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Towards Fostering Growth Mindset Classrooms: Identifying Teaching Behaviors that Signal Instructors' Fixed and Growth Mindsets Beliefs to Students

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Abstract

Students who perceive their instructors to endorse growth (vs. fixed) mindset beliefs report better classroom experiences (e.g., greater belonging, fewer evaluative concerns) and, in turn, engage in more behaviors that promote academic success (e.g., class attendance and engagement). Although many instructors personally endorse growth (vs. fixed) mindset beliefs, their students often perceive their beliefs quite differently. And, to date, little is known about *how* students come to perceive their instructors as growth-minded or as fixed-minded. To address this, the present research employs a social cognitive classification paradigm to identify teaching behaviors that *students* perceive as communicating instructors' mindset beliefs. College students ($N_{Students}$=186) categorized specific teaching behaviors ($N_{Behaviors}$=119) as signaling either fixed or growth mindset beliefs. Even after controlling for students' personal mindset beliefs and the warmth of the teaching behavior, we found that when instructors suggest everyone can learn, offer opportunities for feedback, respond to struggling students with additional support and attention, and place value on learning it signals to students that their instructor endorses more growth mindset beliefs. Conversely, when instructors suggest that some students are incapable, fail to provide opportunities for feedback, respond to students' struggle with frustration and/or resignation, and place value on performance and brilliance it signals to students that their instructor endorses fixed mindset beliefs.

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1. Introduction

"Are we communicating to our students that they are capable and that as their teachers we have high expectations for their success? Importantly, positive presuppositions—the assurance that we are confident in their capacity to learn—goes beyond isolated comments. Our assumptions are conveyed in every verbal and nonverbal message we give to our students, both individually and as a group."

- *Steele & Cohn-Vargas (2013, p. 91)*

College students who think that their teachers view intelligence as a *fixed*, unchangeable trait experience greater psychological vulnerability in the classroom (e.g., less belonging, greater imposter feelings) and, in turn, exhibit worse achievement outcomes, including lower class attendance, poorer grades, and greater dropout intentions compared to students who think their teachers view intelligence as a *malleable* trait that can develop with hard work, persistence, and good strategies (Canning et al., 2021, LaCosse et al., 2021; Muenks et al., 2020). Given how influential students' perceptions of their teachers' mindset beliefs are for students' educational outcomes, it is important to understand how students come to perceive their teachers as endorsing these mindset beliefs. Yet, there is a dearth of research on this topic—we know little about the *antecedents* of students' perceptions of teacher mindset beliefs. Are there certain teaching behaviors and practices, for example, that are more often perceived by students as communicating fixed or growth mindset beliefs on the part of teachers? If there is indeed consensus among students that some teaching behaviors signal more of a fixed mindset while others signal more of a growth mindset, it is important to understand those behaviors both from a theoretical and practical perspective. Theoretically, it is important that we learn how the beliefs of powerful actors in an environment (here, teachers in a classroom) are communicated to and perceived by others (here, students). And, from a practical perspective, we hope this research will provide actionable insights that can be harnessed by educators to communicate growth mindset beliefs in a way that students will effectively perceive them.

1.1 What are Fixed and Growth Mindsets?

Mindsets (also termed implicit or lay theories) are people's lay beliefs about the fixedness or malleability of human traits, like intelligence, social ability, athleticism, and personality (Dweck et al., 1995; Hong et al., 1999). When people endorse *growth mindset beliefs,* they believe that human traits are malleable and can be changed through effort and flexibly adopting useful strategies, whereas when people endorse *fixed mindset beliefs*, they believe that human traits are rigid and unchanging—you either have the trait or you don't (Dweck, 2006; Yeager & Dweck, 2012). These mindset beliefs matter because they predict people's responses to challenging circumstances. In the classroom context, when students encounter intellectual difficulties, like anticipating a really difficult test or getting critical feedback from a teacher, students who endorse more growth mindset beliefs are more likely to persevere, construing their difficulties as tough but surmountable challenges. By contrast, students who endorse more fixed mindset beliefs are more likely to construe those same difficulties to mean that they lack the required intellectual ability, thereby viewing perseverance in response to such struggles as futile and pointless (Dweck & Leggett, 1988). In this way, a tendency toward fixed mindset beliefs can sabotage students, leading them to prematurely withdraw effort and, in some cases, dismiss entire subject areas as beyond their reach (e.g., "*I'm just not a math person*"; Dai & Cromley, 2014).

Fortunately, student mindset beliefs are themselves malleable, making such beliefs a clear point of intervention. Social psychologists have shown that helping students adopt growth mindset beliefs—usually through direct-to-student mindset programs or interventions—can increase their motivation (Lin-Siegler et al., 2016; O'Rourke et al., 2014) and boost their academic performance (Blackwell et al., 2007; Paunesku et al., 2015; Yeager et al., 2016, 2019, 2021). By showing students that they can grow their intelligence, students become more

motivated to persevere through academic challenges and begin to see failure as an opportunity to learn.

1.2 Teacher Mindset's Influence on Student Motivation and Achievement

Encouraging students to adopt growth mindset beliefs, however, must be accompanied by supportive classroom environments. Researchers are increasingly finding that equipping students with growth mindset beliefs is not as effective in yielding desirable motivational and achievement outcomes when the broader classroom context is incompatible with or unsupportive of the growth mindset messages (Canning et al., 2019, 2021; LaCosse et al., 2021; Muenks et al., 2020; Walton & Yeager, 2020; Yeager et al., 2019, 2021). For example, in one large-scale, nationally representative study, researchers found that the treatment arm of a direct-to-student growth mindset intervention only improved students' end-of-term math performance when treated students were taught by math teachers who personally endorsed growth mindset beliefs (vs. fixed mindset beliefs; Yeager et al., 2021). The researchers used the analogy of planting a seed in fertile (vs. infertile) soil. A growth mindset message is better able to take root and thrive in environments where there are compatible messages and practices from teachers that afford and support students' growth mindset beliefs and behaviors.

Why are students' perceptions of teacher mindset beliefs so pivotal? These perceptions may be influential, in part, because of the teacher-student power imbalances relatively common in classroom settings. Teachers are gatekeepers of knowledge and academic opportunity; they set course policies, evaluate classwork, and assign grades. Intuiting that their teachers' beliefs about students' ability and potential may influence their own academic outcomes, students—who occupy relatively less powerful positions in the classroom—may be especially motivated to understand the beliefs of their teachers (e.g., Ebenbach & Keltner, 1998; Galinsky et al., 2006).

Understanding the antecedents of student-perceived teacher mindset beliefs can help teachers to shape their students' perceptions in ways that afford growth-minded interpretations of critical feedback, struggle, and incremental progress. Yet, little research has examined how students come to infer their teachers' mindset beliefs. And such work is especially important given evidence suggesting occasional inconsistencies between what teachers *say* their mindset beliefs are and what students *perceive* their teachers' mindset beliefs to be (Kroeper et al., 2022). That is, even when teachers report endorsing growth mindset beliefs, students can perceive them as endorsing relatively fixed mindset beliefs. What explains this perceptual disconnect? This is a basic social cognitive question. How do people infer the beliefs of another? Behavioral observation is one pathway. People routinely and spontaneously infer the dispositions of others from behavioral observation (Uleman et al., 1996)—so it is quite likely that this extends to how students' inform their perceptions of teacher dispositions. Indeed, field studies in actual classroom settings reveal that there is relative consensus among students in the same classroom environment (taught by the same teacher) that their particular teacher endorses more fixed (or growth) mindset beliefs—and those perceptions are distinct from their perceptions of other teachers in different classroom environments (Kroeper et al., 2022). This suggests that there is *something observable* about the classroom context, possibly what teachers are saying and doing, that is perceived by students in the class (with relative consensus) as indicative of their teachers' mindset beliefs (see also Haimovitz & Dweck, 2016, 2017; Rattan et al., 2012; Sun, 2019). This also suggests that, in the case of disconnects, teachers may be (unwittingly) communicating mindset beliefs that they do not personally endorse through what they say and do in the classroom.

1.3 Which Teaching Behaviors Signal Teacher Mindset to Students?

If teacher mindset beliefs are communicated to students through what teachers say and do in class (Rattan et al., 2012; Sun, 2019), then which behaviors are most often perceived by students as fixed-minded and which as growth-minded? Although the mindset literature says little about *the specific* teaching behaviors that signal teacher mindset *to students*, there is some evidence in the teacher education literature demonstrating that teachers with more growth mindset beliefs often behave differently in the classroom from teachers with more fixed mindset beliefs (Butler, 2000; Lee, 1996; Moorman & Pomerantz, 2010; Rissanen et al., 2018; Sun, 2018). For example, more fixed-minded teachers tend to encourage students to demonstrate their abilities (e.g., emphasizing the importance of earning high grades), while more growth-minded teachers tend to encourage students to develop mastery (e.g., focusing students on their learning and improvement; Park et al., 2016). Fixed-minded teachers also focus more attention on high-achieving students, presumably because focusing on low-achieving students is viewed as a waste of time and resources by fixed-minded teachers who believe students either have the skills and abilities to do well or they don't; by contrast, growth-minded teachers often devote more attention to low-achieving students to ensure that they are keeping up with the material and developing their abilities (Rissanen et al., 2018).

More recently, qualitative research—based on focus group discussions with college students—evidenced four key categories of teaching behaviors and practices that signal teacher mindset beliefs to *students* (Kroeper et al., 2022):

(1) **Messages about Success**: when teachers describe the characteristics required for success in class (e.g., hard work, help-seeking, and perseverance, vs. innate, natural talent or brilliance) and communicate that they think some students are likely (vs.

unlikely) to make progress and succeed, students infer their teachers have growth mindset beliefs;

(2) **Provision of Opportunities**: when teachers provide many (vs. few) opportunities for practice and more (vs. less) feedback to students, students infer their teachers' growth mindsets;

(3) **Response to Struggle**: when teachers respond to student struggle, confusion, or poor performance with support, strategies, and additional opportunities to improve (vs. with frustration and resignation that improvement is not possible), students infer their teachers' growth mindsets;

(4) **Value Placement**: when teachers place value on student learning and development by showcasing improvement or commenting on students' development (vs. placing value on effortless, flawless performance and "natural" brilliance) students infer their teachers' growth mindsets.

See Table 1 for examples of fixed- and growth-signaling teaching behaviors and practices within each theme.

[Insert Table 1]

Using a handful of the behaviors that emerged from these qualitative focus groups, the researchers conducted a quantitative field study, asking a separate group of students to report how their teachers behaved over the past semester and their perceptions of their teachers' mindset beliefs. Consistent with the focus group research, this study revealed that when students perceived teachers to suggest that *everyone* is capable of academic success, when they provided opportunities to improve, offered reassurance and support for struggling students, and valued learning, students perceived their teachers to have more growth mindset beliefs. But when

students perceived teachers as suggesting that some students are incapable, when they failed to provide feedback, responded to student struggle with frustration, and placed more value on performance than on learning, students perceived their teachers to have more fixed mindset beliefs.

Although these initial findings are informative in identifying categories of teaching behaviors that shape students' perceptions of teachers' mindsets, the present research extends that initial theorizing, and validates it using a novel social cognitive method and a much larger array of teaching behaviors and practices sourced from the mindset literature, and, in so doing, addresses several limitations of this earlier work. First, the present work presents students with a much larger array of specific teaching behaviors (119 behaviors, vs. only 16 behaviors), sourced from the mindset literature broadly (Barger, 2018; Blackwell et al., 2007; Butler, 2000; Dweck & Leggett, 1988; Gunderson et al., 2013; Haimovitz & Dweck, 2016; Lee, 1996; Moorman & Pomerantz, 2010; Mueller & Dweck, 1998; Park et al., 2016; Rattan et al., 2012, 2018; Rissanen et al., 2018; Stipek et al., 2001; Sun, 2018, 2019)—and these behaviors include those we expected to signal teachers' growth mindset beliefs to students as well as those we expected to signal teachers' fixed mindset beliefs.[1] Second, the student reports in the earlier work (Kroeper et al., 2022) were all retrospective and assessed at the same point in time—asking students at the end of the term to report on both their teachers' mindset beliefs as well as the extent to which their teachers engaged in particular behaviors and practices during the term. Thus, it is somewhat unclear whether students' perceptions of their teachers' behavior signaled their teacher's mindset

[1] Our original predictions regarding how most students would categorize cues and our data exclusion plans were preregistered on the Open Science Framework prior to data processing and analysis (see https://osf.io/d28aq/?view_only=85cc3df98bc24a92b5fe8eacfa701c39). Overall, we found that 92 of the 119 cues (77.3%) were categorized by the majority of students as predicted. Refer to the Supplementary Information for more details regarding the research team's a priori predictions.

beliefs or, conversely, if perceptions of their teacher's mindset beliefs influenced students' recollections of their teacher's behavior and practices. To address this, the current study presents students with teaching behaviors and practices and asks students to quickly categorize those behaviors as indicative of teachers' fixed or growth mindset beliefs. This approach makes causal inference clearer and allows us to examine whether there is strong or weak consensus between students with regard to each teaching behavior. Together, these two methodological changes allow us to replicate and extend past work in this area, building toward a more reproducible science (Open Science Collaboration, 2015), while also strengthening mindset theory, by empirically addressing the social cognitive problem of how students infer the mindset beliefs of their teachers. Moreover, this work offers practical insights for educators, insofar as we identify specific teaching behaviors and practices that can be harnessed by educators to more intentionally signal their growth mindset beliefs (and to avoid unintentionally signaling fixed mindset beliefs) to students.

