**Teachers' Growth Mindsets and the Differential
Treatment of High- and Low-Ability Students**

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Abstract

We examined the relation between teachers' beliefs about the nature of intelligence (their growth mindsets) and their treatment of high versus low ability students. Teachers with weaker growth mindsets reported being more likely to use restrictive instructional practices (controlling and performance-oriented) overall than teachers with stronger growth mindsets, and teachers were more likely to use restrictive practices when working with a low-ability student than when working with a high-ability student. By contrast, the hypothesized student ability level $\times$ teacher growth mindset $\times$ instructional practice type. A number of important potential limitations and their implications for future research on these relations are discussed.

Keywords: growth mindsets, teacher beliefs, instructional practices, differential treatment, student ability.

Teachers' Growth Mindsets and the Differential Treatment of High- and Low-Ability Students

Teachers play an instrumental role in the cognitive and motivational development of their students (Cornelius-White, 2007; Langens, 2007; Nye, Konstantopoulos, & Hedges, 2004; Urdan & Schoenfelder, 2006; Wentzel, 2002). However, the types of instructional practices they implement in their classrooms can vary greatly (Brookhart, 1994; Cizek, Fitzgerald, & Rachor, 1996; Goode, 1983; McMillan, Myran, & Workman, 2002). Some teachers engage in practices that promote students' sense of autonomy and encourage them to master the class content. These *supportive practices* have repeatedly been linked to positive student outcomes, such as increased academic engagement, greater conceptual understanding in math, and higher course grades (Jang, Reeve, Ryan, & Kim, 2009; Niemiec & Ryan, 2009; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Renkl & Helmke, 1992; Stipek, Givvin, Salmon, & MacGyvers, 2001). In contrast, other teachers tend to rely more on practices that make students feel controlled and concerned with outperforming their peers. Such *restrictive practices* have been shown to undermine students' intrinsic motivation, their preference for challenging tasks, their growth mindsets regarding intelligence, and their performance on problems requiring analytical reasoning (Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Park, Gunderson, Tsukayama, Levine, & Beilock, 2016; Soenens & Vansteenkiste, 2005).

Because the types of instructional practices that teachers utilize have implications for a variety of student outcomes, it is important to identify individual difference factors that help explain why some teachers prefer one type of practice over another. One such factor is teachers' beliefs about the nature of intellectual ability, also known as their *growth mindsets* (Dweck & Molden, 2017). Several studies have shown that compared to teachers who believe that

intelligence can be developed incrementally with effort (i.e., those who have a *growth* mindset), teachers who believe that intelligence is a fixed entity (i.e., those who have a *fixed* mindset) are more likely to rely on performance-oriented and controlling instructional practices in the classroom (Jonsson & Beach, 2012; Leroy, Bressoux, Sarrazin, & Trouilloud, 2007; Park et al., 2016; Stipek et al., 2001).

In general, these studies have tended to examine how teachers' academic mindsets affect the types of practices that teachers engage in with *all* students in their classrooms. However, teachers sometimes differentiate their instruction based on their perceptions of individual students' abilities (for review, see Babad, 1993). As a result, there is reason to expect that teachers' mindsets might also influence the extent to which they engage in different kinds of practices when interacting with students they perceive to be high versus low in ability. This is an important topic of study because *differential treatment* can adversely affect the academic performance and self-confidence of students who are perceived to be low in ability (Babad, 1993; Jussim, Robustelli, & Cain, 2009). In the present work, we investigated the relation between teachers' growth mindsets and instructional practices they use with high versus low ability students.

Categories of Instructional Practices

One element that characterizes teachers' instruction is the extent to which they rely on autonomy-supportive versus controlling practices (Ryan & Deci, 2016). Autonomy-supportive practices involve tailoring class material to students' personal interests, encouraging students to play an active role in their own learning, and providing students with opportunities to become increasingly independent in their learning (Reeve, 2012; Reeve & Jang, 2006). In contrast, controlling practices restrict students' autonomy and rely on methods of external regulation in

order to motivate and engage students. Examples of such practices include pressuring students to think and act in specific ways, limiting their participation during class lessons, and using rewards or punishments to manage their motivation (Good & Brophy, 1974; Sarrazin, Tessier, Pelletier, Trouilloud, Chanal, 2006). Prior research shows that a broad range of important academic outcomes are positively associated with teachers' use of autonomy-supportive practices and negatively associated with their use of controlling practices (Black & Deci, 2000; Boggiano et al., 1993; Grolnick & Ryan, 1987; Hardre & Reeve, 2003; Stronge, Ward, & Grant, 2011).

