Basic and Applied Social Psychology

ISSN: 0197-3533 (Print) 1532-4834 (Online) Journal homepage: http://www.tandfonline.com/loi/hbas20

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To cite this article: Sarah D. Herrmann, Robert Mark Adelman, Jessica E. Bodford, Oliver Graudejus, Morris A. Okun & Virginia S. Y. Kwan (2016) The Effects of a Female Role Model on Academic Performance and Persistence of Women in STEM Courses, Basic and Applied Social Psychology, 38:5, 258-268

To link to this article: http://dx.doi.org/10.1080/01973533.2016.1209757

BASIC AND APPLIED SOCIAL PSYCHOLOGY
2016, VOL. 38, NO. 5, 258–268
http://dx.doi.org/10.1080/01973533.2016.1209757

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The Effects of a Female Role Model on Academic Performance and Persistence of Women in STEM Courses

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ABSTRACT

Women are more likely to leave science, technology, engineering, and mathematics compared to men, in part because they lack similar role models such as peers, teaching assistants, and instructors. We examined the effect of a brief, scalable online intervention that consisted of a letter from a female role model who normalized concerns about belonging, presented time spent on academics as an investment, and exemplified overcoming challenges on academic performance and persistence. The intervention was implemented in introductory psychology (Study 1, $N = 258$) and chemistry (Study 2, $N = 68$) courses. Relative to the control group, the intervention group had higher grades and lower failing and withdrawal rates.

The need for science, technology, engineering, and mathematics (i.e., STEM[1]) professionals is greater than ever before; the number of STEM careers in the United States is forecasted to increase by 1 million by 2018, and 92% will require postsecondary education (Carnevale, Smith, & Melton, 2011; Carnevale, Smith, & Strohl, 2010). To meet this demand, American universities need to produce 100,000 additional graduates in STEM fields per year (Holden & Lander, 2012). However, the United States ranks 27th in the proportion of STEM bachelor's degrees awarded among developed countries (OECD, 2009; US Congress Joint Economic Committee, 2012).

Dropout rates are significantly higher among STEM majors compared to other majors (Holden & Lander, 2012; The National Academies, 2010; Tobias, 1990). Most students who leave STEM majors do so in the first 2 years of college, partly because they perform poorly or lose interest after taking introductory courses (Holden & Lander, 2012). Many STEM fields emphasize challenging introductory courses designed to "weed out" students early in their academic careers, a philosophy unique to these areas (Mervis, 2011; Seymour & Hewitt, 1997; Suresh, 2006). The increased dropout rate among STEM majors may be attributable to low average grades typical of the sciences that may discourage students (Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010; Stinebrickner & Stinebrickner, 2013) and, for women, to the lack of role models that sustain motivation to succeed in STEM fields.

As compared to men, women are more likely to drop out of STEM majors (Strenta, Elliott, Adair, Matier, & Scott, 1994). Several psychological interventions have increased performance and persistence among female STEM students (Miyake et al., 2010; Shapiro, Williams, & Hambarchyan, 2013; Stout, Dasgupta, Hunsinger, & McManus, 2011; Walton, Logel, Peach, Spencer, & Zanna, 2015). Although previous interventions have shown promising results, they may be labor intensive (e.g., laboratory studies), be time consuming (e.g., long-term interventions), and have limited reach (e.g., in-class studies). The present research proposes an integration of several successful approaches and tests whether a brief, scalable, online intervention can provide academic benefits for female STEM students.

One factor in the underrepresentation of women in STEM fields is that female students experience greater uncertainty and feelings of not belonging, making them unsure of their social bonds and sensitive to cues of rejection (Ethier & Deaux, 1994; Mendoza-Denton, Downey, Purdie, Davis, & Petrzak, 2002; Walton & Cohen, 2007; Walton et al., 2015). Past research demonstrates that limited representation of women, or subtle cues such as stereotypically male objects, decreases women's feelings of belonging in STEM majors (Aronson, Quinn, & Spencer, 1998; Aronson &

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Steele, 2005; Ceci, Williams, & Barnett, 2009; Cheryan, Plaut, Davies, & Steele, 2009; Davies, Spencer, & Steele, 2005; Good, Rattan, & Dweck, 2012; Hyde, Lindberg, Linn, Ellis, & Williams, 2008; Inzlicht & Ben-Zeev, 2000; Murphy, Steele, & Gross, 2007; Pronin, Steele, & Ross, 2004; Stockard & Wood, 1984). Indeed, women who have left STEM fields have cited an unwelcoming environment contingent on their underrepresented group identity (Seymour & Hewitt, 1997).

For women in STEM, there is a lack of similar role models; men comprise the majority of STEM faculty at universities in the United States (National Science Foundation, National Center for Science and Engineering Statistics, 2013). This gender disparity may signal that women do not belong or cannot succeed in these fields (Walton & Cohen, 2007). The effects of these differences are evident in the gender breakdowns in tertiary education and beyond; as of 2012, women made up only 41% of doctoral degree recipients, 32% of postdoctoral fellows, and 37% of faculty in STEM fields (National Science Foundation, National Center for Science and Engineering Statistics, 2013). Thus, cues of limited representation may perpetuate the gender gap, as fewer women graduate students and faculty serve as role models for the next generation of women in STEM.

Role models

Role models are important for motivational processes because they help to indicate particular goals and to suggest the path that one should follow to achieve those goals (Collins, 1996; Lockwood & Kunda, 1997). Effective role models must be perceived as competent (Marx & Ko, 2012; Marx, Monroe, Cole, & Gilbert, 2013) and of the same gender or ethnic group (Lockwood, 2006; Marx & Goff, 2005; Marx & Roman, 2002; McIntyre, Paulson, & Lord, 2003), and individuals must be aware of the role model's success in a mutual area of interest, although direct contact with a role model is not necessary (Marx & Roman, 2002).

However, if a role model's achievements seem unattainable, it may result in a negative social comparison (Collins, 1996). Lockwood and Kunda (1999) demonstrated that role models are effective when participants are primed with neutral information or are asked to think about their current academic selves; however, if participants are primed to think about their highest hopes for their future (i.e., their "best self"), the role model led to discouragement. The "best self" prime anchors participants' assessment of their own perceived ability and makes the role model's accomplishments seem unattainable. Thus, it is important for role models to communicate that they have experienced challenges (e.g., Lin-Siegler, Ahn, Chen, Fang, & Luna-Lucero, 2016).

