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Improving Student Outcomes in Higher Education: The Science of Targeted Intervention

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Abstract

Many theoretically based interventions have been developed over the past two decades to improve educational outcomes in higher education. Based in social-psychological and motivation theories, well-crafted interventions have proven remarkably effective because they target specific educational problems and the processes that underlie them. In this review, we evaluate the current state of the literature on targeted interventions in higher education with an eye to emerging theoretical and conceptual questions about intervention science. We review three types of interventions, which focus on the value students perceive in academic tasks, their framing of academic challenges, and their personal values, respectively. We consider interventions that (*a*) target academic outcomes (e.g., grades, major or career plans, course taking, retention) in higher education, as well as the pipeline to college, and (*b*) have been evaluated in at least two studies. Finally, we discuss implications for intervention science moving forward.

Keywords

intervention; achievement gaps; belonging; utility value; values affirmation

INTRODUCTION

Many theoretically based interventions have been developed over the past two decades to improve educational outcomes in higher education, and there has been great interest and excitement about the potential of these brief and cost-effective interventions to address important societal issues (Wilson 2011). Researchers have found that targeted interventions can have powerful and long-lasting effects when they address specific motivational processes at crucial time points in the educational process. Some have called these targeted interventions motivation interventions (Lazowski & Hulleman 2016) or social-psychological interventions (Wilson 2006, Yeager & Walton 2011), reflecting their theoretical grounding. Walton (2014) has referred to them as wise interventions because they are theoretically precise and address basic psychological processes that can interfere with optimal academic functioning. Indeed, these three labels all capture a critical feature of targeted interventions—a basis in theory that identifies the most powerful levers of change in academic settings.

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The theories that underlie these interventions take into account the context, the person, and person \times context interactions to address real-world problems and are thus inherently social psychological. We refer to these social-psychological interventions as targeted because they target a specific problem, the psychological process underlying the problem, the students who should benefit from intervention, and the Specific academic outcomes that should reveal those benefits.

Targeted interventions address specific educational problems, such as closing achievement gaps for underrepresented racial/ethnic minority (URM) students; promoting science, technology, engineering, and mathematics (STEM) career pursuit among women; increasing interest and engagement in gateway science courses; or helping first-year students cope with the college transition. With a well-defined problem, interventions can target the psychological processes most relevant to the problem. Students can struggle in college or lose motivation in fields of study for many reasons. They may lack a strong preparatory background for college or financial resources, and we would not expect social-psychological interventions to address these structural factors. However, students may also struggle for more psychological reasons: They may lack interest in certain topics and become disengaged in classes, or they may lack confidence in their abilities. They may experience identity threat in certain fields and wonder if an academic discipline is right for them, or they may doubt whether they belong in college. They may experience a cultural mismatch between institutional norms and their own values. All of these psychological processes are critical for academic outcomes, and all can be targeted by social-psychological interventions.

In addition to identifying the specific problem targeted by an intervention, it is important to consider the implications for measurement of academic outcomes. Some interventions focus on promoting motivation and performance in particular courses, where measures would thus be course specific, such as engagement, interest, and course grades. Others focus on promoting motivation in a field or broader domain, such as STEM fields or engineering, in which case the outcome measures would be field specific, such as course taking, retention in those fields, or interest in a discipline. Many interventions are even more general, targeting academic adjustment and performance in college, in which case the outcome measures would be college general, such as college adjustment and fit, overall grade point average (GPA), and graduation rate. The primary outcomes targeted by an intervention serve as a measure of intervention efficacy, but they can also trigger positive recursive processes that drive longer-term impacts. For example, if a student gets a good grade in a critical gateway science course, they may become more interested in the field, take more science courses, and eventually pursue a STEM career. Figure 1 shows our conceptual model.

THREE TYPES OF INTERVENTIONS

In this review, we consider a wide range of targeted interventions that have been tested in higher education and distinguish between three types of intervention: those that focus on how students perceive value in academic tasks (task value interventions), those that change the way students frame academic challenges (framing interventions), and those that focus on students' personal values (personal values interventions). These interventions are all student-centered and share some core features: All convey some information hypothesized to affect a

psychological process and engage the student in a process of active reflection that often involves conversation or writing. There are important differences, however, in their domain specificity and the behaviors, thought processes, and academic outcomes they target. In short, the primary difference is in where they focus students' attention and reflection.

Task value interventions focus on the task at hand, which can be defined as a specific topic in a class or a field of study, but the emphasis is always on academic content. These interventions communicate the value or importance of the content, either by providing examples of the relevance or usefulness of academic tasks for personal goals or by encouraging students to think about task value for themselves through writing exercises. For example, in a utility-value intervention (a type of task value intervention) implemented in a college biology class, students wrote about how course topics were relevant to their own lives or useful for themselves or others (Harackiewicz et al. 2016a). In a communal utility-value intervention, Brown et al. (2015) provided students with information about how biomedical research could address communal goals (helping others, working with others). Such task value interventions focus on how students perceive their coursework or fields of study, which can then be connected with personal goals through a process of reflection. Because of their task specificity, these interventions may be most relevant for stimulating engagement and performance in specific courses or promoting interest in particular fields.

Framing interventions focus on the challenges that students may face during academic transitions and help students cope with adversity by framing challenges as common and improvable. They include a broad range of interventions designed to address a variety of common concerns, such as doubts about belonging, doubts about ability, or group-specific challenges (e.g., coming to college as a URM student), by helping students adopt a more adaptive outlook or mindset. For example, Walton & Cohen's (2007) social belonging intervention provided statistics and quotes from more senior students illustrating the fact that challenges of adjustment to college are common and can be overcome. These interventions focus on influencing how students think about challenges, whereas task value interventions focus on the task at hand. Framing interventions may be most relevant for promoting adjustment during critical academic transitions, such as the transition to college, and for academic performance at a general level across courses or domains.

Personal values interventions focus on students' core values. Like framing interventions, these interventions center on the student, but they work more indirectly by reinforcing personal values rather than the academic tasks at hand. For example, in their seminal values affirmation intervention with middle school students, Cohen and colleagues (2006) asked students to choose their most important values from a list and then write about why those values were important to them. The same intervention has been used in college physics classes (Miyake et al. 2010). These values are broad (e.g., friends and family, independence, sense of humor), and writing about them reinforces a student's sense of identity and self-worth, providing a buffer against threats so that they can cope with adversity in college. As such, this may be the most general of the three types of intervention considered in this review, and personal values interventions may be particularly relevant for promoting academic adjustment and performance at a general level, across courses or domains and over time.

SCOPE OF REVIEW

In this review, we consider interventions that (a) target academic outcomes (e.g., grades, major or career plans, course taking, retention) in higher education, as well as the pipeline to college, and (b) have been evaluated in at least two studies.¹ Those that meet our criteria are summarized in Tables 1–3. Many of the interventions covered in this review have also been tested in middle school or high school contexts, but because we focus on interventions that target educational issues in college, we focus our review on experimental studies conducted in college and university settings and discuss studies from other contexts only if they were critical in the development of interventions tested in higher education contexts (e.g., Cohen et al. 2006, Hulleman & Harackiewicz 2009) or if the intervention was implemented in high school with a follow-up in college (e.g., Harackiewicz et al. 2012, Yeager et al. 2016).

The intervention studies we review are diverse. They range in scope from small-scale field studies, with interventions administered in labs or single classes, to large-scale field trials. Some interventions were integrated into classes, but others were administered outside of classes, in prematriculation activities, special orientation projects, or laboratory studies. We focus on the context and sample for the research, the educational problem targeted, the specific intervention tested, and the outcome measures assessed, examining whether targeted outcomes are course or field specific (e.g., course grades, STEM grades) or college general (e.g., overall GPA), as well as longer-term effects, such as course taking over time or career choices.

