Theoretical and methodological directions in mindset intervention research

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Abstract
Growth mindset interventions directed at students aim to change students’ beliefs about the malleability of ability. These interventions have had mixed results, with some showing impressive findings (e.g., improving grades and persistence in science and closing performance gaps), while other implementations have shown null findings. This heterogeneity suggests that growth mindset interventions should not be viewed as a sole solution for improving educational outcomes for students and that further research is needed to identify the contextual factors that influence their effectiveness. We propose new theoretical directions in mindset research that adopts an anti-deficit model and moves away from focusing exclusively on students and their belief systems. Instead, we encourage a new wave of mindset research that considers the institutional, cultural, and contextual environment that either corroborates or negates students’ mindset beliefs. We propose a new approach to mindset research that emphasizes innovative approaches to better understand the conditions under which mindset interventions are effective.

KEYWORDS
applied psychology, educational psychology, intelligence, intrapersonal processes, motivation, psychology, social psychology and personality
Mindset beliefs, also known as implicit beliefs or lay theories, are beliefs about the fixedness or malleability of human characteristics, such as intelligence or ability (Dweck, 1999). Individuals who hold a fixed mindset believe that the focal characteristic is innate, whereas those with a growth mindset believe that the focal characteristics is malleable and can be developed over time through effort, learning, and applying the right strategies (Dweck, 1999; Dweck & Leggett, 1988). While research has investigated mindset beliefs about a variety of human characteristics, this review will focus on students’ mindset beliefs about their intellectual abilities, which we will refer to as “mindset beliefs” throughout for simplicity. Extensive research has illustrated how mindset beliefs operate as a meaning system that influences the types of goals students set, how they attribute, interpret, and respond to struggles, and whether they seek or avoid challenging tasks and learning opportunities (Dweck, 1999; Dweck & Leggett, 1988; Heine et al., 2001; Hoyert & O’Dell, 2008; Smiley et al., 2016). Mindset beliefs influence students’ social psychological experiences in the classroom. For example, growth mindset beliefs have been positively linked to students’ sense of belonging, level of trust in their instructor, and engagement in the course (Cavanagh et al., 2018; Hoffman et al., 2002). This research has highlighted a ripe opportunity for intervention. By teaching students how to develop a growth mindset, students should, in theory, reap the positive benefits of adopting a growth mindset. Mindset interventions are particularly appealing because they are relatively low-cost to implement and target one of the few factors influencing student academic success that is malleable.

In this paper, we review the literature on mindset interventions directed at students—those that seek to improve student outcomes by nudging students to adopt growth mindset beliefs. Although we narrow our focus exclusively on mindset interventions related to academics, mindset interventions have been used in many other domains to improve outcomes such as mental health, physical health, social functioning, and leadership skills, among others (see Burnette, Billingsley, Banks, et al., 2022; Burnette, Billingsley, & Hoyt, 2022; Walton & Wilson, 2018, for reviews). We highlight the growing uncertainty about the effectiveness of these interventions in education and review the recent literature on how instructors’ mindset beliefs may be one moderator to explain the heterogeneity of effects. We propose new theoretical directions in mindset research that moves away from focusing exclusively on students and their belief systems, and instead, considers the institutional, cultural, and contextual environment that either corroborates or negates these belief systems. We conclude with recommendations for emphasizing methodological approaches that will spark a new agenda for mindset research and advance our understanding of when, why, and for whom mindset interventions are effective.

2 | MINDSET INTERVENTIONS DIRECTED AT STUDENTS

Mindset interventions leverage psychological theory and research to communicate targeted messages at critical time points to shape how students construe their educational experiences (Walton & Wilson, 2018). Mindset interventions typically consist of an online program that teaches students about what a growth mindset is (e.g., reading a scientific article about how the brain is malleable) and rely on “saying-is-believing” writing techniques (e.g., a letter to a future student) to cement the intervention message. Mindset interventions work by targeting and influencing recursive psychological processes (i.e., positive feedback loops) that compound positive effects over time (see Figure 1 for a theoretical process model). Studies investigating the mechanisms through which mindset interventions improve outcomes have found that they can be particularly beneficial for first-generation college students and Persons Excluded due to their Ethnicity and/or Race (PEERs; Asai, 2020; Fink et al., 2018; Paunesku et al., 2015; Walton & Wilson, 2018; Yeager et al., 2016). Mindset interventions can be powerful because students, especially first-generation college students and PEERs, may construe challenges (e.g., poor exam grades) as a sign that they are not “college material,” and reduce their sense of belonging (Canning, LaCosse, et al., 2020). Mindset interventions disrupt these maladaptive construals and suggest an alternative interpretation (i.e., a poor exam grade signals the
need to seek help, rather than signals lack of innate ability). This reconstrual can lead to long-term positive outcomes by increasing engagement (e.g., attending office hours, utilizing course resources), which then reinforces a more adaptive psychological construal (e.g., “I belong here”) and supports better long-term academic trajectories. By providing an adaptive construal—the idea that learning is a process and abilities can improve with effective strategies—mindset interventions interrupt negative cycles and initiate positive ones instead.