Role model interventions improve performance by reducing concerns about representing one's group in a stereotyped domain and, therefore, inoculating participants from stereotype threat (Dasgupta, 2011; Dasgupta & Asgari, 2004; Davies et al., 2005; Marx & Goff, 2005; Marx & Roman, 2002; McIntyre et al., 2003; Shaffer, Marx, & Prislin, 2012; Shapiro et al., 2013; Stout et al., 2011). Exposure to a similar role model increases career motivation (Buunk, Peiró, & Griffioen, 2007), identification (Ramsey, Betz, & Sekaquaptewa, 2013), performance on GRE-like exams (Marx & Roman, 2002; McIntyre et al., 2003; Shapiro et al., 2013), perceived success (Lockwood, 2006), academic and career aspirations (Nauta, Epperson, & Kahn, 1998; Nauta & Kokaly, 2001; Shapiro et al., 2013), and reduced implicit self-stereotyping (Asgari, Dasgupta, & Stout, 2012).

Exposure to stereotypical male role models has been shown to lower women's interest, belonging, and perceived success in STEM because of perceived dissimilarity (Asgari et al., 2012; Cheryan, Drury, & Vichayapai, 2013; Cheryan, Siy, Vichayapai, Drury, & Kim, 2011; Drury, Siy, & Cheryan, 2011). Exposure to a female STEM expert, however, increases women's STEM self-concept and implicit attitudes toward STEM (Stout et al., 2011). According to Drury et al. (2011), role models, regardless of gender, can *recruit* women into STEM (e.g., Baruch & Nagy, 1977; Cheryan et al., 2011; Downing, Crosby, & Blake-Beard, 2005; Lunneborg, 1982), but female role models are more effective at *retaining* female students (Barbercheck, 2001; Cheryan & Plaut, 2010; Schmader, Johns, & Forbes, 2008; Steele, 1997).

A relevant role model could also help students connect hoped-for identities and the actions necessary to attain those identities (Oyserman & Destin, 2010; Oyserman, Terry, & Bybee, 2002). Absence of positive role models may make it difficult to envision attaining the benefits of a college degree. Research on Identity-Based Motivation (Oyserman, 2009) has illustrated that perceiving a strong connection with one's future self may enhance motivation. Role models may set examples for perseverance during difficult times (Oyserman, Bybee, & Terry, 2006). In addition, framing education as an investment has been shown to increase academic performance for middle school students (Destin & Oyserman, 2010). Furthermore, recent research has demonstrated that feeling connected to one's future self plays a pivotal role in the college context and has a positive impact on academic achievement by directing attention away from the present and toward the future, which promotes self-control (Adelman et al., 2016).

The story-editing approach and psychological interventions

There is a growing literature on brief psychological interventions designed to improve academic performance and persistence. Small psychological changes can yield large effects that persist over time (Walton, 2014; Wilson, 2011; Yeager & Walton, 2011). A variety of interventions have been empirically validated, including teaching incremental theories of intelligence (e.g., Aronson, Fried, & Good, 2002; Blackwell, Trzesniewski, & Dweck, 2007; Paunesku et al., 2015; Yeager et al., 2016), affirming values to buffer from stereotype threat (e.g., Cohen, Garcia, Apfel, & Master, 2006; Cohen, Garcia, Purdie-Vaughns, Apfel, & Brzustoski, 2009; Cook, Purdie-Vaughns, Garcia, & Cohen, 2012; Covarrubias, Herrmann, & Fryberg, 2016; Miyake et al., 2010; Walton et al., 2015), and enhancing belonging by changing attribution styles (Walton & Cohen, 2007, 2011; Walton et al., 2015; Wilson & Linville, 1982, 1985). Table 1 provides a summary of the interventions that have used social-psychological frameworks to intervene in educational settings. These interventions share the assumption that changes in narratives (called the story-editing approach) from brief interventions can result in sustainable, positive benefits when individuals reframe narratives about themselves and their "story" in the world (Wilson, 2011). The interventions in Table 1 have been classified as focusing on attributions or belonging with academic performance outcomes (e.g., grade point average [GPA]).

Attribution interventions

Attribution theory proposes that when students are able to attribute poor performance to unstable factors (i.e., study strategy) rather than stable factors (i.e., ability), they have better outcomes. Wilson and Linville (1982, 1985) recruited self-identified struggling college students to view videos of upperclassmen describing how their grades improved over time. In addition, the upperclassmen encouraged students to attribute poor grades to unstable factors rather than stable ones. Participation took place in a lab in two one-on-one visits (Wilson & Linville, 1982) or one visit in groups of four to six (Wilson & Linville, 1985). Compared to a control group, intervention participants had higher GRE scores, had higher GPAs, and were less likely to drop out of college 1 year later (Wilson & Linville, 1982, 1985).

In a similar intervention, middle school students received an attribution intervention, a theories of intelligence intervention—where participants were taught that intelligence was malleable—or received both interventions as part of a course curriculum (Good, Aronson, & Inzlicht, 2003). Participants met with college-aged mentors twice and e-mailed for one semester. Results demonstrated that girls in the intervention conditions had higher math scores on a state standardized test compared to those in the control condition. In addition, all intervention participants had higher reading scores compared to control participants. Thus, attribution interventions encourage students to attribute poor performance to malleable factors so that they can change their behavior in the future to improve performance.

Belonging interventions

Belonging interventions normalize feelings of not belonging and emphasize that such feelings are temporary. In one belonging intervention, participants in a 1-hr lab study read surveys about how most students feel that they don't belong initially and that those feelings dissipate over time (Walton & Cohen, 2007, 2011). Participants were then videotaped giving a speech to 1st-year students about how their worries about belonging in college had decreased (e.g., a "saying-is-believing" task).

Table 1. Past belonging and attribution interventions methods.

Study	Intervention	Methods	Dependent variables
Good, Aronson, and Inzlicht (2003)	Attribution, theories of intelligence, or both	As part of course curriculum, seventh-grade students communicated with a college mentor (25 mentors, 3-hr training session, 1 mentor per 6 students) in-person (90 min, 2x) and via e-mail throughout the school year.	Standardized test
Wilson and Linville (1982)	Attribution	Lab study. Two visits, 1-on-1 with research assistant, watched videotape. No information on session length.	GPA, GRE
Wilson and Linville (1985)	Attribution	Lab study. One visit, Ps in groups of 4–6. Watched videotape. No information on session length.	GPA, GRE
Walton and Cohen (2007, 2011)	Belonging	Pre-questionnaire. Lab visit (3–10 days post questionnaire) to receive intervention and complete dependent measures (1 hr). Ps received $30 for participation.	GPA
Walton et al. (2015)	Affirmation or social-belonging intervention	Pre-questionnaire. Forty-one classroom sessions (ranging from 1-on-1 to four participants per session). Completed belonging exercise or affirmation, saying-is-believing writing assignment (45–60 min). Ps received keychain to remind them of the intervention.	Engineering GPA

Note. GPA = grade point average; P = Participants.