Our goal is to assess the state of the intervention research literature, with an eye to theoretical and conceptual questions about intervention science more generally. What makes these interventions so powerful? How replicable are the effects obtained to date? When possible, we evaluate evidence for targeted intervention processes, i.e., whether the researchers identified processes that help us understand how the intervention works and whether they tested for mediation of intervention effects. In addition, we consider whether intervention effects extended across contexts or over time through recursive processes. Figure 2 shows our classification system, the specific interventions tested, and the number of experimental studies evaluated in each category.

TASK VALUE INTERVENTIONS

Of the task value interventions reviewed in this article, the utility-value intervention is supported by the highest number of randomized controlled trials (Harackiewicz et al. 2016b, Tibbetts et al. 2016b). This intervention is grounded in Eccles and colleagues' (Eccles et al. 1983, Eccles & Wigfield 2002) expectancy value model, which posits that the most proximal predictors of achievement and achievement-related choices (e.g., which courses to take, how hard to study for an exam) are students' expectations that they can succeed and the extent to

¹Several other promising interventions have not (yet) been tested in multiple studies and are therefore not included: Acee & Weinstein's (2010) and Yeager and colleagues' (2014) task value interventions; Landau and colleagues' (2014), Jamieson and colleagues' (2016), and Browman & Destin's (2016) framing interventions; and Kizilcec and colleagues' (2017) intervention, which is a hybrid of task value and personal values interventions. In addition, two studies in our review also contain tests of interventions not (yet) tested in multiple studies: Yeager and colleagues' (2016) critical feedback and cultural fit interventions and Walton and colleagues' (2015) affirmation training intervention are not included in this review.

which they value the task or topic. Thus, the students who are most likely to struggle in a given course are those with low expectations of success (due to either a history of poor performance or a lack of confidence) and those who do not see the value in what they are learning. The hypothesis driving the utility-value intervention is that if educators can help their students find value in the course material, this will give students a reason, and thus the motivation, to engage with the material and ultimately improve their performance. Specifically, the intervention targets utility value, the value perceived in a task or topic as a result of its usefulness for achieving short- or long-term goals. For example, students might perceive utility value in a physiology course because they can use what they learn to make their workouts safer and more effective.

There are two basic strategies by which educators can promote perceptions of value: They can tell students that course topics are useful and important (i.e., educators communicate value directly), or they can task their students with discovering that value for themselves (i.e., students generate value), most often through a writing exercise in which students relate course topics to their own lives (Canning & Harackiewicz 2015, Durik et al. 2015, Gaspard et al. 2015). Both strategies were tested first with several laboratory studies and then in the field, although self-generated utility-value interventions are more common in the field (for a review, see Harackiewicz & Hulleman 2010, Harackiewicz et al. 2014b). Because these interventions target value in particular content, most are course-level interventions. However, it is important to note that engaging students with the content of a course also engages them with the content of that field. This is one avenue by which these seemingly granular, content-focused interventions could have far-reaching consequences, such as impacting students' educational and career choices.

Course-Specific Task Value Interventions

The course-specific task value interventions tested to date have been self-generated utility-value interventions. In a prototypical self-generated utility-value intervention, students complete a series of course writing assignments in which they choose a topic covered in the current unit of the course and either discuss the relevance and utility value of the topic (the intervention condition) or summarize the topic (the control condition). This intervention provides students opportunities to make concrete connections between what they are learning and things that they care about, fostering perceptions of value as well as engagement with the course content. The first field test of this intervention was in high school science classes (Hulleman & Harackiewicz 2009). The utility-value intervention was particularly effective for students with low expectations of success, improving their grades in the science course and increasing their interest in science more broadly. Since this initial high school study, the intervention has been tested in a variety of college courses, with promising results.

Hulleman et al. (2010) administered a utility-value intervention twice during the second half of the semester in one large section of a college introductory psychology course. Among students who performed poorly on early exams, the utility-value intervention increased interest in the field of psychology, as well as intention to major in psychology. Furthermore, Hulleman and colleagues found that the mechanism driving these effects was the targeted

process of perceived utility value. In other words, for students who were initially struggling, the intervention increased perceptions of value for the material they were learning, which, in turn, increased their interest in the field and their intention to major in psychology.

Another study, conducted in two large sections of an introductory psychology course, found that the utility-value intervention increased final exam scores and interest in psychology for all students on average and for students who performed poorly on initial exams in particular (Hulleman et al. 2017). In addition, they found that the utility-value intervention had the strongest positive effects for the students who were most at risk in this context, males who performed poorly on initial exams. They examined intervention mechanisms and found that, for students with low grades on early exams, the intervention increased their confidence (i.e., performance expectations) and that this confidence, in turn, explained higher final exam grades.

Hulleman and colleagues' (2010, 2017) work in large introductory psychology courses demonstrates that the utility-value intervention can be effective for struggling students, including groups of students who tend to underperform. This raises the possibility that the utility-value intervention can address achievement gaps. Harackiewicz and colleagues (2016a) tested this possibility with a large-scale field trial in eight sections of an introductory biology course for STEM majors (over four semesters). Their approach was novel in two ways. First, they used an intersectional analysis to examine achievement gaps for first-generation (FG) college students (i.e., those for whom neither parent has a four-year college degree) and URM students, as well as students at the intersection of these groups, who are both FG and URM (FG-URM). Second, they examined students' motivational profiles to understand the characteristics of different groups that might influence their receptivity to the intervention.

Harackiewicz and colleagues (2016a) found that FG-URM students had a unique motivational profile: They were least confident about their background in biology and were uncertain about their belonging in college more generally. However, they were also highly motivated to perform well in the course and to use their education to give back to society and help others, especially their families and communities. Harackiewicz and colleagues hypothesized that the utility-value intervention might give FG-URM students opportunities to connect course material to their positive motivations (i.e., their desire to use their education to help others), which could make the intervention particularly powerful for this group. Indeed, the intervention increased grades for all students on average and for FG-URM students in particular, reducing the achievement gap between FG-URM and majority students by 61%. Interestingly, the intervention was also effective for students with low prior GPAs (above and beyond the FG-URM intervention effect), replicating prior work by Hulleman and colleagues (2010), and for any students with higher levels of helping motives (not just FG-URM students).

Harackiewicz and colleagues (2016a) examined intervention mechanisms and found that the intervention effect for FG-URM students was mediated by engagement. Students in the utilityvalue condition, and FG-URM students in particular, wrote longer essays, indicating that they engaged more with the material than did students in the control condition. This

engagement, in turn, explained increases in course performance. To explore how this played out in the content of the essays, Harackiewicz and colleagues analyzed the essays using text analysis (Pennebaker et al. 2007). Utility-value essays contained more personal pronouns and more words related to social relationships, especially family, which is concordant with FG-URM students' desire to give back to their families and communities. Furthermore, these essays contained more words indicative of cognitive engagement and insight. This is consistent with experimental work showing that task value interventions increase engagement and conceptual change (Johnson & Sinatra 2013). Beigman Klebanov and colleagues (2017) analyzed these same essays using natural language processing techniques. They found that utility-value writing was characterized by argumentative and narrative elements, suggesting that students were both providing personal narratives and building arguments and claims (e.g., about why biology is valuable). Together, these analyses reveal some of the ways that writing about utility value can increase engagement and promote learning.

Canning and colleagues (2018) tested the utility-value intervention in three sections of an introductory biology class for STEM majors but varied the number of utility-value assignments (from zero to three) to examine the effects of intervention dosage on performance. They also followed students to see whether they enrolled in the second course in the biology sequence and whether they abandoned plans to major in STEM (93% of students entered the course with plans to major in a STEM field), as measures of STEM persistence. They found that students who received at least one utility-value assignment earned higher grades in the course, were more likely to enroll in the second biology course, and were less likely to abandon their STEM major. However, students assigned the maximum dosage (three assignments) earned the highest grades and were most likely to take the next biology course, suggesting that students benefited from multiple doses of the intervention. Moreover, the intervention's positive effect on continuation to the second course (a distal outcome) was mediated by grades in the first course. In other words, students who performed better as a result of the utility-value intervention were more likely to take another biology course, suggesting one mechanism by which a course-specific intervention can influence field-specific outcomes through recursive processes.

