

Paper 2: “If I can’t answer this question, I’ll fail the whole exam”: Examination anxiety, GCSE achievement and tendency to draw the worst possible conclusion

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Abstract

General Certificate of Secondary Education (GCSE) examinations represent a significant source of worry and anxiety for students in their final two years of compulsory education, referred to as Key Stage 4 in the UK (Denscombe, 2000; Putwain, 2007). A small inverse relationship has been reported between the appraisal of examinations as threatening, as measured through the test anxiety construct, and GCSE achievement (Putwain, 2008). Test anxiety is hypothesised to have an interfering effect on achievement through occupying cognitive resources, however it may not be the perception of examinations as threatening that is responsible for interference effects, *per se*, but how the student responds to that threat (Putwain, in press). Some students respond to test anxiety with a ‘catastrophic’ response in which they find it difficult to read and interpret questions, and to recall material required to respond to assessment demands. In contrast, other students respond to test anxiety with a positive response in which they will persist in trying to answer questions and experience a ‘return’ of material required. The present study aims to investigate this relationship further by examining whether the strength and/ or magnitude of the test anxiety – GCSE achievement relationship is influenced by the tendency to catastrophise and draw negative conclusions about events, as measured through the cognitive distortions construct. Two schools were recruited following a mailshot inviting participation. Self-report data for test anxiety and cognitive distortions were collected from 224 students in their final year of compulsory schooling, approximately six weeks before GCSE examinations began. Test anxiety data was collected using the *Revised Test Anxiety* scale (Benson *et al.*, 1992), whilst cognitive errors data was collected using the *Children’s Negative Cognitive Error Questionnaire* (Leitenberg *et al.*, 1986). Questionnaire order was counterbalanced and presented in a single pack. Examination performance data was collected in Mathematics, English Language and Science. GCSE Grades (A*-G) were converted to a numerical value (8-1). Results indicated an inverse relationship between GCSE achievement and two components of test anxiety: worry and bodily symptoms (headaches, muscle tension, etc.). The magnitude of the GCSE achievement – worry relationship was increased by catastrophising (a belief in the worst possible outcome) and selective abstraction (selectively focusing attention on the negative elements of a situation) and the GCSE achievement – bodily symptoms relationship was increased by selective abstraction only. These findings are broadly consistent with those reported in both UK and international contexts. They provide further evidence that in the high stakes context provided by the GCSE, test anxious students who experience high levels of worry and/ or bodily symptoms, may be achieving less than their low test anxious counterparts. The findings in this exploratory study are useful in establishing the nature and direction of interactions between test anxiety and students’ response to this anxiety, which could be used to inform the development of subsequent research and treatment. They suggest that interventions which focus directly on reducing examination-related worries may not be as effective as those which focus on both worry and bodily symptoms test

anxiety. Secondly, the cognitive element of interventions may benefit from specifically and explicitly addressing a student's response to test anxiety.

Introduction

A robust finding in the literature is that test anxiety, the debilitating anxiety experienced by students in assessment contexts, shows a small, but significant inverse relation with measures of achievement and/ or assessment performance. An exploratory study of test anxiety in a sample of students in their final year of compulsory schooling in England suggested that highly test anxious students who also had a tendency to catastrophise, a type of cognitive distortion, were at greater risk of low examination performance (Putwain, 2009). The study described in this paper sought to examine in more detail, the moderating influence of cognitive distortions in a sample of students at the same stage of schooling. Measures of test anxiety, cognitive distortions and examination performance were used to establish if cognitive distortions increased the strength of the test anxiety – examination performance relationship.

The test anxiety construct

Evidence suggests that high stakes examinations represent a significant source of worry and anxiety for school aged students (Connor, 2001; 2003; Gallagher & Millar, 1996; Kyriacou & Butcher, 1993; Owen-Yeates, 2005; Putwain, 2009). In the educational and psychological literature such phenomena are often researched using the test anxiety construct, which has been conceptualised as a situation-specific trait in the extent to which people find examinations as threatening (Spielberger & Vagg, 1995). It is characterised as a form of social-evaluation anxiety, a group of sub-clinical anxieties including sports, public speaking and so forth, where performance is judged or evaluated by others (Zeidner, 1998; Zeidner & Mathews, 2005). Narrow definitions tend to focus on fear of failure (e.g., Hong, 1999; Meijer, 2001), however broader definitions also include threats to esteem, the consequences of assessments and of being judged in a derogatory way by others (e.g., Spielberger, 1966).

Test anxiety has distinct cognitive, physiological-affective and behavioural components (Zeidner & Mathews, 2005). The cognitive component refers to negative thoughts which arise during examinations and other assessments, self-deprecating statements such as "I am going to fail this exam". The physiological-affective component refers to the person's perception of their physiological state which might include tension, trembling, feeling sick and so forth. The behavioural component refers to poor study and test-taking skills, and inattentive/ distracted behaviours during tests. Test anxiety is primarily thought of as having a debilitating effect on assessment task performance; highly test anxious students may, for example, become easily distracted during an examination, have difficulty in reading and understanding questions and assessment demands and/or experience difficulty in the recall of learned material (King, Ollendick & Gullone, 1991). The assessment task performance of highly test anxious students is lower than their low test anxious counterparts of equal ability (Hembree, 1988), an effect which is attributed to worrisome thoughts occupying or interfering with cognitive resources (Eysenck, Santos, Derekesan, & Calvo, 2007; Owens, Stevenson, Norgate & Hadwin, 2008).