Compared to a control condition, African American participants in the treatment condition had significantly higher GPAs for 3 consecutive years, were more likely to be in the top quarter of their class, and reported greater happiness and improved health after the intervention (Walton & Cohen, 2007, 2011).

Another intervention by Walton et al. (2015) tested the belonging intervention among women in a competitive, male-dominated engineering program. In this intervention, 1st-year students were invited to take part in research sessions held in engineering classrooms where they were given a social belonging intervention. The materials indicated that many incoming male and female engineering students feel that they do not belong and that these feelings dissipate with time. Participants then completed a written "saying-is-believing task" and received a keychain to remind them of the intervention. Female students in the intervention condition had significantly higher 1st-year engineering GPAs compared to participants in a control condition. Thus, belonging interventions are effective because they train participants to perceive difficulties as normal and temporary. However, past attribution and belonging interventions have involved lengthy (45- to 90-min) lab visits or small-group classroom sessions with research assistants, thereby limiting their scalability.

The present studies

The present research tests an intervention that incorporates themes from successful interventions in a narrative format that is delivered online. We extend existing approaches by providing a female role model who (a) normalizes poor performance and feelings of not belonging (e.g., Walton & Cohen, 2007, 2011; Walton et al., 2015; Wilson & Linville, 1982, 1985), (b) directs students to think about time and effort spent on academics as an investment for the future (e.g., Destin & Oyserman, 2010), and (c) serves as an example that similar others can overcome challenges to succeed (e.g., Lin-Siegler et al., 2016; Marx & Roman, 2002; Ramsey et al., 2013; Stout et al., 2011). This should be especially effective for women in STEM, who may have fewer role models.

In contrast to previous psychological interventions that have employed time-consuming and expensive programs that have limited reach (e.g., in-person laboratory studies, multiple sessions/longitudinal interventions, in-class studies, and/or individually tested; Good et al., 2003; Miyake et al., 2010; Walton & Cohen, 2007, 2011; Walton et al., 2015; Wilson & Linville, 1982, 1985), the present study employs a brief (5-min), easy-to-implement online intervention that is scalable to large groups (Table 1). We examine the effects of the intervention on women's course performance and DEW (grades of D or E/F, or W, course withdrawal) rate in introductory psychology (Study 1) and chemistry courses (Study 2).

By studying women in psychology and chemistry courses, we can examine the generalizability of the effects of the intervention in courses in which women outnumber men and men outnumber women. Although course grade overlaps with DEW rate, course grade does not take into account students who withdraw from the course and does not focus on grades such as D and E, which require students to repeat the course or take an alternative course. Of importance, receiving a DEW makes students off-track and being off-track as 1st-year students is associated with increased risk of dropping out from college (Tinto, 1993).

Study 1

The first study investigated whether reading a letter from a female role model who discussed the benefits of a college degree, feelings of not belonging, and attributions for poor performance would impact course grades and DEW rate for students in an introductory psychology course. Although women in this course were not numerically underrepresented, the course was characterized by low passing rates, is a common prerequisite for students, and had a male instructor; three of the four teaching assistants for the course were male. In addition, introductory psychology courses have been used in several studies investigating women in STEM (e.g., Cheryan & Plaut, 2010; Nosek, Banaji, & Greenwald, 2002).

In the intervention condition, participants read a letter in which a graduate student discussed her experiences as a 1st-year student in introductory psychology, thereby serving as a role model. Role models may be especially valuable for underrepresented students who lack access to similar individuals who have been successful in college. We hypothesized that students who read the role model letter would have higher course grades and a lower failure and withdrawal rate compared to students in the control condition.

Methods

Participants

Two hundred fifty-eight female students (M age = 18.42, SD = 1.16) in an introductory psychology course at a large southwestern university participated for extra credit.[2] The ethnic makeup of the sample was 31.8% European American, 27.1% Latino, 10.5% Asian or

Asian American, 24.8% African or African American, .8% Native American, .8% Middle Eastern, and 4.3% multiracial or other. Because this was the initial test of this intervention, there was no stopping rule; we sought to collect as much data as possible before the 7th week of the semester.

Materials and procedure

Following the first examination in the 5th week of the semester, the male instructor invited students via e-mail to participate in the survey on "experiences of college students" for extra credit. Participants completed the survey online through Qualtrics. Participants were randomly assigned to condition. In the role model condition, students were told that experimenters had asked a graduate student, Sarah, to write about her transition to college. The intervention drew upon themes from successful past interventions, including attribution (i.e., "I studied hard for the first test, and felt like I did well on it, but when I got it back, my grade was much lower than I expected!"), belonging (i.e., "I remember thinking, 'Why am I paying a ton of money to go to classes and spending all my time working on them, if I can't even get good grades?'"), and emphasized the value of a college degree (i.e., "You are paying money now, but you get great bang for your buck; the value of a college degree across a life span is two million dollars!"). Finally, the role model served as an example of overcoming adversity to achieve one's goals (i.e., "I am a graduate student now and even worked as a Teaching Assistant last year") and once again normalized challenges at the beginning of college (i.e., "I saw a lot of students in office hours going through the same thing that I did in college"). Participants in the control condition proceeded to the demographic portion of the survey. Participation took approximately 5 min.

At the end of the semester, with the participants' consent ($n = 240$), course grades and DEW rates, which indicate whether a student is in good standing, were collected from the University Office of Institutional Analysis. Course grades were converted to a 4.0 scale, ranging from 0.0 (E) to 4.0 (A).

Results

First, we expected that participants in the role model condition would have higher course grades compared to those in the control condition. As expected, participants in the intervention condition had higher course grades ($n = 120$, $M = 2.93$, $SD = 1.07$) compared to participants in the control condition ($n = 120$, $M = 2.64$, $SD = 1.31$). A d of .24 indicates that participants in the intervention group on average earned approximately one fourth of a standard deviation higher grade than participants in the control group, which is considered a small effect size (Figure 1).