Another important dimension of instruction is the extent to which teachers' classroom practices emphasize the goal of attaining mastery in a particular domain versus outperforming one's peers. Mastery-oriented practices, such as praising students for their effort and hard work, encourage students to develop a deep conceptual understanding of the material and to focus on their individual progress over time (Patrick, Anderman, Ryan, Edelin, & Midgley, 2001; Retelsdorf, Butler, Streblow, & Schiefele, 2010). In contrast, performance-oriented practices, such as publicly praising a student for receiving a high test score, encourage students to learn only what they need to know in order to earn good grades and to focus on how they compare to other students (Dweck & Leggett, 1988; Park et al., 2016; Patrick et al., 2001; Stipek et al., 2001). As with the previous dimension, research suggests that important student outcomes are positively associated with mastery-oriented instructional practices and negatively associated with performance-oriented practices (see Meece, Anderman, & Anderman, 2006, for a review).

Because of the theoretical distinction between the autonomy-supportive versus controlling dimension of instruction and the mastery- versus performance-oriented dimension, prior research has generally treated these factors separately. However, as discussed above, prior research has also revealed substantial overlap in the supportive nature and implications for

students of autonomy-supportive and mastery-oriented practices, as well as in the restrictive nature and implications of controlling and performance-oriented practices. The current study thus examined the two dimensions of instruction as a single construct, contrasting teachers' use of mastery-oriented and autonomy-supportive practices (i.e., *supportive instructional practices*) with their use of performance-oriented and controlling instructional practices (i.e., *restrictive instructional practices*). Prior research lends support for this approach. For examples, factor analyses of elementary school teachers' instructional practices have shown that teachers' use of mastery-oriented practices and autonomy-supportive practices load onto one factor, whereas their use of performance-oriented practices load onto a separate factor (Stipek et al., 1998; see also Moorman & Pomerantz, 2010).

The Relation Between Teachers' Academic Mindsets and Instructional Practices

Because the practices that teachers utilize have implications for key student outcomes, it is important to identify factors that help explain when teachers will prefer one set of practices over the other. One factor that has been shown to influence teachers' use of mastery- versus performance oriented instructional practices are their *growth mindsets*—their beliefs about whether intellectual ability is generally innate and unchangeable, or generally improvable with effort. For example, Stipek and colleagues (2001) conducted a study in which they assessed sixth-grade teachers' self-reported beliefs about mathematics teaching and observed their instructional practices during math lessons. The authors found that teachers' fixed mindsets regarding math ability were significantly positively associated with their use of performance-oriented practices, but marginally negatively associated with their provision of autonomy and their emphasis on conceptual understanding. Furthermore, Park and colleagues (2016) reported a similar association between elementary school teachers' fixed mindsets and their self-reported

use of performance-oriented practices. In addition, a study by Leroy and colleagues (2007) found that teachers' fixed mindsets were negatively associated with teachers' self-reported support of students' autonomy (e.g., "In class, I encourage students to ask questions").

One potential explanation for these findings is that teachers with a fixed mindset are more likely than teachers with a growth mindset to conclude that students who are struggling to complete a challenging task have reached the limits of their ability in that domain (see Dweck, 1999), and thus there is not much that they as teachers can do to help these students improve their ability. This conclusion may lead them to engage in performance-oriented behaviors aimed at ensuring that their students at least meet the minimum performance standards of the class. Indeed, concerns about meeting performance standards can lead to teachers to engage in performance-oriented practices with their students (Deci, Spiegel, Ryan, Koestner, & Kauffman, 1982; Flink, Boggiano, & Barrett, 1990), and such concerns may be especially salient among teachers faced with struggling students who do not believe that these students' abilities can be improved. Conversely, teachers with a growth mindset may be more likely to interpret struggle as instrumental to the development of new skills (i.e., mastery). This interpretation may lead them to engage in mastery-oriented behaviors that foster intellectual growth even when initial performance outcomes are poor (i.e., when student ability is perceived as being low).