Drawing on transactional models of stress/ anxiety and cybernetic models of self-regulation, Zeidner and Mathews (2005) propose a self-referent model of

evaluation anxiety which can be directly applied to test anxiety. In this model, executive processing is triggered by either an external situational threat (e.g. a forthcoming examination) or internal stimuli (e.g. thoughts of failure). Immediate distress and increases in state anxiety occur through accessing negative self-knowledge (e.g. a perception of low competence or an avoidant motivation), counterproductive coping strategies (e.g. self-blame) and metacognitive beliefs (e.g. that it is important to monitor worry). Longer-term distress is maintained by dysfunctional styles of person-situation interaction (e.g. avoiding situations where task-relevant skills and knowledge can be practiced and evaluated). Although assessment task performance is not explicitly addressed in this model, other transactional models of test anxiety (e.g. Lowe *et al.*, 2008; Zeidner, 1998) propose impaired performance arises from the interference-inducing effects of increases in state anxiety.

The multidimensionality of test anxiety is well established in the literature. A distinction between worry and emotionality, corresponding to cognitive and physiological-affective components of test anxiety was first proposed by Liebert and Morris (1967). This distinction has been extensively replicated in numerous factorial validity studies (for a brief review see Benson, Moulin-Julian, Schwarzer, Seipp & El-Zahhar, 1992) and has strongly influenced subsequent theorising about test anxiety (see Spielberger *et al.*, 1978) including the development of widely used measurement instruments such as the Test Anxiety Inventory (Spielberger, 1980). One of the most significant implications of this distinction is that the debilitating effects on assessment task performance are largely attributable to the worry component whilst the influence of the emotionality component is much weaker. More recent research uses a four-factor conception of test anxiety comprising of two cognitive components, worry and test-irrelevant thinking, and two physiological-affective components, tension and bodily symptoms (Benson *et al.*, 1992; Sarason, 1984). Worry represents specific thoughts concerning performance evaluation whereas test-irrelevant thinking represents distracting thoughts which do not directly concern evaluation. Tension items refer to a general perception of affective-physiological state whereas bodily symptoms items refer to more specific features, for example headaches and difficulty breathing (Sarason, 1984; Zeidner, 1998). Research examining the association between this conception of test anxiety and examination performance with undergraduate students has found mixed results. One study reported significant inverse relations only with the worry component (Keogh, Bond, French, Richards & Davis, 2004). However, another study reported significant inverse correlations between performance (summed across three examinations) and worry, test-irrelevant thoughts and tension, with the association between performance the strongest (McIlroy, Bunting & Adamson, 2000).

Test Anxiety and cognitive distortions

In a qualitative study of students taking their General Certificate of Education (GCSE) examinations, the school leaving qualification in England and Wales, Putwain (2009) reported differences amongst highly test anxious students in self-reported experiences of cognitive interference and cognitive deficits during examinations. The students described typical characteristics of test anxiety such as having difficulties in answering examination questions due to an inability to interpret assessment demands or recall the information required for the answer. Some students, however, would persevere with their examination, move onto a question they could understand and/ or answer and return to the earlier question at a later

point, often with a return of the 'lost' memory. In contrast, other anxious students described a 'catastrophic' response in which they panicked and found it very difficult to continue answering subsequent questions. This analysis would suggest that some types of students, those who are both highly test anxious *and* with a tendency to catastrophise, would be at a greater risk of cognitively induced performance deficits than students who may be highly test anxious but do not have as strong a tendency to catastrophise.

Catastrophising beliefs are regarded in the clinical literature as type of cognitive distortion, a belief that underlies negative affect (Beck, 1976; 1985). In addition to catastrophising (a belief in the worst possible outcome, for instance, "If I will fail this exam my whole life will be a failure"), other cognitive distortions include overgeneralising (a belief that negative outcomes will occur in all situations, for instance "I will fail all my exams"), personalising (excessive attribution of failure to internal causes, for instance "I will not pass this exam because I am a failure) and selective abstraction (selectively focusing attention on negative elements, for instance "I will fail my exam because I could not answer some questions"). Evidence has shown how such cognitive distortions contribute to anxiety symptoms in adult anxiety disorders (Clark, 1996; Clark & Wells, 1995), in adolescents (Weems, Berman, Silverman & Saavedra, 2001) and tend to be endorsed more strongly in highly test anxious schoolchildren (Leitenberg, Yost & Carroll-Wilson, 1986). While research has established how cognitive distortions may be associated with the subjective phenomenology of anxiety, research has yet to establish if cognitive distortions are associated with particular performance outcomes in anxious persons. The phenomenon of test anxiety would seem an appropriate manifestation of anxiety with which to examine the moderating influence of cognitive distortions given that concern with performance and failure is a defining feature of test anxiety and that test anxiety is associated with lower examination performance.

Cognitive distortions are not explicitly addressed in Zeidner & Mathews' (2005) model of test anxiety, but as patterns of beliefs involved in the processing of threat stimuli correspond, to secondary appraisal, acting on the same level as executive processes or self-referent beliefs that influence the choice of coping strategies. Thus, a test anxious student might initially appraise a high stakes examination as threatening due to its important consequences which triggers performance related cognitions. However, the types of beliefs held by that student would determine, in part, the continuing appraisal of the examination as threatening. A student with strong catastrophising beliefs, for example, would continue to appraise the examination as threatening, and, as a result, would engage in performance interfering cognitions and/or behaviours. A student without strong catastrophising beliefs would be less likely to continue to appraise that examination as threatening and enlist fewer performance interfering responses as the examination progressed. A similar pattern of appraisal would be expected for the beliefs characterised by generalisation, personalising and selective abstraction. Thus, it would be expected that self-reported test anxiety would interact with cognitive distortions in predicting examination performance such that the inverse relationship between test anxiety, particularly the worry component, and exam performance would be stronger for students who also report a tendency to experience cognitive distortions.

