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Understanding Long-Term Effects of Motivation Interventions in a Changing World

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Abstract

As intervention science develops, researchers are increasingly attending to the long-term effects of interventions in academic settings. Currently, however, there is no common taxonomy for understanding the complex processes through which interventions can produce long-lasting effects. The lack of a common framework results in a number of challenges that limit the ability of intervention scientists to effectively work toward their goal of preparing students to effectively navigate a changing and uncertain world. A comprehensive framework is presented to aid understanding of how interventions that target motivational processes in education produce downstream effects years after implementation. This framework distinguishes between three types of processes through which interventions may produce long-term effects: *recursive processes* (feedback loops by which positive effects can build on themselves over time), *non-recursive chains of effects* (“domino effects” in which proximal outcomes affect distinct distal outcomes), and *latent intrapersonal effects* (changed habits, knowledge, or perceptions that affect how students respond in different situations in the future). The framework is applied to intervention research that has reported long-term effects of motivation interventions, evidence for the processes described in this framework is evaluated, and suggestions are presented for how researchers can use the framework to improve intervention design. The chapter concludes with a discussion of how application of this framework can help intervention scientists to achieve their goal of positively influencing students’ lifelong trajectories, especially in times of change and uncertainty.

Keywords

intervention science; long-term effects; motivation in education; recursive processes; values affirmation; utility value; social belonging

Research on motivation interventions in education has surged over the past decade. Increasingly, basic social-psychological research has been applied to the development of

We propose a comprehensive framework describing the processes through which motivation interventions may bring about long-term effects on educational outcomes. Specifically, in this chapter, (i) a framework delineating theoretically distinct patterns of long-term intervention effects is presented, (ii) this framework is used to review studies that report long-term effects of motivation interventions, and (iii) the evidence for the theorized processes underlying these long-term effects is evaluated. Finally, (iv) implications of the framework for intervention design are discussed.

A Framework for Understanding Long-Term Intervention Effects

We draw from current theory and empirical research to propose a framework distinguishing three processes through which interventions may produce effects on academic outcomes that persist or amplify over time. To illustrate these processes, consider an intervention that encourages college students to reflect on the value of the material they are learning in a difficult introductory biology course. How might this intervention, implemented in a single course, lead to long-term effects on students' educational outcomes?

One well-documented process by which interventions can produce long-lasting effects is the initiation or interruption of *recursive processes* (Cohen et al., 2009; Cohen & Sherman, 2014; Harackiewicz & Priniski, 2018; Walton & Wilson, 2018; Yeager & Walton, 2011). Recursive processes are feedback loops in which two or more variables reciprocally influence one another. In the context of our example, by prompting students to reflect on the value of course material, the intervention may increase the amount of value students perceive in the course material, which may then lead them to spend more time studying. Having more exposure to the material through additional studying, the students may come to perceive even more value in the material, further encouraging more studying, and so on, in a self-perpetuating cycle. Therefore, to the degree that the intervention increases perceptions of value, it may initiate this type of positive recursive process (see Figure 1). This example illustrates a recursive process that occurs within the individual, but recursive processes may also involve the social environment, as would be the case if a student's improved performance drew positive attention from their teacher, leading to improved future performance, and so on.

Second, an intervention can initiate a chain of effects that does not require recursive feedback loops. This type of process, which we term a *non-recursive chain of effects*, is a "domino effect" in which intervention effects on a proximal outcome in turn affect *distinct* distal outcomes. Such a process may occur primarily on the intra-individual level, and/or in interaction with the social system. In our example, encouraging students to reflect on the value of course material may initiate an intra-individual chain of effects whereby increasing students' perceptions of value leads them to spend more time studying, in turn increasing their confidence in their ability to be successful in the field. That is, one change to an individual (e.g., increased value perceptions) may lead to any number of other psychological changes (e.g., increased confidence). On the other hand, an intervention may also initiate a chain of effects whose influence is dependent upon the social system. In such a "trigger-and-channel" process (Goyer et al., 2017), the proximal influence of an intervention is channeled by existing opportunities in the social structure to produce a longer-term impact. In our

example, proximal effects of the intervention on students' perceived value of biology (the "trigger") may be channeled by opportunities in the social system (i.e., availability of appealing courses and the opportunity to major in biological fields) to produce a long-term effect on the likelihood that students will take additional biology courses and set them on a trajectory toward enrolling in a biological major (see Figure 2). Thus, non-recursive chains of effects may operate on the intra-individual level, in interaction with the social system, or both.

Finally, another way in which interventions can produce long-term effects on academic outcomes without affecting recursive feedback loops or initiating a chain of effects, is by producing lasting changes within an individual that exert an influence later in time. Specifically, an intervention may change students' habits, knowledge of strategies, or perceptions of particular types of situations, and this may affect their behavior and outcomes later in time. In our example, encouraging students to reflect on the value of course material, may teach students the habit of thinking about the value of what they learn in their courses (Hulleman, Kosovich, Barron, & Daniel, 2017). This habit may be particularly important when students encounter material that is not initially interesting to them, because reflecting on value may help them to become interested in the otherwise uninteresting material. Intervention effects may therefore be undetected until a student encounters a course that they find to be less interesting, at which point their new habit will help them develop interest in the course (see Figure 3). We refer to this type of process as a *latent intrapersonal effect* because it involves dormant changes within an individual that might produce effects later on, independently of recursive processes or non-recursive chains of effects.