Differential Treatment of Students

The studies described in the previous section provide evidence of a relation between teachers' mindsets and their general use of mastery- versus performance-oriented instructional practices. However, research has shown that teachers may also differentiate their instruction based on their perceptions of individual students' abilities. Specifically, this literature has shown that teachers may more inclined to engage in supportive practices with students whom they

perceived as being high in academic ability (or potential) than with students they perceived as being low in ability. For instance, Brophy and Good (1970) found that teachers were more than twice as likely to provide supportive feedback following a correct answer and only a third as likely to provide controlling feedback following a mistake to students for whom they had higher expectations (i.e., those they perceived to have stronger academic abilities) than to students for whom they held low expectations (i.e., those they perceived to have weaker abilities). Similar results were found by Babad, Inbar, and Rosenthal (1982): overall, teachers were more supportive and less controlling towards students for whom they had high (versus low) expectations. This was true regardless of whether teachers' expectations were based on experience or were induced by experimenters and unrelated to students' actual abilities. Such patterns of differential treatment are important because they can ultimately produce or exacerbate observable differences in actual ability; that is, they can lead to expectancy effects (e.g., Brattesani, Weinstein, & Marshall, 1984; Kuklinski & Weinstein, 2001).

The Present Research: The Relation Between Teachers' Academic Mindsets and Differential Treatment

The present research aims to connect the literature on teacher mindsets with the literature on teachers' differential treatment of low versus high ability students. As discussed, teachers with a fixed mindset may be more likely than those with a growth mindset to use restrictive practices when interacting with a struggling student because they are likely to infer that the student has reached the limits of his or her ability (see Dweck, 1999). However, these teachers may be especially likely to make this inference when they perceive the student to be lacking innate ability in that domain. By contrast, when they believe that the student's ability is high, the same teachers may instead infer that any setbacks are merely a bump in the road toward mastery.

Consistent with this possibility, we expected that teachers with a fixed mindset would be more likely than teachers with a growth mindset to report using restrictive practices and less likely to report using supportive practices than teachers with a growth mindset with students that they perceive as being *low* in ability. In contrast, we thought that the two groups of teachers might be equally likely to engage in these practices with students they perceive as being high in ability. Relatedly, we expected teachers with a fixed mindset to engage more in restrictive practices (and less in supportive practices) with low ability students than with high ability students, whereas we expected teachers with a growth mindset to be equally unlikely to engage in restrictive practices with these two groups. That is, we expected teachers with a fixed mindset to be more likely than teachers with a growth mindset to differentiate their treatment of high and low ability students.

Method

Data and Participants

This study leveraged data from the National Study of Learning Mindsets (NSLM), the largest-ever randomized controlled trial of a growth mindset program in the U.S. in K-12 settings, in which a brief online growth mindset program was administered to 9th grade students during the 2015-2016 academic year. The NSLM features a nationally representative probability sample of regular U.S. public high schools. This study specifically examined responses from the 354 math teachers from 76 schools who completed the relevant NSLM measures (*N* teachers per school: $M = 4.66$, $SD = 3.07$, range = 1-13; age: $M = 37.8$ years, $SD = 11.2$; teaching experience: $M = 12.0$, $SD = 9.9$; 53.1% female, 31.9% male, 15.0% not indicated; 71.5% White, 13.6% non-White, 15.0% not indicated; highest educational attainment: 35.0% bachelors, 45.8% masters, 2.0% PhD, 17.2% not indicated).

Access to the NSLM data is restricted. Thus, before applying for access to the full NSLM teacher- and school-level data, the Mindset Scholars Network (who control access to the NSLM data) provided us with a sample consisting of data from a random sample of 20% of teachers. This 20% sample was used to finalize our hypotheses, materials, and analytic plan, which were all then preregistered at https://osf.io/8jxzp/?view_only=da907c89970a43d2bababe30f3be6f96.

