Does Increased Effort Compensate for Performance Debilitating Test Anxiety?

Abstract

Objective: It is well established that test anxiety is negatively related to examination performance. Based on attentional control theory, the aim of this study was to examine whether increased effort can protect against performance debilitating test anxiety.

Method: Four hundred and sixty-six participants (male = 228, 48.9%; white = 346, 74.3%; mean age = 15.7 years) completed self-report measures of test anxiety and effort that were matched to performance on a high-stakes secondary school examination.

Results: The worry and bodily symptoms components of test anxiety were negatively, and effort, positively related to examination performance. Effort moderated the negative relation between bodily symptoms and examination performance. At low effort the negative relationship was amplified and at high effort was attenuated.

Conclusions: Compensatory effort protects performance against bodily symptoms but not worry. It is possible that the cognitive load on working memory arising from the combination of worry and examination demands may be too high to be compensated by effort.

Keywords: Test anxiety, worry, bodily symptoms, attentional control theory, examination performance

Impact and Implications

This study builds on the evidence base for test anxiety and examination performance with two implications for practitioners. First, the study further highlights the need for test anxiety interventions in school-aged populations. Second, test anxiety interventions can incorporate effort-building strategies to counteract the negative effect of anxiety.

A central premise of attentional control theory (Derakshan & Eysenck, 2009, 2011; Eysenck, Derakshan, Santos, & Calvo, 2007) is that although anxiety may negatively impact on performance efficiency (speed of task performance), performance effectiveness (accuracy of task performance) can be maintained with effort. Evidence for the protective role of effort on performance effectiveness has relied on lab studies (e.g., Ansari & Derakshan, 2011; Hayes, MacLeod, & Hammond, 2009). Studies examining test anxiety and effort in naturalistic settings, such as education (e.g., Eklöf & Nyroos, 2013; Komarraju, & Nadler, 2013), have not examined relations with achievement outcomes or how they might interact. In the present study we address this gap in the literature. The aim was to examine if effort reduced the negative relation between test anxiety and examination performance in a sample of final year secondary school students taking General Certificate of Secondary Education (GCSE) examinations. GCSEs are high-stakes school exit examinations taken by students at the end of compulsory secondary schooling in England, Wales, and Northern Ireland (aged 16 years).

Test Anxiety: The Anxiety Experienced in Evaluative Situations

Test anxiety is widely considered to be a trait-like tendency to appraise evaluative situations as threatening (Spielberger & Vagg, 1995). An evaluative situation is defined as one where a person's performance is assessed (actual or perceived assessment by others) and includes the tests and examinations taken by students at all stages of education, public speaking, driving tests, and so on. Once developed in childhood or early adolescence, persons will show a tendency to appraise evaluative situations as threatening (Spielberger, 1966; Szafranski, Barrera, & Norton, 2012). Furthermore, studies have shown that like other forms of childhood anxieties (e.g., Clark, Caldwell, Power, & Stansfeld, 2010; LeBeau et al., 2010; McLaughlin et al., 2011) without intervention test anxiety will persist over time (Putwain, Chamberlain, Daly, & Saddredini, 2014; Weems et al., 2015; Yeo, Goh, & Liem, 2016).

Test anxiety develops from a perceived threat to one's goals, including self-worth, educational or occupational aspirations, or one's self-identity (Putwain, 2009). Such concerns become prominent in late childhood and early adolescence. Students become exposed to testing regimes in school that emphasize negative feedback and academic credentials (Crosnoe, Riegle-Crumb, Muller, 2007; von der Embse & Witmer, 2014) during a developmental period of heightened sensitivity to evaluative judgment and self-esteem (e.g., Blakemore, & Mills, 2014; Marsh & O'Mara, 2008). Most individuals will experience transient moments of high state anxiety at some point during an evaluative situation. Highly test anxious persons, however, will consistently experience high levels of state anxiety in evaluative situations (Zeidner, 2014). Thus, test anxiety can be summarized as being a situation-specific form of trait anxiety.

Test anxiety, like other forms of anxiety, consists of worrisome thoughts and affective-physiological responses (Lowe et al., 2006; Segool, von der Embse, Mata, & Gallant, 2014). Worrisome thoughts are self-focused, negative concerns with failure (actual or perceived) and the consequences of failure. Affective-physiological responses refer to the feelings associated with anxiety (e.g., tension) as well as physiological indicators of anxiety (e.g., elevated heart rate). Accordingly, self-report measures of test anxiety have included multidimensional measurement models of various worry and affective-physiological dimensions. In the present study we use a four-factor model of test anxiety (Hagvet & Benson, 1997; Sarason, 1984) that includes two cognitive components (worry and test-irrelevant thoughts) and two affective-physiological components (tension and bodily symptoms). Test-irrelevant thoughts are distracting non-task-focused cognitions that do not principally focus on failure (e.g., daydreaming about a forthcoming sports match). Tension refers to general feelings associated with anxiety and bodily symptoms to the perception of specific physical indications of anxiety. For expediency, we refer to 'test anxiety' when referring to

propositions that do not differentiate specific components of test anxiety (worry, test-irrelevant thinking, tension, and bodily symptoms). Where we refer to a specific component (e.g., worry) we are making a point relevant to that component only.

