</td>
<td>38</td>
<td>56</td>
<td>18</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>46.37</td>
<td>5.423</td>
<td>.670</td>
<td>35</td>
<td>57</td>
<td>22</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>39.50</td>
<td>6.364</td>
<td>.433</td>
<td>35</td>
<td>44</td>
<td>9</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>54.00</td>
<td>8.888</td>
<td>.433</td>
<td>44</td>
<td>61</td>
<td>17</td>
</tr>
</tbody>
</table>

Screening

There were no outliers in any of the clusters, as assessed by boxplots; data was normally distributed for each cluster, as assessed by the Shapiro-Wilk test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .421$).

Analysis

The difference in the attentional control score was statistically significant between the clusters, $F(4,76) = 12.258, p < .001, \eta^2_p = .392$. A Tukey post hoc analysis revealed significant differences between several clusters. There was a mean decrease in the attentional control score between cluster 1($M = 55.28, SD = 5.61$) and cluster 2($M = 46.14, SD = 4.46$) of 9.14, 95%CI [4.67, 13.60], $p < .001$, a mean decrease between cluster 1 and cluster 3($M = 46.37, SD = 5.42$) of 8.91, 95%CI [4.51, 13.32], $p < .001$ and a mean decrease between cluster 1 and cluster 4($M = 39.50, SD = 6.36$) of 15.78, 95%CI [4.77, 26.79], $p = .001$. There was a mean increase in the attentional control score between cluster 4($M = 39.50, SD = 6.36$) and cluster 5($M = 54.00, SD = 8.89$) of
14.50, 95%CI [1.01, 27.99], \( p = .029 \). No other cluster differences were statistically significant.

6.8.1.3 How do the clusters differ from one another in terms of the calculated attentional bias index?

A one-way ANOVA was conducted to determine if the attentional bias index (ABI) was different between the clusters generated by the cluster analysis.

Table 6.40. Attentional bias index data by cluster.

<table>
<thead>
<tr>
<th>Clusters</th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>-3.00</td>
<td>4.828</td>
<td>.424</td>
<td>-10.58</td>
<td>6.23</td>
<td>16.81</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>-17.15</td>
<td>6.981</td>
<td>.599</td>
<td>-35.11</td>
<td>-6.12</td>
<td>28.99</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>10.58</td>
<td>7.349</td>
<td>.316</td>
<td>-0.10</td>
<td>28.50</td>
<td>28.6</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>50.43</td>
<td>7.831</td>
<td></td>
<td>44.90</td>
<td>55.97</td>
<td>11.08</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>-50.86</td>
<td>12.497</td>
<td>.013</td>
<td>-65.29</td>
<td>-43.56</td>
<td>21.73</td>
</tr>
</tbody>
</table>

Screening

There was one outlier in cluster 3 (participant no. 79), as assessed by boxplots. This was checked for measurement accuracy and as it appeared a genuine value it was kept in the dataset; to check the impact of this, the analysis was also run with this value removed, no substantive differences were uncovered. ABI data, as assessed by the Shapiro-Wilk test, was normally distributed for clusters 1, 2 and 3 (\( p > .05 \)), however cluster 5 was not normally distributed (\( p = .013 \)). As the one-way repeated measures ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112) it was still considered the most appropriate test. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances (\( p = .157 \)).

Analysis

The difference in the attentional bias score was statistically significant between the groups, \( F(4,76) = 123.343, p < .001, \eta^2_p = .867 \). A Tukey post hoc analysis revealed significant differences between all the clusters.
6.8.1.4 How do the clusters differ from one another in terms of pre-TSST state anxiety?

A one-way ANOVA was conducted to determine if the pre-TSST state anxiety was different between the clusters generated by the cluster analysis.

Table 6.41. Pre-TSST state anxiety data by cluster.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>32.78</td>
<td>9.384</td>
<td>.028</td>
<td>22</td>
<td>58</td>
<td>36</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>38.93</td>
<td>9.813</td>
<td>.050</td>
<td>20</td>
<td>57</td>
<td>37</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>38.77</td>
<td>9.020</td>
<td>.558</td>
<td>23</td>
<td>59</td>
<td>36</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>33.50</td>
<td>9.192</td>
<td>.558</td>
<td>23</td>
<td>59</td>
<td>36</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>45.67</td>
<td>2.082</td>
<td>.463</td>
<td>44</td>
<td>48</td>
<td>4</td>
</tr>
</tbody>
</table>

Screening

There was one outlier in cluster 1 (participant no. 91), as assessed by boxplots. This was checked for measurement accuracy and as it appeared a genuine value it was kept in the dataset; to check the impact of this, the analysis was also run with this value removed (details can be found in 6.8.1.4.1). Pre-TSST state anxiety data, as assessed by the Shapiro-Wilk test, was normally distributed for clusters 2, 3 and 5 ($p > .05$), however cluster 1 was not normally distributed ($p = .028$). As the one-way ANOVA is robust to deviations from normality (Maxwell & Delaney, 2004, p. 112) it was still considered the most appropriate test. There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .214$).

Analysis

The difference in the pre-TSST state anxiety was not statistically significant between the clusters, $F(4,76) = 2.140, p = .084, \eta^2_p = .101$. A Tukey post hoc analysis revealed none of the cluster differences were significant.

6.8.1.4.1 How do the clusters differ from one another in terms of pre-TSST state anxiety (outlier removed)?

Following the removal of the outlier identified in 6.8.1.4 a one-way ANOVA was run again to determine if there was a meaningful difference in the results.
Table 6.42. Pre-TSST state anxiety data by cluster (outlier removed).

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>17</td>
<td>31.29</td>
<td>7.174</td>
<td>.132</td>
<td>22</td>
<td>46</td>
<td>24</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>38.93</td>
<td>9.813</td>
<td>.050</td>
<td>20</td>
<td>57</td>
<td>37</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>38.77</td>
<td>9.020</td>
<td>.558</td>
<td>23</td>
<td>59</td>
<td>36</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>33.50</td>
<td>9.192</td>
<td></td>
<td>27</td>
<td>40</td>
<td>13</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>45.67</td>
<td>2.082</td>
<td>.463</td>
<td>44</td>
<td>48</td>
<td>4</td>
</tr>
</tbody>
</table>

Screening

There were no outliers in any of the clusters, as assessed by boxplots; data was normally distributed for each cluster, as assessed by the Shapiro-Wilk test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .060$).

Analysis

The difference in pre-TSST state anxiety was significantly different between the groups, $F(4,75) = 3.161, p = .019, \eta^2_p = .144$. A Tukey post hoc analysis revealed the only significant difference in pre-TSST state anxiety was a marginally significant ($p = .049, d = .089$) mean increase between cluster 1 ($M = 31.29, SD = 7.174$) and cluster 2 ($M = 38.93, SD = 9.813$) of 7.634, 95% CI[.03, 15.24].

6.8.1.5 How do the clusters differ from one another in terms of post-TSST state anxiety?

A one-way ANOVA was conducted to determine if the post-TSST state anxiety was different between the clusters generated by the cluster analysis.

Screening

There were no outliers in any of the clusters, as assessed by boxplots; data was normally distributed for each cluster, as assessed by the Shapiro-Wilk test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .545$).
Table 6.43. Post-TSST state anxiety data by cluster.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>50.39</td>
<td>11.693</td>
<td>.724</td>
<td>27</td>
<td>73</td>
<td>46</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>50.32</td>
<td>11.392</td>
<td>.911</td>
<td>28</td>
<td>75</td>
<td>47</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>54.27</td>
<td>13.415</td>
<td>.793</td>
<td>32</td>
<td>73</td>
<td>41</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>44.50</td>
<td>7.778</td>
<td>.853</td>
<td>39</td>
<td>50</td>
<td>11</td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>63.33</td>
<td>5.508</td>
<td>.900</td>
<td>58</td>
<td>69</td>
<td>11</td>
</tr>
</tbody>
</table>

**Analysis**

The difference in the post-TSST state anxiety was not statistically significant between the clusters, $F(4,76) = 1.621, p = .178, \eta^2_p = .079$. A Tukey post hoc analysis revealed none of the cluster differences were significant.

6.8.1.6 How do the clusters differ from one another in terms of the change in state anxiety (pre- to post-TSST)?

A one-way ANOVA was conducted to determine if the change in state anxiety (pre- to post-TSST) was different between the clusters generated by the cluster analysis.

Table 6.44. Change in state anxiety data by cluster.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>18</td>
<td>17.61</td>
<td>10.711</td>
<td>.306</td>
<td>0</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>28</td>
<td>11.39</td>
<td>10.250</td>
<td>.853</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>30</td>
<td>15.50</td>
<td>9.062</td>
<td>.516</td>
<td>-7</td>
<td>31</td>
<td>38</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>2</td>
<td>11.00</td>
<td>16.971</td>
<td>-1</td>
<td>23</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Cluster 5</td>
<td>3</td>
<td>17.67</td>
<td>7.506</td>
<td>.927</td>
<td>10</td>
<td>25</td>
<td>15</td>
</tr>
</tbody>
</table>

**Screening**

There were no outliers in any of the clusters, as assessed by boxplots; data was normally distributed for each cluster, as assessed by the Shapiro-Wilk test ($p > .05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances ($p = .621$).
Analysis

The difference in the change in state anxiety (pre- to post-TSST) was not statistically significant between the clusters, $F(4,76) = 1.328, p = .267, \eta^2_p = .065$. A Tukey post hoc analysis revealed none of the cluster differences were significant.

6.8.2 Quantitative characteristics of each cluster.

Following the analysis of the differences between them, the clusters can be summarised as follows.

6.8.2.1 Cluster 1.

Table 6.45. Summary of data for Cluster 1.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Anxiety (Worry)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($M = 14.39, SD = 4.056$)</td>
<td>18</td>
<td>14.11</td>
<td>4.874</td>
<td>.109</td>
<td>8</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>Attentional Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($M = 48.38, SD = 6.610$)</td>
<td>18</td>
<td>55.28</td>
<td>5.613</td>
<td>.823</td>
<td>46</td>
<td>66</td>
<td>20</td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($M = -3.32, SD = 18.493$)</td>
<td>18</td>
<td>-3.00</td>
<td>4.828</td>
<td>.424</td>
<td>-10.58</td>
<td>6.23</td>
<td>16.81</td>
</tr>
<tr>
<td>Pre-TSST State Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($M = 36.27, SD = 9.544$)</td>
<td>18</td>
<td>32.78</td>
<td>9.384</td>
<td>.028</td>
<td>22</td>
<td>58</td>
<td>36</td>
</tr>
<tr>
<td>Post-TSST State Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($M = 52.34, SD = 11.108$)</td>
<td>18</td>
<td>50.39</td>
<td>11.693</td>
<td>.724</td>
<td>27</td>
<td>73</td>
<td>46</td>
</tr>
<tr>
<td>State Anxiety (pre- to post-TSST)</td>
<td>18</td>
<td>17.61</td>
<td>10.711</td>
<td>.306</td>
<td>0</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.

This group of participants, Cluster 1, were identified as distinct from others by a 5-solution cluster analysis, clustered on the worry component of trait anxiety ($M = 14.11, SD = 4.87$), attentional control ($M = 55.28, SD = 5.61$), and the calculated attentional bias index ($M = -3.00, SD = 4.88$). Participants in this cluster showed no significant differences to participants in the other clusters in terms of their trait worry, but were significantly higher than participants in clusters 2, 3 and 4 in terms of their attentional control.

Participants in this cluster displayed a very small negative attentional bias (i.e. towards threat); however, this was effectively no attentional bias. In this aspect they were significantly different to all other clusters. Participants in this cluster displayed
the lowest levels of pre-TSST state anxiety; after removing an observed outlier, they were marginally significantly different to cluster two in this respect. In terms of post-TSST state anxiety and the change in state anxiety this cluster was not significantly different to the other clusters.

### 6.8.2.2 Cluster 2

Table 6.46. Summary of data for Cluster 2.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Trait Anxiety (Worry)</td>
<td>28</td>
</tr>
<tr>
<td>(M = 14.89, SD = 4.056)</td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>28</td>
</tr>
<tr>
<td>(M = 48.38, SD = 6.610)</td>
<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td>28</td>
</tr>
<tr>
<td>(M = -3.32, SD = 18.493)</td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td>28</td>
</tr>
<tr>
<td>(M = 36.27, SD = 9.544)</td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td>28</td>
</tr>
<tr>
<td>(M = 52.14, SD = 11.108)</td>
<td></td>
</tr>
<tr>
<td>State Anxiety</td>
<td>28</td>
</tr>
<tr>
<td>(pre- to post-TSST)</td>
<td></td>
</tr>
<tr>
<td>(M = 14.52, SD = 10.061)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.

This group of participants were identified as distinct from others by a 5-solution cluster analysis, clustered on the worry component of trait anxiety (M = 14.93, SD = 3.71), attentional control (M = 46.14, SD = 4.46), and the calculated attentional bias index (M = -17.16, SD = 6.98). Participants in this cluster showed no significant differences to participants in the other clusters in terms of their trait worry; they were significantly lower than participants in cluster 1 in terms of their attentional control. Participants in this cluster displayed a negative attentional bias (i.e. towards threat); in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, participants in this cluster displayed a marginally significant difference to those in cluster 1. Post-TSST state anxiety and the change in state anxiety this cluster was not significantly different to the other clusters.
Table 6.47. Summary of data for Cluster 3.

<table>
<thead>
<tr>
<th>Trait Anxiety (Worry)</th>
<th>n</th>
<th>M</th>
<th>SD</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
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<tr>
<td></td>
<td></td>
<td>30</td>
<td>15.10</td>
<td>4.130</td>
<td>.153</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>(M = 14.89, SD = 4.056)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td></td>
<td>30</td>
<td>46.37</td>
<td>5.423</td>
<td>.670</td>
<td>35</td>
<td>57</td>
</tr>
<tr>
<td>(M = 48.38, SD = 6.610)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td></td>
<td>30</td>
<td>10.58</td>
<td>7.349</td>
<td>.316</td>
<td>-0.10</td>
<td>28.50</td>
</tr>
<tr>
<td>(M = -3.32, SD = 18.493)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td></td>
<td>30</td>
<td>38.77</td>
<td>9.020</td>
<td>.558</td>
<td>23</td>
<td>59</td>
</tr>
<tr>
<td>(M = 36.27, SD = 9.544)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td></td>
<td>30</td>
<td>54.27</td>
<td>13.415</td>
<td>.793</td>
<td>32</td>
<td>73</td>
</tr>
<tr>
<td>(M = 52.14, SD = 11.108)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Anxiety (pre- to post-TSST)</td>
<td>30</td>
<td>15.50</td>
<td>9.062</td>
<td>.516</td>
<td>-7</td>
<td>31</td>
<td>38</td>
</tr>
<tr>
<td>(M = 14.52, SD = 10.061)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.

This group of participants were identified as distinct from others by a 5-solution cluster analysis, clustered on the worry component of trait anxiety (\(M = 15.10, SD = 4.13\)), attentional control (\(M = 46.37, SD = 5.43\)), and the calculated attentional bias index (\(M = +10.58, SD = 7.35\)). Participants in this cluster showed no significant differences to participants in the other clusters in terms of their trait worry; they were significantly lower than participants in cluster 1 in terms of their attentional control. Participants in this cluster displayed a small positive attentional bias (i.e. away from threat); in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety and the change in state anxiety this cluster was not significantly different to the other clusters.

6.8.2.4 Cluster 4.

This cluster of two participants were identified by a cluster analysis as distinct from other participants. They were clustered on the worry component of trait anxiety (\(M = 17.50, SD = 0.71\)), attentional control (\(M = 39.50, SD = 6.36\)), and the calculated attentional bias index (\(M = +50.43, SD = 7.83\)). Participants in this cluster showed no significant differences to participants in the other clusters in terms of their trait worry; they were significantly lower than participants in clusters 1 and 5 in terms of their attentional control.
Table 6.48. Summary of data for Cluster 4.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 4</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
</tr>
<tr>
<td>Trait Anxiety (Worry)</td>
<td>2</td>
</tr>
<tr>
<td>((M = 14.39, SD = 4.056))</td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>2</td>
</tr>
<tr>
<td>((M = 48.38, SD = 6.610))</td>
<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td>2</td>
</tr>
<tr>
<td>((M = -3.32, SD = 18.493))</td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td>2</td>
</tr>
<tr>
<td>((M = 36.27, SD = 9.544))</td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td>2</td>
</tr>
<tr>
<td>((M = 52.14, SD = 11.108))</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (pre-to post-TSST)</td>
<td>2</td>
</tr>
<tr>
<td>((M = 14.52, SD = 10.061))</td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.

Participants in this cluster displayed a large positive attentional bias (i.e. away from threat), in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety and the change in state anxiety this cluster was not significantly different to the other clusters.

6.8.2.5 Cluster 5.

Table 6.49. Summary of data for Cluster 5.

<table>
<thead>
<tr>
<th></th>
<th>Cluster 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
</tr>
<tr>
<td>Trait Anxiety (Worry)</td>
<td>3</td>
</tr>
<tr>
<td>((M = 14.39, SD = 4.056))</td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>3</td>
</tr>
<tr>
<td>((M = 48.38, SD = 6.610))</td>
<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td>3</td>
</tr>
<tr>
<td>((M = -3.32, SD = 18.493))</td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td>3</td>
</tr>
<tr>
<td>((M = 36.27, SD = 9.544))</td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td>3</td>
</tr>
<tr>
<td>((M = 52.14, SD = 11.108))</td>
<td></td>
</tr>
<tr>
<td>State Anxiety (pre-to post-TSST)</td>
<td>3</td>
</tr>
<tr>
<td>((M = 14.52, SD = 10.061))</td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.
This cluster of three participants were identified by a cluster analysis as distinct from other participants. They were clustered on the worry component of trait anxiety ($M = 15.33, SD = 3.06$), attentional control ($M = 54.00, SD = 8.89$), and the calculated attentional bias index ($M = -50.86, SD = 12.50$). They were comparable with all other participants in terms of their trait worry, but reported significantly higher levels of attentional control than cluster 4. Participants in this cluster displayed a large negative attentional bias (i.e. towards threat); in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety and the change in state anxiety this cluster was not significantly different to the other clusters.

6.8.3 Characterisation of the clusters.

The clusters can be briefly characterised as follows:

- Cluster 1 - No attentional bias.
- Cluster 2 - Small attentional bias towards threat.
- Cluster 3 - Small attentional bias away from threat.
- Cluster 4 - Large attentional bias away from threat.
- Cluster 5 - Large attentional bias towards threat.
Chapter 7 - Qualitative Results

The aim of this chapter is to present the qualitative findings from the main research study. There are five sections; each one dedicated to an individual cluster of participants. These sections will describe the composition of each cluster based on the quantitative data, provide a summary of the contemporaneous observations made by the author as the participants from that cluster underwent the TSST procedure, and summarise the findings and interpretations of directed content analysis performed on the participants’ interview data.

The participant groups identified by the cluster analysis (see section 6.8) were used as the basis for a directed content analysis. The aim of this was to investigate the participants’ responses to the semi-structured interview to uncover how they related to their patterns of trait test anxiety, attentional control, state anxiety and attentional bias. Hence, the initial coding categories were based on the key areas of the theoretical model employed in the study: attentional bias, attentional control, the evaluative situation (TSST), state anxiety and trait test anxiety. Within these main categories, responses were coded into several sub-categories. The full coding schedule can be found in Appendix 8.

7.1 Cluster 1 - No Attentional Bias (18 participants)

7.1.1 Summary of Cluster 1’s characteristics.

This group of participants were identified as distinct from other clusters by a 5-solution cluster analysis, clustered on the worry component of trait anxiety ($M = 14.11$, $SD = 4.87$), attentional control ($M = 55.28$, $SD = 5.61$), and the attentional bias index ($M = -3.00$, $SD = 4.88$). They were comparable with all other participants in terms of their trait test anxiety, but scored significantly higher than clusters 2, 3 and 4 in terms of their attentional control. Participants in this cluster displayed a very small negative attentional bias (i.e. a bias towards threat); however, this was so small it was effectively no attentional bias; in this aspect they were significantly different to all other clusters. Participants in this cluster displayed the lowest levels of pre-TSST state anxiety. Initially this did not appear significantly different to other clusters; however, after removing an observed outlier, they were marginally significantly different to cluster 2 in this respect. In terms of post-TSST state anxiety and the change in state anxiety during the TSST procedure, participants in this cluster were not significantly different to those in the other clusters.
Table 7.1. Summary of Quantitative Data for Cluster 1.

<table>
<thead>
<tr>
<th></th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trait Anxiety (Worry)</td>
<td>18</td>
<td>14.11</td>
<td>4.874</td>
<td>.109</td>
<td>8</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>((M = 14.89, SD = 4.056))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>18</td>
<td>55.28</td>
<td>5.613</td>
<td>.823</td>
<td>46</td>
<td>66</td>
<td>20</td>
</tr>
<tr>
<td>((M = 48.38, SD = 6.610))</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td>18</td>
<td>-3.00</td>
<td>4.828</td>
<td>.424</td>
<td>-10.58</td>
<td>6.23</td>
<td>16.81</td>
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<td>((M = -3.32, SD = 18.493))</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td>18</td>
<td>32.78</td>
<td>9.384</td>
<td>.028</td>
<td>22</td>
<td>58</td>
<td>36</td>
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<tr>
<td>((M = 36.27, SD = 9.544))</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td>18</td>
<td>50.39</td>
<td>11.693</td>
<td>.724</td>
<td>27</td>
<td>73</td>
<td>46</td>
</tr>
<tr>
<td>((M = 52.14, SD = 11.108))</td>
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</tr>
<tr>
<td>State Anxiety (pre-to post-TSST)</td>
<td>18</td>
<td>17.61</td>
<td>10.711</td>
<td>.306</td>
<td>0</td>
<td>33</td>
<td>33</td>
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<tr>
<td>((M = 14.52, SD = 10.061))</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means are shown in column 1 for comparison.

7.1.2 Author’s impressions of Cluster 1 participants during the TSST tasks.

The following is a summary of the author’s field notes. These were made at the time the participants were undertaking the TSST protocol.

The number of participants in this group \((n = 18)\) led to a variety of behaviours being observed during the TSST process. Several of these participants appeared particularly calm and confident on their arrival at the experiment room; with one, participant no. 25, even introducing herself to the interview panel. However, others came across as slightly anxious and apprehensive about the process; participant no. 4 appeared amused, but explained afterwards that this was a response to her nerves. Whilst the majority of these participants appeared to find the process challenging and stressful, the impression that they gave was of apprehension and mild concern rather than observable levels of intense anxiety. Generally, they were unable to complete the presentation task and spoke on the subject for less than five minutes; however, they frequently dealt well with the interviewers’ questions and often appeared to use these as prompts. The mental maths appeared to be the task that most of the participants found to be more challenging and where increases in anxiety were more apparent to the observer.

Overall, this cluster of participants gave the impression of being concerned by the TSST process rather than displaying high levels of worry or anxiety, the majority
reported feeling more stressed or anxious upon completing the tasks than they had at the start.

Participant 106 stood out from this group; she only appeared slightly apprehensive at the beginning of the task and spoke fluently during the presentation. However, during the maths task she suddenly became very upset and the decision was taken to stop the process.