These three processes can operate independently, but they can also work simultaneously or in concert with one another to preserve and amplify intervention effects over time (see Figure 4). In our example, by asking students to reflect on the value of course material, the intervention may increase value perceptions, which may create a *recursive process* with studying behavior. This increased studying may lead to a *non-recursive chain of effects* by improving performance in the introductory biology course, which in turn, may encourage students to take more biology courses in the future. The intervention may also teach students the habit of thinking about the value of course material on their own. This may have a *latent intrapersonal effect*, helping students maintain interest when they encounter a less engaging topic in another course later on.

A Review of Long-Term Intervention Effects on Educational Outcomes

In this section, the framework is used to review research showing long-term effects of motivation interventions on educational outcomes. Three types of interventions were identified that evidence long-term effects (i.e., effects on outcomes measured after the semester in which the intervention was implemented): values affirmation (e.g., Cohen et al., 2009), utility value (e.g., Hulleman & Harackiewicz, 2009), and social belonging (e.g., Walton & Cohen, 2007).

Values Affirmation

The values affirmation (VA) intervention is based in research on stereotype threat, which is postulated to occur when members of a group that is negatively stereotyped within a particular academic domain worry that performing poorly within the domain will confirm the stereotype (Aronson, Fried, & Good, 2002; Steele & Aronson, 1995). Such effects have been found, for instance, among African American students taking an intelligence test (Steele & Aronson, 1995) or female students taking a math test (Spencer, Steele, & Quinn, 1999). The VA intervention was designed to reduce the pernicious effects of stereotype threat by encouraging students to focus on their personal values outside of the threatened domain (Cohen et al., 2006). A typical VA intervention asks students to select a few personally important values from a list (e.g., relationships with friends and family, learning and gaining knowledge), and write an essay about why those values are important to them. These affirmations are theorized to bolster personal integrity, reduce worry about the performance situation, and thereby improve performance. Understanding the processes by which this intervention may produce lasting effects is critical in a time of globalization in which educational systems must address the needs of an increasingly diverse body of students, including immigrants and refugees, some of whom may face stereotype threat.

The VA intervention has been found to improve students' performance in short-term situations, as well as academic outcomes as long as nine years post-intervention (Goyer et al., 2017). Values affirmation was initially theorized to produce long-term effects by interrupting a negative recursive process (Cohen et al., 2006). When students experience stereotype threat, they perform more poorly, which further increases stereotype threat and creates a feedback loop between threat and poor performance. By reducing stereotype threat, the VA intervention is theorized to interrupt and even reverse this cycle: a reduction in stereotype threat may improve a student's performance, in turn reducing future concern about stereotype threat, and so on.

In the seminal field experiment, Cohen and colleagues (2006) administered a VA intervention to middle-school students and found that it improved African American students' classroom performance over the course of a semester, reducing the racial achievement gap by about 40%. Consistent with theorizing that values affirmation interrupts a recursive cycle between performance and threat perceptions, the intervention also decreased the accessibility of racial stereotypes (although the accessibility measure was not significantly related to performance). In a follow-up study, Cohen and colleagues (2009) found that these performance effects persisted for an additional two years, such that African American students in the intervention condition had higher GPAs over two years, compared to African American students in the control group. Since then, several other field experiments have shown similar positive effects of VA on African American students' academic performance over long periods of time (e.g., Borman, Grigg, & Hanselman, 2016; Cook, Purdie-Vaughns, Garcia, & Cohen, 2012; Dee, 2015; Hanselman, Bruch, Gamoran, & Borman, 2014).

Recent research has also extended these initial findings to examine whether VA can produce positive long-term effects for other groups. Sherman and colleagues (2013) found that the intervention mitigated the negative performance trajectory of Latino/a middle-school

students over the course of three years. Other studies have since found similar effects for Latino/a students at middle school (Borman et al., 2016; Hanselman et al., 2014) and college levels (Brady et al., 2016). Finally, recent research has demonstrated that VA can improve academic outcomes not only for members of stereotyped racial/ethnic groups, but also for women in physics (Miyake et al., 2010). Harackiewicz and colleagues (2014) found that a VA intervention improved the course grades and semester GPAs of first-generation (FG) college students (i.e., students for whom neither parent has a college degree) taking an introductory biology course, closing the social class achievement gap by about 50%. In a follow-up study, Tibbetts and colleagues (2016, Study 1) found that this intervention effect persisted over three years.

Cohen and Sherman (2014) have suggested that long-term effects of this intervention are due to interruption and reversal of the feedback loop between stereotype threat and poor academic performance. The most common way of exploring this recursive process has been to conduct time-course analyses, collecting multiple measures of academic performance over time and examining whether performance trajectories differ depending on whether students received the intervention. If stereotype threat creates a negative feedback loop with performance, then stereotype-threatened students should perform worse and worse over time, and an intervention that interrupts this process should mitigate (and potentially even reverse) this decline. Indeed, the studies that have conducted time-course analyses to test VA effects have found such patterns (Borman et al., 2016; Bowen, Wegmann, & Webber, 2013; Brady et al., 2016; Cohen et al., 2006; Cohen et al., 2009; Sherman et al., 2013; Tibbetts et al., 2016).

More recent studies have begun to explore the mechanisms of VA effects in more detail. Hanselman et al. (2014) and Dee (2015) tested VA interventions across multiple middle schools and found that the intervention was more effective for minority students in more threatening environments (i.e., schools with fewer minority students) and in higher-performing schools (i.e., schools in which average academic achievement and improvement over the school year were relatively higher than other schools), respectively. Together, these results are consistent with the theorized process of VA working by reducing threat, and suggest that VA may be particularly effective in environments that provide more support for affirmed students' achievement.

