

Exploring Effects of Mixed Mindset Messages From Science, Technology, Engineering, and Mathematics Instructors

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Instructors who create growth mindset cultures by communicating that students' abilities can improve can reduce their students' anxiety and increase their belonging and motivation, resulting in higher performance. However, in real college classrooms, it is unlikely that instructors ever perfectly communicate a growth mindset or a fixed mindset; rather, their messages may be mixed. Across three studies ($N = 1,312$), we find that undergraduate science, technology, engineering, and mathematics students who encounter mixed mindset messages anticipate worse motivational and psychological outcomes than students who encounter "pure" growth mindset messages (Studies 1–2) and, often, than students who encounter no mindset messages at all (Study 2). Further, as the fixed mindset components in a message increase, students' outcomes steadily deteriorate, until reaching a saturation point of approximately 75% fixed mindset messages (Study 3). These findings underscore the importance of instructors sending clear growth mindset messages and avoiding fixed or mixed ones.

Keywords: mindset, instructors, science, technology, engineering, and mathematics, mixed, messages

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Recent experimental and field research has found that instructor mindsets about intelligence predict students' experiences in their science, technology, engineering, and mathematics (STEM) courses and their academic outcomes (e.g., Canning et al., 2019, 2022; Fuesting et al., 2019; LaCosse et al., 2021; Muenks et al., 2020, 2021; Rissanen et al., 2019; Schmidt et al., 2015; Sun, 2018). When instructors endorse or communicate a growth mindset (i.e., believing intelligence can grow), their students have more positive psychological experiences, feel more comfortable seeking help, are more motivated and engaged, and achieve higher grades, than when instructors endorse or communicate a fixed mindset (i.e., believing intelligence is fixed). The traditional takeaway from these studies is that to create motivationally supportive environments, instructors should convey a growth mindset to their students. However, despite good intentions

to communicate a "pure" growth mindset, instructors often send mixed mindset messages (e.g., Barger et al., 2022; Hecht et al., 2022; Zhang et al., 2020, 2024), wherein growth and fixed mindset beliefs are simultaneously communicated. As an example, consider a teacher who says: "You were born to be successful!" which implies that success is due to innate ability (fixed mindset), but then follows it up with: "You practiced a lot and it can be seen in this result!" which implies that hard work can improve ability (growth mindset; Zhang et al., 2020). Though researchers have found that these mixed messages are prevalent (e.g., Barger et al., 2022; Hecht et al., 2022; Zhang et al., 2020, 2024), we know little about how these mixed messages are actually perceived by students and what the impacts are on students' motivational and academic outcomes.

Instructors' Growth and Fixed Mindset Messages Impact Students' Outcomes

According to Dweck's (1999) mindset theory, people hold different mindsets about the nature of intelligence, typically categorized as either a "growth mindset" (the belief that intelligence is malleable and can be developed) or a "fixed mindset" (the belief that intelligence is static and unchanging; see Dweck, 2024, for review). Recent conceptualizations, however, emphasize that these mindsets are not dichotomous and static (a common misconception) but exist on a continuum, with individuals often shifting between these two mindsets (e.g., Murphy, 2024). In some situations, individuals may adopt more of a growth mindset, in others, more of a fixed mindset, or even some combination of the two (e.g., Keating & Heslin, 2024).

In the earliest studies of mindset, researchers tended to examine mindset at the level of individual students (Blackwell et al., 2007; Dweck & Leggett, 1988; Hong et al., 1999). At this individual

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level, research finds that students with stronger growth (vs. fixed) mindsets tend to have more adaptive cognitions, emotions, and behaviors—particularly in the face of challenges or obstacles—which leads to higher motivation and achievement overall (see Dweck & Yeager, 2019, for review; but also see Macnamara & Burgoyne, 2023, for criticisms of mindset theory as it pertains to individuals). However, mindset has not only been conceptualized at the individual level, but at the context level as well. That is, in addition to the individual mindsets students bring into the classroom, there is also a mindset culture in the classroom itself that uniquely impacts students' cognitions, emotions, and behaviors (see Murphy et al., 2021). In the classroom setting, Murphy et al. (2021) conceptualize the mindset culture as including instructors' beliefs (i.e., mindsets), instructors' behaviors (i.e., practices), and students' perceptions and experiences of the culture (Canning & Limeri, 2023; Hecht, Bryan, & Yeager, 2023; Hecht, Murphy, et al., 2023). According to this framework, mindset cultures can impact students' motivation to learn, psychological safety, effort/persistence, and performance.

Researchers have found that STEM instructors' mindsets, whether measured directly (Canning et al., 2019; Heyder & Brunner, 2018; Heyder et al., 2020; Yeager et al., 2022) or as perceived by students (Canning et al., 2022; Covarrubias et al., 2019; Fuesting et al., 2019; Hecht et al., 2022; Kroeper et al., 2024; LaCosse et al., 2021; Muenks et al., 2020, 2021; Rattan et al., 2018), have unique impacts on students' outcomes, even taking into account students' own mindsets. For example, Muenks et al. (2020) found that when students perceived their STEM instructors to have stronger fixed (vs. growth) mindsets, they reported feeling greater psychological vulnerability, including higher concerns about being negatively evaluated, higher impostor feelings, higher negative affect, and a lower sense of belonging, in those instructors' classes. These experiences of psychological vulnerability, in turn, were associated with downstream outcomes including lower interest in the instructor's field and lower achievement.

This body of work, which includes both experimental and nonexperimental studies (see Murphy et al., 2021, for review), has demonstrated that the mindsets that instructors communicate to students are important predictors of students' psychological experiences, motivation, and achievement.

Challenges of Communicating Growth Mindset Messages in Real Classroom Settings (and How Unintended Fixed Messages Can Creep in)

Instructors seldom (if ever) openly declare their mindset beliefs in class, whether they support a growth mindset ("I have a growth mindset, so I believe your intelligence can grow") or a fixed mindset ("I have a fixed mindset, so I believe your intelligence cannot grow"). Nevertheless, students still form impressions of their instructors' mindset beliefs (Kroeper, Muenks, et al., 2022; Lou & Noels, 2020; Muenks et al., 2021). Given the importance of instructors' mindsets for students' outcomes, it is critical to understand how instructors communicate growth versus fixed mindsets to their students (Murphy et al., 2021). So, what are the messages, behaviors, and practices that signal to students their instructors' beliefs? Several studies have explored this by interviewing instructors about their practices (DeLuca et al., 2019; French, 2019; Geist, 2021) or observing instructors in real-world classrooms (Rissanen

et al., 2019; Sun, 2018), identifying a number of practices common among instructors with fixed or growth mindsets.

Particularly relevant to the current study, Kroeper, Muenks, et al. (2022, Study 1), using focus groups, asked undergraduate students what made them think that their instructors had fixed or growth mindsets. They found that students said that instructors communicated their mindsets via explicit messages about progress and success; opportunities for practice and feedback; instructors' responses to poor performance; and placing value on student learning and development. These categories were further validated using quantitative analyses with new student samples (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022, Study 2). This work demonstrated that students could tell what their instructors believed about intelligence—whether it can grow or not—just from their words and actions, without needing their instructor to directly declare their mindset beliefs.

“Mixed” Mindset Messages

Since instructors, like everyone else, can dynamically shift between growth and fixed mindset beliefs (Keating & Heslin, 2024), and because students then imperfectly infer their instructors' mindsets from instructor words, behavior, and practices (e.g., Kroeper, Muenks, et al., 2022)—rather than from clear mindset declarations—there is ample room for misunderstandings and conflicting messages. Indeed, there is often misalignment between what instructors say they believe, what instructors say they do, and what students perceive that instructors do in the classroom (e.g., Muenks, 2024). Although in an ideal world, instructors would always communicate motivationally supportive growth mindsets to their students, it is commonly the case that the messages instructors send in real-world academic contexts are more mixed (Hecht et al., 2022; Zhang et al., 2024).

Reasons Instructors Convey “Mixed” Mindset Messages

Why might instructors communicate a mixture of fixed and growth mindset messages simultaneously? Much psychological research has shown that it is quite common for people to hold inconsistent or incoherent beliefs (diSessa et al., 2004) and that vague and ambiguous actions are common in many different interpersonal contexts (e.g., Molden & Higgins, 2004). Some of these mixed messages may therefore arise due to instructors holding inconsistent beliefs (Keating & Heslin, 2024) and/or misunderstanding what a growth mindset means—for example, equating a growth mindset with an overwhelmingly positive attitude (Patrick & Joshi, 2019) or believing that anyone can succeed with hard work alone (Buttrick, 2020; Schuetze, 2022). Other instructors may understand the growth mindset concept and feel social and/or cultural pressure to publicly endorse it (Zhang et al., 2024) but remain unconvinced by the research supporting it (Pelletier et al., 2020). Another reason for these mixed messages may be a lack of correspondence between beliefs (as reported in one context) and behaviors (in a different context). Indeed, recent conceptualizations of mindset have suggested that all individuals hold both growth and fixed mindsets, and where one falls on the continuum of these beliefs at any given moment can be triggered by environmental cues (Murphy, 2024). This may lead instructors to report having a growth mindset under one set of conditions, but then act in ways that are inconsistent

with that belief under a different set of conditions (e.g., Barger et al., 2022; Sun, 2019; Yettick et al., 2016; Zhang et al., 2024).

