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Putwain, DW, Daly, AL, Chamberlain, S and Sadreddini, S

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Academically buoyant students are less anxious about and perform better in high-stakes examinations

Abstract

Background. Prior research has shown that test anxiety is negatively related to academic buoyancy, but it is not known whether test anxiety is an antecedent or outcome of academic buoyancy. Furthermore, it is not known whether academic buoyancy is related to examination performance.

Aims. To test a model specifying reciprocal relations between test anxiety and academic buoyancy and establish whether academic buoyancy is related to examination performance.

Sample. 705 students in their final year of secondary education (Year 11).

Methods. Self-report data for test anxiety and academic buoyancy were measured in two waves in Year 11. Examination performance was taken from the mean English, mathematics and science scores from the high-stakes General Certificate of Secondary Education examinations taken at the end of Year 11.

Results. Measurement invariance was demonstrated for test anxiety and academic buoyancy across both waves of measurement. The model for the worry component of test anxiety showed reciprocal relations with academic buoyancy. Worry predicted lower mean GCSE score and academic buoyancy predicted a higher mean GCSE score. The model for the tension component of test anxiety showed that higher buoyancy was related to lower tension and academic buoyancy predicted a higher mean GCSE score. Tension was unrelated to future academic buoyancy and did not predict mean GCSE score.

Conclusion. Academic buoyancy protects against the appraisal of examinations as threatening by influencing self-regulative processes and enables better examination performance. Worry, but not tension, shows a negative feedback loop to academic buoyancy.

Keywords. Test anxiety, worry, tension, academic buoyancy, examination performance

Academically buoyant students are less anxious about and perform better in high-stakes examinations

Introduction

High-stakes examinations have important consequences for students, teachers and schools. Results are used to inform educational decisions about students and influence the subsequent life trajectory of students (Heubert & Hauser, 1999; Segool, von der Embse, Mata, & Gallant, 2014). More recently, results have been used in both the UK and elsewhere in accountability policy reforms to judge school and teacher effectiveness and, in some cases, pay and tenure (Koretz & Hamilton, 2006; Hanushek & Raymond, 2005). Students differ widely in the way that they approach and respond to the pressure posed by high-stakes examinations. Some students thrive under such pressure, some seem relatively unbothered by it, whereas others seem to choke (e.g., Barksdale-Ladd & Thomas, 2000; von der Embse & Hasson, 2012; Wang & Shah, 2013). Understanding the factors that influence students' responses to examination pressure and performance on high-stakes examinations is of interest to a wide variety of educational professionals including teachers, school managers, educational and school psychologists.

In this study we examine two salient individual differences variables in students' performance in the General Certificate of Secondary Education (GCSE) examinations, which are taken at the end of secondary education in England, Wales and Northern Ireland. GCSE examinations are high-stakes as outcomes can, and do, influence subsequent life trajectories including entry to the labour market, employment opportunities and access to post-compulsory education and training (Denscombe, 2000; Onion, 2004; Roberts, 2004). These two individual difference variables are academic buoyancy, students' perceived capacity to withstand the challenge and pressure posed by high-stakes examinations (Martin & Marsh, 2009), and test anxiety, the tendency for students to appraise high-stakes examinations as threatening (Zeidner, 2007, 2014). Over two waves of data collection we examine how these two variables, which could be particularly salient in relation to high-stakes examinations, relate to each other and predict GCSE examination performance.

Test anxiety: the appraisal of examinations as threatening

Test anxiety is defined as the tendency to appraise performance-evaluative situations, such as examinations, as threatening (Spielberger & Vagg, 1995). It has long been considered to be multidimensional in nature, consisting of a cognitive component, such as worrisome thoughts concerning failure, and an affective-physiological component, which refers to perceptions of physiological arousal (Morris & Liebert, 1970; Spielberger, Gonzalez, Taylor, Algaze, & Anton, 1978). Meta-analyses including studies based on students in all stages of education (from primary, or elementary, school through to higher education) have reported small to moderate negative correlations between the worry component of test anxiety and performance on tests and examinations, whereas correlations between the affective-physiological component and performance are usually smaller and often negligible (e.g., Hembree, 1988; Chapell *et al.*, 2005). A recent review of 7,176 studies using samples of students in higher education found that, of the 41 non-cognitive factors included in the review, test anxiety exhibited the fourth strongest relation with performance ($r^+ = -.24$) after self-efficacy (performance self-efficacy and academic self-efficacy), effort regulation and grade goal (Richardson, Abraham, & Bond, 2012).