Test Anxiety and Attentional Control Theory

Test anxiety shows a negative relation with various measures of academic performance, including class grades and examination marks, that is typically stronger for the worry component (Hembree, 1988; von der Embse et al., 2017). Early cognitive interference theories proposed that the test anxious person becomes self-preoccupied with performance and failure, directing attention away from task demands (Sarason, 1988; Wine, 1971). The major contemporary cognitive interference theory of anxiety and performance is the attentional control theory (ACT: Derakshan & Eysenck, 2009; 2011; Eysenck et al., 2007). According to ACT anxiety results from a perceived threat to one's goals resulting in attention being directed towards the source of the perceived threat and deciding how to respond to that threat. As a consequence, attentional focus on current tasks is reduced unless that task directly involves threat.

In ACT, anxiety and in particular the worry component, is proposed to effect performance in two key ways. The first is to interfere with working memory (WM) processes, namely inhibition (the ability to control automatic or task-irrelevant stimuli) and shifting (moving back and forth between multiple task operations), resulting in reduced WM capacity for current task processing (e.g., Dutke, & Stöber, 2001; Owens, Stevenson, Norgate, & Hadwin, 2008). The second is to motivate the person to reduce the adverse anxiety state, or its effects. The reduced efficiency of WM processing resulting from anxiety need not necessarily have a detrimental impact on performance; the use of increased effort to use more processing resources can compensate for the interfering effect on efficiency to maintain task performance (e.g., Hardy, Beattie, & Woodman, 2007; Hardy & Hutchinson, 2007). Thus,

highly test anxious persons can show equivalent performance to that of non-test anxious counterparts by increasing effort. Effort is conceptualized in ACT as the application of increased cognitive resources to a task. Like anxiety, effort can be represented as more state-like (the degree of effort applied in a particular task or lesson) or more trait-like (the general level of effort that one applies). To ensure an appropriate fit with test anxiety, we defined and measured effort in the present study as being more trait-like; the general level of effort made by students in their examination preparation.

Although ACT is a general theory of anxiety and performance, and not solely constrained to test anxiety, the central tenet of attentional disruption to task performance makes ACT highly applicable to investigating the relation between test anxiety and performance in the cognitive interference tradition. Lab studies have shown how the lower performance of highly test anxious persons on cognitive tasks relative to non-test anxious persons is attributable to reduced WM capacity (Dutke, & Stöber, 2001; Putwain, Shah, & Lewis, 2014; Richards, French, Keogh, & Carter, 2000). Furthermore, naturalistic studies have shown how the negative relationship between test anxiety and the performance of primary school children on standardized tests is mediated by working memory capacity (Owens, Stevenson, & Hadwin, 2012; Owens, Stevenson, & Hadwin, & Norgate, 2012; Owens et al., 2008).

Studies have supported the role of compensatory effort in maintaining performance against the efficiency-sapping effects of anxiety in a variety of lab tasks (e.g., Ansari & Derakshan, 2011; Hardy et al., 2007; Hardy & Hutchinson, 2007; Hayes et al., 2009) although an upper limit to the compensatory effects of effort is likely to depend on task demands (Wilson, Smith, Chattington, Ford, & Marple-Horvat, 2006). Effort has been shown to positively correlate with academic performance, such as GPA and examination marks (e.g., Eklöf & Nyroos, 2013; Komarraju, & Nadler, 2013; Richardson, Abraham, & Bond, 2012).

The role of effort in predicting achievement, however, is not usually considered in relation with other factors that influence how effort is perceived by the person.

According to self-worth theory, failure following effort could pre-empt negative attributions of one's ability leading to low self-esteem (Covington, 2009; Martin, Marsh, & Debus, 2001; Martin, Marsh, Williamson, & Debus, 2003). Since heightened test anxiety represents an anticipation of threat to one's self-worth (Putwain, 2009), it is empirically advantageous to examine effort and test anxiety together in relation to examination performance. Relations between test anxiety and effort are equivocal with some studies reporting negative correlations (Komarraju, & Nadler, 2013; Pekrun, Goetz, Perry, Kramer, Hochstadt, & Molfenter, 2004; studies 3 and 6) and others reporting positive (Eklöf & Nyroos, 2013) or null correlations (Pekrun et al., 2004; studies 4 and 5).

However, no studies have been specifically conducted to examine the compensatory role of effort on performance with test anxiety, or in naturalistic settings. To address this gap in the literature and provide a test of ACT in an educational context this study examined how test anxiety and effort interacted to predict examination performance in a sample of secondary school students studying for GCSEs. English, science, mathematics, one foreign language, and one humanities subject, are compulsory. The remaining subjects are chosen from the options offered by a particular school and students will typically study up to ten subjects in total. GCSE performance can have a profound impact on a student's life trajectory. Access to further education and training (academic, vocational, or technical) depends on a particular profile of GCSE grades and pass grades in English and mathematics are minimum entry requirements for all employment other than routine or manual (Hodgson & Spours, 2011).

In line with previous studies we anticipate that test anxiety, particularly worry, would be negatively related to examination performance. Following the propositions of ACT, effort should moderate this relationship to protect examination performance against high test anxiety. That is, at higher levels of effort the negative relationship between test anxiety and examination would be attenuated.

