Online Motivational Interventions: Improving Academic Achievement in Female STEM Students

N. C. Hall, H. Wang, S. Rahimi, & J. Ranellucci
Department of Educational and Counselling Psychology, McGill University

Background

To address continually decreasing enrollment and rising attrition in post-secondary STEM degree programs, AR programs for women (AUGC, 2011; Cheryan, 2012; Engineers Canada, 2012), this study examined the longitudinal achievement benefits of web-based, motivational programs for female students in the natural sciences over a 1-year period.

Despite a lack of gender differences in mathematics and science aptitude (e.g., Ceci et al., 2009; Hyde et al., 2008; Weber et al., 2007), female’s subjective perceptions of competence are lower in STEM domains as compared to males (e.g., Schunk & Pajares, 2005). From a motivational perspective, Weiner’s (1985, 2006) attribution theory underscores the importance of perceptions of personal control in predicting student engagement and achievement, with over 30 years of research showing that interventions encouraging personally controllable explanations (attributions) for academic setbacks to consistently improve academic motivation and performance (i.e., Attributional Retraining (AR); for reviews, see Forsterling, 1985; Haynes et al., 2009; Wilson et al., 2002).

However, despite considerable research on post-secondary students in social science programs, there exists remarkably few studies evaluating the longitudinal achievement effects of motivational interventions for female college students in STEM programs. Following from recent studies highlighting school children on math performance (e.g., Germany: Dresel & Haugwitz, 2008), and web-based AR on performance. In the second phase, participants experienced (aptitude test) improving achievement within 3 months, and the abstract writing-based AR format having a longer-term benefit on GPA one year later.

Attributional retraining. In the first AR phase, participants first reviewed a brief, web-based reading (i.e., an informational schematic) based on an AR handbook used in previous in-person AR studies (e.g., Perry & Struthers, 1994). The reading consisted of various statements informing them of the benefits of personally controllable attributions (e.g., effort: “I didn’t study hard enough”) as opposed to uncontrollable attributions (e.g., ability: “I’m not smart enough to succeed in this course”) following poor performance. In the second phase, participants completed a timed aptitude test or writing assignment.

The aptitude test (Hall et al., 2004; Perry & Dickens, 1984) consisted of two sections including verbal analogy and mathematics questions (5 minutes per section). The test was intentionally difficult in order to elicit reactance and promote the use of the adaptive failure attributions. The writing assignment (cf., deep learning; Entwistle, 2000) required students to abstractly reflect on the information summarizing the content presented, listing potential reasons for poor performance in students, and providing examples of how they could incorporate the AR information into their studies (15 minutes). The writing test exercise was followed by a debriefing page after which the AR reading was presented a final time for review.

Method

Participants and procedures. The sample consisted of 52 female students enrolled in 1 of 6 STEM disciplines at the University of California, Irvine (physical sciences, biological sciences, health sciences, computer/information sciences, engineering, medicine). Participants were compensated with course credit or entered into a raffle for an iPod. In the Winter ’07 semester, participants were automatically assigned by the study website to the AR treatment or

Method (cont’d)

No AR control group based on the order at which they arrived at the preceding questionnaire (1 = No AR, 2 = Test AR, 3 = Writing AR, 4 = No AR, etc.). The time required to read and respond to the intervention content was ~20-30 minutes. Sessional GPAs for the Winter ’07 and Fall ’07 semesters were obtained from the UCI Registrar’s Office for all participants.

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Analysis & Results

A repeated-measures ANCOVA was conducted with the AR intervention (No AR, Test AR, Writing AR) and Time (Winter ’07, Fall ’07) as predictors of sessional GPA. Fall ’06 GPA was included as a covariate to control for potential confounds due to prior achievement. Results showed a within-subjects interaction between Time and AR on students’ GPA, F(2,48) = 3.458, p = .040. Immediate gains were observed for participants in the Writing AR condition by the end of the semester, however this improvement was no longer evident by the fall semester. In contrast, participants in the Writing AR condition did not show immediate gains in GPA, but did obtain higher GPAs by the fall semester.

Discussion

The present findings are consistent with recent research underscoring the benefits of web-based motivational interventions for improving achievement in college students in demonstrating significant, long-term benefits of online AR on sessional GPA over an academic year for females in STEM disciplines. The significant interaction effect observed further suggests that different intervention formats may realize their effectiveness at different times, with the more applied/direct AR format involving a mock failure experience (aptitude test) improving achievement within 3 months, and the abstract writing-based AR format having a longer-term benefit on GPA one year later. Taken together with recent findings with junior college students in STEM disciplines showing self-efficacy to be a significant predictor of adjustment and persistence specifically for females (Simon et al., 2014), these results suggest that web-based programs may be effective in improving perceptions of competence, emotional well-being, and attainment-related outcomes in female students in STEM programs. Further research is warranted to examine the utility of larger-scale, institutionally administered, web-based programs for facilitating adaptive motivational beliefs, with the benefits of these programs in the natural sciences expected primarily for female students.

References