Field-Specific Task Value Interventions

Many studies of course-specific task value interventions also found effects on field-level outcomes, such as interest in the field (Hulleman et al. 2017), intention to major in the field (Hulleman et al. 2010), retention in a STEM major, or course taking in a field (Canning et al. 2018). In addition, some task value interventions targeted field-level outcomes directly. Brown and colleagues (2015) developed an intervention designed to promote interest in biomedical careers by helping students perceive the value of biomedical research for achieving communal (i.e., helping-oriented) goals. They communicated utility value directly by giving students an article that described how a research project could help others. Across three laboratory studies, they found that the communal utility-value intervention increased students' interest in pursuing a career in biomedical research, relative to a control group, and that these effects were mediated by the perceived communal value of biomedical research (Brown et al. 2015).

In an experimental field study, Harackiewicz and colleagues (2012) tested a directly communicated utility-value intervention to help parents of high school students see the value of math and science course taking and share that value with their teens. They hypothesized that giving parents tools (two brochures and a website) to help them talk about the importance of math and science would influence their teens' perceptions of value and elective course choices. Indeed, teens whose parents received the utility-value intervention took, on average, an extra semester of math or science in their last two years of high school, relative to a control group whose parents did not receive the intervention.

A five-year follow-up of these students found that the intervention had also increased students' math and science scores on college preparatory exams (i.e., the ACT) by 12 percentile points (Rozek et al. 2017). Importantly, these short-term outcomes (course taking and ACT scores in high school) had long-term consequences. Rozek and colleagues found indirect effects of the intervention such that students whose parents had received the utility-value intervention took more math and science courses in high school and earned higher ACT scores, and that these targeted high school outcomes were predictive of students' college STEM course taking, majors, and career aspirations. Thus, even when an intervention is not expected to directly influence long-term outcomes—this intervention targeted parental involvement and high school course taking—short-term intervention effects can initiate recursive processes that impact students' long-term trajectories.

Task Value Interventions: Summary and Discussion

Together, these studies show that task value interventions can be a powerful tool for engaging students in thinking and writing about the why of learning, giving them a platform for exploring how their coursework can help them achieve important personal goals. A consistent pattern of results has emerged across a variety of contexts and modes of intervention delivery; these interventions have proven most effective for students who struggle in courses. However, there is also evidence of main effects in almost all of these studies; in other words, some utility-value interventions have had positive effects for all students on average (Harackiewicz et al. 2012, 2016a; Brown et al. 2015; Canning et al. 2018; Hulleman et al. 2017), and it will be important to clarify when and why task value interventions should work for all students versus only for those who struggle (Schwartz et al. 2016). Careful attention has been paid in these studies to targeted motivational processes in these studies, with evidence for mediation of intervention effects by the targeted process of perceived utility value and other processes such as positive expectancies and engagement. Finally, the results of Canning et al. (2018) and Rozek et al. (2017) document some recursive effects from the targeted outcomes (course grades and high school course taking) to more distal outcomes, illuminating important pathways for the long-term effects of utility-value interventions.

Perhaps unsurprisingly given the theoretical grounding of these interventions, they most often focus on single courses or particular fields. Indeed, we did not find any task value interventions targeting college-general outcomes (e.g., cumulative GPA). However, the evidence indicates that task value interventions can increase motivation at the field level both directly, in a single-session laboratory study (Brown et al. 2015) and a semester-long biology

course (Canning et al. 2018), and indirectly, over a span of five years, by promoting STEM course taking and test performance in high school (Rozek et al. 2017). Furthermore, recent work (Brown et al. 2015, Harackiewicz et al. 2016a) suggests connecting specifically to helping-oriented goals might be a powerful intervention technique (Thoman et al. 2015, 2017). In fact, Yeager and colleagues (2014) and Paunesku et al. (2015) have developed a task value intervention for high school students that focuses students on self-transcendent (helping-oriented) goals for learning. Like other task value interventions, the purpose intervention has shown positive effects on grades for low-performing students. Although there have not been enough studies testing the purpose intervention at the college level for inclusion in this review, initial work is promising. In sum, current research suggests that task value interventions can have broad implications for educational trajectories.

FRAMING INTERVENTIONS

Framing interventions include a diverse set of interventions to counteract the maladaptive ways students might interpret challenges. Drawing on attribution theory (Weiner 1974, Ross & Nisbett 2011), these interventions tap into processes by which students make sense of their academic experiences. For example, a student who receives bad grades in their first semester might attribute their poor performance to a lack of intelligence (a maladaptive attribution) or to the steep learning curve of adjusting to college, which they will overcome in time (an adaptive attribution). Thus, framing interventions target common maladaptive beliefs by providing students with alternate frames. Two messages are key: that challenge is a normal or natural experience (i.e., not exclusively attributable to an individual's own shortcomings) and that students can exercise control over their academic outcomes through personal growth (i.e., challenges can be overcome with effort). These messages are particularly important in the transition to college for underrepresented students (e.g., URM students, FG students, women in STEM) who may experience adversity as evidence that the college environment is unwelcoming or even discriminatory, posing major threats to their sense of belonging (Walton 2014). Therefore, almost all of the studies in this category are college-general interventions targeting students' framing of challenge in the transition to college.

Early work by Wilson & Linville (1982, 1985) tested an intervention using this attributional approach. They showed struggling first-year students statistics and interviews indicating that most students' grades were lower than anticipated their first semester but improved over time. Some participants also wrote an essay explaining to high school students how initial low grades were attributable to temporary factors (e.g., not knowing how to take college exams). Such saying-is believing exercises are designed to increase internalization of the intervention message by having students convey it in their own words (often through writing) to benefit students who will face similar challenges in the future (Aronson 1999). Across three studies, the intervention improved students' performance on GRE problems immediately after the intervention and improved students' college GPAs in the following semester, although both effects were stronger for men than for women (Wilson & Linville 1985). These strategies have informed the design of interventions in more recent work. In fact, a research group in Canada has implemented a very similar treatment protocol, called attributional retraining (AR), with introductory psychology students (for a review, see Perry

& Hamm 2017, Perry et al. 2014),² and all the interventions reviewed below draw, at least in part, on the methods developed by Wilson & Linville.

College-General Framing Interventions

Our review identified three types of framing interventions that were tested at the college-general level and met our inclusion criteria. These interventions include social belonging interventions, difference education interventions, and mindset interventions.

Social belonging interventions.—The seminal work on the social belonging intervention was conducted by Walton & Cohen (2007, 2011) to address achievement gaps for African American students at a selective college. Second-semester students read statistics and quotes from more senior students indicating that most students worry about whether they belong in college during their first year but that these concerns lessen over time. Participants then wrote an essay about why that would be the case, using examples from their own experiences, and recorded a video testimonial for future students. Control activities were similar but focused on adjusting to the physical environment in college (e.g., the architecture, weather). This intervention improved African American students' GPAs the semester after the intervention (Walton & Cohen 2007) as well as their overall GPAs, measured at a postgraduation follow-up (Walton & Cohen 2011). Daily diary measures collected in the week after the intervention revealed that, for African Americans in the intervention condition, experiences of adversity no longer influenced their sense of belonging, and this decoupling process mediated the intervention effects on GPA (Walton & Cohen 2011). In addition, Walton & Cohen found that African American students in the intervention condition reported engaging in more adaptive academic behaviors (e.g., emailing professors, spending more time studying) in the week following the intervention (Walton & Cohen 2007) and reported higher levels of a sense of belonging, health, and well-being in the postgraduation survey (Walton & Cohen 2011).