Academic buoyancy: Withstanding academic setbacks, challenges and pressures

Academic buoyancy is defined as the capacity to withstand the routine types of setbacks, challenges and pressures experienced by the majority of students during their education (Martin & Marsh, 2009). These could, for instance, refer to temporary periods of underperformance, dips in motivation and engagement, receiving negative feedback on a piece of work or dealing with academic-related stresses and pressures (Martin & Marsh, 2008a,b). These types of experiences are routine for many secondary students and allows the construct of academic buoyancy to be differentiated from resilience, which refers to more severe forms of adversity, such as chronic bullying (Martin & Marsh, 2009; Martin, 2013). The latter example of dealing with academic-related stresses is most relevant to the present study, whereby some academically buoyant students might have an increased capacity to withstand the pressures and stresses associated with high-stakes examinations. Evidence from cross-sectional and longitudinal studies using samples of secondary school students (aged 11-19 years) shows that academic buoyancy is positively related to myriad adaptive educational outcomes including greater self-efficacy, planning and persistence, lower anxiety (general academic anxiety) and lower failure avoidance (Martin, 2013; Martin, Colmar, Davey, & Marsh, 2010; Martin, Ginns, Brackett, & Malmberg, 2013; Martin & Marsh, 2006). Academic buoyancy shows relatively consistent correlations with judgements of personal competence, difficulty of learning new things and school and effort across different academic subjects (Malmberg, Hall, & Martin, 2013). In common parlance, one might say that academically buoyant students are better at ‘coping’ with the pressure associated with preparing for and taking high-stakes examinations. However, we have avoided using this term as evidence shows that academic buoyancy is not related to greater use of adaptive coping strategies, such as task preparation, or less use of maladaptive strategies, such as task avoidance (Putwain, Connors, Symes, & Douglas-Osborn, 2012).

Relations between test anxiety and academic buoyancy

The self-regulative model of test anxiety put forward by Zeidner and Matthews (2005) proposes that test anxiety is distributed across several self-regulative and transactional stress processes. The appraisal of a performance-evaluative situation, such as an examination, as more threatening is influenced by negative self-beliefs and avoidant motivation (e.g., Preiss, Gayle, & Allen, 2006; Putwain, Woods, & Symes, 2010), low control attributions and strategic withdrawal of effort (e.g., Gadbois & Sturgeon, 2011; Midgley & Urdan, 2001). Short-term increases in distress, state anxiety and worry result from the accessing of negative self-beliefs (e.g., poor competence beliefs) and counterproductive coping strategies (Mathews, Hillyard, & Campbell, 1999; O'Carroll & Fisher, 2013; Spada & Moneta, 2012). Metacognitive beliefs (e.g., that worry is an effective coping strategy) play a role in the maintenance of negative self-referent beliefs, with longer term distress and worry arising from a self-defeating cycle of maladaptive person-situation interactions (Mathews et al.. 1999; Spada & Moneta, 2012).

In the context of this model, Putwain and Daly (2013) proposed that academic buoyancy can protect against the appraisal of a performance-evaluative situation as threatening. Academically buoyant students are able to draw on positive self-beliefs (e.g., competence beliefs and motivation) and to respond to lower than anticipated marks or grades on schoolwork and examinations with effort and strategic attributions (see Malmberg et al., 2013; Martin, 2013; Martin et al., 2010, 2013; Martin & Marsh, 2006, 2008a,b). Academic buoyancy would be expected impact on key self-regulative mechanisms, as proposed by Zeidner and Matthews (2005), to reduce the appraisal of performance-evaluative situations as threatening and result in lower test anxiety. Evidence is consistent with this proposition. Studies using cross-sectional designs have shown that academic buoyancy negative correlates with both general academic anxiety and test anxiety in adolescent secondary school students (Martin, 2013; Martin & Marsh, 2006, 2008b; Putwain *et al.*, 2012). Furthermore, studies utilising longitudinal designs have confirmed that the negative correlation between academic buoyancy and academic anxiety in secondary school students remains when controlling for autoregressive relations with prior academic buoyancy (Martin *et al.*, 2010) and prior academic anxiety (2008a).

The ordering of test anxiety and academic buoyancy

General academic anxiety has been shown in secondary school students to predict lower (future) academic buoyancy, while controlling for prior general academic anxiety (Martin *et al.*, 2010), with a reciprocal pattern of inverse relations between academic buoyancy and general academic anxiety found by Martin and Marsh (2008a) and Martin *et al.* (2013). In other words, students who tend to experience greater academic anxiety also tend to be less academically buoyant. However, research has yet to establish the ordering of test anxiety and academic buoyancy. Does test anxiety predict lower academic buoyancy while controlling for prior academic buoyancy, and does academic buoyancy predict lower (future) test anxiety while controlling for prior test anxiety? It is important to address the anxiety that may be specifically related to high-stakes examinations, as well as academic anxiety more generally, as the results of high-stakes examinations are used to inform decisions about students, teachers and schools (see Segool *et al.*, 2014).

Demonstrating that academic buoyancy is an antecedent of test anxiety would support the argument outlined by Putwain and Daly (2013), where academic buoyancy is theorised to impact on self-regulative mechanisms to influence the appraisal of performance-evaluative situations as more or less threatening. Following the self-regulative model of test anxiety (Zeidner & Matthews, 2005), highly buoyant students have more positive self-beliefs, stronger motivation, and make more adaptive responses to setbacks, and they subsequently experience lower test anxiety. However, it is also possible that, like general academic anxiety (Martin & Marsh, 2008a; Martin *et al.*, 2013), academic buoyancy and test anxiety would be reciprocally related. The self-regulative model of test anxiety (Zeidner & Matthews, 2005) proposes a feedback loop from the student’s interaction with the situation to the situational threat. Over time, especially in the preparation period before high-stakes examinations, it would be expected that, in a cycle of ongoing appraisal, test anxiety would feedback to buoyancy to influence beliefs about one's capacity for responding positively to the performance-evaluative pressure posed by a high-stakes examination.