Aim of the Present Study

The aim of the present study was to test the proposition that effort would protect performance from high test anxiety. As test anxiety is considered to be a domain general construct (Everson, Tobias, Hartman, & Gourgey, 1993), in line with the matching specificity principle (see Swann, Chang-Schneider, & McClarty, 2007) relations with examination performance were examined by aggregating scores from examinations in three key subjects (English, science, and mathematics) and effort was operationalized in a domain-general fashion. Furthermore, to ensure a good fit with the conceptualization of test anxiety as being a trait-like characteristic, effort was also measured as being trait-like. Since gender differences have been shown in English, science, and mathematics (Voyer & Voyer, 2014), and gender and age differences in test anxiety (Putwain, 2007; Putwain & Daly, 2014), gender and age were included as covariates. The following hypotheses were examined:

H1: Test anxiety will be negatively correlated, and effort, positively correlated with examination performance.

H2: Effort will moderate the relations between test anxiety and examination performance; a stronger relation will be found at low effort and a weaker relation at high effort.

As empirical findings regarding test anxiety and effort are equivocal we do not offer a specific hypothesis on how these constructs are related.

Method

Participants

The participants in this study were 466 students drawn from four English secondary schools (*n* = 237 female students, 51%; *n* = 228 male students, 49%; *n* = 1 missing) in a convenience sample. All students were in their final year of secondary education (Year 11) with a mean age of 15.71 years (*SD* = .5; range = 15-16 years). The ethnic heritage of students was predominantly white Caucasian ethnic background (*n* = 346, 72%) with fewer students from Asian (*n* = 76, 16%), Black (*n* = 22, 5%), other and mixed heritage backgrounds (*n* = 20, 4%), with *n* = 4 missing. Fifteen percent of students (*n* = 70) were eligible for free school meals, a proxy for low income. A small proportion of data were missing (0.7%) that were unrelated to study variables. These were handled, in subsequent analyses, using full-information maximum likelihood (Muthén & Muthén, 2017).

Measures

Test anxiety was measured using Hagvet and Benson's (1997) *Revised Test Anxiety Scale*. This scale comprises four components of test anxiety: Worry (6 items: e.g., 'During exams I find myself thinking about the consequences of failing'), test-irrelevant thoughts (4 items: e.g., 'During exams I find myself thinking of things unrelated to the material being tested'), tension (5 items: e.g., 'During exams I feel very tense'), and bodily symptoms (5 items: e.g., 'I have great difficulty breathing during an exam'). Participants responded to items on a four-point scale (1 = Almost Never, 4 = Almost Always). Previous studies have shown data collected using this four-factor model to show good construct validity, predictive validity, and internal consistency (e.g., Benson & El-Zahhar, 1994; Benson, Moulin-Julian, Schwarzer, Seipp, & El-Zahhar, 1992; Putwain & Symes, 2012). The internal reliability of the four latent scales in the present study (see Table 1) were good (McDonald's ω ≥ .81).

Effort was measured using three items ('I work hard for exams', 'In general, I work hard at school', and 'When I do school work, I work very hard') adapted from Chouinard, Karsenti, and Roy (2007) to refer to exams and/ or school work rather than mathematics as

per the original scale. Participants responded on the same four-point scale used for test anxiety (1 = Almost Never, 4 = Almost Always). The internal reliability of the latent effort scale in the current study (see Table 1) was good (McDonald's ω = .83).

Examination grades were taken from GCSE English, mathematics, and science. GCSE examinations were graded using a criterion-referenced system on an eight-point letter scale (A*, A, B, and so on through to G). An A* grade is the highest grade possible and a grade G is the lowest grade possible. These were converted to a numerical equivalent (A* = 8, A = 7, B = 6, G = 1), such that a higher grade was given a higher numerical value. In the GCSE grading system a grade C is considered the minimum pass grade. Examination papers were set, marked and awarded by an external, government approved and regulated awarding body. Schools were provided with the overall grade for each student. Thus, it is not possible to report the internal consistency of examination grades by question. In keeping with the conceptualization of test anxiety as non-subject specific, the grades from English, mathematics, and science, were treated as indicators for a single latent construct (examination grades) with a possible range of 3 (i.e., a grade G in English, science, and mathematics) to 24 (i.e., a grade A* in English, science, and mathematics). The internal reliability of this single latent construct (see Table 1) was good (McDonald's ω = .91).

Procedure

Test anxiety and effort items were presented in a randomized order to participants as part of a questionnaire pack that also included information about the aim of the study, demographics questions, ethical principles, and permission to link questionnaire data to examination grades. The questionnaires were administered by trained research assistants who emphasized to participants that questionnaires were not part of a test, that it was permissible to ask for assistance with reading if required, and explained how to withdraw participation. Data were collected in February and March of the school year, during a period of the school

timetable used for non-teaching purposes (form period) so not to interfere with teaching activities. GCSE examinations were taken throughout May and June approximately three to four months after questionnaire data were collected. The project was approved by an institutional ethics committee and written consent provided by the Head Teacher of participating schools and individual participants. Passive (opt-out) consent was provided by parents/ carers of participants.