Yeager and colleagues (2016) adapted this social belonging intervention so that it could be delivered online and tested at scale to address three different goals: to increase rates of college enrollment among charter high school students (study 1), to address persistence gaps for disadvantaged (URM and FG) students at a public flagship university (study 2), and to address performance gaps for disadvantaged students at a highly selective private university (study 3). In all three studies, the intervention materials conveyed the same messages as Walton & Cohen's (2007) belonging intervention, but the student quotes were customized for each context. The intervention delivered during senior year at charter high schools increased the percentage of students who stayed enrolled full-time through their first year of college (32% in the control group versus 45% in the intervention group), and this effect was mediated by a measure of students' social and academic involvement behaviors on campus (e.g., living on campus, using academic support services).

²There are many studies of AR (see, e.g., Hall et al. 2007, Haynes et al. 2006, Perry et al. 2010), but we do not include these studies in our review because they employ different methodology. AR treatment interventions have been studied with longitudinal quasi-experimental designs with treatment not randomized at the student level, whereas all the studies included in our review conducted randomization at the student level.

In studies 2 and 3, the intervention was delivered as part of the online orientation process in the summer before college. In study 2, the intervention increased the percentage of disadvantaged students who stayed enrolled full-time through their first year of college (69% in the control group versus 73% in the intervention group). This effect was mediated by a survey measure of social and academic involvement. In study 3, the intervention increased first-year GPA among disadvantaged students, as well as these students' social and academic involvement behaviors (e.g., having a mentor, using academic support services). Together, these studies demonstrate that the social belonging intervention can be adapted to target students' framing of belonging concerns across a variety of contexts, with impressive results (Yeager et al. 2016).

Difference education interventions.—Stephens and colleagues (2014) developed the difference education intervention to provide a more adaptive frame for FG college students in the transition to college. These students are less likely to have the procedural knowledge needed to take advantage of campus resources and less likely to feel a sense of belonging or fit in the college environment due to a cultural mismatch between their values and institutional norms (Stephens et al. 2012). In the difference education intervention (Stephens et al. 2014), first-year students attended a one-hour panel in which a diverse group of students discussed how their backgrounds were sources of both challenge and strength and described strategies they used to navigate challenges and become a successful student. Participants then recorded a video testimonial for future students. Control participants attended a similar panel, but the panelists did not discuss their backgrounds. All students in the intervention condition reported more academic and social engagement at the end of the first year of college, and FG students in the intervention condition earned higher first-year GPAs than FG students in the control condition, an effect that was mediated by their increased use of campus resources (e.g., emailing professors, attending office hours). In a follow-up study two years later, students from the difference education intervention condition mentioned more aspects of their background in a speech about their college experience, indicating that they retained the intervention message and were more comfortable talking about the role of background. In addition, FG students from the intervention condition showed higher levels of anabolic balance reactivity, a measure of physiological striving, compared to FG students from the control condition. Stephens and colleagues (2015) concluded that the difference education intervention initiated recursive processes that helped FG students view their backgrounds as a source of strength and cope more effectively with stressful tasks.

Mindset interventions.—Mindset interventions are based on Dweck's (1999) work on lay theories of intelligence, wherein a maladaptive theory would be that intelligence cannot be changed (a fixed mindset), whereas an adaptive theory would be that intelligence is malleable and can be increased with effort (a growth mindset). The prototypical mindset intervention is an eight-week program to teach middle school students about brain plasticity and how they could develop their intelligence by exercising their brain like a muscle (e.g., Blackwell et al. 2007). Whereas this method is not practical in college contexts, a few studies have tried to distill this message into a briefer intervention for college students.

Aronson and colleagues (2002) developed an intervention to combat stereotype threat, with the idea that the stereotype that African Americans have a fixed lack of intelligence could be rendered powerless if one holds the belief that intelligence is malleable. The mindset intervention, delivered in a laboratory setting, involved a brief video explaining how researchers have found that the brain can grow and develop new neuronal connections and a saying-is-believing exercise. This intervention closed gaps between African American and White students' GPAs in the semester after the intervention, and this effect was mediated by students' growth mindset beliefs.

Yeager and colleagues (2016) also tested mindset interventions in studies 1 and 2 of their social belonging research, described above. Participants read an article summarizing the scientific research supporting the idea that intelligence is malleable and then wrote an essay expressing this message to future students who might be struggling in school. In both studies, some students were randomly assigned to receive both the social belonging intervention and the mindset intervention, which allowed a test of combined intervention. In study 1, the mindset intervention had no effect on college enrollment, and the combined intervention was no more effective than the social belonging intervention alone. In study 2, all three interventions increased enrollment among disadvantaged students; there were no differences in the effectiveness of the mindset intervention, the social belonging intervention, and the combined intervention.

Field-Specific Framing Interventions

Only one study has adapted a framing intervention to address a field-specific problem: Walton and colleagues (2015) adapted Walton and Cohen's (2007) original social belonging intervention (a college-general intervention) to address the gender achievement gap in an engineering program. First-semester engineering students in the intervention condition were given statistics and quotes from senior engineering students and wrote a letter to a future engineering student conveying the intervention messages in their own words. Women in male-dominated engineering majors (e.g., mechanical engineering) who received the social belonging intervention earned higher first-year engineering GPAs, perceived adversity as more manageable, had more friendships with their male colleagues, and, by the second semester, were more confident that they could succeed in the field, compared to women in the control group.

Framing Interventions: Summary and Discussion

The framing interventions reviewed above target an impressive number of educational problems, but they share a common goal: improving students' academic experiences by providing adaptive frames for common challenges, from belonging concerns, to beliefs about performance and intelligence, to cultural mismatch. They can have far-reaching benefits for students' academic adjustment and long-term outcomes. Across a variety of contexts and modes of intervention delivery, the pattern of results indicates that these interventions have improved important academic outcomes for students adjusting to college. The targeted populations have varied from students struggling in school (Wilson & Linville 1982) to African American students (Aronson et al. 2002), first-generation students (Stephens et al. 2014), women in engineering (Walton et al. 2015), and disadvantaged

students in general (Yeager et al. 2016), and this impressive diversity suggests the great potential of the framing approach for a number of educational problems.

However, as with task value interventions, there is also some evidence of positive effects for all students on average (Stephens et al. 2014, 2015; Yeager et al. 2016), and it will be important to clarify when and why framing interventions work for all students. Some results are more consistent than they first appear, once the problem is clearly defined. For example, Yeager et al. (2016) noted that almost all students in their study 1 were either URM or FG students and, thus, predicted a main effect for the belonging and mindset interventions. Other findings are inconsistent; Yeager et al. (2016, study 1) failed to find an effect of the mindset intervention, and Stephens et al. (2014) found a main effect of the difference education intervention that specifically targeted FG students. Overall, however, the consistency of findings is impressive, and we anticipate that the pattern of results will become increasingly clear as more work is done to replicate these findings within the same contexts (Wilson & Linville 1985, Walton & Cohen 2011) and between contexts (Yeager et al. 2016).

Exploration of targeted processes in these studies has focused less on the specific cognitive processes hypothesized to drive intervention effects (with the exception of Aronson et al. 2002) and more on the academic behaviors that students report in academic transitions. These behaviors are typically assessed with surveys and represent adaptive behaviors such as emailing professors, making friends, and attending office hours. Such measures capture an approach orientation consistent with a positive framing of challenge, but they vary widely across studies. It will be important to standardize such measures so that results can be compared across studies. However, the mediation analyses reported by Stephens et al. (2014) and Yeager et al. (2016) clearly suggest that such measures are key to understanding how framing interventions work in college transitions. Less attention has been paid to recursive processes in the framing studies reviewed above, in part because these studies are more recent, with less opportunity for follow-up over time. However, there is some evidence that physical health processes may be implicated over time (Walton & Cohen 2011, Stephens et al. 2015), and this is a promising direction. Surprisingly, scant attention has been paid to the content and style of students' writing in these interventions, and this might be a missed opportunity for extending the study of these intervention dynamics. Continued exploration of targeted and recursive processes over time will be essential for understanding how framing interventions work to improve student outcomes.