Aims of the present study

The present study aimed to extend the existing literature by examining whether and how the test anxiety – examination performance relationship is moderated by cognitive distortions in the context of a high stakes examination (GCSE examinations). Cognitive distortions are conceptualised as moderating factors which will influence the strength and/ or direction of the test anxiety – assessment task performance relationship (see Baron & Kenney, 1986). It is predicted that an inverse relationship will be observed between test anxiety, particularly the worry component, and GCSE examination performance which will be stronger for students who self-report a greater proclivity towards cognitive distortions. An additional aim of this study is to provide evidence for the test anxiety – examination performance relationship in a UK context at, arguably, the most critical stage of schooling (Denscombe, 2000). Although there has been much media interest and debate in the UK surrounding the increased pressure of testing and examinations in schools, particularly English schools, (e.g., Times Educational Supplement, 2005) and given that the relationship has been well established in a number of other countries (e.g., O’Neil & Fukumura, 1992; Seipp & Schwarzer, 1996), with some notable exceptions (e.g. Gregor, 2005; Keogh *et al.*, 2006) there is remarkably little data available on test anxiety in samples of UK students, particularly those of a school age (see Putwain, 2007). The findings of this study will, therefore, contribute more generally to an understanding of test anxiety in the UK.

Method

Participating students and institutions

Data was collected from 244 Year 11 students in two suburban secondary schools located in the Northwest of England of whom 121 were male and 123 female. The mean age was 15.6 years ($SD = .49$). Students were following GCSE courses, or their vocational equivalent, in a number of subjects. Some of these are chosen by students and others, including Mathematics, English Language and Science are a statutory requirement. The GCSE programme of study is followed over a nineteen month period in Years 10 and 11, the final two years of compulsory schooling in the UK and collectively referred to as Key Stage 4 (KS4). At the point of data collection for this study, students were nearing the end of their GCSE programme of study. Both schools were specialist status (one was a specialist language college and the other a specialist sports college) and in the two year period before data collection for this study, when judged on the basis of Department for Children, Families and Schools (DCFS) data for KS4, one school would be considered as performing equivalent to the local and English average and other as above average (DCFS, 2008). The most recent Office for Standards in Education (OFSTED) reports (both schools were inspected 2007-8) described both schools as outstanding².

Instrumentation

Test anxiety data was obtained using the *Revised Test Anxiety* scale (TRA: Benson *et al.*, 1992). This twenty-item questionnaire requires students to respond to statements (e.g. ‘I am anxious while taking exams’) using a Likert-format response from four ordered categories (1 = almost never, 4 = almost always). Item wording referring to ‘tests’ was changed to ‘exams’ in order to emphasise the high stakes nature of the assessments associated with the GCSE examinations. Construct validity and reliability have been reported in a number of studies (Benson *et al.*,

1992; Benson & El-Zahhar, 1994; Hagtvet & Benson, 1997) and this measure has been used in contemporary test anxiety research with adolescent students in the UK (e.g., Keogh *et al.*, 2006). Separate scores are provided on four factorially derived subscales: worry (6 items; e.g. 'I worry a great deal before taking an exam'), test-irrelevant thinking (4 items; e.g. 'I think about current events during an exam'), tension (5 items; e.g. 'During exams I feel very tense') and bodily symptoms (5 items; e.g. 'I get a headache during an important exam'). Excellent reliability coefficients of .80-.82, based on the current sample, are reported in Table 1 below.

Cognitive distortions were measured using the *Children's Negative Cognitive Error Questionnaire* (CNCEQ; Leitenberg *et al.*, 1986). This twenty-four item questionnaire provides scores for four theoretically derived scales: catastrophising, overgeneralisation, personalising and selective abstraction. Each of these subscales contains six hypothetical scenarios (two social, two academic and two athletic) and a possible negative interpretation (e.g. In your last English homework, although most of the spelling was correct, you spelled excellent wrongly. You think "I'm no good at spelling"). Students respond on a five-point scale (1 = Not at all like I would think, 5 = Almost exactly like I would think) reversed so that a higher score indicated a greater tendency towards cognitive distortions. Item wording was changed from the original North American version to a vocabulary more appropriate for school-children in the UK (e.g. 'recess' changed to 'break time', 'gym class' to 'PE lesson', 'softball to basketball' and so forth)¹. Test-retest and internal reliability along with validity estimates were reported in Leitenberg *et al.* (1986) and has this measure been used in subsequent research with children and adolescents (e.g., Weems *et al.*, 2001). Reliability coefficients of .67-.82 are reported in Table 1 below and are generally acceptable or better.

GCSE achievement data was collected in three subjects: Mathematics, English Language and Science. These subjects were chosen as representing three of the more important GCSE subjects; English Language, Mathematics and Science are three of the five subjects schools have a statutory requirement to teach at KS4 (the others are Citizenship and Information and Communication Technology – see QCA, 2007a, 2007b). Moreover, at the time of writing English and Mathematics are included in the calculation upon which secondary school effectiveness in England and Wales is based (the number of students attaining five A*-G grades at GSCE, or equivalent, including English and Mathematics – see DCSF, 2008). GCSE Grades (A*-G) were converted to a numerical value using the current convention for educational research in the UK (e.g. Flaxman, *et al.*, 2002; Schagen & Schagen, 2005). A grade of A* is given a numerical value of 8, a grade of A given a numerical value of 7 and so forth down to a value of 1 for a grade G. An unclassified grade receives a value of 0 in this system. Where students had taken separate science courses in Biology, Chemistry and Physics instead of a combined Science GCSE, a single mean science score was calculated and a total GCSE points score was calculated from the sum of the grades in Mathematics, Science and English Language.

Design and procedure

Data was collected at two time points. Self-report questionnaire measures of test anxiety and cognitive distortions were collected in March/ April of Year 11 (the final year of compulsory schooling in the UK), approximately two months before the start of GCSE examinations. GCSE examination performance in Mathematics, English Language and Science was collected in August when results are made

available to schools by the national awarding bodies. The GCSE examinations are conceptualised as high stakes as they influence access to educational and occupational opportunities and are considered by adolescents as markers of personal identity upon which self-judgements (i.e. success/ failure) are made (Denscombe, 2000).