Understanding the Effects of Combining Fixed and Growth Messages

In all sorts of interactions, people are motivated to understand others' behavior (Berger & Calabrese, 1974), particularly when it is vague or ambiguous. This may especially be the case when trying to understand the behavior of a person who holds power (Ebenbach & Keltner, 1998; Galinsky et al., 2006), such as a student trying to understand how instructors' behaviors in a classroom may communicate their beliefs about intelligence or ability. Preliminary correlational research suggests that perceiving mixed mindset messages leads to negative consequences for students, such as lower grades (Buttrick, 2020). However, no research to our knowledge has experimentally explored the effects of instructor mixed mindset messages as compared to "pure" growth messages, pure fixed messages, or no mindset messages. As discussed above, much research has shown that pure growth mindset messages lead to better outcomes than pure fixed mindset messages (Canning et al., 2022; Covarrubias et al., 2019; Fuesting et al., 2019; Hecht et al., 2022; Kroeper et al., 2024; LaCosse et al., 2021; Muenks et al., 2020, 2021; Rattan et al., 2018). However, psychological theory offers multiple theoretical frameworks that could explain whether and how mixed messages will differ (or not) from pure mindset messages or no mindset messages.

First, in line with theories that propose that "uncertainty is bad" because ambiguous messages decrease one's cognitive resources and increase one's psychological distress (e.g., Major et al., 2003; Salvatore & Shelton, 2007), one might expect that mixed mindset messages could have worse impacts on student outcomes than pure fixed mindset messages. That is, it may be less cognitively demanding and/or distressing for students to be given clearer messages—even if they are "bad"—than to be given messages that are unclear. On the other hand, it is also possible that, in line with research suggesting that "bad is stronger than good" (Baumeister et al., 2001), students will be most attentive to fixed mindset messages. This would lead one to expect that students' outcomes would increasingly worsen as the number of fixed mindset messages increase, meaning that pure fixed mindset messages lead to the worst outcomes for students.

We also compare mixed mindset messages to no mindset messages in Studies 1 and 2. The no mindset messages condition is likely to be something students encounter in real life—that is, some instructors may simply provide very few messages that communicate their mindset, or, because they fear unintentionally sending fixed mindset messages, they may choose to say nothing about student ability or potential at all. If students perceive no mindset messages and mixed messages as equally unclear, then we may expect that no mindset messages will have similar effects to mixed messages because "uncertainty is bad" (Salvatore & Shelton, 2007). On the other hand, since mixed messages include fixed components (whereas no mindset messages do not), we may also expect that mixed mindset messages could lead to worse outcomes than no mindset messages because "bad is stronger than good" (Baumeister et al., 2001).

The Present Studies

In the present studies, we experimentally investigate the impact of mixed mindset messages (i.e., messages communicating both

growth and fixed mindsets simultaneously) on undergraduate students' perceptions of their instructors, as well as their anticipated motivation, psychological experiences, behavior, and performance. We chose this set of dependent variables using the Murphy et al. (2021) framework that proposes that (a) teachers' practices impact students' perceptions of instructors and (b) growth mindset cultures impact student motivation to learn, psychological safety, effort/persistence, and performance. These outcomes have also been linked with instructor mindsets in prior experimental and nonexperimental work (Kroeper et al., 2024; LaCosse et al., 2021; Muenks et al., 2020; White et al., 2024). In all three studies, we manipulated instructor messages using hypothetical emails that professors sent after a first exam (e.g., Canning et al., 2024; Carrell & Kurlaender, 2023; Covarrubias et al., 2019).

In Study 1, we compared three message conditions: mixed mindset, "pure" growth mindset, and no mindset messages. Consistent with prior research (Buttrick, 2020; Fuesting et al., 2019; LaCosse et al., 2021; Muenks et al., 2020), we hypothesized that pure growth mindset messages would lead to more positive motivational and psychological outcomes compared to no mindset messages and mixed mindset messages. However, we chose not to formulate a directional hypothesis about whether mixed messages would lead to more positive outcomes than no mindset messages because the literature offers several possible theoretical explanations. The "bad is stronger than good" theory (Baumeister et al., 2001) would suggest that mixed messages would lead to worse outcomes than no mindset messages, whereas the "uncertainty is bad" theory (Salvatore & Shelton, 2007) would suggest that mixed messages and no mindset messages would lead to similar outcomes, assuming each are perceived as unclear.

Study 2 replicated and extended Study 1 by adding a pure fixed mindset message condition, thus completing a 2 (growth messages: present vs. absent) \times 2 (fixed messages: present vs. absent) design. This design enabled comparisons across all four conditions, including a direct comparison of mixed messages and pure fixed messages. Again, we hypothesized that the pure growth condition would have the best outcomes, but we chose not to formulate directional hypotheses about how the other three conditions would differ from each other. The "bad is stronger than good" theory (Baumeister et al., 2001) would suggest that the pure fixed condition would have the worst outcomes, followed by the mixed condition, and then the no mindset messages condition; whereas the "uncertainty is bad" theory (Salvatore & Shelton, 2007) would suggest that mixed messages and no mindset messages may lead to similar, and worse, outcomes than the pure fixed condition.

Finally, in Study 3, we took an even more granular approach by manipulating the proportion of fixed (vs. growth) mindset components in mixed messages (0%, 25%, 50%, 75%, or 100%). This design enabled us to explore how the dosage of fixed mindset components in mixed messages impacts students' outcomes, including whether even a single fixed mindset message has a negative impact.

Development of Stimuli

When developing the stimuli for all three experiments, we were careful to balance theoretical consistency, ecological validity, and experimental control. Although we designed controlled experiments to more precisely establish causal effects, we also closely aligned the experimental conditions with contexts, behaviors, and messages that are common in real college classrooms. Several considerations

guided our decisions. First, we chose to manipulate emails from a hypothetical professor after the first exam, as the first exam is often a motivationally significant time in the semester (Benden & Lauermann, 2022). This is often the first clear indicator to students of how well they are doing in the course and can be upsetting if students did not do as well as they expected or hoped. Students also make important decisions about whether or not to drop a course after the first exam. Thus, this would be a time in which professor mindset messages would likely be salient to students. Indeed, prior field experiments have found that emails from faculty sent at this time can support student motivation, increase positive perceptions of professors, and improve performance—especially for underrepresented minority students, first-generation students, and those in their first year of college (e.g., Canning et al., 2024; Carrell & Kurlaender, 2023). Second, an email is a clear and direct way to communicate mindset messages, allowing us to control the content of each specific sentence. This gave us more experimental control than trying to manipulate other aspects of a professor's behavior (e.g., what they say or do in class). Third, emails are something relatively easy that professors can change in their own practice and do not require a large amount of time or resources. Thus, we hoped that the results from this study could be easily translated to practice. See below in the Method sections for more specific details about how we designed the content of the emails for each study.

Study 1

In Study 1, which served as a proof-of-concept study that helped build the foundation for subsequent studies, we examined how mixed mindset messages impact undergraduate STEM students' perceptions of their professor, anticipated motivation, anticipated fear of help-seeking, and performance expectancies as compared to pure growth mindset messages and no mindset messages.

Method

Participants and Procedure

We conducted a power analysis using G*Power 3.1 (Faul et al., 2007) which indicated that for a one-way, three-group analysis of variance (ANOVA) design with 80% power and $\alpha = .05$, we would need 246 participants to detect a medium effect size of $f = .20$. Participants were 281 undergraduate students from a large, public university in the southwest United States ($M_{\text{age}} = 20.28$; 71.5% female, 27.0% male, 1.4% nonbinary; 40.1% Asian, 31.2% White, 14.0% Multiracial, 7.2% Latinx, 3.6% Middle Eastern or North African, 3.2% Black, 0.4% American Indian or Alaskan Native, 0.4% Native Hawaiian or Pacific Islander) who were recruited from a biochemistry course (participants made up 84% of the total course enrollment).

After completing the consent form, participants completed an online survey using the Qualtrics survey platform, including the experimental manipulation described below, for extra credit in the middle of the Fall 2020 semester. We did not include an attention check. We obtained Institutional Review Board approval for all studies prior to data collection. All participants were included in the analyses, although degrees of freedom vary slightly due to a small amount of missing data on some variables.

Materials

Manipulation of Professor Mindset. Participants were asked to imagine a hypothetical scenario in which a professor in one of their biochemistry classes sent an email to all students in the class directly after posting grades from the first exam, and then answer some questions about what they may think or feel in that scenario. Participants were randomly assigned to one of three conditions (see Table 1).

We carefully designed the content of the emails based on prior research (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022). The first two sentences and the last sentence of the email were identical across conditions. However, four target sentences in the middle of the email were manipulated. The first target sentence communicated what success depends on (innate ability vs. hard work); the second sentence communicated whether it is possible to develop one's skills; the third sentence communicated characteristics of successful students; and the fourth sentence communicated advice or strategies for moving forward. All of these sentences are aligned with the "explicit messages about progress and success" category from Kroeper, Muenks, et al. (2022) and Kroeper, Fried, and Murphy (2022). In designing the exact language, we were careful to make sure that the sentences sounded natural and flowed well; thus, we did not counterbalance the order of the sentences across conditions (only the content). Further, because the "explicit messages about progress and success" category identified in prior research (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022) included both explicit messages and provision of strategies, we included both of those elements in our email. In the pure growth condition, all of these sentences communicated a growth mindset, and in the mixed condition, all of these sentences simultaneously communicated a growth and fixed mindset. In the no mindset condition, we did not include any of the target sentences in the middle of the email and only included the first two sentences and the last sentence of the email.