PERSONAL VALUES INTERVENTIONS

The values affirmation intervention is based in self-affirmation theory (Steele 1988), which argues that individuals are motivated to maintain an overall sense of self-integrity. If a student experiences identity threat in an important academic domain (e.g., a woman taking a physics test), then their self-integrity is called into question. Self-affirmation interventions give people an opportunity to reflect on sources of self-worth in other domains. Writing about personal values affirms self-integrity on a broader level and thereby diminishes the negative impact of identity threats in a particular situation. This intervention is not specific

to threats in particular domains and has been implemented in a variety of contexts (e.g., health, relationships, sports; see Cohen & Sherman 2014 for a review).

Cohen and colleagues (2006, 2009) were the first to implement this intervention in an academic context. They found that, when three cohorts of seventh graders completed a values affirmation exercise in class, African American students performed better and had higher overall GPAs for the term than African American students in the control group, and that their GPAs in core courses remained higher over two years, especially among those with lower initial GPAs. They argued that early improvements in performance initiated recursive processes that disrupted the negative performance trajectory observed in the control condition. Indeed, the intervention effects on GPA in year 2 (distal outcome) were mediated by GPA in year 1 (targeted outcome). These effects have been replicated in several middle school studies (e.g., Bowen et al. 2013, Sherman et al. 2013, Borman et al. 2016), and more recent work at the middle school level has focused on understanding the mediators, moderators, and boundary conditions for these effects. For example, Shnabel and colleagues (2013) examined the values affirmation essays from the original Cohen studies (Cohen et al. 2006) and found that all students wrote more about social belonging in the values affirmation condition, and that this improved grades for African American students. Thus, recent work provides strong evidence that values affirmation can have both immediate and longterm benefits for underrepresented students, but it is also important to note that there have been some failures to replicate these findings in middle school contexts (Dee 2015, Protzko & Aronson 2016, Hanselman et al. 2017).

Course-Specific Values Affirmation Interventions

Miyake and colleagues (2010) conducted the first test of a values affirmation intervention in college to address gender gaps in an introductory physics course. To make the values affirmation exercise fit seamlessly in a college science course, the instructor told students that the exercise was a chance to practice their writing skills. It was implemented as an in-class activity in the first week of the semester and as an online homework assignment in the fourth week (just prior to the first midterm exam). Thus, in contrast to the social belonging or difference education interventions, the values affirmation intervention was fully integrated into the class and presented as a course assignment. It improved women's exam grades and scores on a standardized physics exam, reducing achievement gaps between women and men in the course.

Harackiewicz and colleagues (2014a) implemented the values affirmation intervention in an introductory biology course for STEM majors, using the same basic methods as Miyake et al. (2010). However, this intervention was targeted for a different problem, the social class achievement gap between FG and continuing-generation (CG) students. FG students in the intervention condition earned higher grades in the biology course as well as higher overall GPAs that semester, reducing the social class achievement gap. In addition, FG students in the intervention condition were more likely to enroll in the next course in the biology sequence. This effect was mediated by course grades: The intervention improved FG students' grades in the biology course, which, in turn, increased their likelihood of

continuing in biology. Together, these two studies suggest that the values affirmation intervention can be integrated into college science classes with positive effects.

In the Harackiewicz et al. (2016a) utility-value intervention study, discussed above, the researchers also tested a values affirmation intervention crossed with the utility-value intervention in a 2×2 design. The values affirmation intervention was implemented exactly as it was by Harackiewicz et al. (2014a), but the positive effect for FG students was not replicated, and there were no significant interactions with the utility-value intervention. The researchers discussed a number of factors that might have accounted for this nonreplication, most notably that the social class achievement gap was larger in the semester that the Harackiewicz et al. (2014a) study was conducted. Indeed, previous research suggests that values affirmation is more effective when achievement gaps are larger (Hanselman et al. 2014). Another possibility is that the addition of the utility-value intervention (which involved three more writing assignments) dampened the effects of the values affirmation intervention. This analysis suggests that it may not work to combine different types of writing interventions in a single semester. Although the values affirmation intervention can have powerful effects, it is sensitive to contextual and sample differences in ways that we do not yet fully understand. More research is needed to identify factors that moderate the effectiveness of the values affirmation intervention in college contexts.

College-General Values Affirmation Interventions

Self-affirmation interventions are designed to combat identity threats on a broad level. When groups are threatened by stereotypes about intelligence or ability, their identity threat is not limited to a single course. Therefore, it is not surprising that interventions implemented in a single course can have downstream college-general effects (e.g., on overall GPA), as was the case in Cohen et al.'s (2009) original study and Harackiewicz and colleagues' (2014a) study in college biology. However, the interventions we review in this section target college-general effects as the primary outcomes. Furthermore, like much of the more recent work on values affirmation interventions in middle school contexts, each of these studies has a particular focus on the moderators and mediators of intervention effects.

Whereas other work focused on demographic moderators, such as gender, social class, or race, Layous and colleagues (2017) examined psychological moderators of values affirmation intervention effects. They noted a common theme for all the groups that have benefited from values affirmation: threats to a sense of belonging. Thus, in a sample of primarily White undergraduates, Layous and colleagues administered the values affirmation exercise in a laboratory setting and tested whether the intervention would be effective for students with a low sense of belonging. They found no effects of the intervention on a math test administered immediately after the intervention. However, when they examined students' grades over two semesters, they found that the values affirmation intervention improved GPAs for all students on average compared to the control condition, and that this effect was stronger for men and for students with low levels of belonging.

Brady and colleagues (2016) implemented the values affirmation intervention in a laboratory study and then followed students overtime. They found a positive effect on postintervention GPAs for Latino students at a two-year follow-up, but the effect was negative for White

students. In the fourth semester after the intervention, participants returned to the lab and completed a stressful academic task (making a list of everything they had to get done before the end of the semester), after which they were given a blank piece of paper to write about whatever was on their mind. Brady and colleagues analyzed these essays and found that Latino students who had received a values affirmation intervention two years earlier showed spontaneous self-affirmations in their writing. In other words, they focused on personal values and positive sources of worth. Furthermore, Latino students from the affirmation condition reported more confidence in their ability to cope with all the tasks they needed to complete, compared to those in the control condition. Brady and colleagues tested whether these spontaneous self-affirmations mediated the effects of the intervention on confidence and GPA. They found that among Latino students, the intervention increased their tendency to self-affirm, which improved their confidence in their coping ability, leading to better grades that semester. These results provide insight into the recursive processes through which the values affirmation intervention influenced academic performance over a two-year period.

Tibbetts and colleagues (2016a) conducted a follow-up study of the Harackiewicz et al. (2014a) sample and found that the values affirmation intervention improved FG students' overall postintervention GPAs over the course of three years. They used text analyses to investigate the mechanisms of these long-term effects. Their analysis was grounded in cultural mismatch theory (Stephens et al. 2012), which states that, although everyone holds both independent and interdependent values to some degree, FG students face a mismatch because university culture places more emphasis on independence, where as FG students have more interdependent backgrounds. Therefore, Tibbetts and colleagues coded for both independent and interdependent writing. They found that the effects of the values affirmation intervention on course grades, academic belonging, and overall GPA three years later were all mediated by independent themes. In other words, for FG students, writing about independence in their values affirmation essays led to higher grades in the biology course, higher levels of academic belonging, and higher GPAs over a three-year period. Although most FG students who wrote about independence also wrote about interdependent themes (95%), it was affirming their independent values (which match the academic context) that proved most beneficial in this context.