7.1.3 Directed content analysis, Cluster 1.

The participant interviews have been coded and analysed in accordance with the key areas of the model being investigated, namely, trait test anxiety, the modified-TSST, attentional control, state anxiety and attentional bias.

7.1.3.1 Trait test anxiety.

Just over half (10 out of 18) of these participants reported that they worry about exams; however, there appears to be some variation in how strong this worry is. Some comments indicated that the levels of worry experienced by some is relatively high; for example, “I judge myself really harshly, I put pressure on myself, I couldn’t sleep before my exam results and I cried cos I got one B.” (83) “I do exams in a separate room; I struggle doing them in a hall.” (91) “I want everything to be perfect, for me that’s a big issue. I want perfection.” (91) “Yes, a lot. I worry months before and after.” (76) However, others suggest that the worry these participants experience is mild, “Yeah, a little but I don’t stress out a whole lot which probably isn’t that good cos I don’t do that much revision. I’ve never been someone who’s incapacitated by nerves or anything.” (8) “Yeah, leading up exams I’m not that nervous but when I’m actually doing them I get more nervous.” (36)

There is clear variation in how these individuals perceive their worries about examinations; this is also true in how they believe it leads them to respond. Their worries lead some of these individuals to prepare and revise well in advance of the exam, “Just one of those things, if I revise I feel a bit better.” (67) “Yes, I do and get to revising and try to think if I fail I fail. Preparing helps beforehand but afterwards I worry anyway.” (83) “Revise a lot. Prepare, but it can get in the way.” (45) While for others, there appears little they can do to address their concerns, “I don’t know, I just try

6 Participant 91 was the outlier identified in 6.8.14.
and get on with it.” (30) “No, just the way it is. It’s always in the back of my head.” (76)

The relative importance of the exam seems to have an impact on how anxious some of these individuals become; “Definitely, also this year if I don’t get an A I can’t go to Uni.” (99) “It depends if I’ve revised and I’m confident but it can be different cos if exams really mean a lot to me like English Lit then I get really nervous despite the fact I’d done a lot of preparation.” (21)

External pressures also play a role; for example, pleasing others, “I think I worry about results more than the exam. No, when I did my GCSE’s I wasn’t worried about results at all actually. It more pressure from teachers, not pleasing them more than the results I get.” (2), and not wanting to let others down “I judge myself really harshly, I put pressure on myself, I couldn’t sleep before my exam results and I cried cos I got one B. It’s the pressure of the school, everyone was good at everything, and all the teachers were expecting you to do well. It was the money as well, a mixture of everything.” (83)

A minority of this group (7 out of 18) report they do not worry about exams in advance of them; “No, I worry about how I’m not worrying about exams if that makes sense? I think I should be stressed and I’m not. Like going into the GCSE I was calm and everyone was stressing out and I think I should be stressing out as well.” (25) “I don’t, they don’t hit me till the last moment.” (49) A number reported that the anxieties they experience about the examination process do not bother them in the period leading up to exams, but appear afterwards while they are waiting for their results; “It depends on the subject but I feel on average I don’t really get nervous as such. I tend to get nervous after them rather than before.” (17) “I’m more worried about the results afterwards.” (23)

7.1.3.1.1 Summary of Cluster 1’s comments on trait test anxiety.

In summary, there is some variation in how this cluster of participants responded when they are describing their feelings about examinations; some suggested that the process is one they find causes them concern and worry, while others appeared unconcerned. There appears to be several factors impacting on their trait levels of test anxiety and how this manifests itself; some are driven to prepare, while others are more ambivalent about the prospect of examinations.
7.1.3.2 The modified-TSST.

The majority of this cluster (13 out of 18) reported that they found the interview panel to be rude or unhelpful; for example, “They were just silent and staring at me, a bit intimidating.” (67) “They didn’t smile; they just looked blankly at me. They made me more nervous.” (2) If they’re friendly you can reciprocate the behaviour, but they weren’t and I felt a sort of wall.” (4) For some this added to the difficulty of the task, e.g. “I think it added to it because they were just staring at me, waiting for me to speak and I didn’t have anything else to say.” (30), “The lack of expression, the microphone, the camera was making me feel horrible. It was scary, they made me really nervous. I felt very like isolated. I couldn’t get my words out; the silence was hard.” (83) Three of these participants appeared to be less concerned by the attitude of the interviewers, “Fine, she was neutral, not encouraging. It didn’t really bother me.” (17) “Alright, I’d have liked it if they had had a bit more expression.” (36) “Fine, not particularly encouraging.” (76) None of these participants made any reference to the interviewers as being helpful or supportive, with a few exceptions, the consensus appeared to be that their attitude was unhelpful and added to the challenge of the task; however, their comments were generally not as extreme as those made by individuals in some other clusters.

A number of participants (10 out of 18) in this cluster made comments indicating they felt judged by the interview panel, “The cameras and microphone, the fact that I was being watched and I felt under pressure.” (45) “I felt so embarrassed, that they were judging me.” (99), with one specifically mentioning they felt the evaluation was negative, “I didn’t feel like they were impressed.” (2) Many commented they felt they were being judged but did not elaborate if this felt particularly negative.

A small number of this group (5 out of 18), made comments indicating they felt it was important to make a good impression on the interview panel, “Yes. I wanted to give them a good impression.” (45) “Doing interviews, you want to make a good impression and do well. In interviews, I have to look good for someone else.” (25) “Its perceived authority, I wanted to impress them.” (91) For some this could be because they felt they “should” have been able to do the tasks, “I should have been able to calm down and do that.” (99)

When asked how the TSST process compared to an examination this group were split in terms of whether it did or did not induce similar feelings. Those responding affirmatively (7 out of 18) included, “It reminded me of an invigilator cos they’re very much reserved. I always really prepare myself for exams and I feel like I should be able
to answer the questions” (99) “Yes, definitely. I get into an exam and I start to panic, I want to do well and impress the examiner. At the end of the day someone is looking at my work, they don’t know me and will judge what I’ve written. I want my writing to be perfect, my answers to be correct.” (91) “Yes, when I did that, that’s how I feel sometime just before an important exam. The computer is how I feel in an exam. You get nervous beforehand but when you get down to work you’re more calm.” (2) Others indicated that the TSST process was more stressful than an examination, “I think I felt more nervous on this one cos in an exam I know no one is going to be looking down on my paper; nobody will be looking at me if I’m doing anything right or wrong. It’s just me knowing what I’m doing.” (49) Some suggested the process was not similar to an examination at all, “No because when I do tests there’s only going to be one person who sees it so it doesn’t matter as much as this.” (23) “In an exam, it’s more proving to me I can do well. In interviews, I have to look good for someone else.” (25)

7.1.3.2.1 Summary of Cluster 1’s comments on the modified-TSST.

In summary, the TSST procedure was one that most of these participants did not enjoy; the attitude of the interview panel appeared central to this, with some of them, though by no means all, feeling judged. There was a mixed response regarding whether the TSST could elicit similar feelings to an examination situation; however, it did appear that the feelings it generated in these individuals were more powerful and intense than those experienced in an examination.

7.1.3.3 Attentional control.

Only a small number of this cluster (5 out of 18) referred to “going blank”, “My mind went blank as I knew I only had three minutes to think of everything I wanted to say for five minutes.” (4) “My mind went blank a bit and I just didn’t know what else to write.” (30) “I knew my mind was going to go blank straight away cos it always does when I’m put under pressure.” (61) One participant (no. 99), suggested a lack of concentration “I don’t think I fully listened to the instructions and I wasn’t entirely sure what I had to do.” The majority (13 out of 18) commented that they were able to maintain their focus on preparing and carrying out the tasks, “I knew what I was going to do and I was talking about stuff I knew about.” (17) “I only had three minutes so I couldn’t not think about the task.” (2) “It was a bit stressful cos I had to plan this to last five minutes so I was anxious but I was ok.” (23) “I focused on what the task was and
avoid the camera, try not to make eye contact.” (67) “No, I could think of what I wanted to say.” (21)

7.1.3.3.1 Summary of Cluster 1’s comments on attentional control.

In summary, these comments suggest that while individuals may have been concerned about the TSST process, the majority of participants in this cluster did not believe this impacted on their ability to focus or maintain their attention on the tasks they were given.

7.1.3.4 State Anxiety.

The majority, though by no means all (11 out of 18), of these individuals reported feeling nervous, anxious or worried during the TSST process. Comments which indicated this include, “I felt kind of panicky cos I had to think of something quickly. Nervous.” (45) “At first I felt relaxed co I knew what I was going to say, but then after a couple of minutes I ran out of points and I was coming up with random, stupid ideas. I was trying to make time pass quickly, I started to get a bit uncomfortable and nervous cos I didn’t know what to say.” (49) “I felt a bit uneasy cos I was being filmed”. (99) “Very nervous. I always use hand movements and I was very restless.” (91)

Less than half (6 out of 18) reported experiencing a lack of control or similar feelings, “It was kind of like rushed cos I haven’t prepared this before so it was my first time planning it. If it was for an interview I’d have time to plan what I needed to include.” (23) “I felt nervous when I asked how much time I had left and she just said, “you still have time”, I would rather know. Made me feel out of control and I didn’t know how much stuff I needed to make up.” (25) “I was just scared that I wouldn’t last five minutes and I’d forget what I was going to say. What I’d prepared.” A similar proportion (5 out of 18), indicated they felt unable to cope with the tasks: for example, “I was quite nervous as I’ve never done something like that before and I forgot half of what I put on the sheet.” (67) “I didn’t understand it. I was nervous so I stopped.” (36)

One, participant no. 8, reported they felt in control throughout, “I think I coped ok. I didn’t do it very well but I didn’t feel that phased.” Other comments indicated confusion, “I couldn’t answer the questions cos I don’t know what I want to do.” (2), frustration “Really frustrating having to start again.” (83), and embarrassment, “I kept thinking I had to minus 12 but it was 13, it was really embarrassing and stressful that I couldn’t do it.” “I felt so embarrassed, that they were judging me.” (99)
In contrast to the above, a number of these individuals were positive in their assessment of how they felt; for example, feeling relaxed “I felt quite relaxed cos it was about something personal.” (21) “I was feeling comfortable cos I thought I knew what I wanted to say and cos I had everything there, it was in my head.” (49), in control “I didn’t see the point of making notes when you can’t use them.” (17), and confident “I felt alright cos I’d prepared. At one point I thought I’d said enough.” (76)

7.1.3.4.1 Summary of Cluster 1’s comments on state anxiety.

In summary, while a majority of the individuals in this cluster reported a level of worry or anxiety around the TSST process, this did not come across as particularly extreme. An exception was participant no. 83; “The lack of expression, the microphone, the camera was making me feel horrible. It was scary, they made me really nervous”. It must also be noted that not all of these individuals found the process challenging, with some making comments that indicated they were relaxed and felt in control.

7.1.3.5 Attentional bias.

Approximately half of these participants (8 out of 18) reported that they were distracted to some degree by the worries they were experiencing, “I suppose because if I wasn’t anxious I would have spoken more clearly, but because I was nervous it impaired my speech a bit.” (30) “I was self-conscious and awkward; I felt I wasn’t able to find anything to say to fill in the gaps. I was saying stuff where I didn’t even know what I was going on about” (83) “I was looking round the room to see what the ladies were doing, I was wondering what was going on. I was anxious because they were strangers and their white coats. It was really distracting me from getting on with it. It was making my mind go blank.” (99)

Specific concerns related to the mistakes they were making, indicating these were also a source of distraction for some of these participants; for example, “Yes, when I kept making a mistake it was putting me off.” (23) “When I got it wrong the first time I was thinking they’ll think I’m some dumb girl. I felt like I didn’t reach my targets as I should have. For me it was, I needed to reach this.” (49) “When I had to do it again I was thinking that I’d got the first bit right but it was when I got down to the point I made the mistake I kept thinking what I’d done wrong?” (2) For others, the tasks themselves appeared to be distracting, “I found at first it was just flowing and then I had to think of a point then I could talk fluently after that, but it got harder. I was just
distracted by having to think of new points.” (2) “Yeah, I was thinking about the task rather than what’s involved if that makes sense?” (4)

7.1.3.5.1 Summary of Cluster 1’s comments on attentional bias.

In summary, the responses of the participants in this cluster indicated that for some of them their concerns about success on the tasks, making mistakes, and the nature of the tasks themselves may have been causing a level of distraction. It is unclear is whether they felt these distractions were having an impact on their task performance.

7.1.3.6 Summary of comments made by Cluster 1.

The individuals in this group, demonstrated a range of diverse responses to the areas discussed in the post-TSST interview. Approximately half of these individuals expressed some concerns about the examination process; however, while some of them described a very strong set of feelings with a tangible impact on them, others reported more mild feelings of concern and apprehension. The importance of the exam certainly seems to be a factor in how anxious these individuals feel; higher stakes examinations and the consequences associated with them lead to greater levels of worry and anxiety. External pressures, such as the perceived pressure from parents and teachers, coupled with a sense of “letting others down” was also mentioned by some as a source of anxiety. For those that reported being worried by the process, revising and preparing is mentioned as a way of addressing these concerns; however, some do not have clear strategies to deal with their anxieties and feel that they are simply part of life while they sit examinations. Some of these individuals reported that exams do not concern them beforehand; hence they do not feel the need to adopt strategies to deal with this. For others, their concerns appear to surface after the examination is complete and they are waiting for their results.

For the most part these individuals found the TSST procedure difficult and a source of stress and anxiety. They found the attitude adopted by the interviewers particularly challenging and cited this as a cause of worry; it appears that if they had been more supportive that the experience would have been quite different. However, these concerns were not expressed in a manner that suggested the participants’ reactions were particularly extreme. A small number of this group were unconcerned by the attitude of the interview panel. Other sources of concern for these individuals were that their performance on the tasks was being judged negatively and that they felt the need to
make a good impression on the interviewers; something they did not perceive themselves as doing. Many reported that the TSST induced feelings that were similar in nature to those experienced in examinations, albeit more intensely.

When questioned about their ability to maintain their attention during the TSST process, a minority of this group made comments to the effect that they “went blank”, or reported that concentration was a challenge. In contrast to this there were also a number of participants who recognised that the process was stressful and challenging, but that they were able to remain focussed. There is no single clear theme that appears to be running through this cohort when describing their ability to maintain attention when under pressure.

The majority of these participants reported increased levels of state anxiety during the TSST process; this is coupled with negative emotions associated with a lack of control and an inability to cope with the situation. There were also contrasting comments that suggested some of them experienced little or no anxiety. Though it is clear the process was difficult for some of these participants, the language used did not give the impression that the anxieties they were experiencing were particularly extreme or causing them concern.

Around half of the participants in the cluster reported a level of distraction during the TSST process; this appears to be down to the presence of the interviewers, the mistakes they were making, and the nature of the tasks themselves. It is not possible to ascertain from the comments made if these participants believed the distraction they were experiencing was impacting upon their performance on the tasks.

### 7.2 Cluster 2 - Small Attentional Bias towards threat (28 participants)

#### 7.2.1 Summary of Cluster 2 characteristics

This group of participants were identified as distinct from others by a 5-solution cluster analysis, clustered on the worry component of trait anxiety ($M = 14.93$, $SD = 3.71$), attentional control ($M = 46.14$, $SD = 4.46$), and the attentional bias index ($M = -17.16$, $SD = 6.98$). They were comparable with all other participants in terms of their trait test anxiety, and only significantly lower than cluster 1 in terms of their attentional control. Participants in this cluster displayed a small negative attentional bias (i.e. towards threat), in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, participants in this cluster displayed a marginally significant difference to those in cluster 1. Post-TSST state anxiety and the change in state anxiety in this cluster were not significantly different to the other clusters.
Table 7.2. Summary of Quantitative Data for Cluster 2.

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<td></td>
<td>n</td>
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<td>SD</td>
<td>Normality</td>
<td>Min</td>
<td>Max</td>
<td>Range</td>
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<td>Trait Anxiety</td>
<td>28</td>
<td>14.93</td>
<td>3.711</td>
<td>.419</td>
<td>8</td>
<td>23</td>
<td>15</td>
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<td>(Worry) (M = 14.89, SD = 4.056)</td>
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<tr>
<td>Attentional Control</td>
<td>28</td>
<td>46.14</td>
<td>4.461</td>
<td>.612</td>
<td>38</td>
<td>56</td>
<td>18</td>
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<tr>
<td>(M = 48.38, SD = 6.610)</td>
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<tr>
<td>Attentional Bias</td>
<td>28</td>
<td>-17.15</td>
<td>6.981</td>
<td>.599</td>
<td>-35.11</td>
<td>-6.12</td>
<td>28.99</td>
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<tr>
<td>Index (M = -3.32, SD = 18.493)</td>
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<tr>
<td>pre-TSST State Anxiety</td>
<td>28</td>
<td>38.93</td>
<td>9.813</td>
<td>.050</td>
<td>20</td>
<td>57</td>
<td>37</td>
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<tr>
<td>(M = 36.27, SD = 9.544)</td>
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<tr>
<td>post-TSST State Anxiety</td>
<td>28</td>
<td>50.32</td>
<td>11.392</td>
<td>.911</td>
<td>28</td>
<td>75</td>
<td>47</td>
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<tr>
<td>(M = 52.14, SD = 11.108)</td>
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<tr>
<td>State Anxiety</td>
<td>28</td>
<td>11.39</td>
<td>10.250</td>
<td>.853</td>
<td>-8</td>
<td>33</td>
<td>41</td>
</tr>
<tr>
<td>(pre-to post-TSST) (M = 14.52, SD = 10.061)</td>
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Note: Sample means are shown in column 1 for comparison.

7.2.2 Author’s impressions of Cluster 2 participants during the TSST tasks.

The following is a summary of the author’s field notes. These were made at the time the participants were undertaking the TSST protocol.

This was a large group of participants (n = 28) and, unsurprisingly, they displayed a range of observable behaviours throughout the TSST process. The majority appeared calm at the start, though signs of apprehension were also apparent. During the process the majority initially spoke confidently, but were unable to fill the full five minutes with their presentations; from this point they either simply repeated themselves or relied on the interviewers’ questions to prompt them. As with other clusters, it was the mental maths task that seemed to be the more challenging; many of these participants became increasingly agitated during this part of the process. For example, participant no. 97 started to laugh, which she explained was a response to her nerves, she also asked what the consequences were for “failing”. Participant no. 93 appeared to be coping well but suddenly asked to stop the maths task when she began to make mistakes. Generally, these participants appeared more anxious after they had completed the TSST process than when they began, though it had clearly impacted some more than others.
7.2.3 Directed content analysis, Cluster 2.

The participant interviews have been coded and analysed in accordance with the key areas of the model being investigated, namely, trait test anxiety, the modified-TSST, attentional control, state anxiety, and attentional bias.

7.2.3.1 Trait test anxiety.

Twenty-two out of the 28 participants in this cluster reported that they worry about exams with a range of feelings being reported. Comments from those reporting stronger feelings of worry include: “Yes, a lot. I think the build-up to exams, like now I’m stressing and they’re a few months away” (113) “Yes, I do stress about exams. Quite a long time before, like I’ve got mocks in a couple of months and I’m already worrying about them.” (52) “Definitely, 100%. Yeah, my exams were awful, I get really nervous.” (72) One participant, no. 86, reported how this worry manifests itself physically, “Massively, I get really ill. I’ve been ill for the past seven years. I’ve got really bad IBS, had hypnotherapy for it. I have to tell myself that I don’t care.” (86) Others expressed their concerns less strongly; “A little bit, didn’t worry about my GCSEs but A-levels are harder.” (105) “On the day, maybe the night before.” (19) “Yeah kind of. The day before I’m worried. Not long term.” (42) For some of these participants, their concerns appear connected to the importance of the examination they are sitting, for example, “Yeah, I worry a lot. My GCSEs were the first ones that mattered I was panicking a lot for 2 or 3 months before.” (37) “It depends how important they are. SATs I didn’t bother with but A-levels I’m already revising.” (93) “I didn’t worry about my GCSEs but A-levels are harder.” (105) One participant, no. 62, clearly related her worries to the long-term importance of the exams, “You get your grades back and you get judged for the rest of your life off them. You have one chance to not mess it up.” These comments suggest those who recognise the importance of the exam report stronger feelings of worry. Though interestingly, another participant, no. 32, reported the opposite; “I worry about them more when we do these mini tests and I end up not failing but not doing as well as I hoped and I think about the bigger picture. If I can’t get the little test right, then can I get the big exams done.” For others their worries appeared linked to their confidence regarding the examinations; “In an exam that I’m not comfortable with, I’m ok in performing arts and maths, when you need the knowledge it’s harder.” (108) “I am if I’ve tried hard. If I try hard than do really bad then I’m really sad, but if I don’t try then I don’t know what I’m
worrying about.” (59) “It depends on what lesson it is, some I thought I’ll be able to do this ‘cos it’s dead easy but with some of them I thought I’m not so good.” (63) It appears that where confidence is low the individual is likely to experience higher levels of concern.

Interestingly, participant 74 indicates that they feel their concerns associated with examinations may actually be beneficial: “Yes, a lot. I get really stressed. I don’t stress at all till the week before than its panic. I don’t sleep, don’t eat. As I walk into the exam I’m really stressed but as soon as I open the exam everything go es. I think it works well for me.” (74)

Along with the strength of feeling itself, there was also a range of responses from participants when describing the length of time over which they experienced their worries. “I’m stressing and they’re a few months away.” (113) Quite a long time before, like I’ve got mocks in a couple of months and I’m already worrying about them.” (52) “I get really scared. The week before it really ramps up.” (98) “On the day, maybe the night before.” (19) “The day before I’m worried. Not long term.” (42) “I’ll revise in advance but it hits me the night before and that’s when I do loads of work. I need the pressure.” (93) This last comment, as with participant 74, suggests that for some the anxiety associated with the examinations may have a facilitative effect.

In an attempt to alleviate their concerns a number of these participants (8 out of 28) reported that they believe preparation helps them: “Revise to make sure you’re as prepared as you can be.” (64) “it makes me revise, it gets me to prepare.” (84) Whereas, others reported the opposite: “I just stress about it, it really gets in the way. I’m so worried about it and stressed that I don’t do any work. Then I do all my revision the night before.” (113) “If I try hard than do really bad then I’m really sad, but if I don’t try then I don’t know what I’m worrying about.” (59) Other participants (11 out of 28) reported that they do not feel there is anything they can do about their worries. “Just have to deal with it, just get on with it. Thought it was normal.” (37) “Usually it’s just a case of get on with it, most of the time I can’t do anything about it.” (63) “I try and focus but just one of those things.” (75) “Nothing, just the way it is.” (98) There is no common theme that is apparent in how these participants attempt to deal with the test anxiety they experience or the impact it has on their behaviour.
7.2.3.1.1 Summary of Cluster 2’s comments on trait test anxiety.

In summary, while there is some variation in how this cluster of participants responded when describing their feelings about examinations, the majority reported feeling worried and anxious about them. For some, this occurs for a significant period of time prior to the examination. The relative importance of the examination appears to play a role in the severity of participants’ concerns; higher stakes examinations such as GCSEs and A-levels are associated with more powerful feelings. This is most likely due to the individuals’ awareness of opportunities afforded by success in these examinations; self-confidence in the subject, or lack thereof, was also associated with the anxiety they experience. While some suggested that their stress encourages them to revise, others were clear that their worries act a block and there is little they can do about them.