Measures

See Table 2 for descriptive statistics, reliability coefficients, and correlations. All measures used a 1–6 Likert scale. The full text of all measures can be found in the online supplemental materials.

Perception of professor fixed mindset was measured with a three-item scale adapted from previous research (Muenks et al., 2020; e.g., "Professor Smith seems to believe that students have a certain amount of intelligence, and they really can't do much to change it"; $\alpha = .78$).

Positive perceptions of the professor assessed how friendly, smart, trustworthy, and effective Professor Smith seemed (e.g., "Professor Smith seems friendly"; Muenks et al., 2020); these four items were combined into a composite ($\alpha = .92$).

Anticipated motivation measured how motivated ("How motivated would you be in this class?") and engaged ("How engaged would you be in this class?") students would be in Professor Smith's class; these two items were highly correlated ($r = .84$) and therefore combined into a composite.

Anticipated fear of help seeking included three items assessing worries about help seeking in Professor Smith's class (Karabenick, 2003; e.g., "I would feel like a failure if I needed help in this class"; $\alpha = .90$).

Table 1
Manipulation of Faculty Mindset Messages in Studies 1 and 2

Condition	Faculty email
Pure growth	Dear students, By now you will have seen your grade from the first exam. I know that some of you will be happy with your grade and others will not. Just remember, success in this class is a function of how hard you work to develop your skills and to what extent you use effective study strategies. You can always improve and do better. I have noticed that the most successful students in the class also tend to work hard and use strategies that make their study time efficient. One strategy you can use is to find a study group to work with so that you can learn from each other. I encourage you to come speak with me or the TAs if you have any questions about the exam. Best, Professor Smith
Pure fixed (Study 2 only)	Dear students, By now you will have seen your grade from the first exam. I know that some of you will be happy with your grade and others will not. Just remember, success in this class is a function of how much natural ability you have and whether you know how to use that talent. It is uncommon for students to substantially improve. I have noticed that the smartest students in the class also tend to pick things up easily. One strategy you can use is to find a student who is smarter than you to study with so that they can tutor you. I encourage you to come speak with me or the TAs if you have any questions about the exam. Best, Professor Smith
Mixed	Dear students, By now you will have seen your grade from the first exam. I know that some of you will be happy with your grade and others will not. Just remember, success in this class is a combination of talent and hard work. Even if you are not a genius, you can still always improve and do better. I have noticed that the smartest students in the class also tend to work the hardest. One strategy you can use is to find a student who is smarter than you to study with so that you can learn from them. I encourage you to come speak with me or the TAs if you have any questions about the exam. Best, Professor Smith
Control (no mindset messages)	Dear students, By now you will have seen your grade from the first exam. I know that some of you will be happy with your grade and others will not. I encourage you to come speak with me or the TAs if you have any questions about the exam. Best, Professor Smith

Note. TA = teaching assistant.

Performance expectancies were assessed with one item (“I think I would get a good grade in this class”; Muenks et al., 2020).

Results

All data and code for all studies can be found at <https://osf.io/tujkq>. We conducted one-way ANOVAs to examine the effects of mindset condition on each outcome (see Table 3 and Figure 1).¹ A distinctive pattern appeared for the first three dependent variables: perception of professor fixed mindset, positive perceptions of the professor, and anticipated motivation. For all three, a significant effect of condition was found. Students in the pure growth condition exhibited the most positive effects and differed significantly from those in the other two conditions.

However, students in the mixed messages condition and no mindset messages condition did not significantly differ from one another.

For performance expectancies, the pattern slightly changed. It again revealed a significant effect of condition. However, for this variable, students in the pure growth condition only significantly differed from those in the no messages (control) condition. They did not significantly differ from the mixed messages condition, and the mixed messages condition did not significantly differ from the no messages condition.

¹We did not control for students’ personal mindsets in analyses because they were weakly correlated with our variables; see Table S1 in the online supplemental materials.

Table 2
Study 1 Means, Standard Deviations, Ranges, Reliability Coefficients, and Correlations

Variable	1	2	3	4	5
1. Perception of professor fixed mindset	—				
2. Positive perceptions of the professor	-.69**	—			
3. Anticipated motivation	-.49**	.71**	—		
4. Anticipated fear of help seeking	.50**	-.39**	-.38**	—	
5. Performance expectancies	-.38**	.57**	.65**	-.33**	—
<i>M</i>	2.64	4.10	3.65	3.21	3.89
<i>SD</i>	1.19	1.21	1.20	1.45	1.14
Range	1–6	1–6	1–6	1–6	1–6
Reliability coefficient	.78	.92	.84	.90	

Note. Anticipated motivation only had two items, and thus, the reliability coefficient is the bivariate correlation between the two items. Otherwise, we report Cronbach’s alpha for the reliability coefficient.

** $p < .01$.

Table 3
Study 1 ANOVA Results

Variable	<i>F</i> (2, 278)	<i>p</i>	η^2
Perception of professor mindset	29.30	<.001*	.17
Positive perception of professor	23.75	<.001*	.15
Anticipated motivation	10.57	<.001*	.07
Anticipated fear of help seeking	8.07	<.001*	.05
Performance expectancies	5.47	.005*	.04

Note. To control error rates for the family of tests at $\alpha < .05$, the Bonferroni correction for multiple tests was used and individual tests were conducted at $\alpha' < .01$. ANOVA = analysis of variance.

* $p < .01$.

For anticipated fear of help seeking, the condition effect remained significant. Here, the pure growth condition again resulted in the best outcome: the lowest fear of help-seeking. However, the mixed messages condition differed significantly from the no messages condition, with the mixed messages producing the worst outcome: the greatest fear of help-seeking. The pure growth and no messages conditions did not significantly differ. Findings for all outcomes were robust even when significance levels were corrected to control for Type I error rates for conducting multiple tests (see Table 3).

Discussion

Study 1 served as a foundational, proof-of-concept study on how students interpret mixed mindset messages. As hypothesized, pure growth mindset messages led to the best outcomes—including perceiving the professor positively and anticipating greater motivation, a lower fear of help-seeking, and better performance expectancies in the course. Also as hypothesized, mixed mindset messages led to significantly worse outcomes than pure growth messages for every variable except performance expectancies. Notably, however, mixed

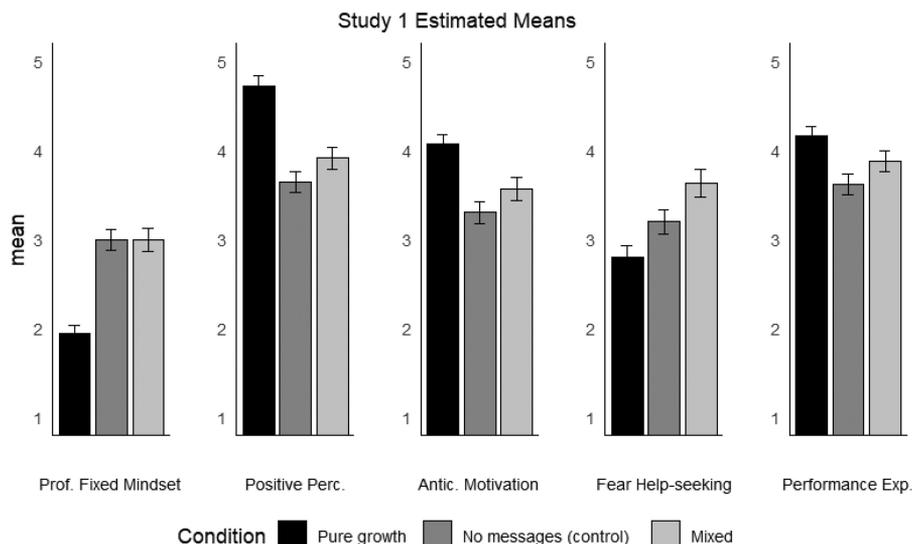
mindset messages generally did not significantly differ from the no mindset messages condition. The exception for this pattern was anticipated fear of help seeking, where mixed mindset messages led to worse outcomes than no mindset messages at all—which demonstrated some support for the “bad is stronger than good” theory (Baumeister et al., 2001). In this case, it is possible that fixed mindset components in mixed messages (e.g., “Success in this class is a combination of talent and hard work”) can overshadow growth mindset components, leading students to be more apprehensive about seeking help, perhaps for fear of being labeled “untalented.” Nevertheless, results from Study 1 suggest that although clear growth mindset messages are optimal, avoiding mindset messaging altogether is not necessarily more beneficial than sending mixed messages, except in specific areas like help-seeking behavior.

These findings raised several new questions. First, do mixed mindset messages produce better, worse, or similar effects than pure fixed mindset messages? Second, do the growth or fixed portions of mixed messages seem to have the greatest impact on student outcomes? To answer these questions, Study 2 probed whether fixed statements are more salient to students than growth statements in mixed messages, or whether the observed negative effects of mixed messages can be explained merely by a reduction in growth statements.

