Paradoxical Effects of a Motivational Intervention for College Students in STEM (Science, Technology, Engineering, and Mathematics) Disciplines

Objective

College students in STEM disciplines are expected to successfully deal with academic stress and heightened competition while maintaining the emotional, psychological and physiological health needed to achieve superior performance (Wai et al., 2010). As such, these students are at risk of overconfidence and the negative implications thereof for psychological and emotional well-being, as well as disengagement (Ruthig et al., 2008). One motivational strategy that can help students cope with disappointment is downgrading their expectations (Heckhausen et al., 2010). Given the potential benefits of this motivational strategy for academic adjustment, and the demonstrated benefits of prior interventions in which downgrading expectations corresponded with gains in academic motivation, emotions, and performance (Hall et al., 2006b), the present study evaluated the effects of a motivational program encouraging downgrading for pre-medicine college students on their self-reported expectancies (academic expectations and optimism), academic emotions (enjoyment and anxiety), well-being (illness symptoms and depression), and academic achievement.

Background

This study was informed by the motivational theory of life-span development (Heckhausen & Schulz, 1995; Heckhausen et al., 2010) According to the theory, the motivational strategies individuals use largely depend on the control that they perceive to have over their environment. Individuals who perceive that their behaviour has an impact on the environment (i.e., primary control) are hypothesized to use adaptive strategies to modify their behaviour so as to maximize their chances of success. In contrast, those who perceive that they are limited in their ability to change their environment may use cognitive strategies to adapt to their existing context (i.e., secondary control).

Heckausen et al., (2010) distinguish between engagement- and disengagement-oriented secondary-control strategies. When an individual decides to commit to a certain goal, allocate motivational resources to that goal, focus on the advantages of pursuing the goal, and avoid distractions, they are using primary control strategies. Goal downgrading, on the other hand, occurs when the individual decreases the importance or value of an existing goal, and enhances the importance of other, alternative goals. This disengagement is often combined with self-protection, a process which ensures the preservation of the individual's motivational resources from such negative experiences through strategies such as downward social comparison and focusing on the positive elements of failure events.

The ability to alternate between primary and secondary control based on performance outcomes, has repeatedly been found to have positive effects on students' overall motivation, academic emotions, performance, and health (Hall et al., 2006a, 2006c; Wrosch et al., 2007; Ruthig et al., 2008). When an academic goal becomes unattainable, it is most adaptive for the student to disengage from it and reengage in another, more attainable goal (Wrosch et al., 2003). This pattern of primary and secondary control self-regulation was found to be associated with optimal levels of self-mastery (McCarthy et al., 2006), perceived stress (Wrosch et al., 2003; Hall et al., 2006a), intrusive negative thoughts (Wrosch et al., 2003), and depressive symptoms (Ruthig et al., 2008; Wrosch et al., 2003).

No previous literature was found to explore the role of downgrading expectations as a motivational strategy on overconfident students' expectancies, academic emotions, health, and achievement motivation. Thus, the present study's aim was to administer an intervention program in which downgrading as a motivational strategy was explicitly encouraged (secondary control) to pre-medicine students, specifically focusing on how it affects the variables listed above using self-reported data from

student surveys. It is anticipated that by downgrading their expectations, students will lower their academic expectations and overall optimism, will demonstrate higher positive academic emotions (enjoyment vs. anxiety), will report lower illness and depression symptoms, as well as report greater mastery-oriented achievement motivation (Hall et al., 2006c; McCarthy et al., 2006).

Methods

Participants & Procedure

The study sample consists of 52 college students (mean age = 18.25, *SD* = .52; 34.5% male) enrolled in foundational biological and physical sciences courses at the University of California, Irvine. During the Winter quarter of 2007, all participants completed an online questionnaire including demographic measures (e.g., age, gender, ethnicity, course load) and assessing participants' motivation, emotions, and well-being (15 minutes). Following the questionnaire, students were required to attend one of multiple in-person sessions in which either the intervention or control activities were administered (activities were randomly assigned to experimental sessions; 30 minutes).

Participants were recruited from multiple introductory-level courses in the biological and physical sciences departments via mass emails from the directors of the respective student affairs offices. Participants who completed both Phases 1 and 2 were entered into a raffle for four video iPods, with participants who completed the Phase 3 web questionnaire also being entered into a raffle for gift certificates valid at the UCI Bookstore ranging from $10 to $50.