2. Overview of the Present Research

Given the important role that perceived teacher mindset plays in students' psychological and achievement outcomes (e.g., LaCosse et al., 2021; Muenks et al., 2020, Yeager et al., 2021), more efforts must be directed toward developing an empirically grounded understanding of *how* students come to perceive their teachers as fixed- or as growth-minded. Thus, the present research has two primary aims, the first theoretical and the second practical.

Theoretically, we aim to strengthen the existing social cognitive theory of how teaching behaviors shape students' perceptions of their teachers' mindsets. By examining the ways that students perceive and classify teaching behaviors and practices, we stand to learn a lot about how teachers may (unintentionally) communicate fixed mindset beliefs and how they could more

effectively communicate growth mindset beliefs to their students. To this aim, we examine two main research questions: first, are students consensually differentiating between teaching behaviors and practices? And, second, if there is consensus about which specific behaviors signal growth and fixed teacher mindset beliefs, to what extent do the four teaching behavioral themes identified above explain this variance?

Regarding the first research question, we expect that students will indeed differentiate between teaching behaviors and practices at the item level and that consensus between students will emerge such that students will categorize certain teaching behaviors as signaling teachers' growth mindset beliefs with relatively high consensus while other behaviors will be categorized as signaling teachers' fixed mindset beliefs with relatively high consensus. We also expect there to be some teaching practices and behaviors that are more ambiguous and less clearly categorized by students as signaling fixed or growth mindset beliefs. The social cognitive method we employ (i.e., a multi-trial categorization task) allows us to examine such variance at the item level (within students) as well as the variance between students.

Regarding the second research question, we expect the teaching behavior themes developed in previous work (Kroeper et al., 2022) to explain substantial variance between individual teaching behaviors and practices. We hypothesize that teaching behaviors will more often signal growth mindset beliefs to students when the teacher communicates that everyone can learn; offers opportunities for feedback; responds to struggling students with additional support and attention; and/or places value on learning (over performance). By contrast, we expect that teaching behaviors will more often signal a fixed mindset to students when they articulate that some (or all) students are incapable; fail to provide opportunities for feedback;

respond to student struggle with frustration or resignation; and/or place value on performance (over learning).

Practically, these theoretical insights generate actionable behavior and practice recommendations that educators can leverage to effectively communicate growth mindset messages to their students. To this aim, interested readers can find two lists of teaching behaviors and practices in the Supplementary Information. Appendix 1 provides readers with teaching behaviors that most students (≥ 90%) consensually agree signals *growth mindset beliefs on the part of teachers*. Appendix 2 provides readers with teaching behaviors that most students (≥ 90%) consensually agree signals *fixed mindset beliefs on the part of teachers*.

3. Method

3.1 Participants

One-hundred and eighty-six college students (M_{age} = 18.91 years, 54.8% women, 76.9% White) were recruited from a Midwestern university to participate in a study examining perceptions of teachers and their classroom policies and behaviors. We recruited as many participants as possible throughout a single college semester. In exchange for participation, students received partial credit toward an introductory psychology course requirement.

3.2 Design

We employed a within-subjects, quantitative design, wherein each college student ($N_{Subjects}$ = 186 subjects) categorized each teaching behavior ($N_{Behaviors}$ = 119 behaviors) as indicative of teachers' growth or fixed mindset beliefs ($N_{Observations}$ = 21,333 observations).[2]

[2] Two-hundred participants were initially recruited to participate in this study. Twelve students were excluded from all analyses for taking over 15 minutes to complete the learning module and, therefore, not having enough time to complete the categorization task within the 30-minute study timeframe. Additionally, two students were dropped from the study for failing to complete the personal beliefs survey. As a result, our final sample includes the 186 students who fully completed the study. All participants, regardless of study completion, earned course credit.

3.3 Procedure

Students arrived at the laboratory and were seated at a computer. They were asked to read a brief study information sheet that overviewed the upcoming tasks: a categorization task and a personal beliefs survey. They provided consent and then moved on to complete the study components (described in detail below). After completion (or after 30 minutes had elapsed), students were debriefed and granted their participation credit.

3.3.1 Categorization Task Instructions. We first provided brief instructions to ensure that all students had a clear understanding and definition of fixed and growth mindset beliefs. Specifically, we informed students that people can hold differing beliefs about the fixedness or malleability of intelligence—that people with fixed mindset beliefs tend to believe that intelligence is a fixed, stable trait that does not change very much over time, whereas people with growth mindset beliefs tend to believe that intelligence is a malleable trait that can improve (Hong et al., 1999). It was important to define these terms in advance of the categorization task because students likely arrived at the lab with differing levels of familiarity with the growth and fixed mindset labels and, without clear definitions, their responses (choosing between "Fixed-Minded" or "Growth-Minded") would be less meaningful.[3] Students were then told that they would see a series of behaviors and practices exhibited by teachers. Their task would be to categorize them as "Fixed-Minded" or "Growth-Minded" as they saw fit—we emphasized that

[3] After reading the task instructions, students completed a short 4-item quiz designed to test their comprehension of the instructions (e.g., "Which of the following statements describes a GROWTH mindset?"; Correct answer: "Human traits, like intelligence, can be changed or improved"). Students needed to answer all 4 questions correctly before they could move onto the categorization task. If students answered any questions incorrectly, they were asked to re-read the task instructions and try again. Most participants finished reading the task instructions and completing the comprehension quiz in a single attempt (93.0%) and within three minutes of starting the study (M = 2.19 minutes, SD = 0.37). The task instructions, comprehension quiz questions, and answers are provided in the Supplementary Information.

there were no right or wrong answers, we were just interested in how they categorized teaching behaviors and practices in terms of communicating a teacher's mindset beliefs.

3.3.2 Categorization Task. The *categorization task* consisted of six practice trials, included to help students develop a sense for how the categorization software worked, followed by 119 test trials.[4] The task involved sorting stimuli as quickly as possible into one of two categories.[5] At the beginning of each trial, students clicked the "start" button at the bottom center of their computer screen. Immediately, this button was replaced by a teaching behavior or practice (a cue). At the exact time the cue appeared, students' mouse cursors were automatically locked and centered at the bottom of the screen. The software then automatically unlocked students' mouse after the category labels ("Fixed-Minded" and "Growth-Minded") were revealed in the top corners. Once the category labels appeared, students were free to make their categorization decision by moving their cursor to categorize the behavior or practice as "Fixed-Minded" or "Growth-Minded" (or, in the case of practice trials, as "Fruit" or "Veggie").

[Insert Figure 1]

3.3.2.1 ***Practice Trials.*** For the practice trials, students were shown the names of six fruits and vegetables (i.e., apple, celery) and were encouraged to categorize them as "Fruit" or "Veggie" as quickly and as accurately as possible (see Figure 1, panel A).

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[4] As students categorized the various teaching behaviors, we tracked their computer mouse movements using MouseTracker software (v. 2.84; Freeman & Ambady, 2010). Mouse tracking software is typically used to identify decision conflict—or uncertainty in decision-making. We used mouse tracking software with the intention of exploring the teaching behaviors that students had the most and least difficulty categorizing. Multilevel analyses, however, revealed very little variability in decision conflict at the Behavior-Level (ICC = .02). Instead, most variability in decision conflict occurred at the Student-Level (ICC = .30). This suggests that most behaviors were similarly easy (or difficult) for students to categorize; instead, the variability that we observed suggests that some students simply had more difficulty (or ease) categorizing behaviors overall compared to other students. We provide the full mouse tracking analyses with all the decision uncertainty indicators for interested readers in the Supplementary Information.

[5] Students were asked to sort stimuli as quickly as possible. This instruction is in line with best practices using mouse-tracking software, and it is meant to ensure that students' mouse trajectories reflect real time mental processing of cues (Freeman & Ambady, 2010; Kieslich et al., 2019).

3.3.2.2 ***Test Trials.*** In the test trials, students were shown the 119 teaching behavior cues, one at a time, in randomized order. Their task was to categorize each cue as either "Fixed-Minded" or "Growth-Minded" (see Figure 1, panel B). For half of the trials, the "Fixed-Minded" category label appeared in the top-left corner of the screen and the "Growth-Minded" category label appeared in the top-right corner. For the other half of the trials, the category labels switched sides.[6]

3.3.3 Personal Beliefs Survey. After completing the categorization task, students were directed to complete a survey assessing their personal mindset beliefs and other demographic information.[7]

3.4 Predictors

Each teaching behavior was qualitatively coded by the research team for the presence (+1) or absence (0) of the teaching behavior themes: messages about success, provision of opportunities, response to struggle, and value placement. Multiple themes could be present within a single behavior. For each theme that was marked present, we further coded the teaching behavior's mindset direction as "*growth-signaling*" (+1) or "*fixed-signaling*" (-1) as it pertained to that particular theme.[8] This coding allowed for a theory-driven categorization of each behavior or practice that could later be compared to students' categorizations.[9] See Table 2 for descriptive statistics regarding the teaching behavior themes and Table 3 for correlations among the teaching behavior themes.

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[6] Category label ordering had no detectable effect on students' categorization decisions ($p = .465$).
[7] See the Supplementary Information for full survey measures.
[8] See the Supplementary Information for the teaching behavior themes codebook.
[9] Interrater reliabilities were high (all average measures ICCs > .80). All disagreements were resolved through discussion. See the Supplementary Information for further details about coding and interrater reliability.

Using this theory-driven approach, we found that growth-signaling teaching behavior themes were slightly more represented in the stimulus set (57.59%) than fixed-signaling teaching behavior themes (42.40%). Only 2 behaviors and practices were coded as signaling neither mindset.

[Insert Table 2]

[Insert Table 3]

3.5 Covariates

3.5.1 Student Mindset Beliefs. People often use their own beliefs and motivations as a starting point when perceiving the beliefs and motivations of others (Gordon, 1986). Indeed, in earlier work, students who themselves tended to endorse growth mindset beliefs were somewhat more likely to perceive their teachers as growth-minded; and the same was true for students who tended to endorse fixed mindset beliefs (Kroeper et al., 2022). In the present analyses, however, we were predominantly interested in understanding the link between specific teaching behaviors and practices and students' perceptions of teachers' mindset beliefs above and beyond students' own personal mindset beliefs. For this reason, we included students' personal mindset beliefs as a covariate. We assessed students' personal mindset beliefs using an adapted version of Dweck's validated mindset scale (1999) ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*), that consists of 6 items including "You can learn new things, but you can't really change your basic intelligence" ($\alpha = .712$). All items were scored so that higher values indicate stronger growth mindset beliefs.

3.5.2 Students' General Perceptions of Teachers' Mindset Beliefs. As another covariate, we also examined whether students perceived that most professors at their university, in general, endorse growth or fixed mindset beliefs. Students rated their agreement or

disagreement with 4 items (α = .834), including "In general, most professors at [school name] seem to believe that students have a certain amount of intelligence, and they really can't do much to change it," ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*). All items were scored so that higher values indicate stronger perceived growth mindset beliefs.

3.5.3 Behavioral Cue Warmth. A common misunderstanding of growth mindset (often referred to as "false growth mindset"; Dweck, 2016a) is that people presume that any and all positivity directed toward students is indicative of growth mindset beliefs and, conversely, that any and all negativity is indicative of fixed mindset beliefs. While theoretically, there could be some overlap between warm teaching practices and growth mindset teaching practices, these factors are conceptually distinct (Rattan et al., 2012) and the question of overlap remains an open empirical question since few growth mindset teaching practices have been identified from students' perspective. In the literature, there are clear examples of warmth and mindset divergence. For example, a teacher can be warm and reassuring as they communicate a strong fixed mindset belief—namely that a student is incapable of academic success (e.g., a teacher saying to a struggling student, "It's okay, you're just not a math person" as in Rattan et al., 2012), just as a teacher can be cold and harsh as they communicate a student is capable (e.g., a teacher reprimanding a student for not working as hard as they can). Still, given the seeming ubiquity of false growth mindsets in education (Dweck, 2016b), we suspected that students might conflate—at least to some degree—warmth with growth mindset beliefs in their categorization decisions. For this reason, the research team coded each teaching behavior cue for warmth (1 = *warmth*, 0 = *neither/ambivalent,* -1 = *coldness*) and included this variable as a covariate so that we can examine students' perceptions of mindset above and beyond a cue's warmth or coldness.

3.6 Outcomes

3.6.1 Categorization Decision. At the Observation-Level (N = 21,333 observations), we recorded each students' binary categorization decision for each teaching behavior cue (0 = "*Fixed-minded*", 1 = "*Growth-minded*"). This variable served as the primary outcome in the multilevel binary logistic regression models, addressing the question of whether the teaching behavior themes (i.e., messages about success, provision of opportunities, response to struggle, and value placement) indeed predict students' categorization decisions in the expected direction.

3.6.2 Proportion Growth. At the Behavior-Level (N = 119 behaviors), we computed a *proportion growth score* to quantify the proportion of students who categorized each teaching behavior cue as growth-minded (vs. fixed-minded). This score was calculated by dividing the number of students who categorized the cue as "growth-minded" by the total number of students. Scores closer to 0 indicate that a larger proportion of students categorized the behavior as "fixed-minded," whereas scores closer to 1 indicate that a larger proportion of students categorized the behavior as "growth-minded." This outcome served a descriptive purpose, addressing the question of how much consensus there was between students in their categorization of the teaching behavior cues.

4. Results

4.1 Descriptive Statistics

4.1.1 Categorization Decision. In 62.48% of observations, students categorized teaching behavior cues as signaling growth mindset beliefs (vs. fixed mindset beliefs). Recall, however, that a slight majority of the behavioral cues were qualitatively coded as 'growth-signaling' (57.59%), so this slight preference for growth mindset (vs. fixed mindset) categorization decisions among students is not particularly surprising. See Tables S1 and S2 for full descriptive statistics and correlations at the observation-level of analysis.

