

Supplementary Information for

Efficiently exploring the causal role of contextual moderators in behavioral science

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This PDF file includes:

Supplementary text
Tables S1 to S16

Supplementary Information Text

Data and syntax. Anonymized data and syntax from each of the four studies can be accessed here: <https://osf.io/rmf9b/>.

Additional measurement detail.

Study 1 measures.

All items in this study were measured on a 6-point *Strongly disagree—Strongly agree* Likert-type scale unless otherwise noted.

Growth mindset motivational framework. We operationalized participants' growth mindset beliefs in terms of the established construct of a *motivational framework* (see Gunderson et al., 2013). The core of a growth mindset motivational framework is the belief that intelligence is malleable, which sets up associated meaning-making and action tendencies that can either help or hinder performance in school (2). Specifically, adolescents with a *growth mindset motivational framework* (also called an incremental theory motivational framework; Gunderson et al., 2013) tend to view effort, challenges, and persisting in the face of setbacks as routes to greater ability. Those with a *fixed mindset motivational framework* (also called an entity theory motivational framework), on the other hand, may tend to see challenges as risking a display of low ability, and may see setbacks or needing to exert effort as signs of low ability. We pre-registered this measure of participants' motivational frameworks, rather than only their beliefs about the malleability of intelligence, to more fully capture how they make meaning of learning situations and connect more directly with the action tendencies that teachers' affordances might support or undermine. Of note, the findings were the same using a narrower measure of participants' beliefs about the malleability of intelligence.

We measured participants' motivational frameworks with two items assessing participants' beliefs about the malleability of intelligence ("To be honest, you can't really change how intelligent you are", reversed; "You can always substantially change how intelligent you are") and one item measuring their associated beliefs about effort ("When you have to try really hard in a subject in school, it means you can't be good at that subject", reversed; $\alpha = .67$). This short-form measure of participants' motivational frameworks was developed through a pilot study that informed the present research. (We also measured participants' baseline achievement goals, which are another component of the growth mindset motivational framework, and findings are the same if these items are included; see Table S4 for results and the indices document at <https://osf.io/us57r> for items).

Manipulation check. Perceived teacher mindset beliefs were assessed with two items: "This math teacher seems to believe that students can't really change how good they are at math" (reversed) and "This math teacher seems to believe that only some students will understand the hardest problems" (reversed); $r = .71$, $\alpha = .87$. Perceived teacher affordances were assessed with three items: "This math teacher seems like they would only give good grades to students who have a natural 'talent' for math" (reversed), "This math teacher makes me feel like I would be able to learn the material in their class, even if I struggle sometimes," and "This math teacher seems like they would reward students for trying hard and improving"; $\alpha = .78$.

Outcomes. Learning-oriented choices—the focal outcomes—were defined as decisions that would serve to further students' learning, but might come at the cost of performing well or looking "smart". We focused on these decisions for two reasons. First, they may explain the effects of the growth mindset motivational framework on important downstream academic outcomes (3). Understanding such proximal behavioral inclinations is important for identifying the most powerful intervening processes to target with interventions (see Miller et al., 2017). Second, learning-oriented choices are a consequential factor that can propel adolescents toward positive developmental outcomes, providing access to valued careers that are associated with wealth, well-being, and longevity (5).

We measured assignment choice with a hypothetical decision task adapted from previous research (6, 7). Participants were asked to imagine that the teacher handed out two extra credit assignments from which the participant could choose, and that they would get the same number of points for trying either one. One assignment was framed as an *easy review* on which participants would probably get most of the problems right without having to think very much. The other assignment was framed as a *hard challenge* on which participants would probably get most of the problems wrong but might learn something new. We assessed participants' choice of assignment (0 = easy assignment, 1 = hard assignment). Comfort with academic risk-taking was assessed with the three items: "If I were in this teacher's class, I would feel comfortable raising my hand when I am confused," "If I were in this teacher's class, I would feel comfortable going to the teacher for help after class," and "If I were in this teacher's class, I would feel comfortable volunteering to solve a problem on the board in front of my classmates"; $\alpha = .88$.

Covariates. See the indices document at <https://osf.io/us57r> for all covariate items.

Study 2 measures.

Due to space limitations for this study with a national panel of adolescents, we used only representative items from the larger scales in Study 1 to measure each construct (in some cases, only a single item). All items in this study were measured on a 6-point *Strongly disagree—Strongly agree* Likert-type scale unless otherwise noted.

Growth mindset motivational framework. The same pre-registered growth mindset motivational framework composite from Study 1 was used ($\alpha = .57$).

Manipulation check. Perceived teacher mindset beliefs were assessed with one item: "This math teacher seems to believe that students can't really change how good they are at math" (reversed). Perceived teacher affordances were also assessed with one item: "This math teacher seems like they would only give good grades to students who have a natural 'talent' for math" (reversed).

Outcomes. Comfort with academic risk-taking was assessed on a two-item scale: "If I were in this teacher's class, I would feel comfortable raising my hand when I am confused," "If I were in this teacher's class, I would feel comfortable going to the teacher for help after class"; $r = .77$, $\alpha = .87$. Assignment choice was measured with the same hypothetical decision task as in Study 1.

Covariates. See the indices document at <https://osf.io/69urj> for all covariate items.

Study 3 measures.

All items in this study were measured on a 6-point *Strongly disagree—Strongly agree* Likert-type scale unless otherwise noted.

Growth mindset motivational framework. Due to a programming error, the measure of growth mindset motivational framework in this study only included the two negatively-worded items ($\alpha = .69$, $r = .53$) from the full composite and did not include the positively-worded item.

Manipulation check. Perceived teacher mindset beliefs ($\alpha = .80$, $r = .67$) and affordances for the growth mindset ($\alpha = .74$) were measured using the same items as used in Study 1.

Outcomes. Comfort with academic risk-taking ($\alpha = .91$) and assignment choice were measured using the same items as used in Study 1.

Covariates. See the indices document at <https://osf.io/ykb4p> for all covariate items.

Study 4 measures.

All items in this study were measured on a 6-point *Strongly disagree—Strongly agree* Likert-type scale unless otherwise noted.

Growth mindset motivational framework. The same pre-registered growth mindset motivational framework composite from Study 1a was used ($\alpha = .53$).

Manipulation check. Perceived teacher warmth, the manipulation check for this study, was adapted from (8) and measured with four items: “This math teacher seems warm,” “This math teacher seems friendly,” “This math teacher seems mean” (reversed), and “This math teacher seems like they would treat students with kindness”, $\alpha = .91$. We also explored condition effects on perceived teacher mindset ($\alpha = .74$) and affordances for the growth mindset ($\alpha = .79$) using the same composites from Study 1a. We expected that effects of the warm manipulation on these two perceptions measures would be weaker than the effects of the growth mindset manipulation in the previous studies.

Outcomes. Comfort with academic risk-taking ($\alpha = .90$) and assignment choice were measured using the same items as used in Study 1a.

Covariates. See the indices document at <https://osf.io/zrxem> for all covariate items.

Research questions and concordance with pre-registered analysis plans.

Below, we list what was planned and what we did for each of the four studies.

Study 1.

RQ1: What is the effect of the adapted growth mindset intervention on students' growth mindset beliefs (i.e., the manipulation check)?