Study 2

Study 2 replicated and extended Study 1 by adding a pure fixed mindset condition. Thus, there were four conditions: pure growth, pure fixed, mixed, and no mindset messages. This addition created a 2 (growth messages: present vs. absent) \times 2 (fixed messages: present vs. absent) design so that we could examine main effects of each factor as well as their interaction. This study also added more dependent variables including both positive and negative perceptions of the professor and interest in taking the professor’s course. We also added more measures of students’ anticipated psychological experiences in the

Figure 1
Estimated Means for Study 1



Note. Bars reflect standard errors. Prof = professor; perc = perceptions; antic = anticipated; exp = expectancies.

professor's course, including their sense of belonging, evaluative concerns, imposter feelings, positive affect, and negative affect, as well as their anticipated behaviors, including their anticipated effort, attendance, and dropout intentions. Prior research has linked these variables to students' perceptions of professors' mindsets (Kroeper et al., 2024; LaCosse et al., 2021; Muenks et al., 2020; White et al., 2024).

Method

Participants and Procedure

We conducted a power analysis using G*Power 3.1 (Faul et al., 2007) which indicated that for a one-way, four-group ANOVA design with 80% power and $\alpha = .05$, we would need 277 participants to detect a medium effect size of $f = .20$. Although the power analysis suggested a minimum of 277 participants, our preregistered recruitment plan was to collect data from a large course in which all enrolled students would be invited to participate. After excluding 45 participants for failing one of two attention checks, our final sample included 555 undergraduate students from a large, public university in the southwest United States ($M_{\text{age}} = 20.41$; 68.8% female, 29.5% male, 0.9% nonbinary, 0.5% other, 0.2% missing; 39.1% Asian, 25.0% White, 15.7% Multiracial, 13.0% Latinx, 4.5% Black, 2.5% Middle Eastern or North African, 0.2% missing).

Students were recruited from a large biochemistry course (participants made up 77% of the total course enrollment) and completed an online survey for extra credit at the beginning of the Fall 2022 semester. After being randomized to a condition, participants were told to imagine a hypothetical scenario in which an instructor in one of their classes sent an email to all students in the class directly after posting grades for the first exam. To ensure that participants carefully read the email, a page timer required them to spend at least 15 s on the page with the instructor email before moving on to respond to dependent variable items. Participants could then move through the survey at their own pace. Two attention checks were employed in the latter halves of the surveys to ensure that participants were not answering questions without having first read the items (Alvarez et al., 2019). In both cases the attention check items explicitly stated that "this is an attention check" and then directed participants to select a specific number from a 1–6 response scale. Participants failed the attention checks if they selected the wrong number or did not answer the question at all.

Materials

Manipulation of Professor Mindset. The manipulation of professor mindset was the same as in Study 1 except we added the pure fixed mindset condition (see Table 1). The pure fixed mindset condition followed the same sentence format as the other conditions described in Study 1, with each sentence communicating a fixed mindset in line with prior research (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022).

Measures

See Table 4 for descriptive statistics, reliability coefficients, and correlations.²

Perception of professor fixed mindset was measured with the same three-item scale ($\alpha = .91$) and anticipated motivation was measured with the same two-item scale ($r = .76$) reported in Study 1.

Perceptions of the professor slightly differed from Study 1, with participants rating both positive (i.e., friendly, smart, trustworthy, effective, warm; $\alpha = .94$) and negative perceptions of the professor (i.e., cold, biased, ineffective; $\alpha = .87$). They also indicated how interested they would be in taking a course with the professor (three items, e.g., "How appealing do you think a class taught by Professor Smith would be?"; $\alpha = .97$).

Anticipated Psychological Experiences. To assess anticipated feelings of belonging, six items were adapted from Murphy and Zirkel (2015) (e.g., "How much would you feel that you "fit in" during Professor Smith's class?"; $\alpha = .94$). Three items measured positive affect (e.g., "On a typical day in Professor Smith's class, I would feel enthusiastic"; $\alpha = .91$) adapted from Watson et al. (1988). Anticipated evaluative concerns were assessed using five items adapted from Wout et al. (2010) (e.g., "On a typical day in Professor Smith's class, how much would you worry that you might say the wrong thing?"; $\alpha = .93$). To measure imposter feelings, four items were used (e.g., "On a typical day in Professor Smith's class, I would be afraid others would discover how much knowledge or ability I really lack"; $\alpha = .91$) from Leary et al. (2000). Three items measured negative affect (e.g., "On a typical day in Professor Smith's class, I would feel nervous"; $\alpha = .90$) adapted from Watson et al. (1988). Finally, anticipated fear of help-seeking was measured with the same three items as in Study 1 ($\alpha = .91$).

Anticipated behavior refers to participants' anticipated effort, attendance, and dropout intentions, all adapted from Muenks et al. (2020). For anticipated effort, students responded to a three-item measure (e.g., "I think I would be willing to put in extra effort if the professor asked me to"; $\alpha = .84$). Anticipated attendance was measured with one item ("How often would you attend Professor Smith's class?"). Dropout intentions were also measured with one item ("How often would you think about dropping out of Professor Smith's class?").

Performance expectancies were measured with three items (e.g., "I think I would get a good grade in Professor Smith's class"; Muenks et al., 2020; $\alpha = .79$).

Results and Discussion

Our main analyses were preregistered (<https://aspredicted.org/b9x4-d7k6.pdf>). Replicating the analyses from Study 1, we first conducted one-way ANOVAs. We found that the overall F tests were statistically significant for all outcomes (see Table 5). Findings were robust even when significance levels were corrected to control for Type I error rates for conducting multiple tests (see Table 5).³ Post hoc comparisons between groups revealed a distinctive pattern across almost all outcomes (see Figure 2). The pure growth mindset condition had the most positive effects for students (consistent with our preregistered hypotheses), while the pure fixed mindset condition had the least favorable outcomes. As in Study 1, the no mindset messages condition usually did not differ significantly from the

² We also measured students' anticipated achievement goals as an alternate measure of students' anticipated motivation. However, since we directly measured students' anticipated motivation, we decided to remove anticipated achievement goals from the text for sake of parsimony and brevity.

³ These results remained consistent when including participants who failed at least one of the attention checks. See pp. 22–24 and Tables S4 and S5 in the online supplemental materials, for the results and discussion of this analysis.

Table 4
Study 2 Means, Standard Deviations, Ranges, Reliability Coefficients, and Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Perc of prof fixed mindset	—														
2. Pos perc of prof	-.69	—													
3. Neg perc of prof	.74	-.83	—												
4. Course interest	-.67	.83	-.77	—											
5. Antic motivation	-.62	.73	-.70	.72	—										
6. Belonging	-.66	.80	-.75	.78	.75	—									
7. Pos affect	-.56	.72	-.62	.77	.67	.77	—								
8. Eval concerns	.53	-.57	.59	-.54	-.53	-.70	-.50	—							
9. Imposter feelings	.40	-.42	.45	-.41	-.46	-.64	-.46	.74	—						
10. Neg affect	.47	-.52	.55	-.51	-.54	-.71	-.52	.73	.72	—					
11. Antic fear of help seeking	.46	-.50	.51	-.47	-.50	-.62	-.43	.62	.65	.58	—				
12. Antic effort	-.52	.61	-.55	.70	.64	.59	.63	-.36	-.27	-.36	-.33	—			
13. Antic attendance	-.28	.29	-.30	.34	.40	.35	.32	-.22	-.23	-.26	-.20	.44	—		
14. Dropout intentions	.50	-.57	.56	-.60	-.59	-.63	-.55	.51	.47	.60	.45	-.41	-.35	—	
15. Perf exp	-.37	.47	-.46	.51	.55	.59	.50	-.50	-.59	-.61	-.45	.41	.30	-.55	—
<i>M</i>	3.49	3.44	3.84	2.65	3.52	3.11	2.57	3.93	3.80	3.54	3.43	3.72	4.19	3.14	3.69
<i>SD</i>	1.44	1.18	1.25	1.26	1.21	1.12	1.05	1.31	1.22	1.30	1.39	1.16	0.94	1.52	1.03
Range	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-5	1-5	1-6
Reliability coefficient	.91	.94	.87	.97	.76	.94	.91	.93	.91	.90	.91	.84			

Note. Anticipated motivation only had two items, and thus, the reliability coefficient is the bivariate correlation between the two items. Otherwise, we report Cronbach's alpha for the reliability coefficient. All correlations were significant at $p < .05$. Perc = perceptions; prof = professor; pos = positive; neg = negative; antic = anticipated; eval = evaluative; perf = performance; exp = expectancies.

mixed mindset messages condition. Yet when the two did differ, the mixed mindset messages condition had worse outcomes than the no mindset messages condition, supporting the "bad is stronger than good" theory (Baumeister et al., 2001). The difference between the no mindset messages condition and the mixed mindset messages condition was significant for several variables that measured negative student experiences: concerns about being negatively evaluated by the professor, fear of help seeking, and negative perceptions of the professor. This finding suggests that, for these student experiences, it is not just the absence of growth mindset messages (like in the no mindset messages condition), or the uncertainty of the message (since the no mindset messages and mixed mindset messages condition share this uncertainty), but the presence of fixed mindset messages (in the

mixed mindset messages condition) that is harmful. We also generally found that mixed messages still produced better student outcomes than pure fixed mindset messages. This finding implies that the growth mindset components in mixed messages can alleviate some of the negative effects of fixed mindset components, even though fixed messages may have a stronger influence overall.