Dweck and Yeager (2019) describe in their framework how mindset beliefs operate as a meaning system that influences the types of goals students set (e.g., avoid looking dumb vs. master the material), the attributions students make about failure (failure either reveals low ability or poses a useful learning opportunity), and the beliefs students have about effort (trying hard is either an indicator of low ability or how learning occurs). These goals, attributions, and beliefs about effort then predict challenge-seeking, resilience, and performance. Within this framework, mindset interventions directed at students are designed to shift the meaning system within the individual from one that is maladaptive to one that is adaptive. Our model builds on this individual-level meaning-system by situating this psychological process in the context of other messages students might receive in their environment, such as the mindset messages from their instructor. We also incorporate students' social identities that might be stigmatized in these environments, making external mindset messages more or less effective for some students.

Mindset interventions have been implemented with students of all ages. In one study, a mindset intervention given to incoming first-year undergraduates increased the likelihood that socially or economically disadvantaged students (e.g., PEERs and first-generation college students) would complete their first year of college, and those who did also had improved grades, thus decreasing achievement gaps (Yeager et al., 2016). Follow-up investigations revealed that this intervention yielded these positive effects by increasing students’ engagement, measured by their use of student support services and developing more mentoring relationships (Yeager et al., 2016). Similarly, Aronson et al. (2002) conducted a growth mindset intervention with undergraduates that reduced racial achievement gaps by improving African American students’ GPA. This study also found that students who received the intervention were more academically engaged, measured by their enjoyment of and identification with academics.

It is important to note that despite numerous studies showing promising benefits of mindset interventions, there has been considerable variability in the success of intervention attempts (e.g., Orosz et al., 2017). Recently, meta-analytic researchers have tried to quantify the impact that these interventions have on student outcomes. Sisk et al.’s (2018) meta-analysis of mindset interventions revealed that, among studies conducted with undergraduates (13 independent samples; N = 7871), there was no average effect of mindset interventions ($d = 0.08$, 95% CI $= [-0.02, 0.17]$, $p = 0.123$). However, they found high heterogeneity of effect sizes, suggesting that some implementations of mindset interventions were more successful than others. Similarly, the results of two “dueling” meta-analyses also found that the average effect of growth mindset intervention was close to zero (Burnette, Billingsley, Banks,
et al., 2022; Macnamara & Burgoyne, 2022). However, for at-risk students (e.g., from low socioeconomic backgrounds, underrepresented due to race/ethnicity or gender, or in some cases, students who have low prior test performance), the average effect on academic achievement was moderate, suggesting that mindset interventions may yield disproportionate benefits for some students (Burnette, Billingsley, Banks, et al., 2022; Macnamara & Burgoyne, 2022). These meta-analyses differ in their interpretations of heterogeneity and meta-analytic approaches, resulting in different conclusions about whether mindset intervention “work” or not (see Tipton et al., 2022 for a discussion of the implication of these differential approaches).

Despite the debate about quantifying the true effect size of mindset interventions, it is clear from this literature that encouraging students to adopt a growth mindset **might not be enough on its own** if the environment does not support or reinforce this mindset. For instance, Walton and Yeager (2020) describe a “seed and soil” metaphor, in which interventions are unlikely to be effective if the context in which the intervention in employed does not afford the core tenants of the intervention. In other words, growth mindset interventions will only “take root” in fertile soil, an environment that is supportive of students endorsing a growth mindset. Burnette et al.’s (2022a) Mindset Intervention Effectiveness Model corroborates this notion and points to a dearth of research that examines contextual affordances as a moderator of intervention effectiveness. Thus, research suggests that mindset interventions pose strong potential to address inequity in education (e.g., Yeager et al., 2016), but there remain many open questions about how implementation, measurement, and context affect the efficacy of interventions that must be answered before these techniques can be used reliably in education.