4.1.2 Proportion Growth. At the Behavior-Level, proportion growth scores traversed the entire range of possible scores—with some behavioral cues being categorized by all students as fixed-minded and others being categorized by all students as growth-minded. Again, the average proportion growth score was skewed somewhat toward the growth (vs. fixed) side of the spectrum ($M = 0.62$, $SD = 0.42$). As indicated above, however, slightly more cues were a priori identified as growth-signaling (vs. fixed-signaling), so this result was not particularly surprising and was in line with theoretical predictions.

Overall, most teaching behaviors and practices matched the theory-driven categorizations—with high consensus between students. Only 6 cues (5.0% of all cues) had proportion growth scores falling between .40 and .59, indicating very weak consensus; 3 cues (2.5%) had scores between .30 and .39 or between .60 and .69, indicating weak consensus; 13 cues (10.9%) had scores between .20 and .29 or .70 and .79, indicating moderate consensus; and only 1 cue (0.8%) had a score between .10 and .19 or .80 and .89, indicating strong consensus. The remaining 96 cues (80.7%) had proportion growth scores falling between .00 and .09 or .90 and 1.00, indicating very strong consensus. See Tables S3-S4 in the Supplementary Information for full descriptive statistics and correlations at the Behavior-Level of analysis.

4.2 Main Analyses

4.2.1 Research Question 1: Are students consensually differentiating between the various teaching behaviors and practices? Categorization decisions were nested within Behavior and within Student (i.e., a cross-classified, multilevel structure). We calculated intraclass correlation coefficients for these two clustering variables. As predicted, the intraclass correlation coefficients revealed little variance at the Student-Level ($ICC_{Student} = 0.0001$, 95% CI [0.00, 0.02]), but substantial variance at the Behavior-Level ($ICC_{Behavior} = 0.74$, 95% CI [0.72,

0.76]),[10] suggesting that Behavior-Level effects (rather than Student-Level effects) are the main drivers of variation in students' categorization decisions. Thus, students indeed consensually distinguished between individual fixed- and growth-signaling teaching behaviors and practices.

4.2.2 Research Question 2: Do the teaching behavior themes predict categorization decisions? Turning next to our second research question, we examined whether the theoretically-driven teaching behavior themes identified in previous research and used to code the 119 behaviors—messages about success, provision of opportunities, response to struggle, and value placement—explained the substantial Behavior-Level variance in students' categorization decisions and, if so, whether these themes predicted categorization decisions in the expected direction.

To assess this, we conducted a multilevel logistic regression analysis (Hox, 2010; Kreft & Leeuw, 1998) that allowed us to estimate variability in the intercepts for each student and for each teaching behavior cue. [11, 12] Student binary categorization decisions were entered as the outcome variable, and the four teaching behavior codes were entered as fixed predictors. [13, 14] As covariates, we included students' personal mindset beliefs, students' general perceptions of teachers' mindset beliefs, and each behavior's warmth. Finally, we added random effects for

[10] Intraclass Correlation Coefficients were estimated in R version 4.0.2, using the ICCBin package (Hossain & Chakraborty, 2017), because the outcome variable is binary. We adopted the Chakraborty and Sen (2016) resampling method for estimation of the ICC and its confidence interval, due to its increased estimation precision over other approximation methods.

[11] All multilevel analyses were conducted in R version 4.0.2, using the lme4 package (Bates et al., 2015).

[12] Prior to running this model, we examined whether the multilevel logistic regression model improved model fit over a standard logistic regression model. Initially, we estimated an empty logit model, that lacked fixed and random effects, with categorization decision as the binary outcome variable. In a second model we added random effects for Behavior and for Student. Then we compared model fit (see Table 4). The second model offered a clearly superior fit over the first model ($AIC_{Difference}$ = 18,735.71), so we proceeded with the multilevel logistic regression model for the focal analysis.

[13] Effects coding was used to examine the role of the teaching behavior themes on categorization decisions: +1 "*growth-signaling*", -1 "*fixed-signaling*".

[14] Each theme was also entered and examined independently, resulting in similar conclusions. See the Supplementary Information for these analyses.

Behavior and for Student (see Table 5 for the full summary of model fit statistics). Here, effect sizes are depicted as odds ratios (recommended OR benchmarks: 1.68 = small, 3.47 = medium, 6.71 = large; Chen et al., 2010).

Compared to a random intercepts model lacking fixed effects and covariates, a model including random effects, fixed effects, and covariates was a statistically significant improvement ($\chi^2 = 216.71$, $df = 8$, $p < .001$; $AIC_{Difference} = 200.71$; $BIC_{Difference} = 136.97$), even after accounting for its added complexity. Consistent with hypotheses, each of the four teaching behavior themes significantly and uniquely predicted categorization decisions in the expected direction ($ps \leq .001$). Students were significantly more likely to perceive a teaching behavior as growth-minded (vs. fixed-minded) when it indicated that all students are capable of academic success ($b = 3.06$, $SE = 0.34$, $p < .001$; OR = 21.43, 95% CI [11.11, 41.35]), when it provided opportunities to improve ($b = 1.71$, $SE = 0.31$, $p < .001$; OR = 5.52, 95% CI [3.02, 10.08]), when it offered support and reassurance to struggling students ($b = 0.91$, $SE = 0.28$, $p = .001$; OR = 2.48, 95% CI [1.44, 4.27]), and when it valued learning ($b = 1.12$, $SE = 0.21$, $p < .001$; OR = 3.07, 95% CI [2.03, 4.66]). Based on these data, it appears that students *are* attentive to the mindset meanings underlying common teaching behaviors and practices and generally categorize them as predicted by theory. These findings suggest college students interpret mindset cues much like mindset scholars interpret them.

While the analysis above controlled for three covariates—i.e., behavioral cue warmth, students' personal mindset beliefs, and students' general perceptions of teachers' mindset beliefs—the theme codes predict students' categorization decisions as hypothesized whether these covariates are included in the model or not.[15] As expected, cue warmth was a significant

[15] Analyses without covariates are provided in the Supplementary Information for interested readers.

predictor of categorization, such that teaching behaviors coded as warm were more likely to be categorized as growth-minded than those coded as cold (b = 2.37, SE = 0.46, p < .001; OR = 10.69, 95% CI [4.31, 26.56]), and cues coded as neutral were also more likely to be categorized as growth-minded than those coded as cold (b = 1.72, SE = 0.50, p < .001; OR = 5.59, 95% CI [2.11, 14.82]). However, teaching behaviors coded as warm were not significantly more likely to be categorized as growth-minded than those coded as neutral (b = 0.65, SE = 0.43, p = .128; OR = 1.91, 95% CI [0.83, 4.41]). Interestingly, students' personal mindset beliefs did not significantly predict their categorization of teaching behaviors and practices (b = -0.05, SE = 0.07, p = .483; OR = 0.95, 95% CI [0.83, 1.09]), suggesting that students were not merely relying on their own personal mindset beliefs to make these judgments of teachers' behaviors and practices. Lastly, students' general perceptions of teachers' mindset beliefs appeared to influence categorization decisions, such that the more students generally perceived teachers at their school to endorse growth mindset beliefs, the more likely they were to categorize teaching behavior cues as growth-minded (b = 0.22, SE = 0.06, p < .001; OR = 1.24, 95% CI [1.10, 1.40]).

[Insert Table 4]

[Insert Table 5]

5. General Discussion

Over decades, mindset research has shown that growth (vs. fixed) mindset beliefs about intelligence promote positive academic outcomes (Blackwell et al., 2007; Dweck & Bempechat, 1983; Hong et al., 1999; Yeager & Dweck, 2012)—leading students to persevere in the face of intellectual difficulty and, ultimately, attain higher levels of educational achievement. Increasingly though, it has become clear that the power of growth mindsets to boost student motivation and achievement depends largely on contextual factors (Dweck & Yeager, 2019;

Walton & Yeager, 2020; Yeager, 2019, 2021), including instructors' mindset beliefs and practices. When classroom environments support and encourage students' growth mindset beliefs, students are far more likely to flourish (Canning et al., 2019; Yeager et al., 2019, 2021). Indeed, students who *perceive* their teachers to endorse growth (vs. fixed) mindset beliefs report better classroom experiences (e.g., greater belonging, fewer evaluative concerns) and, in turn, engage more in behaviors that promote greater academic success (e.g., attending class, high class engagement; Muenks et al., 2020; see also LaCosse et al., 2021). As we pointed out, however, there are sometimes disconnects between what teachers purport to believe about the nature of intelligence and what students perceive their teachers as believing (Kroeper et al., 2022). Moreover, no study has brought together the many fixed- and growth-mindset teaching behaviors and practices in the literature to examine how students perceive these behaviors and the teacher mindset beliefs that students infer from them. The purpose of the present research is to bridge this gap in the literature by illuminating the teaching behaviors and practices that inform *students'* perceptions of teachers as growth-minded or as fixed-minded. Taken together, this research can help teachers understand how to more effectively communicate growth mindset messages to their students, namely by increasing the collective understanding of how students categorize certain teaching behaviors as fixed- or growth-minded.

In the present study, students were presented with a series of teaching behaviors and asked to categorize them as either growth-minded or fixed-minded. Consistent with hypotheses, all four teaching behavior themes drawn from previous literature (Kroeper et al., 2022) were statistically significant predictors of students' perceptions of teachers' mindset beliefs: messages about success, provision of opportunities, response to struggle, and value placement. We take

each of these theory-driven categories in turn to show how the specific teaching behaviors categorized by students aligned with the theory-driven categories identified in the literature.

First, and fairly straightforwardly, **messages about success** that communicate all students are capable of academic success were perceived by students as signaling that a teacher has a growth mindset. For example, 97% of students categorized the cue: *"At the start of the semester, the professor says, 'This course is difficult, but I know you can all rise to the challenge'"* as growth-minded. However, behavioral cues that communicated that some students were incapable of academic success were perceived by students as signaling fixed mindset beliefs on the part of teachers. For example, 100% of students categorized the cue: "*At the start of the semester, the professor says, 'Some of you won't do well in this class, no matter how hard you try*'" as fixed-minded. Notably, out of the four teaching behavior themes, this theme was the strongest predictor of student-perceived teacher mindset beliefs (odds ratio = 21.43), perhaps due to the clarity of the signal and the explicitness of the messages. Messages about success make a teacher's beliefs about students' abilities and what it takes to be successful (innate talent vs. hard work and good strategies) unambiguous.

Second, when teaching behaviors involved **opportunities for feedback and practice**, students perceived the behavior as signaling a teacher's growth mindset. For example, 99% of students categorized the behavior: "*Professor offers additional practice problems*" as growth-minded. By contrast, when teachers fail to provide such opportunities, students perceive these behaviors as signaling a fixed-mindset on the part of teachers. For example, 98% of students categorized the cue: "*Professor is rarely available to help students outside of class*" as fixed-minded.

Third, when teachers **respond to students' struggle** with additional strategies and reassurance that improvement is possible, students perceived the teacher to have a growth mindset. For example, 98% of students categorized the behavior: "*To struggling students, the professor says, 'Mistakes are opportunities to learn"*" as growth-minded. Conversely, when teachers respond to students' struggle with frustration or with resignation that improvement is impossible, students perceived the teacher to have a fixed mindset. For instance, 98% of students categorized the cue: '*To struggling students, the professor says, "It's okay, you're just not a math person"*" as fixed-minded.

Lastly, when teaching behaviors and practices **place value** on learning and development through praise (or reprimand), encouragement (or discouragement), or through classroom policies that reward learning and development, students perceived the teacher as growth-minded. For example, 100% of students categorized the cue: "*Professor gives out candy or small prizes to students who try new methods*" as growth-minded. However, when teachers place value on effortless performance or on innate brilliance, students are more likely to perceive the teacher as fixed minded. For example, 96% of students categorized "*Professor reprimands students for being dumb*" as fixed-minded.

These theory-driven teaching behavior themes—messages about success, provision of opportunities, response to struggle, and value placement—are useful because they provide conceptual categories for researchers interested in understanding the types of behaviors that signal teachers' mindset beliefs to students; and they provide some actionable behavioral guidelines for teachers and practitioners interested in cultivating more growth mindset classrooms. It is also important, however, to examine the behaviors that did not align with those themes. For example, we found that the warmth (or coldness) of a behavioral cue sometimes

influenced mindset categorization decisions, such that warmth was conflated with growth-mindedness and coldness with fixed-mindedness, even when the theory-driven behavioral themes would suggest the opposite. For example, the behavior: "*Professor gives out candy or small prizes to students who perform best on the exam*" was a priori hypothesized as a fixed mindset signaling cue by the research team because the behavior rewards performance (vs. learning) goals. However, 58% of students categorized it as growth-minded, likely because the professor was nice and giving out rewards. According to prominent mindset theorists, such misconceptions and over-generalizations (termed *false growth mindset*) are common as mindset research has been popularized and used in practice (Dweck & Yeager, 2019). Importantly though, warmth and coldness perceptions did not always trump students' perceptions of the teachers' mindset beliefs. For instance, while the behavioral cue: "*To struggling students, the professor says, 'It's okay, you're just not a math person'*" may sound warm and reassuring, 98% of students categorized it as fixed-minded, as did the research team, as the cue suggests the teacher's resignation that some people are incapable of math success. Future experiments could be designed to systematically tease apart the warm-cold and fixed-growth mindset dimensions by creating stimuli that vary systematically along these two dimensions, although we would caution researchers who pursue this route to attend to face validity in the behavioral cues that are examined when conducting such a study.