- Our pre-registered plan was to cross the teacher manipulation with a novel manipulation to change students' growth mindset motivational frameworks (i.e., a short-form growth mindset intervention). However, the novel manipulation failed to change students' growth mindset motivational frameworks ($p = .240$). Therefore, in all analyses, we replaced the pre-registered contrast for this manipulation with students' measured growth mindset motivational frameworks. Note that this measure of students' motivational frameworks corresponds to the pre-registered moderator in Studies 2-4. In addition, as noted in the main text, an advantage of measuring pre-established motivational frameworks is that this avoids potential demand effects that could come from being asked to apply newly acquired beliefs immediately after a persuasive intervention. See Table S5 for analyses showing that results did not change controlling for this manipulation.

RQ2: What is the effect of an affording (vs. undermining) teacher on students' (a) perceptions of the teacher and (b) hypothetical challenge-seeking behavior?

- We pre-registered that we would test this research question (and RQs 3 and 4) using ordinary least squares (OLS) regression models. Instead, for the reasons described in the main text, we used Bayesian causal forest (BCF) analysis, which is more conservative than OLS regression. Testing each of the research questions using OLS yielded results that were consistent with BCF (see Table S3).
- We pre-registered that we would test effects on an additional learning-oriented choice (i.e., challenge-seeking) outcome: challenging course-seeking. Items included "This teacher would make me interested in taking more challenging math courses in the future" and "This teacher would make me want to avoid challenging math courses in the future and instead take the easiest and fewest math courses possible" (reversed). The two items on the scale were not highly correlated ($r = -.42$), possibly because the items differed in directionality and were the only two items displayed together on a single survey page. Therefore, we do not include this measure in the main text, but we report effects on the outcome in Table S3. Effects on this outcome were consistent with effects on the other two learning-oriented choices outcomes.
- We tested effects on several secondary outcomes, including achievement goals (agreement with items like "If I were in this teacher's class, it would be more important for me to learn than to get the best grades"), perceived teacher attitudes toward effort (agreement with items like "This teacher would look down on you if you had to put in a lot of effort in order to succeed," reversed), perceived teacher attitudes toward failure (rated likelihood that, of a student who got a bad grade, the teacher would think, for example, that the student "can get a higher score next time if they find a better way to study"), feelings of being respected by the teacher (agreement with "In this class, this teacher would treat me with respect"), and anticipated shame if they were to experience failure in the teacher's class (agreement with "If I were in this teacher's class, I would probably feel embarrassed if I got a problem wrong on the board in front of my peers", reversed). These outcomes all showed the same interaction effects as the focal outcomes in the study (see the Table S3). Each of the items for these secondary outcomes can be found in the indices document at <https://osf.io/us57r>.

RQ3: What is the effect of the growth mindset intervention on students' (a) perceptions of the teacher and (b) hypothetical challenge-seeking behavior?

- We tested and report the effects of students' growth mindset motivational frameworks rather than the effects of the novel growth mindset manipulation (see RQ1, above).
- We include effects on challenging course-seeking in Table S3 (see RQ2, above).

RQ4: Do the effects of the growth mindset intervention vary as a function of teacher affordances?

- We tested and report the interaction between students' measured growth mindset motivational frameworks and teacher practices condition rather than the interaction between the novel growth mindset manipulation and teacher practices condition (see RQ1, above).
- We include effects on challenging course-seeking in Table S3 (see RQ2, above).
- We include effects on each of the secondary outcomes in Table S3 (see RQ2, above).

Additional note: Participants in this study were included in another related study approximately 6 months earlier in which they were assigned to an intervention or control group. We used blocked random assignment to assign students to condition in the present study (i.e., we conducted random assignment *within* each prior condition). Analyses showing that results do not change controlling for prior condition are presented in Table S5.

Study 2.

RQ1: What is the effect of an affording (vs. undermining) teacher on students' perceptions of the teacher?

- We pre-registered that we would test this research question (and RQs 2 and 3) using ordinary least squares (OLS) regression models. Instead, for the reasons described in the main text, we used BCF analysis, which is more conservative than OLS regression. Testing each of the research questions using OLS yielded results that were consistent with BCF (see Table S8).

RQ2: What is the effect of an affording (vs. undermining) teacher on students' hypothetical challenge-seeking behavior?

RQ3: Do the effects of an affording (vs. undermining) teacher vary as a function of (a) students' awareness of growth mindset and (b) students' mindset beliefs?

- We pre-registered that we would test students' awareness of the growth mindset and their mindset beliefs simultaneously as moderators of teacher condition effects. In the main text, we chose to test students' mindset beliefs and several demographic factors as moderators to examine whether the effects from Study 1 were consistent across demographic groups. However, in Table S9 we present results from a model testing the two pre-registered moderators simultaneously in a model. We find that students' growth mindset motivational frameworks, but not their awareness of the growth mindset, moderate the effects of teacher condition.

Study 3.

RQ1: Looking only at the two conditions that are the same as our previous study (i.e., fully growth mindset vs. fully fixed mindset), will we replicate the effects of the manipulation on (a) the manipulation check, and (b) the link between growth mindset motivational framework and learning-oriented choices?

- We pre-registered that our BCF models would treat teacher condition as the treatment and growth mindset motivational framework as the moderator. However, for ease of interpretation (to identify *where* growth mindset beliefs were associated with outcomes), we treated motivational framework as the "treatment" (i.e., the focal predictor variable) and teacher condition as the moderator.
- As in Study 1 we pre-registered that we would test effects on challenging course-seeking, but as in Study 1, the items were not highly correlated ($r = -.21$). Therefore, we do not include this measure in the main text, but we report effects on the outcome in Table S12. Effects on this outcome were consistent with effects on the other two learning-oriented choices outcomes.
- We planned to test effects on a behavioral "make-a-math-worksheet" measure of challenge seeking in which students make their own math worksheet and select easy, medium, or hard problems (see Yeager et al., 2016, 2019). This measure is normally collected in real school contexts in which students are told that they will complete the worksheet if there is time at the end of the session. However, for the present study it had to be adapted so that participants evaluated what type of worksheet they would create if the task were assigned by the hypothetical teacher, and students were not told that they would complete the worksheet at the end of the session. Due

to these important differences in the measure, we do not report the outcome in the main text, but effects are reported in Table S12.

RQ2: Looking at the two “mixed” growth mindset teacher conditions (either only growth mindset messages or only growth mindset opportunities), are there weaker, stronger, or the same effects compared to the fully fixed mindset condition on (a) the manipulation check, and (b) the link between growth mindset motivational framework and learning-oriented choices?

- We treated motivational framework as the “treatment” (i.e., the focal predictor variable) and teacher condition as the moderator (see RQ1, above).
- We did not include effects on challenging course-seeking or the make-a-math-worksheet measure in the main text (see RQ1, above).

Study 4.

RQ1 (Manipulation Check): Does the manipulation of a teacher’s warmth change students’ perceptions of the teacher’s warmth, as expected?

- As in Study 3, we pre-registered BCF models that would treat teacher condition as the treatment indicator, but instead we treated condition as the moderator and growth mindset motivational framework as the “treatment” (i.e., the focal predictor variable).

RQ2: Does simply making a fixed mindset teacher appear warmer cause students’ mindsets to predict their learning-oriented choices more than the conventional (firm) fixed mindset teacher, and to the same extent as the growth mindset teacher from previous replications?