Schools were recruited following a mailshot inviting participation sent to a sample of coeducational state funded schools, likely to represent a broad range of ability and socio-demographic categories. Permission to collect data was granted at an institutional level by the Head Teacher of a participating school, prior to data collection, and individual consent sought from students at the point of data collection. Questionnaire order was counterbalanced and presented in a single pack with an individual information/ consent sheet to a whole year cohort during form time. The aims of the project along with anonymity and consent issues (including retrospective withdrawal) were explained to students by the researchers who remained present during data collection to answer queries by participating students about questionnaire items. Nine students were absent on the day of data collection or declined to participate.

Results

Descriptive statistics and bivariate correlations

Descriptive statistics and bivariate correlations for test anxiety, cognitive distortions and GCSE achievement are reported in Table 1. Significant positive correlations were observed between test anxiety and cognitive distortions which tended to be moderate – strong for the worry and bodily symptoms components and small-moderate for the test-irrelevant thinking and tension components³. Small, but significant, inverse correlations were observed between the worry and bodily symptoms components of test anxiety and GCSE achievement, stronger for Mathematics than for other subjects. The relationships between the test-irrelevant thinking and tension components of test anxiety and GCSE achievement were non-significant with the exception of the small inverse correlation between test-irrelevant thinking and Mathematics. With three exceptions, small, but significant, inverse correlations were observed between cognitive distortions and GCSE achievement. The exceptions to this general trend were for the relationships between Science and overgeneralisation, Science and personalisation and between Mathematics and personalisation. Strong positive inter-correlations were reported between the different cognitive distortions and between GCSE subjects. The test anxiety components showed strong positive inter-correlations with the exception of test-irrelevant thinking, for which inter-correlations were weak.

Descriptive statistics indicate that mean scores for worry and tension components of test anxiety fell midway in the range of possible scores. Mean scores for test-irrelevant thinking and bodily symptoms fell closer to the bottom of the possible range. Mean scores for all four cognitive distortions were close to the bottom of the range. While this may be expected for a non-clinical population, it resulted in all four cognitive distortions showing a positive skewed distribution of scores ($z > 1.96$). Mean scores for Mathematics, English Language and Sciences were in the range of 5-6 equivalent to a GCSE grade C (considered a pass grade).

Given the violated parametric assumption of normality, assumptions of homoscedasticity and linearity in subsequent regression analyses were considered carefully through visual inspection of P-P plots and plots of standardised residuals against predicted values for explanatory and criterion variables. No violations of homoscedasticity and linearity were identified, consistent with the conceptualisation of test anxiety as a debilitating form of anxiety where an inverse linear, rather than curvilinear, relationship with performance is observed. No data transformations were therefore considered necessary. The strong intercorrelations between the cognitive distortions variables may pose a problem for multicollinearity in regression analysis and Tabachnick & Fidell (2001) urge caution when $r > .7$, however in subsequent regression analyses tolerance statistics were all $> .2$ and variance inflation factor statistics were all > 1 indicating that multicollinearity was not a particular cause for concern here. No cognitive distortions variables were excluded or merged from subsequent analyses.

Table 1 Zero order correlations, descriptive data and reliability coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Test Anxiety												
Worry (1)	--	.50**	.63**	.57**	.49**	.52**	.45**	.41**	-.29**	-.18**	-.19**	-.23**
Test Irrelevant Thinking (2)		--	.27**	.28**	.23**	.27**	.20**	.24**	-.15*	-.09	-.11	-.10
Tension (3)			--	.52**	.32**	.33**	.31**	.24**	.01	.12	.06	.09
Bodily Symptoms (4)				--	.50**	.45**	.43**	.42**	-.24**	-.18**	-.22**	-.22**
Cognitive Distortions												
Catastrophising (5)					--	.79**	.72**	.67**	-.15*	-.17*	-.13*	-.16*
Overgeneralisation (6)						--	.75**	.72**	-.13*	-.17*	-.12	-.14*
Personalisation (7)							--	.70**	-.12	-.13*	-.09	-.14*
Selective Abstraction (8)								--	-.17*	-.17*	-.14*	-.18*
GCSE Examination Performance												
Mathematics (9)									--	.73**	.83**	.93**
English Language (10)										--	.74**	.87**
Science (11)											--	.92**
Total points (12)												--
Possible Scale Range	6-24	4-16	5-20	5-20	6-30	6-30	6-30	6-30	1-8	1-8	1-8	3-24
Observed Scale Range	6-24	4-16	5-20	5-20	8-30	7-30	8-30	7-30	1-8	2-8	1-8	5-24
Mean	13.00	8.91	12.82	8.69	6.08	6.96	6.38	6.05	5.64	5.86	5.76	17.13
SD	4.10	3.06	4.01	3.46	4.56	4.99	4.29	3.89	1.54	1.46	1.47	4.09
Cronbach's α	.82	.83	.81	.80	.78	.82	.74	.67	^a	^a	^a	^a

* $p < .05$; ** $p < .01$

^aIt is not possible to calculate reliability coefficients for GCSE grades

Moderational Analysis

The main aim of this study was to establish whether cognitive distortions moderated (i.e. changed the magnitude and/or direction of) the test anxiety – GCSE achievement relationships. Table 1 indicates that the associations between individual GCSE subject grades and two of the test anxiety subscales, worry and bodily symptoms, merit further analysis. As significant, though weak, relationships with worry and bodily symptoms were observed for all three of the GCSE subjects included in this study, moderational analyses proceeded using a composite GCSE points score (summed across the three subjects) to provide a general indication of how cognitive distortions may influence the test anxiety – GCSE achievement relationship. The moderational analysis followed the *modus operandi* suggested by Baron & Kenney (1986) in which explanatory variables are entered into a hierarchical regression in three steps. Thus, the test anxiety score (either worry or bodily symptoms) were entered in step 1, the moderating variables (cognitive distortions) in step 2 and interactions between test anxiety and cognitive distortions (for either worry or bodily symptoms) in step 3. A significant interaction term at step 3 would indicate that cognitive distortions were influencing either the direction and/or magnitude of the test anxiety – GCSE achievement relationship. All test anxiety and cognitive distortions scores were mean centred to reduce the occurrence of multicollinearity between interaction terms and their component variables (Aiken & West, 1991). Results of the hierarchical regressions are shown in Table 2.