5.1 Theoretical and Practical Contributions

The present research makes important theoretical contributions to mindset theory (Dweck et al., 1995; Hong et al., 1999). Whereas the majority of mindset research has focused on *students' personal mindset beliefs*, this study extends an emerging line of work demonstrating that students' perceptions of their teachers' mindset beliefs greatly influence students'

motivation and achievement (e.g., Canning et al., 2019, 2021; LaCosse et al., 2021 Muenks et al., 2020; Rattan et al., 2018). More specifically, the present research is among the first to draw on social cognitive methods to illuminate the many teaching behaviors and practices that inform students' perceptions of teachers' mindset beliefs. This study demonstrates how 119 specific behaviors drawn from the mindset literature align with the theory-driven behavioral categories of messages about success, provision of opportunities, responses to struggle, and value placed on learning and development; and how each behavior signals a teacher's fixed or growth mindset to students.

Practically speaking, this work offers actionable advice for educators. We suspect that many teachers are interested in learning how to communicate growth mindset beliefs to their students, and some may be unsure of how to do so effectively. The present research practically addresses this need by providing teachers with evidence-based recommendations for behaviors that *students* perceive as signaling growth mindset beliefs (and how to avoid the behaviors that students perceive as signaling fixed mindset beliefs). See the Supplementary Information for two lists that outline these teaching behaviors, ordered by the consensus of students' perceptions.

Going forward, we hope to use the results of this study to develop teacher-focused interventions that help teachers communicate their growth mindset beliefs in the classroom. Although student-focused interventions have been successful, we encourage researchers to consider teacher-focused intervention approaches. Given that direct-to-student mindset interventions are particularly effective when teachers themselves endorse growth mindset beliefs (e.g., Yeager et al., 2021), it is important to help teachers understand how what they say and do in the classroom shapes students' perceptions of their mindset beliefs. Effective teacher-focused mindset interventions would help teachers understand how to communicate and embody the

growth mindset through their teaching practices so that their students perceive them as growth-minded. The present study advances research in this direction, by identifying behavioral themes and illuminating actionable behaviors and practices that could communicate teachers' fixed or growth mindset beliefs to students.

5.2 Limitations and Future Directions

All studies have limitations, and we are hopeful that the limitations here will inspire future research on how teaching behaviors signal teacher mindset in classroom settings. Of course, reading a behavior or practice on a computer monitor is different from experiencing the same behavior or practice in a real-world academic setting. The benefit of asking students to rate these behavioral cues is that we could keep the behaviors and testing environment controlled; however, this high internal validity sacrifices some external validity. In classroom settings, there is likely to be meaning in the way certain teaching behaviors and practices are implemented (e.g., tone or nonverbal behavior) that students might additionally use to categorize their teachers' mindset beliefs. Still, it is important to remember that the teaching behaviors chosen for the present study were sourced from qualitative studies and observational field studies conducted in actual classrooms (e.g., Kroeper et al., 2022; Rissanen et al., 2018), thus they do represent behaviors and practices that are common in classroom settings. Moreover, this method enables a more comprehensive view about how students perceive teachers' mindset beliefs from specific, literature-sourced teaching behaviors than in previous research. In future work, however, researchers could test whether students infer these same teacher mindset beliefs when the learning environment contains the behaviors and practices identified here (e.g., using videotapes of teaching or classroom transcripts).

The specific teaching behaviors studied here were evaluated by college students in the United States and, for this reason, were described in ways that are well-suited to U.S. college contexts. This may mean that some teaching behavior cues will require adaptation before being applied to new educational contexts (e.g., K-12 classrooms; educational settings outside the U.S.). Before adapting teaching behavior *cues*, however, we recommend that educators refer to the four teaching behavior *themes*—i.e., messages about success, provision of opportunities, response to struggle, and value placement—and ensure that their adaptations truly reflect these themes, and that they do so in a contextually authentic way. These teaching behavior themes were sourced from a variety of studies, cutting across different ages and educational contexts (e.g., elementary school through college; U.S. and non-U.S. samples) and, therefore, may be more generalizable than the specific behaviors, though the generalizability of these themes should be directly tested in future research.

The present study greatly expands our previous understanding about the specific teaching behaviors and practices that signal teachers' mindset beliefs to students. Nevertheless, there is more to learn with regard to ambiguous teaching behaviors and practices that sometimes signal fixed mindset beliefs and sometimes signal growth mindset beliefs. Almost all the behavioral cues included in our study fell neatly within the aforementioned theory-driven behavioral themes. Moreover, when more than one theme applied to a given teaching behavior, the mindset direction was mostly consistent (i.e., always growth-signaling or always fixed-signaling). This means that teaching behaviors that signal conflicting mindset messages are still poorly understood (i.e., *ambiguous* mindset cues; Molden & Higgins, 2004). While we did not have enough ambiguous mindset cues to systematically explore here, we suspect that when teachers do not explicitly express the *reason* for their behaviors, practices, or policies (e.g., to help

students learn and develop), their behaviors are likely to be more confusing to students. Further, we suspect that the meaning derived from ambiguous mindset cues will depend on the other behaviors and practices in the learning environment, however this is a question for future research. To investigate cue ambiguity, future work might utilize methods designed to assess decision conflict (e.g., computer mouse-tracking; Freeman & Ambady, 2010) or include a greater number of response options (e.g., including a "mixed-mindset" category, in addition to "growth-minded" and "fixed-minded" categories). Another open question is how students make meaning of inconsistent mindset behaviors and practices. For example, even highly growth-minded teachers are likely to enact fixed-signaling behaviors on occasion. Will students perceive their teacher in line with the majority of their growth-minded behavior, or do small inconsistencies in teacher behavior undermine this perception? Understanding how students make sense of ambiguous and inconsistent behavioral cues is a clear next step for researchers, one that is sure to offer important theoretical and practical contributions.

5.3 Conclusion

The present research contributes to mindset theory by illuminating the behaviors and practices that inform students' perceptions of teachers' mindset beliefs. The takeaways of this work are cautiously optimistic. Teachers, by intentionally engaging in certain growth-signaling behaviors and avoiding other fixed-signaling ones, may be able to create a learning environment infused with growth mindset, which, consistent with previous research, should positively influence students' psychological and achievement outcomes (Canning et al., 2019, 2021; LaCosse et al., 2021; Muenks et al., 2020; Rattan et al., 2018). In particular, teachers can avoid fixed mindset behaviors such as signaling that some students are incapable, that it is a chore to support struggling students and/or provide feedback to them, and that signal effortless

performance and innate brilliance are valued above all else. Instead, by deliberately communicating that all students are capable, providing opportunities for practice and feedback, offering support to struggling students, and explicitly valuing learning and development, teachers can communicate their growth mindset beliefs.

Conflict of Interests Statement

The authors declare no conflict of interests.

Research Disclosure Statement

We report all manipulations, measures, and exclusions in these studies.

Data Availability Statement

The de-identified dataset, codebook, and method file are publicly available on the Open Science Framework (OSF) website (https://osf.io/3jxn4/?view_only=3937dbae146e4e37a2178a9cfda977a0).

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Table 1. *Teaching Behavior Themes and Examples*

Theme	Definition	Growth-Signaling Examples	Fixed-Signaling Examples
Messages about Success	…messages that everyone can (or that some cannot or are unlikely to) make progress and succeed	"At the start of the semester, the professor says, 'I have high expectations for all of my students.'" "At the start of the semester, the professor says, 'This course is difficult, but I know you can all rise to the challenge.'"	"At the start of the semester, the professor says, 'Some of you won't do well in this class, no matter how hard you try.'" "At the start of the semester, the professor says, 'If you do not get the concepts early and quickly, you should drop the course.'"
Provision of Opportunities	…providing many (or few) opportunities for practice and feedback to students	"Professor offers additional practice problems." "Professor allows students to submit work for feedback before turning it in for a grade."	"Professor is rarely available to help students outside of class." "Professor makes it so that the course grade is solely determined by a midterm and a final."
Response to Struggle	…responding to student struggle, confusion, or poor performance with support and additional opportunities to improve (or with frustration and resignation that improvement is not possible)	"To struggling students, the professor says, 'Mistakes are opportunities to learn.'" "When students need help, the professor says, 'It's okay, sometimes it takes time to understand these concepts.'"	"Professor believes that experiencing failure debilitates performance and productivity." "To struggling students, the professor says, 'It's okay, you're just not a math person.'"
Value Placement	…placing value on student learning and development by showcasing improvement or commenting on students' development (vs. placing value on effortless, flawless performance and "natural" brilliance)	"Professor publicly celebrates the students who develop their skills." "Professor tells students that their primary goal for the class should be to build their skills and learn."	"Professor praises students for their brilliance" "Professor gives out candy or small prizes to students who perform best on the exam."

Table 2. *Descriptive Statistics: Teaching Behavior Themes*

Theme	Growth-Signaling	Fixed-Signaling	Total
Messages about Success	11	17	28
Provision of Opportunities	35	15	50
Response to Struggle	28	22	50
Value Placement	36	27	63
Total	110	81	191

Note. Each cue (N_{Cues} = 119) was coded according to whether it was growth-signaling or fixed-signaling for each teaching behavior theme (i.e., messages about success, provision of opportunities, response to struggle, and value placement). Multiple themes could be present within a single cue. Two cues had 0 teacher behavior themes present. Fifty-seven cues had only 1 teacher behavior theme present. Forty-six cues had 2 teacher behavior themes present. Fourteen cues had 3 teacher behavior themes present. Zero cues had all 4 teaching behavior themes present. Overall, there were slightly fewer fixed-signaling themes in this stimulus set (42.40%) than growth-signaling themes (57.59%).

Table 3. *Correlations among Teaching Behavior Themes*

Measure	*1.*	*2.*	*3.*	*4.*
1. Messages about Success	--			
2. Provision of Opportunities	.084	--		
3. Response to Struggle	.224*	.519***	--	
4. Value Placement	.107	.306**	.207*	--
5. Behavioral Cue Warmth	.358***	.597***	.518***	.275***

Note. Pearson correlations (N_{Cues} = 119). Each cue was coded according to whether it was growth-signaling or fixed-signaling for each teaching behavior theme. Multiple themes could be present within a single cue. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 4. *Summary of Model Fit Statistics*

		Model 1			Model 2		
Fixed Effects		Est.	*SE*	*p*	Est.	*SE*	*p*
	Intercept	0.51	0.01	< .001	0.97	0.35	.005
Random Effects		Est.	*SD*		Est.	*SD*	
	Student	--	--		0.38	0.62	
	Behavior	--	--		13.78	3.71	
Testing Effects							
	Deviance	28,230			9,491		
	AIC	28,232			9,497		
	BIC	--			9,521		
	df Residual	21,332			21,330		

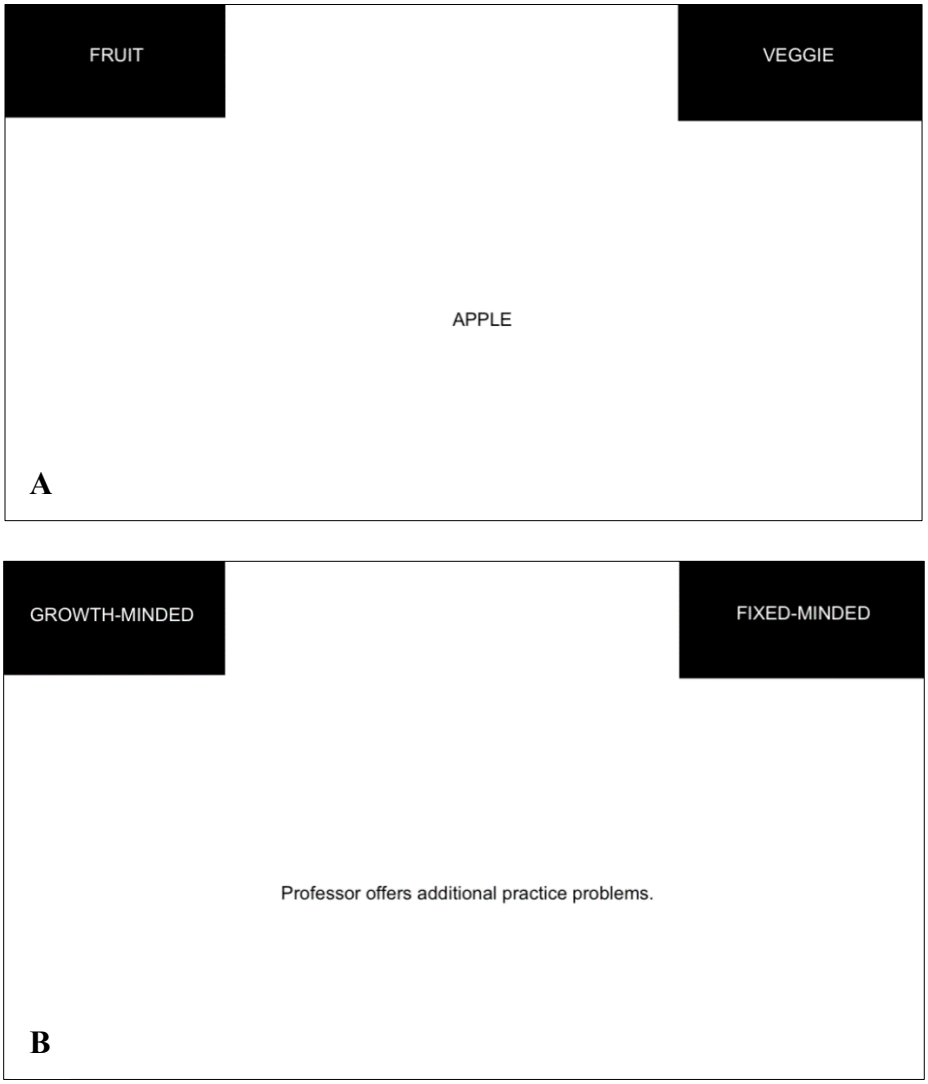
Note. Model 1 refers to the empty model and Model 2 refers to the random intercepts model. In both models, the outcome is Categorization Decision, a binary variable measured at the Observation-level. In Model 2, we are estimating two random effects: Student, Behavior. $N_{Observations}$ = 21,333, $N_{Students}$ = 186, $N_{Behaviors}$ = 119.