Test anxiety, academic buoyancy and performance of high-stakes examinations

As reported above, meta-analytic reviews have established small to moderate inverse relations between the worry component of test anxiety and examination performance in students at all stages of education (Hembree, 1988; Chapell *et al.*, 2005; Richardson *et al.*, 2012). Research has also begun to examine the relationship between academic buoyancy and academic achievement. Small positive correlations have been reported between academic buoyancy and performance on mathematics and English tests in primary school children aged 7 to 11 years (Miller, Connolly, & McGuire, 2013) and numeracy and literacy tests in secondary school students aged 11 to 14 years (Martin, 2014). However, research has yet to examine relations between academic buoyancy and academic performance on a high-stakes examination such as the GCSE, where academic outcomes have a greater impact on future life trajectory. On the basis of the research showing how academic buoyancy is related to positive educational and learning-related outcomes that are facilitative for performance on high-stakes examinations, such as higher persistence and self-efficacy and lower procrastination and disengagement (Martin, 2013; Martin & Marsh, 2008a,b; Martin *et al.*, 2010), we anticipated that academic buoyancy would show a positive relationship with GCSE examination performance.

As academic buoyancy is negatively related to test anxiety (Putwain *et al.*, 2012), it is possible that any positive relations between academic buoyancy and examination performance are an artefact of lower academic or test anxiety. That is, students who are low in test anxiety perform better in examinations and are more academically buoyant. Although academic buoyancy may correlate positively with examination performance, the relationship is not direct or causal; both result from a common third variable, that of low test anxiety. We control for this possibility in the present study by examining relations between test anxiety and examination performance, and between academic buoyancy and examination performance, in a single model.

Aim of the present study

The aim of the present study was to examine reciprocal relations between test anxiety and academic buoyancy, and vice versa, and then to examine relations with examination performance. Test anxiety and academic buoyancy have generally been conceptualised and operationalised at the subject, or domain, general level rather than in the context of a specific subject such as mathematics (see Everson, Tobias, Hartman, & Gourgey, 1993; Malmberg, Hall, & Martin, 2013). However, examining relations with performance in a specific subject would introduce a high degree of domain specificity mismatch between the psycho-educational constructs (test anxiety and academic buoyancy) and measures of examination performance (see Swann, Chang-Schneider, & McClarty, 2007). Our study sought to avoid such specificity by using the mean score from three of the statutory subjects that must be studied and examined at GCSE: English, mathematics and science.

We hypothesised reciprocal relations between test anxiety and academic buoyancy over two waves of measurement. That is, higher test anxiety at the first wave of measurement would predict lower academic buoyancy at the second wave of measurement (H_1) and that lower academic buoyancy at the first wave of measurement would predict higher test anxiety at the second wave of measurement (H_2). Test anxiety at the second wave of measurement would predict a lower mean GCSE score (H_3) and academic buoyancy at the second wave of measurement would predict a higher mean GCSE score (H_4). Our a priori model is presented in Figure 1. There are robust and well-replicated gender differences in the substantive variables included in this study. Female students typically report greater test anxiety (Putwain, 2007; Putwain & Daly, 2014) and lower academic buoyancy than male students

(Martin *et al.*, 2010; Martin & Marsh, 2008b). A recent meta-analysis of studies from all stages of education, elementary school through to higher education, reported that female students outperformed male students in English, mathematics and science (Voyer & Voyer, 2014). To ensure that relations between test anxiety, academic buoyancy and examination performance were not influenced by, or artefacts of, gender, it was included as a covariate in the model presented in Figure 1.

[Figure 1 here]

Method

Participants

The sample comprised 705 secondary school students (363 male, 336 female and 6 not reported), with a mean age of 15.03 years (*SD* = 0.58), in their final year of compulsory secondary education (Year 11). Participants were drawn from 11 state-funded English co-educational schools. The proportion of students in our sample eligible for free school meals (as a proxy for low income) was 16.81% (the average for English schools at the time of data collection was 15.9%).

Measures

Self-reported cognitive and affective components of test anxiety were measured using the worry and tension scales, respectively, from the *Revised Test Anxiety Scale* (Benson, Moulin-Julian, Schwarzer, Seipp, & El-Zahhar, 1992). The worry scale consisted of six items (e.g., 'During exams I find myself thinking about the consequences of failing') and the tension scale consisted of five items (e.g., 'During exams I feel very tense'). Participants responded to items on a four-point scale (1 = almost never, 2 = sometimes, 3 = often and 4 = almost always). A higher score in this metric represents higher worry and tension. These scales have demonstrated good internal reliability and good factorial, predictive and divergent validity in prior studies (e.g., Benson & El-Zahhar, 1994; Hagtvet & Benson, 1997; Putwain, Connors,

& Symes, 2010). Table 1 shows that, the internal reliability and factor loadings in the present study were acceptable at both waves of data collection (Cronbach's α > .70).