Another development in VA intervention research has been exploration of intrapersonal changes that exert latent intrapersonal effects. Brady and colleagues (2016) tested a VA intervention at a public 4-year university, and found that the intervention improved Latino/a students' GPAs over the course of two years, resulting in a 90% reduction in the Latino/a-White achievement gap. Interestingly, they conducted a two-year follow-up laboratory study with a subset of these participants, in which a sense of psychological threat was induced. Students were then asked to write an essay about what was on their minds. The researchers coded these open-ended essays for spontaneous instances of self-affirmation and found that Latino/a students who had received the VA intervention two years earlier were more likely to spontaneously affirm themselves. This study provides the first evidence that in addition to affecting an ongoing recursive process, VA interventions may have effects over time by producing latent intrapersonal effects. Specifically, the original intervention may have taught

students an implicit strategy of thinking about valued aspects of themselves when experiencing psychological threat, leading to more adaptive coping in threatening situations much later in time.

Finally, a recent longitudinal experiment showed that VA interventions can have positive long-term impacts by initiating a non-recursive chain of effects. Goyer and colleagues (2017) found that a VA implemented in middle school increased Latino American students' likelihood of entering a college-readiness track two years post-intervention (i.e., enrollment in more difficult courses, decreased placement in a remedial clinic, decreased enrollment in an alternative high school). Additionally, they found that the VA intervention increased African American students' probability of enrolling in college seven to nine years post-intervention. Taken together, the authors interpret these findings as evidence of a "trigger-and channel" process by which VA can help students to enter a more positive academic trajectory that exists within the social system (e.g., a college-readiness track), and being placed in this trajectory leads students to achieve improved outcomes over time. In other words, by improving performance in the short-term, VA may initiate a non-recursive chain of effects by increasing students' enrollment in difficult courses, in turn increasing enrollment in a mainstream (rather than alternative) high school, thereby increasing students' chances of enrolling in college.

In sum, research to date suggests that the VA intervention can improve the academic performance of students from threatened groups as long as nine years post-implementation. Theory and research suggest that long-term effects of VA can result from interruption of a recursive process between perceptions of threat and academic performance, although more research is necessary to confirm the ongoing reciprocal relationship between threat perceptions and performance. More recent evidence suggests that VA may also improve performance by producing latent intrapersonal effects, equipping students with a method to cope with particularly threatening situations that can remain dormant until threat is experienced. Finally, a "trigger-and-channel" process demonstrated in recent research indicates that VA may also produce long-term benefits by initiating non-recursive chains of effects.

Utility Value

The Utility Value (UV) intervention is based in expectancy-value theory (Eccles et al., 1983; Eccles & Wigfield, 2002), which postulates that students' achievement-related decisions and behaviors are most proximally determined by their expectations for success and perceived value of academic tasks. The theory would predict, for example, that a student who values learning about philosophy and expects to be successful in this domain will invest more effort in studying philosophy than a student with lower expectations for success and/or value in this domain. The intervention targets *utility value*, a particular type of value defined as the perception that academic material will be useful for achieving short- and long-term personal goals.

The most common form of the intervention is a curricular activity embedded in high school or college courses as a series of assignments in which students are asked to write about how course material is useful to them or relevant to their lives (Hulleman & Harackiewicz, 2009).

Specifically, the UV intervention aims to increase students' perceptions of relevance and value in a particular academic domain, which has been shown to influence performance and interest, as well as choice of courses, major, and future career (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). Understanding the long-term impacts of this intervention in science education is of great importance, as the need for professionals with skills in the science, technology, engineering, and mathematics (STEM) fields continues to grow (National Science Board, 2014). More generally, UV interventions are timely due to students' increased skepticism about school and the value of education to bring change in their lives.

The UV intervention is principally expected to have effects via non-recursive chains of effects. For example, a UV intervention may promote perceptions of relevance in biology, which may in turn improve performance in biology, leading to additional biology course-taking, and subsequently a career in the biological sciences. The UV intervention therefore has the potential to create downstream effects independently of recursive processes by initiating a "domino effect" in which effects on proximal outcomes go on to influence distinct distal outcomes. The UV intervention has been most commonly found to influence performance and interest in semester-long courses. In the seminal study, Hulleman and Harackiewicz (2009) embedded a series of UV (or control) writing assignments in ninth-grade science courses. They found that the intervention promoted performance in the courses for students with low expectations for success. Recent research suggests that the UV intervention can also close achievement gaps for disadvantaged students in a course. Harackiewicz, Canning, Tibbetts, Priniski, & Hyde (2016) randomly assigned college students to complete UV or control writing assignments in an introductory biology course, testing whether intervention effects differed depending on whether students were underrepresented minorities (URMs; i.e., African American, Latino/a, Native American), FG college students, or both. In addition to a positive main effect of the intervention on course grades, they found that the intervention was especially effective for students who were both FG and URM (FG-URM), improving course grades by .51 grade points for these students and closing the achievement gap by 61% relative to continuing-generation majority students.

Profile analyses of FG-URM students revealed that, at baseline, these students were especially likely to care about using their college education to help others. Harackiewicz and colleagues speculated that the opportunity to connect course content to these helping goals may have increased FG-URM students' engagement in the UV essays (relative to control essays), and thereby improved their performance in the course. Consistent with this possibility, they found that the effect of the intervention on grades for FG-URM students was mediated by engagement with the writing assignment (i.e., number of words written). Taken together, these studies suggest that the UV intervention can improve performance in high school and college courses for all students, on average, but can have especially strong effects for disadvantaged students. An important question is whether these increases in performance initiate a non-recursive chain of effects, encouraging students to further pursue an education in a related field.