Table 2 Hierarchical regression to establish moderational analysis

Variable	R^2	ΔR^2	ΔF	β^a	
Step 1	Worry (W)	.05	.05	12.09***	-.23***
Step 2	Catastrophising (CAT)	.07	.02	0.78	-.11
	Overgeneralisation (OVR)				.10
	Personalisation (PER)				.02
	Selective Abstraction (SAB)				-.10
Step 3	W x CAT	.12	.05	2.92*	.31**
	W x OVR				.06
	W x PER				-.13
	W x SAB				-.19 [^]
Step 1	Bodily Symptoms (BS)	.05	.05	11.16***	-.22**
Step 2	Catastrophising (CAT)	.06	.01	0.67	-.06
	Overgeneralisation (OVR)				.07
	Personalisation (PER)				-.01
	Selective Abstraction (SAB)				-.10
Step 3	BS x CAT	.09	.03	1.60	.17
	BS x OVR				.01
	BS x PER				.08
	BS x SAB				.20 [^]

[^] $p = .06$, * $p > .05$, ** $p < .01$, *** $p < .001$

^a β coefficients from the final regression equation

Worry scores accounted for 5% of the variance in GCSE total points score, cognitive distortions an additional 2% and the interaction terms a further 5%. A significant interaction was observed for worry x catastrophising ($p \leq .01$) and a marginally significant interaction for worry x selective abstraction ($p = .06$). In order to probe the nature of these interactions, Aiken and West (1991) suggest the

regression slopes are recalculated at different values of the moderator ($\pm 1SD$) and plotted graphically. Figure 1 represents the separate regression slopes for catastrophising, at high (+1SD) and low values (-1SD) and to assist interpretation worry scores were also simplified to high and low scores at $\pm 1SD$. At low levels of worry there is little difference in achievement between the high and low catastrophising students. At high levels of worry, however, achievement of high catastrophising students is lower than for the low catastrophising students. Simple slope analysis indicated that both the slope for low catastrophising ($t = -2.96$; $p = .004$) and high catastrophising ($t = 3.95$; $p < .001$) differed significantly from zero.

Figure 1 *The influence of catastrophising on the worry – GCSE attainment relationship*

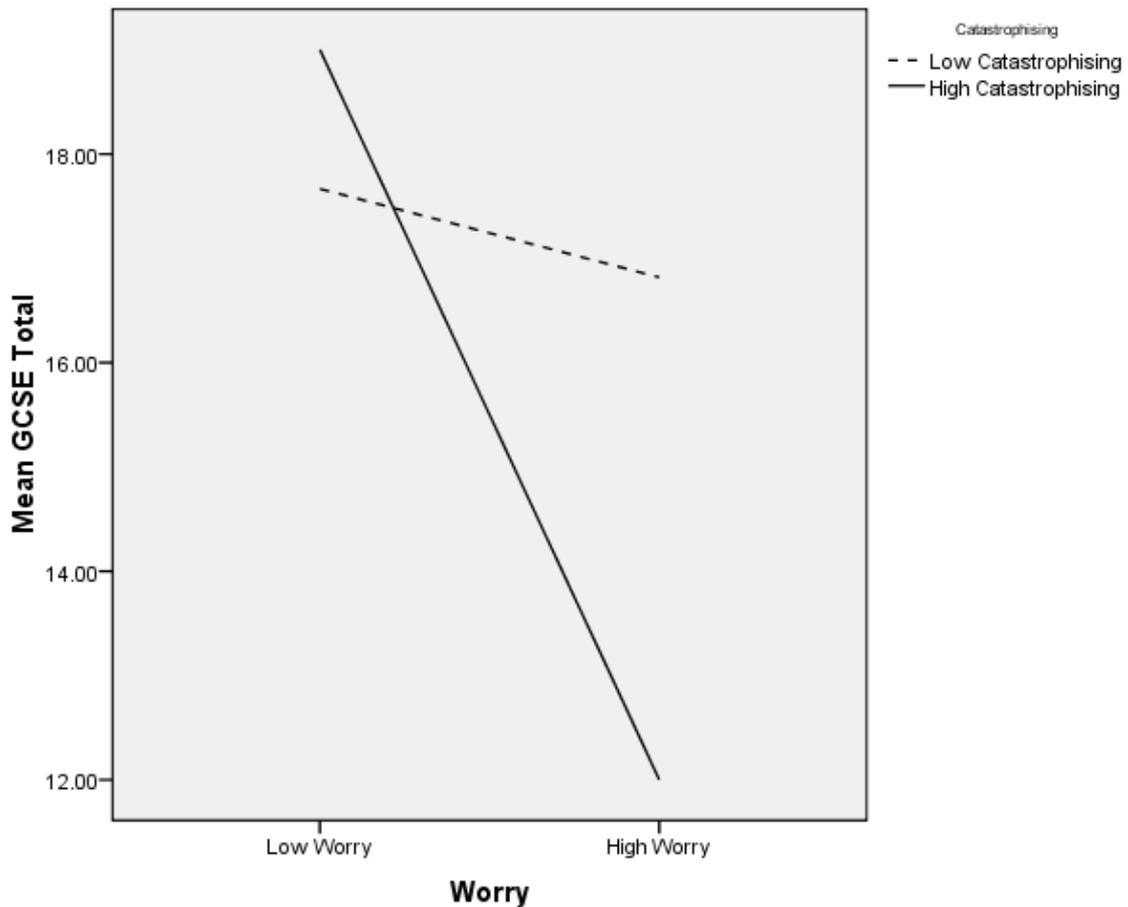
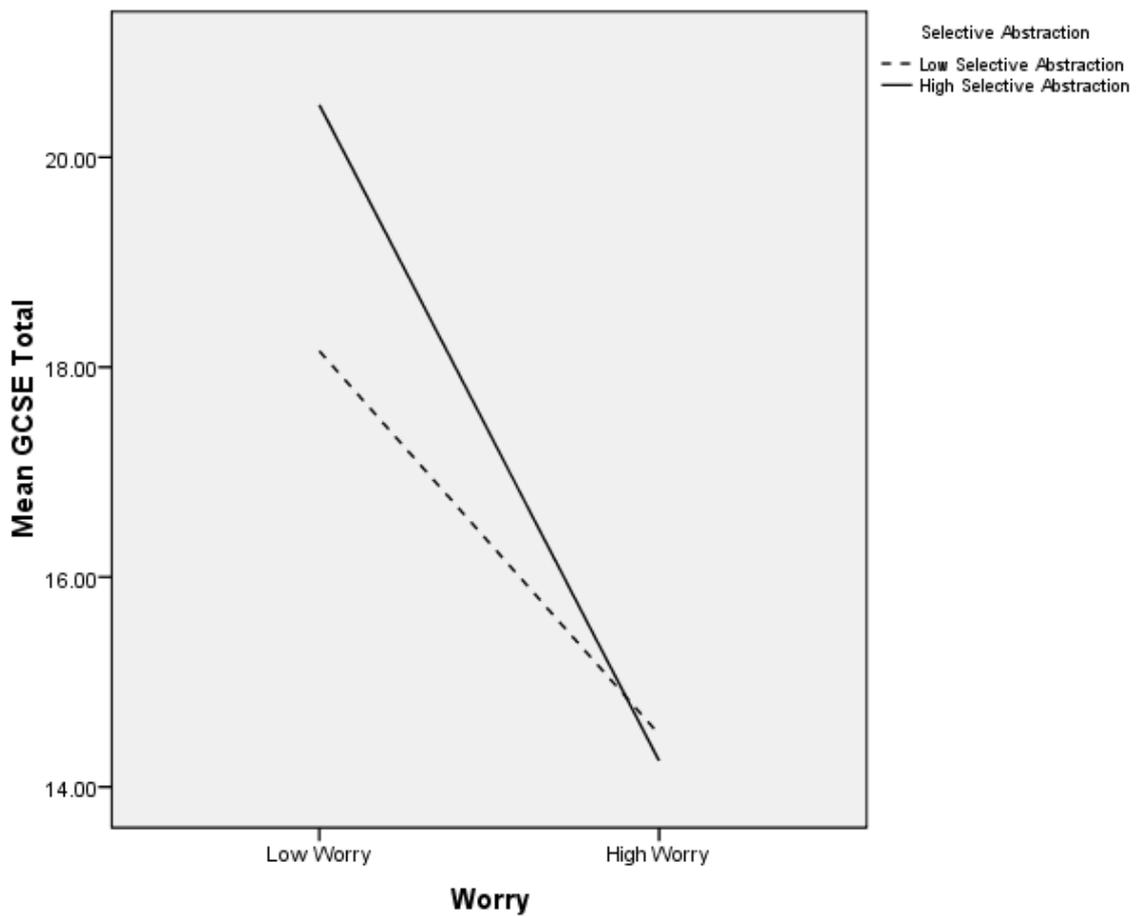


