The Influence of Teacher Practices and Student Perceptions on Student Motivation

By

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Abstract

Motivational self-views, such as growth mindset—the belief that abilities are malleable—and mastery goal orientation—the drive to focus on learning—predict positive academic achievement. Interventions to promote these self-views lead to greater achievement, but only when students have a supportive learning environment that can cultivate the growth of these self-views. Therefore, a better understanding of which aspects of the learning environment help shape motivational self-views is needed. The current study extends previous research by examining both observed teacher practices and students' self-reported perceptions of the teacher and classroom environment to identify which aspects of the learning environment foster positive self-views. Multilevel Bayesian analyses of 495 6th and 7th graders nested within 17 teachers indicated that it is the students' perceptions of their learning environment, not the objective learning-oriented practices, that foster positive self-views. This suggests that more work is needed to understand what influences students' perceptions and how teachers can more effectively create a learning environment that fosters positive self-views in students.

Keywords: motivation, growth mindset, goal orientation, self-views, perceptions, teacher practices

Introduction

Students spend most of their active learning time in formal classroom environments, especially during the elementary and middle school years. These classroom environments play key roles in students' academic outcomes, such as their measures of self-efficacy and achievement in the classroom (Schunk & Ertmer, 1999; Hamre et al., 2013). The classroom environment exposes students to multiple agents of influence that are not present in their home environments, such as peers and different teachers across the school day. They are also beginning to hold perceptions of themselves based on the experiences and interactions they have in the classroom environment (e.g., Marsh et al., 2012). The significant amount of time spent in the classroom environment makes it important to understand how various aspects present within these environments influence students' learning outcomes. Research documents several components that individually have been found to be associated with students' thoughts, feelings, and behaviors in the classroom, including the practices and beliefs of the classroom teacher, and the classroom learning structure that the teacher supports, which together compose the "learning environment." Additionally, there are individual differences in how students experience and perceive these practices and interactions which ultimately affects students' academic outcomes.

In examining the influence of the learning environment on academic outcomes, the views students hold of themselves is an outcome of particular interest, as students are more likely to be engaged and succeed academically when they feel confident and capable in the classroom (e.g., Schunk, 1981). However, it is not clear from past research how the learning environment contributes to the development of self-views. In a single learning environment, multiple students have shared experiences– for example, the lessons teachers deliver and the messages they convey to the class. These teaching practices may directly influence students' self-views. However, students also have individual unshared experiences driven by how they perceive these practices. For example, a teacher might tell the class to compare their work with a classmate and discuss how they arrived at an answer to a problem.

Student A and Student B hear their teacher give the same instruction but arrive at different interpretations based on their perceptions of the instruction. From this instruction, Student A may perceive that they did something incorrectly in solving the problem and need to find the correct solution from another student. Student A may be left feeling that they are not smart enough to solve the problem. Student B may perceive the exercise as an opportunity to learn new strategies to solve problems, and therefore feel more encouraged to work toward solutions in the future. As a result, the shared experience of the teaching practice can lead to different outcomes due to students' unique perceptions that lead to different experiences of the learning environment.

Research has identified both *teacher practices*, or the ways in which teachers instruct, interact with, and respond to their students, and *student perceptions*, or how students view their teacher and classroom, as important factors (Ruzek et al., 2016; Patrick et al., 2001). While both have been found to be associated with student academic outcomes, few studies have examined objectively observed practices and perceptions simultaneously in the same study. As a result, the unique and combined influence of teacher practices and student perceptions of their learning environment is unknown. The goal of the present study is to address this gap by testing both student-reported perceptions of their learning environments and observed teacher practices collected via objective observations, as predictors of students' self-views to better understand the relative utility of each in fostering positive academic outcomes.

Students' Self-views: The Beliefs Held and Behaviors Demonstrated

The self-views students hold contribute to their motivation and achievement outcomes. For example, student self-efficacy has been found to predict the ways in which students set and pursue goals (Schunk, Meece, & Pintrich, 2014). When students perceive themselves as capable of growth, they are more likely to work harder to facilitate that growth, compared to students who do not hold those

self-views. Here I explore two core aspects of students' *motivational* self-views: growth mindset and goal orientation.

Growth Mindset is the extent to which students believe their abilities and intelligence are malleable. Researchers have identified a growth mindset as a key component of one's self-view that contributes to motivation and achievement outcomes. Students who endorse more of a growth mindset view their abilities and intelligence as malleable, or something they can grow and improve with effort. Students who endorse more of a fixed mindset view their abilities and intelligence as fixed, innate qualities that cannot be changed. In both laboratory and real-world contexts, endorsing a growth mindset, compared to fixed, has been found to predict important outcomes, including grades (Blackwell, Trzesniewski, & Dweck, 2007), smaller performance gaps for marginalized groups (Steele, Spencer, & Aronson, 2002), and better well-being (Chan, 2012). Students who believe they can become smarter view themselves differently than students who do not believe they are capable of getting smarter. Students who endorse growth mindset beliefs are then more likely to see value in working hard to become smarter.

Goal Orientation is the belief students hold about how to effectively improve their abilities and intelligence. According to the classic achievement goal theory (Ames, 1992), students who hold mastery-oriented goal orientations are more likely to work towards fully understanding a topic and improving their skills, rather than focusing on performance measures, such as grades or test scores (commonly referred to as holding a performance orientation). Students' goal orientations are expected to contribute to their self-views as mastery-oriented students will be less discouraged by mistakes and will see setbacks and challenges as opportunities for personal growth. These students are more likely to ask for help when needed and persist in their learning even when it is difficult (Dweck & Leggett, 1988).

While there are multiple elements that affect how students view themselves, such as their feelings of self-efficacy or levels of interest and engagement, students' growth mindset and goal

orientation beliefs in particular form the motivational self-views students hold about why and how they should pursue their goals in their learning environments. Currently, there is little understanding of how learning environments contribute to shaping these self-views. Students experience the practices that their teachers deliver, but they also may react and respond to those practices in different ways, based on their individual perceptions of the practices. Findings from this study will take a necessary step toward gaining a better understanding of the factors within the learning environment that shape positive motivational self-views. This information can then be used to inform intervention efforts aimed at promoting positive motivational self-views, and in turn, students' academic persistence and achievement.

Do Teacher Practices Influence Student Self-views?

Previous research has shown that teachers' instructional practices influence students' development in the classroom, as practices are a common mechanism through which teachers communicate their expectations and values in the classroom to their students. Therefore, it is expected that teacher practices will influence student motivation and achievement outcomes. Several studies have found support for this. For example, when teachers create a supportive environment by providing instructional support, students' socioemotional development and achievement outcomes are positively impacted (e.g., Allen et al., 2013; Ruzek et al., 2016). Additionally, emotionally supportive practices have been associated with student motivation and engagement (e.g., Wang & Eccles, 2014; Patrick et al., 2007).

In the context of self-views, teachers' use of mastery-oriented teaching practices has been found to be an important element of the learning environment that influences student outcomes (e.g., Meece, Anderman, & Anderman, 2006; Eccles & Roeser, 2009). For example, teachers who recognize and acknowledge students' efforts and encourage students to learn through their mistakes and failures convey to their students that they value mastery of skills, even if it takes time and means struggling

along the way. While past research has connected teachers' uses of mastery-oriented teaching practices and students' perceptions of a mastery-oriented environment, less is known about the direct effect of these practices on students' own motivational self-views. For example, research has failed to find an association between teachers' use of mastery-oriented practices with their students' growth mindsets (Park et al., 2016; Sun, 2015). However, Park and colleagues did find that teachers' use of fixed mindset practices was associated with students' fixed mindsets (2016). This study also relied on teacher and student reports of teacher practices, rather than direct observations. Together, these limited findings present a mixed view, leaving it unclear whether teacher practices are an important element of the learning environment in shaping students' self-views. Therefore, more work is needed to further examine this potential association.