Researchers have recently found that the UV intervention can have long-term effects on important academic decisions, such as course taking, majoring, and career aspirations (Canning et al., 2018; Harackiewicz et al., 2012; Rozek et al., 2017). Canning and colleagues (2018) randomly assigned college students within the first course of a two-course introductory biology sequence to complete either UV or control writing assignments over the course of the semester. The intervention improved students' grades in the course and increased the likelihood of students taking the second course in the biology sequence. Course grades partially mediated the effects on continuing to the next course, suggesting that the intervention impacted an important proximal outcome (course grades), which in turn influenced a more distal outcome (course taking) through a non-recursive chain of effects.

Follow-up analyses of the Harackiewicz et al. (2016) study evidence long-term effects that are consistent with this type of non-recursive process and extend further in time (Hecht et al., 2018). Students' enrollment in a second biology course and biomedical major were assessed two years after Harackiewicz et al. (2016) implemented the UV intervention in an introductory biology course. The intervention had more positive effects on each of the two long-term outcomes for students with higher levels of confidence in biology. The goal of this study was to identify processes that may explain such long-term intervention effects, and two linguistic mechanisms were assessed by examining students' writing assignments: engagement with learning material (i.e., number of words written) and reflection on course material with a personal focus (i.e., use of personal pronouns). The intervention effects for more confident students were partially mediated by personal focus, indicating that the intervention increased students' reflection on the personal relevance of the course material, which in turn amplified the effect of confidence on pursuit of a biology education. There were also indirect effects suggesting that the effect of the intervention on course grade (via engagement) for FG-URM students may, in turn, have led to increased pursuit of a biology education. These results suggest that the UV intervention can affect long-term academic decisions for different students by initiating separate non-recursive chains of effects. By increasing reflection on the personal relevance of course material, the UV intervention can encourage more confident students to pursue an education in a given domain. At the same time, by increasing engagement with course material, the intervention can improve performance in an introductory course for students who struggle, which may in turn affect students' educational trajectories.

Another type of UV intervention has been implemented to target parents' perceptions of the utility value of STEM courses for their high school students, and has also shown potential for long-term effects. In this intervention parents of high school students received information about the value of math and science education for their children via brochures and a website, with the goal of stimulating conversations about the value of math and science when students were making crucial decisions about elective course-taking in high school (Harackiewicz, Rozek, Hulleman, & Hyde, 2012). This parent-targeted UV intervention was found to increase the number of math and science courses taken by students over their last two years of high school, as well as students' math and science standardized test (ACT) scores. Further extending this research, Rozek et al. (2017) conducted a five-year follow-up study, and found that high school course-taking and ACT scores were predictive of pursuit of a STEM education in college (i.e., STEM course taking, career aspirations,

perceived value, and major), with significant indirect effects of the intervention on college STEM pursuit through these high school variables. These findings suggest that UV interventions can produce effects on important long-term outcomes such as course taking, college majoring, and career pursuit through non-recursive chains of effects in which impacts on more proximal outcomes in turn affect distal outcomes.

Although research to date on the long-term effects of UV interventions principally points to non-recursive chains of effects, these interventions may also work through recursive processes and/or latent intrapersonal effects that simply were not measured in existing studies. For example, given that UV interventions have been found to improve performance, they may in turn increase students' confidence, leading to improved performance over time, creating a recursive cycle between confidence and performance. Future research, such as studies implementing time course analyses on performances throughout a semester (or across multiple courses over time), is necessary to examine this possibility. Another possibility is that the intervention may create a latent intrapersonal effect, teaching students to habitually reflect on the value and relevance of course material, which may exert an influence on behaviors later in time. For example, in a longitudinal correlational study, Hulleman et al. (2017) found that the frequency with which students spontaneously connected course material to their lives was positively related to interest and valuation of course material, but they did not find this measure of connection frequency to be affected by their UV intervention. Future research should follow up on this possibility, testing for UV intervention effects on connection frequency. In sum, evidence to date suggests that the UV intervention influences students' educational trajectories through non-recursive chains of effects, increasing engagement and reflection on the personal relevance of course material, improving outcomes in particular courses, and in turn, influencing course-taking and majoring decisions.

Social Belonging

The Social Belonging (SB) intervention was developed by Walton and Cohen (2007) to mitigate the negative effects of uncertainty about belonging in an academic setting. The intervention is informed by the insight that students who are underrepresented in a particular setting may particularly worry about fitting in, and these worries may interfere with academic progress. The researchers developed the SB intervention to mitigate the effects of belonging uncertainty. Understanding how such an intervention may operate over time is of great significance as the increasing need for a college-educated workforce means that students from groups that have historically been underrepresented in university contexts may be encouraged to pursue higher education but have concerns about their belonging. The SB intervention may be critically important for helping students who experience belonging uncertainty navigating educational transitions and entry into novel fields (e.g., women in engineering; Chubin, May, & Babco, 2005).

The SB intervention was first implemented among first-year college students, encouraging them to attribute their concerns about belonging to the struggles faced by all college students in a new academic context, rather than to their own racial group (Walton & Cohen, 2007). African American and White students were randomly assigned to receive either the SB

intervention or a control activity. Students in the SB condition read the results of a survey from more senior college students about how they had initially worried about fitting in, but that this worry decreased over time. To reinforce the message through “saying-is-believing” processes (Higgins & Rholes, 1978), they were asked to advocate the message to future students. The intervention improved semester GPAs for African-American students but had no effect for White students.