However, there were some exceptions to the overall pattern of results, and these yielded additional points of interest. For multiple variables, we did not detect differences between the pure growth mindset condition and the no mindset messages condition (sense of belonging, imposter feelings, negative affect, and fear of help seeking, negative perceptions of the professor, anticipated dropout intentions, and performance expectancies); both conditions yielded similarly positive outcomes. Additionally, for a few variables the pure fixed mindset condition did not detectably differ from the mixed mindset messages condition (concerns about being negatively evaluated, imposter feelings, fear of help seeking, anticipated attendance, and performance expectancies); both conditions yielded similarly negative outcomes. Finally, there were a few variables where the pure growth mindset condition did not detectably differ from the mixed mindset messages condition (imposter feelings, anticipated attendance, anticipated dropout intentions, and performance expectancies).

To explicitly test the unique effects of growth and fixed components, we then conducted factorial ANOVAs with two factors: growth messages (absent or present) and fixed messages (absent or present; see Table 6). These analyses were not preregistered. The results showed that fixed mindset components consistently had a main effect on students' responses, while growth mindset components did not achieve a significant effect for five variables: evaluative concerns, imposter feelings, negative affect, fear of help seeking, and performance expectancies. These findings were significant at $\alpha < .001$, correcting to control for conducting multiple tests. We also found two fixed \times growth interactions, on perceived professor mindset and negative perceptions of the professor. For these two variables, the presence of growth mindset

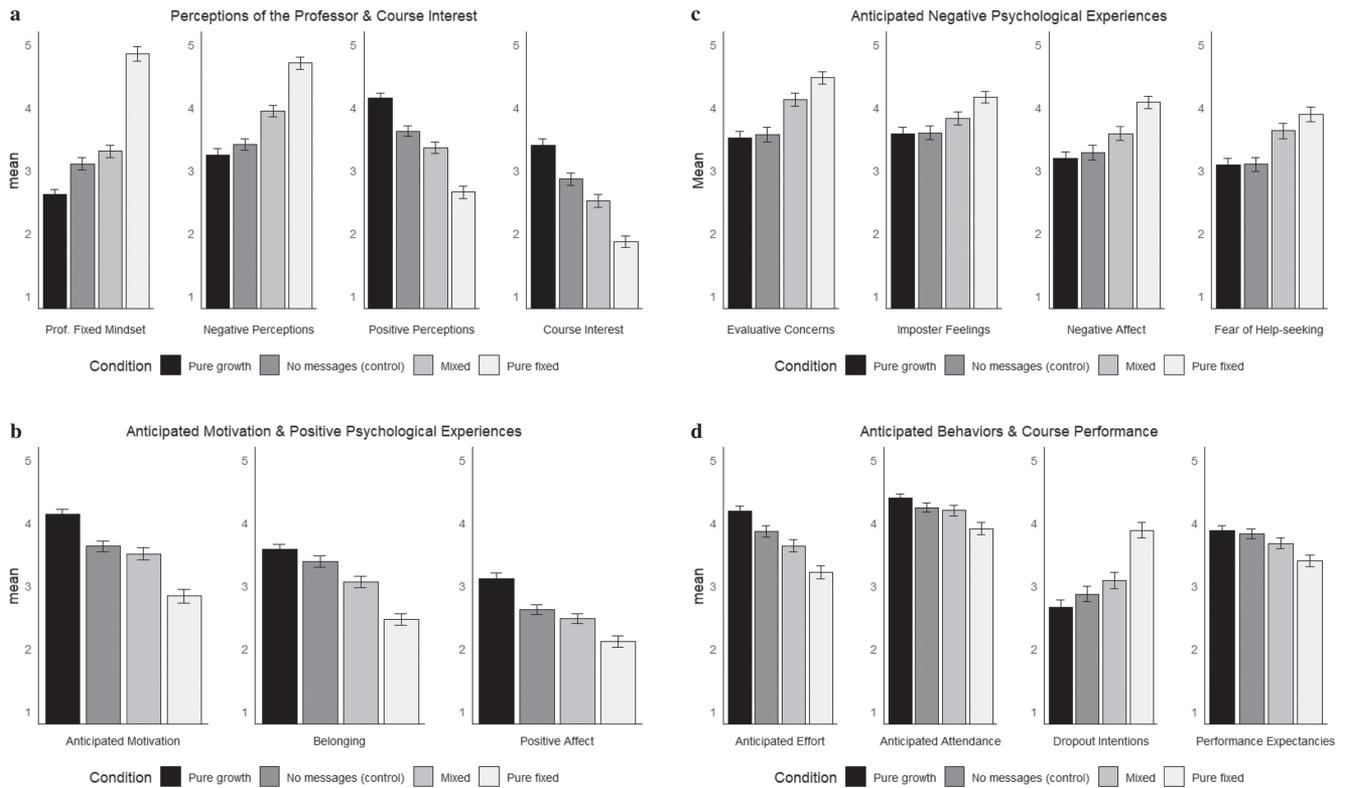
Table 5
One-Way ANOVA Results for Study 2

Variable	<i>F</i> (3, 551)	<i>p</i>	η^2
Perception of professor mindset	96.95	<.001*	.35
Positive perceptions of professor	49.24	<.001*	.21
Negative perceptions of professor	49.10	<.001*	.21
Course interest	44.83	<.001*	.20
Anticipated motivation	32.32	<.001*	.15
Belonging	30.56	<.001*	.14
Positive affect	24.19	<.001*	.12
Evaluative concerns	19.11	<.001*	.09
Imposter feelings	7.20	<.001*	.04
Negative affect	14.51	<.001*	.07
Anticipated fear of help seeking	12.42	<.001*	.06
Anticipated effort	19.30	<.001*	.10
Anticipated attendance	6.97	<.001*	.04
Dropout intentions	19.03	<.001*	.09
Performance expectancies	6.34	<.001*	.03

Note. To control error rates for the family of tests at $\alpha < .05$, the Bonferroni correction for multiple tests was used and individual tests were conducted at $\alpha' < .0033$. ANOVA = analysis of variance.

* $p < .0033$.

Figure 2
Estimated Means for Study 2



Note. Bars reflect standard errors.

messages led to more positive outcomes only when fixed mindset messages were also present (see Figures S1 and S2 in the online supplemental materials). The results suggest that fixed mindset messages may be more consistently salient to students (e.g., in

line with the “bad is stronger than good” theory; Baumeister et al., 2001) and thus instructors should identify and remove as many fixed messages as possible and replace them with growth messages.

Table 6
Factorial ANOVA Results for Study 2

Variable	Growth main effect $F(1, 551)$	p	η_p^2	Fixed main effect $F(1, 551)$	p	η_p^2	Fixed \times Growth interaction $F(1, 551)$	p	η_p^2
Perc of prof mindset	105.36	<.001*	.16	150.85	<.001*	.22	28.74	<.001*	.05
Pos perc of prof	47.59	<.001*	.08	97.44	<.001*	.15	0.94	.33	.00
Neg perc of prof	24.17	<.001*	.04	110.7	<.001*	.17	9.87	.00*	.02
Course interest	37.83	<.001*	.06	94.95	<.001*	.15	0.31	.58	.00
Antic motivation	38.88	<.001*	.07	56.07	<.001*	.09	0.78	.38	.00
Belonging	19.74	<.001*	.03	65.27	<.001*	.11	5.12	.02	.01
Pos affect	25.76	<.001*	.04	45.88	<.001*	.08	0.57	.45	.00
Eval concerns	3.45	.06	.01	51.36	<.001*	.09	1.83	.18	.00
Imposter feelings	3.05	.08	.01	15.73	<.001*	.03	2.40	.12	.00
Neg affect	7.57	.01	.01	31.50	<.001*	.05	3.67	.06	.01
Antic fear of help seeking	1.43	.23	.00	34.18	<.001*	.06	1.22	.27	.00
Antic effort	15.54	<.001*	.03	41.42	<.001*	.07	0.29	.59	.00
Antic attendance	8.11	.00*	.01	11.79	<.001*	.02	0.67	.41	.00
Dropout intentions	16.46	<.001*	.03	33.87	<.001*	.06	5.61	.02	.01
Performance exp	3.65	.06	.01	12.23	<.001*	.02	1.76	.18	.00

Note. To control error rates for the family of tests at $\alpha < .05$, the Bonferroni correction for multiple tests was used and individual tests were conducted at $\alpha' < .0011$. ANOVA = analysis of variance; perc = perceptions; prof = professor; pos = positive; neg = negative; antic = anticipated; eval = evaluative; exp = expectancies.
* $p < .0011$.

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Study 3

Study 3 pursued more granular analyses of mixed mindset messages by varying the proportion of fixed versus growth mindset components in mixed messages. Unlike Studies 1 and 2, which used a single mixed mindset condition with an equal balance of growth and fixed mindset components, Study 3 recognized that real instructors may not always use an even mix of the two mindsets. Some instructors may primarily use fixed mindset language with only a few growth mindset components, while others may use mostly growth mindset language with only a few fixed mindset components. This design enabled us to explore how the dosage of fixed mindset components in mixed messages impacts students' outcomes, including whether even a single fixed mindset message has a negative impact.

To test the effects of different proportions of fixed and growth mindset messages on students, Study 3 manipulated the amount of fixed and growth mindset components in an instructor's email. For the sake of simplicity, these various proportions (i.e. a message that is 25% fixed and 75% growth) are described simply in terms of the dosage of fixed statements, so mixtures are described as having a 0%, 25%, 50%, 75%, or 100% dosage of fixed messages. Manipulating the proportions across conditions allowed us to examine whether an email containing one growth and three fixed mindset components (i.e., a high fixed mindset dosage) would have a more negative impact on students than an email containing three growth and one fixed mindset components (i.e., a low fixed mindset dosage).