Do Student Perceptions of their Classroom Context Influence Their Self-views?

The mixed findings from studies of teacher practices may be due to the fact that students do not perceive practices in the same way. That is, one observable practice may be perceived as communicating different things across different students. In this case, students' perceptions of their learning environments may influence their beliefs instead of the individual practices themselves. Research has found that when students perceive their teachers as encouraging mistakes as learning experiences, rather than as something to avoid, they show increased academic interest, increased self-efficacy, higher levels of engagement, and are more likely to use adaptive learning strategies compared to peers who do not perceive their teachers as providing the same support (Ryan & Patrick 2001; Urdan, 2010). Previous research has identified multiple elements of the learning environment that students may perceive in meaningfully different ways.

First, students may hold different perceptions about their learning environment's goal structure. A classroom with a mastery-oriented goal structure is one that communicates to students that mistakes and failure are part of the learning process, and that there is value in working toward a full

understanding of learning the material, even if it means struggling along the way. Students' perceptions of a mastery goal structure have been linked to their own achievement goals and use of adaptive learning behaviors (Bardach, 2020; Kaplan, Gheen, & Midgley, 2002). These associations are likely due to an underlying relation between how students perceive their learning environment's goal structure and the beliefs they hold about themselves. For example, if students perceive their teacher as supportive of their pursuit of mastery and improvement, rather than valuing only grades and test scores, they are more likely to be motivated to employ effort even when they struggle or fail, ask questions when they need help, and believe they can improve if they continue to work hard and not give up-- all learning beliefs and behaviors associated with positive motivational self-views. On the other hand, if students fail to perceive their teacher as believing all students are capable of success, they may not see the value in investing effort or seeking challenges to grow their skills (low mastery-orientation).

Recent research has also examined the influence of students' perceptions of their teachers, including teachers' mindset beliefs and teachers' uses of mastery-oriented practices. Teachers communicate their beliefs and expectations to students in what they say and do, and how they respond to their students' efforts, successes, and failures. If a teacher believes one student is more capable of improvement and growth than another and reflects this belief through practices visible to their students, their students may hold different perceptions about what constitutes "success" in their classroom and how they should work toward it. One student may see the importance of working hard to become smarter, while another may not see the value in employing effort. In this case, the former student would hold growth mindset beliefs, and the latter would hold fixed mindset beliefs.

Indeed, a recent study found that college students were able to perceive the mindset beliefs their teachers held, and these in turn affected their own academic outcomes. When college students perceived their professors to hold fixed-mindset beliefs, they were more likely to experience negative affect and intention to drop that professor's class, compared to students who perceive their professor to

endorse a growth mindset (Muenks et al., 2020). While most research on younger student perceptions tend to focus on perceptions of teacher emotional or instructional support (e.g., Barksdale et al., 2019), elementary and middle school students are likely to hold perceptions of their teachers' mindsets as well, as these students spend even more time in their learning environments and with their teachers, and therefore have more opportunities to experience teacher practices and messaging. However, to my knowledge, no studies have examined perceptions of teachers' mindsets and goal orientation in younger students.

Research has also found that teachers' use of mastery-oriented practices predicts students' perceptions of their learning environment's goal orientation (Meece et al., 2006). For example, teachers who encourage students to ask for help and experiment with different learning strategies create an environment that students perceive as mastery-oriented. Students who hold these perceptions are then more likely to hold mastery-, rather than performance-oriented beliefs themselves (Meece et al., 2006). This suggests that the observable practices teachers deliver may not be directly communicating their beliefs to their students. Instead, these practices may influence students' perceptions of the learning environment.

The current study aims to extend the research on students' learning environments by examining both objective measures of the learning environment and students' perceptions, and their associations with students' self-views. In doing so, findings will contribute to a better understanding of the unique and combined contributions of the learning environment (created by teacher practices as well as the beliefs conveyed through those practices) and student perceptions of their environments on the development of students' self-views. Findings will provide information about the classroom components that should be considered (and to what extent) in developing curricula and interventions aimed at promoting growth mindset.

Do Student Perceptions Moderate the Effect of Teacher Practices on Student Outcomes?

Finally, research shows that perceptions of the same teacher practice can vary across students within a class. For example, students within the same class receive the same instructions for an assignment, but some students will perceive those instructions as being clearly explained while others in the same class do not (Bardach et al., 2021). From a motivational perspective, some students may be more likely to perceive a practice as communicating growth mindset or mastery-oriented messages than others. Therefore, teaching practices may only be effective at fostering motivational self-views when the student perceives the messages as communicating growth mindset and mastery-oriented beliefs. If students do not perceive the practices in this way, then the practices could be ineffective at influencing self-views.

In sum, previous work has examined the influence of teacher practices and student perceptions on student outcomes, and the influence of teacher practices on student perceptions. However, the combined influence of practices and perceptions as predictors of student motivation outcomes have yet to be tested in the same model. The present study will test whether teachers' use of mastery-oriented practices influence students' reported self-views; and whether this effect is influenced by students' perceptions of those practices as communicating fixed or growth mindset values.

The Current Study

The current study tests three aims:

1. Examine the role of teacher practices in fostering students' motivational self-views.
    a. Hypothesis 1: Students' motivational self-views are influenced by their *teachers' classroom practices,* as teachers communicate their beliefs and expectations for students through the things they say and do in the classroom during observations of their curriculum delivery.
2. Examine the role of students' perceptions of their learning environment and of their teachers in fostering their motivational self-views.

a. Hypothesis 2: Students' motivational self-views are influenced by their *perceptions* of their learning environment, their teachers' motivational beliefs, and their teachers' classroom practices.

3. Examine the role of the interplay between teacher practices and student perceptions in fostering student motivational self-views.
    a. Hypothesis 3: There will be a significant interaction effect between teacher practices and student perceptions on student motivational self-views, such that use of mastery-oriented practices will be predictive of students' mastery orientation and growth mindset only when students perceive classroom practices as communicating growth mindset or mastery-oriented values. In other words, student perceptions will moderate the effect of teacher practices on their outcomes.

To test these hypotheses, I used data from 495 students nested within 17 teachers to test the role of teacher practices using independent observer reports and student self-reported perceptions of their teacher and learning environment.

Method

Participants

In the efficacy study from which our data were collected, teachers from 12 middle schools (grades 6 to 8) located on the East and West coasts of the United States were recruited through email and mail outreach, site visits, and presentations at school and district meetings. Eligible participants for Cohorts 1 and 2 were core science teachers who (i) did not have extensive exposure to growth mindset curricula or books; (ii) were working at schools where at least two teachers were willing to participate, and (iii) were located close enough to receive on-site visits from implementation staff. Due to recruitment challenges for Cohort 2, eligibility was broadened for Cohorts 3 and 4 to include core math

and English teachers as well; as before, at least two teachers of the same subject needed to be willing to participate.

The intervention group received an online growth mindset intervention (MindsetWorks 2020), while the control group participated in their regularly scheduled math, science, or English classes. Students in both groups completed confidential, computer-based surveys that assessed their perceptions of their teacher and classroom goal structure as well as their growth mindset and goal orientations. Baseline measures were collected between October and January during a typical class, and endline surveys were conducted five to six months later. Teacher practices were observed before students completed the endline survey. Participants for this study comprised the subset of control teachers (N = 17) and their students (N = 495) for whom observations of teaching practices were conducted, and who were not missing any data on the dependent variables. On average, 29.23 students were nested within each teacher. Students were 45% male and racially diverse: 48% Hispanic, 14% Asian, 14% Black or African American, 7% Mixed Ethnicity, 11% White, and 6% Other Ethnicity. Teachers were 17% male and 10% Hispanic, 6% Asian, 19% Black or African American, 7% Mixed Ethnicity, 48% White, and 10% Other Ethnicity.