Walton and Cohen speculated that this intervention might also produce long-term effects by interrupting a recursive process through which belonging uncertainty undermines performance, increasing belonging uncertainty, and so on. Consistent with this possibility, a follow-up study found that the effects of the SB intervention persisted three years after the intervention was implemented. African American students in the SB condition displayed a significant positive increase in GPA over time, whereas those in the control condition did not (Walton & Cohen, 2011). This effect was mediated by the decoupling of sense of belonging from experiences of daily adversity. In other words, to the extent that the SB intervention helped students to see experiences of adversity as unrelated to their sense of belonging, it reduced their belonging uncertainty, improved their performance, and so on. Thus, the SB intervention promoted positive long-term effects on performance through a process that involved both latent intrapersonal effects (decoupling) and recursive processes (between decreased belonging uncertainty and improved performance). The intrapersonal changes in construal of adversity and disruption of the recursive effects of belonging uncertainty may have other benefits as well. Walton and Cohen (2011) found that the SB intervention also improved African American students’ general health outcomes (e.g., fewer doctor visits, greater subjective happiness).

In a recent set of studies Yeager and colleagues (2016) tested a SB intervention across three diverse samples and included additional variables potentially implicated in the recursive relationship between belonging uncertainty and academic outcomes. First, an intervention was tested among graduating seniors from an urban charter school network (88% African American, 67% FG). The intervention was found to increase the rate of students’ full-time enrollment across the first year of college (Yeager et al., 2016, study 1), and this effect was mediated by improved academic and social integration on campus (e.g., use of academic support services, participation in extracurricular activities). In a second study, the intervention was tested among a sample of incoming students at a four-year public university (24% URM, 19% FG). The intervention was found to increase full-time enrollment among disadvantaged students over the course of the first year of college (Yeager et al., 2016, study 2). This effect was also mediated by increases in academic and social integration. In a third study, conducted among incoming students at a selective, private university (23% URM, 13% FG), Yeager and colleagues (2016, study 3) found the SB intervention to produce improvements in disadvantaged students’ first-year GPAs and social and academic integration eleven months post-intervention.

These studies demonstrate that SB interventions can produce positive long-term effects on students’ persistence in college. Yeager and colleagues (2016) argued that the intervention worked by decreasing the degree to which underrepresented students construed experiences of adversity as signals that they do not belong. The intervention is thus believed to interrupt

a negative recursive process through which belonging uncertainty leads to withdrawal from the social environment, poorer performance and lower persistence, and in turn, confirmation of initial doubts about belonging. Expanding on prior theorizing about the recursive processes affected by SB interventions (Walton & Cohen, 2007), these studies suggest that when students are uncertain of whether they belong in an academic context, they may be more reluctant to take advantage of potentially beneficial resources that require them to engage with the social environment, such as attending a professor's office hours or joining a study group, and this neglect of potentially beneficial resources may lead to poorer performance and persistence. The SB intervention may therefore reverse this cycle by decreasing belonging uncertainty, improving integration on campus, leading to increased achievement and persistence.

As SB research accumulates, the findings provide insight into how the intervention produces long-term effects. First, the SB intervention may produce a latent intrapersonal effect by altering students' subjective construal of daily experiences of adversity. Second, through this change in construal, the intervention may influence a recursive process through which reductions in belonging uncertainty lead to increased academic and social integration, which then promote performance and persistence, which further decrease belonging uncertainty, thereby producing effects that are preserved and even amplified over time.

Implications for Intervention Design

A precise understanding of the ways in which motivation interventions can produce long-term effects may enable researchers to more effectively design interventions to have downstream effects on desired outcomes. Interventions are often designed with the intention of influencing proximal outcomes (e.g., course performance, academic and social integration, value for a domain), with attention paid to longer-term effects only after these proximal outcomes have been influenced. By attending to the ways in which an intervention may operate via recursive, non-recursive, or latent intrapersonal processes to produce downstream effects in the design phase, researchers can more effectively target the trajectories that their interventions are most likely to influence. Specifically, understanding the ongoing processes in a particular context *prior to* intervening is essential to realizing this goal. For instance, an intervention that attempts to improve course performance over time by targeting a recursive cycle between sense of belonging in the course and engagement in the course outside of class (e.g., going to office hours) will only be effective to the degree that sense of belonging and engagement are related in this context. If, for instance, the course affords few opportunities for external engagement, sense of belonging and engagement will be weakly correlated, and it will not be possible to initiate a positive recursive cycle between these variables. In other words, to generate positive long-term effects, it is essential for researchers to understand the ongoing processes in a context that can be leveraged to produce these effects (Dee, 2015; Hanselman et al., 2014).

Therefore, we recommend that prior to intervening, researchers conduct theoretically-driven longitudinal studies in a particular context to document the motivational processes that influence targeted outcomes over time. Then, after these processes are well understood, development and implementation of an intervention to influence these processes will be

more effective. For instance, an initial study may document a “channel” within a university by which performance in a challenging introductory college science course strongly predicts whether or not students continue to take similar courses throughout college, and ultimately obtain a degree in that field (Hecht et al., 2018). This documentation would provide a strong basis for intervening upon this non-recursive chain of effects by attempting to improve performance in that particular introductory course. We suggest that researchers use our framework to hypothesize the existence of recursive processes, non-recursive chains of effects, and/or latent intrapersonal effects in a particular context, measure these processes to confirm (or revise) these hypotheses, and finally intervene to capitalize on these existing processes to produce the desired outcomes.