Materials

Instructional practices. Teachers were first presented with two scenarios in which they were asked to imagine a student in their class. In one scenario, the student was presented as being lower in math ability—specifically, “Imagine that one of your 9th grade math students was very discouraged in math class. The student kept getting low grades on assignments. The student didn’t always try, but when he or she did try hard, the student would still get things wrong, even after practicing.” In the second scenario, the student was presented as being higher in math ability—specifically, “Imagine one of your math students was doing very well in math class. The student is getting really high grades on assignments, often without trying or putting in much time. The student doesn’t ask questions because he or she isn’t confused by very much.”

We examined two measures of teachers’ treatment of higher- and lower-ability students. First, after reading each scenario, teachers were asked to indicate what they would say to that student. These *open-ended* responses to both scenarios were coded by two independent raters along three dimensions: autonomy-supportiveness versus controllingness (e.g., “Acknowledges or prompts a dialogue/discussion about their rationale or the unique way in which they have chosen to think about or approach their work” versus “Proposes to make the student do the work in the teacher’s own/preferred way”), mastery-orientation versus performance-orientation (e.g., “Emphasizes the importance of understanding course material” versus “Emphasizes the

importance of getting the right answer or of not making mistakes on course work”), and positivity versus negativity (e.g., “Expresses warmth, approval, encouragement, or gave positive feedback to the student” versus “Expresses frustration, annoyance, or hostility or gave negative feedback to the student”).¹

The coding scheme was compiled from prior work (Moorman & Pomerantz, 2010; Reeve & Jang, 2006; Turner & Patrick, 2004; Wallace & Sung, 2017; Yeager, 2008). All responses were independently coded by two undergraduate research assistants who were blind to scenario (high- versus low-ability student) and to which responses to the two scenarios were provided by the same teacher. Responses were coded as 1 = “Primarily [controlling] / [performance-oriented] / [negative]”, 2 = “Neither primarily [autonomy supportive nor controlling] / [mastery- nor performance-oriented] / [neg. or pos.]”, 3 = Primarily [autonomy supportive] / [mastery-oriented] / [positive]. The interrater reliabilities were good to excellent (Hallgren, 2012), with ICCs = .723 (autonomy versus control for high-ability student; $M = 2.46$, $SD = .65$), .775 (autonomy versus control for low-ability student; $M = 2.55$, $SD = .70$), .833 (mastery versus performance for high-ability student; $M = 2.56$, $SD = .69$), .770 (mastery versus performance for low-ability student; $M = 2.49$, $SD = .67$), .858 (positivity versus negativity for high-ability student; $M = 2.60$, $SD = .50$), .798 (positivity versus negativity for low-ability student; $M = 2.51$, $SD = .60$) and remaining disagreements were solved through discussion. However, exploratory factor analyses² suggested that the supportive and restrictive codings did not cluster similarly across the high- and low-

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¹ We originally attempted to code autonomy-supportiveness, controllingness, mastery-orientation, performance-orientation, positivity, and negativity all separately, but we had difficulty attaining acceptable levels of interrater reliability using this format.

² All exploratory factor analyses (EFA) described herein were conducted as follows. The number of factors to extract was determined by Horn’s Parallel Analysis (HPA; Horn, 1965), with polychoric correlations, principal components analysis, and the mean eigenvalue criterion (as recommended by Garrido, Abad, & Ponsoda, 2013). Principal axis factoring was then used to extract factors from the polychoric matrix and an oblimin rotation was then applied. Squared multiple correlations were used as initial estimates of communalities.

ability student scenarios: while all three loaded at $>.459$ for teachers' responses to the low-ability scenario, only autonomy-support and positivity loaded together ($>.433$) for their responses to the high-ability scenario (mastery = $-.385$). For consistency, we therefore chose to analyze the coding categories separately for both scenarios.

As a second measure of teachers' treatment of higher- and lower-ability student, after completing the writing prompt for a given scenario, teachers were asked how likely they would be to use five instructional practices with the student in question. EFAs were then used to identify the supportive and restrictive practices that clustered together. The supportive practices identified were "Let's see what you don't understand and I'll explain it differently" and "Let's look at what went wrong in your process and see what happens when we fix it" for the low-ability student scenario ($M = 4.12$, $SD = .95$, $\omega_T = .71$) and "Great job, you must be working hard" for the high-ability student scenario ($M = 3.28$, $SD = 1.07$), and the restrictive practices included "Don't worry—it's okay to not be a math person" and "Keep working hard and you'll get it" for the low-ability student scenario ($M = 3.43$, $SD = 1.22$, $\omega_T = .74$) and "You're lucky that you're a math person" for the high-ability student scenario; $M = 1.84$, $SD = .81$). Teachers responded to these *closed-ended* items on 6-point scales, which were reverse-coded for our analyses so that higher values denoted greater likelihood (1 = "Extremely likely," 6 = "Not likely at all").