Measures

Mastery-Oriented Teaching Practices. Teacher practices were assessed with observer ratings of Catalan and colleagues' (2021) Teaching Mindset Practices Observation Protocol, summarized in Table 1 (see Appendix A for details about the development of the protocol and reliability testing). Observers had high inter-rater reliability using the protocol, M ICC = .96, 95% CI [0.92, 0.98]. Classrooms were observed two to three times before the second student survey was administered. Ratings across all observations and practices were averaged to create a cumulative, formative score of mastery-oriented teaching practices for each classroom, and included observations of teachers' growth mindset messaging, use of process feedback, student-centered approach practices, and student engagement practices.

Teaching Practices	Description
Growth mindset messages	Talks about how abilities or intelligence is malleable and can be increased
Process feedback	Evaluates and assesses students referring to effort, strategies and/or persistence
Student-centered activity	Promotes student participation in classroom activities
Student-centered approach	Encourages students to participate in the conceptual thinking of the lesson

Table 1. Practices were rated from 1= Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always

Growth Mindset. Students' growth mindset was assessed with four items from Dweck (1999) rated from 1 = *Strongly disagree* to 5 = *Strongly agree.* Items include "You have a certain amount of intelligence and you really can't do much to change it"; "Your intelligence is something about you that you can't change very much"; "To be honest, you can't really change how intelligent you are"; "You can learn new things but you can't really change your basic intelligence". All items were reverse-coded and averaged to create a composite variable, such that a higher composite score indicates greater growth mindset. Alphas for this scale were .71 at Time 1 and .78 at Time 2.

Mastery Goal Orientation. Students' mastery goal orientation was assessed with 5 items from Midgley et al. (2000), rated from 1 = *not at all true* to 5 = *completely true* Items included, "It is important to me that I learn a lot of new concepts this year", "One of my goals in class is to learn as much as I can", and "It is important to me that I improve my skills this year". All items were averaged to create a composite variable. Alphas for this scale were .76 at Time 1 and .83 at Time 2.

Perceived Mastery Goal Structure was assessed with Midgley and colleagues' (2000) six-item Classroom Mastery Goal Structure scale using the "In my [subject] class" stem, rated from 1 = *not at all true* to 5 = c*ompletely true*. Items included, "trying hard is very important", "it's important to understand the work, not just memorize it", and "it's OK to make mistakes as long as you are learning." Students rated either their core science (35%), math (34%) or English (31%) class, and all students at the same school rated the same subject, which was determined by the subject where the intervention was delivered for treatment students. Scores at baseline and midline were averaged to capture students' experiences of the classroom goal structure across the year. Alphas for this scale were .75 at Time 1 and .83 at Time 2.

Perceived teacher mindset. One item was used to measure students' perceptions of their teacher's mindset. Using the "In my [subject] class" stem, students rated the item "My teacher seems to think that some kids are smarter and others are not" from 1 = *not at all true* to 5 = *completely true.* Students rated either their core science (35%), math (34%) or English (31%) class and all students at the same school rated the same subject, which was determined by the subject where the intervention was delivered for treatment students. Scores at baseline and midline were averaged to capture students' experiences of the classroom goal structure across the year.

Perceived teacher's mastery-oriented practices. One item was used to measure students' perceptions of their teacher's use of growth mindset and mastery-oriented related practices. Using the "In my [subject] class" stem, students rated the item "If you don't understand something the teacher explains it another way" from 1 = *not at all true* to 5 = *completely true*. Students rated either their core science (35%), math (34%) or English (31%) class and all students at the same school rated the same subject, which was determined by the subject where the intervention was delivered for treatment students. Scores at baseline and midline were averaged to capture students' experiences of the classroom goal structure across the year.

Model and Analysis Plan

Multilevel analyses were conducted in M*Plus* Version 8.6 (Muthén & Muthén, 2017), where students (Level 1) were nested within classrooms (Level 2). Paths *a* and *b* in Figure 1 were first modeled separately, then followed by an alternate model combining both practices and perceptions as predictors. Missing data were handled with the Bayesian analysis default in M*Plus*, which retains all cases and produces asymptotically the same results as full information maximum likelihood estimation (Muthén & Muthén, 1998-2017).

Two models were initially tested to examine both the fixed and random effects of teacher practices, as I initially hypothesized that there would be heterogeneity in the slope on student perceptions across teachers. However, the addition of the random slope did not predict significant variability in student outcomes, so all student-level predictors were treated as fixed. Student characteristics (gender and ethnicity) were examined, but not related to the outcome variables of interest, so were not included as predictors in the model.

For all models, Bayesian estimation was used to estimate the effect of teacher practices and student perceptions on students' self-reported beliefs and behaviors at the end of the year, as well as to test whether students' perceptions moderate the influence of teaching practices on these same beliefs and behaviors. Bayesian analyses provide outcome estimates by iterating a model thousands of times. After the final iteration, the model has learned about thousands of potential answers, and produces a posterior distribution. The posterior distribution provides information about when and how likely the estimate of each outcome is. The estimates reported in this study refer to the mean of the posterior distribution determined by the analyses. In addition to the data provided, Bayesian analyses use prior information about the models as the iterations are completed. The models in this study were run using generic weakly informative priors that indicate a normal distribution (Gelman, 2009), N(0,1) for both model paths.

A key advantage of Bayesian estimation over frequentist estimation is that the model results are presented as distributions, instead of point estimates. In this case, the effects of teacher practices and student perceptions are presented as a distribution of likely values, creating an estimate of posterior probability. Similar to frequentist *p*-values, posterior probabilities can be used to indicate how certain we are about a finding. However, unlike frequentist *p*-values, posterior probabilities are a statement about how certain we are about a finding in the context of our model, priors, and data. From this distribution, we are able to estimate the proportion of effects that were positive (i.e., when students' outcomes are above 0).

To test hypotheses 1 and 2, a single multilevel model (Model 1) was run to test for associations between student motivational beliefs and (1) their teacher's use of growth mindset practices and (2) their self-reported perceptions of their teachers and learning environments. This single multilevel model approach allowed me to test for the influence of both practices and perceptions, while controlling for the other. The equation for the model is as follows:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(\textit{Student perceptions}) + \beta_{2j}(\textit{T1 Student self-views}) + \varepsilon_{ij}$$

$$\text{Level 2: } \beta_{0j} = \gamma_{00} + \gamma_{01}(\textit{Teacher practices}) + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

where Y_{ij} represents student *i*'s self-views at the end of the year, nested within teacher *j*. β_{1j} represents the association between students' average perceptions across the year and students' self-views at the end of the year, β_{2j} represents the association of students' self-views at the beginning and end of the school year, γ_{01} represents the association between teaching practices across the year and the average student's mindset at the end of the year, and εij is the deviation of student i under teacher j from the average mindset of students nested within teacher j. Student perceptions and teacher practices will be tested as predictors to determine the effect of each on students' self-view outcomes across the school

year. Parameters whose beta estimates fall above or below zero 85% of the time will be considered to have strong effects on students' self-views.

Model 2 tests the proposed interaction (H3), where student perceptions moderate the effect of teacher practices on students' self-views. The model for the second equation is as follows:

Level 1: $Y_{ij} = \beta_{0j} + \beta_{1j}(T1\ Student\ perceptions) + \beta_{2j}(T1\ student\ growth\ mindset) + \varepsilon_{ij}$

Level 2: $\beta_{0j} = \gamma_{00} + \gamma_{01}(T1\ Teacher\ practices) + \mu_{0j}$

$\beta_{1j} = \gamma_{10} + \gamma_{11}(T1\ Teacher\ practices)$

$\beta_{2j} = \gamma_{01} + \gamma_{11}(T1\ Teacher\ practices)$

where γ_{01} is the association between teaching practices and mindset at the end of the year, γ_{10} is the association between students' perceptions and their self-views at time 2, γ_{11} is the estimate of the interaction between teacher practices and student perceptions, when both predictors are included in the model.