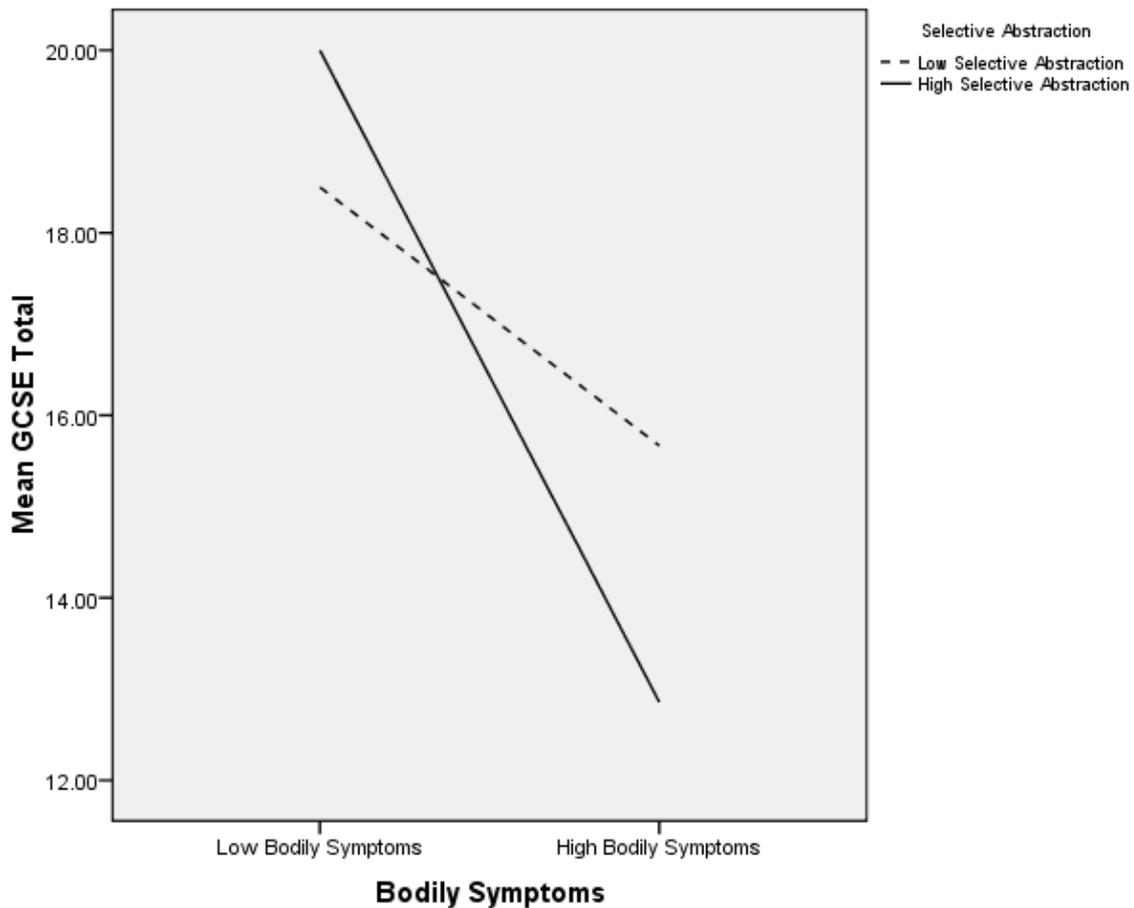
Figure 2 represents the separate regression slopes for selective abstraction, at high (+1SD) and low values (-1SD). A steeper slope is shown for the high selective abstraction students, who achieve higher grades than the low selective abstraction students at low worry scores, but similar achievement at high worry scores. Simple slope analysis indicated that both the slope for low selective abstraction ($t = 2.40$; $p = .02$) and high selective abstraction ($t = -2.45$; $p = .02$) differed significantly from zero.