7.2.3.2 The modified-TSST.

The majority of this cluster of participants (17 out of 28) made comments to the effect that they found the interview panel intimidating. For example, “They made me feel nervous because they were writing stuff down, I know it sounds dead clichéd but because they were wearing the (lab) coats it made me feel like it was more official.” (63) “The interviewers were very intimidating.” (93) “They were scary. I felt like I wasn’t getting much of a response so it was quite nerve-wracking not knowing if I was saying something right or wrong.” (84) “Made it a lot more intimidating than it could have been made it much harder.” (62) “They were very, I don’t know, I think they made me feel nervous.” (81) There were also comments that suggested they interviewers were not encouraging or even rude; “They were just staring and not speaking. I smiled and they just looked at me.” (66) “They gave me dirty looks.” (70) “They were rude, not encouraging.” (75) Some of these participants articulated that this added to the difficulty of the task, “They made it harder, they didn’t help.” (84) “They made me feel I was doing it completely wrong.” (66) “Under pressure, even when you finished they just looked at you and didn’t say anything.” (105) None of these participants made any reference to the interviewers as being helpful or supportive; the consensus was that their attitude was unhelpful and added to the challenge of the task.

The majority of these participants (21 out of 28) reported feeling judged by the interview panel; “Felt like they were judging me.” (62) “Yeah, definitely (felt judged). Made me feel more nervous.” (63) “I definitely felt they were judging me.” (72) “Yes cos they were writing notes. They didn’t smile or anything, very professional.” (80) Six
of these participants also commented that they were concerned by the judgements being made; “Yes, really worried about that” (86) “Yes, definitely. I cared what they thought and it seemed such a simple task. (74)” “Yeah, a lot. Made me feel more anxious, like I was doing it wrong.” (66) “Being judged by them, I wanted to do well even if it was an experiment. The camera put me off.” (98) These comments suggest that most of the participants felt that they were being judged by the interview panel; those who expressed their feelings about this suggest that this judgement added to their anxiety.

A number of these participants (10 out of 28) reported that they felt it was important to make a good impression on the interview panel. “The pressure to do well. I need to impress everyone.” (19) “It’s important what they think of me.” (52) “I was trying to make a good impression and I made an awful impression.” (84) “I was more nervous, the way I see it it’s the anxiety of doing an interview. I needed to impress. (93) With one expressing that they recognised this was the only pressure they experienced: “There are not really any consequences but I wanted to look the best I could” (89) The need to impress the interviewers appeared to bring with it added pressure for some of these participants. Others reported that some of the pressure they experienced came from their belief that they should be able to do the task; “I do maths A-level; I shouldn’t have been that bad. I don’t know my 13 times table.” (81) “It was really frustrating cos I should be able to do it.” (97) “It was embarrassing, mental maths has always been my downfall ever since primary school. Even though I’m doing A-level maths.” (84) It is apparent that for some that the fact that they were not meeting their own internal standards was a source of pressure on the task. Some of these participants indicated that they believed they would struggle with the tasks from the start. “I can’t do maths. I don’t think I could do that sum even if I wrote it down.” (59) “I knew I wouldn’t last five minutes speaking.” (81) “I was trying to remember the things I could write down and knowing that when I stood up there I’d probably forget them anyway.” (89) Whether these participants had realised the tasks were not designed to be completed or if this is an approach they adopt to manage their expectations when in challenging situations is unclear. However, they did not explicitly comment that they felt the tasks were unfair or unreasonable.

When asked how their feelings during the TSST process compared to an examination, the majority of these participants (17 out of 28) indicated that it was similar in some way. For example, “Yeah, with the speaking one it was like my English exam when I messed up.” (32) “Yeah, because when you’re doing an exam you always think about getting the answer right or putting enough information to get you the full
marks. Same thing here, I wanted to get them all right in the maths and the speaking was like writing a long essay.” (37) “Yeah, definitely cos it’s just the fear of failing really.” (63) “Yes, yes. Under pressure my mind goes blank like in the mental maths. Sometimes in exams I just go blank even if I know the stuff, the situation affects me.” (71) “Yes, in maths exams I’m presented with a problem and I know what to do but then I suddenly I can’t do it full stop.” (84) “It felt the same, the anxiety.” (97) “It was like an exam, in an exam you only have a few minutes to prepare your one hour answer so it fairly realistic.” (98) The participants could articulate the similarities between the feelings they experienced during the TSST procedure and those they experience in an examination.

7.2.3.2 Summary of Cluster 2’s comments on the modified-TSST.

To summarise, these participants found the TSST process difficult, with the attitude of the interview panel cited as a particular cause for concern; they were seen as challenging and unhelpful. There was a general sense of being negatively judged by the interviewers which was an additional cause for concern by some. A number of these individuals reported that they wanted to give a good impression of themselves, something they clearly felt they were unable to do; others reported they were not living up to their own standards and expectations. Many of the participants in this cluster indicated that the feelings they experienced during the TSST process were similar to those they experience during an examination.

7.2.3.3 Attentional control.

Seven of the 28 participants reported that they went “blank”, or words to that effect, during the TSST process; “Once I’d said everything I’d written down I didn’t know what to say and went blank.” (19) “Yeah, I’d say that. I was actually going to say something else but because I was so nervous I forgot what I was about to say.” (52) “my mind was blank and I didn’t know what to write.” (59) “couldn’t do the rest. My mind went blank.” (62) “under pressure my mind went blank.” (71) Others refer to difficulties concentrating; “I was losing track of what I was saying, I was aware I didn’t know what I was saying.” (86) “I was ok at the start but after a couple of minutes I drew a blank and couldn’t remember what I was trying to say.” (89) These comments suggest that some of these participants were struggling to maintain their attention on the tasks during the TSST process.
When the participants were asked directly if they felt they were able to focus on the task, responses were mixed. Ten reported that they were able to focus; “I could still focus.” (32) “I was just like get on with it.” (58) “I was pretty chilled. I could focus on it.” (71) “I could do it cos it was a familiar topic for me. I know what I want to do.” (86) While others responded that maintaining focus was difficult; “I try to focus on what was being said but it was quite hard.” (52) “I could get on with it but I thought it was a bit like distracting cos you were writing stuff down then you kept on staring at me.” (63) “No, I didn’t realise how intense it would be.” (74)

7.2.3.3 Summary of Cluster 2’s comments on attentional control.

In summary, there was a variability within this cluster of participants, regarding how they felt they were able to maintain their attention or if they could stay focussed during the TSST process. However, explicitly referred to going blank or struggling to focus during the tasks.

7.2.3.4 State anxiety.

Sixteen of the 21 participants in this cluster reported feeling nervous or worried during the TSST process; “When I went up I got really nervous, she wasn’t smiling or responding. Felt really weird inside.” (52) “Really nervous, my mind went blank quite a lot.” (62) “I felt quite scared about the time, it’s just not nice. I was nervous, anxious.” (72) “Nervous, like I didn’t have much to say. That was making me nervous.” (80) “Very nervous. Just the amount of time I had to prepare, the fact you’re on video and people will be watching it over and over.” (98)

The same number of participants (16 out of 21) also reported feeling a lack of control during the TSST process. Indicative comments include; “I didn’t really know what to think and what to say, I don’t actually know what I want to do.” (113) “Cos I thought it was going to be a minute, but cos it was going to be longer I wasn’t sure what to say.” (37) “As time went on I realised I couldn’t speak for five minutes. I knew I’d run out of things to say.” (71) “I was out of my comfort zone.” (72) “It was quite nerve-wracking not knowing if I was saying something right or wrong.” (84) A further six participants made comments indicating they felt unable to cope during the tasks.

In contrast to these responses, 12 of these participants made comments which indicated that at times they felt calm or relaxed; “I was calm; it was ok once I knew the topic.” (108) “I was quite happy with how it went cos it was a hard task.” (64) “I felt fine; I thought it was a pretty easy task.” (93)
7.2.3.4.1 Summary of Cluster 2’s comments on state anxiety.

In summary, most of these participants reported increased levels of worry and anxiety during the TSST procedure, it appears the difficult nature of the tasks and the challenging attitude of the interviewers contributed to this. As well as general feelings of worry and anxiety the participants also reported that feelings relating to a lack of control or being unable to cope were also contributing to their worries.

7.2.3.5 Attentional bias.

Seventeen of these 28 participants made a comment that indicated their worries were distracting them from the task. “I was worried in case I had a mind blank” (19) “I wasn’t really focused on the words; I was still thinking about what had gone on.” (52) “They were distracting me a bit. Wondering how much time I had left.” (70) “They distracted me; I just wanted to get it over with. “I forgot what the question was, I was going completely off topic and I was trying hard to ramble without sounding like I didn’t know what I was talking about. I became really panicky.” (74) In contrast, two participants recognised they were worried but felt they could put these concerns to one side. Two main areas of concern leading to distraction arose; getting the task wrong and the task itself. For example, there were several comments relating to errors or mistakes; “I was kind of distracted, thinking like if I make an error, I didn’t know if I was making an error.” (37) “I’m still thinking about it now, thinking if I was giving the wrong answers.” (42) “I was quite distracted cos I kept thinking maybe I’ve done something wrong or something.” (63) Others described distraction as coming from the task itself; “I was a bit shaky and the instructions went in one ear and out the other, I wasn’t taking it in. I was thinking of the previous task.” (74) “Yes, in maths exams I’m presented with a problem and I know what to do but then I suddenly I can’t do it full stop.” (84)

7.2.3.5.1 Summary of Cluster 2’s comments on attentional bias.

In summary, the majority of these participants reported a level of distraction during the TSST process. The sources of this were their own worries, the mistakes they were making, and if they were fully meeting the requirements of the tasks. While the presence of distracting thoughts was clear, it was less certain how these were impacting on these individuals and if they were able to perform to their best despite them.
7.2.3.6 Summary of comments made by Cluster 2.

The majority of this group reported that they worry about tests and examinations. There is a range in how strongly these feelings were expressed; some suggested they experience high levels of anxiety that occur well in advance of the examination, while others described lower levels of short-lived worry. For some their concerns appear to be related to the importance of the examination and the long-term consequences of failure, others suggested their confidence in the subject plays a role in their anxiety. Preparation was again mentioned as a response to the anxiety experienced by a number of these participants, though no common theme emerged from the analysis.

Most of the participants in cluster two found the TSST process to be a source of concern; they considered the interview panel rude, unhelpful, and intimidating. It was apparent that this added to the difficulty of the situation. A majority also felt that the interview panel were judging their performance; those who expressed their feelings about this reported that they were concerned and worried that these judgments were negative. For some of these participants, the desire to make a good impression on the interview panel was a source of anxiety, especially when it became clear that this was not what was occurring. Others reported they were worried as they believed they should have been able to do the task regardless of its obvious complexity and challenge. These participants were able to identify a number of similarities between the feelings they experienced during the TSST procedure and those they experience in an examination.

The majority of these participants reported they were distracted by their worries during the TSST process and made comments that referred to going blank or the equivalent. A smaller number of these individuals commented that while they were concerned during the tasks, they believed they were still able to perform adequately on them.

Many of these participants reported feelings of worry and anxiety during the TSST process, alongside these general feelings, they also described a lack of control and an inability to cope with the demands of the tasks. There was a variety in the strength of language used to communicate these feelings.

The majority of these participants made comments that indicated their worries were distracting them from the tasks they were asked to complete during the TSST process. These concerns were centred around making mistakes and the demands of the tasks. For some, though not all, the language used indicated that they believed their
feelings of distraction could have been impacting on their task performance or contributed to them “going blank”.

7.3 Cluster 3 - Small Attentional Bias away from threat (30 participants)

7.3.1 Summary of Cluster 3 characteristics

This group of participants were identified as distinct from others by a 5-solution cluster analysis, clustered on the worry component of trait anxiety (\(M = 15.10, SD = 4.13\)), attentional control (\(M = 46.37, SD = 5.43\)), and the attentional bias index (\(M = +10.58, SD = 7.35\)). They were comparable with all other participant clusters in terms of their trait test anxiety, but were significantly lower than cluster 1 in terms of their attentional control. Participants in this cluster displayed a small attentional bias away from threat (a positive bias), in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety, and the change in state anxiety this cluster was not significantly different to the other clusters.

Table 7.3. Summary of Quantitative Data for Cluster 3.

<table>
<thead>
<tr>
<th></th>
<th>(n)</th>
<th>(M)</th>
<th>(SD)</th>
<th>Normality</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
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<tr>
<td>Trait Anxiety (Worry)</td>
<td>30</td>
<td>15.10</td>
<td>4.130</td>
<td>.153</td>
<td>7</td>
<td>21</td>
<td>14</td>
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<tr>
<td>((M = 14.89, SD = 4.056))</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Attentional Control</td>
<td>30</td>
<td>46.37</td>
<td>5.423</td>
<td>.670</td>
<td>35</td>
<td>57</td>
<td>22</td>
</tr>
<tr>
<td>((M = 48.38, SD = 6.610))</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Attentional Bias Index</td>
<td>30</td>
<td>10.58</td>
<td>7.349</td>
<td>.316</td>
<td>-0.10</td>
<td>28.50</td>
<td>28.6</td>
</tr>
<tr>
<td>((M = -3.32, SD = 18.493))</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>pre-TSST State Anxiety</td>
<td>30</td>
<td>38.77</td>
<td>9.020</td>
<td>.558</td>
<td>23</td>
<td>59</td>
<td>36</td>
</tr>
<tr>
<td>((M = 36.27, SD = 9.544))</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>post-TSST State Anxiety</td>
<td>30</td>
<td>54.27</td>
<td>13.415</td>
<td>.793</td>
<td>32</td>
<td>73</td>
<td>41</td>
</tr>
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<tr>
<td>State Anxiety (pre- to post-TSST)</td>
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<td>15.50</td>
<td>9.062</td>
<td>.516</td>
<td>-7</td>
<td>31</td>
<td>38</td>
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<tr>
<td>((M = 14.52, SD = 10.061))</td>
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</table>

*Note.* Sample means are shown in column 1 for comparison.

7.3.2 Author’s impressions of Cluster 3 participants during the TSST tasks.

The following is a summary of the author’s field notes. These were made at the time the participants were undertaking the TSST protocol.
This was a large group of participants \((n = 30)\) representing over one third of the sample population of the study. As such, there was a range of behaviours and attitudes observed during the TSST process. A number of these participants appeared calm and confident on their arrival at the experiment room; while others appeared more apprehensive. The majority of these participants appeared to find the process challenging and stressful; however, the impression that they gave was of apprehension and mild concern rather than observable levels of intense anxiety. Generally, they were unable to complete the presentation task and spoke on the subject for less than five minutes; they dealt well with the interviewers’ questions and often appeared to use these as prompts. The mental maths appeared to be the task that most of the participants found to be more challenging and where increases in anxiety were most apparent to the observer.

Whilst many of these participants did not appear excessively worried by the process, this was clearly not the case for this entire group. Several appeared very nervous at the start of the process and these feelings seemed to intensify; a number of participants gave the impression that they were becoming distracted from that task. Examples of these concerns include participant 18, who asked for clarification of the consequences of not completing the task, several who spoke for less than 90 seconds and required questions from the interviewers to progress with the presentation, and those who were only able to complete the first calculation of the maths task before becoming stuck.

### 7.3.3 Directed content analysis, Cluster 3.

The participant interviews have been coded and analysed in accordance with the key areas of the model being investigated, namely, trait test anxiety, the modified-TSST, attentional control, state anxiety, and attentional bias.

#### 7.3.3.1 Trait test anxiety.

The majority of these participants (23 out of 30), reported that they worry about exams to some extent though there was variability in their strength of feeling. In response to the question “Do you worry about exams?” comments that indicated strong feelings of worry, include; “Ridiculously! That was a big thing for me to do (referring to the TSST procedure). I had a counsellor at school, I get really nervous. When I’m in there it’s ok it’s the feelings I get before it. Just have to keep revising and preparing.” (109) “A bit like how I responded to this; I’m fine leading up to them, not nervous at
all but when I’m in the situation I become overwhelmingly nervous.” (111) “I hate exams so much.” (Participant cries). (112) “From the get go of the term. It’s like I need to do this now I need to do this. Straight away, it’s always there.” and “When I was doing my GCSE’s it was the same. That little voice in your head saying, “you’re not going to do it”. (34) “I worry that something might go drastically wrong and then it’s the be all and end all.” (87) “I worry a lot, I’m panicking in the exam.” (43) These responses indicate that some of these participants are aware that they find examinations worrying and that this worry impacts on how they approach the examination process.

Others who reported worrying about exams, expressed their feelings less strongly. For example, “Yes, I suppose so. Not like worrying to the point I’m crying and overly stressed but I do feel a bit sick on the morning (of an exam).” (103) “Yes, I think I get worried I won’t be prepared for them. Before my GCSEs I was quite stressed I wouldn’t be prepared but sort of on the day I was calmer.” (13) “I do quite a bit before but I’m not really that nervous till I’m in the exam.” (34) “I always say, no I don’t mind. When I’m at home I always think I should be revising or something and it gets worse.” (77) “Possibly, I do get a bit nervous. I don’t think I perform badly in them.” (92) These responses are indicative of those that suggest these participants find exams concerning but that they do not believe it has a particular impact on them.

It is clear that while many of this group of participants recognise their worries surrounding the exam process there is a wide variation in both the strength of feelings and the time over which they are experienced. For some, these worries push them to prepare for the examination well in advance, for example “When I’m in there its ok it’s the feelings I get before it. Just have to keep revising and preparing.” (109) “I do loads of revision so I feel ready.” (104) “Depends on what it is and how much I’ve revised. I get nervous if I haven’t done enough.” (22) “I try to think the more I do the less I need to worry.” (44) “Yes, revision and prepare. If I’ve revised well I’m ok.” (78) For others, however, it appears that there is little they can do to alleviate their anxiety; “No, just the way it is. It’s always in the back of my head.” (78) “Just part of it, I’ve always been like that.” (96)

The relative importance of the examination appears to play a role for some of the participants in their anxiety, for example; “Less important exams didn’t bother me, I was in the frame of mind I can do this, but now...” (111) The level of preparation also seems to impact on anxiety levels for some; “Depends on what it is and how much I’ve revised. I get nervous if I haven’t done enough.” (22) “Yes, I think I get worried I won’t be prepared for them. Before my GCSEs I was quite stressed I wouldn’t be prepared but
sort of on the day I was calmer.” (13) “I react well generally when I know what I’m doing and if I’ve revised a lot and I’m prepared.” (26)

External pressures from the home or school context also contribute to the participants’ worries surrounding examinations, for example; “Oh yes. I know I had to do well. I was at a private school before and the idea that my parents are paying for my education, that pushed me to work harder. But I was stressed cos if I didn’t get the grades I’d be letting people down.” (14)

A small minority of this group (7 participants) reported that they do not get anxious about examinations, for example; “Not really, I’m really chilled out in exams.” (104) “For me, no. When I’m in an exam I just work.” (68) “I’m stressed when I’m revising but not when I go into the exam.” (79) For some this leads to a lack of preparation that they are able to recognise, “Depends on the subject I think, sometimes I’m confident but that may not always be a good thing cos I don’t revise as much as I should.” (47)

7.3.3.1.1 Summary of Cluster 3’s comments on trait test anxiety.

There is a wide variation in how this group of participants responded when they were describing their feelings about examinations; however, most suggested that the testing process is one they find causes them some level of concern and worry. It is clear that their anxiety manifests itself in a number of ways; for example, some are driven to prepare, while others adopt a more avoidant approach.

7.3.3.2 The modified-TSST.

Half of these participants made comments to the effect that the interview panel were rude or unhelpful. Examples include “I looked at them for confirmation and they weren’t giving it to me. They just had blank faces.” (100) “They showed no emotion so it made me feel a bit unsure if I was saying the right thing.” (47) “They weren’t helpful, really stern.” (90) Some went as far as to say they were scared or intimidated; “Really intimidated, the expressions on their faces just didn’t change. Not encouraging at all.” (107) “I was more stressed then because I think it’s quite scary because they had straight faces. Not like when people are encouraging you and smiling,” (13) None of these participants made any reference to the interviewers as being helpful or supportive. The consensus appeared to be that their attitude was unhelpful and added to the challenge of the task.
Just over half of these participants (16 out of 30) reported feeling judged by the interview panel, with a smaller number explicitly expressing concerns about negative evaluations being made about them. “But I found the pressure of them looking at me and judging me nerve-wracking.” (100) “I think that’s what was making me nervous. The fact I was being judged on it and evaluated.” (111) “Yeah, I was scared of being negatively judged.” (34) “It’s just like the pressure when you’re in front of people you don’t want to mess up. It’s like they’ll remember it, I always have the mind-set that they’ll remember how I messed up.” (68) Others reported feeling judged but did not indicate if this was an experience that was perceived as either negative or positive. It is clear that the attitude of the interview panel, for some of the participants, triggered concerns about the judgments that were being made about them; however, this was not the case for everyone. While the panel’s attitude was not helpful, it was not always perceived as indicating negative judgement.

Five of these participants, commented to the effect that they felt it was important to make a good impression on the interview panel; “I suppose it the first impression; you don’t want it to be bad.” (13) “It’s just like the pressure when you’re in front of people you don’t want to mess up. It’s like they’ll remember it, I always have the mind-set that they’ll remember how I messed up.” (68) One was explicit that there was a pressure to live up to internal standards; “It’s more my own perception of myself. I don’t want to embarrass myself to what I perceive, so if I said something that didn’t make sense I’d find that embarrassing. But people may not notice. It’s my standards.” (22) For some of these participants it is clear they felt the desire to make a good impression and that this brought with it additional pressure; these feelings can be externally driven, where individuals believe that it is the kind of situation where one is expected to make a good impression, or internally driven by a desire to meet their own standards.

When asked how their feelings during the TSST process compared to an examination many of these participants (18 out of 30) indicated that it was similar in some way. Examples include, “I think when I was doing the speaking task I felt like I was doing an exam. I know what I’m trying to say, I just don’t know how to get it across. Trying to focus, being able to express it in a condensed way.” (101) “Yeah, the nerves that I get before an exam were the same.” (107) “Yes, exactly the same. The pressure, stress, the time, I hate exams so much.” (112) “Yes, cos when you don’t have enough to say it’s the same as not having enough to write in an exam. I just have to waffle.” (46) “The pressure of proving yourself and being judged is like an exam.” (77)
However, others who indicated the TSST provoked similar feelings to an exam articulated how the process also differed. “Well, yes. I find I’d rather do exams with writing, they’re less stressful than interviews as it’s face to face. But exams mean a lot more.” (100) “Kind of, I think it’s a bit different cos with the presentation I could maybe compare that to an English exam when you’re writing and you have to keep a flow of ideas but it’s different to Science when you have a question and answer.” (13) “Yeah, slightly but I feel more at ease in an exam, more pressure here.” (44). These responses indicated that despite the participants recognising that exams are more important, the TSST scenario added to the pressure they felt when attempting to complete the presentation and mental maths tasks. A small number of these participants (4 out of 30) reported that they did not feel the TSST process was representative of an examination. For example, “I don’t know, I don’t feel as pressured in exams. It the people watching me that bothered me.” (103) “That was different. With an exam you know what’s going to be on it but the topics are so broad that you’re not always sure what that is.” (14)

It is clear that for the majority of these participants, the TSST elicited feelings similar to those experienced in an examination situation. Where differences were reported between the two situations, it appears that the feelings generated were similar in nature to an examination, but more intense during the TSST due to the presence of the interviewers and the immediacy of their judgment.