We also explored what would happen when the number of fixed mindset sentences moved from zero to one. This would reveal whether a message reaches a critical point with only one fixed mindset component, resulting in negative consequences for students, or if the effect of fixed mindset components is more gradual, with increasing negative effects as the number of fixed mindset components increases. By examining the effects of varying fixed mindset dosages, this design aimed to clarify Study 2 findings.

Method

Participants and Procedure

In order to compare five fixed mindset dosage levels (0%, 25%, 50%, 75%, and 100%), we conducted a power analysis using G*Power 3.1 (Faul et al., 2007), which indicated that for a one-way, five-group ANOVA design with 80% power and $\alpha = .05$, we would need 305 participants to detect a medium effect size of $f = .20$. However, to allow exploratory analyses of sentence-positioning effects, we increased the minimum sample size. For these analyses, after creating conditions for every possible combination of fixed and growth sentences across the four manipulated sentence positions (creating a total of 16 conditions), we estimated that we would need at least 30 participants per condition, yielding a minimal sample size of 480. This approach enabled us to compare the four conditions within a given dosage level for sentence-positioning effects. After excluding one participant who did not consent to be in the study, 20 participants who indicated they were not a student, and eight participants who failed one of two attention checks, our final sample was 476 undergraduate students recruited from Prolific ($M_{\text{age}} = 21.97$; 59.0% female, 36.1% male, 3.8% nonbinary, 1.1% other; 52.9% White, 19.3% Asian, 12.8% Multiracial, 7.1% Latinx, 6.5% Black, 0.8% Middle Eastern or North African, 0.4%

other) who met the prescreening criteria of being currently enrolled in college and pursuing a STEM major.

Students completed the study online and were paid \$2.38 for their participation on average, for a 7-min study (at a rate of \$20.44 per hour). The experimental procedure, including the attention checks, was the same as in Study 2, except that a page timer required them to spend at least 20 s (rather than 15) on the page with the instructor email.

Materials

Manipulation of Professor Mindset. Like Studies 1 and 2, participants were asked to imagine receiving an email from a hypothetical instructor (Professor Smith) after first exam grades were posted. Participants were randomly assigned to one of 16 conditions. The email in each condition had the same opening and closing paragraphs, but the middle paragraph containing four sentences varied by condition. As with Studies 1–2, these were carefully designed based on prior research (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022). The first sentence communicates what success depends on (innate ability vs. hard work); the second sentence communicates whether it is possible to develop one's skills; and the fourth sentence communicates advice or strategies for moving forward, consistent with Studies 1–2. Each of these maps onto the "explicit messages about progress and success" category identified in Kroeper, Muenks, et al. (2022). However, in Study 3, we adjusted the third sentence to communicate advice for struggling students, rather than characteristics of successful students; this maps onto the category "responses to struggling students." We changed this because we wanted to be more explicit about what the professor would recommend for struggling students, given that in real-world contexts, this may be particularly salient and important information after the first exam (Benden & Lauermaun, 2022). Again, we were careful to make sure that the sentences sounded natural and did not counterbalance the order of the sentences across conditions (only the content). Further, we included both explicit messages and provision of strategies in our email, rather than just explicit messages, as this is consistent with what students reported in prior qualitative work (Kroeper, Muenks, et al., 2022).

Each sentence was manipulated to convey either a growth or fixed mindset. For example, Sentence 1 was always about success in the class, but the growth version of Sentence 1 emphasized that success is "... a function of how hard you work to develop your skills and whether you use effective study strategies," whereas the fixed version asserted that success is "... a function of how much natural ability you have and whether you know how to use that talent." Thus, unlike Studies 1–2 where the mixed mindset message condition had sentences that communicate both a growth and a fixed mindset simultaneously, the sentences in Study 3 contained either growth or fixed mindset messages but were mixed together in different combinations.

This design resulted in five condition groupings that differed by the number of fixed mindset components, or dosage level, ranging from zero to four. The groups included a pure growth mindset condition (Dosage Level 0) with only growth mindset components, a pure fixed mindset condition (Dosage Level 4) with only fixed mindset components, and three mixed mindset conditions with varying percentages of fixed mindset components (Dosage Levels 1, 2, and 3 with 25%, 50%, and 75% fixed mindset components, respectively). Unlike Studies 1 and 2, Study 3 did not include a condition

without any mindset messages. The exact wording of all condition manipulations can be found in the online supplemental materials.

Measures

We used the same measures from Study 2. See Table 7 for descriptive statistics, reliability coefficients, and correlations. Reliability coefficients ranged from $\alpha = .80$ to $\alpha = .97$.

Results and Discussion

The Effects of Fixed Mindset Dosage

We preregistered all analyses (<https://aspredicted.org/d2nz-x25m.pdf>). To investigate whether the effect of mixed messages varied by fixed mindset dosage, we performed one-way ANOVAs (see Table 8 and Figure 3). The conditions were grouped by dosage level, with one condition at Dosage Level 0, four at Dosage Level 1, six at Dosage Level 2, four at Dosage Level 3, and one at Dosage Level 4. Because the dosage groups were unbalanced, some outcomes showed variance heterogeneity. Therefore, for these outcomes, we used Games–Howell post hoc tests to obtain results that were robust to differences in group size (Games & Howell, 1976; Stevens, 2007). For all other outcomes, we used Tukey’s honestly significant difference post hoc tests for pairwise group comparisons (Stevens, 2007).

A consistent pattern emerged across variables. Like Studies 1 and 2, the pure growth mindset condition (Dosage 0) yielded the best outcomes. In the mixed message conditions, outcomes worsened gradually across all variables as fixed mindset dosage levels increased. For several variables (perception of professor fixed mindset, positive and negative perceptions of the professor, interest in taking a course with the professor, anticipated motivation, evaluative concerns, and anticipated dropout intentions) this trend was significant for each fixed mindset dosage increment between Dosage 0 and Dosage 3. However, for other variables (belonging, positive affect, imposter feelings, negative affect, anticipated fear of help seeking, anticipated effort, and performance expectancies) a two- or three-increment fixed mindset dosage increase was required before statistically significant differences in outcomes emerged. Only one null effect was observed, for anticipated attendance. Findings were robust even when significance levels were corrected to control for Type I error rates for conducting multiple tests (see Table 8). These findings generally supported the “bad is stronger than good” theory (Baumeister et al., 2001).⁴

Surprisingly, however, for all outcomes the incremental change from Dosage 3 (a mixed mindset condition with three fixed and one growth components) to Dosage 4 (the pure fixed mindset condition) was not statistically significant. This suggests that mixed messages may reach a saturation point, where the presence of a single growth component is no longer detectable.

Does a Single Fixed Message Have Negative Consequences?

To explore whether a single fixed mindset component could have a significant negative impact on student outcomes, we compared Dosage Level 0 (pure growth mindset) to an aggregate of the Dosage Level 1 conditions, which all included only one fixed mindset component (see Table S2 in the online supplemental materials). Findings indicate that even a single fixed mindset component

negatively impacted most student outcomes, particularly in their perceptions of the professor, course interest, anticipated motivation, psychological experiences, and intentions to drop a course. However, for other consequences to emerge, including anticipated fear of help-seeking, effort, and performance expectancies, a cumulative effect involving higher doses of fixed mindset components may be required.⁵

General Discussion

Growth mindset messages support students’ motivation, psychological safety, and achievement (see Murphy et al., 2021); yet evidence suggests that “pure” growth mindset messages may be uncommon, and that instructors often send mixed mindset messages (Zhang et al., 2024). What are the consequences of these mixed messages for students? The present studies investigated the impact of mixed mindset messages (relative to pure growth and pure fixed mindset messages) on students’ perceptions, motivation, and anticipated behavior in a STEM classroom context. The findings suggest that pure growth mindset messages are the most motivationally and psychologically supportive, while pure fixed mindset messages are generally the least supportive, consistent with prior research (Canning et al., 2019, 2022; Fuesting et al., 2019; LaCosse et al., 2021; Muenks et al., 2020, 2021; Rissanen et al., 2019; Schmidt et al., 2015; Sun, 2018). Mixed mindset messages, however, are no more effective than providing no mindset messages at all, as found in Studies 1 and 2 (see also Buttrick, 2020), and sometimes even lead to worse outcomes, as Study 2 found. Further, Study 2 revealed that while fixed statements in mixed messages always negatively affect students, growth statements less consistently provide a positive effect. Finally, Study 3 demonstrated that as the number of fixed statements increases in a mixed message, outcomes generally worsen. These findings generally support the theory that people are more attuned to “bad” messages than “good” messages (Baumeister et al., 2001).

Building on and extending prior literature that looks at which behaviors signal to students their professors’ fixed and growth mindsets (Hecht, Bryan, & Yeager, 2023; Hecht, Murphy, et al., 2023; Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022; Murphy et al., 2021), the present studies demonstrate that email messages can signal instructor mindset, consistent with Canning et al. (2024) and Covarrubias et al. (2019). Further, the specific messages embedded in the emails—what the professor believes success in the class depends on (innate ability vs. hard work), whether it is possible to develop one’s skills, characteristics of successful students, and advice or strategies for struggling students—were salient indicators of instructor mindset, consistent with categories of mindset-relevant instructor behavior identified in prior qualitative and quantitative work (Kroeper, Fried, & Murphy, 2022; Kroeper, Muenks, et al., 2022). In Study 3, our measure of perceived professor fixed mindset—our manipulation check—increased with each additional

⁴ These results remained consistent when including participants who failed at least one of the attention checks. See pp. 22–24 and Tables S4 and S5 in the online supplemental materials, for the results and discussion of this analysis.