[Table 1 here or below]

Self-reported academic buoyancy was measured using the four-item *Academic Buoyancy Scale* (Martin & Marsh, 2008). Participants responded to items (e.g., 'I think I'm good at dealing with schoolwork pressures') on a five-point scale (1 = strong disagree, 5 = strongly agree). A higher score in this metric represents higher academic buoyancy. Prior research using this scale has reported good internal reliability and good factorial, predictive and divergent validity (e.g., Martin, 2013; Martin & Marsh, 2008, 2009; Putwain *et al.*, 2012). In the present study, the internal reliability and factor loadings of data at both waves of data collection (see Table 1) were acceptable (Cronbach's α > .70).

Academic achievement was measured using the mean of scores from English, mathematics and science GCSE examinations. At the time of data collection, GCSE examinations used an eight-point letter grading system (A* is the highest, A is the next highest and so on, with G the lowest). These were converted to an eight-point numerical scale (A* = 8, A = 7 and so on, to G = 1) so that a higher score represents a better examination grade (see Daly & Pinot de Moira, 2010). A grade C (5.00 – 5.99 using this metric) is considered to be a pass grade. English, mathematics and science were chosen as these subjects are statutory and, therefore, examination scores would be available for all participants, unlike other subjects.

Procedure

Recruitment letters were sent to Head Teachers of schools outlining the project details and inviting them to participate in the study. Schools were offered book tokens but no incentives were offered to individual students. The data reported here were collected using self-report questionnaires in the final year of secondary education (Year 11). Questionnaires were administered in a pack, together with information and consent sheets, in normal school time during a timetabled period used for administrative and pastoral purposes. The teachers responsible for administering questionnaires were given an instruction sheet that included details about the purpose of the study, ethics (that participation was voluntary, how to withdraw data, etc.) and that the questions did not comprise a test. Written consent was provided by the Head Teacher of each participating school and individual students. Parents were informed of the study via the school newsletter and passive parental consent was sought (parents were asked to inform the school if they wished to withdraw their child from the study). The first wave of data were collected in January (T_1), the second wave of data collected in March (T_2), and GCSE examinations were taken in May and June.

Results

Preliminary analyses

Descriptive data are reported in Table 1. The internal reliability coefficients of worry, tension of academic buoyancy at both waves of measurement were adequate (Cronbach's $\alpha \geq .70$), all data were normally distributed within acceptable limits (skewness and kurtosis ±1) and factor loadings for latent variables (based on the measurement model described below) were satisfactory ($\lambda \geq .40$). Estimates of multivariate kurtosis using Mardia's statistic suggested that data were not multivariate normal at T_1 (27.42, $p < .01$) or T_2 (30.11, $p < .01$). The percentage of missing data was relatively low (2.13% of variables). In subsequent confirmatory factor analyses (CFAs) and structural equation models (SEMs) missing data were handled using the full information maximum likelihood method in M*plus* 7.1 (Enders, 2006; Muthén & Muthén, 2012).

[Table 1 here]

Measurement models comprising self-reported test anxiety (worry and tension) and academic buoyancy were separately assessed for T_1 and T_2. Parameters for these and all subsequent models were estimated using the robust maximum likelihood estimator and the clustering of student level data in schools corrected using the “cluster” and “complex” commands in M*plus* (Muthén & Muthén, 2012). Model fit was assessed using the root mean square error of approximation (RMSEA), the standardised root mean square residual (SRMR), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI). Acceptable and good fitting models are indicated by RMSEA and SRMR indices $\leq$ .08 and $\leq$ .05, respectively, and CFI and TLI indices $\geq$ .90 and $\geq$ .95, respectively (Marsh, Hau, & Grayson, 2005; Marsh, Hau, & Wen, 2004). CFAs for the T_1 and T_2 measurement models, reported in Table 2, were in the good to acceptable range of model fit indices.

To examine models using the same construct measured at different points in time, it is necessary to first demonstrate that measurement properties are equivalent (or invariant) at each wave of measurement. We used a procedure referred to as longitudinal factorial invariance (Meredith, 1993), where a series of CFAs were examined that ‘fixed’ or ‘constrained’ parameters (for factor loadings, factor variance and intercepts) to be identical for worry, tension and academic buoyancy, at both waves of measurement. A deterioration of model fit by greater than .01 in the CFI, TLI and RMSEA statistics would indicate that measurement properties at the two waves of measurement were not equivalent (Chen, 2007; Cheung & Rensvold, 2002). Tests of longitudinal factorial invariance for the measurement model of test anxiety and academic buoyancy at T_1 and T_2 are reported in Table 2.