### 3 | INSTRUCTOR MINDSET BELIEFS

Interventions directed at students (i.e., those that aim to change students' belief systems) are not by themselves sufficient to remedy large-scale inequities. Recent calls have emphasized the importance of creating environments that are supportive and inclusive of all students (Asai, 2020). A large-scale, nationally representative, randomly-sampled study of mindset interventions found that interventions for high school students were only effective when the peer norms were supportive of growth mindset, indicating the broad importance of context on intervention success (Yeager et al., 2019). Evidence is growing that mindset messages from instructors can affect students’ experiences both directly and indirectly. Instructors communicate their mindset beliefs in a number of ways (e.g., syllabus, emails, and one-on-one interactions with students). These messages communicate what (e.g., flawless, top performance vs. learning and development) and who (those who are “gifted” vs. “hard working”) are valued in the classroom (Barger, 2019; Canning et al., 2019; LaCosse et al., 2021; Rattan et al., 2018). For example, when instructors make quick judgments of students’ ability and recommend that struggling students drop difficult courses, rather than seek help, they implicitly communicate a fixed mindset (Barger, 2019; Rattan et al., 2012). Messages like these suggest to students that seeking help would be futile without inherent ability and may exacerbate existing inequities (Canning et al., 2019; LaCosse et al., 2021). However, instructors who promote growth mindset messages can reverse these effects and motivate students to seek help when they struggle and approach challenging tasks as learning opportunities (Canning et al., 2019; Rattan et al., 2018).

Canning et al. (2019) conducted a university-wide study, in which they surveyed 150 STEM instructors about their mindset beliefs and linked their responses to over 15,000 students that these instructors taught over a two-year period. The results revealed that students earned higher grades and were more motivated when their STEM instructor endorsed more of a growth mindset, compared to when their STEM instructor endorsed more of a fixed mindset. This was especially true for PEERS; the racial performance gap was cut in half in courses taught by these growth-mindset instructors. Further studies illuminate several potential mechanisms. Instructors with growth mindsets engender greater trust, sense of belonging, and academic engagement and also fewer feelings of being an impostor among their students (Cavanagh et al., 2018; LaCosse et al., 2021; Muenks, Canning et al., 2020; Rattan et al., 2018). Muenks et al. (2020) conducted an experience sampling survey study, in which they surveyed students on their smartphones...
directly after some of their classes to capture their in-the-moment classroom experiences. They found that students who perceived that their instructor endorsed more fixed mindset beliefs experienced greater psychological vulnerability in their classes—specifically, they reported less belonging in class, greater evaluative concerns, and greater imposter feelings in those instructors’ classes, which in turn predict greater dropout intentions, lower class attendance, less class engagement, and lower grades. In one study, a college instructor built trust with their students in part by communicating a growth mindset, which resulted in students becoming more engaged in the course and achieving higher grades (Cavanagh et al., 2018). Another study found that instructor emails containing growth mindset messages increased help-seeking (i.e., attending tutoring sessions) and grades among marginalized STEM students (Covarrubias et al., 2019). This work suggests that it is crucial to understand how instructors can effectively communicate growth mindset messages.

4 | NEW THEORETICAL DIRECTIONS: MOVING AWAY FROM A DEFICIT MODEL OF GROWTH MINDSET

Mindset theory has yielded promising strategies for improving student outcomes by nudging students to adopt growth mindset beliefs. However, if the work on mindset theory is misused or misunderstood, it has the potential to yield unintentional harms by promoting a student-deficit perspective (Valencia, 2010). While mindset interventions can improve equity in student outcomes, they can also promote a perspective that places blame for poor outcomes on students for having the “wrong” beliefs. This deficit model emphasizes “fixing” the student’s belief system and can potentially ignore contextual effects that present barriers to making this belief system realized (Dweck & Yeager, 2019; Patrick & Joshi, 2019; Tewell, 2020). For example, a student who personally endorses a growth mindset may not be able to persist with this mindset if the environment is not supportive of this belief system. This too-narrow focus on students’ personal mindset beliefs fails to acknowledge the complex suite of contextual factors that influence students’ trajectories and outcomes.