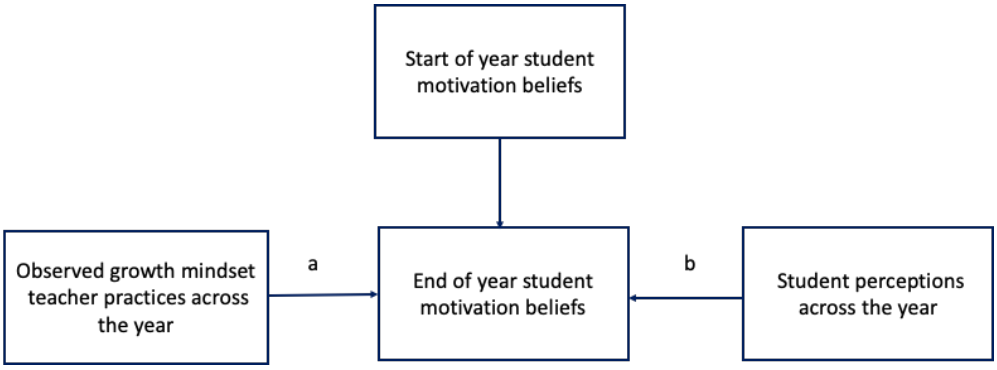


Figure 1. Model 1 tests the influence of observed teacher practices and student perceptions on students' motivational self-view beliefs at the end of the year. Students' beliefs at the beginning of the year are included as control variables.

Results

See Appendices B-E for descriptive statistics and correlation coefficients for all student-reported measures and observed teacher practices, and model estimates.

Model Fit

For all models testing the influences of teacher practices and student perceptions on student motivation outcomes, posterior predictive checks indicated the models fit the data well, with *ppp* values ranging from .48 - .50. Therefore, for all models run, the differences between the simulated and observed datasets were not different from zero.

Do Observed Teacher Practices Predict Students' Self-views at the End of the Year?

Using multilevel modeling, I tested my first hypothesis of whether teachers' use of mastery-oriented practices predicted students' growth mindset and mastery goal orientation at the end of the year (see Figure 2). I tested this hypothesis first using an average of observed teacher practices across all the mastery-oriented practices, and then tested each practice individually.

Average Observed Teacher Practices

Growth mindset. Observed teacher mastery-oriented practices were not associated with increased student mindset at the end of the school year, controlling for students' baseline growth mindset. The posterior distribution showed that 95% of students' growth mindset estimates were likely to fall below 0. The mean of the posterior distribution for this parameter was β = -.09 (*SD* = .05, 95% CI [-.19, .01]).

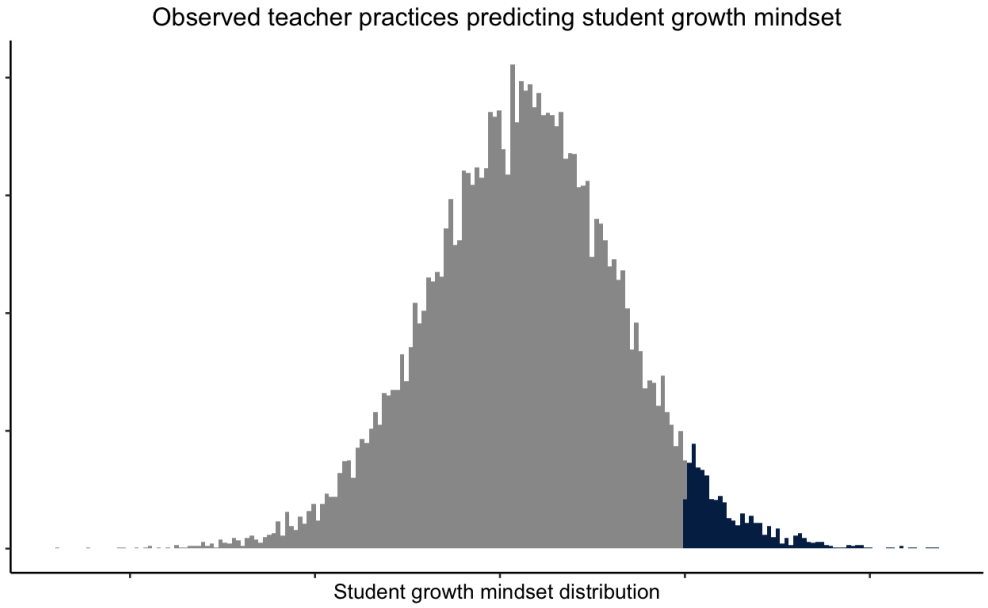
Mastery goal orientation. Observed teacher mastery-oriented practices were weakly associated with students' mastery goal orientation at the end of the school year, controlling for students' baseline mastery goal orientation. The posterior distribution showed that 70% of students' mastery goal orientation estimates were likely to fall above 0, suggesting a positive relation, but with a moderate

amount of uncertainty. The mean of the posterior distribution for this parameter was *β* = .02 (*SD* = .05, 95% CI [-.07, .12]).

Individual Observed Teacher Practices

Growth mindset. Teachers' use of process feedback (*β* = -.07, *SD* = .05, 95% *CI* [-.17, .03]), growth mindset messaging (*β* = -0.09, *SD* = 0.05, 95% *CI* [-0.19, 0.00]), student-centered activity practices (*β* = -0.07, *SD* = 0.05, 95% *CI* [-0.18, 0.04]), and student-centered conceptual thinking practices (*β* = -0.04, *SD* = 0.05, 95% *CI* [-0.14, 0.07]) were weakly negatively related to student growth mindset, with posterior distributions for all individual practices suggesting the majority of students' growth mindsets would fall below 0.

Mastery goal orientation. The relation between the average observations of teacher mastery-oriented practices and mastery goal orientation seems to have been driven primarily by growth mindset messaging (*β* = 0.05, SD = 0.05, 95% CI [-.04, .14]) with the other practices showing weaker relations: process feedback (*β* = -0.01, SD = 0.05, 95% CI [-0.10, 0.09]), student-centered activity practices (*β* = 0.01, SD = 0.05, 95% CI [-0.08, 0.10]), and student-centered conceptual thinking practices (*β* = 0.02, SD = 0.05, 95% CI [-0.08, 0.11]).



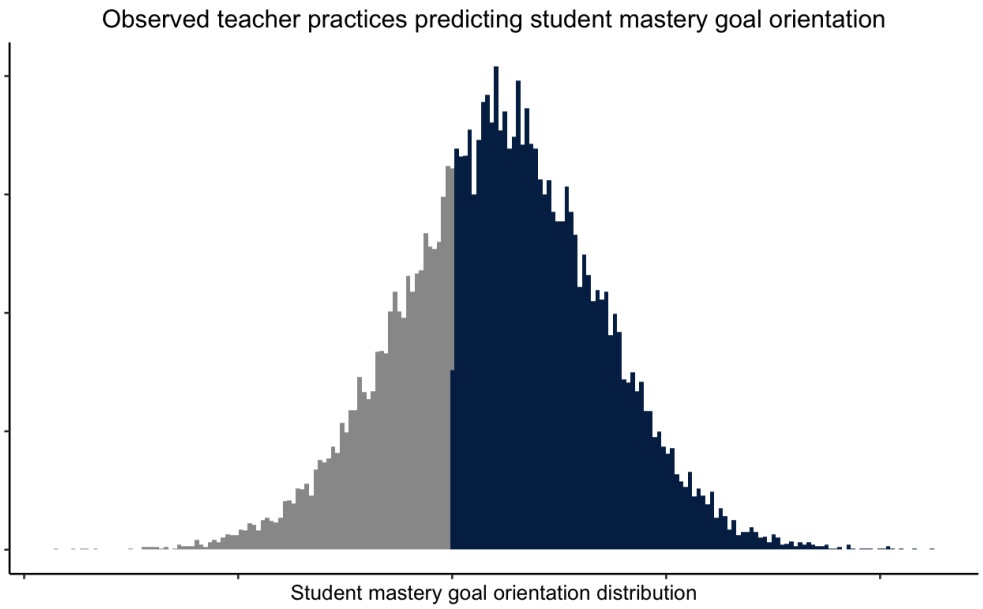


Figure 2. Distribution of likelihood that teachers' observed growth mindset practices have a positive effect on students' self-views at the end of the year. Dark blue bars represent draws from the posterior distribution that were over zero.