Analytic Strategy

Following a preliminary analyses of descriptive statistics, our strategy followed two steps. First, latent bivariate correlations between anxiety, effort, examination performance, gender, and age were examined using a confirmatory factor analysis (CFA). A measurement model was specified with the four components of test anxiety (worry: 6 indicators, test-irrelevant thinking: 4 indicators, tension and bodily symptoms: 5 indicators each), effort (3 indicators), and examination grade (3 indicators), all represented as latent variables. Gender (0 = male, 1 = female) and age were included as covariates of all substantive study variables (test anxiety, gender, and examination grade) and modeled as manifest variables. All variables were allowed to freely correlate and were estimated using maximum likelihood in M*plus* v.8 (Muthén & Muthén, 2017). Third, latent interactions between the four components of test anxiety and effort were examined using the latent moderated structural equation (LMS) approach (Klein & Moosbrugger, 2000) in M*plus* v.8 (Muthén & Muthén, 2017). Since model fit indices are not generated using the LMS approach, we followed the two-stage approach advocated by Maslowsky, Jager, and Hemken (2015). Based on the measurement model used to generate latent bivariate correlations, we initially examined a latent regression model that did not contain interaction terms (Model 1) in order to obtain model fit indices. Model 1 was subsequently compared to a model that included interaction terms (Model 2).

Results

Descriptive Statistics and Bivariate Correlations

Descriptive statistics are shown in Table 1. Test anxiety, effort, and grade, were all normally distributed (skewness and kurtosis within ±1) and standardized factor loadings, taken from the measurement model described below, were all satisfactory ($\lambda \geq .52$). Model fit of the CFA used to estimate latent bivariate correlations was interpreted using the Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), and the Tucker–Lewis index (TLI). RMSEA and SRMR indices of <.08 and <.06, respectively, and CFI and TLI indices of >.95, are indicative of a good model fit (Marsh, Hau, & Grayson 2005). On this basis, the CFA showed a good fit to the data: $\chi^2(324) = 731.23$, $p < .001$, RMSEA = .044, 95% CIs [.037, .051], SRMR = .034, CFI = .961, and TLI = .952. Latent bivariate correlations are shown in Table 2. Worry and bodily symptoms correlated negatively, and effort positively, with examination grades. Test-irrelevant thinking was negatively, and tension positively, correlated with effort. Male students reported lower tension, bodily symptoms, and effort. Older students reported lower worry, tension, and bodily symptoms.

Latent Interactions between Test Anxiety and Effort

Model 1, that did not include latent interactions between the four test anxiety components and effort, showed a good fit to the data using the same criteria that were applied to the measurement model used to generate latent bivariate correlations: $\chi^2(325) = 750.34$, $p < .001$, RMSEA = .045, 95% CIs [.038, .052], SRMR = .036, CFI = .954, and TLI = .950 (see Figure 1). Model 1 was subsequently compared to Model 2 that included interaction terms. Model 2 initially included all interaction terms between test anxiety and effort. Only one of the interactions terms, however (bodily symptoms × effort), was statistically significant. To ensure the inclusion of non-statistically significant interaction terms did not bias parameters, given high colinearity between test anxiety and effort, model estimates were reported from a

cleaned version of Model 2 that only included the interaction term for bodily symptoms $\times$ effort.

The relative advantage of Model 2 over Model 1 was assessed using the Akaike Information Criterion (AIC) and sample-size adjusted Bayesian information criterion (aBIC), the log likelihood ratio test, and the change in the proportion of variance (ΔR^2) explained in examination grades. Smaller AIC and aBIC values are indicative of a better fitting model (Hix-Small, Duncan, Duncan, & Okut, 2004). The log likelihood ratio test corresponds to a $\chi 2$ distribution with one degree of freedom corresponding to the single interaction term. A statistically significant log likelihood ratio test would indicate that Model 1 showed a loss of model fit.

Model 2 showed lower AIC (ΔAIC = -8.41) and aBIC indices (ΔaBIC = -8.13) suggesting that the inclusion of the interaction term provided a better model fit. The log likelihood ratio test showed a statistically significant loss of fit in Model 1 compared to Model 2 ($D = 10.40$, $p <.001$). Furthermore, Model 2 explained a greater proportion of variance in examination grades than Model 1 ($\Delta R^2 = .12$). Thus Model 2, including the interaction terms between bodily symptoms and effort, offered a better fit and explained a greater proportion of variance in examination grades than Model 1 that did not include this interaction term. Standardized covariances (rs) between test anxiety and effort for Models 1 and 2 are shown in Table 3.

In Model 2 (see Figure 2), examination grades were predicted negatively by worry (β = -.45, $p =.02$) and bodily symptoms (β = -.43, $p <.001$), and positively by tension (β = .36, $p =.02$) and effort (β = .37, $p <.001$). Test-irrelevant thoughts was not a statistically significant predictor of examination grades (β = .21, $p =.07$) and a statistically significant interaction was shown for bodily symptoms and effort (β = .26, $p =.02$). There was no compelling theoretical reason on which to select particular conditional values of effort or bodily symptoms so the

interaction was probed with simple slopes at ±1SD. As both bodily symptoms and effort were

nornally distributed, we anticipate that simple slopes for the relationship between bodily

symptoms and examination grades at ±1SD effort would provide practically meaningful

results based on variance in the data. At low (-1SD) effort the negative relationship between

bodily symptoms and examination grades was stronger ($B = -2.07$, $p <.001$), than at mean ($B = -1.25$, $p =.001$) effort. At high effort the relationship became non-significant ($B = -.43$, $p =.25$). Simple slopes are graphed in Figure 3. The relation between bodily symptoms and

examination performance was subsequently examined along all values of effort using the

Johnson-Neyman technique (see Bauer & Curran, 2005). The point at which the negative

association between bodily symptoms and examination performance became statistically

significant (i.e., the $p <.05$ region of significance) was at +.5SD effort.