The first CFA assessed a baseline measurement model that included self-reported test anxiety and academic buoyancy at both time points and allowed corresponding item residuals from T_1 and T_2 to correlate. The second CFA constrained factor loadings to be equal across T_1 and T_2 (the configural model) and showed a reasonable model fit. The third CFA constrained factor variances and covariances to be equal across T_1 and T_2 (the metric model), and showed acceptable model fit indices with no deterioration in model fit (ΔCFI, ΔTLI and

ΔRMSEA all < .001) from the configural model. A fourth CFA constrained item intercepts to be equal across T_1 and T_2 (the scalar model), and showed acceptable model fit indices with no deterioration in model fit (ΔCFI, ΔTLI and ΔRMSEA all ≤ .001) from the metric models. In summary, these analyses show that the measurement models of test anxiety and academic buoyancy at T_1 and T_2 were sufficiently invariant to warrant examining relations over time.

[Table 2 here]

Standardised latent bivariate correlations between test anxiety, academic buoyancy and examination performance (reported in Table 3) were estimated from a CFA that included the baseline measurement model, gender and mean GCSE score in English, science and mathematics as a single manifest variable. Participating schools provided a composite score for performance in English, science and mathematics and we were not able to model mean GCSE performance as a latent variable. This CFA showed a reasonable fit to the data, $\chi^2(423) = 586.11$, $p < .001$, RMSEA = .040, SRMR = .051, CFI = .948, TLI = .939. Due to the relatively large sample size, all correlations were statistically significant at $p < .01$ (with the exception of gender and GCSE score) and interpretation of coefficients is more appropriately guided by size rather than statistical significance. Worry was positively correlated with tension, and academic buoyancy was negatively correlated with both worry and tension. Mean GCSE score showed small negative correlations with worry and tension, and small positive correlations with academic buoyancy. Worry, tension and academic buoyancy were also positively correlated from T_1 to T_2. Female students reported higher test anxiety scores and lower academic buoyancy.

[Table 3 here]

Structural Equation Modelling

A SEM was specified to examine whether the worry and tension components of test anxiety at T_1 predicted academic buoyancy at T_2, and whether academic buoyancy at T_1 predicted the worry and tension components of test anxiety at T_2 (cross-lagged paths). Paths were also specified from the same construct at T_1 and T_2, which provided an estimate of temporal stability. Different constructs at the same wave of measurement were allowed to correlate and measurement errors for each item were allowed to correlate between T_1 and T_2. Finally, paths were specified from worry, tension and academic buoyancy at T_2 to GCSE score and gender included as a covariate. Paths to achievement from variables measured at all earlier waves of data collection are more typically found in studies using sequential designs that model reciprocal effects between achievement and a substantive variable (e.g., academic self-concept or boredom) measured at alternate waves of measurement (e.g., Marsh & O'Mara, 2008; Pekrun, Hall, Goetz, & Perry, 2014). In the 'classic' cross-lagged model used here, especially where T_1 and T_2 measures were collected so close together, and there is no sequential modelling of earlier achievement or examination performance data, there was a risk of paths to GCSE score not being adequately differentiated by T_1 and T_2 measures. Accordingly, we did not include paths from T_1 from worry, tension and academic buoyancy to GCSE score.

The SEM showed a reasonable fit to the data, $\chi^2(423) = 586.62$, $p < .001$, RMSEA = .040, SRMR = .051, CFI = .948, TLI = .939. Keith (2006) suggests that standardised coefficients (betas) > .05 are considered as small, > .10 as moderate, and > .25 as large. Statistically significant stability paths were found from T_1 to T_2 worry ($B = 0.81$, $SE = 0.22$, $\beta = .62$, $p < .001$), T_1 to T_2 tension ($B = 0.66$, $SE = 0.14$, $\beta = .61$, $p < .001$) and T_1 to T_2 academic buoyancy ($B = 0.62$, $SE = 0.15$, $\beta = .56$, $p < .001$). Statistically significant correlations (*p*s all < .001) were found between worry and academic buoyancy (T_1 $r = -.66$, T_2 $r = -.29$), worry and tension (T_1 $r = .82$, T_2 $r = .84$), and tension and academic buoyancy (T_1 $r = -.60$, T_2 $r = -.33$).

Statistically significant cross-lagged paths were found from T_1 academic buoyancy to T_2 worry (B = -0.16, SE = 0.04, β = -.19, $p < .001$) and from T_1 worry to T_2 academic buoyancy (B = -0.36, SE = 0.16, β = -.20, p = .03). GCSE score was predicted by worry (B = -0.45, SE = 0.12, β = -.17, $p < .001$) and academic buoyancy (B = 0.34, SE = 0.12, β = .16, p = .007).

Female students reported statistically higher worry (T_1 B = 0.22, SE = 0.07, β = .30, p = .001; T_2 B = 0.13, SE = 0.05, β = .14, p = .01) and tension scores (T_1 B = 0.41, SE = 0.08, β = .35, p = .001; T_2 B = 0.37, SE = 0.05, β = .30, $p < .001$), but lower academic buoyancy scores (T_1 B = -0.47, SE = 0.10, β = -.39, $p < .001$; T_2 B = -0.41, SE = 0.09, β = .35, $p < .001$). There was no statistically significant gender difference in GCSE score. Statistically significant paths are presented in Figure 2, with solid black lines representing structural paths (for stability and cross-lagged) and dotted lines representing correlations. For clarity gender was omitted.