- We planned to test a BCF model using only the current data and to compare the magnitude and variability of effects to those in the nationally representative replication study (Study 2). For simplicity of reporting, we instead combined the data from Study 2 with the data from Study 4 and tested whether the effects of growth mindset motivational framework varied across the four conditions (i.e., the two Study 2 conditions and the two Study 4 conditions). Findings with the pre-registered model that only includes the Study 4 data yields the same conclusions (see Table S15).

Bayesian causal forest models.

Study 1. We specified the analysis to test whether the association between growth mindset framework and each outcome varied depending on condition. The analysis treated growth mindset framework as the focal predictor variable, condition as a potential moderator (and covariate), and gender, URM status, age, general comfort with academic risk-taking, awareness of growth mindset, math anxiety, learning goals, performance-avoidance goals, test anxiety, stress, and stress mindset as additional covariates. Each model included 2,000 iterations (after 10,000 burn-in iterations) and a thinning interval of 4. Missing data for covariates (< 1% missing any covariate) was imputed using the mean for continuous variables and the mode for dichotomous variables, and dummy-coded missingness indicators were also included in the model as covariates. Missing data for outcomes (< 1% per outcome) was handled with listwise deletion.

Study 2. We tested our hypotheses using BCF models. The model structure was identical to that in Study 1, except that in addition to condition, we included gender, URM status, income, and parent education (i.e., at least one parent with a bachelor's vs. no) as potential moderators (and each moderator was also included as a covariate). This allowed us to examine whether the hypothesized pattern of moderation varied across demographic subgroups of participants. Additional covariates in this study included general comfort with academic risk-taking, perceptions of teachers' mindsets, awareness of growth mindset, and age. Missing data for covariates (< 2% missing any covariate) was imputed using the mean for continuous variables and the mode for dichotomous variables, and dummy-coded missingness indicators were also included in the model as covariates. Missing data for outcomes (< 2% per outcome) was handled with listwise deletion.

Study 3. We tested our hypotheses using BCF models. The model structure was identical to that in Study 1, except that it included dummy-coded contrasts for each of the four conditions as moderators. This allowed us to examine whether the association between growth mindset framework and each outcome was greater in each of the three conditions that included growth mindset-supportive messages and/or opportunities, as compared to the fully fixed condition. Covariates included general comfort with academic risk-taking, perceptions of teachers' mindsets, perceptions of teachers' affordances for the growth mindset, math anxiety, performance-avoidance goals, and beliefs about the meaning of failure in math. Missing data for covariates (< 3% missing any covariate) was imputed using the mean for continuous variables and the mode for dichotomous variables, and dummy-coded missingness indicators were also included in the model as covariates. Missing data for outcomes (< 6% per outcome) was handled with listwise deletion.

Study 4. We tested our hypotheses using BCF models. The model for warmth (the manipulation check) included growth mindset framework as the focal predictor variable, condition as a potential moderator (and covariate), and gender, URM status, parental education, age, general comfort with academic risk-taking, perceptions of teachers' mindsets, perceptions of teachers' affordances for the growth mindset, performance-avoidance goals, and beliefs about the meaning of failure in math as additional covariates. Missing data for covariates (< 2% missing any covariate) was imputed using the mean for continuous variables and the mode for dichotomous variables, and dummy-coded missingness indicators were also included in the model as covariates. There was no missingness on any of the outcomes.

Each other outcome was tested in a model in which we combined the present data with the data from the nationally representative adolescent panel in Study 2, enabling us to compare the two fixed mindset teacher conditions in the present study not only to one another, but also to the growth mindset (and fixed mindset) teacher conditions included in nationally representative study. The model structure for these outcomes was identical to that in Study 2, except that it included dummy-coded contrasts for each of the four conditions as moderators. To ensure consistency in measurement between the two studies, we used only items that were present in both studies to create scales for these analyses, and only measures that were present in both studies as covariates. Note that findings regarding comparisons between the two fixed mindset teacher conditions in the present study are substantively identical when (a) using only the data from the present study and (b) using the full set of items and scales available in the present study (see Table S15).

Experimental manipulations.

Study 1 manipulation. The experimental teacher interview responses from Study 1 are presented below.

What the Teacher Says about Learning Math

[FIXED]: Math is challenging for a lot of people and this is going to be a hard class. Math is basically a set of facts and techniques that you need to learn to solve problems. I will tell you the right facts and techniques for solving each kind of problem. It will be up to you to remember them.

[GROWTH]: Math can be difficult at first, but we're going to work together to understand and become comfortable with it. By the end of this class, the types of problems that might have once seemed scary will be familiar and easy to understand. Of course, you will learn formulas and techniques to solve the problems, but you will also gain a deep understanding of the concepts.

What the Teacher Says about Struggling in Class

[FIXED]: If you struggle in this class, remember that not everybody is a "math person" who can easily learn and apply the right facts and techniques for problems. And that's okay. You shouldn't feel bad if you're one of the struggling students.

[GROWTH]: Everyone makes mistakes when they're learning new and more challenging math. In this class, we'll actually celebrate those mistakes. Your mistakes tell me what I need to spend more time on teaching you and your classmates. This means that when you make mistakes it can actually help everyone in the class get smarter! When something doesn't make sense, we'll work together to figure it out and improve our understanding going forward.

What the Teacher Says about Asking Questions

[FIXED]: If you don't understand something I've already taught you, please don't ask questions until after class. I've found that these questions can slow down the students that are staying on track.

GROWTH: I encourage you to ask questions when you feel lost. Questions show me that you're trying to learn the material, and I really like to see that. They also help me to see where I can explain things better and can help the whole class to think about a topic in new ways.

What the Teacher Says about Revising or Redoing Your Work

[FIXED]: When you turn in assignments, whatever grade you get will be final. So, in my class, you should pay attention to the assignments you turn in so that you don't make mistakes.

[GROWTH]: After I grade your assignments, you will be able to revise your work and turn it in again. Making mistakes, recognizing them, and correcting them will help you remember the concepts for a long time, even after you leave my class.

What the Teacher Says about Tests

[FIXED]: In my class, I will give you three tests (one for each major unit) and a final exam that covers all of the units. You cannot make up for problems missed on previous tests, so make sure you're prepared for each test.

[GROWTH]: In our class, we will have three tests (one for each major unit) and a final exam that covers all of the units. I care about seeing improvement, so if you show improvement in your exam grades over the course of term, I'll raise your final grade. Learning is what matters to me.

What the Teacher Says about Students' Performance

[FIXED]: Students usually know where they stand in this class after the first one or two exams. Students who do the best at the beginning of the year are typically the same ones who do well at the end.

[GROWTH]: Students usually show a strong understanding of the material by the end of the year. Students who don't do well at the beginning of the year almost always improve their grades by the end.

How the Teacher Thinks about the Class Overall

[FIXED]: To summarize, I'm going to cover a lot of material, and my goal in this class is that you will be able to solve all of the different types of problems we'll learn about. I will make sure this class is especially useful for the "star students" who demonstrate a natural talent in math and get high grades throughout the year.

[GROWTH]: In sum, this class is set up the way it is because I believe that all students can learn and do well in the class, no matter where they started out.

Study 2 manipulation. The experimental teacher interview responses from Study 2 are the same as those in Study 1.

Study 3 manipulation. There were four experimental conditions in Study 3, resulting from the 2 (Messages: Fixed vs. Growth) × 2 (Opportunities: Fixed vs. Growth) design. The messages and opportunities manipulations are presented below.