Growth mindsets. Finally, teachers completed measures of both their domain-general and math-specific growth mindsets. Domain-general mindsets were assessed with one item ("People have a certain amount of intelligence, and they really can't do much to change it"; $M = 4.75$, $SD = 1.01$), while math-specific mindsets were assessed with two items ("Being a top math student requires a special talent that just can't be taught" and "If you want to succeed in math,

hard work alone won't cut it; you need to have a natural gift and talent"; $M = 4.79$, $SD = .84$, $r(298) = .575$, $p < .001$). All items were culled from prior research (Dweck, 1999; Leslie, Cimpian, Meyer, & Freeland, 2015), and teachers responded to all items using a 6-point scale ("strongly disagree" to "strongly agree"). There was a moderate correlation between the two measures, $r(294) = .510$, $p < .001$.

Covariates. To control for factors that could potentially influence teachers' growth mindsets or endorsement of various instructional practices, seven covariates were included in our models: teachers' gender, race, years of teaching experience, highest educational attainment (see "Data and Participants" section), and awareness and endorsement of growth mindsets, and school quality and percentage of negative stereotyped student at the school.

Awareness and endorsement of growth mindsets. To index teachers' awareness and endorsement of growth mindsets, they responded to two items: Have you ever heard of the concept of a 'growth mindset?' and "Have you ever talked about the 'growth mindset' with your 9th grade math classes?" Teachers received a score of 2 if they indicated that they spoke to their class about growth mindsets (21.5%), 1 if they indicated that they had *not* spoken to their class about growth mindsets but that they had heard of growth mindsets (20.1%), and 0 if they responded no to both (42.1%; 16.4% not indicated).

School quality. The NSLM's school quality measure was constructed by pooling data from several outside sources. The first was GreatSchools.org, which provides within-state school rankings (from 0-10) based upon such factors as school test scores, parent and community ratings, absenteeism, and programs offered. The second source was high school average PSAT scores and Calculus AB and English (Literature and Language) AP participation rates, which were provided by the College Board. The third source was state proficiency levels for math and

reading for 8th grade (gathered from the National Assessment of Education Progress [NAEP]). With these three data sources combined, a structural equation model was used to estimate a latent “school achievement” variable. Based on this variable and the associated loadings, a “school achievement” value was estimated for each school and was then standardized.

Percentage of negatively stereotyped students. The NSLM included data on the percentage of students in each school surveyed who belonged to groups that have historically been subjected to negative intellectual stereotypes—specifically, racial-ethnic minority students (Black, Latinx, and Native-American students; $M = 33.7\%$, $SD = 27.4\%$) and students living in poverty ($M = 18.8\%$, $SD = 9.4\%$). The two values were significantly correlated, $r(72) = .570$, $p < .001$, so they were averaged to produce a composite measure of the percentage of negatively stereotyped students at each school.

Results

We used linear mixed-effects models to test our primary hypotheses (using the R packages *lme4* [Bates, Maechler, Bolker, & Walker, 2015] and *lmerTest* [Kuznetsova, Brockhoff, & Christensen, 2017]). Specifically, we tested 4 models, covering all combinations of the following: with teachers’ closed-ended versus coded open-ended responses as the dependent measures, and with domain-general growth mindsets versus math-specific growth mindsets included as a predictor.³ As applicable to each combination outlined, models included: target student ability level (low-ability [coded 0] versus high-ability [1]) and instructional practice type (restrictive [0] versus supportive [1]) as response-level fixed effects (Level 1), and teacher growth mindsets, gender (male [0] versus female [1]), race (Whiter [0] versus non-White [1]), teaching experience (Level 2), school quality, percentage of negatively stereotyped students

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³ As noted in our preregistration, we had also planned to test these models both with and without outliers (standardized scores of $-/+ 3.29$ [Tabachnick & Fidell, 2013]); however, no outliers emerged.

