Academic Buoyancy in Conceptually Difficult Math Learning: Exploring Students’ Self-Disclosed Emotions, Beliefs, and Perceptions

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***Abstract -* Academic Buoyancy (AB) is defined as a student’s ability to achieve favorable outcomes despite everyday academic stressors, such as poor performance on an assessment or receiving negative feedback. The study of AB is critical given that it has been shown to effectively mediate the effects of academic stress. While some measures of AB exist, none have incorporated student narratives as a means of identifying patterns of AB in classroom settings. Additionally, little research has been conducted into the specific cognitive and affective mechanisms that underlie AB, such as goal orientation (student motivation to perform well). Here, we analyzed the expressive writing samples, defined as self-disclosed narratives outlining students’ feelings prior to a stressful mathematics assessment, of 10-12 year-olds (n=161). We developed a novel expressive writing-based scale which identified patterns of buoyant thinking and goal orientation within the narratives, calling it the Expressive Writing Academic Buoyancy Scale (EWABS). We validated the EWABS against students’ self-reported goal orientations, anxiety, perceptions of ability (self-concept) and perceptions of outcome (self-efficacy). We also sought to understand how categories in the EWABS impacted students’ learnings. Our subgroup analyses allowed us to study who is learning, who isn’t, and why. When taken as a whole, measures included in our survey did not seem to predict students’ learning gains, and there was no relationship between the EWABS and self-reported goal orientation. However, subgroup analyses revealed interesting and highly variable patterns, suggesting that AB operates differently for students, according to their gender and baseline performance on a pre-test.**

# Introduction

Research has shown that students often have negative emotional experiences in the classroom; such as stress, worry, frustration, and anxiety.1 Feelings such as anxiety are predictors of a number of adverse student outcomes, including low academic performance and negative cognitive-affective behaviors, such as failure avoidance.2,3,4 Given its direct effect on young people’s experiences within school contexts, it is of great importance to understand the factors mediating the impact of academic anxiety. Fortunately, recent studies have made tremendous advances in uncovering ways to combat anxiety in the classroom. In this study, we built upon one such advance: academic buoyancy (AB). Defined as students’ ability to achieve favorable academic outcomes despite everyday challenges and stressors, AB is a rich construct that has been shown to decrease the effects of academic anxiety on performance—in some cases fully mediating the effects of academic stress on engagement.4 The present study sought to gain a deeper understanding of the cognitive and affective mechanisms through which AB mediates academic anxiety. Using a novel self-disclosure setting, we built a framework for understanding how AB is expressed in young students’ emotional writing.

AB has been conceptualized as a combination of 5 C’s: ﻿confidence (self-efficacy), coordination (planning), commitment (persistence), composure (low anxiety), and control (certainty about how to do well in school).3,5 It has been associated with greater feelings of control in the classroom as well as the successful management of debilitating stress.5 While studies have provided us with a broad understanding of AB’s numerous correlates, little is known about the specific cognitive and affective mechanisms by which it mediates academic anxiety. Our study filled this gap by building an understanding of the cognitive underpinnings and motivational aspects of AB, as well as establishing a method of identifying AB as it is expressed in students’ spontaneous, written emotional accounts. We propose that the literature on AB may be supplemented with the following cognitive/affective constructs: goal orientation, self-efficacy, reappraisal, and positive self-concept.6,7,8 The links between these constructs and AB have been established, though not studied extensively. Additionally, their cognitive-affective nature sets the foundation for a nuanced understanding of individual variants affecting AB expression. To this end, we developed a novel coding scheme—the Expressive Writing-Academic Buoyancy Scale (EWABS)—which evaluated elementary-school students’ feelings and beliefs prior to a difficult math task in order to assess the variables relevant to AB. Student’s AB, as indicated by their successful performance on an assessment given an adverse academic situation, was examined in relation to validated measures of goal orientation as well as students’ own written accounts of their emotional states.

Our hypotheses were as follows:

1. Mastery goal orientation, reappraisal, self-efficacy, and positive self-concept, which we have argued comprise academic buoyancy, will cooccur.
2. Mastery will have the most impact for students with initially lower performances on a baseline math assessment.
3. Students’ mastery will predict both their immediate and delayed scores on a stressful mathematics assessment.

By using expressive writing as a method of emotional disclosure and investigating potential correlations between our buoyancy scale, validated measures of goal orientation, and children’s learning outcomes, we aimed to build a better understanding of academic buoyancy in practice.

# Method

***Participants*:** Participants were 161 5th and 6th grade children aged 10-12 from five elementary schools in Chicago and the surrounding area (median age = 11.6; SD age = 0.43; 76 females; White (n=43), Black (n=8), Hispanic (n=71), Asian (n=1), Other (n=16), Biracial (n=10).