Messages manipulation

What the Teacher Says about Learning Math

[FIXED]: Math is challenging for a lot of people and this is going to be a hard class. Math is basically a set of facts and techniques that you need to learn to solve problems. I will explain the facts and techniques as clearly as possible. Some of you will probably pick them up right away, and others may not.

[GROWTH]: Math can be difficult, but as we work together, you'll become more comfortable with it. By the end of this class, the types of problems that might have once seemed scary will be familiar and easier to understand. You will learn formulas and techniques to solve the problems and also gain a deep understanding of the concepts.

What the Teacher Says about Struggling in Class

[FIXED]: If you struggle in this class, remember that not everybody is a "math person" who can easily learn and apply the right facts and techniques for problems. And that's okay. You shouldn't feel bad if you're one of the struggling students.

[GROWTH]: Everyone makes mistakes when they're learning new and more challenging math. In this class, we'll actually celebrate those mistakes. Your mistakes tell me what I need to spend more time on teaching you and your classmates. This means that when you make mistakes it can actually help everyone in the class get smarter! When something doesn't make sense, we'll work together to figure it out and improve our understanding going forward.

How the Teacher Thinks about the Class Overall

[FIXED]: To summarize, I'm going to cover a lot of material, and my goal in this class is that you will be able to solve all of the different types of problems we'll learn about. I will make sure this class is especially useful for the "star students" who demonstrate a natural talent in math and get high grades throughout the year.

[GROWTH]: In sum, this class is set up the way it is because I believe that all students can learn and do well in the class, no matter where they started out.

Opportunities manipulation

What Students Said about the Math Teacher

Next, we asked the students to tell us about this teacher's math class. Here's what one of these students said.

We asked: Could you get points back on homework assignments if you didn't get something right the first time?

[FIXED] Student: The teacher's policy was that you couldn't get points back on assignments, even if you went back and fixed your mistakes.

[GROWTH] Student: The teacher's policy was that you could get points back on assignments if you went back and fixed your mistakes.

We asked: If you got some problems wrong on a test, but then figured out what your mistake was and fixed it, could you get a higher score?

[FIXED] Student: The teacher's policy was that you couldn't retake your tests and you had to get the answer right the first time. And if you did better on the next test, you didn't get any extra points for improving.

[GROWTH] Student: The teacher's policy was that you could get points back for fixing your mistakes on tests. And if you did better on the next test, you could get extra points for showing improvement.

We asked: If you were confused about something in class, could you stop the teacher and ask them to clarify it for you?

[FIXED] Student: No, the teacher's policy was that we had to hold our questions and ask them in private after class.

[GROWTH] Student: Yes, the teacher encouraged us to ask questions during class when we were confused.

We asked: Did the teacher give you feedback on your assignments that helped you improve?

[FIXED] Student: No, the teacher just marked our assignments as right or wrong and told the class what we need to change, but never gave me much personal feedback.

[GROWTH] Student: Yes, the teacher gave me personal feedback on my mistakes and tried to help me fix my understanding of the material.

We asked: Did the teacher schedule extra review sessions so that all students could learn the material?

[FIXED] Student: No, apart from talking to the teacher for a few minutes after class, we never got extra time to review the material before or after a test.

[GROWTH] Student: Yes, the teacher held extra review sessions so that we had a chance to ask questions and make sure we understood everything before the tests.

Study 4 manipulation. The firm fixed mindset teacher condition was identical to the fixed mindset teacher condition in Studies 1 and 2. The warm fixed mindset teacher condition is presented below.

What the Teacher Says about Learning Math

[WARM-FIXED]: Math is challenging for a lot of people, and this is going to be hard class. I want you to know that I care that you at least try to remember the set of facts and techniques that you need to solve each kind of problem. I don't expect you to get every one of the facts and techniques perfectly, but I do care that you feel good about yourself.

What the Teacher Says about Struggling in Class

[WARM-FIXED]: If you're struggling, I want you to know that I'm not going to overwhelm you and push you beyond what you can do. Everybody's going through a hard time right now, so if math isn't your thing, I don't want you to stress out about it.

What the Teacher Says about Asking Questions

[WARM-FIXED]: If you don't understand something I've taught you, it's ok to ask questions, but please do so after class. We have a lot to get through during class, and sometimes questions can slow us down. Also, if you didn't get something, don't stress out about it because not everyone will. And I can always go over it again with you after class if you need me to.

What the Teacher Says about Revising or Redoing Your Work

[WARM-FIXED]: When you turn in assignments, whatever grade you get will be final. I don't want you to have to revise your work over and over again on top of all the other work you're doing. So, try to learn the material the first time, and if you get a low grade, that's ok. I want you to know I still care about you.

What the Teacher Says about Tests

[WARM-FIXED]: In my class, I will give you three tests (one for each major unit) and a final exam that covers all of the units. You cannot make up for problems missed on previous tests. I know this sounds like a lot, so if you're feeling overwhelmed, just focus on the concepts you're best at and make sure you feel good about those.

What the Teacher Says about Students' Performance

[WARM-FIXED]: Students can usually get a pretty good sense of how well they will do in this class after the first one or two exams. Remember that no matter how easily the material comes to you, I still care about your well-being.

How the Teacher Thinks about the Class Overall

[WARM-FIXED]: To summarize, I'm going to cover a lot of material in this class. The different types of problems tend to click more easily for some students than others, and that's ok. My goal is for you to feel good about wherever you stand in this class. I will always try to provide you with problems and assignments that you can handle. I promise you I'm not going to push you and make you do the hardest problems unless you're one of the "star students" who demonstrates a natural talent in math and can get the answer easily.

Additional results from the BCF models. Here we report additional results from the BCF models that were not included in the main text. Note that for main effects of condition, we report standardized mean differences (*SMDs*), which are conceptually equivalent to Cohen's *d* but can be calculated from model estimates.

Study 1.

Perceptions of the teacher. Compared to the fixed mindset teacher, the growth mindset teacher was rated as having more of a growth mindset (agreement with items like “This math teacher seems to believe that students can’t really change how good they are at math”), $SMD = 0.83 [0.77, 0.90]$, $pr(SMD > 0) = 1.00$, and as providing more affordances for students to use the growth mindset (agreement with items like “This math teacher seems like they would reward students for trying hard and improving”), $SMD = 0.97 [0.91, 1.04]$, $pr(SMD > 0) = 1.00$. Thus, the manipulation was successful in altering participants’ perceptions of the teacher’s mindset beliefs and provision of affordances.

In the growth mindset teacher condition, participants’ growth mindset motivational frameworks were positively associated with perceived teacher mindset, $\beta = 0.39 [0.34, 0.44]$, $pr(\beta > 0) = 1.00$, and perceived teacher affordances, $\beta = 0.23 [0.19, 0.28]$, $pr(\beta > 0) = 1.00$. Conversely, in the fixed mindset teacher condition, participants’ growth mindset motivational frameworks were negatively associated with perceived teacher mindset, $\beta = -0.01 [-0.06, 0.04]$, $pr(\beta > 0) = 0.62$, and perceived affordances, $\beta = -0.06 [-0.11, -0.02]$, $pr(\beta < 0) = 0.96$ (probability of difference in β s between conditions = 1.00 for each outcome). That is, participants who reported more of a growth mindset framework tended to perceive the two teachers more differently in terms of their support for the growth mindset. Students with a higher level of growth mindset beliefs may have been more “tuned in” to cues that signaled a teacher’s support for these beliefs.