Do Students' Perceptions of their Learning Environments Predict their Self-views at the End of the Year?

The same multilevel model was run to test hypothesis 2, examining whether students' perceptions of their learning environments predicted their reported self-views at the end of the year (see Figure 3). Student perceptions were examined as three distinct components– perceptions of their classroom's goal structure, perceptions of their teacher's mindset, and perceptions of their teacher's use of mastery-oriented practices.

Perceptions of the Classroom Goal Structure

Growth mindset. Students' perceptions of a mastery-oriented learning environment were positively associated with their mindset at the end of the school year, controlling for students' baseline growth mindset. The posterior distribution indicated 99% probability of students' mindsets being

positive at the end of the year. The mean of the posterior distribution for this parameter was β = 0.19 (*SD* = 0.04, 95% *CI* [0.12, 0.28]).

Mastery goal orientation. Students' perceptions of a mastery-oriented learning environment were positively associated with their mastery goal orientation at the end of the school year, controlling for students' baseline mastery goal orientation. The posterior distribution indicated 99% probability of students' mindsets being positive at the end of the year. The mean of the posterior distribution for this parameter was β = 0.40 (*SD* = 0.04, 95% *CI* [0.31, 0.49]).

Perceptions of Teachers' Mastery Oriented Practices

Growth mindset. Results indicated that students' perceptions of their teachers' use of mastery-oriented practices are likely to be positively associated with their mindset at the end of the school year, controlling for students' baseline growth mindset. The posterior distribution indicated 80% probability of students' mindsets being positive at the end of the year, indicating a fairly strong likelihood of a positive association. The mean of the posterior distribution for this parameter was β = 0.05 (*SD* = 0.04, 95% *CI* [-0.03, 0.14]).

Mastery goal orientation. Students' perceptions of their teachers' use of mastery-oriented practices were positively associated with their mastery goal orientation at the end of the school year, controlling for students' baseline mastery goal orientation. The posterior distribution showed 99% probability of students' mindsets being positive at the end of the year. The mean of the posterior distribution for this parameter was β = 0.20 (*SD* = 0.04, 95% *CI* [0.12, 0.29]).

Perceptions of Teachers' Growth Mindset

Growth mindset. Students' perceptions of their teachers' growth mindset were positively associated with their mindset at the end of the school year, controlling for students' baseline growth mindset. The posterior distribution showed 99% probability of students' mindsets being positive at the

end of the year. The mean of the posterior distribution for this parameter was β = 0.13 (*SD* = 0.04, 95% *CI* [0.05, 0.20]).

Mastery goal orientation. Students' perceptions of their teacher's growth mindset were weakly associated with their mastery goal orientation at the end of the year, controlling for students' baseline mastery goal orientation. The posterior distribution showed that 70% of students' mastery goal orientation estimates were likely to fall above 0, suggesting a positive relation, but with a moderate amount of uncertainty. The mean of the posterior distribution for this parameter was β = 0.05 (*SD* = 0.04, 95% *CI* [-0.03, 0.13]).

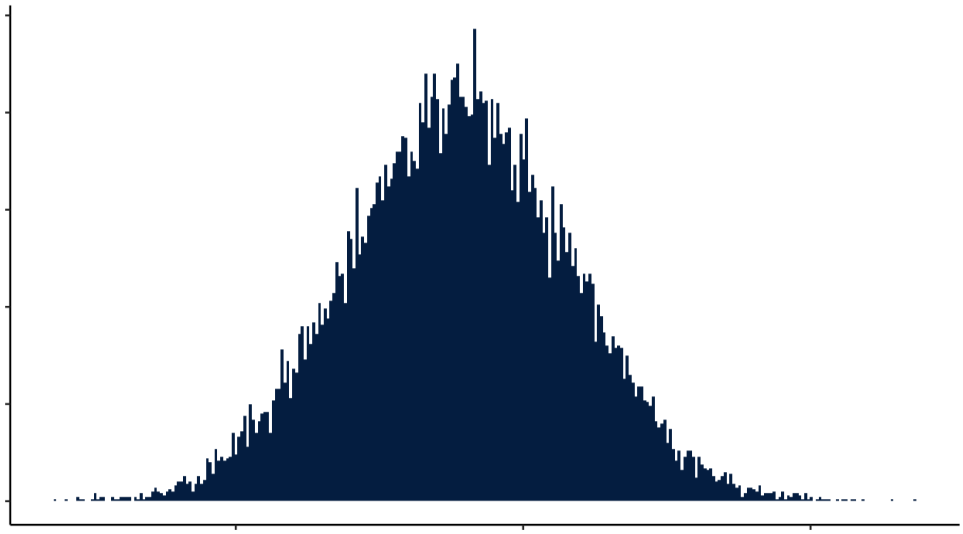
Do Student Perceptions Moderate the Effect of Teacher Practices on Student Self-views at the End of the Year?

Finally, a multilevel model was run to test whether the associations between students' perceptions of their learning environment's mastery structure and student growth mindset vary for students whose teachers were observed using growth mindset practices more often.

Growth mindset. Results from the multilevel model indicated a non-significant interaction estimate. The posterior distribution showed that 57% of students' growth mindset estimates were likely to fall below 0. The mean of the distribution was β = -0.06 (*SD* = 0.04, 95% *CI* [-0.15, 0.04]).

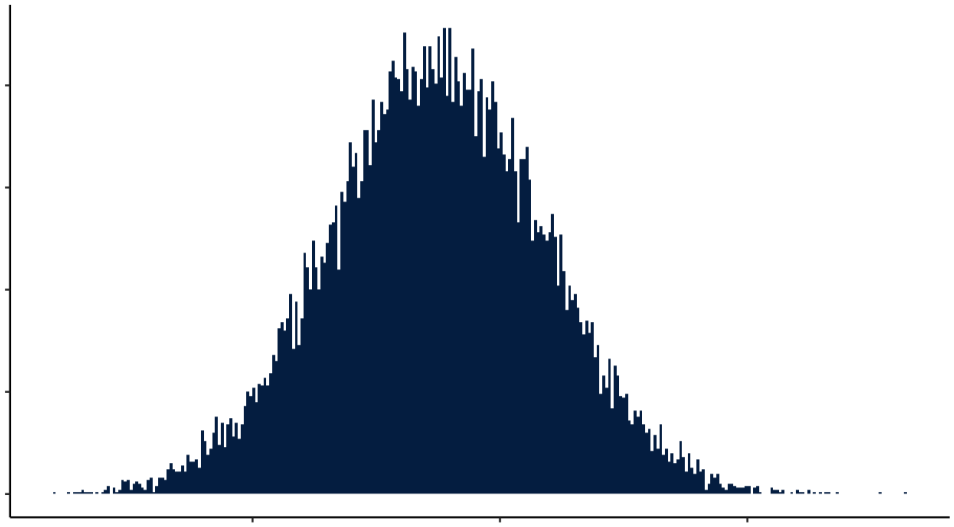
Mastery Goal Orientation. The same model was tested with students' mastery goal orientation beliefs at the end of the year as the outcome. Results indicated a non-significant interaction estimate. The posterior distribution showed that 68% of students' mastery goal orientation estimates were likely to fall below 0. The mean of the distribution was β = -0.02 (*SD* = 0.04, 95% *CI* [-0.10, 0.06]).