Values Affirmation Interventions: Summary and Discussion

Like the framing intervention studies, the values affirmation intervention studies reviewed above targeted an impressive number of educational problems, from gender gaps in a physics course (Miyake et al. 2010) and the social class achievement gap in a biology course (Harackiewicz et al. 2014a) to performance among students with low belonging (Layous et al. 2017). However, the number of tests of values affirmation in college contexts is small, and the results have not been consistent (e.g., Harackiewicz et al. 2016a). This inconsistency highlights the urgency for researchers to demonstrate how this intervention works in college contexts and for whom. Recent studies have provided insights into the psychological moderators of values affirmation interventions (Layous et al. 2017), as well as the proximal and distal mediators of intervention effects. Work by Tibbetts and colleagues (2016a) demonstrated that the content of the values affirmation essays can provide important clues

about their proximal mechanisms, revealing that, for FG students experiencing identity threat due to a cultural mismatch, the benefits of the intervention were mediated by themes of independence. Finally, Brady and colleagues' (2016) work illuminated a more distal mechanism, that values affirmation interventions can improve long-term outcomes through recursive processes involving students' propensity to self-affirm under threat.

Values affirmation interventions were first tested in middle schools, administered by teachers in small classes. In contrast, introductory college classes are large and impersonal, and it may be difficult to administer a personal writing exercise in this context. However, it is not clear that the implementation of the intervention needs to be the same across contexts. Indeed, some of the work at the college level has been implemented in laboratory settings, rather than classrooms, with positive results (Brady et al. 2016, Layous et al. 2017). Given the recent work showing that the content of values affirmation essays works differently for middle school minority students and FG college students (Shnabel et al. 2013, Tibbetts et al. 2016a), it is clear that more work is needed to understand how values affirmation works in different contexts and for different groups.

IMPLICATIONS FOR INTERVENTION SCIENCE

The studies reviewed above reveal the power of a targeted approach to intervention research in higher education. The interventions evaluated in these studies were grounded in theory and developed through laboratory research and small-scale field studies, culminating in the field trials considered in this review. As we survey the progress to date, it seems clear that intervention scientists have made great strides over the past 15 years. The interventions are well crafted and the research methods are rigorous, with careful attention paid to intervention mechanisms and recursive processes.

Conducting randomized controlled field trials is a complicated process. It requires close collaboration with teaching faculty or university administrators, first to adapt the intervention for the particular context and student population and then to implement interventions in courses or academic advising contexts. Well-powered studies require large samples (especially if the intervention is targeted to help underrepresented minority groups) such that these studies can take years to run. The current body of intervention research in higher education spans a wide array of problems, ranging from achievement gaps in college courses, to promoting STEM career pursuit, to facilitating transitions to college for underrepresented students. However, these studies represent the first wave of a new science, and there were too few studies in any category of our classification system to permit a more quantitative review. In fact, the impressive range of problems targeted by these interventions proved to be a limitation for our review—there were very few studies targeting the same problems with comparable measures. Although there was strong empirical support for each of the three types of intervention in general, more research is needed to address critical questions of replication and generalizability of findings.

Replication and Beyond

Given that the interventions reviewed above are contextually specific interventions, how should we conceptualize the question of replication? In some ways, the interventions

literature represents an ideal case for thinking about the replication issues currently facing the field—hypotheses are straightforward and well specified (and often preregistered), and the studies are typically well powered, but direct replication is almost never possible. What kind of precision should we expect, and how should we think about conceptual replications and extension of interventions to different populations? How should we interpret nonreplications?

Our review reveals impressive patterns of consistent findings for each type of intervention but also reveals some inconsistencies across studies and some failures to replicate findings. We would not expect each intervention to be equally effective across every implementation, of course; in fact, the pattern of inconsistent findings may help identify areas for future research and qualify conclusions until we have more data in hand. In the case of task value interventions, for example, there was a consistent pattern of findings that the interventions had positive effects for students who struggle in classes [with some internal replications across sections of courses or semesters (e.g., Harackiewicz et al. 2016a)], but there are inconsistencies in the mediators between studies (e.g., perceived values, expectancies, engagement) that raise important questions about intervention mechanisms. In the case of framing interventions, there was a consistent pattern of findings that framing interventions promoted positive outcomes in academic transitions, but some evidence of nonreplication of growth mindset effects (Yeager et al. 2016, study 2). More critically, no two studies in the framing category examined the exact same problem, making it difficult to assess the question of direct replication [however, some studies had internal replications with multiple cohorts (e.g., Walton & Cohen 2011)].

We found more evidence of nonreplication for values affirmation, in part because the foundational studies were conducted earlier (Cohen et al. 2006, Miyake et al. 2010), allowing more time for replication studies to emerge. Indeed, future reviews may contend with more nonreplications of task value and framing interventions, and we expect that the field of intervention science will be all the better for it. As is the case with values affirmation, each replication and nonreplication can tell us something about the intervention, its mechanisms, and the conditions under which it is most effectively implemented. For example, replication studies in middle school have revealed that intervention effects may be moderated by context (Hanselman et al. 2014) and by timing of implementation (Cook et al. 2012).

In addition to questions about the replicability of intervention effects, it is important to think about the generalizability of the mechanism. For example, values affirmation interventions were successfully implemented to address achievement gaps for underrepresented minority students in middle school, then for women in college physics, and then for FG students in college biology classes. Should we expect the intervention to work the same way in all three cases? If a social belonging intervention works for African American students in a selective university, will it work the same way for women in engineering programs or for underrepresented students starting college at their state university? And if a utility-value intervention promotes interest and performance for struggling students in a psychology class, will we expect this to work in the same way that utilityvalue interventions help minority students perform better in college biology classes?

On the one hand, the theories behind these interventions provide hypotheses about general mechanisms that should apply across contexts and populations. For example, if struggling students in psychology and minority students in biology both fail to see any value in what they are learning, a utility-value intervention might work for both groups. On the other hand, our application of theory needs to be more context dependent; we might implement the intervention differently or invoke different mechanisms for how the intervention works in particular contexts. In the Harackiewicz et al. (2016a) study, FG minority students believed that biology was valuable (the vast majority had biology-related majors), but they benefited from the utility-value intervention because it allowed them to connect course content to their helping goals. This particular mechanism is likely not generalizable to all populations. These questions become even more complicated when considering recursive processes, which interact with natural processes in the environment (e.g., performing well in a biology course may catch the attention of faculty, who invite the student to join their lab, which increases the likelihood that the student will pursue a career in that field, etc.), and are thus context dependent, at least to some degree. Thus, our theories will need to be informed and revised by what we learn from testing interventions in multiple contexts. Moving forward, it will be important to consider these issues as we design and evaluate intervention research.

Implementation: How and Where?

There are four ways that these interventions have been implemented in randomized controlled trials: (a) in laboratory sessions, with assessment of academic outcomes (e.g., Aronson et al. 2002, Brown et al. 2015); (b) in orientation or advising sessions outside of class (Stephens et al. 2014, Walton et al. 2015); (c) in preorientation activities, included as part of the prematriculation process (Yeager et al. 2016); or (d) in classes, integrated into the class structure (e.g., Harackiewicz et al. 2016a, Miyake et al. 2010). There are methodological trade-offs associated with each mode of delivery. Lab studies offer the greatest control and opportunity for in-depth assessment of targeted processes. For example, Brady and colleagues (2016) were able to explore self-affirmation and recursive processes by bringing participants back into the lab two years after participating in a laboratory-based values affirmation study. Similarly, Stephens et al. (2015) were able to collect physiological data to examine recursive processes two years after a differences education intervention. However, any time participants are brought back to the lab for follow-up, researchers must contend with attrition and problems of self-selection that undercut the power of randomization at the original point of implementation. Selection bias may also apply when students are recruited for advising or orientation sessions scheduled outside of classes. Although randomization within these contexts allows evaluation of treatment effects within the sample, the generalizability of the studies is unclear. In these cases, it is imperative that researchers describe recruitment procedures and characterize their sample relative to the targeted population. The inclusion of campus-wide control groups (e.g., Walton & Cohen 2011, Stephens et al. 2014) can be helpful in this process.