Additionally, understanding how interventions interface with environmental characteristics and constraints can allow researchers to optimize intervention effectiveness (Yeager & Walton, 2011). This aspect of intervention design is particularly important in light of the increasingly changing political and educational climates that characterize the world today. As features of students’ environments continue to change, understanding how the effects of interventions can be amplified (or hindered) by different circumstances will be essential to the design of interventions that produce desired outcomes over a long period of time. For example, a more detailed understanding of the contextual factors that influence the effectiveness of VA interventions (Dee, 2015; Hanselman et al., 2014) would enable researchers to better determine whether to implement this intervention in a particular context, and how to maximize its impact.

Finally, better theorizing and measurement of long-term processes in context can help shed additional light on boundary conditions for these interventions. When the context is carefully studied both before and after the implementation of an intervention, researchers will be better able to identify the anticipated and unanticipated challenges students face that may dampen or amplify intervention effects. This will enable researchers to better understand and learn from results that are weaker or stronger than expected. In other words, researchers can plan for the possibility that situational factors can increase or decrease the effects of an intervention in unexpected ways, and careful attention to this possibility in design and measurement can provide opportunities to advance theory on the basis of unanticipated outcomes.

Our framework focuses on how intervention effects on proximal educational outcomes (e.g., course performance) interact with other factors within and outside of the individual, and how interventions can cause lasting changes within students that prepare them for a variety of situations. By accounting for the ways in which students may be affected by social and institutional factors, this framework can aid understanding of how the long-term effects of interventions may be influenced by changing circumstances. Thus, the framework is well suited to help researchers develop more specific hypotheses about the processes by which intervention effects will unfold over time, design intervention studies that will measure (and therefore more directly test) these hypothesized processes, and ultimately contribute to a more precise understanding of how interventions can impact students’ lives far into the future. Given a good understanding of a particular context, researchers may be able to anticipate how intervention effects on a proximal variable will interact over time with other

variables through recursive processes and non-recursive chains of effects, and thus design more effective interventions with long-term impacts. In addition, researchers may be able to capitalize on latent intrapersonal effects to prepare students for known challenges that will occur later in time, or to cope adaptively with the changes and uncertainties that increasingly define the educational experience. For instance, researchers may choose which intervention to implement based on the types of skills students will need to face anticipated challenges (e.g., implementing a VA intervention in a context in which underrepresented students may face increased levels of stereotype threat).

Conclusion

Application of this framework may improve the clarity of communication between intervention scientists and foster a mutual understanding of the mechanisms underlying long-term effects of motivation interventions. It may also guide the development of interventions intended to produce long-term effects and measures to document the processes explaining these effects. Interventions can affect outcomes years after implementation, and with careful design, they may help students not only to cope with the specific challenges and uncertainties that exist in the world today, but also the new sets of challenges that will arise in the distant future. Of course, intervention effects may also decay when mitigated by unpredicted changes in the social or institutional structure, but thoughtful attention to long-term processes can help researchers to reduce this likelihood and increase the probability of sustained or even amplified effects.

By applying a common theory to understand long-term intervention effects, the community of intervention scientists can better understand the complex processes through which intervention effects are perpetuated and amplified over time. Improved understanding of these processes can lead to more nuanced theory development, improvement of intervention design, and increased precision in testing for long-term intervention impacts. All of these benefits will ultimately allow educational intervention researchers to better accomplish their goal of using basic psychological research and theory to improve students' lifelong trajectories.

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References

- Aronson J, Fried CB, & 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
- Borman GD, Grigg J, & Hanselman P (2016). An effort to close achievement gaps at scale through self-affirmation. *Educational Evaluation and Policy Analysis*, 38, 21–42. doi: 10.3102/0162373715581709