Table 5. *Summary of Model Fit Statistics*

	Model 2			Model 3		
Fixed Effects	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept	0.97	0.35	.005	0.79	0.37	.035
Messages about Success	--	--	--	3.06	0.34	< .001
Provision of Opportunities	--	--	--	1.71	0.31	< .001
Response to Struggle	--	--	--	0.91	0.28	.001
Value Placement	--	--	--	1.12	0.21	< .001
Covariates	Est.	*SE*	*p*	Est.	*SE*	*p*
Students' Personal Mindset Beliefs	--	--	--	-0.05	0.07	.483
Students General Perceptions of Teacher Mindset Beliefs	--	--	--	0.22	0.06	< .001
Behavioral Cue Warmth (vs. Neutral)	--	--	--	-0.65	0.43	.128
Behavioral Cue Warmth (vs. Coldness)	--	--	--	-2.37	0.46	< .001
Random Effects	Est.	*SD*		Est.	*SD*	
Student	0.38	0.62		0.35	0.59	
Behavior	13.78	3.71		2.17	1.47	
Testing Effects						
Deviance	9,491			9,274		
AIC	9,497			9,296		
BIC	9,521			9,384		
df Residual	21,330			21,322		

Note. Model 2 refers to the random intercepts model, already reported in Table 4. Model 3 refers to the focal model. In both models, the outcome is Categorization Decision, a binary variable measured at the Observation-level and we are estimating two random effects: Student, Behavior. In Model 3, "warm" is set as the reference category for the Behavioral Cue Warmth covariate. $N_{\text{Observations}}$ = 21,333, N_{Students} = 186, $N_{\text{Behaviors}}$ = 119.

Figure 1. *Categorization Task: Visual Representation of Computer Screen*



Note. During practice trials (see panel A), students were shown a fruit or vegetable word and were prompted to categorize it as "FRUIT" or "VEGGIE." In the test trials (see panel B), students were shown a teaching behavior cue and were prompted to categorize it as "GROWTH-MINDED" or "FIXED-MINDED.

Supplementary Information

Table of Contents

Appendices

Appendix 1

Growth-Signaling Teaching Behaviors

The following teaching behaviors signaled a growth mindset to the majority of participating college students (≥ 90% of students; all cues belonging to the "very strong agreement" cluster). In the table, teaching behaviors are ordered by their proportion growth score, with higher scores indicating greater student consensus that the cue signals a growth mindset. We have also indicated the relevant "growth-signaling" teaching behavior themes present in each cue (+1).

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.93	Professor says, "The process you use to find the answer is more important than the end result."			1	1
0.93	When students need help, the professor says, "It's okay, sometimes it takes time to understand these concepts."			1	
0.93	Professor bumps up students' final grades if they put in a lot of effort during the semester.				1
0.94	Professor presents information about the class grades throughout the semester so that struggling students are motivated to seek help.		1	1	
0.94	Professor makes class participation part of the overall course grade so they can better engage with the material.		1		1
0.94	Professor recommends online resources that supplement course content.		1		
0.94	Professor says, "If you come to the lectures, do the homework and practice sets, and seek help when you're struggling, you should all be able to do well in this course."	1	1	1	
0.94	Professor monitors students' progress in the course to make sure all students stay on track with their learning.				1
0.95	Professor believes failure is an important part of the learning process.			1	1
0.95	Professor assigns self-reflection activities		1		

Supplementary Information

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.95	Professor adjusts instruction speed based on student feedback.			1	
0.96	Professor allows students to submit work for feedback before turning it in for a grade.		1		
0.96	Professor adapts instruction as needed.			1	
0.96	Professor's class policy requires students to regularly attend class so they can better engage with the material.		1		1
0.96	Professor publicly celebrates the students who develop their skills.				1
0.96	Professor explains concepts so that students can apply them outside the classroom.				
0.96	Professor shows struggling students different ways to solve a problem.		1	1	
0.97	Professor solicits anonymous student feedback about how the course is going so that she can better support student learning.				1
0.97	Professor tells students that they are expected to participate in class so they can engage with the material and learn.		1		1
0.97	Professor gives out candy or small prizes to students who put in a lot of effort.				1
0.97	Professor gives out candy or small prizes to students who show the most improvement on the exam since the previous one.				1
0.97	Professor publicly celebrates the students who overcome an academic struggle.				1
0.97	Professor encourages asking questions during class time.		1	1	1
0.97	Peer-review activities are made available.		1		
0.97	Professor teaches multiple methods to solve a problem in order to foster deep learning of the material.		1		1

Supplementary Information

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.97	Professor believes that he can get through to even the most struggling student.	1		1	
0.97	At the start of the semester, the professor says, "This course is difficult, but I know you can all rise to the challenge."	1			
0.97	Peer-review activities are made available to help students learn.		1		1
0.97	Professor encourages students to visit the academic support center to improve their work.		1	1	1
0.97	Professor encourages students to work with a tutor.		1	1	1
0.98	Professor reviews how to solve the commonly missed questions after the test in order to help students understand how to improve in the future.		1	1	
0.98	Professor discusses student feedback about the course with the class so he can better support student learning.				1
0.98	To a student who did poorly on the exam, the professor says, "You should visit my office hours or the TA's office hours to review the exam material."		1	1	
0.98	Professor adjusts instruction style based on student feedback.			1	
0.98	Professor assigns self-reflection so students can assess how they have improved.		1		1
0.98	Professor adapts instruction as needed to make sure students are learning.			1	1
0.98	Professor encourages students to work with a tutor to improve their work.		1	1	1
0.98	Professor recommends a variety of study strategies to struggling students.		1	1	
0.98	To struggling students, the professor says, "Mistakes are opportunities to learn."			1	

Supplementary Information

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.98	At the start of the semester, the professor says, "Any student can do well in my class."	1			
0.98	At the start of the semester, the professor says, "Even if you haven't mastered these concepts yet, you can still succeed."	1		1	
0.98	Professor's class policy allows students to make up missed assignments because he believes students should have a second chance to learn.		1	1	1
0.98	Professor helps students cultivate positive attitudes about learning.				1
0.98	Professor tells students that their primary goal for the class should be to build their skills and learn.				1
0.98	Professor recommends online resources that supplement course content to increase students' mastery of the topic.		1		1
0.98	Professor provides timely feedback on assignments so students can learn from their mistakes.		1	1	1
0.99	Professor encourages students to provide ways to improve the course on course evaluations.				1
0.99	Professor allows students to correct errors and turn in the revisions in order to improve their grade on the assignment.		1	1	-1
0.99	Professor encourages students to email questions so they can improve their understanding of the material.		1	1	1
0.99	Professor believes she can help all students make significant improvements.	1			
0.99	Professor offers additional practice problems.		1		
0.99	Professor tries different ways of explaining the course material.		1		
0.99	Professor encourages students to attend office hours.		1		1
0.99	Professor believes she can increase every student's intellectual ability.	1			

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.99	Professor believes that anyone can be a top student in the class.	1			-1
0.99	Professor makes homework assignments part of the overall course grade so students are motivated to practice.		1		1
0.99	At the start of the semester, the professor says, "It may be challenging, but all of you can do well if you work hard, seek help, and try different learning strategies."	1			
0.99	Professor and TAs hold review sessions before each exam to help struggling students understand the material.		1	1	
0.99	Professor offers additional practice problems to improve learning.		1		1
0.99	Professor discusses ways students can improve their grades throughout the semester.		1	1	-1
1.00	Professor gives out candy or small prizes to students who try new methods.				1
1.00	Professor tries different ways of explaining the course material to ensure that all students understand.	1	1	1	

Appendix 2

Fixed-Signaling Teaching Behaviors

The following teaching behaviors signaled a fixed mindset to the majority of participating college students (≥ 90% of students; all cues belonging to the "very strong agreement" cluster). In the table, teaching behaviors are ordered by their proportion growth score, with lower scores indicating greater student consensus that the cue signals a fixed mindset. We have also indicated the relevant "fixed-signaling" teaching behavior themes present in each cue (-1).

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.00	At the start of the semester, the professor says, "Some of you won't do well in this class, no matter how hard you try."	-1			
0.00	Professor encourages struggling students to drop the class.			-1	-1
0.01	Professor does not hold regular office hours because he believes this extra time will do little to help students in the class.		-1	-1	
0.01	Professor says, "Based on past experiences, only the smartest 80% will pass the exam."	-1			-1
0.01	At the start of the semester, the professor says, "If you do not get the concepts early and quickly, you should drop the course."	-1			
0.01	At the start of the semester, the professor says, "Not all students are capable of doing well in my class."	-1			
0.01	Professor and TAs do not offer review sessions before each exam.		-1		
0.01	Professor tells students that the course syllabus is unchangeable.				
0.01	Professor does not review how to solve commonly missed questions after the test.		-1	-1	

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.01	Professor refuses to answer questions about things students should already know.		-1	-1	
0.01	Professor discourages students from asking questions during class time.		-1	-1	
0.01	Professor believes you can learn new things, but you can't really change your basic intelligence.	-1			
0.02	Professor believes some students are never going to make a lot of progress this year.	-1			
0.02	Professor believes some students are more capable than others.	-1			
0.02	Professor is rarely available to help students outside of class.		-1		
0.02	To struggling students, the professor says, "It's okay, you're just not a math person."	-1		-1	
0.02	Professor is rarely available to help students outside of class because she believes this extra time will do little to help students in the class.		-1	-1	
0.02	To struggling students, the professor says, "Making mistakes is a signal that this topic isn't right for you."	-1		-1	
0.02	Professor believes that being a top student requires a special aptitude.	-1			-1
0.02	Professor says, "The smartest students probably won't need to attend class to do well."	-1			-1
0.02	Professor does not offer review sessions before each exam because he thinks the extra help won't make much of a difference on students' final grades.		-1	-1	-1
0.02	Professor does not review how to solve commonly missed questions after the test because students do not need to understand the question since the test is over.		-1	-1	-1
0.03	Before a challenging lesson, the professor says, "Some of you will understand this lesson, some of you won't."	-1			

Proportion Growth	Cue	Messages about Success	Provision of Opportunities	Response to Struggle	Value Placement
0.03	Professor believes students' abilities stay mostly constant during the course of the school year.	-1			
0.03	Professor does not hold regular office hours.		-1		
0.04	Professor does not give partial credit--the answer is marked either right or wrong.		-1		
0.04	Professor encourages struggling students to consider changing majors.			-1	-1
0.04	Professor reprimands students for being dumb.			-1	-1
0.05	Professor makes it so that the course grade is solely determined by a midterm and a final.		-1		
0.05	At the start of the semester, the professor says, "If you haven't mastered prerequisite concepts, consider dropping this course."	-1		-1	
0.05	At the start of the semester, the professor says, "The students that come in with strong math ability end up being the top performers in the class."	-1			-1
0.07	Professor does not provide extra credit opportunities.		-1	-1	
0.07	When students need help, the professor says, "It's okay if you didn't do as well as you wanted--this subject isn't for everyone."	-1		-1	
0.09	Professor presents information about the class' grades only at the end of the semester because giving students grade information throughout the semester won't make much of a difference in their overall performance.		-1	-1	-1

Supplemental Tables

Table S1

Observation-Level Descriptive Statistics

Measure	*N*	Mean	*SD*	Minimum	Maximum	Skewness
Categorization Decision	21,333	0.62	0.48	0.00	1.00	- 0.52
Decision Conflict	21,333	0.00	0.69	- 1.50	11.44	1.81
Maximum Deviation	21,333	0.49	0.54	- 0.97	1.89	0.07
Area Under the Curve	21,333	1.18	2.07	- 4.37	48.66	3.47
Reaction Time (*seconds*)	21,333	5.87	0.99	4.93	46.37	10.44
X-flips	21,333	7.21	5.41	0.00	53.00	1.99

Note. Decision Conflict (α = .632) is a composite score comprised of standardized decision conflict indicators (i.e., Maximum Deviation, Area Under the Curve, Reaction Time, and x-Flips).

Table S2

Observation-Level Correlations

Measure	*1.*	*2.*	*3.*	*4.*	*5.*
1. Categorization Decision	--				
2. Decision Conflict	-.005	--			
3. Maximum Deviation	.0002	.776***	--		
4. Area Under the Curve	.002	.830***	.696***	--	
5. Reaction Time	-.010	.536***	.195***	.214***	--
6. X-flips	-.005	.615***	.248***	.379***	.069***

Note. Pearson correlations (N = 21,333). † $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$

Supplementary Information

Table S3

Behavior-Level Descriptive Statistics

Measure	*N*	Mean	*SD*	Minimum	Maximum	Skewness
Proportion Growth	119	0.62	0.42	0.00	1.00	- 0.58
Decision Conflict	119	0.002	0.11	- 0.17	0.46	1.24
Maximum Deviation	119	0.49	0.07	0.35	0.68	0.25
Area Under the Curve	119	1.18	0.27	0.68	2.05	0.74
Reaction Time (*seconds*)	119	5.88	0.24	5.60	7.12	2.19
X-flips	119	7.21	0.34	6.45	7.96	- 0.31

Note. All variables aggregated at the Behavior-Level. Reaction Time is depicted in seconds.