When interventions are embedded in prematriculation activities or incorporated into class curricula, samples are more representative of the targeted population, with fewer concerns about selection bias. However, it is essential to track whether all students complete prematriculation and required course assignments to evaluate treatment compliance and

fidelity (O'Donnell 2008, Hulleman & Cordray 2009). Implementation in these contexts requires close collaboration with course instructors or deans to ensure that materials are appropriate for the context and that randomization is carried out properly. Moreover, when working in these contexts, it is important to design control conditions that are plausible, i.e., that have pedagogical value (in the case of course-based interventions) or make sense as prematriculation orientation activities. For example, in control conditions of the utility-value intervention study in biology classes (Harackiewicz et al. 2016a), students were asked to write essays summarizing course material, whereas students in the intervention condition were asked to summarize information and then explain the relevance and utility value of that information. Thus, the intervention had pedagogical value for all students, which could justify its inclusion in curricula. The major disadvantage of these approaches is that it is much more difficult to examine targeted processes. There are limited opportunities to administer questionnaires, let alone measure physiological data. Even when possible, there are risks: The more that data collection is added to the course or orientation, the more that it will be experienced as a research study, reducing the authenticity and potential generalizability of the findings.

Thus, all delivery methods have benefits and disadvantages. Intervention scientists must consider the goals of their study. A study that aims to test process questions is perhaps best conducted in the laboratory. However, a study that aims to test how the intervention works in the field will need to be embedded in the educational context (i.e., the course, prematriculation activities, orientation, or advising sessions, depending on the intervention). Indeed, there is an important interplay between laboratory and context-embedded studies: Interventions tested in the lab are scaled up for field tests, which then suggest additional process questions to be tested in the lab, so that the intervention can be refined. For example, after their analyses of values affirmation essays from field studies, Shnabel et al. (2013) and Tibbetts et al. (2016a) returned to the lab to manipulate writing themes to test their field-driven hypotheses.

Implementation: Who and Why?

In the range of intervention studies reviewed above, researchers have targeted different groups of students in different contexts—women in physics classes and engineering programs, African American students at a selective university, students who struggle on early exams in psychology classes, etc.—as well as broader groups of students. For example, Yeager et al. (2016) targeted disadvantaged students, defined differently in each of three studies, based on historical achievement data in each context: In study 1, all participants were either URM or FG students; in study 2, the disadvantaged group included all African American, Latino, and FG students; in study 3, the disadvantaged group included all African American, Latino, Native, Pacific Islander, and FG students. Harackiewicz et al. (2012) targeted all parents and teens with their directly communicated utility-value intervention. Other researchers targeted narrower groups of students at the intersection of two dimensions—i.e., low-performing males in psychology classes (Hulleman et al. 2017) and FG-URM students in biology classes (Harackiewicz et al. 2016a). The dizzying array of populations targeted in the studies reviewed above indicates how differently problems have been conceptualized and how difficult it is to compare results across studies.

Given that targeted interventions focus on specific educational problems for particular groups of students, it is important to consider the individual characteristics that may predispose students to benefit from a given intervention. For example, framing and values affirmation interventions have proven to alleviate belonging concerns, thus promoting academic performance for underrepresented students (e.g., African American students in college, women in physics) and students with a low sense of belonging. Utility-value interventions have been powerful in improving performance for students who struggle in a class and for students with strong helping motives by increasing their engagement with course content and helping them to connect the material to their own lives and goals. In order to implement an intervention with maximum effectiveness, it is important to consider the specific processes that social-psychological interventions target and how those processes vary across different populations.

If interventions target a general process, such as belonging concerns in the transition to college, it may be theoretically consistent to target all disadvantaged students in that context. With other interventions, however, hypotheses may be more specific. We recommend that researchers (continue to) conduct pilot work and use focus groups (e.g., Walton et al. 2015) to assess the problem, population, and context. This process has two major benefits. First, baseline assessment and focus groups can help identify which type of intervention might be appropriate in a given context and which groups might be most responsive that intervention (e.g., Harackiewicz et al. 2016a). Second, a deeper understanding of the context will provide insight into the ways in which intervention materials can be customized to be most resonant with students. When assessing students' motivational profiles, it is important to remember that students' identities overlap and intersect, with implications for intervention. For example, an intervention that benefits women may not benefit FG students, and FG women may have a unique set of needs that would not be well addressed by either interventions for women or interventions for FG students (Cole 2009).

In addition to the intersectionality of demographic categories (e.g., race and gender), it may be fruitful to consider overlap between demographic categories and psychological variables. Layous and colleagues' (2017) work suggests that values affirmation interventions can be effective for any student with belonging concerns. Does this fully explain the benefits of values affirmation for underrepresented minorities or FG students? Likewise, interventions that target achievement gaps may be working primarily through benefits for low performers or through other characteristics of the group. For example, Yeager and colleagues' (2016) definition of disadvantaged students as groups with a history of poor performance raises the interesting possibility that the positive effects of social belonging interventions could be indicative of positive effects for poor performers more generally.

As a final note, we think it will be important in future work to conduct more fine-grained analyses of intervention mechanisms for different groups. Much of the work in this review investigates mechanism in terms of psychological processes or behaviors affected by the intervention, and this work is crucial. However, there is another, more proximal layer of mechanism that has been gaining attention in recent work. Nearly all of the interventions in this review involve some amount of writing, and text analysis of students' essays may offer new insights into how different groups internalize intervention messages and what types of

writing interventions have the greatest benefits for students. Indeed, work by Harackiewicz and colleagues (2016a), Beigman Klebanov and colleagues (2017), Shnabel and colleagues (2013), and Tibbetts and colleagues (2016a) demonstrates that these words, direct from students' pensor keyboards, can reveal underlying intervention mechanisms.

In sum, our review suggests that targeted interventions can be powerful in improving student outcomes in higher education. However, there are many theoretical and methodological issues to address as we continue to build a toolbox of interventions that target critical problems in education. We recommend that researchers and practitioners proceed with cautious optimism and continue the arduous but crucial work of understanding how, when, and for whom motivational interventions can improve educational outcomes.

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Figure 1.
Conceptual model of targeted interventions.

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	Task value	Framing	Personal values
Course specific e.g., engagement, interest, course grades	Utility-value intervention (4)	X	Values affirmation intervention (3)
Field specific e.g., course taking, interest in field, career choices	Communal utility-value intervention (3) Parent utility-value intervention (2)	Social belonging intervention (1)	X
School general e.g., enrollment rates, retention, overall GPA	X	Attributional reframing (3) Mindset intervention (3) Difference education intervention (2) Social belonging intervention (5)	Values affirmation intervention (3)

Figure 2.

Targeted interventions in higher education can be divided into three types (task value, framing, and personal values) targeting outcomes at three levels (course specific, field specific, and school general). This figure summarizes the interventions that have been tested in each category of this classification system, as well as the number of experimental studies conducted (in parentheses).