Comfort with academic risk-taking. In the growth mindset teacher condition, participants who reported more a growth mindset motivational framework reported greater comfort with academic risk-taking, $\beta = 0.08 [0.04, 0.13]$, $pr(\beta < 0) = 0.99$. However, this association was meaningfully reduced (and became negative) in the fixed mindset teacher condition (probability of difference in β s between conditions = 1.00); $\beta = -0.19 [-0.24, -0.15]$, $pr(\beta < 0) = 1.00$. In addition, compared to the fixed mindset teacher condition, participants in the growth mindset teacher condition tended to report being more comfortable taking academic risks, $SMD = 0.82 [0.76, 0.88]$, $pr(SMD > 0) = 1.00$

Main effects on assignment choice. The teacher practices manipulation showed main effects on choice of the challenging assignment. Compared to the fixed mindset teacher condition, participants in the growth mindset teacher condition were more likely to choose the challenging assignment, $SMD = 0.18 [0.11, 0.25]$, $pr(SMD > 0) = 1.00$.

Study 2.

Perceptions of the teacher. As in Study 1, the growth mindset teacher was rated as having more of a growth mindset and providing more affordances for the growth mindset than the fixed mindset teacher ($pr(SMD > 0) = 1.00$ for each outcome). In addition, as in Study 1, participants’ growth mindset motivational frameworks were more positively associated with perceived teacher mindset and perceived teacher affordances in the growth mindset teacher condition than in the fixed mindset teacher condition (probability of difference in β s between conditions > 0.95 for each outcome). In other words, participants who reported more of a growth mindset framework tended to perceive the two teachers more differently in terms of their support for the growth mindset.

Comfort with academic risk-taking. Effects on comfort with academic risk-taking were consistent with those in Study 1. A growth mindset framework predicted comfort with academic risk-taking positively and more strongly in the growth mindset teacher condition relative to the fixed mindset teacher condition (probability of difference in β s between conditions = 1.00). Growth mindset framework was positively associated with comfort with academic risk-taking in the growth mindset teacher condition, $\beta = 0.09 [0.03,$

0.14], $\text{pr}(\beta < 0) = 0.98$, and negatively associated with comfort with academic risk-taking in the fixed mindset teacher condition, $\beta = -0.07$ [-0.12, -0.02], $\text{pr}(\beta < 0) = 0.95$.

As with assignment choice, this pattern did not differ by demographic subgroup, with one exception: a growth mindset framework \times condition \times parent education interaction (probability = .90). For both students whose parents did not have a bachelor's degree and those who did, the association between growth mindset motivational framework and comfort with academic risk-taking was more positive in the growth mindset teacher condition than the fixed mindset teacher condition (probabilities $> .99$ for each group). However, the growth mindset framework \times condition \times parent education interaction indicated that this difference in the association between conditions was somewhat greater for students whose parents did not have a bachelor's degree than for those whose parents did not have a bachelor's degree.

Simple effects on assignment choice. As noted in the main text, the associations between growth mindset framework and choice of the challenging assignment were more positive in the growth mindset teacher condition than the fixed mindset teacher condition (probability of difference in β s between conditions = 0.94). Here we report the simple effects. Growth mindset framework was positively associated with choice of the challenging assignment in the growth mindset teacher condition, $\beta = 0.17$ [0.11, 0.24], $\text{pr}(\beta < 0) = 1.00$, and less positively associated with assignment choice in the fixed mindset teacher condition, $\beta = 0.09$ [0.03, 0.14], $\text{pr}(\beta < 0) = 0.96$.

Study 3.

Perceptions of the teacher. Compared to the fixed messages/fixed opportunities teacher, each of the other teachers was rated as having more of a growth mindset ($\text{pr}(\beta > 0) = 1.00$ for each pairwise comparison) and as providing more affordances for the growth mindset ($\text{pr}(\beta > 0) = 1.00$ for each pairwise comparison). In addition, compared to the growth messages/growth opportunities teacher, each of the other teachers was rated as having less of a growth mindset ($\text{pr}(\beta > 0) = 1.00$ for each pairwise comparison) and as providing a lesser degree of affordances for the growth mindset ($\text{pr}(\beta > 0) = 1.00$ for each pairwise comparison). Thus, the teacher whose messages and opportunities both supported a growth mindset was perceived as the most supportive of the growth mindset, and the other teacher scenarios fell in order as expected. Participants' own growth mindset frameworks also predicted their perceptions of teachers' mindsets, as in Studies 1 and 2 (see the SI).

Condition differences in participants' perceptions of teachers' support for the growth mindset largely varied as a function of participants' motivational frameworks, consistent with the patterns observed in Studies 1 and 2. As compared to participants in the fixed messages/fixed opportunities teacher condition, the association between motivational framework and perceptions was more positive in the three other conditions for perceived teacher mindset ($\text{pr}(\beta > 0) > 0.97$ for each pairwise comparison) and perceived affordances ($\text{pr}(\beta > 0) > 0.94$ for each pairwise comparison). As compared to participants in the growth messages/growth opportunities teacher condition, the association was less positive in the three other conditions for perceived teacher mindset ($\text{pr}(\beta < 0) > 0.74$ for each pairwise comparison) and perceived affordances ($\text{pr}(\beta < 0) > 0.82$ for each pairwise comparison). That is, the association between growth mindset motivational framework and perceptions of teacher growth mindset support was most positive in the growth messages/growth opportunities condition, least positive in the fixed messages/fixed opportunities condition, and between these two magnitudes in the conditions with the teachers who provided only growth mindset messages or opportunities.

Comfort with academic risk-taking. Both messages and opportunities mattered jointly contributed to the association between participants' growth mindset motivational frameworks and their comfort with academic risk-taking. Consistent with Studies 1 and 2, the association was stronger and more positive in the growth messages/growth opportunities condition than in the fixed messages/fixed opportunities condition (probability of difference in β s between conditions = 1.00). The association in the *fixed messages/growth opportunities* and *growth messages/fixed opportunities* conditions was also somewhat more positive than in the *fixed messages/fixed opportunities* condition (probability of difference in β s between conditions > 0.95 for each pairwise comparison), but somewhat weaker and less positive than the association in the *growth messages/growth opportunities* condition (probability of difference in β s

between conditions > 0.77 for each outcome, with the exception of the *fixed messages/growth opportunities* condition, for which the association was roughly the same as the growth messages/growth opportunities condition for comfort with academic risk-taking, probability of difference in β s between conditions = 0.55). It is possible that, in contrast to choosing a more challenging assignment, growth mindset opportunities alone were sufficient to make students with more of a growth mindset motivational framework feel comfortable taking academic risks such as raising their hand when confused.

As compared to participants in the fixed messages/fixed opportunities teacher condition, participants in each of the other teacher conditions reported more comfort with academic risk-taking ($\text{pr}(\beta > 0) = 1.00$ for each pairwise comparison). In addition, as compared to participants in the growth messages/growth opportunities teacher condition, participants in each of the other teacher conditions reported less comfort with academic risk-taking ($\text{pr}(\beta > 0) > 1.00$ for each pairwise comparison)

Main effects on assignment choice. Main effects of the teacher scenarios on choice of the challenging assignment were consistent with effects on teacher perceptions (i.e., highest levels when the teacher whose messages and opportunities supported the growth mindset). As compared to participants in the fixed messages/fixed opportunities teacher condition, participants in each of the other teacher conditions were more likely to choose the hard (vs. easy) hypothetical assignment ($\text{pr}(\beta > 0) > 0.80$ for each pairwise comparison). In addition, as compared to participants in the growth messages/growth opportunities teacher condition, participants in each of the other teacher conditions were less likely to choose the hard (vs. easy) hypothetical assignment ($\text{pr}(\beta > 0) > 0.85$ for each pairwise comparison).