An anti-deficit approach to mindset beliefs shifts the focus away from the individual and towards the institutional, societal, and cultural context that they navigate (Valencia, 2010). Many researchers working in mindset theory are shifting towards an anti-deficit approach by bringing attention and focus to the mindset culture of the institution in which students exist (Hecht et al., 2021; see also Burnette et al., 2017, 2019 for an example of compensatory messaging as a solution for blaming the individual). A growing body of work suggests that these contextual messages affect how students respond to interventions (Barger, 2019; Binning, Limeri et al., 2020; Canning et al., 2019; Schmidt et al., 2015; Yeager et al., 2021). Instructor messages may either corroborate student-level intervention messages, thereby enhancing their effect, or function as counter intervention messages, dampening or negating any intervention effect. A recent, large-scale (N > 12,000), double-blind, randomly assigned experiment with a nationally representative sample of high school students showed that an intervention promoting growth mindset among students improved grades and persistence in STEM. Importantly, this benefit was greater in classrooms where the teacher endorsed a growth mindset, thereby enhancing or corroborating the intervention message (Yeager et al., 2021). Another study found that growth mindset interventions were not successful when focused solely on the individual students’ beliefs, but were successful when the interventions framed a growth mindset as the ethos of the university, suggesting that cultural messages shape how students interact with intervention messages (Yeager et al., 2016).

The next generation of mindset research takes an anti-deficit perspective by asking how our institutions and leaders can create environments that allow all students to succeed. Although mindset interventions present exciting potential to improve student outcomes and reduce or eliminate social inequities, research needs to systematically explore the contextual factors that influence when and where interventions are most effective. Along this line, Bryan et al. (2021) call for a “heterogeneity revolution” in which heterogeneous effects are no longer hidden, but instead explicitly leveraged by using a systematic approach to provide a more nuanced understanding of causal
mechanisms. Only when heterogeneity is examined systematically can growth mindset interventions inform policy and widespread adoption.

5 | FUTURE RESEARCH: EMPHASIS ON TESTING INSTRUCTOR-BY- STUDENT INTERACTIONS

Mindset research has capitalized on the strengths of both lab-based and ecological studies conducted in classrooms with students. The lab-based studies have allowed researchers to carefully isolate causal effects with controlled experiments, albeit in hypothetical environments and scenarios. For example, Rattan et al. (2012) asked students to read hypothetical feedback from an instructor and report how receiving that feedback would make them feel. Similarly, Muenks et al. (2020) and LaCosse et al. (2021) presented students with videos of instructors introducing their course using either growth or fixed mindset language and then asked these students to anticipate how they would feel and behave if they were to take the hypothetical course. These studies enable researchers to control for the myriad environmental and contextual factors that would influence how instructor communication actually impacts students, but simultaneously sacrifices the ability to understand whether the way instructors deliver these messages have a similar impact in real-world contexts.

Ecological field studies (i.e., conducted in real classrooms) have shown promising correlational evidence that mindset beliefs and messages from instructors impact real-world student experiences and outcomes (Canning et al., 2019; Yeager et al., 2021). However, these studies often suffer from confounding factors. For example, it could be that growth mindset interventions directed at students are more effective when the teacher also endorses a growth mindset, because teachers who endorse a growth mindset may be more encouraging or positive, use more evidence-based teaching practices, or have more effective classroom management skills, among other characteristics. These confounding characteristics make it difficult to interpret the results of these ecological field studies and make causal conclusions.

An ideal future direction for mindset research would be to conduct an intervention experiment in a real classroom context randomizing students to receive growth mindset messages from their instructor. Randomization at the student-level—such that within a class section, one student receives growth mindset communication from their instructor, whereas their classmate receives control communication from their instructor—will allow researchers to control for instructor-level confounding characteristics, such as their personality, teaching style, and pre-existing mindset beliefs, and section-level confounding variables, such as day/time and variation in student characteristics. This type of research design would provide more power to detect effects and determine causality than most of the current research, which typically use different sections, instructors, or terms as control groups.

Using this methodology, Canning et al. (in preparation) randomly assigned all students in a college biology course (N = 417) to receive an email from their instructor after each exam containing either a growth mindset message (e.g., "I believe that every student can improve their skills, learn from their mistakes, and be successful in this course. Remember learning is a process and occurs over time.") or a control message with generic encouragement ("Happy to meet during office hours or at another time to discuss this with you."). They found that growth mindset messages from the instructor improved grades in the class for all students, on average, compared to students who received the control messages, $\eta_p^2 = 0.011$. They also found a significant interaction between condition and generational status, $\eta_p^2 = 0.009$, indicating that the growth mindset messages were more beneficial for first-generation college students (i.e., those for whom neither parent/guardian obtained a bachelor’s degree), compared to continuing-generation college students (i.e., students who have at least one parent/guardian who obtained a bachelor’s degree). In the control condition, continuing-generation students, on average, significantly outperformed first-generation students, earning 0.74 grade points higher in the course on a 4.0 scale. However, in the growth mindset condition this gap in performance between continuing-generation and first-generation students was not significantly different, with continuing-generation students, on average, earning only 0.33 grade points higher in the course. Importantly, these
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effects held even when controlling for students’ own personal mindset beliefs. This preliminary study combines the strengths of lab-based experiments that can be well-controlled with the strengths of ecological field studies which provide insight into real-world impacts of such messaging.