(Level 3), and all interactions of teacher growth mindsets, target student ability level, and instructional practice type. All models included the NSLM's teacher-level weights and random intercepts for teachers and schools. All continuous predictors were grand mean centered.

Analysis of Closed-Ended Measures

Table 1. Results of linear mixed-effects models predicting teachers' closed-ended responses from their growth mindsets, target student ability level, instructional practice type, their interactions, and all relevant covariates.

	<i>F</i>	<i>df</i>	<i>p</i>	η^2
With domain-general growth mindsets				
Student ability level (A)	394.89	1, 874.84	< .001	.493
Instructional practice type (P)	328.68	1, 872.16	< .001	.410
Teacher growth mindsets (M)	3.63	1, 286.47	.058	.005
A $\times$ P	54.20	1, 872.16	< .001	.068
A $\times$ M	.47	1, 876.88	.494	.001
P $\times$ M	2.74	1, 872.09	.098	.003
A $\times$ P $\times$ M	.61	1, 872.09	.433	.001
Percentage of neg. stereotyped students	4.65	1, 293.03	.032	.006
School quality	.00	1, 333.90	.959	.000
Teacher age	.60	1, 285.44	.440	.001
Years teaching experience	1.60	1, 278.09	.206	.002
Teacher gender	1.12	1, 283.99	.291	.001
Teacher race	.12	1, 327.18	.728	.000
Teacher education	.06	2, 301.92	.938	.000
Teacher awareness of growth mindsets	.70	2, 270.82	.500	.002
With math-specific growth mindsets				
Student ability level (A)	402.65	1, 880.88	< .001	.494
Instructional practice type (P)	334.81	1, 878.02	< .001	.410
Teacher growth mindsets (M)	.51	1, 274.08	.474	.001
A $\times$ P	51.88	1, 878.02	< .001	.064
A $\times$ M	.17	1, 878.16	.680	.000
P $\times$ M	8.85	1, 877.99	.003	.011
A $\times$ P $\times$ M	.46	1, 877.99	.496	.001
Percentage of neg. stereotyped students	1.19	1, 89.60	.279	.001
School quality	.32	1, 53.29	.575	.000
Teacher age	1.94	1, 286.81	.165	.002
Years teaching experience	2.93	1, 281.39	.088	.004
Teacher gender	1.15	1, 267.44	.284	.001
Teacher race	.00	1, 292.63	.942	.000
Teacher education	.24	2, 303.38	.787	.001
Teacher awareness of growth mindsets	1.05	2, 160.28	.352	.003

Figure 1. Domain-general growth mindsets $\times$ student ability level $\times$ instruction practice type interaction predicting teachers' closed-ended responses.

Table 1 and Figure 1 show the results of the analyses of the closed-ended instructional practice measures with teachers' domain-general growth mindsets included as a predictor. As shown, on average, teachers were significantly more likely to indicate that they would use supportive practices (estimate marginal means [EMM] = 3.71, SE = .12) than restrictive practices (EMM = 2.68, SE = .12); however, consistent with previously published findings, this effect was moderated by participants' mindsets (Leroy et al., 2007; Muenks et al., 2015; Park et al., 2016; Stipek et al., 2001). Specifically, teachers with stronger growth mindsets were less likely to use restrictive practices (EMM = 2.55, SE = .12) than those with weaker growth mindsets (EMM = 2.80, SE = .13), $t(2740339)$, p = .083. Teachers' endorsement of supportive practices did not

vary based on teacher mindsets (weaker growth mindset teachers: $EMM = 3.73$, $SE = .13$; stronger growth mindset teachers: $EMM = 3.68$, $SE = .12$), $t(2738442)$, $p = .955$.

The analysis also revealed a significant student ability level $\times$ instructional practice type interaction. Specifically, consistent with findings from the teacher expectancy literature (Babad, 1993; Jussim, et al., 2009), teachers were significantly more likely to use restrictive practices with the low-ability student ($EMM = 3.45$, $SE = .12$) than with the high-ability student ($EMM = 1.90$, $SE = .12$). $t(19160327)$, $p < .001$. However, in contrast to the teacher expectancy literature, teachers were also significantly more likely to use supportive practices with the low-ability student ($EMM = 4.06$, $SE = .12$) than with the high-ability student ($EMM = 3.35$, $SE = .12$). $t(19141478)$, $p < .001$. In other words, teachers were more likely to endorse using all instructional practices with the low-ability student ($EMM = 3.76$, $SE = .12$) than with the high-ability student ($EMM = 2.63$, $SE = .12$).