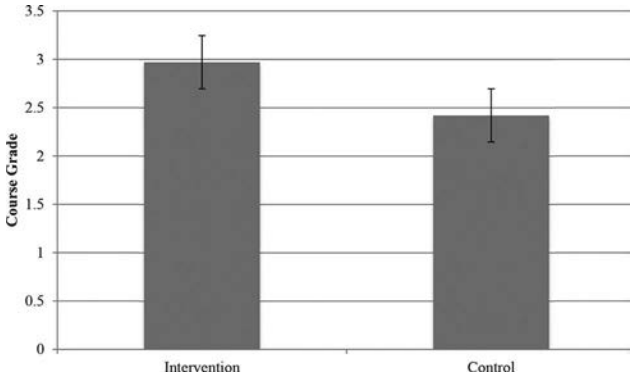

Figure 1. Effect of condition (intervention/control) on psychology course grade.

Second, we expected that participants in the role model condition would have a lower DEW rate compared to those in the control condition. The outcome variable was coded as follows: 0 = *grade of A, B, or C*; 1 = *grade of D, E or W*. The predictor was condition (0 = control; 1 = intervention). The odds of receiving a DEW were .24 to 1 in the control group (23 participants had a DEW and 96 did not) and .09 to 1 in the intervention group (10 participants had a DEW and 111 did not). The odds ratio of .38 indicates that the odds of receiving a DEW in the intervention condition were 62% less than in the control condition.

Discussion

As predicted, providing a role model who normalized poor initial performance and feelings of not belonging and stressed the value of a college degree enhanced course grades and decreased the DEW rate for women in an introductory psychology course, a nontraditional STEM course. Because psychology has more women role models than other STEM fields, our findings for women may be stronger in other disciplines. Therefore, in Study 2, we address this limitation by replicating the study in an introductory chemistry course, where women were numerically underrepresented.

Study 2

Study 2 sought to replicate and extend the findings of Study 1 with a sample of female students in a challenging introductory STEM course: general chemistry. We hypothesized that students in the role model condition would have higher grades and a lower overall DEW rate compared to students in the control condition. Further, we proposed that the effect of the intervention would be

stronger for women in chemistry than in psychology, as there are more stereotypes, greater underrepresentation, and fewer similar role models.

Methods

Participants

Sixty-eight female students (M age = 19.91, SD = 2.83) from an introductory chemistry course completed the study for extra credit.[3] The ethnic makeup of the sample was 56.5% European American, 10.1% Latino, 8.7% Middle Eastern, 10.1% Asian or Asian American, 4.3% Native American, and 7.2% multiracial or other. One participant did not report ethnicity.

Materials and procedure

After Exam 1 grades were posted during the 5th week of the semester, participants were invited by their male instructor to complete the survey through the online survey software Qualtrics. All procedures were identical to Study 1, except that "Psychology" was changed to "Chemistry." At the end of the semester, with their consent (n = 65), participants' course grades and DEW rate were collected from the University Office of Institutional Analysis. Course grades were ranked from 0.0 (E) to 4.0 (A).

Results

First, we examined whether participants in the role model condition had higher course grades compared to those in the control condition. Once again, participants in the intervention condition had higher course grades (n = 29, M = 3.01, SD = .55) than those in the control condition (n = 32, M = 2.40, SD = 1.16). The d of .66 indicates that participants in the intervention group on average earned approximately two thirds of a standard deviation higher grade than participants in the control group, which is considered a medium-to-large effect size (Figure 2).

Second, we examined whether participants in the intervention condition would have a lower DEW rate compared to those in the control condition. The outcome variable was coded as follows: 0 = grade of A, B, or C; 1 = grade of D, E or W. The predictor was condition (0 = control, 1 = intervention). The odds of receiving a DEW were .28 to 1 in the control group (seven participants had a DEW and 25 did not) and .06 to 1 in the intervention group (two participants had a DEW and 31 did not). The odds ratio of .23 indicates that the odds of receiving a DEW in the intervention condition were 77% less than in the control condition.

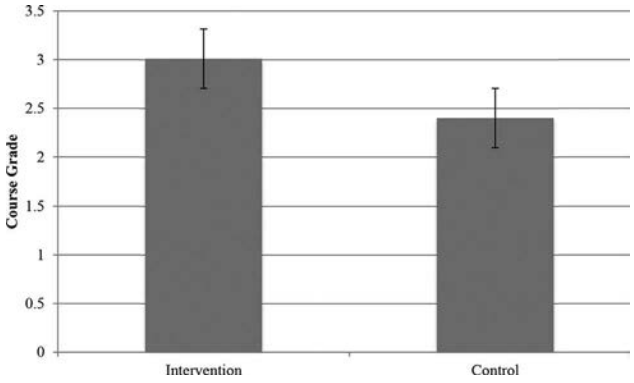

Figure 2. Effect of condition (intervention/control) on chemistry course grade.

Discussion

Study 2 revealed that, relative to the control condition, women in the intervention condition had higher course grades and lower DEW rates. This may be because the author of the letter was a woman who served as a similar role model and who normalized concerns about belonging and emphasized the value of a college degree. Research on women in STEM fields has indicated that they are aware of the stereotype about the gender gap in mathematical ability (e.g., Jones et al., 1984; Miyake et al., 2010; Nosek et al., 2002; Ramsey & Sekaquaptewa, 2011; Steele, James, & Barnett, 2002). Thus, women in STEM fields may face an unwelcoming environment.

General discussion

The purpose of the present research was to propose and test the effects of a brief, online role model intervention on academic performance and persistence for women in introductory psychology and chemistry courses. Across two studies, we found that the intervention improved course grades for women (i.e., ds in psychology and chemistry of .24 and .66, respectively). Similarly, with respect to the odds of receiving a DEW, women benefitted from the intervention in psychology and in chemistry (i.e., odds ratios of .38 and .23, respectively). These findings provide further support for the notion that brief psychological interventions can yield significant effects in educational contexts.

Our proposed intervention built on the story-editing approach, which posits that people can redirect their narratives about themselves to lead to lasting behavioral changes (Wilson, 2011). These concepts are echoed by Yeager, Walton, and Cohen (2013), who suggested that psychological interventions complement traditional educational reforms and systematically enhance student achievement by changing subjective experiences of the academic environment, utilizing recursive processes

that reinforce the effects of brief interventions (see also Garcia & Cohen, 2012; Walton, 2014; Yeager & Walton, 2011). These studies also add to a nascent area of research focusing on scaling up psychological interventions to benefit larger groups of students (e.g., Paunesku et al., 2015; Yeager et al., 2014; Yeager et al., 2016) by investigating the effects of a brief, scalable, online intervention on women's performance in STEM.