Perceived classroom goal structure predicting student growth mindset

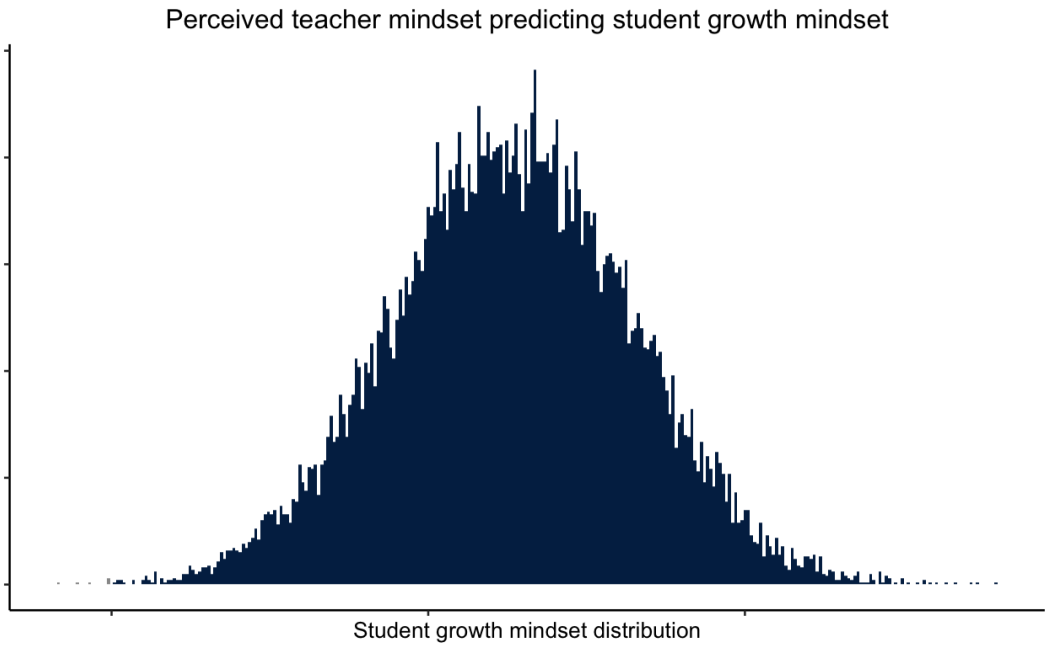


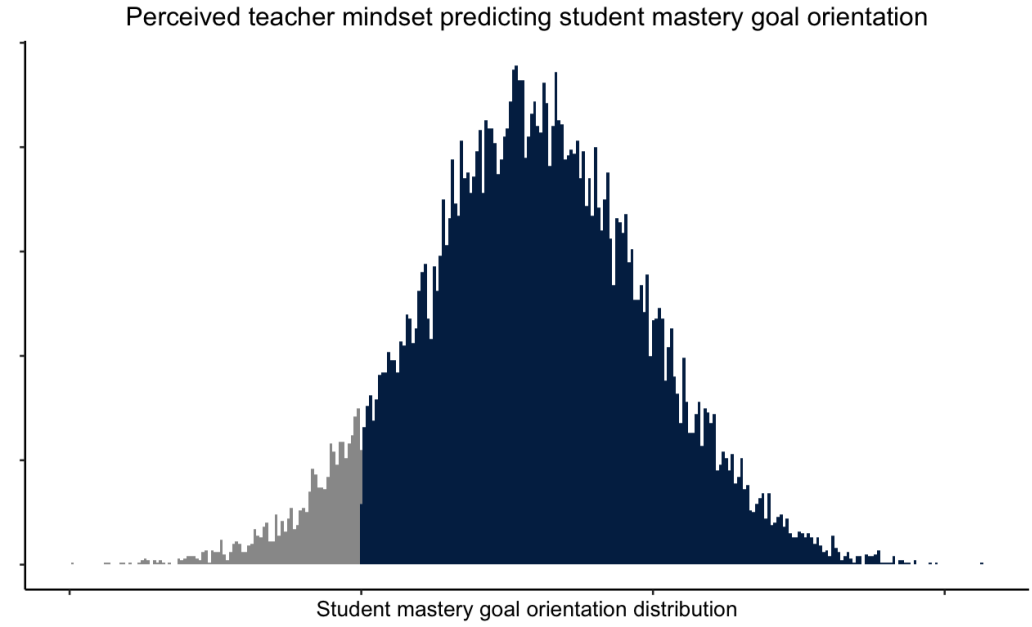
Student growth mindset distribution

Perceived classroom goal structure predicting student mastery goal orientation



Student mastery goal orientation distribution


Perceived teacher mindset predicting student growth mindset
Student growth mindset distribution


Perceived teacher mindset predicting student mastery goal orientation
Student mastery goal orientation distribution

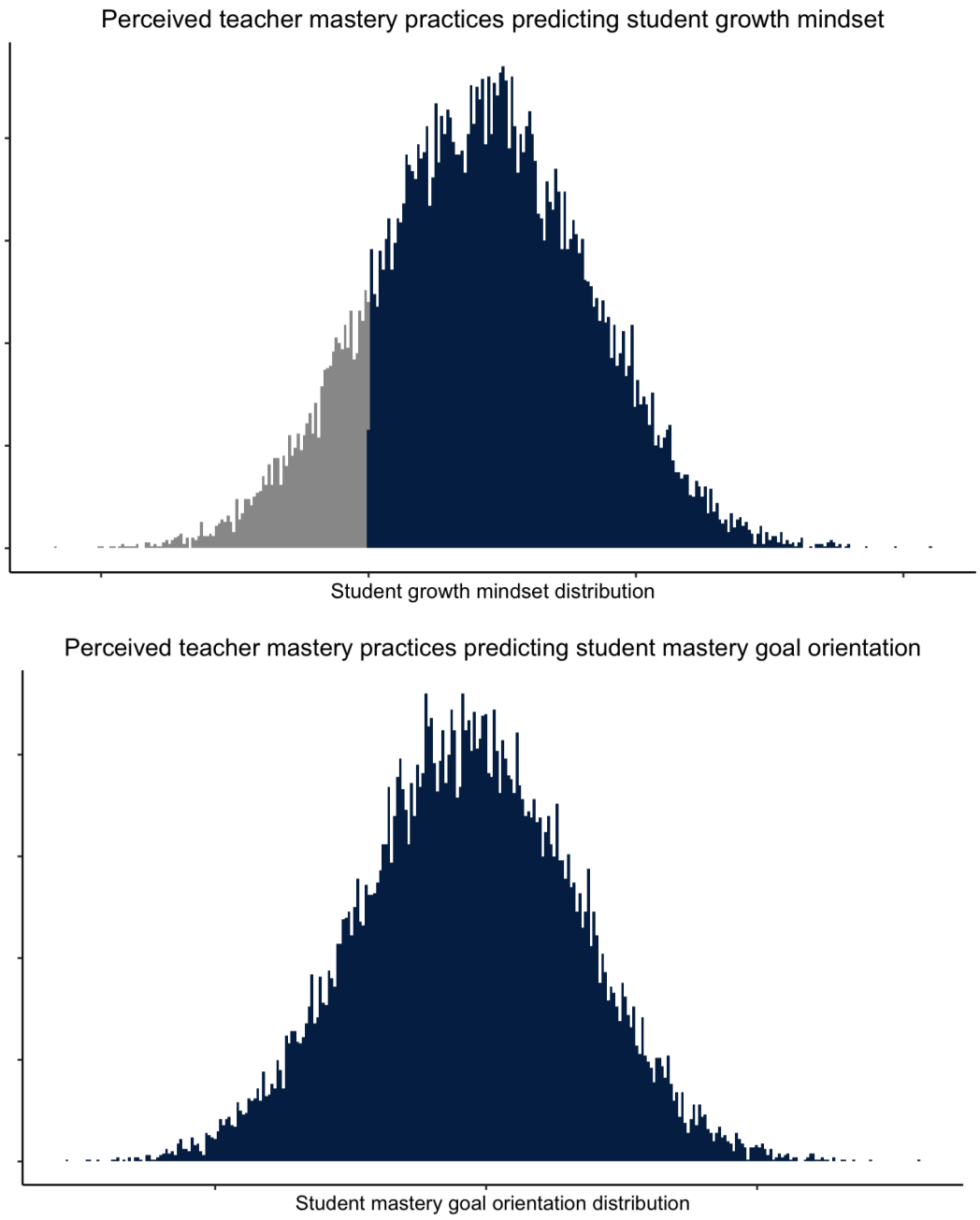


Figure 3. Distribution of likelihood that students' perceptions have a positive effect on their self-views at the end of the year. Dark blue bars represent draws from the posterior distribution that were over zero.