7.3.3.2.1 Summary of Cluster 3’s comments on the modified-TSST.

As could be expected with the number of participants in this cluster, there was a range of responses provided. However, there was a general consensus that the TSST process was challenging, with the attitude of the interview panel seen as adding to this. Many of these participants felt they were being judged, though only a small number made it clear that they felt these were negative judgements. Some commented they had standards they were required to meet; either to make a good impression on the interviewers, or to live up to their own expectations. Just over half of these participants felt the TSST process elicited similar feelings to an examination; a small number of those who expressed an alternative view felt that it generated more intense feelings and worries.
7.3.3.3 Attentional control.

Almost one third of these participants (9 out of 30) refer to “going blank” at some point during the TSST process. “I think so, there was a bit in the middle of the presentation where I went blank. I knew I had to talk about something but I didn’t know what, that made me stop talking.” (111) “I got a mental block; just couldn’t think.” (60) “I was too worried and I thought that cos I didn’t know what to say in the first one as well, my mind just went blank.” (95) Others, while not describing “going blank”, make comments that indicate maintaining concentration was challenging. “Kind of hard when you’ve two people there and you’re trying to work out something, your mind just goes all over the place.” (31) “I get really nervous and weird things pop into my mind that are nothing to do with it.” (43) “It was hard to think, I repeated myself a lot and to think of what I’d written down and to try and remember that.” (73) These comments indicated that a number of the participants in this cluster were struggling to maintain their attention fully on the task, it would appear that their worries and the pressure of the situation were contributing to this.

When asked directly if they were able to focus, the responses from these participants were mixed. Several participants reported that they were able to focus on the task despite recognising that the process was stressful. “I was fine, I know this isn’t going to affect my career and I’m the kind of person who can speak about things.” (14) “Yes, I had a bit to say but the time was bothering me.” (103) “I wasn’t feeling too bad, just thinking how am I going to fill the five minutes up.” (34) “I could focus but it was distracting.” (78) However, others described how their worries were preventing them from focussing fully on the task. “I had a bit to say but the time was bothering me.” (109) “I was thinking about what I could say but I was panicked that I only had three minutes; I kept looking at the clock.” (44) “I was thinking how hot I was and that I wouldn’t be able to last for five minutes.” (22)

7.3.3.3.1 Summary of Cluster 3’s comments on attentional control.

There is an obvious variability within this cluster regarding how the participants felt the stresses and anxieties associated with the tasks impacted on their attention and their ability to concentrate and focus for the duration of the TSST process. Some found it particularly difficult to maintain the attention and report “going blank”, while others were recognised that their worries were not causing them undue problems with the tasks.
7.3.3.4 State anxiety.

The majority of this cluster of participants (22 out of 30) reported feeling nervous or worried during the TSST process. Indicative comments included “Sick, mad, nervous.” (109) “Nervous cos they just sat there watching me. I felt complete open and exposed. I could feel myself babbling on then I panicked.” (14) “Really nervous, I could feel the people staring at me, it was really awkward.” (22) Some also mentioned the physical symptoms associated with anxiety “Really nervous, I could feel myself going red.” (111) “Very nervous, I could feel my heart beating really fast.” (112)

A majority (18 out of 30) made comments that indicated the felt a lack of control during the TSST procedure. These comments included “I didn’t feel I could stop and say I was finished.” (109) “There were quite a few moments when I had nothing else to say but I knew I had to speak for five minutes.” (13) “I was more worried that I wasn’t going to fill the five minutes, I didn’t mind the information I was putting down cos I know what I’m going to do in the future.” (18) “I didn’t think I would have enough to talk about, I couldn’t think of that many things. I felt out of control” (26) Additionally, some of these participants reported an inability cope with the tasks as exemplified by the following comments; “I’m not really sure what I want to do yet so I didn’t know what to include.” (46) “I didn’t know what to say. I know what I want to do but didn’t have loads of reasons.” (107) “I didn’t really know what I was going to talk about cos I’ve got no idea what I want to do after college.” (104) “I wasn’t expecting it to be that hard I think it was the odd number.” (111) These feelings appear to be due to both the novel nature of the task itself and the topic of the presentation being one that the participants felt they were not able to answer suitably at that point.

More specific comments related to confusion, “A lot more difficult than I thought, I got myself confused.” (26) “I couldn’t get it right, kept getting confused.” (78); frustration, “I think the hard part was having to start again, very frustrating.” (101) and embarrassment, “Stupid, no maybe just a bit silly, embarrassed.” (107) “At first I didn’t panic cos I thought everyone makes mistakes, but when I kept making the same mistake I just felt embarrassed.” (87)

7.3.3.4.1 Summary of Cluster 3’s comments on state anxiety.

To summarise, many of these participants reported increased levels of anxiety during the TSST procedure, with the challenging nature of the tasks and the attitude of the interviewers contributing to this. As well as general feelings of worry and anxiety, the participants also reported that feelings relating to a lack of control or being unable to
cope were also contributing to their concerns. Feelings of confusion, frustration, and embarrassment were also shown to be contributing to the negative experiences that participants described during the TSST. While it seems clear that many of the participants in this cluster experienced an increased level of anxiety during the TSST process, there was a variability in how individuals were affected.

7.3.3.5 Attentional bias.

Most of these participants (27 out of 30) reported that their worries were distracting them from the tasks to a greater or lesser extent; “Yes, cos I was trying to think what number it was. Nerves always get in the way, I just start thinking about what I’ve done wrong and I can’t think of the right thing.” (109) “There was a bit in the middle of the presentation where I went blank. I knew I had to talk about something but I didn’t know what, that made me stop talking.” (111) “I was scared, I felt like I couldn’t do it, I didn’t know what to do in my head. It’s like you’ve got a little devil on your shoulder.” (34) “Yeah they were distracting and getting in the way. I get really nervous and weird things pop into my mind that are nothing to do with it.” (43) “Yeah, like a voice saying, you’re not going to do this, there’s no point.” (34) The above comments show that for some participants their worries were clearly a distraction; however, others seemed less concerned by their worries and anxieties: “I could just get on with it.” (104) “No, I was able to put them to one side, they didn’t bother me.” (18) “Not that much, I looked at the back of the room.” (46) “I was a bit distracted but it was ok.” (73). The responses from this cluster of participants in this area were variable; while many commented that they were aware of their worries, few reported these feelings strongly.

For some of the participants, specific concerns that they were making mistakes appeared to be a distraction: “Nerves always get in the way, I just start thinking about what I’ve done wrong and I can’t think of the right thing.” (109) “I thought oh my god I’ve got to start again, kind of made me feel even more nervous, I have to repeat myself.” (31) “I lost focus and felt like I wasn’t doing it right.” (22) “The moment I hear error my head just goes and gets annoyed.” (68) “At first I didn't panic cos I thought everyone makes mistakes, but when I kept making the same mistake I just thought, I felt embarrassed.” (87) Rather than concerns due to the pressure of the process and judgement of others, these distractions appeared to be due to the fact that the participants were either unsure what mistake they had made or that they were then
required to start again at the beginning of the task and repeat what they had already done.

For some of these participants the very nature of the tasks appeared to be distracting them from performing at their best. “I was thinking about the task. I’m not very confident with presentations so I stutter a lot. It was getting in the way a bit.” (111) “I was distracted. Yes, the time limit and not being able to fill it.” (26) “Cos I knew I’d have to a maths challenge at the end of it I was working myself up about it.” (87)

7.3.3.5.1 Summary of Cluster 3’s comments on attentional bias.

In summary, the responses of the participants in this cluster suggested that, for some of them at least, their concerns about success on the tasks, making mistakes, and the nature of the tasks themselves were playing on their minds and may have been causing a level of distraction. What is unclear is whether they felt these distractions were having an impact on task performance or if they were able to cope with them alongside completing the tasks.

7.3.3.6 Summary of comments made by Cluster 3.

This is a large cluster of participants, representing over one third of the total population of the study; hence, it is not surprising that they demonstrated a range of diverse responses to the areas discussed in the post-TSST interview. The majority of this cluster reported that they worry about tests and examinations, though their responses show variability. Some displayed strong feelings that would appear to have an impact upon them, both in advance of, and during the examinations. Others were able to explain that upcoming examinations make them nervous, but that they do not believe these worries have an impact upon them. It does appear that for some, the relative importance of the examination and its consequences have a role to play in their levels of anxiety; high-stakes tests elicit greater anxiety. Their response anxiety is also variable; some believe it causes them to revise and prepare in advance, while others do not identify there is anything they can do to alleviate their worries and they simply have to, as they put it “live with it”. For some the anxiety they experience is clearly due to external pressures, such as the context of the school or not wanting to let their parents or teachers down. There is also a sizeable number of these participants who reported that examinations do not make them anxious in any way, nor do they believe that their worries or concerns impact upon their performance.
Generally, these participants found the TSST procedure to be challenging and a source of differing levels of anxiety; the rude and unhelpful attitude of the interviewers was frequently cited as a reason for this. Many felt the interview panel were judging them, though only a small number were explicit that they were concerned by the negative nature of these judgements. There were a small number who were concerned about making a good impression on the interview panel; however, it is unclear if this was to meet their own internal standards, or due to a belief that it is what is expected in this type of situation.

When questioned about their ability to maintain their attention during the TSST process, a minority of this group made comments to the effect that they “went blank”, others reported that concentration was a challenge. In contrast to this, there were also a number of participants who recognised that the process was stressful and challenging but that they were able to remain focussed. There is no common theme that appears to be running through this cohort when describing their ability to maintain attention when under pressure.

The majority of these participants reported increased levels of state anxiety during the TSST process; this was coupled with negative emotions associated with a lack of control and an inability to cope with the situation. Additional comments made reference to feelings of confusion and frustration. Though it is clear the process was difficult for many of these participants, the language used does not give the impression that for the majority of them the anxieties they were experiencing were particularly extreme or causing them concern.

Where participants in this cluster described being distracted from the tasks during the TSST process they did not use language that indicates they felt this was especially problematical. Specific distractions included the mistakes that they were aware they were making and if they fully understood what was required in the tasks.

**Group 7.4 Cluster 4 - Large Attentional Bias away from threat (2 participants)**

**7.4.1 Summary of Cluster 4 characteristics.**

This cluster of two participants (nos. 6 and 69) were identified by a cluster analysis as distinct from other participants. They were clustered on the worry component of trait anxiety \( (M = 17.50, SD = 0.71) \), attentional control \( (M = 39.50, SD = 6.36) \), and the attentional bias index \( (M = +50.43, SD = 7.83) \). They were comparable with all other participants in terms of the worry component of trait test anxiety, but reported significantly lower levels of attentional control than clusters 1 and 5.
Participants in this cluster displayed a large attentional bias away from threat, in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety, and the change in state anxiety this cluster were not significantly different to the other clusters.

Table 7.4. Summary of Quantitative Data for Cluster 4.

<table>
<thead>
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<tr>
<td>Attentional Control ($M = 48.38, SD = 6.610$)</td>
<td>2</td>
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<tr>
<td>Attentional Bias Index ($M = -3.32, SD = 18.493$)</td>
<td>2</td>
</tr>
<tr>
<td>pre-TSST State Anxiety ($M = 36.27, SD = 9.544$)</td>
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</tr>
<tr>
<td>post-TSST State Anxiety ($M = 52.14, SD = 11.108$)</td>
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</tr>
<tr>
<td>State Anxiety (pre-to post-TSST) ($M = 14.52, SD = 10.061$)</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note.* Sample means are shown in column 1 for comparison.

### 7.4.2 Author’s impressions of Cluster 4 participants during the TSST tasks.

The following is a summary of the author’s field notes. These were made at the time the participants were undertaking the TSST protocol.

Participant 6 - This participant appeared calm and relaxed during the task briefing. Despite being unsure about her career and university pathway, she spoke confidently about her possible options; however, she only spoke for approximately 90 seconds before running out of things to say. This participant dealt well with prompts from the interview panel to continue and explained calmly that she was unable to add anything else. She dealt well with the maths task and did not appear flustered when she made mistakes; she reported feeling more stressed after the procedure than she had before.

Participant 69 - This participant appeared calm and confident during both the briefing and that task itself. She spoke fluently during the presentation and was able to explain her decision-making process clearly. Despite making mistakes she coped well
with the maths task and did not appear frustrated when having to return to the start and begin again. This participant reported feeling the same after the process as she had at the start.

7.4.3 Directed content analysis, Cluster 4.

The participant interviews have been coded and analysed in accordance with the key areas of the model being investigated, namely, trait test anxiety, the modified-TSST, attentional control, state anxiety, and attentional bias.

7.4.3.1 Trait test anxiety.

Participant 6 reported worrying about exams as they approach, “Yes, when it gets near them. Not months in advance.” While Participant 69 commented “I don’t usually until the day of the exam and then I start worrying a bit.” Neither reported that they have specific strategies to deal with this, illustrated by “I just live with it.” (69) These participants made no comments regarding how these worries impact on their behaviour, nor how they manifest themselves physically.

7.4.3.1.1 Summary of Cluster 4’s comments on trait test anxiety.

In summary, it was not clear that participants 6 and 69 struggle particularly with anxiety associated with examinations. The worries they reported appear to be relatively short-lived and seem to have little or no impact upon their behaviour before or during examinations.

7.4.3.2 The modified-TSST.

Participant 6 reported feeling pressured by the interview panel “Cos they were looking at me” and “Straight-faced, not encouraging, just sat there negative.” They also commented “… really nervous, they were scary.” In contrast, participant 69 reported no additional pressure due to the interviewers, describing them as “Pretty friendly.” In this cluster, the perceived attitude of the interview panel was varied with the two participants offering contrasting views.

In response to the question “Did you feel judged?”, participant 6 responded affirmatively; “Yes” “I wasn’t sure if I was saying the correct thing.” Participant 69 was less sure, simply replying “Maybe”. While participant 6 was clear that she was being judged, it did not come across that she was especially worried by the negative nature of this judgement; rather she wanted to be sure she was doing what was required
of her. Participant 69’s comment, especially with no follow-up, would indicate she was unconcerned by the prospect of being judged by the interview panel.

These participants did not refer to any feeling of external pressure due to wanting to make a good impression on the interview panel, nor concerns that they felt they would fail the task before they started it.

When asked how representative the TSST procedure was of an examination the participants responded “Yes cos you feel pressure and you want to make sure what you’re writing is actually, like, what you’re supposed to.” (6) and “Yes, because I forgot everything when I got up there. That’s what happens when I get in exams, I just forget everything.” (69) These responses suggest that for both of these participants the TSST procedure uncovered similar concerns to those occurring in examination situations.

### 7.4.3.2.1 Summary of Cluster 4’s comments on the modified-TSST.

To summarise, these participants reported views of the TSST process that contrast with each other. Participant 6 found the attitude of interviewers added to the difficulty of the task and expressed concern about the judgements they made. Participant 69 did not seem concerned either by the attitude of the interviewers nor the prospect she was being judged.

### 7.4.3.3 Attentional control.

When discussing their ability to maintain their attention on the task neither of these participants directly mentioned “going blank”. However, Participant 69 does report that during the presentation “I forgot everything when I got up there.” There were no other references to problems with concentration or confusion, other than participant 69 stating, “That’s what happens when I get in exams, I just forget everything.” Both participants demonstrated an ability to focus on the task; for example, “I was thinking about what I was going to say and how I was going to say so much in five minutes.” (6) They made no comments that they were aware that the anxieties they were feeling were having an impact on their ability to perform on the tasks.

### 7.4.3.3.1 Summary of Cluster 4’s comments on attentional control.

From the limited responses in this area, it is unclear whether these participants could maintain their attention on the tasks or if they found this difficult. Where a lack of attention was mentioned by participant number 69, it was not clear if this was due to
the anxiety she was experiencing. These responses, especially in the context of how other participants responded, could indicate that these participants did not perceive that their worries or anxieties were particularly intrusive.

7.4.3.4 State anxiety.
Both participants reported feeling nervous during the TSST process “Really nervous, they were scary.” (6) and “Kind of nervous (during the presentation), I felt like I had forgotten everything.” (69) Participant 6 also reported feeling pressured about how they would fit everything into the time; “I was thinking about what I was going to say and how I was going to say so much in five minutes.” Additionally, Participant 69 reported, when they made mistakes on the maths task, feeling “… a bit annoyed at myself I guess.” Participant 6 commented “It was quite frustrating having to go back to the start and do it all again, then you got, at start I was really trying to get it right then when you had to keep starting again you sort of lost interest.” It is not clear if this frustration was adding to the anxiety of the process or if it was simply causing them to lose interest in the tasks.

7.4.3.4.1 Summary of Cluster 4’s comments on state anxiety.
In summary, these participants did not find the TSST an enjoyable experience. While it was clearly challenging and frustrating, it was unclear if it was causing them increased levels of anxiety. It did not appear that the potentially negative judgements of the interview panel were perceived as having an impact on them or their performance on the task.

7.4.3.5 Attentional bias.
These participants briefly described how their worries and anxieties impacted upon them during the task; “Yes, they distract me and the way I do it. They get in the way.” (6) “Yes, because I forgot everything when I got up there.” (69) Participant 6 also refers to the negative attitude of the interview panel, describing them as “scary”. They made no reference to other factors such as the judgment of others or the consequences of failure as distracting them from the tasks; however, participant 6 suggested that she was distracted when she began the dot-probe task; “I was still thinking about it (the TSST procedure). Kind of thinking about what I’d said.” Importantly, these participants did not appear concerned about the impact of any distractions on their performance on
the tasks. Only participant 69 reported noticing the words used in the dot-probe task and that she was looking for exam-based words from that point on.

7.4.3.5.1 Summary of Cluster 4’s comments on attentional bias.

It is noticeable that these participants did not employ powerful descriptions when discussing how their anxieties were distracting them. They could recognise they were worried but did not appear to be consumed by these worries. There is nothing to suggest there was a cycle of worry that they felt unable to disengage from.

7.4.3.6 Summary of comments made by Cluster 4.

This cluster of participants displayed the highest levels of bias away from threat. They offered differing views on whether the TSST procedure was unpleasant and if it caused them heightened levels of anxiety. It was unclear if participants 6 and 69 normally struggle with anxiety associated with tests and examinations; concerns that were mentioned arise shortly before the examination and were not communicated in a way that suggested they have an impact on the participants’ behaviour. These participants made few comments that related to how they maintained their attention during the TSST; hence, it is difficult to make clear inferences. However, one interpretation of their lack of references to this, is that they did not believe that their worries or anxieties were intruding upon them during the TSST process. Participants nos. 6 and 69 found the TSST procedure challenging and frustrating; however, it was unclear if it was causing them increased levels of anxiety. The judgements the interview panel were making did not appear to be having an impact upon them. When describing how their anxieties may have been distracting them from the tasks, they did not communicate that they felt that this was impacting on their performance; it was not clear if the worries they may have had during the TSST procedure were distracting them.

7.5 Cluster 5 - Large Bias Towards Threat (3 participants)

7.5.1 Summary of Cluster 5 characteristics.

This cluster of three participants were identified by a cluster analysis as distinct from other participants. They were clustered on the worry component of trait anxiety ($M = 15.33, SD = 3.06$), attentional control ($M = 54.00, SD = 8.89$), and the attentional bias index ($M = -50.86, SD = 12.50$). They were comparable with all other participants in terms of the worry component of trait test anxiety, but reported significantly higher
levels of attentional control than cluster 4. Participants in this cluster displayed a large attentional bias towards threat (i.e. a negative ABI), in this aspect they were significantly different to all other clusters. In terms of pre-TSST state anxiety, post-TSST state anxiety, and the change in state anxiety this cluster were not significantly different to the other clusters.

Table 7.5. Summary of Quantitative Data for Cluster 5.

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<th></th>
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Note. Sample means are shown in column 1 for comparison.

7.5.2 Author’s impressions of Cluster 5 participants during the TSST tasks.

The following is a summary of the author’s field notes. These were made at the time the participants were undertaking the TSST protocol.

Participant 16 - This participant appeared slightly flustered from the start of the process. However, she spoke confidently and passionately on a topic that was driven by her own experiences. After she ran out of things to say, she dealt well with questions from the interview panel despite appearing to be very nervous. She found the maths task especially challenging and was only able to do the first calculation before she kept making the same mistake. The participant asked to end the task early and was instructed to carry on. At the second time of asking this request was complied with as it was clear that she could otherwise become unnecessarily distressed. The participant reported feeling far more nervous than at the start of the process and said, “I feel like a retard.” To ensure the participant returned to a calm state she remained with the
experimenter for a period of time while the nature of the process was explained in
detail. After this she went back to her lesson with a teacher who was familiar with what
had gone on.

Participant 20 - This participant came across as confident during the briefing and
at times during the task itself. She seemed relieved when the topic for the presentation
was explained to her. She coped well with the presentation task and spoke for over four
minutes. During the maths task she performed fluently and reached 1651, at this point
she made a mistake. There was a noticeable change in her composure from then on; she
made multiple mistakes and struggled with the task, unable to regain her previous
fluidity. She reported feeling much less relaxed than at the start of the process.

Participant 33 - This participant appeared cheerful on arrival; however, as the
task was explained she appeared to become increasingly daunted by it and seemed
nervous. She made a confident start to the presentation but once she ran out of things to
say she struggled for the remainder of the time. Again, she made a good start to the
maths task but quickly started to make mistakes and simply stopped. Her first comment
at the end of the process was “I did not like that!” She reported feeling much more
nervous than she had done at the start.

7.5.3 Directed content analysis - Cluster 5.
The participant interviews have been coded and analysed in accordance with the
key areas of the model being investigated, namely, trait test anxiety, the modified-
TSST, attentional control, state anxiety, and attentional bias.

7.5.3.1 Trait test anxiety.
All three participants reported worrying about examinations, comments
included; “Yes, loads. (How long before?) The start of the course! Especially in this
school cos it’s a top school.’ (16) “I think I don’t want to let down my parents so yes I
do worry.” (20) and “I do worry and get horrible feelings in my stomach.” (33). The
duration of these feelings vary from many months before the exam, “from the start of
the course” (16) and “I’m worried already” (20) (in December discussing an exam in
May), to a shorter-lived anxiety “About a week before, it’s not months and months.”
(33) They do not feel that they can do anything to alter this pattern of anxiety but
reported that it does drive them to work and prepare for their exams, e.g. “(How do you
cope with that?) Work as hard as I can!” (20) However, it is not clear that this strategy
is particularly helpful, “‘(How do you cope with that?) Revise loads, prepare. But the more I revise the more stressed I get.” (16).

7.5.3.1.1 *Summary of Cluster 5’s comments on trait test anxiety.*
In summary, these participants were clearly aware of their anxiety towards examinations and tests and could recognise how far in advance of an exam these feelings impact upon them. A common strategy of dealing with these worries is to prepare and revise for the examinations, though it is not clear how beneficial this is; it may in fact be counterproductive.

7.5.3.2 *The modified-TSST.*
The interview panel were obviously seen as unhelpful to these participants and did not offer the guidance that was needed. Comments included, “They just added to the anxiety of it.” (16), “…when I didn’t know what to say and they said I still had time left.” (20), “(They were) silent. Makes it worse.” (33). This unhelpful attitude added to the challenge of the tasks and made the participants feel under greater pressure than if they had been offered support and encouragement.