Given the stark statistics about the increased dropout of women in STEM, an important takeaway message from this research is that having female role models describe overcoming challenges, normalize feelings of not belonging, and emphasize the importance of a college degree may be effective for increasing performance and persistence for women in these domains (e.g., Lin-Siegler et al., 2016). These role models need not be present so long as they are similar and successful in an area of mutual interest, consistent with past research (e.g., Marx & Roman, 2002).

Three limitations of the present studies should be acknowledged and addressed in future research. First, because the intervention incorporated features from previous approaches (e.g., role models, belonging, attribution), it is not clear which of these approaches in the current intervention are responsible for the effects on course grades and DEW rates. The independent effectiveness of these approaches has been demonstrated in previous studies. Therefore, it was not the aim of the present research to test the independent effects of these approaches. It is also not valid to draw conclusions about the independent effects of these approaches after we substantially simplified their presentations to fit our present purpose. Our major goal was to integrate these approaches into a narrative and deliver a brief, online intervention that can be applied to a large population of students in the future. Furthermore, it should be noted that the intervention was compared with a nonsubstantive control group.

Second, it is important to identify mediators of the effects of the intervention on academic performance and persistence. The present study did not examine any potential mediators of the effect on academic performance. Potential mediators may include STEM identification (Stout et al., 2011), feelings of belonging (Dasgupta, 2011), social integration (Shook & Clay, 2012; Walton & Carr, 2012; Walton et al., 2015), or academic self-efficacy (Stout et al., 2011). Specifically, consistent with research from Stout et al. (2011), we may observe that exposure to a female role model increases implicit identification with STEM, which in turn may increase academic performance. In addition, we may observe that exposure to a female role model "inoculates" women in STEM, thereby increasing social belonging and buffering against stereotypes (Dasgupta, 2011; Stout et al., 2011). Alternately, social belonging may increase female students' social integration with others in their majors, which may improve performance (Shook & Clay, 2012; Walton & Carr, 2012; Walton et al., 2015). Another possibility is that exposure to a female role model increases academic self-efficacy, the belief that one is capable of succeeding in a given domain (e.g., Stout et al., 2011).

However, as noted in a recent special edition of *Basic and Applied Social Psychology*, properly demonstrating mediation is challenging (Grice, Cohn, Ramsey, & Chaney, 2015; Kline, 2015; Tate, 2015; Thoemmes, 2015; see also MacKinnon, 2008). Issues identified with mediation analyses include overreliance on the null hypothesis significance testing procedure (Kline, 2015; see also Trafimow & Marks, 2015, 2016), assumptions of modularity (Kline, 2015), emphasis on parameter-centered rather than person-centered analyses (Grice et al., 2015), and use of mediation in cross-sectional research without clear time precedence (Kline, 2015; Kraemer, Wilson, Fairburn, & Agras, 2002; MacKinnon & Fairchild, 2009; Tate, 2015).

A third limitation is that the present study did not address whether there is an interaction with role model and participant gender. Future research would benefit from further examining how gender-matching of role models impacts grades. Specifically, do female students need a role model of the same gender to succeed in STEM majors? Drury et al. (2011) suggested that male role models can effectively recruit women into STEM fields but that female role models are necessary to retain these students. Another possible extension would be testing the effect of gender ratio of actual role models (e.g., instructors, teaching assistants) on performance and persistence of men and women in STEM courses.

In conclusion, the present research tested a brief, online role model intervention that normalized feelings of not belonging, directed students to think about academics as an investment, and provided an example of overcoming challenges to succeed. In two studies in psychology and chemistry courses, female participants who received the role model intervention had higher course grades and lower DEW rates, compared to control conditions. The magnitude of the intervention effects ranged from small (i.e., course grades in psychology) to medium-to-large (i.e., course grades in chemistry). As can be seen in Table 1, the present studies are among the first to test brief, scalable, online interventions that can be easily delivered to large numbers of students (e.g., as part of orientation, at the beginning of a challenging course). This research contributes to the growing body of literature suggesting that

brief psychological interventions can exert positive, long-term effects on academic performance.

Notes

1. Although definitions of STEM vary by institution, the National Science Foundation characterizes STEM fields as the academic and professional disciplines of science, technology, engineering, and mathematics, including social and behavioral sciences such as psychology, economics, sociology, and political science (American Psychological Association, 2010; National Science Foundation, Division of Science Resources Statistics, 2010).
2. Male students were also invited to participate in the study; however, they were not the focus of this study and there were no differences in their performance by condition. Thus, the results are not presented here.
3. As in Study 1, male students were invited to participate in the study; however, they were not the focus of this study and there were no differences in their performance by condition. Thus, the results are not presented here.

Funding

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A160023 to Arizona State University. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

References

Adelman, R. M., Herrmann, S. D., Bodford, J. E., Barbour, J. E., Graudejus, O., Okun, M. A., & Kwan, V. S. Y. (2016). Feeling closer to the future self and doing better: Temporal psychological mechanisms underlying academic performance. *Journal of Personality*. Advance online publication. doi:10.1111/jopy.12248

American Psychological Association. (2010). Psychology as a core science, technology, engineering, and mathematics (STEM) discipline. In *Report of the American Psychological Association 2009 Presidential Task Force on the Future of Psychology as a STEM Discipline*. Washington, DC: Author.

Aronson, J., Fried, C., & Good, C. (2002). Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. *Journal of Experimental Social Psychology*, *38*, 113–125. doi:10.1006/jesp.2001.1491

Aronson, J., Quinn, D. M., & Spencer, S. J. (1998). Stereotype threat and academic underperformance of minorities and women. In J. K. Swim & C. Stangor (Eds.), *Prejudice: The target's perspective* (pp. 83–103). San Diego, CA: Academic Press. doi:10.1016/B978-012679130-3/50039-9

Aronson, J., & Steele, C. M. (2005). Stereotypes and the fragility of academic competence, motivation, and self-concept. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 436–456). New York, NY: Guilford Press.

Asgari, S., Dasgupta, N., & Stout, J. (2012). When do counter-stereotypic ingroup members inspire versus deflate? The effect of successful professional women on young women's leadership self-concept. *Personality and Social Psychology Bulletin*, *38*, 370–383. doi:10.1177/0146167211431968

Barbercheck, M. (2001). Mixed messages: Men and women in advertisements in science. In M. Wyer M. Barbercheck D. Giesman H. O. Ozturk & M. Wayne (Eds.), *Women, science, and technology: A reader in feminist science studies* (pp. 117–131). London, England: Routledge.