Study 4.

Perceptions of the teacher. The warm fixed mindset teacher was rated as warmer than the firm fixed mindset teacher, $SMD = 0.93$ [0.82, 1.06], $\text{pr}(SMD > 0) = 1.00$. Thus, the manipulation was successful. Interestingly, the association between participants' own motivational frameworks and perceptions of warmth varied somewhat by condition (probability of difference in β s between conditions = 0.86). Whereas participants with more of a growth mindset motivational framework perceived the firm fixed mindset teacher as somewhat less warm than participants with more of a fixed mindset motivational framework, $\beta = -0.09$ [-0.21, 0.00], $\text{pr}(\beta < 0) = 0.88$, perceptions of the warm fixed mindset teacher's warmth did not vary depending on participants' motivational frameworks, $\beta = 0.01$ [-0.07, 0.10], $\text{pr}(\beta > 0) = 0.57$.

Surprisingly, compared to the firm fixed mindset teacher, the warm fixed mindset teacher was rated as having more of a growth mindset $SMD = 0.53$ [0.41, 0.67], $\text{pr}(SMD > 0) = 1.00$, and as providing more affordances for the growth mindset, $SMD = 0.64$ [0.51, 0.77], $\text{pr}(SMD > 0) = 1.00$. However, this condition effect was substantially smaller than the effect of the growth mindset condition in the study with the nationally representative panel (Study 2; SMD s > 0.90 for each outcome). To make direct comparisons, we combined the present data with the data collected from the nationally representative panel (Study 2) and found that, indeed, the warm fixed mindset teacher in the present study was rated as having less of a growth mindset, $SMD = -0.79$ [-0.89, -0.68], $\text{pr}(SMD > 0) = 1.00$, and as providing a lesser degree of affordances for the growth mindset, $SMD = -0.55$ [-0.65, -0.44], $\text{pr}(SMD > 0) = 1.00$, than the growth mindset teacher in Study 2. Therefore, although the warm fixed mindset teacher was rated as having more of a growth mindset than the firm fixed mindset teacher, the manipulation altered these perceptions much less than the growth mindset teacher manipulation.

Participants' growth mindset frameworks were also more positively associated with perceived teacher mindset and affordances in the warm fixed mindset teacher condition than the firm fixed mindset teacher condition (probability of difference in β s between conditions > 0.90 for each outcome), but less positively associated with these outcomes in the warm fixed mindset teacher condition than in the growth mindset teacher condition from Study 2 (probability of difference in β s between conditions > 0.90 for each outcome).

Comfort with academic risk-taking. Simply making a fixed mindset teacher's demeanor warmer did not strengthen the association between students' growth mindset motivational frameworks and comfort with

academic risk-taking in the way that a growth mindset-supportive teacher did. The association did not meaningfully differ between the warm and firm fixed mindset teacher conditions (probability of difference in β s between conditions = 0.67). In addition, when we combined the present data with the data collected from the nationally representative panel (Study 2), we found that participants' growth mindset frameworks were more associated with comfort with academic risk-taking in the growth mindset teacher condition from Study 2 as compared to the warm fixed mindset teacher condition in the present study (probability of difference in β s between conditions = 0.96). Thus, this study showed that when a teacher's messages and opportunities supported a fixed mindset, even if the teacher's demeanor was warm, they nevertheless nullified the benefits of students' growth mindsets for comfort with academic risk-taking.

With regard to main effects, participants reported more comfort with academic risk-taking in the warm fixed mindset teacher condition as compared to the firm fixed mindset teacher condition, $SMD = 0.69$ [0.57, 0.82], $pr(SMD > 0) = 1.00$, and less comfort with academic risk-taking as compared to the growth mindset teacher condition from Study 2, $SMD = -0.20$ [-0.30, -0.11], $pr(SMD > 0) = 0.99$.

Main effects on assignment choice. Participants chose the challenging (vs. easy) assignment somewhat more often in the warm fixed mindset teacher condition as compared to the firm fixed mindset teacher condition, $SMD = 0.12$ [-0.01, 0.26], $pr(SMD > 0) = 0.88$, and choice of the challenging assignment did not meaningfully differ between the warm fixed mindset teacher condition and the growth mindset teacher condition from Study 2, $SMD = 0.02$ [-0.08, 0.13], $pr(SMD > 0) = 0.61$.

Table S1. Correlations and descriptive statistics for key variables in Study 1. *** $p < .001$, ** $p < .010$, * $p < .050$.

Variable	1	2	3	4	5
1. Growth Mindset Framework	—				
2. Perceived Teacher Mindset	.19***	—			
3. Perceived Teacher Affordances	.11***	.70***	—		
4. Comfort with Academic Risk-Taking	.03	.52***	.72***	—	
5. Choice of Challenging Assignment	.10**	.17***	.18***	.22***	—
N	1094	1086	1084	1086	1092
<i>M</i> , Proportion [†]	4.37	3.67	3.92	3.60	.34 [†]
<i>SD</i>	0.95	1.38	1.19	1.35	0.47

Table S2. Random assignment balance tests for Study 1.

Primary Predictor	Growth Mindset Teacher Practices Condition		Fixed Mindset Teacher Practices Condition		Condition Comparison	
	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Growth Mindset Framework	4.34	0.91	4.39	0.98	-0.90	.371
Demographics	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Gender (Girl)	.53 [†]	0.5	.50 [†]	0.5	1.10	.271
Race/Ethnicity (URM)	.52 [†]	0.5	.53 [†]	0.5	-0.19	.850
Other Experimental Conditions	<i>M</i> , Proportion [†] <th><i>SD</i></th> <th><i>M</i>, Proportion[†]</th> <th><i>SD</i></th> <th><i>t</i></th> <th><i>p</i></th>	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Motivational Framework Manipulation (Treatment)	.51 [†]	0.50	.48 [†]	0.50	0.97	.333
Condition in Prior Experiment (Treatment)	.48 [†]	0.50	.47 [†]	0.50	0.56	.579

Table S3. Unconditional model for all outcomes in Study 1. Note: Consistent with the pre-registered plan for OLS analyses, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is coded (growth = .5, fixed = -.5) and growth mindset motivational framework is standardized.

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices								
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment			Challenging Course Seeking		
	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>
Condition	1.19	16.66	< .001	1.18	19.44	< .001	1.13	15.39	< .001	0.09	3.33	.001	0.94	14.36	< .001
Growth Mindset Framework	0.28	7.89	< .001	0.15	5.05	< .001	0.06	1.73	.084	0.05	3.42	.001	0.09	2.76	.006
Condition × Growth Mindset Framework	0.55	7.69	< .001	0.36	5.89	< .001	0.39	5.34	< .001	0.07	2.63	.009	0.32	4.94	< .001
Predictor	Achievement Goals			Perceived Teacher Attitudes						Academic Emotions					
	Achievement Goals			Perceived Attitudes Toward Effort			Perceived Attitudes Toward Failure			Respect			Shame		
	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>
Condition	0.62	10.99	< .001	0.86	12.57	< .001	0.76	14.10	< .001	0.94	13.87	< .001	-0.71	-8.50	< .001
Growth Mindset Framework	0.11	3.78	< .001	0.28	8.22	< .001	0.15	5.53	< .001	0.07	1.93	.054	-0.19	-4.55	< .001
Condition × Growth Mindset Framework	0.17	3.03	.003	0.38	5.58	< .001	0.33	6.12	< .001	0.40	5.94	< .001	-0.35	-4.18	< .001

Table S4. Models replicating reported findings using expanded measure of growth mindset framework in Study 1. Note: Consistent with the pre-registered plan for OLS analyses, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is coded (growth = .5, fixed = -.5) and growth mindset motivational framework is standardized.