Participants 16, 20 and 33 all thought the interview panel were judging their performances. Responses to the question “Did you feel judged?” included; “Yes, they were constantly looking at me and when I got the numbers wrong I thought they must think I was stupid.” and “Patronising and they didn’t even smile.” (16) “Small. Because they were just staring at me, judging me. Makes it worse.” (33). It is clear that the participants believed these judgements to be negative and that they were upset by them. One participant went as far as to describe feeling intimidated; “Intimidated cos they (the interview panel) were always looking at you” (20). This is a very powerful word and is indicative of the strong feelings they were experiencing.

This group did not refer to any feelings of external pressure due to wanting to make a good impression on the interview panel; though this could possibly be inferred from their concerns about being negatively judged. Participant 16 commented “(I felt) Really anxious cos I didn’t know what to say and I knew I was going to mess up, which I did.”, “I started it then I thought I’m not going to be able to do this.” and “I wanted to be good at it.” Participant 33 reported “I just didn’t know what I was going to say and I was scared that I was going to go up there and just run out of words.” These comments suggest that these participants were experiencing a pressure to perform that appears to
be internally driven by their own set of standards and expectations, for example, “I want to be good at it.” (16)

There was a mixed response from these participants when asked how representative their feelings during the TSST procedure were of an examination or test situation. “Yes (similar to an exam), but 20 times more.” (16), “Yes, definitely. When you’re in exams you look at a question and you know you know it but you can’t remember it and get distracted about why don’t I know this?” (20) “When I’m doing an exam its different because they’re on a piece of paper and like they’re, what do you call them, the person that marks your paper is not going to see you so I don’t think it’s as bad. But they’re also more important so that adds to the anxiety.” (33) While the TSST procedure was seen as a suitable proxy for an examination situation, the presence of the interview panel and the proximity of their judgements were seen as intensifying the process in comparison to an exam paper being marked by an unknown other. However, there was an inference by participant 33 that the importance of formal examinations, presumably due to the consequences of failure, may have a different impact on anxiety.

7.5.3.2.1 Summary of Cluster 5’s comments on the modified-TSST.

In summary, the TSST procedure made these participants feel anxious and under pressure to perform. The presence and attitude of the interview panel was seen as a hindrance to successfully completing the tasks and made the participants feel negatively judged, this compounded the difficulty of the situation. Comments indicated that the TSST procedure was able to elicit similar feelings to an examination situation; however, it would appear that these feelings were more intense in nature.

7.5.3.3 Attentional control.

When talking about their ability to maintain their attention, on several occasions the participants in this cluster referred to “going blank”. For example; “…that made me nervous and forget what to say, go blank.” (20) and “At first my mind just went blank and I had no idea what to write” (33). While participant 16 does not directly mention “going blank”, she describes confusion due to not knowing how to approach the task.

When discussing their ability to concentrate on the task during the TSST procedure the following comments stood out; “When I got nervous I couldn’t do it” and “I thought, I’m not going to be able to do this, like a cycle.” (16) This suggests the participant is aware that their anxieties are impacting upon their performance. Participant 20 reports “I kept messing up once I’d made a mistake”, while 33
commented, “I was frustrated cos I had to start again.” These comments indicate that the prospect of making mistakes and having to start the tasks again is impacting on their ability to maintain attention throughout the task (as was the impression of the author while observing the participants).

When asked about their ability to focus on the task the participants indicated that they were finding it difficult, “It took me a minute to get under control.” (33) and “I thought I’m not going to be able to do this (16).

7.5.3.3.1 Summary of Cluster 5’s comments on attentional control.

To summarise, it is clear that these participants were finding it difficult to maintain their attention throughout the task and that they were aware of this difficulty. Comments suggested that this was in part due to the anxiety associated with the requirements of tasks and the participants’ concerns about making mistakes.

7.5.3.4 State anxiety.

All three participants in this cluster reported a range of negative emotions characterising increased state anxiety. Participant 16 said “It was fine at the start, then when I got nervous I couldn’t do it. Everything just went wrong.” They then reported feeling “Really anxious cos I didn’t know what to say and I knew I was going to mess up which I did.” Other comments include concerns about “getting it wrong”, being “embarrassed and awkward” that they “felt terrible”. They described the TSST experience saying, “It was awful!” Participant 20 recognised a change in their mood as the TSST procedure went on “At the start it was fine when I had stuff to talk about but then I felt a bit intimidated; that made me nervous and forget what to say, go blank.” And “(at first) fine but then I kept messing up once I’d made a mistake. I think the nerves built up and I got more distracted.” Participant 33 did not experience a time of calm and was anxious from the very start “At first my mind just went blank and I had no idea what to write but then I just felt really anxious and nervous.” And “I just didn’t know what I was going to say and I was scared that I was going to go up there and just run out of words.” They describe feeling “Out of control” and “small”.

As well as general feelings of anxiety there are also references to specific negative emotions, such as confusion and indecision “I didn’t know what to write, I was confused” (16) and “I had no idea what to write” (33), being embarrassed when giving the presentation (participant 33) and when “getting it all wrong” (16). As already
outlined, these participants were concerned that the interview panel was negatively judging them, this also added to their feelings of anxiety.

All these participants clearly exhibit heightened levels of anxiety due to the TSST procedure. Terms such as “terrible, awful and scared” were used to convey the strength of these emotions. Interestingly two of the participants (16 and 20) could articulate how their anxiety levels changed over time, recognising that they were relaxed at the start “It was fine at the start” (16), “Fine, I felt confident.” (20), but that this changed quite rapidly “when I got nervous I couldn’t do it.” (16) and “then I felt a bit intimidated; that made me nervous and forget what to say, go blank.” (20) Other than the references to feeling relaxed at the start, none of these participants mention experiencing any positive emotions during the TSST procedure.

7.5.3.4.1 Summary of Cluster 5’s comments on state anxiety.

In summary, these participants made frequent references to the anxieties they were experiencing during the TSST process. Along with general comments about feeling nervous, they also referred specifically to feelings of embarrassment and a lack of control. There were no references to the TSST process that could be considered to indicate they found it a positive process.

7.5.3.5 Attentional bias.

These participants consistently described how their worries and anxieties during the TSST procedure were distracting them from the task; this supports evidence from the quantitative results, which show them to be strongly biased towards threat words across all ABDP trials. Comments included, “Yes, my worries were distracting me”, “Nerves totally got in the way” (16). “I felt intimidated, that made me nervous and I went blank”, “… that made me nervous, I forgot what to say, went blank” (20). “I was focussing on my worries more than the task”, “It (worry) gets in the way cos it’s in your head” (33).

As well as their anxieties distracting the participants from the tasks, their attention was drawn to the interview panel and the negative attitude they were displaying; “Their faces, just staring at me distracted me” (20), “They were really patronising and they didn’t even smile. They just added to the anxiety of it.” (16)

Importantly, these participants were aware of the distractions they were experiencing but were unable to do anything about them. “I thought I’m not going to be able to do this. It’s like a cycle” (16). “I kept messing up once I’d made a mistake.
Nerves built up and I got more distracted.” (20) “In exams you know it but you can’t remember (the answer) and get distracted by not knowing.” (20) “My mind just went blank and I had no idea what to write.” (33) Once these participants were distracted from the task, despite being aware of this, it appears they were unable to bring their attention back to it.

It is unclear if the words used in the ABDP were themselves capturing the participants’ attention. “Lots of exam words, negative ones.” (16) “I was aware of them (the exam-threat words)” (20) “I just recognised the words, I don’t think I looked for any.”

7.5.3.5.1 Summary of Cluster 5’s comments on attentional bias.

To summarise, these participants were clearly anxious during the TSST procedure and were aware of this anxiety. They could verbalise how these anxieties intruded on their attention and reduced their ability to perform the tasks as required. Despite this awareness none of these participants were able to re-focus their attention on the tasks, this in turn led to greater anxiety and they become trapped in a cycle that continued until the process was completed.

7.5.3.6 Summary of comments made by Cluster 5.

This group of participants displayed the highest levels of bias towards threat. They reported finding the TSST procedure extremely unpleasant and that it caused them heightened levels of anxiety, leading to them being distracted from the tasks. They reported negative feelings due to the interview panel and the attitude they adopted during the TSST procedure.

These participants all recognised that they suffer from anxiety when confronted with examinations and tests. They do not have strategies to effectively deal with this anxiety; however, they believe that thorough preparation may help them to achieve in examinations despite their anxieties. All three found the TSST procedure difficult and were challenged by a number of factors; the attitude of the interview panel was seen as particularly unhelpful and these participants would have benefitted from greater support and encouragement. The negative judgements that they believed were being made about them were concerning them; it also came across that it was important to them to conform to their own expectations of how they should perform on the tasks. These participants described difficulties with maintaining their attention throughout the task; there were indications that this was due to anxiety arising from the nature of the tasks.
themselves. All these participants could discuss how the TSST procedure led to heightened levels of state anxiety; the language they used to express this indicated very strong feelings. These participants began the process appearing calm; however, they were all in a state of high anxiety by the time the TSST was complete and made no reference to feeling positive at any time during the process. As well as recognising that they were anxious, these participants could clearly describe they were aware that their anxieties were capturing their attention and making it difficult to remain focussed on the tasks they were attempting to complete. They were unable to disengage from their worries and return their attention to the tasks; this had the impact of leading to greater anxiety as they realised the tasks were becoming increasingly challenging and that they were unable to concentrate on them fully.
Chapter 8 Discussion

8.1 Introduction and Aims

The overarching aim of this study was to investigate test anxiety and its underlying variables within an adolescent population in a school/college context. Of specific interest was the investigation of the presence of attentional bias and its relationship to state anxiety in test anxious individuals. Additionally, the influence of trait test anxiety and attentional control on attentional bias was explored alongside the relationships in the proposed model of impaired performance in test anxious students (see Figure 8.1 below). This introduction (section 8.1) restates the aims of the study and the research questions. Following this, the remainder of the Discussion chapter is divided into six further sections; section 8.2 will answer the research questions and discuss the findings; section 8.3 is concerned with the limitations of the study. Section 8.4 will discuss the implications for test anxiety theory, section 8.5 the implications for practice, and section 8.6 the implications for research. There is a brief conclusion to be found in section 8.7.

![Proposed test anxiety process model, adapted from Sarason (1972), Wine (1971) and Zeidner (1998).](image)

Conducting this research in school and college settings provided a far greater challenge than would have been posed if it had been carried out in a laboratory setting.
However, the intention was to inform future work that could potentially include the development of interventions designed to mitigate the negative impact of test anxiety on academic performance. As such interventions would take place in students’ schools and colleges, it was felt that a naturalistic study would provide data and findings with greater ecological validity than would be achieved in a laboratory or off-site situation.

The increased levels of state anxiety associated with the test anxiety construct are only present in individuals when performance evaluation is salient; hence, a proxy for an examination, capable of safely and reliably manipulating state anxiety was required which could be ethically and practically implemented in a school-based setting. To this end, the author modified the existing Trier Social Stress Test (TSST) to make the tasks and scenarios applicable to the 16-18-year-old population being studied and an educational context.

The aims of the study were:

1. To establish an ethically robust protocol for the study of test anxiety in a naturalistic setting.
2. To investigate the presence of attentional bias in highly state anxious adolescents while under performance evaluation.
3. To explore how any such attentional bias is influenced by trait test anxiety and attentional control in an adolescent population.
4. To explore the relationship of attentional control to trait test anxiety and state anxiety.
5. To investigate if evidence is provided to support and refine the proposed model of impaired performance in test anxious students presented in Figure 8.1 above.

To facilitate these aims the study was conducted in two phases, both of which employed a mixed methodology approach. The first phase, a preliminary study was concerned with trialling the modified-TSST protocols in a naturalistic setting and evaluating their impact on the state anxiety of participants (see chapter 4 for full details). This preliminary phase was also used to ensure the attentional bias dot-probe task (ABDP) and other quantitative instruments were suitable for use in the main study.

The second phase, referred to as the main study (see chapter 5), employed the modified TSST alongside the ABDP. Questionnaires were also used to collect data on participants’ levels of trait test anxiety, attentional control, and state anxiety. In both phases, participant interviews were conducted to provide qualitative data.
8.1.1 Research Questions.

The data collected during both phases of the study were analysed using a range of quantitative and qualitative techniques, allowing the author to address the following research questions (brackets indicate the phase in which relevant data were collected):

1) Can the modified TSST protocols be successfully implemented in a school-based setting with highly-test anxious adolescents (Preliminary study) and with adolescents heterogeneous in their levels of trait test anxiety (Main study)?

2) How do the modified TSST protocols impact on state anxiety in a highly test anxious population? (Preliminary study)
   a) Were there differences in self-reported trait test anxiety between the low- and high-PET conditions of the TSST?
   b) Were there differences in measured pre-TSST state anxiety between the low- and high-PET conditions of the TSST?
   c) How does measured state anxiety change during the high- and low-PET TSST procedures?

3) How does the high performance evaluation threat protocol of the TSST impact on state anxiety in population that is heterogeneous in terms of trait test anxiety? (Main study)
   a) How does measured state anxiety change during the TSST procedure?
   b) How does self-reported trait test anxiety interact with changes in state anxiety during the TSST process?
   c) How does self-reported attentional control interact with changes in state anxiety during the TSST process?
   d) How does self-reported trait test anxiety (worry) interact with changes in state anxiety during the TSST process?
   e) How does self-reported trait test anxiety (test irrelevant thinking) interact with changes in state anxiety during the TSST process?

4) What measurement evidence can be provided to support the hypothesised relationships (see Figure 2.2) between self-reported trait anxiety, attentional control,
state anxiety and attentional bias in 16-18-year-olds undertaking a high-stakes program of study? (Main study)

a) What is the relationship between self-reported trait test anxiety and attentional control?

b) What is the relationship between self-reported trait test anxiety and state anxiety (baseline, pre-TSST, post-TSST, change pre- to post-TSST)?

c) What is the relationship between self-reported attentional control and state anxiety (baseline, pre-TSST, and post-TSST, change pre- to post-TSST)?

d) What is the relationship between pre-TSST state anxiety and post-TSST state anxiety?

e) What is the relationship between pre-TSST state anxiety and the change in state anxiety?

f) What is the relationship between post-TSST state anxiety and the change in state anxiety?

g) What is the relationship between self-reported trait test anxiety and attentional bias?

h) What is the relationship between self-reported attentional control and attentional bias?

i) What is the relationship between state anxiety (baseline, pre-TSST, and post-TSST) and attentional bias?

j) What is the relationship between the change in state anxiety (pre- to post-TSST) and attentional bias?

5) What is the difference, if any, between participants’ response times to threat congruent and non-threat congruent trials measured by a dot-probe task (ABDP)\(^9\)? (Main study)

6) How do trait test anxiety, attentional control and state anxiety predict attentional bias in 16-18-year-old students undertaking a high-stakes program of study? (Main study)

a) How do measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

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\(^9\) ABDP - Attentional Bias Dot-Probe Task. See section 3.5.2.
b) How do measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

c) How do the worry component of measured trait test anxiety, attentional control and pre-TSST state anxiety predict attentional bias as measured by the ABDP?

d) How do the worry component of measured trait test anxiety, attentional control and post-TSST state anxiety predict attentional bias as measured by the ABDP?

7) What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)? (Main study)

a) How do the clusters differ from one another in terms of the worry component of trait test anxiety?

b) How do the clusters differ from one another in terms of self-reported attentional control?

c) How do the clusters differ from one another in terms of the calculated attentional bias index?

d) How do the clusters differ from one another in terms of pre-TSST state anxiety?

e) How do the clusters differ from one another in terms of post-TSST state anxiety?

f) How do the clusters differ from one another in terms of the change in state anxiety (pre- to post-TSST)?

8.2 Findings

8.2.1 Research Question 1 - Can the modified TSST protocols be successfully implemented in a school-based setting?

Protocols designed to safely and reliably manipulate state anxiety are required to facilitate test anxiety research in naturalistic settings. These must be rigorous enough to meet the demands of the research community, ethically appropriate to the context and study in which they are being used, and have no long-term impact on participants. To ensure the cooperation of teachers, the protocols must be considered safe for their students and have a benefit to their academic outcomes.

Both the preliminary and main phases of this study demonstrated it was ethically and practically feasible to implement the modified-TSST in educational settings. This was achieved by developing the protocols in collaboration with an experienced teacher, a practising educational psychologist and an academic specialising in educational
research. The diverse and wide-ranging experience of these individuals ensured this was sufficiently robust to meet the demands of this study, that the wellbeing of participants was carefully considered, and that the ambition of the study was aligned with what would be acceptable to teachers and schools. As such, the University of Manchester’s Research Ethics Committee identified the debriefing and distress protocols as exemplary and a model of good practice.

To ensure the practical feasibility of employing the modified-TSST in school-based research, it was vital that the author involved teachers in planning how the experimental sessions would be conducted and was amenable to their requirements in terms of the implementation and timing of experimental sessions. Additionally, by returning to the schools after the data collection was complete, the author was also able to provide both the teachers and students with an opportunity to reflect on the benefits of participating in the research, how it was relevant to their school curriculum, and how they had contributed positively to educational research and the advancement of practice.

A key ethical requirement of the protocol was that the anxiety experienced by the participants was short-lived, with no long-term impact on them; the theory under which the modified-TSST procedure was developed met this need (Dickerson & Kemeny, 2004; Kirschbaum et al., 1993). While long-term anxiety was not explicitly measured following the completion of the procedure, the author remained in contact with the teachers involved following the conclusion of the data collection and met the participants again when delivering the lessons on the research project. No concerns about the TSST protocol were raised by any of the teachers or students involved; informal conversations would suggest that both the nature of the TSST protocol and the thorough debriefing process were instrumental in this outcome.

It is concluded, with the relevant experience and sensitivity it is possible, to safely implement the modified-TSST in ecologically valid contexts such as schools and colleges; as in this study, this offers several advantages over a laboratory-based approach.

Securing the consent of teachers to involve their students is a vital part of all educational research; hence, engaging teachers from the start of the process informs them clearly of the requirements and ensures the appropriateness of interventions for implementation with their students. This reduces the need for modifications to be made later in the planning/development stage, which may be required if teachers are not approached until this point. The induction of anxiety is an area where sensitivity is required; teachers having an in-depth understanding of the intervention, combined with
prior knowledge of their students, leads to a more informed recruitment strategy. This reduces the likelihood of employing participants for whom the process may be overly distressing. While it would be difficult to quantify, conducting the modified-TSST in participants’ schools and colleges could lead to more reliable stress induction. The TSST protocols are a fictional construct; hence, employing them in a location which the participants already associate with examinations may bring with it a degree of realism that would be lacking in an unfamiliar environment.

On a practical level, conducting research in the participants’ schools improves the access to students and the efficiency of communication during the recruitment process. It also ensures a convenient location is available in which to conduct the research sessions, and that they occur at a time compatible with students’ timetables. This results in more efficient use of both participants’ and researchers’ time.

An eventual aim of test anxiety research is developing interventions to support test anxious individuals. These would be implemented with students in their schools and colleges, with teachers and other school staff ultimately gaining the skills to be actively involved in the process. In this regard, it would seem sensible that ecologically valid locations are where the majority of development and trials to evaluate such interventions would take place. Therefore, the modified-TSST is applicable to aspects of future work where the manipulation of state anxiety is required.

8.2.2 Research Question 2 - How do the modified-TSST protocols, low- and high-performance evaluation threat, impact on state anxiety in a highly test anxious population? (Preliminary study)

Prior to undergoing the modified-TSST protocols, no significant differences were found between the low-PET and high-PET participants in terms of their trait test anxiety or state anxiety; hence, the two groups were considered equivalent at this point (see section 4.4). After controlling for pre-TSST state anxiety, post-TSST state anxiety was significantly different between the groups; those in the high-PET condition demonstrated a significant increase, while participants in the low-PET group showed a significant decrease, both groups displayed effect sizes commensurate with those found in adult populations when manipulating anxiety using the TSST (e.g. Hellhammer & Schubert, 2012).

The findings from the participant interviews (see sections 4.4.4 & 4.5) provide evidence of the participants’ feelings during the modified TSST and support the quantitative results in showing that the process generated and maintained state anxiety.
These findings are discussed in detail in conjunction with those from the main phase of the study in section 8.2.4.

In summary, the quantitative results from the preliminary phase of the study show that the modified-TSST protocols manipulated state anxiety in a highly test anxious population; the high-PET protocol was of importance as it provided an instrument for reliably and safely inducing state anxiety in the main phase of the study.

8.2.3 Research Question 3 - How does the high performance-evaluation threat protocol of the TSST impact on state anxiety in population that is heterogeneous in terms of trait test anxiety? (Main study)

The participants’ measured state anxiety increased significantly from both baseline to pre-TSST and from pre-TSST to post-TSST (see 6.4.1). The largest increases in state anxiety occurred between measurements taken immediately before and after the TSST procedure. This is what would have been expected from the literature, for example Kirschbaum (2010).

It is concluded that the modified-TSST procedure can significantly increase state anxiety levels an adolescent population that is heterogeneous in terms of their trait test anxiety.

No statistically significant interaction was uncovered between the participants’ levels of trait test anxiety (see 6.4.2.1), attentional control (6.4.2.2), or the test irrelevant thinking component of trait test anxiety (6.4.3.2), and how their state anxiety changed during the TSST process; while it has been shown that the modified-TSST procedure can increase state anxiety levels, it would appear such increases are independent of these factors. A significant interaction was uncovered between the participants’ levels of the worry component of trait test anxiety and changes in state anxiety (6.4.3.1); those participants in the high-worry group displayed the greatest increases in their state anxiety.

As in the preliminary phase, the modified-TSST procedure reliably and safely increased state anxiety levels. These increases may be related to an individual’s trait worry, though the differences uncovered were associated with a small effect. Further clarification of these findings would be beneficial.
8.2.4 Qualitative findings relating to Research Questions 2 and 3.

The following section discusses evidence gathered from both the preliminary and main phases of the study to summarise the participants comments on the impact of the TSST on their state anxiety.

The overwhelming majority of participants in both phases of the study reported feeling more anxious during the TSST procedure, this is supported by the author’s contemporaneous notes of participants’ behaviour. However, as may be expected from such a large and heterogeneous sample, there is wide range of comments made by participants regarding how their state anxiety was impacted.

Many of the participants describe their anxiety in language that suggests, while the process was unpleasant and stressful, they were not excessively distressed. This agrees with the observations of the author; participants appeared uneasy, but rarely did the process need to be stopped. Few participants reported that the TSST procedure gave them little or no cause for concern.

A sizeable minority of participants reported and exhibited more extreme responses to the TSST process. Some described it in language indicating their anxieties were leading them to feel particularly upset, even fearful. This was also clear from observing the participants; some clearly found the process very difficult and became emotional, one asked to end the process early. On a small number of occasions the author ended the process prematurely when he felt the participant’s anxiety or distress was becoming excessive.