⁵ In an additional exploratory analysis, we found that when the fixed message occurred in Sentence 2, describing the professors’ beliefs about students’ potential for improvement, students perceived the professor to have a stronger fixed mindset, $F(3, 113) = 7.77, p < .01, \eta^2 = .17$ (see the online supplemental materials).

Table 7
Study 3 Means, Standard Deviations, Ranges, Reliability Coefficients, and Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Perc of prof fixed mindset	—														
2. Pos perc of prof	-.80	—													
3. Neg perc of prof	.83	-.91	—												
4. Course interest	-.75	.85	-.83	—											
5. Antic motivation	-.72	.81	-.77	.78	—										
6. Belonging	-.72	.85	-.82	.87	.79	—									
7. Pos affect	-.66	.75	-.73	.82	.74	.81	—								
8. Eval concerns	.61	-.60	.65	-.62	-.54	-.69	-.53	—							
9. Imposter feelings	.48	-.49	.53	-.52	-.49	-.62	-.48	.77	—						
10. Neg affect	.60	-.64	.68	-.64	-.58	-.72	-.56	.81	.71	—					
11. Antic fear of help seeking	.44	-.38	.42	-.39	-.39	-.47	-.35	.54	.59	.52	—				
12. Antic effort	-.63	.72	-.69	.73	.75	.73	.72	-.43	-.39	-.50	-.31	—			
13. Antic attendance	-.30	.39	-.38	.38	.45	.41	.34	-.19	-.22	-.26	-.16	.50	—		
14. Dropout intentions	.66	-.72	.74	-.75	-.71	-.77	-.67	.65	.58	.68	.43	-.62	-.44	—	
15. Perf exp	-.50	.57	-.56	.63	.58	.68	.58	-.54	-.62	-.56	-.36	.49	.36	-.65	—
<i>M</i>	3.64	3.75	3.51	2.96	3.66	3.34	2.80	3.74	3.35	3.34	3.03	3.75	4.19	3.25	3.85
<i>SD</i>	1.51	1.19	1.33	1.43	1.29	1.21	1.26	1.43	1.30	1.39	1.41	1.24	0.95	1.61	1.07
Range	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-5	1-5	1-6
Reliability coefficient	.94	.95	.91	.97	.88	.95	.94	.95	.91	.92	.93	.89			.80

Note. Anticipated motivation only had two items and thus the reliability coefficient is the bivariate correlation between the two items. Otherwise, we report Cronbach's alpha for the reliability coefficient. All correlations were significant at $p < .05$. Perc = perceptions; prof = professor; pos = positive; neg = negative; antic = anticipated; eval = evaluative; perf = performance; exp = expectancies.

fixed mindset sentence, suggesting that each of these messages were indicators of fixed mindset and that students were sensitive to them.

Our findings from Studies 1 and 2—that mixed messages were worse than no mindset messages at all for fear of help seeking (both studies) and evaluative concerns (Study 2)—are also consistent with work suggesting that ambivalent relationships and messages can be harmful (e.g., Holt-Lunstad & Uchino, 2019; Major et al., 2003; Salvatore & Shelton, 2007). Though we were unable to explore this with our data, it is possible that mixed messages could have increased students' cognitive load and/or anxiety; future studies could examine this. Future research, perhaps using qualitative methods, could also specifically examine whether the

uncertainty arising from no mindset messages is similar or different to the uncertainty arising from mixed mindset messages.

In Studies 1 and 2, the mixed messages were exactly 50/50; that is, half of the messages conveyed a growth mindset and half conveyed a fixed mindset. However, in real life, it is unlikely that these messages are perfectly split. Study 3 used a unique design to allow us to examine the specific effects of different proportions or dosages of fixed and growth mindset messages, taking a more nuanced approach to understanding the effects of these mixed messages. We found, with only a few exceptions, the outcomes that were most sensitive to small dosage changes in mindset messages were those that explicitly asked about the professor (e.g., "Professor Smith seems cold"; "On a typical day in Professor Smith's class, how much would you worry that you might make a mistake in front of the professor?"; or "How interested would you be in taking a class taught by Professor Smith?"). Whereas, the outcomes that were slightly less sensitive to small dosage changes were those that were not as directly about the specific professor, but could also involve students' beliefs about peers or their general feelings about the class overall (e.g., "How much would you feel like you belong in Professor Smith's class?"; "On a typical day in Professor Smith's class, I would feel upset"; or "On a typical day in Professor Smith's class, I would feel like an impostor"). Further, we found that once 75% of the mindset messages (three out of four sentences) were in the fixed direction, a saturation point was reached.

Practical Implications

Our findings have practical implications for STEM instructors in the classroom. First, these findings caution instructors against sending any fixed mindset messages at all. However, given that mindset beliefs occur on a continuum (Murphy, 2024) and instructors may have inconsistent beliefs (Keating & Heslin, 2024), misconceptions (Patrick & Joshi, 2019), or skepticism (Pelletier et al., 2020) about growth mindsets, it is possible that instructors are sending fixed mindset messages (or mixed messages) without being aware that

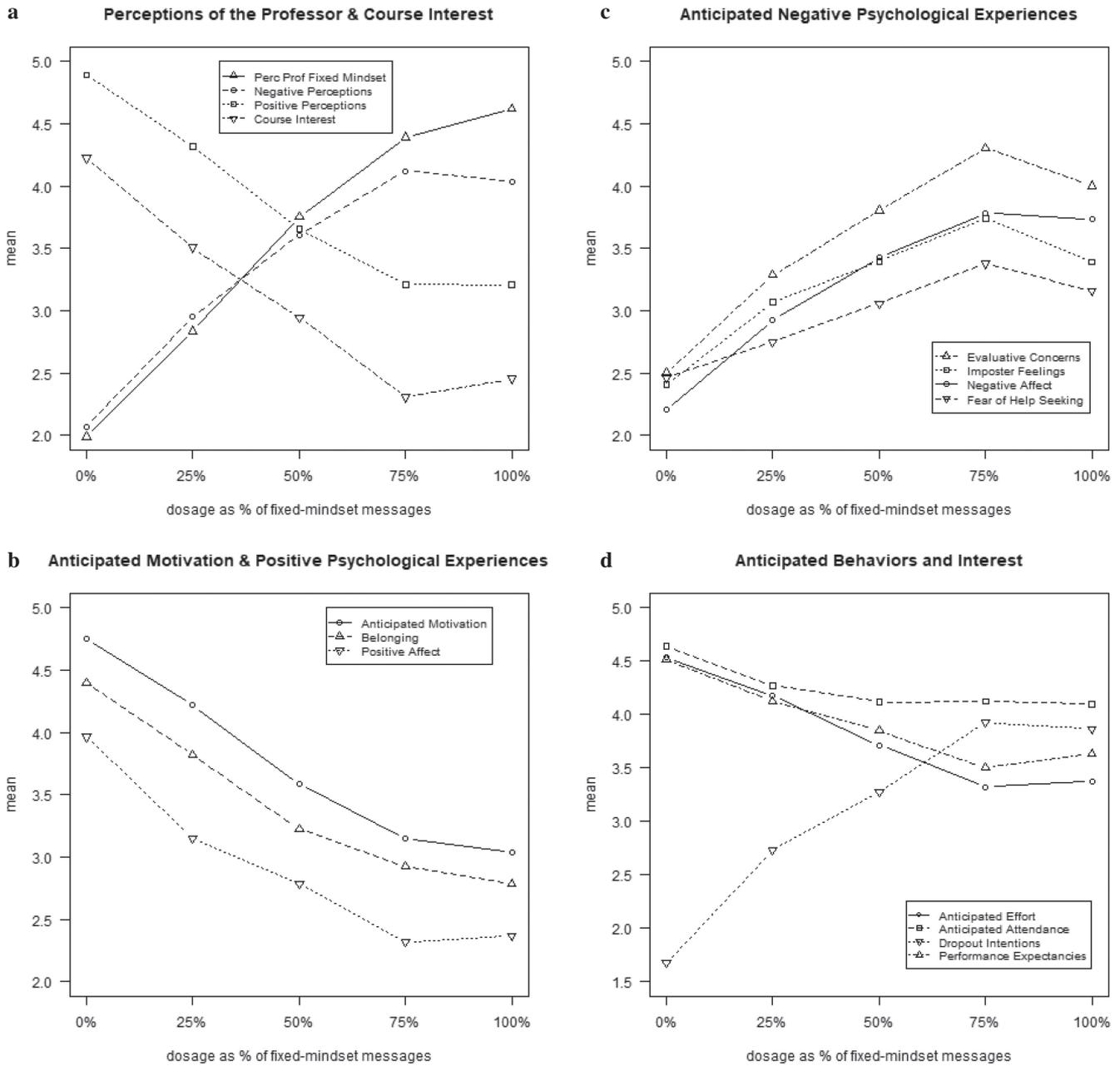
Table 8
Dosage-Level Comparisons: One-Way ANOVA Results Across Dosages for Study 3

Variable	<i>F</i> (4, 471)	<i>p</i>	η^2
1. Perception of professor fixed mindset	35.97	<.001*	.23
2. Positive perceptions of professor	25.53	<.001*	.18
3. Negative perceptions of professor	25.62	<.001*	.18
4. Course interest	19.57	<.001*	.14
5. Anticipated motivation	20.00	<.001*	.15
6. Belonging	17.89	<.001*	.13
7. Positive affect	15.14	<.001*	.11
8. Evaluative concerns	14.80	<.001*	.11
9. Imposter feelings	8.24	<.001*	.07
10. Negative affect	12.33	<.001*	.10
11. Anticipated fear of help seeking	4.32	.002*	.04
12. Anticipated effort	11.59	<.001*	.09
13. Anticipated attendance	2.35	.05	.02
14. Dropout intentions	18.36	<.001*	.14
15. Performance expectancies	8.65	<.001*	.07

Note. To control error rates for the family of tests at $\alpha < .05$, the Bonferroni correction for multiple tests was used and individual tests were conducted at $\alpha' < .0033$. ANOVA = analysis of variance.