Table 1

Summary of task value interventions in higher education

Study	Problem	Context and sample	Intervention	Primary findings
Task value interventions				
Course specific				
Hulleman et al. (2010, study 2) ^a	Promoting engagement for low performers	One section of introductory psychology at a public university (<i>n</i> = 318)	Utility value: two writing assignments, completed as homework	Increased interest in the course and intention to major in psychology for students with low initial exam grades
Hulleman et al. (2017, study 2) ^a	Promoting engagement for low performers	Two sections of introductory psychology at a public university (<i>n</i> = 357)	Utility value: two writing assignments, completed as an online homework activity	Increased interest in the field of psychology and final exam performance for all students and particularly for students with low initial exam scores, especially men
Harackiewicz et al. (2016a) ^b	Racial and social class achievement gaps	Eight sections of introductory biology for STEM majors at a public university (<i>n</i> = 1,040)	Utility value: three writing assignments, completed as homework	Increased course performance for all students and particularly for first-generation underrepresented minority students, as well as students with low prior GPAs and students with high motivation to help others
Canning et al. (2018) ^a	Promoting persistence in STEM	Majority students in three sections of introductory biology for STEM majors at a public university (<i>n</i> = 577)	Utility value: one to three writing assignments, completed as homework	Increased course performance, enrollment in another biology course, and STEM major persistence
Field specific				
Brown et al. (2015, studies 1–3)	Promoting interest in biomedical research careers	Three laboratory studies with undergraduates from public universities (<i>n</i> = 55, 140, 160); studies 1 and 2 took place at a Hispanic-serving institution	Utility value: an article read by students describing how a faculty's biomedical research project could help others	Increased interest in pursuing a career in biomedical research
Harackiewicz et al. (2012) and Rozek et al. (2017)	Promoting STEM motivation	High school students and their parents from the longitudinal Wisconsin Study of Families and Work and a five-year follow-up (<i>n</i> = 181 families)	Utility value: two brochures and a website sent to parents in their teens' tenth- and eleventh-grade years, highlighting the usefulness of STEM courses and strategies for talking about STEM courses with their teens	Increased STEM course taking among the teens in high school, increased math and science scores on ACT college preparatory exam; indirectly increased college STEM course taking, career aspirations, and likelihood of declaring a STEM major in college through the high school STEM outcomes

^aMeasured a combination of course-specific, field-specific, and college-general outcomes.

^bTested interventions from two different categories.

Abbreviation: STEM, science, technology, engineering, and mathematics.

Table 2

Summary of framing interventions in higher education

Study	Problem	Context and sample	Intervention	Primary findings
Framing interventions				
Field specific				
Walton et al. (2015)	Gender gap in engineering	First-year engineering students at a public university; activities were completed one on one or in small groups in engineering classrooms, as a research study ($n = 228$)	Social belonging: reading materials framing belonging concerns in the engineering program, saying-is-believing essay	Increased first-year engineering GPAs for women in male-dominated engineering majors
College general				
Wilson & Linville (1982, 1985)	Promoting performance for first-year students	Three laboratory studies with first-year undergraduates who reported being concerned about their first-semester grades ($n = 31; 37; 36$)	Attributional reframing: booklet and video framing GPA concerns, saying-is-believing essay	Increased overall GPAs in the semester after the intervention was implemented, especially for men
Walton & Cohen (2007, study 2; 2011)	Racial achievement gap	First-year students (second semester) at a selective private university, in a laboratory setting ($n = 37; 92$)	Social belonging: reading materials framing belonging concerns, saying-is-believing essay and video	Increased overall GPAs in the semester after the intervention was implemented (Walton & Cohen 2007) and through senior year (Walton & Cohen 2011) for African American students
Yeager et al. (2016, study 1)	Promoting persistence in college	High school seniors from five urban charter schools who had been admitted to two- or four-year colleges (primarily African American and FG students); activities completed online in high school computer labs in May of their senior year ($n = 584$)	Social belonging: reading materials framing belonging concerns, saying-is-believing essays Mindset: reading materials framing intelligence, saying-is-believing essays Combined: both interventions, received one week apart	Social belonging: increased percentage of students who stayed enrolled full-time through their first year of college Mindset: no effect Combined: increased college persistence to the same degree as social belonging alone
Yeager et al. (2016, study 2)	Racial persistence gap	Incoming students at a public university; activities completed as part of prematriculation tasks online in the summer before college ($n = 7,335$)	Social belonging: reading materials framing belonging concerns, saying-is-believing essays Mindset: reading materials framing intelligence, saying-is-believing essays Combined: shortened versions of both interventions, received in one session	Social belonging: increased percentage of underrepresented (FG and URM) students who stayed enrolled full-time through their first year of college Mindset: increased college persistence among underrepresented students to the same degree as social belonging alone Combined: increased college persistence among underrepresented students to the same degree as either intervention alone
Yeager et al. (2016, study 3)	Racial achievement gap	Incoming students at a selective private university; activities completed as part of prematriculation tasks online in the summer before college ($n = 1,592$)	Social belonging: reading materials framing belonging concerns, saying-is-believing essays	Increased first-year GPAs for underrepresented (FG and URM) students
Stephens et al. (2014, 2015)	Social class achievement gap	First-year students at a selective private university; activities completed as part of a research study in the first month of the semester	Difference education: a discussion panel framing diverse backgrounds and adjustment to college, saying-is-believing video	Increased first-year GPAs for FG college students; increased psychosocial adjustment during the first year of college for all students

Study	Problem	Context and sample	Intervention	Primary findings
Framing interventions				
Field specific				
		(<i>n</i> = 168) Two-year follow-up laboratory study (<i>n</i> = 133)		Improved coping in stressful situations for FG students two years later
Aronson et al. (2002)	Racial achievement gap	Undergraduates at a selective private university; activities completed in small-group laboratory sessions (<i>n</i> = 79)	Mindset: video framing intelligence, saying-is-believing essays	Increased overall GPAs for the quarter after the intervention for all students, especially for African American students

Abbreviations: FG, first-generation; GPA, grade point average; URM, underrepresented racial minority.

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Table 3

Summary of values affirmation interventions in higher education

Study	Problem	Context and sample	Intervention	Primary findings
Values affirmation interventions				
Course specific				
Miyake et al. (2010)	Gender gap in physics	Two sections of introductory physics for STEM majors at a public university ($n = 399$)	Values affirmation: students wrote about their most important values, once as an in-class practice writing exercise and once as an online homework assignment	Increased performance for women on course exams and a standardized physics test
Harackiewicz et al. (2014a) ^a	Social class achievement gap in biology	Three sections of introductory biology for STEM majors at a public university ($n = 798$)	Values affirmation: twice during the semester, students wrote about their most important values as an in-class practice writing exercise	Increased course performance, enrollment in another biology course, and overall semester GPAs for first-generation college students
Harackiewicz et al. (2016a) ^b	Social class achievement gap in biology	Eight sections of introductory biology for STEM majors at a public university ($n = 1,040$)	Values affirmation: twice during the semester, students wrote about their most important values as an in-class practice writing exercise Utility value: see Table 1	No effect
College general				
Layous et al. (2017)	Promoting performance for students with low belonging	First- and second-year undergraduates at a public university; activities completed in small groups in a laboratory setting ($n = 105$)	Values affirmation: students ranked a list of values and wrote about their most important value	Increased overall GPAs for all students and particularly for students with low sense of belonging and for men
Brady et al. (2016)	Racial achievement gap for Latino students	First- and second-year undergraduates; activities completed in a laboratory setting Follow-up two years later ($n = 183$)	Values affirmation: students ranked a list of values and wrote about their most important value	Increased postintervention GPAs for Latino students; decreased postintervention GPAs for White students
Tibbetts et al. (2016a)	Social class achievement gap	Three-year follow-up of an intervention completed in three sections of introductory biology for STEM majors at a public university ($n = 788$)	Values affirmation: twice during the semester, students wrote about their most important values as an in-class practice writing exercise	Increased postintervention GPAs for first-generation college students

^aMeasured a combination of course-specific, field-specific, and college-general outcomes.

^bTested interventions from two different categories.

Abbreviation: STEM, science, technology, engineering, and mathematics.