Baruch, R., & Nagy, J. (1977). *Females and males in the potential scientist pool: A study of the early college years*. Washington, DC: National Science Foundation.

Blackwell, L. A., Trzesniewski, K. H., & Dweck, C. S. (2007). Theories of intelligence and achievement across the junior high school transition: A longitudinal study and an intervention. *Child Development*, *78*, 246–263. doi:10.1111/j.1467-8624.2007.00995.x

Buunk, A. P., Peiró, J. M., & Griffioen, C. (2007). A positive role model may stimulate career oriented behavior. *Journal of Applied Social Psychology*, *37*, 1489–1500. doi:10.1111/j.1559-1816.2007.00223.x

Byars-Winston, A., Estrada, Y., Howard, C., Davis, D., & Zalapa, J. (2010). Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: A multiple-groups analysis. *Journal of Counseling Psychology*, *57*(2), 205–218. doi:10.1037/a0018608

Carnevale, A. P., Smith, N., & Melton, M. (2011). *STEM: Science, technology, engineering, mathematics*. Washington, DC: Georgetown University.

Carnevale, A. P., Smith, N., & Strohl, J. (2010). *Help wanted: Projections of jobs and education requirements through 2018*. Washington, DC: Georgetown University, Center on Education and the Workforce.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin*, *135*, 218–261. doi:10.1037/a0014412

Cheryan, S., Drury, B. J., & Vichayapai, M. (2013). Enduring influence of stereotypical computer science role models on women's academic aspirations. *Psychology of Women Quarterly*, *37*(1), 72–79. doi:10.1177/0361684312459328

Cheryan, S., & Plaut, V. C. (2010). Explaining underrepresentation: A theory of precluded interest. *Sex Roles*, *63*, 475–488. doi:10.1007/s11199-010-9835-x

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology*, *97*, 1045–1060. doi:10.1037/a0016239

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science*, *2*, 656–664. doi:10.1177/1948550611405218

Cohen, G. L., Garcia, J., Apfel, N., & Master, A. (2006). Reducing the racial achievement gap: A social-psychological intervention. *Science*, *313*, 1307–1310. doi:10.1126/science.1128317

Cohen, G. L., Garcia, J., Purdie-Vaughns, V., Apfel, N., & Brzustoski, P. (2009). Recursive processes in self-affirmation: Intervening to close the minority achievement gap. *Science*, *324*, 400–403. doi:10.1126/science.1170769

Collins, R. L. (1996). For better or worse: The impact of upward social comparison on self-evaluations. *Psychological Bulletin*, *119*, 51–69. doi:10.1037/0033-2909.119.1.51

Cook, J. E., Purdie-Vaughns, V., Garcia, J., & Cohen, G. L. (2012). Chronic threat and contingent belonging: Protective benefits of values affirmation on identity development. *Journal of Personality and Social Psychology*, *102*, 479–496. doi:10.1037/a0026312

Covarrubias, R., Herrmann, S. D., & Fryberg, S. A. (2016). Affirming the interdependent self: Implications for Latino student performance. *Basic and Applied Social Psychology*, *38*(1), 47–57. doi:10.1080/01973533.2015.1129609

Dasgupta, N. (2011). Ingroup experts and peers as social vaccines who inoculate the self-concept: The stereotype inoculation model. *Psychological Inquiry*, *22*, 231–246. doi:10.1080/1047840X.2011.607313

Dasgupta, N., & Asgari, S. (2004). Seeing is believing: Exposure to counterstereotypic women leaders and its effect on the malleability of automatic gender stereotyping. *Journal of Experimental Social Psychology*, *40*, 642–658. doi:10.1016/j.jesp.2004.02.003

Davies, P. G., Spencer, S. J., & Steele, C. M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology*, *88*, 276–287. doi:10.1037/0022-3514.88.2.276

Destin, M., & Oyserman, D. (2010). Incentivizing education: Seeing schoolwork as an investment, not a chore. *Journal of Experimental Social Psychology*, *46*, 846–849.

Downing, R. A., Crosby, F. J., & Blake-Beard, S. (2005). The perceived importance of developmental relationships on women undergraduates' pursuit of science. *Psychology of Women Quarterly*, *29*, 419–426. doi:10.1111/j.1471-6402.2005.00242.x

Drury, B. J., Siy, J. O., & Cheryan, S. (2011). When do female role models benefit women? The importance of differentiating recruitment from retention in STEM. *Psychological Inquiry*, *22*, 265–269. doi:10.1080/1047840X.2011.620935

Ethier, K. A., & Deaux, K. (1990). Hispanics in ivy: Assessing identity and perceived threat. *Sex Roles*, *22*, 427–440. doi:10.1007/BF00288162

Garcia, J., & Cohen, G. L. (2012). A social psychological approach to educational intervention. In E. Shafir (Ed.), *Behavioral foundations of policy* (pp. 329–350). Princeton, NJ: Princeton University Press.

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology*, *24*, 645–622. doi:10.1016/j.appdev.2003.09.002

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*, 700–717. doi:10.1037/a0026659

Grice, J. W., Cohn, A., Ramsey, R. R., & Chaney, J. M. (2015). On muddled reasoning and mediation modeling. *Basic and Applied Social Psychology*, *37*, 214–225. doi:10.1080/01973533.2015.1049350

Holden, J. P., & Lander, E. (2012). Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. In President's Council of Advisors on Science and Technology (Ed.), *Report to the president* (p. vi). Washington, DC: Executive Office of the President.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). Gender similarities characterize math performance. *Science*, *321*, 494–495. doi:10.1126/science.1160364

Inzlicht, M., & Ben-Zeev, T. (2000). A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science*, *11*, 365–371. doi:10.1111/1467-9280.00272

Jones, E. E., Farina, A., Hastorf, A. H., Markus, H., Miller, D. T., & Scott, R. (1984). *Social stigma: The psychology of marked relationships*. New York, NY: Freeman.