Discussion

Middle school students spend a great deal of their time in the classroom, learning and interacting with others. They have individual and shared experiences that contribute to the formation of

their self-views. These self-views then influence how they think, feel, and behave in these learning environments. The goal of this study was to identify factors of the learning environment that promote students' growth mindset and mastery orientation beliefs– two core components of students' motivational self-views. This study contributes to an understanding of how teacher practices and student perceptions influence these self-views, especially when both are present in the classroom. A series of competing hypotheses tested whether teacher practices, student perceptions, or a combination of the two had the strongest effect on student self-views. Results from the study indicated that teacher practices were almost completely unrelated to student outcomes. That is, they did not play a direct role in how students' motivational self-views develop. Instead, it was students' perceptions of the learning environment that influenced their self-views. Results did not indicate a significant interaction of teacher practices and student perceptions.

Results from this study show that student perceptions of the learning environment are the driving influence on their self-views. When accounting for students' self-views at the beginning of the school year, results from the present study indicate that influence of their perceptions across the year are strong enough to influence students' growth mindset and goal orientation reported at the end of the year. When students perceived their learning environments to be more mastery-oriented and encouraging of learning and growth despite failure or mistakes, and when they perceived their teacher to have a growth mindset, they were more likely to endorse a growth mindset and hold more mastery-oriented beliefs themselves. Students' perceptions of their teachers' practices also predicted students' self-views, where students who perceived their teachers to use mastery-oriented practices were more likely to endorse a growth mindset and were slightly more likely to hold a mastery goal orientation themselves.

The question that then follows is where these differing perceptions come from and why they vary across students in a shared environment. It may be that students' perceptions are influenced by

pre-existing conceptions they hold based on previous learning experiences with other teachers, by individual student characteristics, or by experiences outside of their learning environments (Bardach et al., 2019; Lam et al., 2015; Calarco, 2011). For example, differences in students' perceptions may stem from their experience of differential teacher treatment, or from different experiences students have based on the specific class context in which they are situated (e.g., students may perceive a practice in a math class differently than they might perceive a similar practice in a different class; see London et al., 2012).

Research has also found that students' experiences of stereotype threat are associated with perceptions of a fixed mindset learning environment (Seo et al., 2020). This may point to situations in which certain groups of students, such as students belonging to a minority group, have experiences that lead to different perceptions among those groups. There may also be bidirectional effects of perceptions at play, where teachers' perceptions of their students (e.g., teachers perceiving some students to be more likely to achieve than others) influence their interactions with students, which in turn impact students' perceptions of their teacher. Results from the present study indicate that the individual and subjective manner in which students experience their learning environments is what influences their outcomes, rather than what a third-party observer sees a teacher say or do. However, more research is needed to better understand the origins of student perceptions, the elements of the learning environment that play a role in their development and what specifically leads to these perceptions varying across students.

Teachers' mastery-oriented practices, which were collected via direct observation, were not found to be associated with students' growth mindset beliefs and were only weakly associated with students' mastery goal-orientation. This finding is in contrast to my hypothesis, that teachers' uses of mastery-oriented practices would predict increases in students' motivational self-views, based on literature highlighting the importance of a teacher's role (e.g,. Patrick et al., 2003). Several studies have

highlighted the influence that teacher practices have on students' feelings of self-efficacy and measures of achievement, such as through the emotional support and support for autonomous learning provided (Allen et al., 2011; Pianta et al., 2008). However, this may not be the case in regard to the specific motivational self-views measured here, and these results add to previous research that have not found direct links between mastery-oriented practices and student growth mindset exist (e.g., Park et al., 2016; Haimovitz & Dweck, 2017). Mastery-oriented practices have been linked to students' own mastery goal orientations, but only indirectly, through students' perceptions of their learning environment's goal structure (Schiefele, 2017). More research is needed to determine whether there are conditions under which teacher practices directly influence students' self-views, or whether they instead work through some intermediary factor to impact student outcomes.

Finally, there was no evidence for a moderating effect of teacher practices and student perceptions influencing student self-views. Together, results from this study support a substantial body of literature that has linked student perceptions with their goal orientations and adaptive learning beliefs and behaviors (Meece et al., 2006, Radovan & Makovec, 2015), and extends these findings by directly linking these same perceptions to students' growth mindset. These findings suggest that students' perceptions of their learning environments and their teachers play a crucial role in the development of their self-views. When students perceive supportive learning environments that view mistakes and failure as learning opportunities, and when they perceive their teachers as contributing to these supportive environments, they will be less worried about encountering struggles and making those mistakes, and instead will be more encouraged to invest the effort necessary to reach their goals, despite the struggles they may encounter. As this study considered mastery orientation and growth mindset as key components of students' self-views, these findings suggest that students' perceptions are directly related to how a student views their abilities, intelligence, and motivation to improve. The

next step is to translate these findings into applications in the natural learning contexts and environments that students will benefit from.

First, future research should conduct similar studies examining whether certain student characteristics or beliefs influence the perceptions they hold. For example, it may be that students who hold mastery goal orientations are more likely to perceive their learning environment as promoting mastery over performance, compared to students who do not hold these orientations. Students who have had more mastery-oriented teachers or learning experiences in the past may carry those experiences over into future classrooms and may already be more inclined to perceive practices or environments as mastery-oriented. In that case, students who have not had these prior experiences might hold different perceptions that should be accounted for in the practices and material delivered. Future studies could observe students across multiple teachers to gain further understanding of how different learning contexts experienced by one student might influence the development of their self-views.

Additionally, future program and intervention development should acknowledge that while all students may receive the same material, instruction, and teacher practices, not all students will perceive the same messages from what they receive. Especially when curriculum is focused on impacting students' motivation, growth mindset, and desire to improve, it is important to consider that these beliefs form differently across students, depending on a number of factors, such as their individual previous experiences. There may not be a "one-size-fits-all" curriculum to show students that they are all capable of learning and growth. Teachers may need to tailor certain aspects of their teaching and pedagogy to foster a beneficial learning environment for all of their students. Given that these differences in perceptions contribute to significant differences in student outcomes, program and intervention developers should address these differences when writing curricula. For example, writers could invite the voices of groups of students with different backgrounds, starting beliefs, or motivational

or academic histories, and include these students in the development and testing of new programs. This could be a first step toward a better understanding of who may benefit from certain programs or program components more, and whether adaptations would benefit students, depending on their background characteristics and starting beliefs.