Table S4

Behavior-Level Correlations

Measure	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*
1. Proportion Growth	--					
2. Agreement Cluster	.075	--				
3. Decision Conflict	-.008	-.444***	--			
4. Maximum Deviation	-.013	-.384***	.867***	--		
5. Area Under the Curve	.016	-.429***	.935***	.863***	--	
6. Reaction Time	-.020	-.365***	.901***	.624***	.760***	--
7. X-flips	.010	-.174†	.155†	.119	.091	-.082

Note. Pearson correlations ($N = 119$). All variables aggregated at the Behavior-Level. We assigned each behavioral cue to one of five Agreement Clusters based on the behavioral cue's proportion growth score, ranging from 1 (Very Weak Agreement) to 6 (Very Strong Agreement). This clustering served a descriptive purpose, addressing the question of how much consensus there was between students in their categorization of the teaching behavior cues. We were interested in sorting behavior cues by the level of student agreement, regardless of whether the behavior was categorized predominantly as "growth-minded" or as "fixed-minded"—we considered this between-behavior variability important to understand. Proportion growth scores between .40 and .59 were assigned to the "very weak agreement" cluster, because nearly half of students categorized those behaviors as growth-minded and nearly half as fixed-minded. Scores between .30 and .39 and scores between .60 and .69 were assigned to the "weak agreement" cluster. Scores between .20 and .29 and scores between .70 and .79 were assigned to the "moderate agreement" cluster. Scores between .10 and .19 and scores between .80 and .89 were assigned to the "strong agreement" cluster. And scores between .00 and .10 and scores between .90 and 1.00 were assigned to the "very strong agreement" cluster, because nearly all students categorized these behaviors as fixed-minded or nearly all students categorized them as growth-minded, respectively. $^{\dagger}p < .10$, $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table S5

Student-Level Descriptive Statistics

Measure	*N*	Mean	*SD*	Minimum	Maximum	Skewness
Students' Personal Mindset Beliefs	186	4.25	0.83	2.33	6.00	-0.03
Students' Perceptions of Teachers' Mindset Beliefs	186	4.11	0.96	1.00	6.00	-0.40

Note. All variables aggregated at the Student-Level.

Table S6

Student-Level Correlations

Measure	*1.*	*2.*
1. Students' Personal Mindset Beliefs	--	
2. Students' Perceptions of Teachers' Mindset Beliefs	.467***	--

Note. Pearson correlations ($N = 186$). All variables aggregated at the Student-Level. $^{\dagger}\ p < .10$, $^{*}\ p < .05$, $^{**}\ p < .01$, $^{***}p < .001$

Table S7

Summary of Model Fit Statistics

	Model 2			Model 3		
Fixed Effects	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept	0.97	0.35	.005	0.60	0.17	< .001
Messages about Success	--	--	--	3.52	0.34	< .001
Provision of Opportunities	--	--	--	2.44	0.30	< .001
Response to Struggle	--	--	--	1.35	0.29	< .001
Value Placement	--	--	--	1.13	0.23	< .001
Random Effects	Est.	*SD*		Est.	*SD*	
Student	0.38	0.62		0.39	0.62	
Behavior	13.78	3.71		2.70	1.64	
Testing Effects						
Deviance	9,491			9,311		
AIC	9,497			9,325		
BIC	9,521			9,381		
df Residual	21,330			21,326		

Note. Model 2 refers to the random intercepts model, already reported in Table 3. Model 3 refers to the primary model reported in the main text (except without covariates). In both models, the outcome is Categorization Decision, a binary variable measured at the Observation-level and we are estimating two random effects: Student, Behavior. $N_{\text{Observations}} = 21{,}333$, $N_{\text{Students}} = 186$, $N_{\text{Behaviors}} = 119$.

Table S8

Summary of Model Fit Statistics

		Model 1			Model 2		
Fixed Effects		Est.	*SE*	*p*	Est.	*SE*	*p*
	Intercept	< 0.001	0.01	.999	-0.01	0.03	.870
Random Effects		Est.	*SD*		Est.	*SD*	
	Student	--	--		0.14	0.38	
	Behavior	--	--		0.01	0.10	
	Residual	--	--		0.32	0.57	
Testing Effects							
	Deviance		10,136			37,424	
	AIC		44,669			37,432	
	BIC	--				37,464	
	df Residual		21,332			21,329	

Note. Model 1 refers to the empty model and Model 2 refers to the random intercepts model. In both models, the outcome is Decision Conflict, a composite score of the standardized decision conflict indicators (i.e., maximum deviation, area under the curve, reaction time, and x-flips) measured at the Observation-level. In Model 2, we are estimating two random effects: Student, Behavior. $N_{\text{Observations}}$ = 21,333, N_{Students} = 186, $N_{\text{Behaviors}}$ = 119.

Table S9

Summary of Model Fit Statistics

	Model 2			Model 3		
Fixed Effects	Est.	*SE*	*p*	Est.	*SE*	*p*
Intercept	-0.01	0.03	.870	0.20	0.16	.183
Messages about Success	--	--	--	-0.12	0.02	< .001
Provision of Opportunities	--	--	--	-0.07	0.02	< .001
Response to Struggle	--	--	--	-0.01	0.02	.511
Value Placement	--	--	--	0.03	0.02	.078
Covariates	Est.	*SE*	*p*	Est.	*SE*	*p*
Students' Personal Mindset Beliefs	--	--	--	-0.03	0.04	.444
Students General Perceptions of Teacher Mindset Beliefs	--	--	--	-0.06	0.03	.051
Behavioral Cue Warmth (vs. Neutral)	--	--	--	0.06	0.02	.008
Behavioral Cue Warmth (vs. Cold)	--	--	--	0.05	0.02	.004
Behavior Cue Character Length	--	--	--	0.002	<0.001	< .001
Random Effects		Est.	*SD*		Est.	*SD*
	Student	0.14	0.38		0.14	0.37
	Behavior	0.01	0.10		0.01	0.07
	Residual	0.32	0.57		0.32	0.57
Testing Effects						
	Deviance	37,424			37,340	
	AIC	37,432			37,366	
	BIC	37,464			37,469	
	df Residual	21,329			21,320	

Note. Model 2 refers to the random intercepts model, already reported in Table S8. In both models, the outcome is Decision Conflict, a composite score of the standardized decision conflict indicators (i.e., maximum deviation, area under the curve, reaction time, and x-flips) measured at the Observation-level. Additionally, both models estimate two random effects: Student, Behavior. $N_{Observations}$ = 21,333, $N_{Students}$ = 186, $N_{Behaviors}$ = 119.

Supplemental Analyses

Cue Coding and Reliability Analyses

Two coders independently reviewed each teaching behavior ($N_{Behaviors}$ = 119) for the mindset themes reported in the main text (i.e., messages about success, provision of opportunities, response to struggle, and value placement). Multiple mindset themes could be present within a single behavior.

Each teaching behavior was qualitatively coded for the presence (+1) or absence (0) of the mindset themes. If a mindset theme was marked present, coders further indicated the teaching behavior's mindset direction as "growth-signaling" (+1) or "fixed-signaling" (-1).

Reliability analyses were conducted in SPSS, using an Absolute-Agreement, Two-Way Random-Effects Model, average measures (see Koo & Li, 2016). All interrater reliabilities were quite high (all ICCs > .800), indicating good interrater agreement, see Table S10. All disagreements were resolved through discussion (via email).

Table S10. Results of ICC Calculation in SPSS Using Average-Rating, Absolute-Agreement, 2-Way Random-Effects Model

		95% Confidence Interval		F Test with True Value 0			
	ICC	Lower	Upper	Value	*df*1	*df*2	*p*
Messages about Success (Presence)	.941	.915	.959	17.01	118	118	< .001
Messages about Success (Direction)	.956	.937	.969	22.81	118	118	< .001
Provision of Opportunities (Presence)	.925	.888	.949	14.05	118	118	< .001
Provision of Opportunities (Direction)	.953	.930	.968	22.43	118	118	< .001
Response to Struggle (Presence)	.873	.817	.911	7.91	118	118	< .001
Response to Struggle (Direction)	.901	.858	.931	10.25	118	118	< .001
Value Placement (Presence)	.800	.713	.861	5.09	118	118	< .001
Value Placement (Direction)	.905	.861	.935	11.09	118	118	< .001

Categorization Decision Analyses (without Covariates)

In the main text, we reported a multilevel logistic regression analysis that included two covariates (i.e., behavioral cue warmth and students' personal mindset beliefs). Although the conclusions drawn from the analysis are the same whether or not these covariates are included, for full transparency, we will report the analysis without covariates below.

Student binary categorization decisions were entered as the outcome variable, and the four teaching behavior themes were entered as fixed predictors. Lastly, we added random effects for Behavior and for Student (see Table S7 for the full summary of model fit statistics). Compared to a random intercepts model lacking fixed effects, this new model, which included random effects *and* fixed effects, was a statistically significant improvement ($\chi^2 = 179.59$, $df = 4$, $p < .001$; $AIC_{Difference} = 171.59$; $BIC_{Difference} = 139.72$), even after accounting for its added complexity. As with the results reported in the main text, each of the four teaching behavior themes significantly and uniquely predicted categorization decisions in the expected direction ($ps < .001$). Students were significantly more likely to perceive a teacher as growth-minded (vs. fixed-minded) when they indicated that all students are capable of academic success ($b = 3.52$, $SE = 0.34$, $p < .001$, odds ratio = 33.82), when they provided opportunities to improve ($b = 2.44$, $SE = 0.30$, $p < .001$, odds ratio = 11.50), when they offered support and reassurance to struggling students ($b = 1.35$, $SE = 0.29$, $p < .001$, odds ratio = 3.85), and when they valued learning ($b = 1.13$, $SE = 0.23$, $p < .001$, odds ratio = 3.11). Consistent with the conclusions drawn when covariates are included in the model (as reported in the main text), it appears that students *are* attentive to the mindset meanings underlying common teaching behaviors and categorize them as predicted.

Categorization Decision Analyses

(Examining Each Mindset Theme Independently)

In the main text, the four mindset themes were entered into Model 3 all at the same time. For transparency, below we report the results when each mindset theme is entered independently. Importantly, the conclusions remain the same.

When the messages about success theme is entered independently (with the same covariates outlined in the main text), the effect remains strong and statistically significant in the expected direction ($b = 2.94$, $SE = 0.46$, $p < .001$; OR = 18.83, 95% CI [7.71, 46.00]), such that when a teaching behavior cue indicated that all students are capable of academic success, students were significantly more likely to perceive that teaching behavior as growth-minded (vs. fixed-minded). All covariates were interpreted in the same way as reported in the main text.

Next, when the provision of opportunities theme is entered independently (with covariates), the effect remains statistically significant in the expected direction ($b = 1.95$, $SE = 0.43$, $p < .001$; OR = 7.01, 95% CI [3.05, 16.12]), such that when a teaching behavior cue offered opportunities for improvement, students were significantly more likely to perceive that teaching behavior as growth-minded (vs. fixed-minded). All covariates were interpreted in the same way as reported in the main text.

Then, when the response to struggle theme is entered independently (with covariates), the effect remains statistically significant in the expected direction ($b = 1.78$, $SE = 0.39$, $p < .001$; OR = 5.93, 95% CI [2.74, 12.82]), such that when a teaching behavior cue offered support and reassurance to struggling students, students were significantly more likely to perceive that teaching behavior as growth-minded (vs. fixed-minded). All covariates were interpreted in the same way as reported in the main text.

Finally, when the value placement them is entered independently (with covariates), the effect remains statistically significant in the expected direction ($b = 1.47$, $SE = 0.31$, $p < .001$; OR = 4.34, 95% CI [2.38, 7.91]), such that when a teaching behavior cue valued learning (vs. innate brilliance), students were significantly more likely to perceive that teaching behavior as growth-minded (vs. fixed-minded). All covariates were interpreted in the same way as reported in the main text.

Mouse Tracking Analyses

Method

As students made their categorization decisions, we also tracked their computer mouse movements using MouseTracker software (v. 2.84; Freeman & Ambady, 2010). Mouse tracking software is typically used to identify decision conflict—or uncertainty in decision-making. We used mouse tracking software with the intention of identifying the teacher behavioral cues that students had the most difficulty categorizing. Multilevel analyses, however, revealed very little variability in decision conflict at the Behavior-Level (ICC = .02). As a result, we saw little utility in categorizing the cues by their mean level of decision conflict. To be fully transparent with readers, however, our mouse tracking analyses are described in detail below.

Apparatus

For the *categorization task*, we utilized MouseTracker software (v. 2.84; Freeman & Ambady, 2010). The screen resolution was set to 1024 × 768. All students used computers running either Windows 8 or Windows 10, with a Dell Optical Mouse (MS116) and a mousepad. We used computer mouse-tracking software to measure students' real time mental processing of mindset cues into perceived teacher mindset beliefs. Motor movements (e.g., the hand motions of someone operating a computer mouse) are continuously updated as people process incoming information (Song & Nakayama, 2008). Thus, mouse-tracking is useful for revealing real-time decision conflict by detecting and recording manual movements while people make categorical decisions, giving insight into the psychological process of decision-making (Freeman, 2018; Stillman et al., 2018).