Discussion

The aim of this study was to examine a central proposition of ACT, that effort can

protect performance against anxiety, in a naturalistic context. Students in their final year of

compulsory schooling competed questionnaire measures of test anxiety and effort that were

matched to high-stakes GCSE examination performance. As anticipated, test anxiety was

negatively related, and effort, positively related to examination performance (supporting *H1*).

The bodily symptoms component of test anxiety interacted with effort to predict examination

performance (partially supporting *H2*). A stronger bodily symptoms and examination

performance relation was shown at low effort. At mean effort this relation became weaker

and at high effort and was no longer statistically significant. Results show a compensatory

role for effort in protecting performance against high bodily symptoms but not, as anticipated,

the worry component of test anxiety.

Negative correlations between test anxiety and examination performance were shown

for two components, worry and bodily symptoms. This is a somewhat usual, but not unique

finding. Many studies have shown a negative relation between worry and academic performance but typically find relations between the affective-physiological component(s) of test anxiety to be smaller than that of worry component. In our study, this was the case for tension, but the negative correlation between bodily symptoms and examination performance was larger than that of worry. Cassady and Johnson (2002), and Putwain, Connors, and Symes (2010), both found negative correlations between bodily symptoms and examination performance. Putwain, Daly, Chamberlain, and Saddredini (2015) found negative correlations between tension and academic performance, and Lowe et al (2008), for physiological hyperactivity (similar to the bodily symptoms scale used in the current study), mathematics test scores, and cognitive ability scores. It is certainly plausible that a high level of bodily symptoms (e.g., panic) would be highly distracting in an evaluative situation, and therefore interfere with performance. It is likely, however, that there are as yet uncovered moderating factors that account for why some studies, but not others, show negative relations with academic achievement.

A key proposition of ACT is that anxiety motivates the person to reduce the anxiety state, or its effects, through increased effort in deploying attentional resources. The findings of our study did not support this proposition; in the present study anxiety did not correlate with effort. However, this is not without precedent. Previous studies have reported positive (Eklöf & Nyroos, 2013), negative (Komarraju, & Nadler, 2013), and null relations (Pekrun et al., 2004; studies 4 and 5), between test anxiety and effort. We do not take issue with the proposal that anxiety motivates persons to take action to reduce that state, or its effects, but consider the possibility that not all highly test anxious persons respond in such an adaptive fashion.

Test anxiety has been shown to be positively related to a variety of non-adaptive strategies including procrastination and avoidance coping (Gadbois & Sturgeon, 2011;

Putwain, Daly, Chamberlain, & Saddredini, 2016; Putwain, Symes, Connors, & Douglas-Osborn, 2012). Furthermore, effort can be withdrawn strategically to avoid the 'double edged sword' of trying and failing (Covington, 2009). It would seem likely that some highly test anxious persons would be motivated to reduce their anxiety by increased effort, but others reduce their anxiety by avoidance strategies. Thus, the relation between test anxiety and examination performance is likely to be moderated by multiple competing constructs, some positive and some negative. Notwithstanding this point, it is more straightforward to test moderation when the predictor (i.e., test anxiety) and moderator variables (i.e., effort) are uncorrelated (Fairchild & McQullin, 2010) as was the case for test anxiety and effort in our study.

In the second of our LMS models, worry, bodily symptoms, and effort, all remained unique predictors of examination performance in addition to the interaction between bodily symptoms and effort. Thus, test anxiety and effort predict subsequent examination performance in both an additive and interactive fashion. Higher worry and bodily symptoms are associated with lower examination performance, controlling for effort, and higher effort is associated with higher examination performance, controlling for worry and bodily symptoms. Although the tension component of test anxiety was a statistically significant predictor of examination performance in this model, we suggest that no interpretative significance is attached to this finding. The substantial increase in the size of the standardized beta coefficient ($\beta = .36$ in Figure 2) from the correlation coefficient ($r = .02$ in Table 2) is a likely artifact of statistical suppression (see Maassen & Bakker, 2001).

As predicted by ACT, effort protected performance against high bodily symptoms, but not worry. One possible explanation for why bodily symptoms, but not worry, interacted with effort is based on cognitive load theory (Kalyuga & Singh, 2016; Sweller, Ayres, & Kalyuga, 2011). Based on the assumption that GCSE examination task demands are high in

cognitive load (see Martin, 2012) the extent to which effort can compensate for anxiety may be limited (Wilson et al., 2006). If the high level of WM demands arising from examination tasks is combined with the interference arising from worry, the level of disruption to WM processes may be too high to be effectively compensated by increased effort. The lower level of WM interference arising from bodily symptoms combined with the high level of WM demands arising from the examination may, however, be amenable to compensatory effort (see Wang & Shah, 2013).

Limitations and Suggestions for Future Research

There are two limitations that we would like to highlight. First, we did not include a measure of performance efficiency. If such a measure was included it would allow for a more refined test of ACT to compare the moderating role of effort for performance efficiency and performance effectiveness (i.e., examination grade); effort would compensate for performance effectiveness but not performance efficiency. Although performance efficiency is not easily measured in naturalistic situations, one simple measure could be the speed at which students completed their examination or how much of the examination was completed in the official time allowed. Second, we did not control for the autoregressive relations with prior achievement. The inclusion of earlier grades, or examination performance, would allow for a more robust test of compensatory effort. Nonetheless, this study provides a useful examination of the performance-protective role of effort as hypothesized by ACT.