Figure 2 The influence of selective abstraction on the worry – GCSE attainment relationship



Bodily symptoms scores accounted for 5% of the variance in GCSE total points score, cognitive distortions an additional 1% and the interaction terms a further 3%. A marginally significant interaction was observed for bodily symptoms x selective abstraction ($p=.06$). Figure 3 represents the separate regression slopes for selective abstraction at high (+1SD) and low values (-1SD) and to assist interpretation bodily symptoms scores were also simplified to high and low scores at $\pm 1SD$. A steeper slope is shown for the high selective abstraction students, who achieve higher GCSE grades to low selective abstraction students at low bodily symptoms scores, but lower achievement at high bodily symptoms scores. Simple slope analysis indicated that the slope for high selective abstraction differed significantly from zero ($t = 3.44$; $p=.001$), but not the slope for low selective abstraction ($t = -0.67$; $p = .50$).

Figure 3 The influence of selective abstraction on the bodily symptoms– GCSE attainment relationship



Discussion

The principal aim of this study was to examine whether cognitive distortions moderated the test anxiety – examination performance relationship, hypothesising that a stronger inverse relationship between test anxiety and examination performance would be found for students who reported greater tendencies towards

cognitive distortions. Findings reported in this study indicate that higher reported levels of test anxiety, particularly in regard to the worry and bodily symptoms components, were associated with lower achievement in GCSE English Language, Mathematics and Science. Greater proneness to different types of cognitive distortion was associated with higher scores on components of test anxiety and, with some exceptions, also associated with lower GCSE achievement, but the effects were smaller than those observed for worry and bodily symptoms. Furthermore, intercorrelations were observed between the different test anxiety components, cognitive distortions and GCSE subject scores. The moderational hypothesis was partially supported; two types of cognitive distortion, catastrophising and selective abstraction, moderated the worry – GCSE achievement relationship and selective abstraction moderated the bodily symptoms – GCSE achievement relationship, however the moderational effects for selective abstraction were moderate at best. Overgeneralisation and personalisation beliefs did not emerge as significant moderators of the test anxiety – GCSE achievement relationship.

These findings are broadly consistent with those reported in both UK and international contexts. The small relationships between test anxiety and exam performance are similar to those reported both in the UK (Putwain, 2008) and in meta-analyses based on international data (Hembree, 1988; Seipp, 1991) and provide further evidence that in the high stakes context provided by the GCSE, highly test anxious students, or to be more precise, those who experience high levels of worry and/ or bodily symptoms, may be achieving less than their low test anxious counterparts. However, tempting as it may be to infer causality in this relationship it would be prudent on the basis of the design used in this study, not to assume high test anxiety was the cause of low achievement. Although explanatory models of the anxiety – performance relationship (processing efficiency theory and attentional control theory – see Eysenck *et al.*, 2007; Owens *et al.*, 2008) indicate that anxiety does play a causal role through occupying working memory resources, rival hypotheses could account for the relationships observed in this study, including the possibility that test anxiety is a proxy measure of ability or a factor influencing learning, or study skills, rather than examination performance directly (*cf.* Spada, Nikcevic, Moneta & Ireson, 2006).

The relationships observed between test anxiety and cognitive distortions are also consistent with previous findings (Leitenberg *et al.*, 1986; Weems *et al.*, 2001) as were the intercorrelations between the different cognitive distortions (Weems *et al.*, 2001), test anxiety components (Benson *et al.*, 1992) and grades for different GCSE subjects (Putwain, 2008). In general, the relationships between cognitive distortions and exam performance were smaller than those observed for the worry and bodily symptoms components of test anxiety. This does not however, preclude their influence as a moderator of the test anxiety – GCSE achievement relationship, where main effects do not have to be significant to interact with a second predictor variable. The finding that bodily symptoms, in addition to worry, was significantly related to GCSE achievement was an unexpected finding however. A great deal of previous work has found stronger inverse performance relationships with cognitive rather than affective-physiological components of test anxiety (for meta-analyses see Hembree, 1988; Seipp, 1991).

Much of this work was based on early two-factor conceptualisations of test anxiety (Liebert & Morris, 1967; Spielberger, 1980) which only distinguished between worry (cognitive) and emotionality (affective-physiological) components rather than the four factor model (Benson *et al.* 1992) adopted in this study. The

findings observed in this study, that one specific cognitive (worry) and one specific affective-physiological (bodily symptoms) component of test anxiety were related to GCSE achievement whilst the general cognitive (test-irrelevant thinking) and general affective-physiological (tension) components were not suggests that the critical distinction lies not between cognitive and affective-physiological dimensions of test anxiety, as previously thought, but between *specific* and *general* components. As the emotionality items used in earlier measures of test anxiety correspond to general tension rather than specific bodily symptoms (Sarason, 1984) it is possible that earlier research based on the worry/ emotionality distinction may not have taken into account the specific nature of worry and the general nature of emotionality.