[Figure 2 here]

Discussion

The aims of this study were to examine reciprocal relations between self-reported test anxiety (worry and tension) and academic buoyancy over two waves of measurement and to examine how test anxiety and academic buoyancy predicted examination performance. The SEM showed a good fit to the data and offered partial support for our hypotheses. Higher worry at T_1 predicted lower academic buoyancy at T_2, and higher academic buoyancy at T_1 predicted lower worry at T_2. However, the cross-lagged paths from T_1 tension to T_2 academic buoyancy and from T_1 academic buoyancy to T_2 tension were not statistically significant. Higher worry at T_2 predicted a lower mean GCSE score, and higher academic buoyancy at T_2 predicted a higher mean GCSE score. H_1, H_2, and H_3, therefore, were supported for the worry component of test anxiety but not the tension component. H_4 was fully supported. In sum, reciprocal relations between test anxiety and academic buoyancy were only shown for the worry component.

The finding of reciprocal relations between worry and buoyancy supports previous findings in the context of general academic anxiety (Martin & Marsh, 2008; Martin, Colmar, *et al.*, 2010; Martin, Ginns *et al.*, 2013). The statistically significant cross-lagged paths from worry to academic buoyancy support the theorising of Putwain and Daly (2013) that academic buoyancy can impact on self-regulative thought to influence the appraisal of a high-stakes examination as more or less threatening. Academic buoyancy could, for instance, help students maintain competence beliefs when they receive negative feedback on a practice examination and attribute this negative feedback to internal and controllable factors, such as preparation strategy and effort, rather than external uncontrollable factors, such as luck or the perceived competence of one's teachers (see Weiner, 1985, 2010). These factors would reduce the likelihood that an examination would be appraised as threatening, with a subsequent effect on test anxiety.

The finding that worry can also influence future academic buoyancy is consistent with previous work (e.g., Martin, Colmar *et al.*, 2010; Martin & Marsh, 2008) that has identified general academic anxiety, or composure, to be the strongest of the '5Cs' (the others are confidence, co-ordination, commitment and control) that contribute to academic buoyancy. This would suggest the presence of a negative feedback loop to academic buoyancy, such that an increase in test-related worries would indicate to the student that they are not as academically buoyant as previously thought (and vice versa). Thus, academic buoyancy and the worry component of test anxiety would be expected to interact in a cyclic fashion over time. Similar feedback loops have been theorised and tested in related areas of educational psychology including achievement emotions and achievement goals (e.g., Linnenbrink & Pintrich, 2002; Pekrun, 2006; Putwain, Larkin, & Sander, 2013) and competence beliefs and academic achievement (e.g., Marsh & Craven, 2006; Marsh & Martin, 2011). The cross-lagged paths between tension and academic buoyancy were not statistically significant, suggesting the feedback loop stems from the cognitive component of test anxiety, rather than affective-physiological component. This may reflect the conceptualisation of academic buoyancy, and the 5Cs contributing to academic buoyancy, as primarily cognitive rather than affective constructs.

The finding that higher worry, but not tension, component of test anxiety predicted a lower mean GCSE score is consistent with findings from meta-analyses (Hembree, 1988; Chapell *et al.*, 2005). Our findings extend the literature by showing that academic buoyancy is positively related to performance on a high-stakes examination as well as lower stakes tests (Martin, 2014; Miller *et al.*, 2013) and further highlights the value of academic buoyancy as an ‘asset-focused’ academic enabler (Martin & Marsh, 2009). Furthermore, the relationship found here between academic buoyancy and examination performance controlled for worry and, therefore, cannot be attributed to an artefact of lower worry, or to greater examination composure. We would expect that the academic buoyancy and examination performance relationship is likely to be indirect and mediated by several adaptive study and learning related factors not included in this study. Previous research has demonstrated links between academic buoyancy to self-efficacy, planning, persistence, uncertain control, failure avoidance and self-handicapping (e.g., Martin & Marsh, 2006, 2008a), all of which would be plausible mediating variables in the academic buoyancy and examination performance relationship.

Limitations and future directions

Our study examined reciprocal relations between test anxiety and academic buoyancy over two waves of data collection that were spaced relatively close together over time. This schedule corresponds more with a test-retest than with a longitudinal timeframe, and we allow for a test of cross-lagged paths only once. A study with three or more waves of data collection would allow for a more thorough test of reciprocal relations by allowing for two or more tests of reciprocal paths. Separating the waves of measurement over longer periods of time would also allow for a more longitudinal dimension to be examined. Nonetheless, our findings provide a useful stepping stone to more complex designs by showing that reciprocal relations do exist between academic buoyancy and test anxiety, and that they are, therefore, worthy of more detailed exploration.