Independent Measures

Intervention. The intervention program was administered to groups of 25 participants and consisted of three phases. During Phase 1, participants completed a GRE-type aptitude test (Abstract Reasoning and Abilities Test; ARAT; Hall et al., 2004) as a simulated failure experience, after which they were immediately debriefed. In Phase 2, participants were provided a short reading (specific to the experimental condition) to be completed individually. The intervention group reading outlined the benefits of downgrading one's expectations when thinking about future academic performance (e.g., Rather than thinking "anything less than the best is failure," more realistic alternatives were presented such as "overly high goals can make you feel like a failure even when you succeed"). Participants in the control group completed a similarly formatted reading discussing medical myths vs. facts. In Phase 3, a writing exercise was administered based on elaborative learning theory (Entwistle, 2000) requiring participants to summarize and discuss the main points of the reading (depth), provide several examples of the issues discussed (breadth), and explain how they could apply the content in their own lives (personal structure) as well as their emotions concerning academic failure (cf., Pennebaker, 1997). During the final phase, participants once again completed the online questionnaire.

Dependent Measure

Academic *expectations* were assessed by summing together responses from three 10-point questions asking participants (1) how successful they expected to be by the end of the academic year, as well as (2) what GPAs they expected to obtain at the end of the semester and (3) by the upcoming fall semester (cumulative GPA; range: 0 to 4.00) (*M* = 12.13 *SD* = 1.77). Six 5-point items derived from Scheier and Carver's (1992) LOT questionnaire were also used to assess *optimism* (*strongly agree*) (*M* = 21.9, *SD* = 4.17, α = .862). Two learning-related *emotions* were assessed using six-item, five-point Likert scales from the Academic Emotions Questionnaire (AEQ; Pekrun et al., 2005), namely *enjoyment* (*M* = 19.61, *SD* = 3.32, α = .522), and *anxiety* (*M* = 17.19, *SD* = 5.03, α = .801). Concerning psychological adjustment, an 8-item, 5-point measure was used to assess how often during the last month they have experienced each of the following *illness symptoms*: sleep problems, headaches, low energy, muscle tension, fatigue, stomach pain, heart pounding, and poor appetite (*M* = 16.35 *SD* = 5.78)**.** *Depressive symptoms* were assessed using a 10-item, 4-point CES-D scale (Radloff, 1997; *M* = 20.90, *SD* = 5.93, α = .705). Finally, five sessional GPAs were obtained from the registrar's office for Winter 2007, Spring 2007, Fall 2007, Winter 2008, and Spring 2008 academic quarters.

Analysis

The analysis used consisted of six one-way ANCOVAs on participants' post-intervention, self-reported academic expectations, optimism, achievement motivation, academic emotions, illness symptoms, and depression, and one repeated-measures ANCOVA on GPA. Literature-informed covariates (Hall et al., 2010) were chosen to control for potentially confounding variables including baseline levels of the self-report measure at Time 1, gender, as well as academic variables including high school grade and cumulative units completed (i.e., level of study) to control for academic experience and aptitude.

Results

Significant treatment effects were observed on expectations, $F(29) = 4.516$, $p < .05$, optimism $F(29) = 8.049$, $p < .05$, and GPA $F(34) = 5.875$, $p < .05$ As depicted in Figure 1, students in the intervention reported higher expectations ($M = 12.74$, $SD = .40$) than controls ($M = 11.36$, $SD = .48$). Figure 1 also illustrates the main effect for optimism showing students in the intervention to report higher optimism ($M = 22.89$, $SD = .65$) relative to controls ($M = 19.82$, $SD = .79$). Finally, Figure 2 shows the intervention to have a consistently negative effect on GPA over a two-year period, with intervention participants (Winter 2007 $M = 3.01$, $SD = .48$; Spring 2007 $M = 3.09$, $SD = .39$; Fall 2007 $M = 2.93$, $SD = .68$; Winter 2008 $M = 2.87$, $SD = .59$; Spring 2008 $M = 2.88$, $SD = .59$) scoring lower than controls (Winter 2007 $M = 3.15$, $SD = .49$; Spring 2007 $M = 3.25$, $SD = .40$; Fall 2007 $M = 3.19$, $SD = .79$; Winter 2008 $M = 3.23$, $SD = .59$; Spring 2008 $M = 3.38$, $SD = .53$). Intervention participants also reported slightly lower illness symptoms relative to controls, but the effect was not statistically significant ($F(29) = 1.892$, $p = .182$).