By contrast, the focal mindset $\times$ ability level $\times$ instruction practice type interaction not significant. In other words, we did not find evidence that the tendency among teachers to use different practices with higher- versus lower-ability students was not moderated by teachers' growth mindsets. Finally, all of the results discussed were largely similar when teachers' math-specific growth mindsets were included instead of their domain-general mindsets (see Table 1), with one exception: teachers' endorsement of restrictive practices did not vary based on teacher mindsets (weaker growth mindset teachers: $EMM = 2.77$, $SE = .13$; stronger growth mindset teachers: $EMM = 2.54$, $SE = .12$), $t(2732580)$, $p = .122$.

Analysis of Open-Ended Measures

Table 2. Results of linear mixed-effects models predicting teachers' open-ended responses from their growth mindsets, target student ability level, instructional practice type, their interactions, and all relevant covariates.

	<i>F</i>	<i>df</i>	<i>p</i>	η^2
With domain-general growth mindsets				
Student ability level (A)	.12	1, 1392.30	.724	.003
Instructional practice type (P)	3.06	2, 1381.15	.047	.134
Teacher growth mindsets (M)	.15	1, 277.14	.700	.003
A $\times$ P	3.00	2, 1381.15	.050	.132
A $\times$ M	.20	1, 1398.66	.657	.004
P $\times$ M	.00	2, 1381.15	.999	.000
A $\times$ P $\times$ M	1.00	2, 1381.15	.369	.044
Percentage of neg. stereotyped students	.92	1, 68.12	.340	.020
School quality	2.05	1, 45.75	.159	.045
Teacher age	1.52	1, 281.72	.218	.033
Years teaching experience	2.42	1, 271.48	.121	.053
Teacher gender	4.99	1, 278.49	.026	.109
Teacher race	2.83	1, 336.16	.093	.062
Teacher education	2.04	2, 324.65	.132	.089
Teacher awareness of growth mindsets	1.16	2, 207.60	.316	.051
With math-specific growth mindsets				
Student ability level (A)	.06	1, 1401.08	.812	.001
Instructional practice type (P)	3.17	2, 1390.23	.042	.110
Teacher growth mindsets (M)	.25	1, 256.43	.620	.004
A $\times$ P	3.21	2, 1390.23	.041	.112
A $\times$ M	.78	1, 1392.65	.376	.014
P $\times$ M	1.46	2, 1390.23	.233	.051
A $\times$ P $\times$ M	5.77	2, 1390.23	.003	.201
Percentage of neg. stereotyped students	.90	1, 67.69	.346	.016
School quality	2.01	1, 44.66	.164	.035
Teacher age	1.33	1, 279.80	.249	.023
Years teaching experience	2.25	1, 268.90	.135	.039
Teacher gender	4.76	1, 278.75	.030	.083
Teacher race	2.43	1, 333.87	.120	.042
Teacher education	1.81	2, 329.01	.166	.063
Teacher awareness of growth mindsets	.93	2, 203.25	.395	.032

Figure 2. Domain-general growth mindsets $\times$ student ability level $\times$ instruction practice type interaction predicting teachers' open-ended responses.

Table 2 and Figure 2 show the results of the analyses of the open-ended instructional practice measures with teachers' domain-general growth mindsets included as a predictor. As shown, the means for all three categories of practices were significantly above the midpoint (autonomy supportiveness: $M = 2.50$, $SD = .68$; mastery-orientation: $M = 2.52$, $SD = .68$; positivity: $M = 2.56$, $SD = .55$, $ps < .001$). This suggests that, on average, teachers were significantly more likely to report planning to use more supportive versus restrictive practices. They were also significantly more likely to report positive practices ($EMM = 2.58$, $SE = .07$) than mastery-oriented practices ($EMM = 2.49$, $SE = .07$), $t(30599402) = -2.35$, $p = .049$.