Kline, R. B. (2015). The mediation myth. *Basic and Applied Social Psychology*, *37*, 202–213. doi:10.1080/01973533.2015.1049349

Kraemer, H. C., Wilson, G. T., Fairburn, C. G., & Agras, W. S. (2002). Mediators and moderators of treatment effects in randomized clinical trials. *Archives of General Psychiatry*, *59*, 877–883. doi:10.1001/archpsyc.59.10.877

Lin-Siegler, X. D., Ahn, J., Chen, J., Fang, A., & Luna-Lucero, M. (2016). Even Einstein struggled: Effects of learning about great scientists' struggles on high school students' motivation to learn science. *Journal of Educational Psychology*, *108*(3), 314–328. doi:10.1037/edu0000092

Lockwood, P. (2006). "Someone like me can be successful": Do college students need same-gender role models? *Psychology of Women Quarterly*, *30*, 36–46. doi:10.1111/j.1471-6402.2006.00260.x

Lockwood, P., & Kunda, Z. (1997). Superstars and me: Predicting the impact of role models on the self. *Journal of Personality and Social Psychology*, *73*, 91–103. doi:10.1037/0022-3514.73.1.91

Lockwood, P., & Kunda, Z. (1999). Increasing the salience of one's best selves can undermine inspiration by outstanding role models. *Journal of Personality and Social Psychology*, *76*, 214–228. doi:10.1037/0022-3514.76.2.214

Lunneborg, P. W. (1982). Role model influencers of nontraditional professional women. *Journal of Vocational Behavior*, *20*, 276–281. doi:10.1016/0001-8791(82)90015-X

MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. New York, NY: Erlbaum.

MacKinnon, D. P., & Fairchild, A. J. (2009). Current directions in mediation analysis. *Current Directions in Psychological Sciences*, *18*, 16–20. doi:10.1111/j.1467-8721.2009.01598.x

Marx, D. M., & Goff, P. A. (2005). Clearing the air: The effect of experimenter race on targets' test performance and subjective experience. *British Journal of Social Psychology*, *44*, 645–657. doi:10.1348/014466604X17948

Marx, D. M., & Ko, S. J. (2012). Superstars "like" me: The effect of role model similarity on performance under threat. *European Journal of Social Psychology*, *42*, 807–812. doi:10.1002/ejsp.1907

Marx, D. M., Monroe, A. H., Cole, C. E., & Gilbert, P. N. (2013). No doubt about it: The effect of role model uncertainty on performance under threat. *Journal of Social Psychology*, *153*(5), 542–559. doi:10.1080/00224545.2013.778811

Marx, D. M., & Roman, J. S. (2002). Female role models: Protecting female students math test performance. *Personality and Social Psychology Bulletin*, *28*, 1185–1197. doi:10.1177/01461672022812004

McIntyre, R. B., Paulson, R. M., & Lord, C. G. (2003). Alleviating women's mathematics stereotype through salience of group achievement. *Journal of Experimental Social Psychology*, *39*, 83–90. doi:10.1016/S0022-1031(02)00513-9

Mendoza-Denton, R., Downey, G., Purdie, V. J., Davis, A., & Pietrzak, J. (2002). Sensitivity to status-based rejection: Implications for African American students' college experience. *Journal of Personality and Social Psychology*, *83*, 896–918. doi:10.1037/0022-3514.83.4.896

Mervis, J. (2011). Weed-out courses hamper diversity. *Science*, *334*(6061), 1333. doi:10.1126/science.334.6061.1333

Miyake, A., Smith-Kost, L. E., Finkelstein, N. D., Pollock, S. J., Cohen, G. L., & Ito, T. A. (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, *330*, 1234–1237. doi:10.1126/science.1195996

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science*, *18*, 879–885. doi:10.1111/j.1467-9280.2007.01995.x

National Science Foundation, Division of Science Resources Statistics. (2010). *Doctorate recipients from U.S. universities: Summary report 2007–08*. Retrieved from https://www.nsf.gov/statistics/2016/nsf16300/digest/nsf16300.pdf

National Science Foundation, National Center for Science, & Engineering Statistics. (2013). *Women, minorities, and persons with disabilities in science and engineering: 2013* (Special Rep. NSF 13–304). Arlington, VA: Author. Retrieved from http://www.nsf.gov/statistics/2015/nsf15311/

Nauta, M. M., Epperson, D. L., & Kahn, J. H. (1998). A multiple groups analysis of predictors of career aspirations among women in science and engineering. *Journal of Counseling Psychology*, *45*, 483–496.

Nauta, M. M., & Kokaly, M. L. (2001). Assessing role model influences on students' academic and vocational decisions. *Journal of Career Assessment*, *9*(1), 81–99.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math ≠ me. *Journal of Personality and Social Psychology*, *83*(1), 44–59. doi:10.1037//0022-3514.83.1.44

OECD. (2009). *Education at a glance 2009: OECD indicators*. Paris, France: Author. Retrieved from http://www.oecd.org/education/skills-beyond-school/43636332.pdf

Oyserman, D. (2009). Identity-based motivation: Implications for action-readiness, procedural-readiness, and consumer behavior. *Journal of Consumer Psychology*, *19*, 250–260. doi:10.1016/j.jcps.2009.06.001

Oyserman, D., Bybee, D., & Terry, K. (2006). Possible selves and academic outcomes: How and when possible selves impel action. *Journal of Personality and Social Psychology*, *91*, 188–204. doi:10.1037/0022-3514.91.1.188

Oyserman, D., & Destin, M. (2010). Identity-based motivation: Implications for intervention. *The Counseling Psychologist*, *38*, 1001–1043.

Oyserman, D., Terry, K., & Bybee, D. (2002). A possible selves intervention to enhance school involvement. *Journal of Adolescence*, *24*, 313–326. doi:10.1006/yjado.474

Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science*, *26*, 784–793. doi:10.1177/0956797615571017

Pronin, E., Steele, C. M., & Ross, L. (2004). Identity bifurcation in response to stereotype threat: Women and mathematics. *Journal of Experimental Social Psychology*, *40*, 142–168. doi:10.1016/S0022-1031(03)00088-X

Ramsey, L. R., Betz, D., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on stereotype threat and implicit science identification among women in STEM. *Social Psychology of Education*, *16*(3), 377–397. doi:10.1007/s11218-013-9218-6.

Ramsey, L. R., & Sekaquaptewa, D. (2011). Changing stereotypes, changing grades: A longitudinal study of stereotyping during a college math course. *Social Psychology of Education*, *14*(3), 377–387. doi:10.1007/s11218-010-9150-y

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review*, *115*, 336–356. doi:10.1037/0033-295X.115.2.336

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Shaffer, E. S., Marx, D. M., & Prislin, R. (2012). Mind the gap: Framing of women's success and representation in STEM affects women's math performance under threat. *Sex Roles*, *68*, 454–463. doi:10.1007/s11199-012-0252-1

Shapiro, J. R., Williams, A. M., & Hambarchyan, M. (2013). Are all interventions created equal? A multi-threat approach to tailoring stereotype threat interventions. *Journal of Personality and Social Psychology*, *104*(2), 277–288. doi:10.1037/a0030461

Shook, N., & Clay, R. (2012). Interracial roommate relationships: A mechanism for promoting a sense of belonging at university and academic performance. *Journal of Experimental Social Psychology*, *48*, 1168–1172. doi:10.1016/j.jesp.2012.05.005

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*, 613–629.