***Procedure:*** The study was conducted over three days. On Day 1, students completed a measure of goal orientation and a pre-test on ratios (the math subject being taught as a part of this experiment). On Day 2, students engaged in 5 minutes of expressive writing prior to watching a 30-minute video lesson on ratio. A week later, on Day 3, students completed a delayed post-test and a measure of baseline executive function.

***Measures:*** *(1) Goal Orientation*:We used sections of the Patterns of Adaptive Learning Survey to assess children’s self-reported mastery, performance-approach, and performance-avoid goal orientations at both individual and classroom levels. [9] *(2) Baseline Ability:*We used a median split of students’ pre-test scores (15 total points) to identify students of high (HPT) and low (LPT) baseline ability.*(3)**Learning:*Learning was measured as the change in how many questions students answered correctly from pretest to Day 2 test (immediate gains) and from pretest to Day 3 test (delayed gains).*(4) Video Lesson:*Using headphones, students watched the same 30-minute video lesson on ratios that compared incorrect and correct problem-solving strategies. *(5) Math Anxiety:*On day 1, students reported their baseline levels of math anxiety by sharing the extent to which they agreed with the statement “Math makes me nervous” using a 5-point Likert scale.

*(6) The Expressive Writing Academic Buoyance Scale (EWABS):* The EWABS is a novel scale we developed through an iterative, grounded coding process (Krippendorf’s alphas > .80) to assess children’s AB. Based on the previously reviewed literature and its demonstrated relationship to key concepts such as self-efficacy and reframing, we developed codes pertaining to goal orientation, reappraisal, self-efficacy, and self-concept. 10,2,12 We used the EWABS to identify constructs related to AB in children’s writing, and we refer to the combination of such constructs in the data as an “academic buoyancy profile”.

# Results & Discussion

***Analytical Plan:*** We conducted analyses at both whole-group and subgroup levels. Subgroups were defined by gender and baseline mathematics ability (pre-test level)to better understand the unique effect of buoyancy on more at-risk students within our sample.

***Descriptive statistics:*** We found gender differences in length of writing, with girls writing a mean of 70.9 words and boys writing a mean 61.2 words *(B* = -9.7*, p* =.017*).* We also found that some EWABS themes were more likely than others to occur in certain subgroups. *T*-tests reveal that girls wrote a greater proportion of negative outcome perception statements (*t*(157) = 3.215, *p* = .002*).*  We found no relationships between EWABS goal orientation and PALS goal orientation categories for all students except LPT boys, for whom PALS mastery negatively predicted EWABS mastery *(B* = -0.05*, p* = .013*)*.

***Whole group analyses:*** Controlling for gender, age, and baseline ability, mastery did not predict students’ immediate (*B* = 7.92*, p* = .121*)* or delayed learning gains *(B* = 7.91, *p* = .097*)*. However, mastery was positively correlated with positive reappraisal *(r*(161) = 0.237*, p* = .002), suggesting that those with higher self-disclosed mastery also had more instances of positive reappraisal.

***HPT Girls:*** Mastery did not predict learning. Rather, analyses indicated that performance-approach predicted learning gains in this sample *(r(24) = 452, p = .03)*. Positive reappraisal was related to performance-approach (r(161) = 0.408, p = .048), and anxiety increased with positive ability perception (r(24) = 0.456, p = 0.005).

***LPT Girls:*** Mastery positively predicted immediate *(B = 27.3, p = .021)* and delayed (*r*(52) = 0.295, *p* = 0.05) learning gains. An inverse relationship was also found between positive reappraisal and math anxiety *(r(52) = -0.315, p =0.033),* indicating that positive reappraisal operates as an anxiety-abating mechanism in this subgroup. Finally, EWABS performance-approach was related to delayed gains (r(24) = 452, p = 0.03), suggesting that once more the approach orientation may be as relevant as mastery in predicting performance among girls.

There were some interesting similarities and contrasts between the behaviors of HPT & LPT girls. First, mastery seemed to be a predictor of positive outcomes for LPT girls only, whereas performance-approach was relevant to gains in both populations. Positive reappraisal was a recurrently relevant construct in both LPT and HPT girls.

***HPT Boys:*** There was a significant correlation between positive reappraisal and delayed gains *(r*(28)= 0.403, *p* = .037*)*, though this relationship was insignificant when controlling for age and executive function *(B = 8.54e-4, p = 0.529)* . Negative ability perception (*r*(28) = 0.469*, p* = .014) and negative outcome perception (*r*(28) = 0.555, p = 0.002) positively predicted math anxiety, hinting at the negative effects of anxiety on students’ sense of self-efficacy (outcome perception) and self-concept (ability perception).