Figure 1

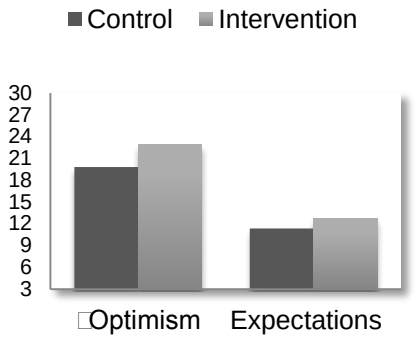
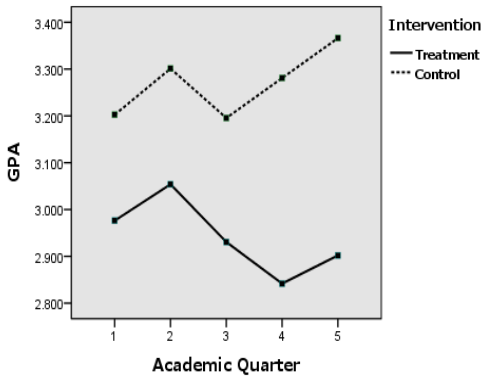


Figure 2



Discussion

The present findings revealed that encouraging college students at risk of overconfidence to downgrade their expectations and adopt more realistic expectations about their academic future had a significant impact on participants' academic expectations, optimism, and GPA. However, the findings observed were contrary to our initial hypotheses in showing the downgrading intervention to contribute to *higher* levels of academic expectations and optimism, and *lower* GPA five subsequent academic quarters as compared to participants in the control condition. More specifically, these results are not consistent with prior research showing interventions encouraging realistic explanations for failure (Haynes et al., 2006; Ruthig et al., 2004; Hall et al., 2006c) and failure-oriented motivational strategies (Hall et al., 2006b) to improve achievement outcomes for overly optimistic college students. Upon further review of the motivational intervention and self-regulation literature, however, it appears our study is not alone in showing adverse effects of well-intentioned programs aimed at supporting motivation and emotional well-being in academic settings.

First, these findings are consistent with recent results showing college students with very high self-esteem to react defensively to brief interventions in which realistic attributions for potential failure experiences are encouraged (e.g., Hall et al., 2010, 2011). Second, similar findings from self-regulated learning research show learning software that explicitly encourages emotion regulation strategies to negatively impact students with high levels of prior knowledge – students already confident in their domain knowledge who

react defensively to suggestions that they prepare themselves psychologically for unsuccessful outcomes (D'Mello et al., 2011; Wolfe et al., 2010). As a potential explanation for this result, Robin and Beer (2001) argue that when overconfident students are faced with failure in a domain in which they are particularly invested, self-enhancement is used as a defensive strategy to maintain self-esteem – a strategy that when inadvertently challenged may result in defensive reactions.

Taken together, these findings suggest that whereas prior research highlights the importance of downgrading aspirations as an adaptive motivational strategy, careful attention must be paid to how this message is presented to students in highly demanding STEM programs where aptitude, prior domain knowledge, and sensitivity to ability-related feedback can result in negative responses to well-intentioned programs if not appropriately addressed. Further research is also warranted to evaluate the combined effectiveness of programs encouraging both engagement (e.g., persistence, effort) and downgrading aspirations, as in Hall et al. (2006b) where expectations decreased but grades improved. Although it was assumed the present STEM population was sufficiently engaged, these findings suggest that reminding them of the benefits of these strategies may present a more balanced motivational message that may be better received. Our results are thus scientifically significant in expanding our understanding of the potential unanticipated consequences of motivational programs encouraging realistic aspirations among students at risk for overconfidence, and further, are of practical relevance in informing efforts by student affairs and counseling professionals in post-secondary education concerning of the potential for well-intentioned programs to backfire when they are not sufficiently tailored to the psychological needs and aptitudes of students in STEM disciplines.

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