- Bowen NK, Wegmann KM, & Webber KC (2013). Enhancing a brief writing intervention to combat stereotype threat among middle-school students. *Journal of Educational Psychology*, 105, 427–435. doi: 10.1037/a0031177
- Brady ST, Reeves SL, Garcia J, Purdie-Vaughns V, Cook JE, Taborsky-Barba S, ... Cohen GL (2016). The psychology of the affirmed learner: Spontaneous self-affirmation in the face of stress. *Journal of Educational Psychology*, 108, 353–373. doi: 10.1037/edu0000091
- Canning EA, Harackiewicz JM, Priniski SJ, Hecht CA, Tibbetts Y, & Hyde JS (2018). Improving performance and retention in introductory biology with a utility-value intervention. *Journal of Educational Psychology*, 110, 834–849. doi: 10.1037/edu0000244 [PubMed: 30294006]
- Chubin DE, May GS, & Babco EL (2005). Diversifying the engineering workforce. *Journal of Engineering Education*, 94, 73–86. doi: 10.1002/j.2168-9830.2005.tb00830.x
- Cohen GL, 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 [PubMed: 16946074]
- Cohen GL, 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 [PubMed: 19372432]
- Cohen GL, & Sherman DK (2014). The psychology of change: Self-affirmation and social psychological intervention. *Annual Review of Psychology*, 65, 333–371. doi: 10.1146/annurev-psych-010213-115137
- Cook JE, Purdie-Vaughns V, Garcia J, & Cohen GL (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 [PubMed: 22082058]
- Dee TS (2015). Social identity and achievement gaps: Evidence from an affirmation intervention. *Journal of Research on Educational Effectiveness*, 8, 149–168.
- Eccles JS, Adler TF, Futterman R, Goff SB, Kaczala CM, Meece JL, & Midgley C (1983). Expectancies, values, and academic behaviors In Spence JT (Ed.), *Achievement and achievement motivation* (pp. 74–146). San Francisco, CA: W. H. Freeman.
- Eccles JS, & Wigfield A (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, 53, 109–132. doi: 10.1146/annurev.psych.53.100901
- Goyer JP, Garcia J, Purdie-Vaughns V, Binning KR, Cook JE, Reeves SL, ... Cohen GL (2017). Self-affirmation facilitates minority middle schoolers' progress along college trajectories. *Proceedings of the National Academy of Sciences*, 114, 7594–7599. doi: 10.1073/pnas.1617923114
- Hanselman P, Bruch SK, Gamoran A, & Borman GD (2014). Threat in context: School moderation of the impact of social identity threat on racial/ethnic achievement gaps. *Sociology of Education*, 87, 106–124. doi: 10.1177/0038040714525970
- Harackiewicz JM, Canning EA, Tibbetts Y, Giffen CJ, Blair SS, Rouse DI, & Hyde JS (2014). Closing the social class achievement gap for first-generation students in undergraduate biology. *Journal of Educational Psychology*, 106, 375–389. doi: 10.1037/a0034679 [PubMed: 25049437]
- Harackiewicz JM, Canning EA, Tibbetts Y, Priniski SJ, & Hyde JS (2016). Closing achievement gaps with a utility-value intervention: Disentangling race and social class. *Journal of Personality and Social Psychology*, 111, 745–765. doi: 10.1037/pspp0000075 [PubMed: 26524001]
- Harackiewicz JM & Priniski SJ (2018). Improving student outcomes in higher education: The science of targeted intervention. *Annual Review of Psychology*, 69, 409–435. doi: 10.1146/annurev-psych-122216-011725
- Harackiewicz JM, Rozek CS, Hulleman CS, & Hyde JS (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science*, 23, 899–906. doi: 10.1177/0956797611435530 [PubMed: 22760887]
- Hecht CA, Harackiewicz JM, Priniski SJ, Canning EA, Tibbetts Y, Hyde JS (2018). Promoting persistence in the biological and medical sciences: An expectancy-value approach to intervention. (Manuscript under review).
- Higgins ET, & Rholes WS (1978). "Saying is believing": Effects of message modification on memory and liking for the person described. *Journal of Experimental Social Psychology*, 14, 363–378. doi: 10.1016/0022-1031(78)90032-X

- Hulleman CS, & Harackiewicz JM (2009). Promoting interest and performance in high school science classes. *Science*, 326, 1410–1412. doi: 10.1126/science.1177067 [PubMed: 19965759]
- Hulleman CS, Kosovich JJ, Barron KE, & Daniel DB (2017). Making connections: Replicating and extending the utility value intervention in the classroom. *Journal of Educational Psychology*, 109, 387–404. doi: 10.1037/edu0000146
- Jacobs JE, Lanza S, Osgood DW, Eccles JS, & Wigfield A (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development*, 73, 509–527. doi: 10.1111/1467-8624.00421 [PubMed: 11949906]
- Lazowski RA, & Hulleman CS (2016). Motivation interventions in education: A meta-analytic review. *Review of Educational Research*, 86, 602–640. doi: 10.3102/0034654315617832
- Miyake A, Kost-Smith L, Finkelstein ND, Pollock SJ, Cohen GL, & Ito TA (2010). Reducing the gender achievement gap in college science: A classroom study of values affirmation. *Science*, 330, 1234–1237. doi: 10.1126/science.1195996 [PubMed: 21109670]
- National Science Board (2014). Science and engineering indicators 2014 (NSB 14–01). Arlington, VA: National Science Foundation Retrieved from <https://www.nsf.gov/statistics/seind14/>
- Rozek CS, Svoboda RC, Harackiewicz JM, Hulleman CS, & Hyde JS (2017). Utility-value intervention with parents increases students' STEM preparation and career pursuit. *Proceedings of the National Academy of Sciences*, 114, 909–914. doi: 10.1073/pnas.1607386114
- Sherman DK, Hartson KA, Binning KR, Purdie-Vaughns V, Garcia J, Taborsky-Barba S, ... Cohen GL (2013). Deflecting the trajectory and changing the narrative: How self-affirmation affects academic performance and motivation under identity threat. *Journal of Personality and Social Psychology*, 104, 591–618. doi: 10.1037/a0031495 [PubMed: 23397969]
- Spencer SJ, Steele CM, & Quinn DM (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, 35, 4–28. doi: 10.1006/jesp.1998.1373
- Steele CM, & Aronson J (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69, 797–811. doi: 10.1037/0022-3514.69.5.797 [PubMed: 7473032]
- Tibbetts Y, Harackiewicz JM, Canning EA, Boston JS, Priniski SJ, & Hyde JS (2016). Affirming independence: Exploring mechanisms underlying a values affirmation intervention for first-generation students. *Journal of Personality and Social Psychology*, 110, 635–659. doi: 10.1037/pspa0000049 [PubMed: 27176770]
- Walton GM, & Cohen GL (2007). A question of belonging: Race, social fit, and achievement. *Journal of Personality and Social Psychology*, 92, 82–96. doi: 10.1037/0022-3514.92.1.82 [PubMed: 17201544]
- Walton GM, & Cohen GL (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, 331, 1447–1451. doi: 10.1126/science.1198364 [PubMed: 21415354]
- Walton GM, & Wilson TD (2018). Wise interventions: Psychological remedies for social and personal problems. *Psychological Review*, 125, 617–655. doi: 10.1037/rev0000115 [PubMed: 30299141]
- Wilson TD (2011). *Redirect: The Surprising New Science of Psychological Change*. New York: Little Brown
- Yeager DS, & Walton GM (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, 81, 267–301. doi:10.3102/0034654311405999
- Yeager DS, Walton GM, Brady ST, Akcinar EN, Paunesku D, Keane L, ... Dweck CS (2016). Teaching a lay theory before college narrows achievement gaps at scale. *Proceedings of the National Academy of Sciences*, 113, E3341–E3348. doi: 10.1073/pnas.1524360113