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices								
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment			Challenging Course Seeking		
	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>	<i>b</i>	<i>t</i> (1090)	<i>p</i>
Condition	1.20	16.50	< .001	1.19	19.35	< .001	1.13	15.43	< .001	0.10	3.45	.001	0.94	14.47	< .001
Growth Mindset Framework (Expanded)	0.28	7.74	< .001	0.16	5.20	< .001	0.13	3.47	.001	0.08	5.41	< .001	0.15	4.59	< .001
Condition × Growth Mindset Framework (Expanded)	0.38	5.19	< .001	0.25	3.99	< .001	0.29	3.88	< .001	0.06	2.03	.042	0.25	3.85	< .001

Table S5. Models replicating reported findings, controlling for other experimental conditions in Study 1. Note: Consistent with the pre-registered plan for OLS analyses, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is coded (growth = .5, fixed = -.5), growth mindset motivational framework is standardized, and the two other experimental conditions are coded (.5, -.5).

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices								
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment			Challenging Course Seeking		
	<i>b</i>	<i>t</i> (1088)	<i>p</i>	<i>b</i>	<i>t</i> (1088)	<i>p</i>	<i>b</i>	<i>t</i> (1088)	<i>p</i>	<i>b</i>	<i>t</i> (1088)	<i>p</i>	<i>b</i>	<i>t</i> (1088)	<i>p</i>
Condition	1.19	16.60	< .001	1.18	19.40	< .001	1.13	15.34	< .001	0.09	3.26	.001	0.93	14.30	< .001
Growth Mindset Framework	0.28	7.86	< .001	0.15	5.06	< .001	0.06	1.71	.087	0.05	3.38	.001	0.09	2.73	.007
Condition × Growth Mindset Framework	0.55	7.66	< .001	0.36	5.86	< .001	0.39	5.32	< .001	0.07	2.59	.010	0.32	4.90	< .001
Growth Mindset Framework Manipulation	0.09	1.32	.188	0.03	0.44	.659	0.06	0.79	.432	0.06	2.09	.037	0.11	1.74	.082
Prior Experiment Condition	0.07	1.03	.305	0.07	1.11	.266	0.04	0.51	.610	0.03	1.06	.288	0.06	0.95	.340

Table S6. Correlations and descriptive statistics for key variables in Study 2. *** $p < .001$, ** $p < .010$, * $p < .050$.

Variable	1	2	3	4	5
1. Growth Mindset Framework	—				
2. Perceived Teacher Mindset	0.12***	—			
3. Perceived Teacher Affordances	0.15***	0.73***	—		
4. Comfort with Academic Risk-Taking	0.04	0.56***	0.56***	—	
5. Choice of Challenging Assignment	0.15***	0.18***	0.22***	0.22***	—
N	802	794	798	797	800
<i>M</i> , Proportion [†]	4.48	3.9	3.83	3.74	.31 [†]
<i>SD</i>	0.92	1.69	1.67	1.58	0.46

Table S7. Random assignment balance tests for Study 2.

Primary Predictor	Growth Mindset Teacher Practices Condition		Fixed Mindset Teacher Practices Condition		Condition Comparison	
	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Growth Mindset Framework	4.45	0.91	4.52	0.93	-1.09	.275
Demographics	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Gender (Girl)	.53 [†]	0.50	.54 [†]	0.50	-0.47	.637
Race/Ethnicity (URM)	.36 [†]	0.48	.37 [†]	0.48	-0.01	.750
Parent Education (Bachelor's)	.44 [†]	0.50	.48 [†]	0.50	-1.00	.316
Income (1: <\$5,000 to 18: >\$200,000)	10.12	4.25	10.17	4.39	-0.15	.877

Table S8. Unconditional model for all outcomes in Study 2. Note: Consistent with the pre-registered plan for OLS analyses, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is coded (growth = .5, fixed = -.5) and growth mindset motivational framework is standardized.

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices					
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment		
	<i>b</i>	<i>t</i> (799)	<i>p</i>	<i>b</i>	<i>t</i> (799)	<i>p</i>	<i>b</i>	<i>t</i> (799)	<i>p</i>	<i>b</i>	<i>t</i> (799)	<i>p</i>
Condition	1.72	17.19	< .001	1.59	15.71	< .001	1.68	17.90	< .001	0.15	4.64	< .001
Growth Mindset Framework	0.23	4.55	< .001	0.27	5.65	< .001	0.09	1.98	.049	0.07	4.54	< .001
Condition × Growth Mindset Framework	0.31	3.13	.002	0.43	4.26	< .001	0.37	3.96	< .001	0.08	2.53	.012

Table S9. Models comparing growth mindset motivational framework and growth mindset awareness (i.e., “Have your teachers, principal, or anyone else at your school ever talked to you about something called the ‘growth mindset?’”) as moderators of condition effects in Study 2. Note: Consistent with the pre-registered plan for OLS analyses, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is coded (growth = .5, fixed = -.5), growth mindset motivational framework is standardized, and growth mindset awareness is coded (aware = .5, not aware = -.5).

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices					
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment		
	<i>b</i>	<i>t</i> (797)	<i>p</i>	<i>b</i>	<i>t</i> (797)	<i>p</i>	<i>b</i>	<i>t</i> (797)	<i>p</i>	<i>b</i>	<i>t</i> (797)	<i>p</i>
Condition	1.72	16.46	< .001	1.61	15.21	< .001	1.63	16.76	< .001	0.15	4.42	< .001
Growth Mindset Framework	0.23	4.54	< .001	0.29	5.64	< .001	0.09	1.84	.067	0.07	4.55	< .001
Condition × Growth Mindset Framework	0.31	3.12	.002	0.43	4.20	< .001	0.38	4.08	< .001	0.08	2.53	.012
Growth Mindset Awareness	0.00	-0.05	.963	-0.01	-0.05	.962	0.17	1.78	.075	-0.02	-0.46	.643
Condition × Growth Mindset Awareness	0.00	-0.02	.984	0.12	0.57	.567	-0.28	-1.43	.153	-0.01	-0.13	.899

Table S10. Correlations and descriptive statistics for key variables in Study 3. *** $p < .001$, ** $p < .010$, * $p < .050$.

Variable	1	2	3	4	5	6
1. Growth Mindset Framework	—					
2. Perceived Teacher Mindset	0.38***	—				
3. Perceived Teacher Affordances	-0.05	0.55***	—			
4. Comfort with Academic Risk-Taking	-0.24***	0.27***	0.76***	—		
5. Choice of Challenging Assignment	0.11***	0.16***	0.19***	0.23***	—	
6. Challenging Course Seeking	0.04	0.51***	0.69***	0.65***	0.37***	—
N	1061	1032	1034	1031	1028	1027
<i>M</i> , Proportion†	4.00	3.09	3.94	4.18	0.30	3.63
<i>SD</i>	1.44	1.48	1.34	1.49	0.46	1.21

Table S11. Random assignment balance tests for Study 3. Note: Demographic data were not collected for this study.