Steele, J., James, J. B., & Barnett, R. C. (2002). Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly*, *26*, 46–50. doi:10.1111/1471-6402.00042

Stinebrickner, T. R., & Stinebrickner, R. (2013). A major in science? Initial beliefs and final outcomes for college major and dropout. *The Review of Economic Studies*, *81*, 426–472. doi:10.1093/restud/rdt025

Stockard, J., & Wood, J. W. (1984). The myth of female underachievement: A reexamination of sex differences in academic underachievement. *American Educational Research Journal*, *21*, 825–838.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. (2011). STEMing the tide: Using ingroup experts to inoculate women's self-concept and professional goals in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology*, *100*, 255–270. doi:10.1037/a0021385

Strenta, C., Elliott, R., Adair, R., Matier, M., & Scott, J. (1994). Choosing and leaving science in highly selective institutions. *Research in Higher Education*, *35*, 513–547.

Suresh, R. (2006). The relationship between barrier courses and persistence in engineering. *Journal of College Student Retention*, *8*(2), 215–239. doi:10.2190/3QTU-6EEL-HQHF-XYF0

Tate, C. U. (2015). On the overuse and misuse of mediation analysis: It may be a matter of timing. *Basic and Applied*

Social Psychology, *37*, 235–246. doi:10.1080/01973533.2015.1062380

The National Academies. (2010). *Expanding minority participation: America's science and technology talent at the crossroads*. Washington, DC: National Academy Press.

Thoemmes, F. (2015). Reversing arrows in mediation models does not distinguish plausible models. *Basic and Applied Social Psychology*, *37*, 226–234. doi:10.1080/01973533.2015.1049351

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition* (2nd ed.). Chicago, IL: University of Chicago Press.

Tobias, S. (1990). *They're not dumb, they're different: Stalking the second tier*. Tucson, AZ: Research Corporation.

Trafimow, D., & Marks, M. (2015). Editorial. *Basic and Applied Social Psychology*, *37*(1), 1–2. doi:10.1080/01973533.2015.1012991

Trafimow, D., & Marks, M. (2016). Editorial. *Basic and Applied Social Psychology*, *38*(1), 1–2. doi:10.1080/01973533.2016.1141030

United States Congress Joint Economic Committee. (2012). *STEM education: Preparing for the jobs of the future*. Washington, DC: Author. Retrieved from http://www.jec.senate.gov/public//index.cfm?a=Files.Serve&File_id=6aaa7e1f-9586-47be-82e7-326f47658320

Walton, G. M. (2014). The new science of wise psychological interventions. *Current Directions in Psychological Science*, *23*, 73–82. doi:10.1177/0963721413512856

Walton, G. M., & Carr, P. B. (2012). Social belonging and the motivation and intellectual achievement of negatively stereotyped students. In M. Inzlicht & T. Schmader (Eds.), *Stereotype threat: Theory, processes, and application* (pp. 89–106). New York, NY: Oxford University Press.

Walton, G. M., & Cohen, G. L. (2007). A question of fit: Race, social fit, and achievement. *Journal of Personality and Social Psychology*, *92*, 82–96. doi:10.1037/0022-3514.92.1.82

Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, *331*, 1447–1451. doi:10.1126/science.1198364

Walton, G. M., Logel, C., Peach, J. M., Spencer, S. J., & Zanna, M. P. (2015). Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. *Journal of Educational Psychology*, *107*(2), 468–485. doi:10.1037/a0037461

Wilson, T. D. (2011). *Redirect: The surprising new science of psychological change*. New York, NY: Little, Brown.

Wilson, T. D., & Linville, P. W. (1982). Improving the academic performance of college freshmen: Attribution therapy revisited. *Journal of Personality and Social Psychology*, *42*, 367–376.

Wilson, T. D., & Linville, P. W. (1985). Improving the performance of college freshmen with attributional techniques. *Journal of Personality and Social Psychology*, *49*, 287–293.

Yeager, D. S., Henderson, H., Paunesku, D., Walton, G. M., D'Mello, S., Spitzer, B. J., & Duckworth, A. L. (2014). Boring but important: A self-transcendent purpose for learning fosters academic self-regulation. *Journal of Personality and Social Psychology*, *107*(4), 559–580.

Yeager, D. S., Romero, C., Paunesku, D., Hulleman, C. S., Schneider, B., Hinojosa, C. & Dweck, C. S. (2016). Using design thinking to make psychological interventions ready for scaling: The case of the growth mindset during the transition to high school. *Journal of Educational Psychology*, *108*(3), 374–391. doi:10.1037/edu0000098

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, *81*, 267–301. doi:10.3102/0034654311405999

Yeager, D. S., Walton, G., & Cohen, G. L. (2013). Addressing achievement gaps with psychological interventions. *Phi Delta Kappan*, *94*, 62–65.

Appendix: Role model intervention letter

We asked a graduate student, Sarah, to write about her transition to college and experience in taking *Psychology/Chemistry*. Below is the response.

"My first semester of college was really hectic. I was in this new place, and everything was so different from my life before college. In addition to the big life change living away from home, I had to go to class, do the readings and homework. To put myself through college, I got a job, so I was also trying to determine how to divide my time between school, work, and social life. I took *Psychology/Chemistry* my first semester, and I went to most of the classes before the first test. I studied hard, and felt like I did well on it, but when I got it back, my grade was much lower than I expected!

I remember thinking, "Why am I paying a ton of money to go to classes and spending all my time working on them, if I can't even get good test grades?" I thought about leaving, but then I imagined what my life would be like without a college degree. My parents worked so hard, paycheck-to-paycheck, and wanted us to have more control over our lives than they did. So I kept reminding myself that the unemployment rate is much higher for people without a college degree. And yes, you are paying money now, but you get great bang for your buck; the value of a college degree across a life span is two million dollars!

As they say, time flies; I graduated two years ago. I am a graduate student now and even worked as a Teaching Assistant last year. It is interesting to look back my experience in college, and then to work with students today. I saw a lot of students in office hours going through the same thing that I did in college.

Hang in there, and good luck!

Sarah"