Finally, these findings also hold implications for education and learning in today's rapidly changing society. In light of the 2020 COVID-19 pandemic, it has become clear that students' learning environments are unpredictable, and the contexts in which students learn and develop may be altered with little warning. The views students hold of themselves, especially during such periods of instability, are likely to also be unpredictable– for example, the majority of students experienced a drastic shift in nearly every aspect of their learning, the most prominent being the shift from in-person to virtual learning. It is likely that students hold different perceptions of a virtual learning environment than they do of a more traditional environment, and these different perceptions may alter how they view their abilities. Students may feel less motivated or less capable of growth when their interactions with their teachers and peers are less rewarding or more difficult to interpret and respond to. Teacher practices may be both delivered and perceived very differently online than they would in person, which may alter the perceptions students directly hold of their teachers as well.

As perceptions are emerging as a driving influencer of student self-views, the multiple contexts in which students may be situated are especially important to consider. During these years, and especially during periods of unstable learning, parents may be more involved in their children's learning than usual, adding an additional layer of complexity to their learning environments and how students perceive them. Future research could contribute to this growing field of interest by examining the differences in perceptions, and the implications of these differences, across different types of learning environments.

Limitations and Future Directions

While the present study has important implications for intervention and program development and future research, there are also limitations that should be considered. First, the sample size did not provide sufficient power to test multilevel mediation. That is, whether teacher practices influence student self-views and motivation via their perceptions. Based on previous research, I would hypothesize that teachers' use of mastery-oriented practices would influence their perceptions of a mastery-oriented learning environment, which would then increase their growth mindset and related beliefs (e.g., Meece et al., 2006). Future research should test these full indirect pathways, as this study did not.

One limitation of this study is that the observed teacher practices, which were collected across a limited number of time points throughout the year, may not provide an accurate idea of what teachers actually say and do to create the overall structure of their classrooms. For example, some teachers may use growth mindset and mastery-oriented practices during certain periods of instruction, but not during others. This variation in teachers' use of certain practices may not be captured in the "thin slices" of a classroom context that observations often capture when collecting observations at pre-selected intervals (Begrich et al., 2021). Additionally, the observations collected may not be enough to provide adequate information about what else teachers do across the year that may influence student outcomes. Observations collected of whole class instruction do not reflect information about teacher-student relationships outside of the observation times or individual interactions during instruction periods. Future studies should aim to include more observation cases and consider ways to adequately capture other sources of influence in students' learning environments.

Conclusion

The views students hold of themselves, and the ways in which these views develop, are important to understand, as these self-views contribute to how students learn, set goals, and motivate

themselves to reach those goals in the classroom. This study builds on existing evidence that highlights the important roles of learning environments and student perceptions of those environments on the beliefs students hold regarding their learning and motivation. As perceptions appear to be the driving factor in students' development of growth mindset beliefs and mastery-oriented learning behaviors, more research is needed to determine the best way to leverage these findings and apply them in both naturalistic classroom and intervention settings.

Appendix A

Observation Protocol: Development, Training and Reliability Testing

Development. The Teaching Mindset Practices (TMP) observation protocol was designed to capture variation in teaching practices for the Brainology efficacy study, which tested the effectiveness of a growth mindset intervention for middle school students' motivation and achievement. The observation protocol was still being developed during the first year of the study and, therefore, observation data were only available for teachers who participated in years two through four. Visit https://osf.io/p4fec/?view_only=a55d6a9014784b49aeb19ff900cffed8 to see the observation form (Form C) used in the current investigation. To develop the protocol, researchers reviewed research on teaching practices that were mastery-oriented and therefore likely to convey a growth mindset (e.g., Clements & Sarama, 2008; Haimovitz & Dweck, 2017; Hamre et al., 2013; Sawada et al., 2002; Sun, 2018). Starting with a list of 21 teaching practices, researchers sought feedback from experts and tested draft protocols in live and recorded classroom observations to refine the protocol to four practices that conveyed the importance of mastery, were central to growth mindset teaching, and that could be feasibly captured by observers.

Training. Researchers drew from prior work on classroom observations to develop a training protocol (e.g., Gargani & Strong, 2014; Hamre et al., 2013; Hill & Grossman, 2013; Hill, Ball, Blunk, Goffney, & Rowan, 2007; Shih & Tarr, 2013). Before each of two training sessions, coders independently watched classroom videos or read classroom transcripts recorded in year one of the project and used the observation protocol to rate the teaching practices that they observed or read about. Coders then met with the researchers and other observers to discuss their ratings and the evidence they used to make those ratings before entering the reliability phase.

Reliability Assessment. Reliability assessment took place in the fall during three sessions prior to classroom visits in which observers independently coded new classroom videos. The three reliability

rounds showed high agreement among observers, average intraclass correlation = .96, 95% CI [.92, .98]. Another reliability test was conducted in the spring of years 2 and 3 to determine whether observers were still rating teaching practices reliably. These tests also indicated high reliability across observers (average intraclass correlation = .94, 95% CI [.86, .96]).

Appendix B

Observed teacher practice	Mean (SD)	Min	Max
Composite (all practices averaged)	2.69 (0.35)	2.17	3.43
Process feedback	1.91 (0.44)	1	3
Mindset Messaging - Growth	1.24 (0.40)	1	2.29
Student-centered - Activity	4.08 (0.39)	3.33	5
Student-centered - Conceptual Thinking	3.54 (0.62)	2	4.5

Teacher practices (observers rated teaching practices 1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always):

Appendix C

Student-reported perceptions	Mean (SD)	Min	Max	Alpha
Perceptions of the learning environment	4.29 (0.57)	2.08	5	0.76
Perceptions of teacher's growth mindset	4.05 (0.95)	1	5	-
Perceptions of teacher's mastery-oriented practices	3.81 (1.15)	1	5	-

Student perceptions, averaged across Time 1 and Time 2.

Appendix D

Variable	1	2	3	4	5	6
1. Growth Mindset T1						
2. Growth Mindset T2	0.55** [.49, .61]					
3. Mastery Goal Orientation T1	0.06 [-.03, .14]	0.08 [-.01, .16]				
4. Mastery Goal Orientation T2	0.08 [-.01, .16]	0.17** [.08, .25]	0.53** [.46, .59]			
5. Perceptions of Learning Environment	0.09 [-.00, .17]	0.20** [.12, .29]	0.54** [.47, .60]	0.55** [.48, .61]		
6. Perceptions of teacher practices	0.01 [-.08, .10]	0.05 [-.04, .14]	0.21** [.13, .30]	0.30** [.21, .38]	0.47** [.40, .54]	
7. Perceptions of teacher growth mindset	0.12** [.03, .21]	0.19** [.11, .28]	0.18** [.09, .26]	0.15** [.07, .24]	0.29** [.20, .36]	0.34** [.26, .41]

*Correlations of student-reported variables with 95% CI. * indicates p < .05. ** indicates p <.01.*

Appendix E

Practice	T2 Growth Mindset	T2 Goal Orientation
Process feedback	-0.07 [-0.17, 0.03]	-0.01 [-0.10, 0.09]
Growth mindset messaging	-0.09 [-0.19, 0.00]	0.05 [-0.04, 0.14]
Student-centered – Activity	-0.07 [-0.18, 0.04]	0.01 [-0.08, 0.10]
Student-centered-Conceptual thinking	-0.04 [-0.14, 0.07]	0.02 [-0.08, 0.11]
Combined teacher practices	-0.09 [-0.19, 0.01]	0.02 [-0.07, 0.12]

Teacher practices predicting T2 Student Outcomes, presented via the distribution mean estimate and 95% CI)

Perception	T2 Growth Mindset	T2 Goal Orientation
Learning environment goal orientation	0.19 [0.12, 0.28]	0.40 [0.31, 0.49]
Teacher's use of mastery-oriented practices	0.05 [-0.03, 0.14]	0.20 [0.12, 0.29]
Teacher's growth mindset	0.13 [0.05, 0.20]	0.05 [-0.03, 0.13]

Student perceptions predicting T2 Student Outcomes, presented via the distribution mean estimate and 95% CI).

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