***LPT Boys:***  Math anxiety was positively related with PALS performance-approach *(r*(54)= 0.388*, p* = .005), PALS classroom performance-approach *(r*(54) = 0.417*, p* = .003*)*, PALS classroom performance-avoid (*r*(54) = 0.38*, p* = .006), and negative ability perception (*r(*54) = 0.411*, p* = .003), highlighting the apparently harmful effects of a performance orientation for this subgroup.

While positive reappraisal was related to positive outcomes in the HPT boys subgroup, it wasn’t as beneficial for the LPT boys, perhaps hinting at an area of intervention.

***General Discussion:*** There is much to be learned from the fact that very few of our hypotheses were supported, and that none of them were consistently supported across subgroups. First, it may be possible that AB is not a consistent trait comprising of goal orientation, reappraisal, self-efficacy, and positive self-concept, but rather a profile of subgroup-specific responses that promote learning. By this definition, AB might change drastically depending on the students being queried.

While all of our hypotheses were largely unsupported by the data, relationships across subgroups offered some support for a conception of AB that includes reappraisal, self-concept, and mastery—though perhaps not all at once. Indeed, our results indicate that AB may manifest as a profile of adaptive responses that varies based on subgroup characteristics.

For HPT girls, for example, the performance-approach goal orientation was the only code that predicted delayed gains. This is especially remarkable given that most of the goal orientation literature identifies boys as most likely to employ a performance-approach goal orientation.11 Also interesting is the fact that both positive ability perception and positive reappraisal were associated with negative outcomes (anxiety and lowered pre-test scores), when logically we might assume these two codes to contribute to positive outcomes. It may be that high-ability girls link positive self-concepts with greater cause for anxiety: failure to demonstrate competence might undermine one’s sense of her own abilities, and subsequently cause anxiety. This is an undoubtedly an area that merits further study.

Results were quite different for LPT girls, where EWABS-measured mastery *did* predict immediate learning gains and, to a lesser extent, delayed gains. Our first hypothesis was also partially supported, as mastery predicted positive reappraisal. EWABS performance-approach was also positively correlated with delayed gains in this group, mirroring HPT girls. It is possible that a mastery goal orientation may in this case indirectly reduce anxiety by way of positive reappraisal.

For HPT boys, greater positive reappraisal predicted larger delayed learning gains. Additionally, both PALS mastery and PALS classroom mastery were significantly related to a decrease in negative ability perception. It is quite encouraging that a strong orientation towards mastery could hypothetically reduce negative beliefs about one’s own abilities. Future investigations might look into the direction of the relationship, as well as seek to understand how reappraisal alone might impact delayed gains.

Results in the LPT boys’ subgroup partially supported our third hypothesis, as EWABS mastery was shown to predict PALS classroom mastery. Interestingly, where performance-approach was a helpful asset to all girls, it proved to be quite detrimental to boys in this condition. It is possible that for children who are already low-scorers, and who *believe* that they will not perform well even before they begin a task, the idea of learning in order to “demonstrate competence” might have significantly adverse effects on their morale and performance—because they do not believe themselves to be competent in the first place. Regardless, it is still unclear why this relationship might be gendered.

# Conclusion

AB is an emerging and exciting concept, with theoretical and practical implications for our understanding of how young students process and overcome adverse academic situations. We took a first step towards exploring the nuanced mechanisms underlying AB by creating the EWABS. The novel self-disclosure context employed allowed us to directly analyze children’s thinking processes in the face of an academically stressful event, a feature which enriches the vastly survey-based methods usually employed in AB research. We validated the EWABS against students’ self-reported goal orientations, anxiety, perceptions of ability (self-concept) and perceptions of outcome (self-efficacy). We also sought to understand how components of the EWABS impacted students’ learning, our subgroup analyses allowing us to observe who is learning, and if so, how. Overall, measures included in our survey did not seem to predict students’ learning gains, and there was no relationship between EWABS and PALS conceptions of goal orientation. However, subgroup analyses revealed interesting and highly variable patterns, suggesting that AB operates differently for students, according to their gender and baseline performance on a pre-test, both of which could be considered risk factors.

Our study made it clear that AB research may benefit by accounting for student voices. While surveys assessing goal orientation and AB are useful, there is much to be learned from children’s perspectives on this subject. Additionally, we have shown that the link between goal orientation and AB is quite complex, and merits further study. By capturing the idea that AB comprises of different “profiles” that vary across students, we expose a need for investigations into how those profiles function, why they are so different, and their long-term costs and benefits.

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