Combining this approach with growth mindset interventions directed at students should reveal how contextual messages impact the efficacy and heterogeneity of mindset interventions. In future research, it will be imperative to test instructor-by-student mindset interactions using random assignment, so that causal effects in real-world contexts can be established within this literature. Given the previous correlational work in this area (Canning et al., 2019; Yeager et al., 2021), we hypothesize that there will be an interaction between these two interventions, such that students who are taught to develop a personal growth mindset and receive growth mindset messages from their instructor should experience more favorable outcomes than students who receive only the mindset intervention directed at students or only receive instructor growth mindset messages (see Figure 1). Both interventions may be needed to increase the efficacy of mindset research in field settings.

6 | FUTURE RESEARCH: EMPHASIS ON MEASURING MINDSET BELIEFS

The success of mindset interventions hinges on their ability to persuade participants to shift their mindsets. Manipulation checks are an important part of experimental design with interventions to ensure that the intervention is eliciting the desired effect (i.e., shift towards growth mindset) in the participants. Yet, a recent meta-analysis revealed that nearly half (46%) of mindset interventions that measured mindsets before and after the intervention failed to shift students’ mindsets (Sisk et al., 2018). This implies that some mindset interventions may fail to produce measurable improvements because they were not effective in convincing students to adopt growth mindset beliefs.

Without an effective manipulation check, null results could either be due to ineffective intervention design or the construct being intervened on (i.e., growth mindset) being disconnected from the desired outcomes (e.g., improved grades and retention). It could be that previous attempts to shift mindset beliefs were ineffective because the measurement of mindset beliefs was unreliable. Indeed, Burnette, Billingsley, Banks, et al. (2022) found in their meta-analysis that the effect of mindset interventions was largest for the most proximal outcomes (i.e., mindset beliefs), compared to more distal outcomes (i.e., grades). Thus, effectively and reliably measuring students’ mindset beliefs is critical to the advancement of mindset research.

Carol Dweck developed the first and most commonly-used measure of mindset, the Implicit Theories of Intelligence Scale (ITIS; Dweck, 1999). The ITIS was designed to be context-general and used to study mindset in a wide variety of contexts. However, interviews with chemistry undergraduates revealed that the measure did not work consistently with this population because they interpret “intelligence,” a key referent in every item of the ITIS, in varied ways (Limeri et al., 2022). To address this issue, Limeri et al. (2020) developed and collected strong validity evidence for a new measure of undergraduates’ mindset beliefs, the Undergraduate Lay Theories of Abilities (ULTRA) measure (Limeri, unpublished: https://psyarxiv.com/u7nvd/). The development process integrated four data-sets providing multiple sources of evidence of validity. First, interviews with 45 undergraduates enrolled in science and math courses focused on identifying language to be used in new survey items, providing evidence of validity based on response process. Then, items were drafted and checked again for evidence of validity based on response process through cognitive interviews with 29 undergraduates. The items were also reviewed for alignment to theory by 11 experts who actively research lay theories, providing evidence of validity based on content. The items were then administered to a sample of undergraduates (n = 1194 at 68 institutions) which demographically matched the population of undergraduates in the United States on a variety of characteristics (e.g., gender, race/ethnicity, type of institution attended, generation in college). Analyses of these data supported the expected factor structure, providing evidence of validity based on internal structure, and also evidence that the measure functions equivalently across a variety of demographic groups (e.g., gender, race/ethnicity, generation in college, type of institution attended, disability status). Finally, the measure was administered to a second sample (n = 1396) along with measures of outcomes (e.g.,
sense of belonging, course grades, and persistence), demonstrating that mindset related to outcomes as expected, providing evidence of validity based on relations to other variables. This new measure will enable researchers to more accurately and reliably evaluate whether interventions actually shift undergraduates’ mindset beliefs.

7 | CONCLUSION

Although successful growth mindset interventions have yielded impressive outcomes (e.g., increasing grades and persistence in science and closing performance gaps), there has been considerable variability in their success. This indicates that (1) growth mindset interventions directed at students should not be considered a magic bullet on their own and (2) research is needed to clarify the contextual factors that influence intervention effectiveness. To reach these goals, we encourage a new wave of mindset research that adopts an anti-deficit model of belief systems and uses rigorous methodology to advance our causal understanding of when and why mindset interventions are effective.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were generated or analyzed for the purposes of this manuscript.

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