Procedure

As described in the main text, participants arrived at the lab in small groups. Between one and five students could be accommodated at a single time. Students were seated at an available computer and asked to read a brief study information sheet that overviewed the upcoming tasks: a learning module, a categorization task, and a personal beliefs survey. The *learning module* and *personal beliefs survey*

procedures were fully outlined in the main text. Below, we will describe the mouse-tracking components of the categorization task in greater detail.

Categorization Task. To prevent students from being hyperaware of their mouse movements and, as a result, consciously trying to control those movements, students were told that this was a "categorization task," rather than a "mouse-tracking task." The *categorization task* consisted of six practice trials, included to help students develop a sense for how the software worked, followed by 119 test trials. For both the practice and test trials, the task involved sorting stimuli as quickly and as accurately as possible into one of two categories.

At the beginning of each trial, students clicked the "start" button at the bottom center of their computer screen. Immediately, this button was replaced by a cue. At the exact time the cue appeared on screen, students' mouse cursors were automatically locked and centered at the bottom the screen, only unlocking after the category labels were revealed in the top corners. To allow students sufficient time to read each cue, the onset of category labels was delayed 4500 milliseconds after cue presentation. Once the category labels appeared, students were free to make their categorization decision.

If students failed to move their computer mouse within 2000 milliseconds of category label onset, they received a warning message notifying them to move faster on subsequent trials. Including this warning message is consistent with best practice recommendations (Scherbaum & Kieslich, 2018). Its purpose is to ensure that students' mouse trajectories reflect their cognitive processing of the cue. That is, students should be making their categorization decisions as they are moving their computer mouse. If, instead, students are making their categorization decisions *before* moving their computer mouse, then their computer mouse trajectory data would not be indicative of their decision-making process. Trials in which students spent longer than 5000 milliseconds to initiate mouse movement were discarded from all analyses (3.7% of total trials).

Practice Trials. For the practice trials, students were shown the names of fruits and vegetables (i.e., apple, celery) and were encouraged to categorize them as "Fruit" or "Veggie" as quickly and as accurately as possible.

Test Trials. In the test trials, students were shown various teacher statements and behavioral cues. Their task was to categorize those cues as either "Growth-Minded" or "Fixed-Minded." For half of the trials, the "Fixed-Minded" category label appeared in the top-left corner of the screen and the "Growth-Minded" category label appeared in the top-right corner of the screen. For the other half of the trials, the category labels switched. These cues were drawn from the mindset literature (Barger, 2018; Canning et al., 2019; Muenks et al., 2020; Rattan et al., 2018; Sun, 2018). Cues were presented to students in a randomized order.

Outcome Measures

Decision Conflict Indices. As students categorized each cue, the MouseTracker software recorded several uncertainty indicators that quantified students' computer mouse movements—a *maximum deviation score*, an *area under the curve score*, an *X-flips score*, and a *reaction time score*. If students were certain about their categorization decision, their computer mouse trajectory should reflect that certainty by approximating a straight path from the start button (at the bottom center of the computer screen) to the selected answer choice (in one of the top corners). If, instead, students were uncertain about their decision, their mouse trajectory should indicate this decision conflict by being more curved and veering somewhat toward the unchosen option (*maximum deviation* and *area under the curve*), by being more variable in its direction along the X-axis (*X-flips*), and/or by being slower (*reaction time*). At the Observation-Level, these decision conflict indicators were standardized, and a composite score was created (α = .632). At the Behavior-Level (N = 119), we computed mean scores of the decision conflict indicators for each cue and calculated a mean composite score.

Covariates

Like in the main text, we included student mindset beliefs, students' general perceptions of teachers' mindset beliefs, and behavioral cue warmth as covariates (see main text for measurement details). New to these analyses, we included behavior cue character length as an additional covariate.

Behavior Cue Character Length. Cues varied widely in their character length—ranging from 37 characters to 214 characters (M = 90.00, SD = 32.36). On average, we expect that the lengthier cues

will take longer for students to read and, possibly, to cognitively process than the shorter cues. Considering that reaction time is a component of the decision conflict composite score, we controlled for cue character length in all analyses involving the decision conflict outcome.

Results

Descriptive Statistics

We ran diagnostic checks to examine the linear relationships between the decision conflict indicators at the Observation-Level. If all four indicators are indeed measuring some aspect of uncertainty in decision-making, then we should expect these indicators to be positively correlated with one another—even if only to a modest degree. As expected, all indicators were significantly, positively correlated at the Observation-Level (all rs $\geq .07$, all ps $< .001$; see Table S2). At the Behavior-Level, we again examined whether the decision conflict indicators positively correlated with one another. Indeed, maximum deviation was strongly, positively correlated with area under the curve ($r = .87$, $p < .001$) and reaction time ($r = .63$, $p < .001$). Likewise, area under the curve was strongly, positively correlated reaction time ($r = .76$, $p < .001$). Unexpectedly, X-flips were not significantly correlated with the other decision conflict indicators at the Behavior-Level (ps $\geq .23$; see Table S4).

Next, we examined whether Agreement Cluster was *negatively* associated with Decision Conflict at the Behavior-Level. We expected that as more students agreed about the categorization of a particular cue (regardless of whether they believed it signaled growth or fixed mindset beliefs), average levels of decision conflict should be *lower*. This is because high levels of student agreement should mean that students were, overall, *less conflicted* about the mindset meaning of the cue. Indeed, we found that as agreement grew stronger, maximum deviation ($r = -.38$, $p < .001$), area under the curve ($r = -.43$, $p < .001$), and reaction time ($r = -.37$, $p < .001$) all significantly decreased. We found a similar pattern for X-flips ($r = -.17$, $p = .06$), but the association was not statistically significant. Taken together, these findings suggest that for cues with greater categorization agreement, students took a more direct mouse path from the bottom of the screen to their categorization choice and took less time to make their categorization decision.

Main Analyses

Is there substantial variance in categorization decisions at the Behavior- and Student-Levels? Consistent with the analyses in the main text, we tested whether multilevel models better accounted for the nested data structure than a standard regression model. First, we estimated an empty linear regression model, that lacked fixed and random effects, with the standardized decision conflict composite at the Observation-level as the outcome variable. In a second model we included random effects for Behavior and for Student (see Table S8). As expected, the second model provided a superior fit over the first model ($AIC_{Difference}$ = 7,237), so we continued with multilevel random intercept models for the remaining analyses.

It should be noted that little variance in decision conflict is being explained by factors at the Behavior-Level (Est. = 0.01, *SD* = 0.10). This does not necessarily mean that all possible teaching behavior cues will be categorized by students with similar ease or difficulty. Instead, this may be a function of the specific cues we chose to study for this project. Perhaps they are "too" clear-cut. At least one of the four teaching behavior themes applied to almost all behavior cues (98.3%) and, as readers may recall from the main text, the majority of cues were categorized with a high degree of consensus (80.7% cues in the "very strong agreement" cluster). In future work, researchers may decide to include intentionally vague or ambiguous cues to better understand whether decision conflict is occurring in this area.

Do the teaching behavior themes predict categorization decisions? We expected that the presence (vs. absence) of the teaching behavior themes would decrease decision conflict. To examine this prediction, we conducted a multilevel linear regression analysis. The standardized decision conflict composite at the Observation-level was entered as the outcome variable, and the four behavior themes

were entered as fixed predictors.[16, 17] As covariates, we included cue character length, student mindset beliefs, students' general perceptions of teachers' mindset beliefs, and behavioral cue warmth. Finally, we added random effects for Behavior and for Student (see Table S9 for the full summary of model fit statistics).

Compared to the random intercepts model described in the previous section, the new model that includes random effects, fixed effects, and covariates provided a better fit to the data ($\chi^2 = 84.56$, $df = 9$, $p < .001$; $AIC_{Difference} = 66$), but the new model's added complexity may not be worth it ($BIC_{Difference} = -5$). The presence of the Messages about Success theme ($b = -0.11$, $SE = 0.02$, $p < .001$) and the Provision of Opportunities theme ($b = -0.07$, $SE = 0.02$, $p < .001$) both significantly decreased decision conflict; however, the presence of the Response to Struggle theme ($b = -0.01$, $SE = 0.02$, $p = .511$) and the Value Placement theme ($b = 0.03$, $SE = 0.02$, $p = .078$) did not. We hesitate to draw too much meaning from this analysis, because there is very little variance at the Behavior-Level. We wonder whether the teaching behavior themes will decrease decision conflict when there is a broader range of cues, some with clear mindset messages (like in the present study) and others with more vague or ambiguous mindset messages.

Turning to our covariates, as expected, behavior cue character length significantly increased decision conflict ($b = 0.002$, $SE = 0.0003$, $p < .001$). That is, cues that took longer to read were, on average, more difficulty to categorize. Behavior cue warmth decreased decision conflict—students exhibited less difficulty categorizing cues that were coded as warmer. That is, relative to teaching behavior cues that were coded as warm, cues coded as neutral ($b = 0.06$, $SE = 0.02$, $p = .008$) and cold produced greater decision conflict ($b = 0.05$, $SE = 0.02$, $p = .004$). Student mindset beliefs exerted no detectable effect on decision conflict ($b = -0.03$, $SE = 0.04$, $p = .44$). Students' general perceptions of teachers' mindset beliefs were a marginally significant predictor of decision conflict, such that the more

[16] Dummy coding was used to examine the role of themes on categorization decisions: +1 "*Theme Present*", 0 "*Theme Absent*".

[17] When effects coding was used for each theme—+1 "*growth-signaling*", -1 "*fixed-signaling*", 0 "*neither*"—there were no significant effects of theme on decision conflict. This suggests that growth-signaling cues were no more difficult for students to categorize than fixed-signaling cues.

students generally perceived teachers at their school to endorse growth mindset beliefs the less decision conflict they exhibited (b = -0.06, SE = 0.03, p = .051).

Discussion

Beyond identifying whether these teaching behaviors were more often categorized as growth- or fixed-minded, using mouse tracking software allowed us to estimate the degree of uncertainty behind these judgments. We hoped that quantifying uncertainty through mouse tracking indicators (i.e., AUC, maximum deviation, X-flips, and reaction time) would allow us to rank order the teaching behavior cues to determine which ones were categorized by students with the least uncertainty. Contrary to our expectations, we found that little variance in decision conflict was explained at the Behavior-Level; instead, considerably more variance in decision conflict could be attributed to Student-Level factors. This finding should not be mistaken to mean that there will be little decision conflict for all possible teaching behavior cues. Instead, this finding may simply be a function of the types of cues we included as stimuli in this study. As we discuss in the main text, few cues included *vague* or *ambiguous* mindset messages. Perhaps if vague or ambiguous cues were included as stimuli, we would see more variance in decision conflict at the Behavior-Level. It seems that, of the cues we tested, they were similarly easy for students to categorize.

Despite low variance at the Behavior-Level, two teaching behavior themes predicted decision conflict. The presence of the Messages about Success and Provision of Opportunities themes significantly reduced decision conflict, suggesting that teachers may be especially interested in enacting teaching behaviors that fall under these themes to quickly and clearly signal their (hopefully growth) mindset beliefs to students.

Limitations

Although we are inferring cognitive processes from mouse trajectories, we cannot directly observe the inner workings of students' minds. Perfectly straight computer mouse trajectories may suggest decision certainty (just as windy, curved paths may suggest uncertainty), but other factors may also influence how students move their cursor during the mouse-tracking task (e.g., technical glitches,

muscle spasms, distraction, anxiety). However, much of this noise variance should be accounted for through the random presentation order of cues. Despite its imperfections, this mouse tracking method provides more insight than ever before into how students make sense of teaching behaviors.

Student-Level Analyses

Participants

One-hundred and ninety-seven undergraduate college students (M_{age} = 18.91 years, 54.8% women, 76.9% White, 9.7% first-generation college students, 98.9% right-handed [18]) were recruited from a Midwestern university student subject pool to participate in the present study. Regarding their current college GPA, 34.4% of students self-reported having between a 3.5 and 4.0 GPA; 34.4% between a 3.0 and 3.4 GPA; 13.4% between a 2.5 and 2.9 GPA; 3.8% between a 2.0 and 2.4 GPA; and 0.5% self-reported having a 1.9 GPA or below. Another 11.8% said that they did not know their current GPA. The remaining 1.6% declined to answer the GPA question. Most students identified as college freshman (69.4%), followed by sophomores (21.5%), then juniors (5.4%), and finally seniors (3.8%).

Measures

The following self-report measures were collected and analyzed at the Student-Level ($N_{Students}$ = 186): *Student Mindset Beliefs*, *Student-Perceived Teacher Mindset,* and *Origins of Mindset Beliefs*.

Student Mindset Beliefs. As described in the main text, we assessed student mindset beliefs on a scale ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*), with items like "You can learn new things, but you can't really change your basic intelligence" (α = .712, 6-items; Dweck, 1999). All items were scored so that higher values indicate growth mindset beliefs about intelligence. In this sample, students' self-reported mindset beliefs gravitated toward the growth side of the mindset continuum (M = 4.25, SD = 0.83).

Student-Perceived Teacher Mindset. Using a scale ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*), we also measured *student-perceived teacher mindset beliefs*, with items like "In general, most professors at [university name] seem to believe that students can learn new things, but they

[18] Previous mouse-tracking research recommends recruiting right-handed individuals due to differences in the mechanics of right- and left-handed people (e.g., Hehman et al., 2015). In pre-screening materials, 100% of recruited students self-identified as right-handed; during the study session, however, 2 participants changed their identification to left-handed.

can't really change their basic intelligence" (α = .83, 4-items; adapted from Muenks et al., 2020). These items were scored so that higher values indicate students perceived their teachers to more strongly endorse growth mindset beliefs about intelligence. Students generally perceived that their university professors more strongly endorsed growth mindset beliefs (M = 4.11, SD = 0.96).