* $p < .0033$.

Figure 3
Estimated Means for Study 3



Note. Perc = perceptions; prof = professor.

they are doing so. In this case, it might be important to focus interventions or workshops on helping instructors reduce fixed mindset messages as much as possible, perhaps by identifying fixed mindset messaging in their course materials, communication, or behaviors and replacing those messages with growth mindset messages. This would significantly shift the focus of most mindset interventions which, at present, emphasize teaching instructors to communicate a growth mindset (e.g., Hecht, Bryan, & Yeager, 2023) rather than helping them reduce fixed mindset messages.

What are examples of the kinds of fixed messages that instructors should remove from their courses, and where do they occur? Students in our studies perceived instructors to hold fixed mindsets when they received explicit messages about intelligence or ability being innate, that is, something you either have or you do not; when they were told that improvement was unlikely; when they were urged to make comparisons of ability with their peers; or when they were told to lower their expectations. These represent four categories of fixed messages which commonly occur in many

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classrooms and which these data suggest should be removed or replaced with growth-oriented alternatives. Our research also focuses on a specific time point in a course when students are most likely to perceive implicit fixed messages: an instructor's responses to student poor performances. If the response after a first exam, project, paper, or homework set is to suggest that "If you don't get it early and quickly, you don't belong in this class," students are likely to perceive a fixed mindset. This suggests that another approach to removing fixed mindset messages would be to look at pivotal moments in a course when students are likely to be assessing their progress and thinking about whether growth is possible.

Although removing fixed messages may have the greatest impact on students, adding growth messages to an environment where fixed messaging is already present can still have benefits. Our studies found that mixed messages usually had more positive effects than pure fixed messages, and Study 3, in particular, showed benefits as the proportion of growth to fixed messages increased. In cases where instructors cannot completely eradicate fixed messages from their courses (e.g., if they have to use a preexisting syllabus and have little control over the exact language), they should focus not only on the removal of fixed messages but also the addition of growth messages where possible. This may be especially important in cases where written materials such as learning management system shells, syllabi, assignment instructions, and email templates, are reused from one semester to the next.

Limitations and Future Directions

In the present studies, we asked students to imagine they had received an email sent by a professor and then report how they think they would feel; we did not manipulate the messages in actual emails in a real classroom, as other studies have done (e.g., Canning et al., 2024). A strength of scenario-based studies is that they can be useful for identifying promising interventions and future directions for research, particularly when they are vivid and authentic (e.g., Hecht et al., 2022). We would argue this is the case for the present studies, since students were asked to read an email sent to them from their professor, a common situation for college students. Further, these scenario-based studies enabled us to manipulate professor messages in ways that may be considered unethical or difficult to do in a field experiment—for example, by testing the effects of strong fixed mindset messages. Nevertheless, effect sizes in scenario-based experimental designs do not reliably signal expected population effects. It would strengthen confidence in these findings and help us understand the size of the real population effects to observe them in authentic, real-world classroom contexts and to measure students' actual (vs. anticipated) experiences, motivation, and behavior—ideally using a longitudinal, cross-lagged panel design.

These studies were also conducted in an online, rather than a laboratory, setting. That is, participants completed the studies on a computer, laptop, or phone in varying locations and under conditions that were not controlled by the researcher. Although there are limitations to this method, this particular manipulation is one that mimics what would naturally occur—that is, when students receive real professor emails, it is also on their own devices and in varying locations. Nevertheless, future researchers could replicate these studies in a laboratory to ensure that participants are paying attention and that aspects of the physical environment are controlled.

These studies suggest several exciting avenues for future research. Our hope is that the current studies serve as foundational, proof-of-concept studies that inspire future work that will better help illuminate the processes, mechanisms, and boundary conditions of the effects of mixed mindset messages on student outcomes. We note below a few examples of future work for which the current set of studies could serve as a "jumping off point."

Are Some Mixed Mindset Messages More Harmful Than Others?

One potential direction involves identifying whether some specific types of fixed mindset messages are more harmful to students than others. In our Study 3, we found some preliminary evidence that the sentence "In my experience, it is uncommon for students to substantially improve their skills throughout the semester, especially if they did poorly on the first exam" led students to perceive the instructor as having a stronger fixed mindset than the other fixed mindset sentences in the email (see online supplemental materials). However, it is not clear whether certain statements or messages may lead to worse outcomes for students, or whether all fixed mindset messages are equally harmful. Indeed, it may even be the case that some mixed mindset messages actually serve to build trust between instructors and students—if, for example, instructors acknowledge the role of natural talent but still emphasize students' ability to improve through the use of effective strategies. It may be the case that students feel that some growth mindset messages are insincere or disingenuous, especially for students who are aware that they are struggling more than their peers. It would be important to explore this in future work to better design instructor-targeted interventions.

What Happens When There Are Disconnects Between Instructor Beliefs and Instructor Behaviors?

Another area of future inquiry could involve examining what happens when there are disconnects between instructor-communicated beliefs and instructor behaviors. In other words, what happens if an instructor communicates strong growth mindsets explicitly (e.g., through emails, like those examined in the present work), but then communicates a fixed mindset implicitly, such as through their course structures, policies, and assessments (Murphy et al., 2021; Trzesniewski et al., 2021)? Do instructors' words or behaviors matter more? And, does the order or timing of these behaviors matter? As discussed above, these questions could be answered via observational data, which would allow for an identification of the most common and impactful ways in which mixed mindset messages are conveyed. However, it could also be interesting to design experiments in which these behaviors are manipulated (see Hecht et al., 2022).

Do Mixed Messages Still Have Negative Impacts if Delivered in a Warm Manner?

A third future direction would be to more directly manipulate the level of warmth within the mixed mindset messages to see if these messages still have the same impacts on students if they are delivered in a "nicer" way. In the present set of studies, we tried to balance this as much as possible (e.g., including phrasing like "One strategy you

can use is to find a student who is smarter than you to study with so that they can tutor you” to convey helpfulness); however, it is still possible that participants viewed the “fixed” aspects of the mixed messages as cold or mean, which could have confounded our results. Some recent experimental research has found that the negative effects of instructors’ fixed mindsets are not entirely driven by being cold and unfriendly (e.g., White et al., 2024); however, researchers have not yet explored this in the context of mixed mindset messages specifically.

Do Mixed Mindset Messages Affect Some Students Differently?

It would also be worthwhile to investigate whether mixed mindset messages have heterogeneous effects for different groups of students. For example, it is possible that students who are underrepresented and/or negatively stereotyped in STEM (e.g., Black, Latine, and Indigenous students; women; or first-generation college students) may be more sensitive to mixed statements (Canning et al., 2019, 2022; LaCosse et al., 2021) due to those students being more vigilant to classroom cues signaling whether their identities are valued (Murphy et al., 2007). Further, the current studies took place in STEM contexts, but it is not known how mixed mindset messages would affect students in non-STEM contexts, such as the humanities or arts. In fields where many people believe that success requires an innate talent (e.g., fields with high field-specific ability beliefs; Muradoglu et al., 2023), growth messages may be more unusual, and thus may be more noticeable to students while also more clearly distinguishing instructors who share them as holding supportive beliefs. However, it is also possible that the opposite may be true in these fields: That fixed mindset messages from instructors would be more salient because they confirm people’s pre-existing beliefs. Future work could explore this.

Does the Medium of Mixed Messages Matter?

Additionally, future research could explore whether mixed messages delivered through different mediums, such as written language in emails and syllabi (e.g., Ozier, 2023) or verbal language in lectures or office hours, impact students differently. It is possible that for some students, what instructors say or do in class is more salient or impactful, and they may not read emails or syllabi closely enough to really be impacted by those messages. For other students, however, written messages in email or syllabi may seem more “official” and thus be stronger cues to instructors’ mindsets. Identifying who may be impacted by which messages in real-world classroom contexts, and what the effects of mixed mindset messaging will be on students’ classroom experiences and motivation, will be an important next step in this work.

Conclusion

The present research highlights the unintended negative effects of mixed mindset messages in the classroom, which can be detrimental to students’ perceptions, motivation, and behavior. Although instructors may intend to promote a growth mindset, the simultaneous communication of growth and fixed mindsets can lead to reduced belonging and motivation, as well as increased evaluative concerns and fear of help seeking. Furthermore, students perceive professors who send mixed mindset messages less positively and

more negatively, with the harmful effects increasing as the fixed beliefs in a message become more prevalent. These findings underscore the importance of avoiding mixed mindset messages in creating a supportive learning environment.

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