Our findings also flag up three useful pointers for future research to consider. First, it is likely that test anxiety motivates persons to reduce the aversive state, or its effects, using both adaptive (increased effort) and maladaptive (reduced effort, procrastination, self-handicapping, and avoidance) strategies. Future research could examine multiple competing moderators of the relations between test anxiety and examination performance. Second, our study, along with others (e.g., Cassady & Johnson, 2002; Lowe et al., 2008; Putwain et al.

2010), found a statistically significant relation between the physiological component of test anxiety and examination performance. Given the number of studies available, it would be possible to conduct a meta-analysis to examine which factors are moderating the relations between affective-physiological test anxiety and academic achievement (e.g., demographics, measures of achievement, and operatonalization of affective-physiological test anxiety). Finally, we speculate that the reason for effort not compensating for worry was that task demands were too high. It would be useful to test this proposition experimentally by selecting persons high and low in the worry and bodily symptoms components of test anxiety and randomly assigning them to anxiety-inducing tasks (such as an examination) established as having high or low WM demands. If our cognitive load explanation were correct, effort would compensate against high worry and bodily symptoms when WM demand is low. When WM demand is high effort would compensate against bodily symptoms but not worry.

Implications for School Psychologists

These findings further highlight the need for interventions to reduce anxiety and fear of failure. Test anxiety interventions are relatively well established for undergraduate students (e.g., Ergene, 2003), intervention programs for school-aged populations are, in general, lacking (von der Embse, Barterian, & Segool, 2013). As accountability practices based on student test performance persist we anticipate the need for such interventions will increase (see Saeki, Pendergast, Segool, & von der Embse, 2015; von der Embse & Witmer, 2014). Psychologists can also advise teachers on building principles of Load Reduction Instruction into their lessons in ways that will benefit highly test anxious students by reducing demands on WM (Martin, 2016). Possibilities include reducing split attention and information integration sequencing to ensure that related instructional materials are presented visually and temporally in ways that do not overburden WM (Mayer & Moreno, 2010). Deliberate practice (Nandagopal & Ericsson, 2012: students rehearse material and are then

given feedback), guided practice (Rosenshine, 2009: supporting students through the steps of learning or problem solving), and mental practice (Sweller, 2012: students imagine or mentally rehearse a concept or procedure) are all instructional strategies that will help to reduce WM demands during examinations by facilitating automaticity of recall.

Conclusion

The findings reported in this study provide a naturalistic test of the role of compensatory effort on test anxiety in a sample of students taking high-stakes final year secondary school exit examinations. Effort protected against bodily symptoms but not worry. This finding was interpreted in the light of cognitive load theory. We speculate that the demands on WM made by the combination of worry and examination tasks were too high to be compensated by effort. The lower level of WM demands arising from the combination of bodily symptoms and examination tasks, however, were amenable to effort compensation.

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Table 1

Descriptive Statistics for Test Anxiety, Effort, Exam Grades

	Possible Range	Mean	*SD*	ω	Skewness	Kurtosis	Factor Loadings
Worry	6–24	13.22	4.03	.81	0.44	-0.39	.59 – .75
Test-irrelevant thoughts	4–16	8.97	3.07	.83	0.36	-0.58	.64 – .82
Tension	5–20	12.98	3.95	.87	-0.08	-0.76	.64 – .84
Bodily Symptoms	5–20	8.78	3.48	.81	0.95	0.16	.52 – .81
Effort	3–15	8.81	2.12	.83	-0.24	-0.70	.66 – .78
Examination Grades	3–24	17.31	3.95	.91	-0.76	0.57	.60 – .98

Note. Mean, standard deviation, skewness, and kurtosis statistics were estimated from observed variables. McDonald's ω and factor loadings were estimated from latent variables.

Table 2

Latent Bivariate Correlations for Test Anxiety, Effort, Exam Grades, Gender, and Age.

	1.	2.	3.	4.	5.	6.	7.	8.
1. Worry	—	.60***	.75***	.68***	-.02	-.26***	-.11	-.20**
2. Test-irrelevant thoughts		—	.33***	.33***	-.31***	-.13	-.03	-.05
3. Tension			—	.63***	.27***	.02	-.27***	-.17**
4. Bodily Symptoms				—	.11	-.31***	-.16*	-.30***
5. Effort					—	.32***	-.21**	-.02
6. Examination Grades						—	.03	.02
7. Gender							—	-.19***
8. Age								—

* *p* <.05. ** *p* <.01. *** *p* <.001.

Note. Gender coded as 0 = male, 1 = female.

Table 3

Standardized Covariances between Test Anxiety and Effort from Models 1 and 2.