This speculative line of theorising is not consistent with previous findings of research using undergraduate samples. For example, McIlroy *et al* (200) found that the general components of test anxiety (i.e. tension and test-irrelevant thinking) were related to examination performance, but not the specific affective-physiological component, bodily symptoms. However, in Keough *et al's* (2004) study only worry was associated with examination performance. Clearly, with the exception of worry, there are inconsistent findings regarding the relation between examination performance and the remaining components of test anxiety. Although unexpected, the finding that bodily symptoms, but not tension, is inversely related to examination performance does make substantive sense. It is not difficult to imagine how headaches, difficulty breathing, trembling muscle tension and so forth (bodily symptoms items) would interfere with learning or examination performance more than feeling anxious or uneasy (tension items). It is possible that the younger population of high-school students targeted in this study is relevant to the examination performance – bodily symptoms relationship. The previous research which did not find an association between these two variables used older students in post-compulsory, undergraduate, education and future research examining the predictive validity of this four-factor structure of test anxiety should investigate this possibility. (A plausible hypothesis in this regard would be that over time, with the experience of repeated testing, students develop strategies that minimize the adverse impact of physiological symptoms on exam performance).

The finding that two forms of cognitive distortion, catastrophising and selective abstraction, increased the strength of the test anxiety – GCSE achievement relationship supports the position that certain negative cognitions might be involved in a continuing appraisal of an examination as threatening, as evidenced through the lower performance of students. Highly test anxious students who also had tendencies to catastrophise (i.e. draw the worst possible conclusion) and/or to selectively attend to negative elements of a situation performed worse in their GCSE Mathematics, English and Science than highly test anxious students who did not have such tendencies. This analysis is consistent with cognitive-appraisal theories of the stress process (e.g., Folkman, 1997, 2008) which suggest a two-stage appraisal process. Primary appraisal occurs when a situation, such as a high stakes examination, is judged to be a threat, harm or challenge. This is followed by secondary appraisal whereby coping processes are initiated to manage the threat, harm or challenge. The intensity of strain outcomes, which could be defined in their psychological terms, such as the degree of state anxiety, or performance outcomes, such as examination grade, would be determined by the continuing appraisal of the situation. The lower GCSE grades achieved by students who were both highly test anxious and who were prone to catastrophising and selective abstraction would suggest that these two cognitive distortions, but not a tendency to overgeneralising

and personalisation, are related to an ongoing appraisal of examinations as threatening.

Two clear implications for interventions aiming to reduce test anxiety and/ or improve examination performance in test anxious students. First, interventions which focus directly on the worry component of test anxiety only may not be as effective as those which focus on both worry and bodily symptoms. Thus we would further reinforce the point made by Flaxman, Bond and Keogh (2002) that test anxiety interventions should include both cognitive and physiological elements to address the worry and bodily symptoms components respectively (behavioural components also, although not the focus of interest in this study). Interventions which focus one component only may not be effectively targeting the way test anxious responses manifest for a particular student. Second, the cognitive element of interventions may benefit from specifically and explicitly addressing cognitive distortions, particularly those involving catastrophising and selective abstraction. The findings of this study suggest that such a strategy would be more likely to result in improved examination performance than targeting test anxiety alone. Promising developments in cognitive bias modification could also be adapted to address cognitive distortions (Koster, Fox & McLeod, 2009) which may of particular benefit to test anxious students.

The principal limitation of this study, briefly discussed above, is that the design precludes a causal interpretation. Although establishing the causal status of test anxiety was not the main focus of this study, it would be useful for future research to establish the exact mechanism by which test anxiety, in conjunction with cognitive distortions, influences GCSE achievement in order to inform the development of future interventions. For instance, if the point of influence is learning rather than the demonstration of learning under examination conditions then students need to be identified and interventions delivered well in advance of high stakes examinations in order to be of any likely benefit. Despite this methodological limitation, the findings in this exploratory study are still useful in establishing the nature and direction of interactions between test anxiety and cognitive distortions, which could be used to inform the development of subsequent research, and providing clear treatment implications.

The findings of this study offer at least three possibilities for further research: First, subsequent research should include measures of prior ability, (although finding a measure which is free from the effects of test anxiety is difficult), learning and/ or study-skills and academic self-concept. This would assist interpretation of the causal role of test anxiety, which to the knowledge of the authors has yet to be demonstrated in a sample of UK students in compulsory secondary for a high stakes examination such as the GCSE. Second, research concerning the factor structure of test anxiety should examine the speculative hypotheses offered in this study regarding relevance of age/ stage of schooling and the general/ specific distinction of test anxiety components to the bodily symptoms – achievement relationship. Third, it would be valuable for outcome research to address the treatment implications suggested here by targeting different manifestations of test anxiety (i.e., both worry and bodily symptoms) along with catastrophising and selective abstraction beliefs. Thus, we would encourage applied psychologists and other practitioners to develop and disseminate protocols for the delivery of such interventions and evaluate their impact (cf. Flaxman *et al.*, 2002).

In conclusion, this study found that two forms of cognitive distortion moderated the test anxiety – GCSE achievement relationship. Students with strong catastrophising and selectively attention beliefs achieved lower grades at high levels

of worry and bodily symptoms than those with weaker catastrophising and selective attention beliefs. These findings are consistent with cognitive-appraisal theories of the stress process and suggest that greater tendencies towards catastrophising and selective abstraction are related to the ongoing appraisal of an examination as threatening. These findings suggest that interventions should address both cognitive and physiological components of test anxiety and that the cognitive element of interventions should also explicitly address cognitive distortions.

Notes

¹A full list of changes to the *Children's Negative Cognitive Error Questionnaire* is available from the first author.

²It is not possible to reference these reports as this would compromise the anonymity of the participating schools.

³We have adopted Cohen's (1992) convention for describing *r* values of small .01 to .03, medium/moderate .03 to .05 and large >.05.

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