Interestingly, most participants did not display distress until the debriefing; they indicated feeling terrible during the process, but had not wanted to show this and chose to complete the tasks. Participants were not explicitly asked why, though some indicated due to the TSST taking place in their school/college with the consent of their teachers, they felt compelled to finish despite being briefed otherwise. Also, as the interviewers were unfamiliar, it was too embarrassing to show their feelings. This could be considered similar to how students behave in examinations; while many of them find tests and examinations worrying and distressing, relatively few demonstrate this and exercise their right to leave the room; rather completing the process and becoming upset afterwards.

When participants described experiencing feelings of anxiety during the TSST process, the attitude of the interview panel was a common theme; being considered rude and unhelpful by participants who mentioned them, including references to being frightening and intimidating. Clearly this added to the anxiety created by the TSST, the
participants would have been reassured had they received greater support. Coupled with this, many participants reported feeling judged by the interviewers, some were clear these were negative judgements; none reported being judged positively. This negative evaluation added to the difficulty of the situation.

The topic for the presentation was the participants’ choice of University course and career pathway, but, they had little control of what they talked about, or how long they talked for. This lack of control was a source of concern for some participants, which was associated with feelings including confusion or embarrassment; this led to increases in anxiety in many participants.

The tasks were designed to seem plausible; comments indicated participants believed this was the case. However, they were unrealistic and impossible to complete within the allocated time resulting in forced failure. By providing insufficient time to prepare, the presentation was rendered exceptionally challenging; participants commented that they realised three minutes was not enough time to gather their thoughts, plan what to say, and compose themselves. Some indicated this made them increasingly worried about how poorly they would perform. Similarly, the maths task initially appeared to be a simple calculation; however, subsequently subtracting 13 from large numbers proved to be exceptionally difficult. The lack of guidance when the participants made mistakes added to the complexity as they were not informed what error they had made. Many participants repeatedly made the same error, but appeared bemused that it was wrong yet again.

Somewhat unexpectedly, an area that provoked concern was the participants’ own expectations of their performance on the tasks; describing feeling embarrassed, frustrated, and stupid. This could be associated with the appearance of the tasks as straightforward.

As expected, during the preliminary study, the high-PET protocol of the TSST reliably induced significant increases in state anxiety. This, coupled with the fact it was successfully implemented in several institutions without concern, led the author to conclude it was suitable for use in the main phase of the study, where it was successfully implemented with a similar impact on state anxiety. The qualitative results from both phases of the study indicate that the nature of the scenarios, the tasks, and the attitude of the interview panel allowed the high-PET protocol to successfully deliver the key components of social evaluative threat, uncontrollability and forced failure required to induce state anxiety (Dickerson & Kemeny, 2004) (see section 2.5.1).
8.2.5 Suitability of the modified-TSST as a proxy for an examination.

The aim when developing the modified-TSST was to employ it as a proxy for examinations in naturalistic test anxiety research, requiring it to induce similar feelings of anxiety. It is proposed the social-evaluative threat, uncontrollability and forced failure employed by the modified-TSST, are analogous to formal examinations where students have no control over questions, rarely complete the entire paper successfully, and judgements are made about their performance.

Participants’ comments indicate that in many cases the TSST induced similar feelings to an examination; therefore, it is considered a suitable proxy. However, some indicated that the feelings generated by the TSST were more intense than an examination; this is discussed in section 8.3.2.

8.2.6 Summary of findings on the implementation and impact of modified-TSST.

To summarise, it has been shown to be practically and ethically feasible, to implement the modified-TSST it in ecologically valid contexts such as schools and colleges. It is also clear, the protocols developed, trialed, and evaluated by the author can safely and reliably manipulate the state anxiety of adolescent populations. There are indications that the high-PET protocol differentially impacts the state anxiety of individuals through their levels of trait worry, though this requires further investigation. Importantly, the induction of state anxiety appears to be short-lived, with no long-term impact on participants. It is concluded, the modified-TSST protocols provide an instrument to manipulate state anxiety, as a proxy for an examination, in school-based test anxiety research, offering an approach to collecting ecologically valid data from school-age populations.

While the modified TSST protocols can be considered safe for use with 16-18-year-olds, it is not recommended that they are employed unless those involved have experience commensurate with the author or other members of the supervisory team responsible for this study. Additionally, the lack of understanding of and/or confidence in the process in some schools may act as a barrier to its implementation. This was exemplified by one assistant head teacher who did not want their students to be involved in the preliminary study. When withdrawing, they said “I don’t get it, I don’t like the sound of it.”

Further limitations are discussed in section 8.3, with implications for practice and research addressed in sections 8.5. and 8.6.
8.2.7 Research Question 4 - What measurement evidence can be provided to support the hypothesised relationships between self-reported trait anxiety, attentional control, state anxiety and attentional bias in 16-18-year-olds undertaking a high-stakes program of study?

8.2.7.1 Trait test anxiety.

There was a moderate negative correlation between trait test anxiety and attentional control, in other words as trait test anxiety increased attentional control fell. There was a strong positive correlation between trait test anxiety and baseline state anxiety, trait test anxiety also displayed a moderate positive correlation with both pre-TSST and post-TSST state anxiety. Higher levels of trait test anxiety leave individuals predisposed to experience more intense state anxiety in evaluative situations (see section 2.3.4); hence, these findings support this theorised relationship between trait test anxiety and state anxiety, including the models of Spielberger and Vagg (1995) and Zeidner (1998).

There was no significant correlation between trait test anxiety and the change in participants’ state anxiety (pre- to post-TSST); those individuals higher in trait test anxiety did not get more or less anxious than their colleagues lower in test anxiety. These findings agree with those in section 6.4.2.1 uncovering no interaction between trait test anxiety and the change in state anxiety; the TSST did not induce greater or lesser state anxiety depending on participants’ trait test anxiety.

8.2.7.2 Attentional control.

There were significant weak negative correlations between attentional control and both pre-TSST and post-TSST state anxiety. A key assumption of Attentional Control Theory (Eysenck et al., 2007), is that anxiety impairs attentional control and increases the allocation of attention towards threatening stimuli. As mentioned in section 2.4.3.6, Attentional Control Theory was initially proposed to explain the impact of test anxiety on performance. However, its proposed impairment by anxiety of an individual’s ability to inhibit and shift attention appears similar to how attentional bias manifests itself. Hence, it could be argued, those predisposed to experience higher state anxiety, are at risk of impaired attentional control and associated attentional bias. These findings of a negative relationship between attentional control and both trait and state anxiety support the basic premise Attentional Control Theory. This is discussed further alongside findings for research question 6 (see section 8.2.9 below).
8.2.7.3 State anxiety.

There was a significant strong positive correlation between pre-TSST and post-TSST state anxiety, those participants who displayed higher levels of anxiety immediately before the TSST also displayed higher levels immediately after it. There was a significant moderate negative correlation between pre-TSST state anxiety and the difference in state anxiety (pre- to post-TSST); the more anxious a participant was before the TSST, the less their anxiety increased during it. Heightened anxiety immediately pre-TSST was likely due to the individual’s negative anticipations of what was about to happen (Hellhammer & Schubert, 2012).

A possible explanation for those participants displaying the highest levels of pre-TSST state anxiety also recording lower increases in state anxiety is they had already rated their anxiety at a maximum score of four on some items. Therefore, they were unable to increase these scores at the post-TSST measurement.

There was a significant strong positive correlation between post-TSST state anxiety and the state anxiety difference, participants who experienced the largest increases in state anxiety would be expected to record the highest post-TSST values.

8.2.7.4 Attentional Bias.

No significant correlations were uncovered between the attentional bias index and either trait test anxiety, attentional control, or state anxiety; this indicates no relationships between these factors and the participants’ patterns of attentional bias. A more complex series of regression analyses was carried out to investigate this area in greater detail, these are discussed in section 8.2.9.

8.2.8 Research Question 5 - What is the difference, if any, between participants’ response times to threat congruent and non-threat congruent trials measured by a dot-probe task?

The ABDP was employed in the main phase of the study to measure the participants’ response times (in milliseconds) to threat congruent and non-threat congruent trials. In keeping with the dominant approach in the field (for example, See et al., 2009), the participants’ mean response times to both types of trial were used to calculate the attentional bias index (ABI) as follows:

Mean RT congruent trials (ms) - Mean RT non-congruent trials (ms)
A negative ABI indicates the individual was responding more quickly to probes associated with threat congruent words, i.e. an attentional bias towards threat. A positive ABI indicates quicker responses to probes following non-threat congruent words, i.e. an attentional bias away from threat.

A repeated measures t-test found participants responded marginally more quickly to threat congruent trials; however, the mean difference (3.32ms) was not significant. Three participants were identified whose ABIs had a studentized residual of +/-3. Repeating the t-test after removing these values uncovered a significantly quicker response to threat congruent trials; however, this was still associated with a small effect.

Response times in this study have mean value of approximately 450ms, this is representative of other studies employing the dot-probe paradigm (de Voogd et al., 2016; MacLeod & Mathews, 1988; MacLeod et al., 1986). Additionally, differences in reaction times to probes of 30-40ms or greater are frequently referred to as considerable and are thought to provide evidence supporting the presence of attentional bias (for example, MacLeod & Mathews, 1988; MacLeod et al., 1986).

This study was unable to replicate the key findings of Putwain et al. (2011) by identifying a significant difference between the response times to threat congruent and non-threat congruent probes. However, the negative ABI values demonstrated by some, suggest those individuals were biased towards the threat congruent words. Therefore, despite the lack of a meaningful pattern of attentional bias in the whole sample, some participants did exhibit an attentional bias towards the threatening stimuli presented during the ABDP. In the work of Putwain et al. (2011), highly trait anxious individuals displayed a mean attentional bias of -23.00ms. In comparison, 12 participants in this study displayed a negative attentional bias approximately equal to or greater than this value.

It is concluded, this study has found evidence to suggest that in a state of heightened anxiety, induced by manipulating performance evaluation threat, several individuals displayed an attentional bias towards the threat congruent stimuli on the dot-probe task. Hence, attentional bias towards threat is a characteristic of how anxiety manifests itself in some individuals in a situation where performance evaluation is salient. The relationship between attentional bias and state anxiety in these situations is not straightforward and warrants further investigation.
8.2.9 Research Question 6 - How do trait test anxiety, attentional control and state anxiety predict attentional bias in 16-18-year-old students undertaking a high-stakes program of study?

A series of hierarchical multiple regressions was carried out to investigate whether the factors of trait test anxiety, attentional control, and state anxiety, could be used to predict an individual’s attentional bias index. Adopting a hierarchical approach allowed the regression models to be built up in stages to uncover the individual variance explained by each factor; trait test anxiety was entered into the model first, followed by attentional control, and finally state anxiety.

The first full regression model employed the trait variables of test anxiety and attentional control along with pre-TSST state anxiety. The regression model was not significant; these factors predicted only 4.9% of the variance in the attentional bias index. Similar findings were uncovered when using post-TSST state anxiety (3.3% of the variance explained), and also when employing the worry component of trait test anxiety alongside attentional control and either pre- or post-TSST state anxiety (4.4% and 3.0% of the variance explained respectively). Hence, these factors were unable to predict the participants’ levels of attentional bias.

8.2.10 Summary of findings relating to attentional bias.

The findings of this study indicate that for some individuals an attentional bias is a facet of their state anxiety in evaluative situations, this is agreement with the robust body of evidence linking attentional bias to anxiety (for example, Bar-Haim et al., 2007; Cisler & Koster, 2010; Clarke et al., 2013; Macleod & Clarke, 2015; MacLeod & Mathews, 1988; MacLeod et al., 1986; Mathews & MacLeod, 2002).

Attentional control has been proposed to have a moderating influence on attentional bias (Cisler & Koster, 2010; Derryberry & Reed, 2002; Helzer et al., 2009; Lonigan & Vasey, 2009; Van Bockstaele et al., 2014); however, the quantitative findings from this study do not show the existence of a significant and consistent relationship between an individual’s attentional control and their attentional bias. No relationships were uncovered between trait test anxiety or state anxiety and attentional bias.

Therefore, none of the above factors could predict the levels of attentional bias uncovered in this study either individually or collectively; hence, they cannot be used to identify those individuals who may experience attentional bias towards threat in examinations. It would seem plausible that there are other variables, unique to the
individual, that play a role in the manifestation of anxiety during performance evaluation, which may account for the varied attentional responses uncovered. These were explored in the analysis of the qualitative data (chapter 7) and are discussed in section 8.2.11 below.

8.2.11 Research Question 7 - What are the reported experiences of cluster group participants in terms of trait test anxiety, attentional control, state anxiety, and attentional bias, in evaluative situations including the Trier Social Stress Test (TSST)?

A cluster analysis placed participants in relatively homogeneous groups, using the worry component of trait test anxiety, attentional control, and the attentional bias index scores. A five-cluster solution was considered to provide the optimum balance between parsimony and explanatory power. The clusters were analysed using both quantitative and qualitative approaches. Firstly, how the clusters differed in terms of the worry component of trait test anxiety, attentional control, state anxiety, and attentional bias was explored using one-way ANOVAS (see section 6.8). Following this, the participants’ responses from the post-TSST interview were analysed using directed content analysis (see chapter 7).

8.2.11.1 Quantitative analysis of the cluster differences.

There were no significant differences between the clusters regarding the worry component of trait anxiety, this was also the case with state anxiety. A statistically significant difference between the clusters was found in their levels of attentional control, further post hoc analysis revealed that cluster 1 was significantly higher than clusters 2, 3, and 4. All clusters were found to be statistically significantly different from each other in terms of their attentional bias index; they were characterised on this variable:

- Cluster 1 - No attentional bias ($M = -3.00\text{ms}$).
- Cluster 2 - Small attentional bias towards threat ($M = -17.15\text{ms}$).
- Cluster 3 - Small attentional bias away from threat ($M = 10.58\text{ms}$).
- Cluster 4 - Large attentional bias away from threat ($M = 50.43\text{ms}$).
- Cluster 5 - Large attentional bias towards threat ($M = -50.86\text{ms}$).
8.2.11.2 Qualitative analysis of the cluster differences.

8.2.11.2.1 Trait test anxiety.

The quantitative analysis of the clusters did not reveal significant differences between them in their levels of trait test anxiety, this is largely reflected in the participants’ comments on their attitudes towards examinations and their approaches to studying. In the larger clusters (1, 2 and 3), the majority of participants reported being concerned about examinations, but there was wide variation in the strength of these feelings. As would be expected from literature regarding what school-age children worry about (section 2.2.2), a common concern was the consequences of failure; many participants also expressed worries about letting themselves down or not meeting their own standards. Interestingly, an emerging issue was that of letting down teachers and parents; this could be indicative of the social-evaluative threat felt by these individuals.

How far in advance of examinations individuals experience anxiety and how these were dealt with also showed variation. Most who indicated a conscious strategy to deal with their worries, reported revision and preparation was the best approach; however, it was not clear if this allayed their concerns. The author received the impression from participants who appeared most anxious about examinations that the strategy of revision and preparation was something they felt they should do, rather than something they believed was going to be beneficial to their performance. Zeidner (1998) suggests that continual revision and over-preparation is one way in which test anxiety manifests itself in the behavior of individuals, Stöber (2004) supports this, but claims this strategy is more prevalent in girls. This sample was heavily biased towards females; therefore, this could explain why such behaviour was a common strategy in this study.

Clusters 4 and 5 represented individuals who demonstrated the more extreme attentional bias scores. The quantitative data did not show their levels of trait test anxiety were significantly different; however, there were differences in their feelings towards examinations. Participants in cluster 4 were not especially concerned by examinations, nor did they report their worries impacted on their behavior in a tangible way. In contrast, those in cluster 5 (bias towards threat) clearly found examinations worrying and were aware of how far in advance these worries were present. They were also clear there was little they could do to address these worries other than to revise and prepare; however, this strategy did not appear to ease their concerns and may even intensify them.
It is suggested the comments made by participants in clusters 4 and 5 are congruent with the patterns of attentional bias they demonstrated on the ABDP; those biased away from threat came across as ambivalent about the threat posed by the exam process, whereas those biased towards threat could describe their anxiety, and its impact upon them, in great detail. When describing the participants in cluster 4 as ambivalent, this did not appear to be intentional avoidance of the threat posed by the examination, rather they gave the impression of a lack of concern about the process and its consequences in general. Those in cluster 5 described examinations, and their associated concerns, in ways that gave the impression that a significant amount of their time and attention was spent worrying about examinations and their perceived threat; however, they have few strategies to deal with this.

8.2.11.2.2 The modified-TSST.

Most participants found the TSST procedure challenging and a source of anxiety; individuals in all clusters cited the attitude of the interviewers and the perception that they were being negatively judged as integral to these feelings. After analysing participants’ comments, the author found little discernible difference between the clusters. See section 8.2.4 for a thorough analysis of the participants’ comments regarding the TSST.

8.2.11.2.3 Attentional control.

The quantitative analysis revealed participants in cluster 1 reported significantly higher levels of attentional control than those in clusters 2, 3 and 4; this is partly reflected in the qualitative data. However, as expected, a range of comments were made in the larger clusters. Participants in cluster 1 recognised that the TSST process had been unpleasant and a cause of concern; however, they suggested that this did not impact upon their ability of focus on the tasks or maintain their attention. Clusters 2 and 3 both displayed a variety of comments related to how these participants maintained their attention during the TSST process. While most reported that they were able to effectively maintain their focus on the tasks, a minority from both clusters explicitly referred to “going blank”, or similar comments suggesting they were struggling to direct their attention towards the tasks.

The responses of the individuals in cluster 4 were unclear regarding how they could maintain their attention; forgetting things and “going blank” was mentioned, alongside an ability to focus on the task. When considering the attitude with which they
approached the tasks, the author was not given the impression that these individuals found the anxiety they experienced particularly intrusive or difficult to deal with. Participant number 69’s responses were particularly interesting; she appeared unconcerned throughout the process and dealt with the tasks well. However, during the interview she made several references to forgetting things during examinations, these were incongruent with her observed behaviour and task performance. The author has hypothesised that this may have been an attempt to manage the expectations of her performance on the tasks; however, it was not clear if these were her own expectations, or those of the interview panel.

Participants in cluster 5 lacked congruence between their levels of attentional control and how they reported feeling and behaving during the TSST; quantitative data were reflective of the sample, yet they reported finding it very difficult to control their attention during the TSST process. Factors associated with the ACS which may have potentially contributed to this are discussed along with other limitations in section 8.3.

8.2.11.2.4 State anxiety.

The quantitative analysis revealed no significant differences between the clusters in terms of their state anxiety. This is reflected in participants’ comments; the majority reported that the TSST was a challenging and unpleasant process, which resulted in feelings of increased anxiety. The range of comments is reflective of some participants finding the process more anxiety-provoking than others. Frequent references were made to how unpleasant the interviewers were, that the participants felt they were being judged, and that they were embarrassed or concerned about the impression they were giving of themselves. A lack of control, alongside confusion and frustration, was also mentioned by many as contributing to their anxiety. Interestingly, few individuals commented that they were concerned about the implications of failure of the task; when asked about this, there was a recognition that the task itself was relatively unimportant, but the desire to perform well or not meeting their own standards was concerning them. Few participants indicated that they were untroubled by the process. The comments made in this area confirm that the modified TSST is able to reliably manipulate anxiety in adolescent populations.

8.2.11.2.5 Attentional bias.

The quantitative analysis uncovered significant differences between all the clusters in terms of their attentional bias index, these were characterised as follows:
• Cluster 1 - No attentional bias \((M = -3.00\text{ms})\).
• Cluster 2 - Small attentional bias towards threat \((M = -17.15\text{ms})\).
• Cluster 3 - Small attentional bias away from threat \((M = 10.58\text{ms})\).
• Cluster 4 - Large attentional bias away from threat \((M = 50.43\text{ms})\).
• Cluster 5 - Large attentional bias towards threat \((M = -50.86\text{ms})\).

Qualitative analysis of the participants’ comments revealed differences between the clusters that were broadly reflective of the quantitative data; however, between clusters 1, 2 and 3 these differences were subtle and difficult to identify. This was anticipated from both their relatively neutral attentional bias scores and the large numbers of individuals within each cluster. Some individuals in these clusters do describe feeling distracted by their worries, though it is less clear if this was impacting on their performance. Attentional Control Theory (Eysenck et al., 2007) proposes anxiety consumes attentional resources, therefore, these comments must be treated with caution; this theory suggests it is unlikely that the participants in these clusters were entirely unaffected by the worries and anxiety induced by the TSST process.

More obvious differences were apparent when examining the responses of participants in clusters 4 and 5; participants who displayed the highest levels of attentional bias. ABIs in cluster 4 indicated a bias away from threat, though this did not appear to be intentional avoidance. These individuals were aware of their worries, suggesting they may “get in the way”; however, the language they used conveyed ambivalence about this, with no reference to pervasive worries that interfered with their functioning. The author’s impression was that these participants were aware of being anxious during the task, but this was not interfering with their processing. It is possible these individuals’ anxieties were impacting on their processing, but that this was not apparent to them. Participant number 69’s comment regarding “forgetting everything” was interesting as it was incongruent with the rest of her interview responses and behaviour. The author’s interpretation was these comments seemed to be an attempt to manage expectations of performance on the tasks.

The individuals in cluster 5 (large bias towards threat) conveyed a very different message from those in cluster 4 (large bias away from threat). They described their anxieties in detail and, significantly, they recognised being distracted by them and struggled to focus on the tasks. Additionally, they also refer to becoming anxious about being distracted. These participants gave the author the impression of individuals who were concerned that their anxieties during the TSST were having a significant impact on
their performance. Their awareness of this made them increasingly concerned, further distracting them from the task at hand. They appeared unable to break this cycle.

8.2.11.3 Summary of differences between the clusters.

No significant quantitative differences were uncovered between the clusters in terms of their trait test anxiety; this was broadly reflected by the qualitative analysis, which uncovered a wide range of attitudes to examinations across the three largest clusters. However, the attitudes of those in clusters 4 and 5 did appear different, with individuals in cluster 5 reporting their worries and anxieties in a far stronger fashion and detailing how they attempt to address these concerns.

Analysis of the qualitative data on the participants’ experiences of the TSST revealed very little difference between the clusters; most participants found it a difficult and unpleasant process. The same was found in relation to state anxiety; with no discernable differences between the comments made in each cluster. This is congruent with the quantitative data on state anxiety.

In terms of attentional control, clusters 1 and 5 displayed significant statistical differences to some of the other clusters. In the case of cluster 1, this was not apparent from the participants’ comments, though this could be due to the size of the cluster and the range of attitudes displayed. The qualitative responses of cluster 5 appeared incongruent with their quantitative data; these participants clearly and strongly described the difficulties they had in maintaining attention during the task.

There appears to be congruence between the quantitative and qualitative data generated by placing the participants into relatively ABI-homogeneous clusters; with participants in cluster 5, who displayed the highest bias towards threat, also commenting the most clearly and strongly in this area. Those in cluster 4 (bias away from threat) displayed less congruence between their quantitative and qualitative data; however, while they did not describe an awareness of avoidance of threat, they made little or no comment to the effect that they believed their performance was compromised by distraction or anxiety. The qualitative analysis of the participants’ comments uncovered subtle differences, particularly on an individual level, that the quantitative analysis was not designed to detect. These are significant in understanding how an individual’s state anxiety manifests itself and relates to their ability to maintain attention. While it was a complex and resource-intensive process, the collection and analysis of the data from the semi-structured interviews, triangulated with quantitative data on key variables and is considered a strength of this study. The author suggests
that qualitative data has a significant role to play in further understanding how test anxiety impacts upon school-age children at an individual level.