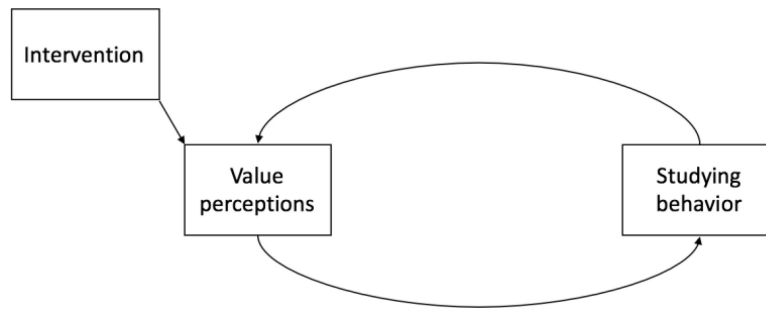


Figure 1.

Example of how an intervention can initiate a *recursive process*. The intervention increases a student's valuation of course material, increasing the amount of time they spend studying the material, which further increases their value perceptions, and so on, creating a positive feedback loop.

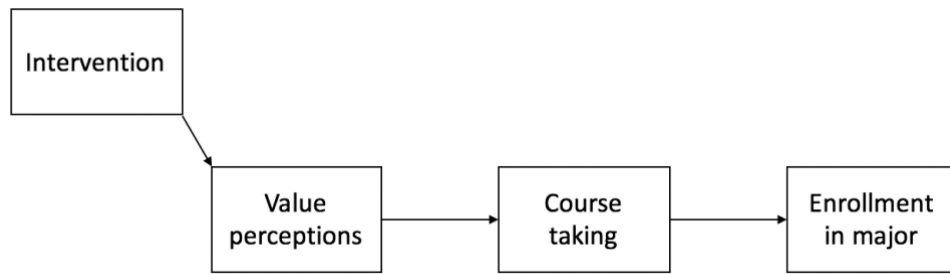


Figure 2.

Example of how an intervention can initiate a *non-recursive chain of effects*. The intervention increases a student's value in a field, leading them to take additional courses in the field, and thereby increasing their likelihood of enrolling in a major in that domain.

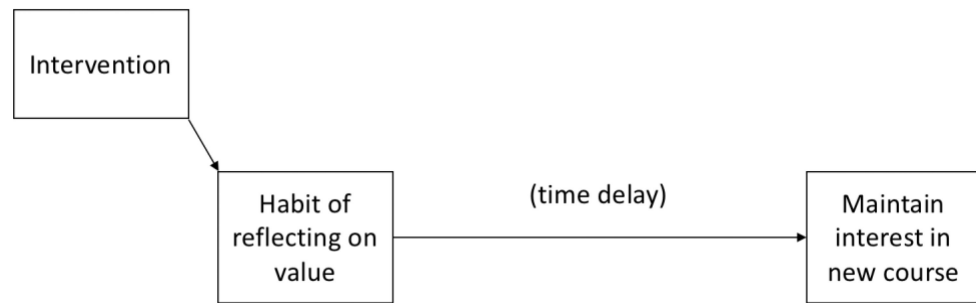


Figure 3.

Example of how an intervention can create a *latent intrapersonal effect*, which exerts an influence later in time. The intervention teaches the habit of reflecting on the value of course material, which helps students maintain interest when they encounter a new topic or course later in time.

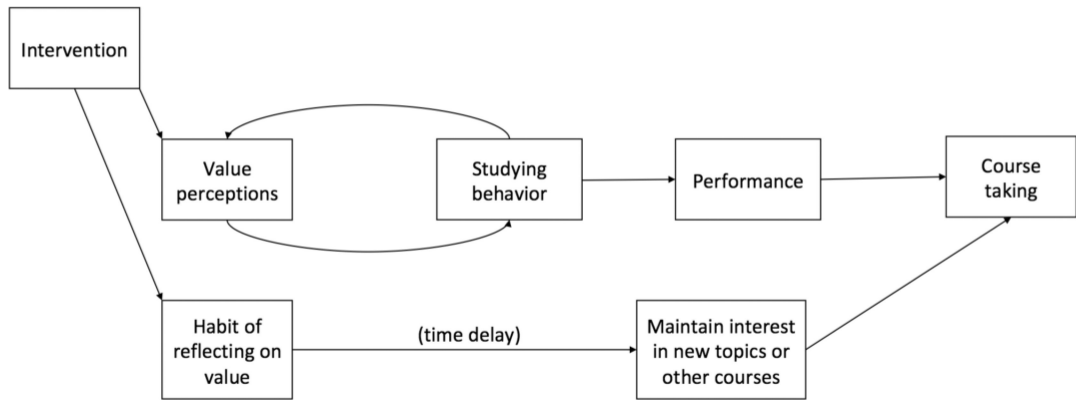


Figure 4. Example of how an intervention can work through multiple processes over time.