	1.	2.	3.	4.	5.
1. Worry	—	.60	.75	.68	-.02[†]
2. Test-irrelevant Thoughts	.60	—	.33	.33	-.31
3. Tension	.75	.33	—	.63	.27
4. Bodily Symptoms	.68	.34	.62	—	.11[†]
5. Effort	-.01[†]	-.32	.28	.11[†]	—

Note. Coefficients from Model 1 above the diagonal and model 2 below. All rs $p < .001$ unless [†] $p > .05$.
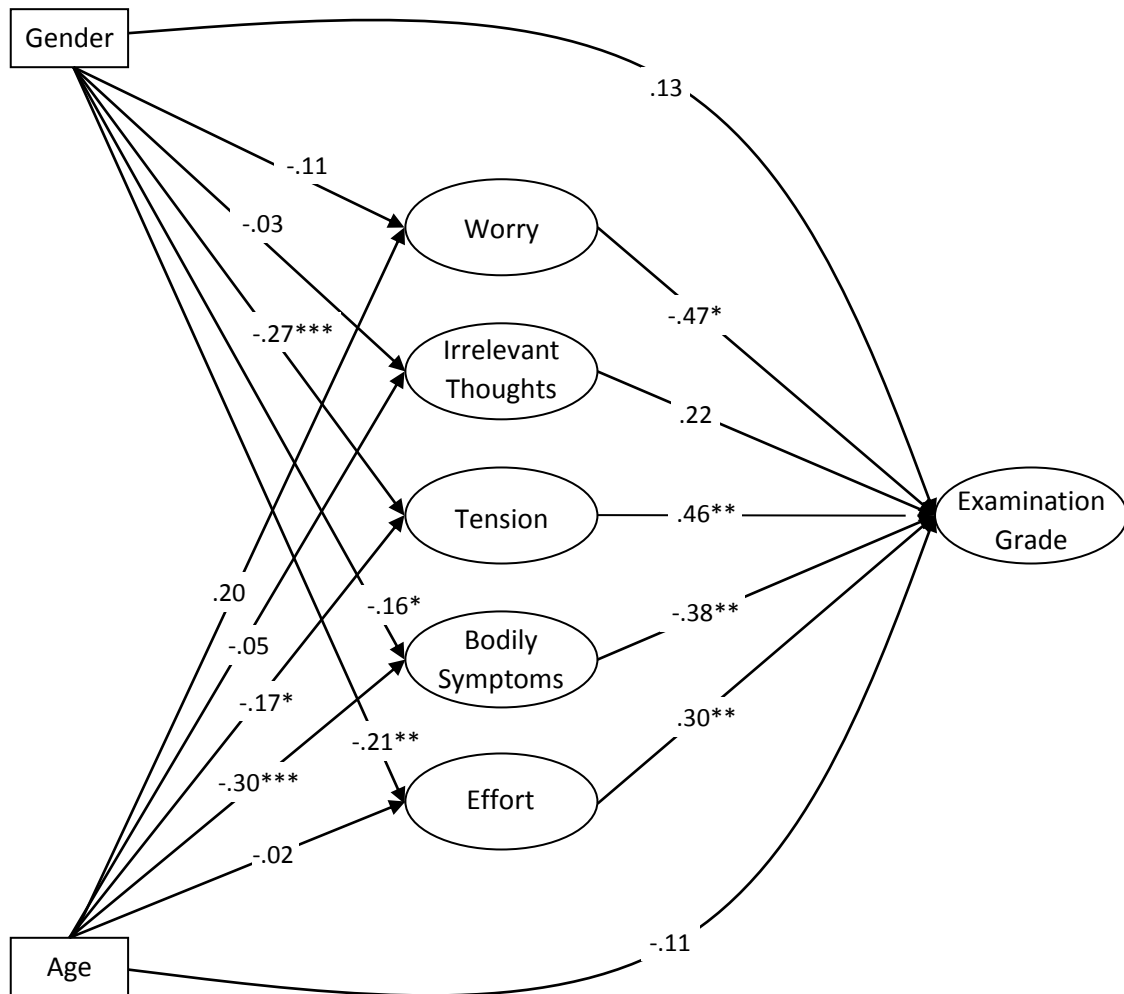
Figure 1. Model 1 to show how test anxiety and effort predicted examination grade with no interaction terms. Gender (0 = male, 1 = female) and age were included as covariates. The statistical