8.2.12 Summary of findings.

In summary, the key findings of this study are:

- The modified-TSST protocols can be safely implemented in a naturalistic setting and are able to induce and maintain heightened state anxiety in an adolescent population.
- Negative relationships exist between trait test anxiety and attentional control, and between state anxiety and attentional control.
- Attentional bias towards threat is a facet of state anxiety for some individuals in evaluative situations, though no overall patterns relating to trait test anxiety, state anxiety, or attentional control were uncovered within the quantitative data analysis.
- An individual’s trait test anxiety, state anxiety, and attentional control cannot be used to predict their levels of attentional bias in evaluative situations.

The impact of the modified-TSST on state anxiety had been expected due to a significant body of prior research demonstrating its ability to induce state anxiety in adult populations across a range of contexts (e.g. Dickerson & Kemeny, 2004; Hellhammer & Schubert, 2012). The challenge came in adapting the scenarios and tasks to ensure they were appropriate to an adolescent population and were representative of an examination; this was successful. Somewhat unexpected, was the relative ease with which the process could be implemented in schools and colleges. It was anticipated teachers would be reluctant to allow anxiety to be induced in their students; colleagues working in the field of educational research were sceptical that school staff and leadership would find this acceptable. The high school experience and sensitivity of the author, the rigorous approach to developing the low- and high-PET protocols, the distress and debriefing procedures, and the involvement of teachers and feedback to students are all considered key to the success of this aspect of the study.

This study identified several individuals who displayed an attentional bias towards threat while experiencing heightened state anxiety; however, this was not predicted by trait test anxiety, attentional control, or state anxiety. An implicit aim of this study was to replicate the key finding of Putwain et al., (2011) by identifying an attentional bias towards threat in test anxious individuals. While uncovering a
straightforward relationship between test anxiety and attentional bias would have been
the ideal outcome with a view to the development of an attentional bias intervention, the
failure to uncover such a pattern was not entirely unexpected due to the subsequent
inability of Putwain et al. (2011) to reliably replicate their results. Additionally, there
were several necessary methodological variations and a different population between
the two studies.

The prospect that attentional bias may not exist in test anxiety cannot be
dismissed; however, this would seem unlikely. Firstly, there is a robust body of
evidence to support the existence of attentional bias in many forms of anxiety (Bar-
Haim et al., 2007; Cisler & Koster, 2010; Clarke et al., 2013). Hence, it makes
conceptual sense that it also a facet of test anxiety; however, it is challenging to identify
due to the impact of a range other variables on the individual. Secondly, both in this
and other studies, test anxious individuals have been found to display an attentional bias
towards threat; therefore, it would seem plausible that methodological or analytical
limitations (section 8.3) play a role in the failure to consistently identify attentional bias
and uncover its relationship to trait test anxiety.

8.3 Limitations of this study

This study was underpinned by a robust methodology; however, there were
important limitations that must be considered. These, along with their potential impact,
are discussed in the following sections.

8.3.1 Limitations of self-report measures.

The use of self-report questionnaires to measure trait test anxiety and attentional
control is considered a limitation of this study due the requirement of participants to
answer honestly, to be self-awareness, and to understand what they are being asked.
However, as a situational-specific trait, test anxiety cannot be directly observed
(Spielberger, 1975); therefore, it is challenging to quantify it in any other way than
through self-report measures. It could also be argued, the truest reflection of a trait is
gained by asking the individual themselves; hence, the Revised Test Anxiety Scale was
considered the most appropriate method to gather trait test anxiety information. Despite
being a measure designed for adults, the RTA is worded in such a way that it was
considered the population in this study (16-18-year olds in full-time education) would
understand what they were being asked and answer accordingly. Participants were also
asked about their trait test anxiety in the qualitative interviews, this facilitated the
collection of a greater depth of information than provided by the RTA alone. A similar approach was adopted with the State-Trait Anxiety Inventory; qualitative data was collected and employed in conjunction with that gathered from this self-report measure.

A self-report scale, the Attentional Control Scale, was used as a measure of the participants’ attentional control. As with the RTA, the items on the ACS were sufficiently clear to be accessible to the study population. For the purposes of this study, participants’ attentional control in examinations was of interest; therefore, the participants were asked to complete the ACS to reflect this. However, due to this instruction being given as the questionnaires were introduced rather than immediately before completing the ACS, it is possible some participants may have answered in a way which reflects their attentional control more generally. If this did occur, the data on attentional control may not truly reflect how some individuals believe they maintain their attention in examinations. This is important as Attentional Control Theory (Eysenck et al., 2007) claims anxiety reduces attentional focus by increasing its allocation towards threatening stimuli; hence, the magnitude of the negative correlations uncovered in this study between attentional control and both trait test anxiety and state anxiety would be impacted by participants reporting how they act generally, rather than in examinations or tests. This must be addressed in future work by ensuring explicit instructions relating to the situation the participants are being asked about are given when using the Attentional Control Scale.

8.3.2 Limitations of the modified Trier Social Stress Test.

Both the quantitative and qualitative data indicate the modified-TSST induced state anxiety in a manner that was congruent with an examination; however, it was suggested by some that the feelings generated were more intense than those experienced during examinations. While the cause of this is not clear, the presence of the interviewers, as opposed to a more distant examiner may have contributed to it, with the effect of triggering greater levels of social-evaluative anxiety than intended. It is important to recognise inducing higher levels of state anxiety than is required for the study of test anxiety is a potential limitation of this work. The impact of this would be to mask worries specific to test anxiety and lead individuals to perceive other unrelated stimuli as threatening. This is particularly important in this study where attentional bias towards the threat posed by examinations is being investigated, as it could result in threat biases unrelated to the testing process being detected and inaccuracies in the participants’ attentional bias index.
8.3.3 Limitations of the attentional bias dot-probe task (ABDP).

Both theory and evidence relating to the TSST suggest that the anxiety it induces is short-lived. However, as it lasts between 20 to 40 minutes from completion of the tasks (Dickerson & Kemeny, 2004), participants’ anxiety levels should have remained elevated long enough to complete the ABDP in an anxious state as intended. However, Hellhammer and Schubert (2012) found that whilst anxiety remained elevated immediately post-TSST when compared to baseline measurement (as was found in this study), the peak values on psychological measures were obtained during the procedure itself. Hence, despite participants being told the evaluative process was continuing while they completed the ABDP, the change in nature of the task, relative familiarity of the examiner (the current author), and time taken to complete the measure of post-TSST state anxiety, may have contributed to their recovery starting earlier than intended.

On reflection, it could well be argued that the evaluative threat induced by the TSST, had been partly attenuated by the time the participants began the ABDP. The experience of the author when observing the participants would agree with this; despite some participants still appearing anxious when completing the dot-probe task, others gave the impression that they viewed it as the end of the process and expressed relief that it was over. A key aspect of the theories underpinning attentional bias is that preferentially attending to threatening stimuli is exacerbated when the individual is experiencing heightened state anxiety (Putwain et al., 2011; Van Bockstaele et al., 2014). Therefore, assuming a bidirectional relationship exists between state anxiety levels and attentional bias (for example, Van Bockstaele et al., 2014), as state anxiety levels fall back towards baseline levels, attentional bias towards threat may also become less prevalent. This would result in the ABDP detecting levels of attentional bias that were lower than individuals were experiencing during their highest state of anxiety, leading to ABI scores being suppressed. To address this, when employing the modified-TSST and the ABDP together, it is recommended that the dot-probe task is made a more integral part of the TSST process; it should be administered by the interviewers rather than the experimenter under the same evaluative conditions as the presentation and maths task.

The ABDP does not directly measure an individual’s attentional bias towards or away from threat, rather it measures response times to threat congruent and non-threat congruent trials, allowing a proxy for attentional bias, the attentional bias index, to be calculated. For this to be an accurate representation of participants’ patterns of attention, it is important that the stimuli employed as threatening are pertinent to the
concerns and anxieties of the participants; hence, capturing that attention of those biased towards threat (See et al., 2009). The majority of participants in this study reported noticing there were words to do with exams and school, many also reported these had a negative focus. In comparison, few participants reported they did not see a pattern or felt the words were random. It was obvious the participants recognised that the ABDP contained words in each trial relating to education or examinations, it was less clear whether the words were seen as particularly threatening or that they were being associated with the feelings of anxiety induced during the modified-TSST. Therefore, it is possible some of the participants reported noticing the threat congruent words because they had an identifiable pattern, as opposed to preferentially attending to them as they were appraised as threatening. This would not be detected as bias by the ABDP.

The words employed in this study were those initially identified by Putwain et al. (2011), where they had been ranked by five test anxious undergraduates as those considered the most and least threatening to test anxious individuals. As previously discussed, school-age children and undergraduates have very different educational experiences, thus it is possible some of these words may not have been entirely appropriate for the population of this study. Modification of the words employed in the trials as threat congruent stimuli is required to ensure they are more pertinent to the anxieties and emotions that school-age individuals experience in examinations. Addressing this would not only ensure the ABDP was more effective in capturing the attentional bias of individuals, it would also serve to facilitate the development of potential attentional bias modification treatments employing the dot-probe paradigm.

### 8.3.3.1 Limitations in the analysis of dot-probe data.

A recent paper, Kruijt, Field and Fox (2016), highlights a potential limitation for the use of data from dot-probe tasks to identify attentional bias. This paper suggests the current convention of using response times to threat congruent and non-threat congruent trials leads to calculate a bias index, as employed in this study and others (for example Putwain et al, 2011; See et al., 2009), results in low reliability for these calculated attentional bias indices. Additionally, Kruijt et al. (2016) question the assumption that attentional bias is a static construct, with the works of Zvielli, Bernstein and Koster (2015) and Iacoviello et al. (2014) discussed in relation to this. Zvielli et al. (2015) propose that attentional bias may fluctuate towards or away from stimuli over time; Iacoviello et al. (2014) also recognise this and suggest attentional bias variability is a more robust indicator of attentional impairment than attentional bias scores. Both
papers offer alternative approaches of interpreting the data from dot-probe tasks.

Importantly, Kruijt et al. (2016) is not a criticism of the dot-probe paradigm itself; rather the approach to analysing the data generated from it. This study also concludes that the analytical techniques suggested by Iacoviello et al. (2014) and Zvielli et al. (2015) do not satisfactorily address the data analysis issues highlighted. Therefore, while the work of Kruijt et al. (2016) raises important questions, no effective alternatives are proposed.

The conclusions of Kruijt et al. (2016) are valid and present an issue that researchers employing the dot-probe paradigm should be aware of; however; at this point it would be considered premature to break with the recognised analytical techniques widely employed in this field. Rather, it would be prudent for the author, and others with an interest in attentional bias, to monitor developments in approaches to the analysis of dot-probe data, and to explore alternative techniques that show promise.

8.3.4 Limitations of the cluster analysis.

A Ward’s method cluster analysis was employed to place the participants of this study in to relatively homogeneous clusters based upon their worry component of trait test anxiety, their attentional control score and their attentional bias index. Two of the clusters identified by this (numbers 4 and 5) were small, containing only two and three participants respectively, as they represented those individuals displaying the highest levels of attentional bias. It is recognised that the size of these clusters raises questions concerning their validity and, in a purely quantitative study, they could represent outliers that may be removed from the dataset. However, as this study employed both quantitative and qualitative approaches, data from these individuals remained in the analysis to facilitate the exploration of the qualitative responses of all participants, including those representing patterns less prevalent in the quantitative data.

8.4 Implications for Test Anxiety Theory

The positive correlations between trait test anxiety and state anxiety indicate that in situations where performance evaluation is salient, individuals high in trait test anxiety are predisposed to experience heightened state anxiety. Additionally, the comments of participants describing how the modified-TSST protocols impacted upon them indicate the generation of state anxiety is dynamic; levels can increase or decrease as the individual reappraises the situation. This supports the dynamic models of the trait/state anxiety relationship proposed by Spielberger and Vagg (1995) and Zeidner
(1998). As these are robust and long-standing theories, this had been expected; however, there is a benefit to the generation of contemporaneous data to test and support seminal research.

The negative correlations between trait and state test anxiety and attentional control indicate relationships that offer partial support for Eysenck’s (2007) Attentional Control Theory. This proposes a relationship in which anxiety impairs an individual’s ability to control their attention by disrupting the balance between the goal-directed and stimulus-driven systems. The correlations between anxiety and attentional control uncovered in this study provide evidence to support aspects of Attentional Control Theory, though they do not provide information on the direction of these relationships. Comments made by participants referring to their anxiety as “getting in the way” or leading them to “go blank” during the TSST are also congruent with aspects of Attentional Control Theory and suggest causality; however, further empirical studies are required to elaborate on the nature of these relationships.

Several participants in this study displayed an attentional bias towards threat as identified by a dot-probe task. However, no significant correlations were uncovered between the attentional bias index and either trait test anxiety, attentional control, or state anxiety; this indicates no relationships between these factors and the participants’ attentional bias. A number of empirical studies (for example, Derryberry & Reed, 2002; Helzer et al., 2009; Lonigan & Vasey, 2009) and reviews of the field (Cisler & Koster, 2010; Van Bockstaele et al., 2014) have proposed a complex relationship between attentional control and attentional bias. However, these results are unable to support this. This is not to say that the relationships proposed by others do not exist; simply, they were not found in this study. As discussed above (see section 8.3), there are several methodological limitations of this study which may have impacted upon the results. There is a body of evidence to suggest the factors of trait test anxiety, attentional control, and state anxiety are related to attentional bias towards threat; future work should focus on providing evidence to illustrate these relationships more clearly.

Based on the findings of this study, the model proposed in section 2.5 has been modified (see Fig. 8.2 below) to reflect the relationships uncovered between trait test anxiety and attentional control, trait test anxiety and state anxiety, and between state anxiety and attentional control; this is indicated by emboldened arrows. The lack of a relationship between attentional bias and other variables is illustrated by a reduction in the intensity of the arrows pertaining to them.
Figure 8.2. Modified test anxiety process model, adapted from Sarason (1972), Wine (1971) and Zeidner (1998).

8.5 Implications for Practice

8.5.1 Identification of attentional bias.

The use of anxiety manipulation protocols and dot-probe tasks is a resource-intensive process; hence, the identification of attentional bias in a more efficient manner would be beneficial. The regression analyses employed to investigate how trait test anxiety, attentional control, and state anxiety predict levels of attentional bias did not uncover relationships that would facilitate identification of attentional bias in individuals using quantitative methods alone (see sections 6.7 and 8.2.9). However, there was congruence for some individuals between their ABI values and how they described anxiety impacts upon them in examinations (section 8.2.11.2.5). The practical implications of this are clear; at this stage, quantitative measures offer limited answers to the complex issue of attentional bias in test anxiety. To better understand how the anxieties associated with the examination process impact upon school-age students there is a requirement to talk with them; the individuals themselves are the experts in the experience of their own feelings. While school-age students will not use terms such as “test anxiety” or “attentional bias”, conversations with individuals may provide valuable information regarding how they approach examinations and how the testing process impacts them.
This may not be as challenging as it may first appear and it is not proposed that every student be interviewed specifically about their feelings towards the examination process. However, classroom teachers, pastoral leaders and SENCOs\(^\text{10}\) talk to students routinely, with conversations frequently on the topic of their worries and concerns. Establishing key themes and phrases which suggest a student is describing patterns of attention associated with attentional bias, i.e. preferentially attending to or struggling to disengage from their worries and anxieties in examinations, could help in identifying those students for whom attentional bias towards threat is an issue. Preliminary findings from data available within this study indicate that phrases relating to worries distracting individuals from exams, nerves or worries leading them to “go blank”, or focussing on worries to the exclusion of other things, could be indicative of an attentional bias. These themes and phrases could be communicated to teachers and educational psychologists, to support wider staff training and to inform conversations with students. They could also be used as a prompt for the conversations teachers may wish to instigate with students where there are explicit concerns about how much they struggle with the examination process. In time, these comments, combined with further research into the nature of attentional bias in test anxiety, may inform the development of self-report screening instruments to facilitate early identification of individuals who may be at risk of attentional bias in examinations.

8.6 Implications for Test Anxiety Research

8.6.1 The modified-TSST procedure.

The modified-TSST has shown itself to have utility in school-based test anxiety research as a method of inducing heightened state anxiety through performance evaluation threat. It is recognised the procedure needs refining (see section 8.3.2); however, in its current form, it does offer an ecologically valid approach to manipulate anxiety in education contexts. Therefore, future research could follow a twin-track approach. Firstly, the modified-TSST could be implemented by experienced researchers in its current format, facilitating the manipulation of state anxiety in studies requiring this. Researchers would need to be mindful of the limitations outlined in section 8.3.2 relating to the levels of anxiety induced and be aware of the implications for their data. Secondly, the modified-TSST protocols could be adapted and trialled to explore how the intensity of feelings generated can be made increasingly congruent.

\(^{10}\) Special Educational Needs Coordinator – In UK schools, this individual is responsible for the school’s SEN policy and will liaise with parents, teachers and external agencies to implement this.
with an examination, while ensuring the impact on state anxiety is maintained. This would require a robust experimental design, which facilitated the collection of both quantitative and qualitative data.

The modified-TSST was resource-intensive in terms of researcher time; each individual session required a team of three people for a minimum of 45 minutes. Additionally, those involved in the sessions were required to have knowledge of working with school-age children and be aware of their responsibilities in regard of their safeguarding. This is feasible in smaller-scale studies such as this, but would be prohibitive when transferring the modified-TSST to regular practice. Having developed the protocol, the author suggests that greater efficiency could be gained by implementing it in schools and colleges with the institution’s existing staff, or those associated with it. It is vital that the person in control of the process, responsible for administering the questionnaires and conducting the interview, be someone familiar with the needs of the study and be suitably qualified in working with young people; for example, a teacher, educational psychologist, or experienced educational researcher. The interview panel could be made up of less-qualified individuals who were able to follow the TSST script (Appendix 5); however, the individual with overall responsibility would need to remain involved in the process and be prepared to intervene in accordance with the distress protocol (Appendix 3).

### 8.6.2 Attentional bias in test anxiety.

Along with investigating the presence of attentional bias in test anxiety with the purpose of advancing knowledge in the field, an aim of this study was to inform possible identification of test anxious individuals experiencing attentional bias in examinations, and to support the development of attentional bias modification treatments to support them. This study failed to uncover patterns facilitating easier identification of attentional bias in individuals. However, employing methodological and analytical techniques widely recognised in the field (for example, Putwain et al., 2011; See et al., 2009), several participants were identified who responded more quickly to probes associated with threat congruent stimuli (see 8.2.8 to 8.2.10), this indicates an attentional bias towards threat in these individuals. Alongside the theoretical implications discussed in section 8.4, these findings suggest the identification of attentional bias in test anxious individuals is an area of research that justifies further investigation.

To date, the field of test anxiety research has been dominated by quantitative
approaches; however, based on the findings of this study, it is recommended that the collection of qualitative data to identify key comments, attitudes, and feelings that indicate an attentional bias is key to future research in this area. This data would need to be employed alongside established research techniques, such as dot-probe tasks, to identify areas of congruence, ensuring the correct individuals were being identified for in-depth analysis of their responses. In time, it may be possible to screen for attentional bias in the first instance using how individuals describe their examination experiences; thus, reducing the reliance on complex processes such as dot-probe tasks, only requiring them to confirm the presence of attentional bias in more manageable numbers of students.

Considering the complexity of data at the individual level that is required, it is proposed that Single Case Experimental Design (SCED) may be the most appropriate methodological approach to further investigate attentional bias in test anxiety. This would allow detailed exploration of participants’ feelings towards examinations and how they believe their anxiety impacts upon them to be triangulated with data from experimental tasks. This approach would provide detailed and valuable information, as well as being efficient in regard of research resources. Alongside greater clarity in the existence of attentional bias in evaluative situations, this level of detail may also support the development of attentional bias modification treatments (ABMT) to address it.

Any attempt to develop and evaluate an ABMT for test anxious students would be a complex process. Considering the individual variation in the manifestation of test anxiety exemplified by the comments of participants in this study, it would be unwise to assume that the effects of an ABMT would be consistent across a test anxious population. Therefore, evaluating the effectiveness of an ABMT by quantitative techniques alone could lead to its impact on individuals being overlooked in favour of population norms. To fully develop and evaluate ABMTs in test anxiety (and anxiety generally), the collection of both quantitative and qualitative data at the individual level would be required; hence, SCED would appear to be an appropriate methodology with which to approach this. Pre-intervention it would facilitate the collection of data to explore participants’ feelings towards examinations and how they believe their anxiety impacts upon them, alongside exploring how individual’s attitudes change throughout an intervention. Post intervention, rather than simply identifying group patterns, the impact of the ABMT could be assessed in depth on an individual level. This has the potential to inform all aspects of the process; participant identification and tailoring of the stimuli, implementation and dosage, and further refinement of the processes.
8.6.3 Attentional bias modification treatment.

It may seem premature to discuss the future of attentional bias modification given the difficulties in reliably identifying those individuals experiencing attentional bias; however, the approaches proposed to identify those individuals at risk of attentional bias in examinations (see 8.5.1) could be employed to suggest individuals for whom ABMT may be an option.

ABMT employs similar instruments to those used in the assessment of attentional bias, with dot-probe tasks being the most common (Macleod & Clarke, 2015). In dot-probe tasks designed to identify attentional bias, the probe is associated equally with both threatening and non-threatening stimuli. However, in tasks designed to reduce attentional bias towards threat, the probe is always presented in association with the non-threatening stimulus. Less common is a subtly different approach to attentional bias modification training employing positive-search procedures (Mogg, Waters, & Bradley, 2017; Waters et al., 2015); here, participants are encouraged to attend to positive stimuli.

Reviews of the field of ABMT (see section 2.4.6) have shown promising results in the reduction of selective attention to threat; however, these have been questioned more recently. For example, Cristea, Kok, and Cuijpers (2015) and Mogoaşte et al., (2014) reported small or non-significant effects from their review of 49 and 43 trials respectively, and suggested rigorous experimental studies were needed to assess the effect of ABMT on attentional bias and anxiety. Cristea et al. (2015) and Mogoaşte et al. (2014) both raised publication bias as a possible cause for his apparent disagreement with more positive findings, and encouraged the reporting of studies with negative findings and small effect sizes to provide a comprehensive view of the field. The conclusions of these reviews have been supported by recent empirical studies (e.g. De Voogd et al., 2016; De Voogd, Wiers, & Salemink, 2017), and the initially promising findings into the value of ABMT, are now increasingly being replaced by a mixed body of evidence which brings its effectiveness into question. However, many of those critical of traditional approaches to ABMT do not dismiss it entirely (for example, Mogg et al., 2017), but suggest that further robust research into a variety of approaches is needed. Hence, the development and trialling of tasks to specifically reduce attentional bias towards threat in test anxious individuals has the potential to contribute to this body of work. However, this must be approached from an unbiased position, by researchers ready to recognise that they may be unable to support the efficacy of the ABMT they design. For example, the recent review by Mogg et al. (2017) has
challenged the convention that ABMT is required to promote orientation of attention away from threat, and suggested that positive-search training (promoting orientation towards positive stimuli) is an under-researched area that shows promise (Mogg et al., 2017; Waters et al., 2015; Waters, Pittaway, Mogg, Bradley, & Pine, 2013).