Origins of Mindset Beliefs. Lastly, we asked students to indicate where they believe their personal mindset beliefs came from. Students were asked the following question: "Thinking back on your life, where do you think your beliefs about intelligence come from? Please check all that apply." Response options included: "My family", "My friends", "My elementary school teacher(s)", "My middle school teacher(s)", "My high school teacher(s)", "My college instructor(s)", "I don't really know—this just seems right to me," and "Another source (please specify)." In order from most selected to least selected, students indicated that their mindset beliefs came from their family (93.0%), their high school teachers (77.4%), their friends (64.0%), their middle school teachers (45.7%), their elementary school teachers (38.2%), and their college instructors (38.2%). Additionally, 5.9% of students indicated that a source other than the ones listed was influential (e.g., academic counselors, coaches, books, the internet). Only 14.5% of students did not identify a source, indicating that their mindset beliefs "just seemed right" to them.

Results

Female students were slightly more likely than male students to personally endorse growth mindset beliefs (r = .18, p = .013). Students who self-reported having lower college GPAs more strongly endorsed growth mindset beliefs than students who self-reported having higher college GPAs, though this relationship was fairly weak (r = .19, p = .017). Student race (1 = White, 0 = POC; r = -.12, p = .096), first-generation status (1 = first-generation, 0 = continuing-generation; r = .06, p = .455), and college year (1 = Freshman to 4 = Senior; r = .02, p = .789) did not significantly correlate with personal mindset beliefs.

As can be expected, students who personally endorsed more growth mindset beliefs were also more likely to perceive that university professors more strongly endorsed growth mindset beliefs (r = .47,

$p < .001$), though, because these constructs were measured at the same time, it is unclear from this analysis whether student mindset beliefs influence perceptions of teacher mindsets or whether it's the other way around.

Few correlations among the mindset belief origins (or between mindset belief origins and the other student-level variables) were statistically significant. Students who said that one type of teacher/instructor shaped their mindset beliefs (e.g., elementary school teachers), were more likely to say that other types teachers/instructors (e.g., middle school teachers or college instructors) had shaped their mindset beliefs ($rs \geq .19$, $p \leq .011$).

Preregistered Categorization Predictions

The research team submitted a preregistration plan on the Open Science Framework website in December 2018, prior to data collection and analysis. The study procedure and data exclusion plans were executed as preregistered. However, there have been several deviations from the preregistered plan. Most notably, after preregistering and collecting data, we became aware of internal laboratory results that led us to also code the teaching behavior cues for the four behavior themes described in the main text: messages about success, provision of opportunities, response to struggle, and value placement (Kroeper et al., 2021). Coding the teaching behaviors in this way was not originally preregistered (nor were the resulting analyses). This means that the results described in the main text would be best described as exploratory.

In the preregistration, we made predictions about how each behavioral cue would be predominantly categorized by students (-1 = *Fixed*, 0 = *Mixed*, 1 = *Growth*). The results presented below describe how our original predictions lined up with the data.

Method

Measures

Categorization Predictions. Prior to data collection, the research team made predictions about how each cue would be categorized. We expected 56 of the 119 cues would be mostly categorized as growth-minded (because they predominantly signaled intelligence was malleable), 40 cues would mostly be categorized as fixed-minded (because they predominantly signaled intelligence was rigid), and the remaining 23 cues would be mixed, with a relatively equal number of students categorizing the cue as growth-minded and fixed-minded (because, *at the time*, we viewed them as relatively more subtle with regard to what they signaled about the nature of intelligence). These predictions were preregistered on the Open Science Framework (OSF) website, prior to data processing and analysis.[19]

Results

Were the research team's preregistered categorization predictions accurate?

[19] The preregistration can be found by following this OSF link: https://osf.io/d28aq/?view_only=85cc3df98bc24a92b5fe8eacfa701c39.

First, we examined whether the research team's *preregistered* cue categorizations predicted how students *actually* categorized the teacher behaviors. We expected teacher behaviors to be categorized as growth-minded when the behavior signaled that intelligence was malleable, as fixed-minded when it signaled that intelligence was rigid, and as mixed when the signal about the malleability or rigidness of intelligence was more subtle.

Overall, we found that 92 of the 119 cues (77.3%) were categorized by the majority of students as we predicted (see Table S11).

Table S11

Crosstabulation: Cue Categorization Predictions by Actual Cue Categorization

		Actual Categorization			
		Fixed	Mixed	Growth	Total
Predicted Categorization	Pred. Fixed	32	5	3	40
	Pred. Mixed	6	4	13	23
	Pred. Growth	0	0	56	56
	Total	38	9	72	119

Note. *Actual Categorization was determined by examining the agreement cluster variable. Cues that were sorted into the "Very Weak" and "Weak" Agreement Clusters were categorized as "Mixed", whereas cues sorted into the "Very Strong," "Strong," and "Moderate" Agreement Clusters were categorized as either "Growth" or "Fixed", dependent on their Proportion Growth Score.*

Examining these data at the Observation-Level, a multilevel logistic regression analysis further supported the accuracy of the research team's predictions. [20] In a random intercept model, we entered student categorization decisions as the outcome variable and used the research team's preregistered cue categorization predictions as a fixed effect predictor (1 = growth, 0 = mixed, -1 = fixed). Additionally, Behavior and Student were entered into the model to account for Behavior-Level and Student-Level random effects. The fixed effect of the research team's preregistered categorization predictions on student categorization decisions was again statistically significant, strong, and positive (β = 3.37, *SE* = 0.22, *OR*

[20] All multilevel modeling analyses were conducted using R (version 4.0.2) and the lme4 package (Bates et al., 2015).

= 29.14, $p < .001$). These analyses reveal that the research team's preregistered behavioral cue categorizations strongly predicted students' actual behavioral cue categorizations.

Supplemental Materials

Below are the full study materials students encountered.

Categorization Task Instructions *(correct answers are highlighted)*

Mindsets are people's personal beliefs about the fixedness or malleability of human characteristics, such as intelligence.

Someone with a **Fixed Mindset** believes that intelligence is **fixed**, it's set in stone, and cannot be changed.

Someone with a **Growth Mindset** believes that intelligence can **grow**, it's malleable and can be developed through dedication and effort.

People with a **fixed mindset** believe that intelligence is just a given. They have **a certain amount of brains** and **nothing can change that**.

True or False? People with a fixed mindset believe that intelligence cannot change.

- True
- False

People with a **growth mindset**, on the other hand, see their intelligence as **a quality that can be developed** through their **dedication and effort.**

Sure, they're happy if they're brainy or talented, but that's just the starting point. Their intelligence **can change and improve**.

True or False? People with a growth mindset believe that intelligence can grow and improve.

- True
- False

In addition to having **their own mindset beliefs**, people are often motivated to **figure out the mindset beliefs of important others in their lives**—like their teachers, bosses, parents, etc.

For example, students can approximate their teachers' mindset beliefs by paying attention to the sorts of things their teachers do and say in the classroom.

True or False? A person can monitor what another person says and does to try and figure out whether that person has a fixed or growth mindset.

- True
- False

In today's study, we are interested in **how students perceive their professors' mindsets** by paying attention to what their professors **do** and **say**.

In the **categorization task**, we will present to you a variety of things that **professors could do or say** in the classroom.

Your job will be to categorize those statements and behaviors as "**growth-minded**" or "**fixed-minded**."

Comprehension Quiz *(correct answers are highlighted)*

Which of the following statements describes a **GROWTH mindset**?

- People are born with natural and unchangeable abilities
- Human traits, like intelligence, can be changed or improved
- People cannot change their personal traits

Your professor believes that anyone can be a top student in the class, as long as they are willing to put in the effort. Based on this information, your professor probably has a…

- …fixed mindset
- …growth mindset

Your professor believes that being a top student in the class requires a special aptitude that some students just don't have. Based on this information, your professor probably has a…

- …fixed mindset
- …growth mindset

Which of the following statements describe a **FIXED mindset**?

- People are born with natural and unchangeable abilities
- People can change their personal traits
- All kinds of traits can be changed, with the right strategies and dedication.

Personal Mindset Beliefs Measure

Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1	2	3	4	5	6

1. Being a "math person" (or not) is something that you can't change. Some people are good at math and other people aren't.
2. Experiencing failure inhibits my learning and growth.
3. You can learn new things, but you can't really change your basic intelligence.
4. You have a certain amount of intelligence, and you can't really do much to change it.
5. Experiencing failure debilitates my performance and productivity.
6. If you're not good at a subject, working hard won't make you good at it.

Perceived Professor Mindset Beliefs Measure

Strongly agree	Agree	Somewhat agree	Somewhat disagree	Disagree	Strongly disagree
1	2	3	4	5	6

1. In general, most professors at [school] seem to believe that students have a certain amount of intelligence, and they really can't do much to change it.
2. In general, most professors at [school] seem to believe that being a "math person" (or not) is something that you can't change; that some people are good at math and other people aren't.
3. In general, most professors at [school] seem to believe that students can learn new things, but they can't really change their basic intelligence.
4. In general, most professors at [school] seem to believe that if you are not good at a subject, working hard won't make you good at it.

Origins of Mindset Beliefs Measure

Thinking back on your life, where do you think your beliefs about intelligence come from? Please check all that apply.

- ☐ My family
- ☐ My friends
- ☐ My elementary school teacher(s)
- ☐ My middle school teacher(s)
- ☐ My high school teacher(s)
- ☐ My college instructor(s)
- ☐ I don't really know—this just seems right to me
- ☐ Another source (please specify) _____

Demographics

How **old** are you?

What is your **year** in college?

- o Freshman
- o Sophomore
- o Junior
- o Senior
- o Other (please specify)
- o Do not know
- o Choose not to answer

What is your **dominant hand**?

- o Right-handed
- o Left-handed
- o Hands are equally dominant
- o Do not know
- o Choose not to answer

What is your **gender**?

- Man
- Woman
- Non-binary (please specify the term you use)
- Agender
- Another identity not listed (please specify the term you use)
- Do not know
- Choose not to answer

What is your **race/ethnicity**? (please check all that apply)

- African American/Black
- Pacific Islander (e.g., Hawaii, Guam, Samoa)
- Indian Subcontinent (e.g., India, Pakistan, Sri Lanka, Bangladesh)
- Middle Eastern (e.g., Japan, China, Korea)
- Southeast Asian (e.g., Indonesia, Thailand, Vietnam, Phillipines)
- White (e.g., European-American, Anglo, Caucasian)
- Hispanic-American, Latino(a), Chicano(a)
- Native American (e.g., Cherokee, Choctaw, Inuit, Navajo)
- Another identity not listed (please specify)
- Do not know
- Choose not to answer

Are you the **first** in your family to attend college?

- Yes
- No
- Do not know
- Choose not to answer

What is the **highest level of education** your **mother** or **primary guardian/caregiver** has attained?

- Some high school
- High school graduate, diploma, or equivalent (e.g., GED)
- Some college, no degree
- Trade/technical/vocational training
- Associate's degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree
- Do not know
- Choose not to answer

What is the **highest level of education** your **father** or **secondary guardian/caregiver** has attained?

- Some high school
- High school graduate, diploma, or equivalent (e.g., GED)
- Some college, no degree
- Trade/technical/vocational training
- Associate's degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree
- Do not know
- Choose not to answer

What was your **high school GPA**?

- 3.5 to 4.0 (or above)
- 3.0 to 3.4
- 2.5 to 2.9
- 2.0 to 2.4
- 1.9 (or below)
- Do not know
- Choose not to answer

What is your **current IU GPA**?

- 3.5 to 4.0 (or above)
- 3.0 to 3.4
- 2.5 to 2.9
- 2.0 to 2.4
- 1.9 (or below)
- Do not know
- Choose not to answer

Teaching Behavior Themes Codebook

Theme	Growth-Signaling (+1)	Fixed-Signaling (-1)
Messages about Success	Behavioral cues that suggested all students are capable of success were coded as growth-signaling (11 cues; e.g., "At the start of the semester, the professor says, 'I have high expectations for all of my students'").	Behavioral cues that suggested that some students are incapable of success were coded as fixed-signaling (17 cues; e.g., "At the start of the semester, the professor says, 'Some of you won't do well in this class, no matter how hard you try'").
Provision of Opportunities	Behavioral cues in which teachers provided opportunities for feedback or additional practice were coded as growth-signaling (35 cues; e.g., "Professor offers additional practice problems").	Behavioral cues in which teachers failed to provide such opportunities were coded as fixed-signaling (15 cues; e.g., "Professor is rarely available to help students outside of class").
Response to Struggle	Behavioral cues in which teachers responded to student struggle with supportiveness and additional strategies were coded as growth-signaling (28 cues; e.g., "To struggling students, the professor says, 'Mistakes are opportunities to learn'")	Behavioral cues in which teachers responded to student struggle with frustration and/or resignation were coded as fixed-signaling (22 cues; e.g., "Professor believes that experiencing failure debilitates performance and productivity").
Value Placement	Behavioral cues suggesting that teachers value learning and development were coded as growth-signaling (36 cues; e.g., "Professor publicly celebrates the students who overcome an academic struggle").	Behavioral cues suggesting that teachers value innate brilliance and effortless performance were coded as fixed-signaling (27 cues; e.g., "Professor praises students for their brilliance").

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Link to Deidentified Data Files

Follow this anonymized link to access the deidentified data files, R scripts, and codebook: https://osf.io/3jxn4/?view_only=3937dbae146e4e37a2178a9cfda977a0

**The datasets uploaded to OSF contain only the primary variables of interest. For access to the full datasets (with all variables), please contact the corresponding author.*