Our study highlighted the importance of attending to the multidimensionality of test anxiety, in that reciprocal relations with academic buoyancy were found for worry, but not the tension component. However, our study was limited to using the ‘classic’ two-factor model of test anxiety. Other models of test anxiety include additional components: Test-irrelevant thinking and specific symptoms of anxiety (Sarason, 1984), social humiliation (Lowe *et al.*, 2008), cognitive obstruction (Friedman & Bendas-Jacob, 1997) and off-task behaviours (Wren & Benson, 2004). There would be merit in examining the reciprocal relations with these other aspects of test anxiety, particularly the cognitive components of test-irrelevant thinking and cognitive obstructions, given that academic buoyancy is primarily conceptualised as a belief-based construct.

Our study has made a useful extension to the academic buoyancy literature by showing relations with performance on a high-stakes test, although we did not control for prior attainment or prior examination performance. Thus, the positive relation shown between academic buoyancy and mean GCSE score could be an artefact of an autoregressive relationship, where students who performed better in previous tests and examinations are simply more academically buoyant. Consequently, a more robust test of the relations between academic buoyancy and educational attainment or examination performance should include prior attainment.

Educational implications

These findings imply that interventions designed to reduce high levels of test anxiety and low levels of academic buoyancy would help students to perform better in high-stakes examinations. The efficacy of test anxiety interventions is relatively well established (Ergene, 2003; Vagg & Spielberger, 1995), although there remains a lack of evidence for school-aged populations (von der Embse, Barterian, & Segool, 2013). There have not yet been any interventions designed to improve academic buoyancy reported in the literature, most likely a result of the nascent stage of the extant literature. There are encouraging findings from positive psychology and social-emotional learning interventions (e.g., Durlak, Weisberg, Dymnicki, Taylor, & Schellinger, 2011; Lyubomirsky & Layous, 2013; Waters, 2011) that may provide direction and insight for interventions that focus on building academic buoyancy directly through incorporating elements of buoyancy into test anxiety interventions.

The aim of positive psychology intervention is to cultivate positive feelings, cognitions and behaviours (Sin & Lyubomirsky, 2009) and of positive education to apply these findings in educational settings (Green, Oades, & Robinson, 2011). These aims are consistent with those of test anxiety interventions that enable students to respond more effectively to evaluative pressure, and the asset-focused nature of buoyancy. Seemingly simple interventions, such as students identifying, reflecting on and recording their strengths can foster positive attitudes towards school, improved academic performance and result in fewer conduct problems (Durlak et al., 2011). Given that interventions in areas related to academic buoyancy, such as academic resilience, have shown promising results (e.g., Brunwasser, Gillham, & Kim, 2009), interventions designed to train or improve academic buoyancy could also yield beneficial results for examination performance and other adaptive learning outcomes.

Theoretically-informed and empirically-evidenced links between test anxiety and academic buoyancy suggest that academic buoyancy could offer useful foci for the site of test anxiety intervention. Based on the Zeidner and Matthews (2005) self-regulative model, these could include: (i) maintaining efficacious self-beliefs following a lower than anticipated mark on a practice examination or classwork; (ii) attributing success and failure to controllable, personal factors, such as effort and strategy; and (iii) controlling thought distortions likely to result in panic during examinations (e.g., “I can’t answer the first question, I’m going to fail the whole examination”).

Conclusion

Academic buoyancy was reciprocally related to the worry component of test anxiety, but not the tension component. Higher academic buoyancy resulted in lower worry and vice versa. Furthermore, lower worry and higher academic buoyancy were related to a better mean score on high-stakes examinations, whereas tension was unrelated to examination scores. These findings offer useful insights into the pathways between these constructs and how these insights may inform the design and evaluation of interventions designed to reduce test anxiety or improve academic buoyancy and examination performance.

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Table 1. Descriptive statistics for worry, tension, academic buoyancy, and GCSE score (*n* = 705)

	Mean	SD	α	Skew	Kurtosis	Factor loadings
T_1 Worry	2.36	0.63	.74	.15	-.58	.47 – .65
T_2 Worry	2.26	0.69	.82	.30	-.47	.51 – .71
T_1 Tension	2.61	0.78	.84	-.07	-.77	.62 – .80
T_2 Tension	2.46	0.82	.88	.05	-.87	.68 – .82
T_1 Academic buoyancy	3.13	0.85	.75	-.24	-.31	.51 – .71
T_2 Academic buoyancy	3.11	0.85	.78	-.07	-.26	.61 – .75
GCSE score	5.19	1.45	—	-.34	.03	—

Table 2. Measurement models and tests of invariance over time

	χ^2(df)	RMSEA	SRMR	CFI	TLI	ΔRMSEA	ΔCFI	ΔTLI
T_1 Measurement Model	205.55 (87)*	.054	.040	.944	.933	—	—	—
T_2 Measurement Model	226.03 (87)*	.062	.041	.947	.936	—	—	—
Baseline Measurement Model	544.71 (237)*	.044	.052	.945	.936	—	—	—
Configural Model	608.69 (396)*	.047	.068	.931	.924	—	—	—
Metric Model	614. 17 (402)*	.047	.071	.931	.924	< .001	< .001	< .001
Scalar Model	630.28 (417)*	.047	.073	.931	.923	< .001	< .001	.001