Ensuring that any dot-probe task is identifying the specific attentional bias it was designed to do is vital; hence, the stimuli used are key. The same is also true for tasks employed in potential ABMT; clearly, a dot-probe task designed to address test anxiety would require very different stimuli from one designed, for a fear of flying. However, identifying appropriate stimuli is a more complex process than selecting words that are related to the anxiety of interest; they must be congruent with the concerns of the individual. Mastikhina and Dobson (2017) suggested that finding optimal stimuli for ABMT would be an important step forward in providing clarity in the ABMT research field; given the issues associated with the threat congruent stimuli discussed in section 8.3.3 above, this is supported by the current research. Taking time to carefully consider and trial the stimuli to be used would seem to be the first step in the development of any new dot-probe tasks or associated treatment programmes.

A question frequently raised in relation to ABMT, is how to maintain the engagement of participants given that multiple sessions are required for the process to have the desired effect. Hence, game-like approaches have been proposed (Dennis & O’Toole, 2014; Macleod & Clarke, 2015), which attempt to make the process enjoyable and increase motivation to take part. This style of training is certainly a possibility that could be explored with adolescent populations if ABMT does indeed show promise.

8.7 Conclusion to the Discussion

A successful and effective modified Trier Social Stress Test has been demonstrated, providing an instrument to manipulate state anxiety in school-based research, though this has the potential to be refined further. Correlations were uncovered between trait test anxiety and state anxiety which support existing theories of the trait-state anxiety relationship. The relationship between anxiety and attentional control is less clear, though there is evidence which may warrant further research. Previous patterns of attentional bias in test anxious individuals were not replicated and its presence could not be predicted using quantitative data. However, attentional bias was found in several individuals and was congruent with how they described their experiences. Limitations of the study were identified and their impact on the findings discussed. Further research in the field of attentional bias and test anxiety must take
account of the potentially complex nature of the relationships between multiple variables. To address this, the combined use of qualitative and quantitative data is recommended within a Single Case Experimental Design paradigm.


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http://doi.org/10.1177/2167702614551572
Appendix 1 - Zeidner’s Transactional Model of Test Anxiety (1998)

**Evaluative situation**
- Nature of task
- Difficulty
- Atmosphere
- Time constraints
- Examiner characteristics
- Setting
- Mode of administration

**Perception of tests: appraisals and reappraisals**
- Threat
- Harm
- Challenge
- Indifference

**State test anxiety**
- Worry
- Emotionality
- Physiological arousal

**Coping reactions**
- Defensive mechanisms
  - Focus
  - Avoidance

**Adaptational outcomes**
- Task-related thinking
  - Performance
    - Accuracy
    - Latency
    - Efficiency
  - Physiological changes
  - Sense of efficacy

**Personal variables**
- Trait test anxiety
- Self-efficacy
- Ability
- Need for achievement
- Information processing capacity
- Study skills
# Appendix 2 - Words Employed in the Attentional Bias Dot-Probe Task

<table>
<thead>
<tr>
<th>Threat Words</th>
<th>Neutral Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment</td>
<td>Abbreviation</td>
</tr>
<tr>
<td>Coursework</td>
<td>Activity</td>
</tr>
<tr>
<td>Cramming</td>
<td>Advertisement</td>
</tr>
<tr>
<td>Exam</td>
<td>Basket</td>
</tr>
<tr>
<td>Exam Mark</td>
<td>Carpet</td>
</tr>
<tr>
<td>Exam panic</td>
<td>Chair</td>
</tr>
<tr>
<td>Exam paper</td>
<td>Collection</td>
</tr>
<tr>
<td>Exam question</td>
<td>Creation</td>
</tr>
<tr>
<td>Exam result</td>
<td>Cup</td>
</tr>
<tr>
<td>Exam worry</td>
<td>Cushion</td>
</tr>
<tr>
<td>Fail</td>
<td>Definition</td>
</tr>
<tr>
<td>Failure</td>
<td>Diagonal</td>
</tr>
<tr>
<td>Frustration</td>
<td>Digit</td>
</tr>
<tr>
<td>GCSE</td>
<td>Electricity</td>
</tr>
<tr>
<td>Going blank</td>
<td>Elephant</td>
</tr>
<tr>
<td>Grade</td>
<td>Floor</td>
</tr>
<tr>
<td>Hurry</td>
<td>Forest</td>
</tr>
<tr>
<td>Incorrect</td>
<td>Frequency</td>
</tr>
<tr>
<td>Incorrect answer</td>
<td>Grass</td>
</tr>
<tr>
<td>Invigilator</td>
<td>Handwriting</td>
</tr>
<tr>
<td>Letting myself down</td>
<td>History</td>
</tr>
<tr>
<td>Marking</td>
<td>Jumper</td>
</tr>
<tr>
<td>Multiple choice</td>
<td>Kilometre</td>
</tr>
<tr>
<td>Revision</td>
<td>Liquid</td>
</tr>
<tr>
<td>SATs</td>
<td>Newspaper</td>
</tr>
<tr>
<td>Study</td>
<td>Oven</td>
</tr>
<tr>
<td>Studying</td>
<td>Personality</td>
</tr>
<tr>
<td>Test</td>
<td>Picture</td>
</tr>
<tr>
<td>Timed exam</td>
<td>Property</td>
</tr>
<tr>
<td>Wrong answer</td>
<td>Radiator</td>
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<td></td>
<td>Room</td>
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<td></td>
<td>Studio</td>
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<td>Table</td>
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<td></td>
<td>Telephone</td>
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<td>Television</td>
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<td>Tree</td>
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<td></td>
<td>Triangle</td>
</tr>
</tbody>
</table>
Appendix 3 - Modified-TSST Debriefing and Distress Protocols

Participant distress protocol
In the unlikely event that a participant in the proposed study experiences a high degree of distress the researchers will:

- Request that the participant temporarily disengage from the activity and withdraw to a quiet private room nearby; explain to the participant that there is no obligation to continue and that they may leave at this point if that is their preference. If the participant were highly distressed, the researcher would ask that they remain in the quiet area until calm and safe to leave. Before departure, the participant will receive the standard debrief (see below).

- Participant will be allowed to recommence/complete assessment if they feel willing and able to do so and if this concurs with the researchers’ observation of the participant. The participant will not be able to recommence the assessment trial if they have already received the standard debrief (see below).

- Additional debrief will be offered to any student who has shown a high degree of distress during the attentional assessment. This will include signposting to appropriate academic and support services (e.g. student counselling) as well as generic services that may be relevant such as student’s medical general practitioner.

- If the researchers feel concerned about the student’s wellbeing, they will make personal contact with the student’s personal tutor or programme director directly following the assessment and will inform the student that they are going to do this as a safeguard to their best interests.
Debriefing instructions

High threat condition:

1. Thank you for taking part, your contribution is extremely valued.
2. Our study is examining the responses of people who are anxious about exams when they perform tasks that may or may not have consequences.
3. The computer-based task you did is comparing how much attention is allocated to potentially anxiety-provoking words (such as ‘exam’) with neutral words (such as ‘chair’).
4. We expect to find that people who find exams worrisome allocate more attention to the anxiety provoking than neutral words. In psychology, this is called an attentional bias.
5. You were in the condition where you gave a presentation about your chosen career pathway. You were told that your presentation was being filmed by the panel as they would analysis it for non-verbal behaviour afterwards and compare it with other presentations. You were then asked to perform a maths task, which was to count down from 2015 in 13s and you were asked to start again every time you made a mistake.
6. We would like to make clear that we will not be scoring your presentation, and we will not be comparing you to any other students. Furthermore, the video camera and microphone were not even turned on and we will not be analysing your non-verbal behaviours. Also, the maths task was designed to be difficult, so don’t worry if you found it hard. No one will know how you did on the maths task.
7. The reason why we told you this was that we needed to try and create a realistic test scenario in which you thought your performance might be judged by others. If we had not told you this, then it would not have been as realistic.
8. In our follow-up project, we will be helping students who find exams particularly worrisome to re-train their anxiety. We believe that this will help them to focus better when preparing for exams and in exams themselves as they will not be so easily distracted by worry or anxiety-provoking stimuli.
9. We appreciate that you may feel that you have been misled and that you might therefore wish to have your results removed. We hope, however, that you will also appreciate that this type of research will contribute to ways in which students can reduce their anxiety and worry about exams, and that a small degree of deception is acceptable if it allows us to develop a protocol for helping people. We did of course receive ethical approval from the University for this research.
10. If you would like to have your data removed, please let us know your participant number.

11. Again, we would like to thank you for your time and participation.
Appendix 4 - Study Instruments

Revised Test Anxiety Questionnaire

Name_________________________________________ Age (yrs & mths)___________
Gender (Circle) M/F Date______________

Directions:
A number of statements, which students have used to describe how they feel about examinations, are given below. Read each statement and put a cross in the circle to the right of the statement to indicate how you feel about examinations.

1. Thinking about my grade in a subject interferes with my work on exam
2. I seem to get confused while taking important exams
3. During exams I find myself thinking about the consequences of failing
4. I feel uneasy before getting an important exam grade back
5. During exams I feel very tense
6. I worry a great deal before taking an important exam
7. During exams I think of things unrelated to what is being tested
8. During exams I think how much brighter than me the other people are
9. I think about current events during an exam
10. I get a headache during an important exam
11. While taking an exam, I often think how difficult it is
12. I am anxious while taking exams
13. While taking exams I sometimes think about being somewhere else
14. During exams I am distracted by thoughts of upcoming events
15. My mouth feels dry during an exam
16. I sometimes find myself trembling before or during an exam
17. While taking an exam my muscles are very tight
18. I have great difficulty breathing during an exam
19. During an exam I think how I should have prepared for it
20. I worry before an exam because I do not know what to expect

Almost never  Sometimes  Almost always
1 2 3 4
STAI Form Y-1

Name__________________________ Age (yrs & mths)__________
Gender (Circle) M/F Date________

Directions:
A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1. I feel calm ……………………………………………………………………………….
   1 2 3 4
2. I feel secure ………………………………………………………………………....
   1 2 3 4
3. I am tense ………………………………………………………………………….
   1 2 3 4
4. I feel strained ……………………………………………………………………….
   1 2 3 4
5. I feel at ease ……………………………………………………………………….
   1 2 3 4
6. I feel upset ………………………………………………………………………...
   1 2 3 4
7. I am presently worrying over possible misfortunes …………
   1 2 3 4
8. I feel satisfied ………………………………………………………………………
   1 2 3 4
9. I feel frightened ………………………………………………………………………
   1 2 3 4
10. I feel comfortable ………………………………………………………………….
    1 2 3 4
11. I feel self-confident …………………………………………………………………
    1 2 3 4
12. I feel nervous ……………………………………………………………………….
    1 2 3 4
13. I am jittery ………………………………………………………………………….
    1 2 3 4
14. I feel indecisive ………………………………………………………………………
    1 2 3 4
15. I am relaxed ………………………………………………………………………….
    1 2 3 4
16. I feel content ……………………………………………………………………….
    1 2 3 4
17. I am worried ………………………………………………………………………….
    1 2 3 4
18. I feel confused ……………………………………………………………………….
    1 2 3 4
19. I feel steady ………………………………………………………………………….
    1 2 3 4
20. I feel pleasant ………………………………………………………………………
    1 2 3 4

Very much so
Moderate so
Somewhat
Not at all
Attentional Control Scale

Name ___________________________ Age (yrs & mths) ____________
Gender (Circle) M/F Date ____________

Directions:
A number of statements relating to your attention are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how it best applies to you.

Almost never Sometimes Often Almost always

1. It is very hard for me to concentrate on a difficult task when there are noises around. 1 2 3 4
2. When I need to concentrate and solve a problem, I have trouble focusing my attention. 1 2 3 4
3. When I am working hard on something I still get distracted by events around me. 1 2 3 4
4. My concentration is good even if there is music in the room around me. 1 2 3 4
5. When concentrating, I focus my attention so I'm unaware of what's going around me. 1 2 3 4
6. When I am reading or studying, I am easily distracted if there are people talking. 1 2 3 4
7. When trying to focus my attention, I have difficulty blocking out distracting thoughts. 1 2 3 4
8. I have a hard time concentrating when I'm excited about something 1 2 3 4
9. When concentrating I ignore feelings of hunger or thirst. 1 2 3 4
10. I can quickly switch from one task to another. 1 2 3 4
11. It takes me a while to get really involved in a new task. 1 2 3 4
12. I find it difficult to coordinate listening to the teacher and writing notes in lessons. 1 2 3 4
13. I can become interested in a new topic very quickly when I need to. 1 2 3 4
14. It is easy for me to read or write while I'm also talking on the phone. 1 2 3 4
15. I have trouble carrying on two conversations at once. 1 2 3 4
16. I have a hard time coming up with new ideas quickly. 1 2 3 4
17. After being interrupted, I can easily shift my attention back to what I was doing. 1 2 3 4
18. It is easy for me to shift my attention away from distracting thoughts. 1 2 3 4
19. It is easy for me to alternate between two different tasks. 1 2 3 4
20. It is hard to break away from one way of thinking and look at things another way. 1 2 3 4
Appendix 5 - TSST Script

Experimental Phase, Task 1 - Presentation

Experimenter’s Role

The experimenter explains to the research participants their first task. This is to give an introductory talk in front of the panel to answer two questions:

1. What do you intend to do after the completion of your A-level studies?
2. What strengths do you have that make you suitable for this role?

The experimenter uses the following script to issue the instructions:
"Your task in this experiment is the following: Explain what course or career do you intend to pursue after the completion of your A-level studies? What strengths do you have that make you suitable for this role? Please note a video camera and a microphone will be recording you for subsequent voice and behavioural analysis and to allow us to judge the quality of your presentation against others. The panel members are trained in behavioural analysis and will take notes during your talk; you should try to leave the best possible impression on them. The panel will reserve the right to ask follow-up question to receive all necessary information from you. Following your talk, you will be given a second task by the panel, which will only be explained to you by the panel. You may make some notes now to help gather your thoughts, but you must not use them during your talk. Do you have any questions?"

After giving the introduction the experimenter provides a pen and paper to the participant who has three minutes to make notes on their presentation, however they cannot use these notes during the talk. During this time a stopwatch is visible, counting down the time for the participant to see. Following this one member of the interview panel (chosen in advance) takes over dealing with the participant.

Task 1 – Oral presentation

Only one member of the interview panel should address the research participant directly, so that coordination problems between the panel members can be avoided.

Ask the participant:
“Please step up to the microphone.”

Pretend to turn on the video camera and microphone then open up the session with the words:

“Please begin your talk.”

All members of the panel remain silent, for as long as the participant continues to speak fluently. In most cases, it is anticipated the participant will come to the end of the talk before the allotted time has passed. After a pause (at least 20 seconds) the panel can alert the participant to the remaining time using the phrase:

"You still have time, please continue.”

Repeat this once or twice. Should it appear that the participant has nothing further to say, then the panel should ask questions until the end of the time period (total time 5 minutes max).

Typical questions include:

- Why do you think you are suited to this career pathway?
- Why do you think you are better qualified than others?
- What do strengths would others say you have?
- What would make you stand out above other candidates?
- How would your teachers describe your work in school?

Task 2 – Mental maths task

After the 5 minutes allocated to the presentation are over the participant is informed by the interview panel about the second task. The following instructions should be given:

“We now want you to solve a calculation task. You must count aloud backwards from 2015 to zero, subtracting 13 at a time. I will give you an example using different numbers: 2033, then 2020, 2007 and so on. Please calculate as quickly and correctly as possible. Should you miscalculate, I will point out your mistake and you must start all over again at 2015. Do you have any questions?”
The correct sequence is on the following page. Should the research participant miscalculate, interrupt with the standard phrase:

"Error, start again at 2015."

This continues until the end of the test period. This part of the test should be concluded after five minutes, unless the participant reaches a count of "0" before that.

After this I will take over again.
Appendix 6 - Interview Schedules

Preliminary Study

1. How were you feeling when you were preparing for your presentation, when you had the 3 minutes? (Probe for nervous/anxious/stressed)
2. What were you thinking about at this time? Where you able to focus on preparing the task? (Probe for distraction)
3. What were you concerned about? (Follow up) Why? (Probe for lack of control, being judged, failing)
4. How did you feel when you were giving your presentation? (Probe for reasons)
5. How did the interviewers make you feel?
6. Did you feel judged in any way? (Explore positive or negative)
7. How about the maths task, how difficult did you find that? (Follow with) How did you feel when you made mistakes?
8. Where any of your thoughts or feelings distracting you from the tasks you were asked to perform?
9. How did you cope with distracting thoughts? (Conditional on answer to Q8)
10. Were the feelings you experienced during the presentation and maths task still affecting you when you came to do the computer program? How?
11. Talking about the computer program, was it easy enough to use and interact with? Did the instructions and layout make sense?
12. Did you read the words?
13. Could you tell me any of the words that stood out? Where there any patterns to the words; categories, or ways of grouping them together?
14. (Conditional on Q.13) Once you noticed that pattern, were you starting to anticipate what the exam word would be?
Main Study

1. How were you feeling when you were preparing for your presentation, when you had the 3 minutes? (Probe for nervous/anxious/stressed)
2. What were you thinking about at this time? Where you able to focus on preparing the task? (Probe for distraction)
3. What were you concerned about? (Follow up) Why? (Probe for lack of control, being judged, failing)
4. How did you feel when you were giving your presentation? (Probe for reasons)
5. How did the interviewers make you feel?
6. Did you feel judged in any way? (Explore positive or negative)
7. How about the maths task, how difficult did you find that? (Follow with) How did you feel when you made mistakes?
8. Where any of your thoughts or feelings distracting you from the tasks you were asked to perform?
9. How did you cope with distracting thoughts? (Conditional on answer to Q8)
10. Were the feelings you experienced during the presentation and maths task still affecting you when you came to do the computer program? How?
11. Talking about the computer program, could you tell me any of the words that stood out?
12. Where there any patterns to the words; categories, or ways of grouping them together?
13. Once you noticed that pattern, were you starting to anticipate what the exam word would be?
14. Are there any similarities between the thoughts and feelings you experienced during the tasks you have just done and how you think or feel in an important exam?
15. Why do you think that was?
16. In the run up to exams do you worry about them? How long beforehand?
17. Is there anything you can do about this? (Conditional on answer to Q16)
Appendix 7 - Participant Information

You are being invited to take part in a research study looking at people’s attitudes to examinations and how they affect their information processing. Before you decide to take part, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

Who will conduct the research?
Prof. Kevin Woods and Rob Buck, from the Manchester Institute of Education, Ellen Wilkinson Building, University of Manchester, Oxford Road, M13 9PL.

Title of the Research
Attentional Bias in Test Anxiety: An Investigative Study.

What is the aim of the research?
We are interested in looking at the how students who may feel anxious about tests and exams react to giving an oral presentation and completing a maths task, and how it affects their completion of an information processing task. We hope the understanding gained from this research will enable us to develop a training package which can develop students’ ability to focus at their best during tests and exams.

Why have I been chosen?
You have been chosen because school/college has given us permission to approach you about taking part in our research.

What would I be asked to do if I took part?
If you decide to take part in the study, you will be asked to complete questionnaires about test-related anxiety and your ability to control your attention. You will be asked on a different day to give a presentation and complete a mental maths task.

All activities will take place at your school or college and we may choose to video record your presentation. The schedule of the activities will be arranged so that it doesn’t interfere with your studies. Information about the presentation will be provided nearer the time. Once you have given the presentation, you will complete a short computer task, a questionnaire about how you are feeling after it and we will ask you some questions about your experience of taking part in the study. We would like to audio record your answers to the questions so that we can listen back to what people have told us. It is not expected that taking part in this study will cause you any risks, pain or discomfort.

What happens to the data collected?
The data collected will be used to improve understanding of how people behave in tests and examinations and inform the development of a training programme to help reduce people’s anxiety about tests.

How is confidentiality maintained?
It is necessary that participants’ anonymity be secured. The researchers will take steps to ensure that all data are stored securely and the anonymity of participants is
maintained e.g. through the use of pseudonyms. All data will be stored on a secure shared drive in a password-protected folder to which only the research team have access. We will not pass on your details to anyone else.

**What happens if I do not want to take part or if I change my mind?**
It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time without giving a reason and without detriment to yourself. If you choose to withdraw from the study up to three weeks after participation, we will remove your data from the dataset. It will not be possible to withdraw your data from the dataset after three weeks as links between individual participants and data will have been erased at that point.

**Will I be paid for participating in the research?**
No, unfortunately it is not possible to offer you payment for taking part in this study.

**What is the duration of the research?**
You will need to take part in the study on two occasions. It is anticipated that completion of the questionnaires, presentation, maths task, computer programme and interview will last a total of approximately one hour. Additional time will be needed to provide participants with instructions at the beginning of the study, and to debrief them at the end. It is anticipated that the total duration will not exceed one and a half hours.

**Where will the research be conducted?**
Experimental sessions will take place at your school or college. Data analysis will occur at the Manchester Institute of Education, Ellen Wilkinson Building, University of Manchester, Oxford Road, M13 9PL.

**Will the outcomes of the research be published?**
It is hoped that the outcomes of this research will be published in a peer-review journal, and possibly presented at an academic conference.

**Contact for further information**
Rob Buck, Manchester Institute of Education, Ellen Wilkinson Building, University of Manchester, Oxford Road, M13 9PL. Email: robert.buck@postgrad.manchester.ac.uk. You can also speak to your Head of Psychology if you have any concerns.

**What if something goes wrong?**
If you wanted to make a formal complaint about the conduct of the research you should contact the Head of the Research Office, Christie Building, University of Manchester, Oxford Road, Manchester, M13 9PL.
Appendix 8 - Directed Content Analysis Coding Schedule

AP - A priori codes, those in the original version of the schedule.
E - Emerging codes added to the schedule during the coding process.

Trait test anxiety
Worry about exams
Yes (AP)
No (AP)
Topic
Maths task (AP)
Presentations (AP)
Behaviour
Nothing I can do/Helplessness (AP)
Preparation (AP)
Must finish (E)
Push myself (E)

The modified-TSST
Interviewers
Friendly/Supportive (AP)
Unhelpful (AP)
Rude (AP)
Intimidating (E)
Expectations
Good impression (AP)
Knew I’d fail (E)
Should be able to do it (E)
Tasks
Lack of preparation (AP)
Time pressure (AP)
Unrealistic (E)
Similar to an exam
Yes (AP)
No (AP)

Attentional Control
Going blank (AP)
Concentration (AP)
Focus (AP)
Notice patterns in the words?
Yes (AP)
No (AP)
Drifting off (E)
State anxiety

High SA
Anxious (P)
Failure (AP)
Judged (AP)
Lack of control (AP)
Nervous/Worried (AP)
Pressure (AP)
Angry/Annoyed (E)
Confused (E)
Embarrassed (E)
Frustrated (E)
Indecisive (E)
Stressed (E)
Unable to cope (E)

Low SA
Confident (AP)
In control (AP)
Relaxed (AP)

Attentional bias/Distraction

By failure
Consequences (AP)
Worries (AP)
Mistakes (AP)
Judgement (E)

By tasks
Task itself (E)
Starting again (E)
Self-check (E)

By words
Exam/School (AP)
No pattern/Random (E)