significance of standardized βs is indicated as * *p* <.05, ** *p* <.01, and *** *p* <.001.
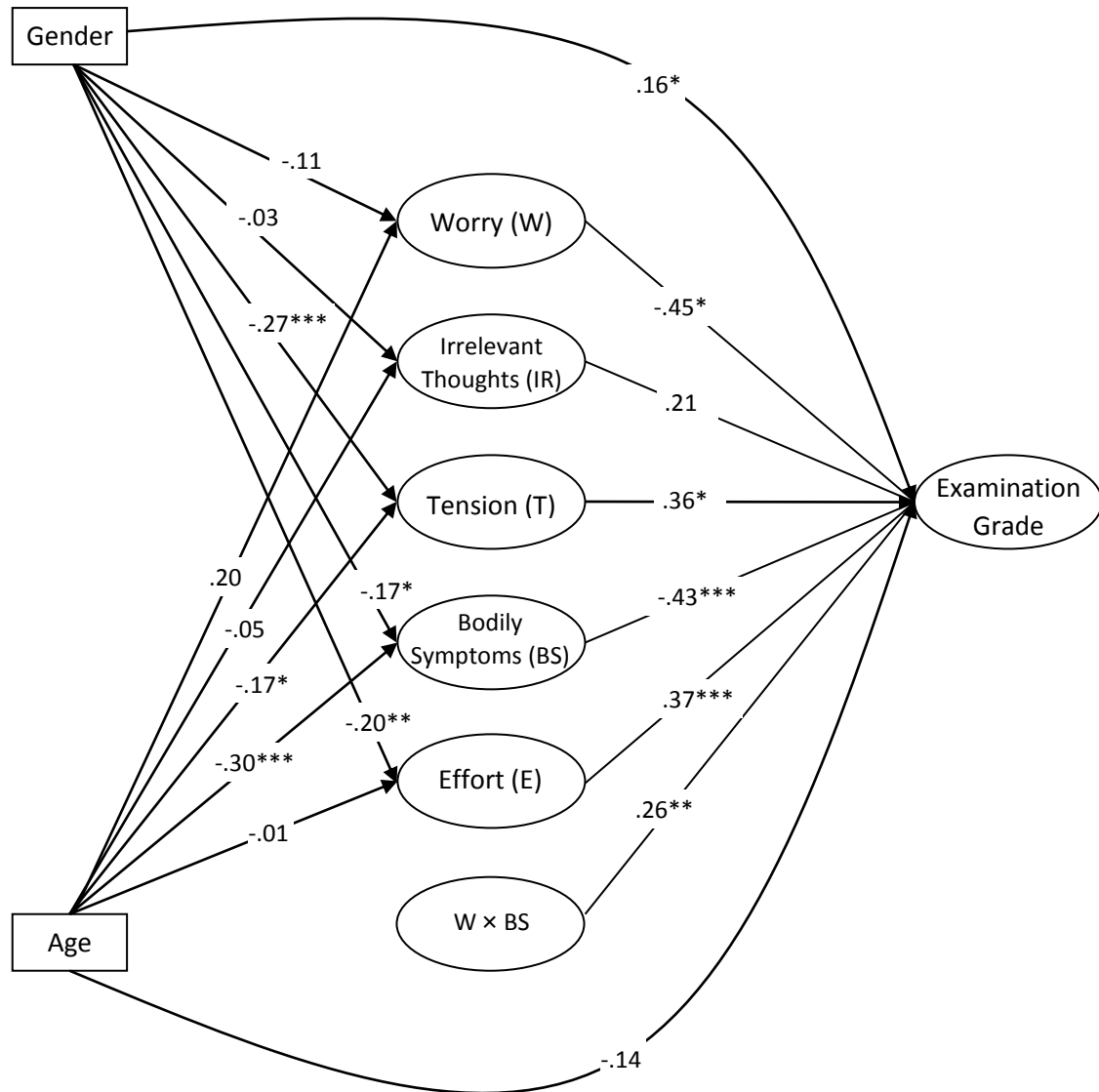
Figure 2. Model 2 to show how test anxiety, and effort, and their interaction, predicted examination grade. Gender (0 = male, 1 = female) and age were included as covariates. The statistical significance of standardized βs is indicated as * $p <.05$, ** $p <.01$, and *** $p <.001$.
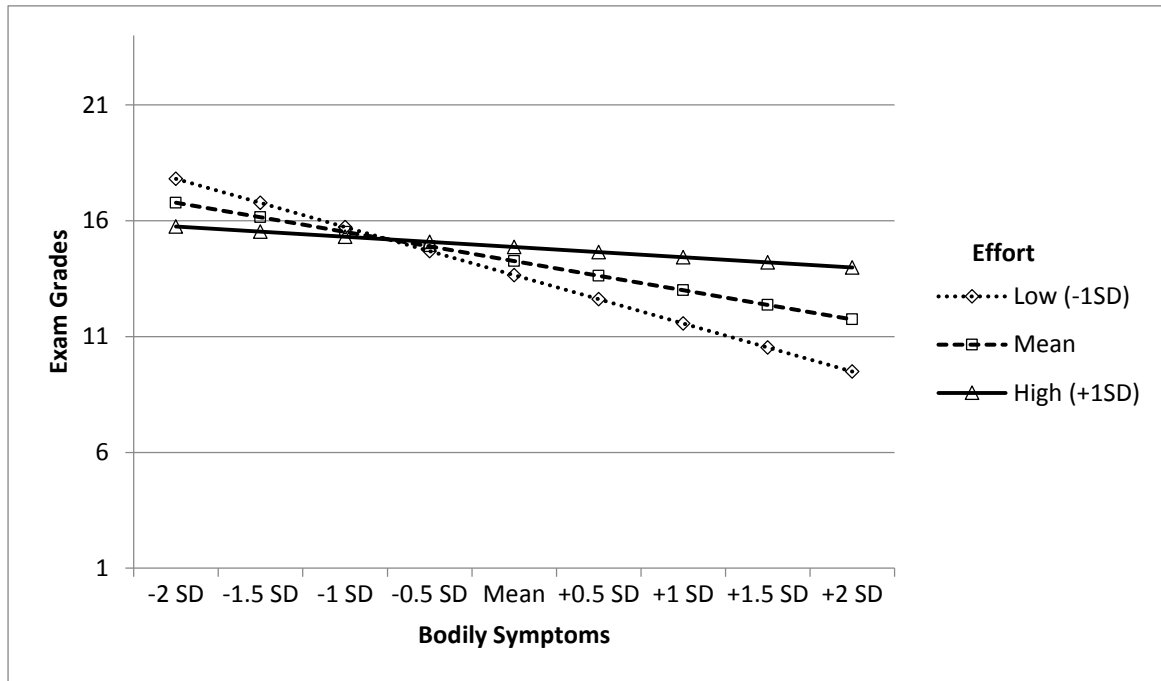
Figure 3. The model-implied interaction effect of bodily symptoms and effort on exam Grades.