*$p \leq .001$

Table 3. Bivariate correlations for test anxiety, academic buoyancy, GCSE score and gender (n = 705)

	1.	2.	3.	4.	5.	6.	7.	8.
1. T_1 Worry	—	.71	.82	.65	-.66	-.52	-.23	.30
2. T_2 Worry		—	.59	.84	-.56	-.59	-.20	.38
3. T_1 Tension			—	.64	-.60	-.47	-.24	.35
4. T_2 Tension				—	-.43	-.50	-.11	.30
5. T_1 Academic buoyancy					—	.66	.16	-.37
6. T_2 Academic buoyancy						—	.17	-.37
7. GCSE score							—	.03
8. Gender								—

Note. All correlations statistically significant at $p < .01$, with the exception of gender and GCSE score

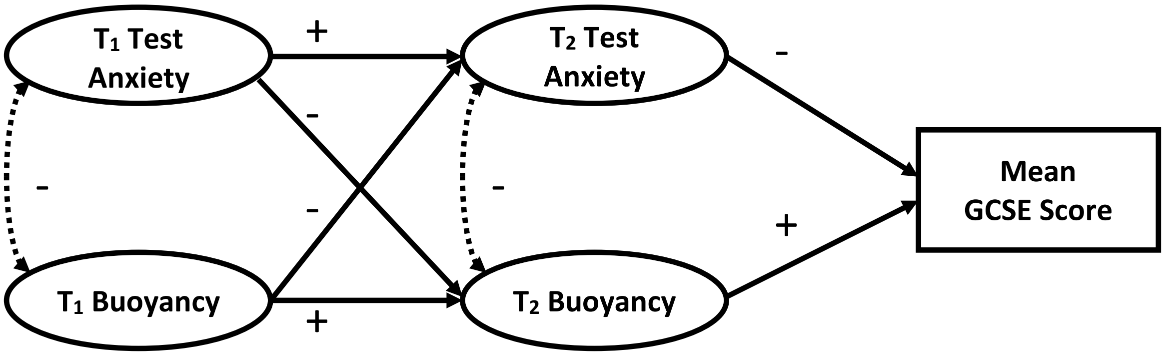

Figure 1. The hypothesised relations between test anxiety, academic buoyancy, and mean GCSE score: A plus sign (+) indicates a positive relationship and minus sign (-) a negative relationship.

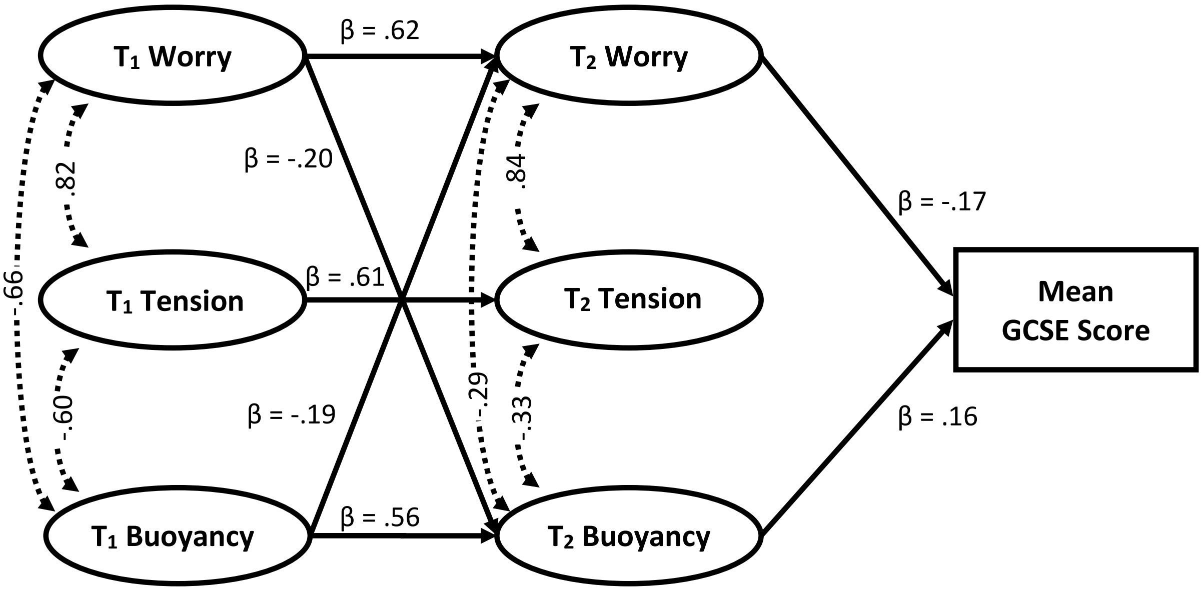

Figure 2. The SEM to examine paths between worry, tension, academic buoyancy, and GCSE score.