Primary Predictor	Fixed Messages, Fixed Opportunities		Growth Messages, Fixed Opportunities		Fixed Messages, Growth Opportunities		Growth Messages, Growth Opportunities		Condition Comparison (Omnibus)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	<i>p</i>
Growth Mindset Framework	4.16	1.38	3.91	1.40	4.01	1.49	3.91	1.46	1.85	.136

Table S12. Unconditional model for all outcomes in Study 3. Note: Consistent with the pre-registered plan for OLS analyses in Studies 1 and 2, we imputed missingness for outcome variables using the mean for continuous variables and the mode for dichotomous variables. Results are unchanged using listwise deletion. Condition is dummy coded (with the fixed messages/fixed opportunities condition as the reference group) and growth mindset motivational framework is standardized.

Predictor	Teacher Perception Outcomes						Learning-Oriented Choices											
	Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment			Challenging Course Seeking			Make-a-math-worksheet score		
	<i>b</i>	<i>t</i> (1074)	<i>p</i>	<i>b</i>	<i>t</i> (1074)	<i>p</i>	<i>b</i>	<i>t</i> (1074)	<i>b</i>	<i>b</i>	<i>t</i> (1074)	<i>p</i>	<i>b</i>	<i>t</i> (1074)	<i>p</i>	<i>b</i>	<i>t</i> (1074)	<i>p</i>
Growth Messages/fixed Opportunities	0.72	7.26	< .001	0.52	6.04	< .001	0.53	5.03	< .001	0.05	1.18	.238	0.46	5.07	< .001	1.27	3.53	< .001
Fixed Messages/growth Opportunities	0.88	8.83	< .001	1.56	18.23	< .001	1.31	12.37	< .001	0.03	0.90	.369	0.91	9.96	< .001	1.32	3.68	< .001
Growth Messages/growth Opportunities	1.70	17.01	< .001	1.97	22.79	< .001	1.67	15.65	< .001	0.09	2.22	.026	1.25	13.58	< .001	1.43	3.96	< .001
Growth Mindset Framework	0.09	1.21	.225	-0.45	-7.17	< .001	-0.69	-8.85	< .001	-0.04	-1.35	.179	-0.22	-3.29	.001	-0.97	-3.74	< .001
Growth Messages/fixed Opportunities × Growth Mindset Framework	0.38	3.69	< .001	0.17	1.95	.052	0.25	2.32	.021	0.12	2.91	.004	0.17	1.76	.079	0.82	2.27	.023
Fixed Messages/growth Opportunities × Growth Mindset Framework	0.63	6.33	< .001	0.65	7.59	< .001	0.61	5.79	< .001	0.09	2.36	.018	0.43	4.71	< .001	0.39	1.11	.266
Growth Messages/growth Opportunities × Growth Mindset Framework	0.85	8.42	< .001	0.78	8.95	< .001	0.60	5.58	< .001	0.14	3.49	.001	0.54	5.79	< .001	0.44	1.23	.218

Table S13. Correlations and descriptive statistics for key variables in Study 4. *** $p < .001$, ** $p < .010$, * $p < .050$.

Variable	1	2	3	4	5	6
1. Growth Mindset Framework	—					
2. Perceived Teacher Warmth	-0.04	—				
3. Perceived Teacher Mindset	0.08	0.56***	—			
4. Perceived Teacher Affordances	-0.02	0.86***	0.67***	—		
5. Comfort with Academic Risk-Taking	-0.17**	0.81***	0.45***	0.78***	—	
6. Choice of Challenging Assignment	-0.01	0.20**	0.19**	0.24***	0.32***	—
N	256	256	256	256	256	256
<i>M</i> , Proportion [†]	4.35	3.82	2.69	3.63	3.61	0.37
<i>SD</i>	1.03	1.35	1.27	1.31	1.56	0.48

Table S14. Random assignment balance tests for Study 4.

Primary Predictor	Growth Mindset Teacher Practices Condition		Fixed Mindset Teacher Practices Condition		Condition Comparison	
	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Growth Mindset Framework	4.24	1.03	4.45	1.02	1.67	.096
Demographics	<i>M</i> , Proportion [†]	<i>SD</i>	<i>M</i> , Proportion [†]	<i>SD</i>	<i>t</i>	<i>p</i>
Gender (Girl)	.46 [†]	0.50	.49 [†]	0.50	0.59	.557
Race/Ethnicity (URM)	.26 [†]	0.44	.25 [†]	0.44	-0.08	.940
Parent Education (Bachelor's)	.53 [†]	0.50	.59 [†]	0.49	0.96	.338

Table S15. Unconditional model for all outcomes in Study 4. Note: There was no missingness for outcome variables in this study. Condition is coded (warm = .5, firm = -.5) and growth mindset motivational framework is standardized.

Predictor	Teacher Perception Outcomes									Learning-Oriented Choices					
	Perceived Teacher Warmth			Perceived Teacher Mindset			Perceived Teacher Affordances			Comfort with Academic Risk-Taking			Choice of Challenging Assignment		
	<i>b</i>	<i>t</i> (252)	<i>p</i>	<i>b</i>	<i>t</i> (252)	<i>p</i>	<i>b</i>	<i>t</i> (252)	<i>p</i>	<i>b</i>	<i>t</i> (252)	<i>p</i>	<i>b</i>	<i>t</i> (252)	<i>p</i>
Condition	1.37	9.46	< .001	0.78	5.22	< .001	1.13	7.61	< .001	1.19	6.63	< .001	0.09	1.42	.157
Growth Mindset Framework	-0.13	-1.75	.081	0.06	0.77	.440	-0.08	-1.12	.262	-0.32	-3.58	< .001	-0.01	-0.33	.743
Condition x Growth Mindset Framework	0.36	2.48	.014	0.45	3.02	.003	0.25	1.69	.092	0.14	0.78	.436	0.06	1.06	.290

Table S16. Means (standard deviations) for the manipulation check measures in Studies 1-4.

Study	Condition	Perceived Teacher Mindset	Perceived Teacher Affordances	Perceived Teacher Warmth
Study 1	Growth Mindset Teacher	4.24 (1.18)	4.49 (0.89)	—
	Fixed Mindset Teacher	3.06 (1.31)	3.30 (1.17)	—
Study 2	Growth Mindset Teacher	4.74 (1.38)	4.60 (1.39)	—
	Fixed Mindset Teacher	3.01 (1.52)	3.02 (1.56)	—
Study 3	Growth Messages/Growth Opportunities Teacher	3.97 (1.60)	4.94 (0.82)	—
	Fixed Messages/Growth Opportunities Teacher	3.17 (1.36)	4.53 (0.81)	—
	Growth Messages/Fixed Opportunities Teacher	2.98 (1.32)	3.47 (1.19)	—
	Fixed Messages/Fixed Opportunities Teacher	2.25 (1.06)	2.83 (1.30)	—
Study 4	Warm Fixed Mindset Teacher	3.08 (1.31)	4.17 (1.03)	4.48 (0.95)
	Firm Fixed Mindset Teacher	2.28 (1.10)	3.06 (1.33)	3.13 (1.36)