The analysis also revealed a significant student ability level $\times$ instructional practice type interaction. However, the only significant difference that emerged was that teachers' were more likely to report planning to use positive practices ($EMM = 2.63$, $SE = .07$) than autonomy-

supportive practices ($EMM = 2.50$, $SE = .07$) with the high-ability student, $t(30386258) = -3.01$, $p = .031$. Thus, in contrast to the closed-ended measure results and the differential treatment literature, teachers did not appear to endorse using different instructional practices with low- and high-ability students. Similarly, the student ability level $\times$ teacher mindset interaction was not significant, suggesting that teachers' growth mindsets did not predict differential treatment of high- and low-ability students.

These results were largely similar when teachers' math-specific growth mindsets were included instead of their domain-general mindsets (see Table 2), with two exceptions. First, the increased likelihood of planning to use positive practices over autonomy-supportive practices with the high-ability student only emerged among those with weaker growth mindsets, $t(32727049) = -3.90$, $p = .005$, not among those with stronger growth mindsets, $t(31768113) = -.38$, $p = 1.000$. Second, teachers with stronger growth mindsets were marginally more likely to plan to use mastery-oriented practices with high ability students ($EMM = 2.63$, $SE = .08$) than teachers with weaker growth mindsets ($EMM = 2.38$, $SE = .08$), $t(13960699) = -3.22$, $p = .058$.

General Discussion

This preregistered study revealed mixed findings regarding the relations between teachers' growth mindsets, instructional practice use, and student ability levels. When examining teachers' responses to closed-ended measures, we found, in line with prior work, that teachers were, on average, more likely to endorse using supportive practices over restrictive practices, that the tendency to avoid using restrictive practices was stronger both among teachers with stronger (versus weaker) growth mindsets and when teachers were working with high (versus low) ability students. Examining teachers' open-ended responses corroborated the finding that teachers were more likely to favor supportive (versus restrictive) practices, but our other findings

were not replicated. And most notably, neither type of measure supported our primary prediction that teachers' tendency to use supportive and restrictive practices differentially with high- versus low-ability students would be more pronounced among teachers with weaker (versus stronger) growth mindsets.

We believe the present work has some potential implication but also reveals some notable potential limitations of the present data source for addressing our primary question of interest. We begin with the implications of the separate positive findings of teacher mindsets and student ability levels on teacher treatment. Based on the main effects associated with both the closed- and open-ended measures, it is clear that teachers, on average, believe that mastery-oriented and autonomy-supportive practices are more constructive than performance-oriented and controlling practices when it comes to working with students. However, the results of the closed-ended measure analyses suggested both that teachers may not exhibit these preferences with all students, and that all teachers may not exhibit these preferences to the same degree. Specifically, replicating prior work (Babad, 1993; Jussim et al., 2009), we found that teachers may be more likely to use restrictive practices when working with low-ability students than with high-ability students, and that teachers with stronger growth mindsets may be more likely to exhibit these preferences than those with weaker growth mindsets. These trends are notable, as meta-analyses have found that students' perceptions of their classrooms as being mastery-oriented were positively associated with a sense of competence, whereas perceptions of classrooms as being performance-oriented were negatively associated with academic performance (e.g., Rolland, 2012). Given these implications, it is interesting to consider why teachers with weaker growth mindsets and teachers working with low-ability students might be more likely to use less

constructive practices. That is, why wouldn't all teachers use restrictive practices to an equally low degree with all students?

One possibility is that teachers may tend to perceive low-ability students as being less likely than high-ability students to substantially benefit from instructional practices allowing them to direct their own learning (i.e., autonomy-supportive and mastery-oriented practices), and perhaps as more likely to benefit from practices meant to ensure they will meet the minimum performance standards for the class (i.e., controlling and performance-oriented practices). Another explanation pertains to what teachers believe about the malleability of intelligence. Specifically, teachers who believe that intellectual ability is large fixed may be personally concerned with demonstrating that they are competent teachers—just as students with fixed mindsets tend to be concerned with demonstrating that they are smart enough to do well academically (Haimovitz, Wormington, & Corpus, 2011; Mueller & Dweck, 1998; Stipek & Gralinski, 1996). Consequently, they may adopt performance goals aimed at maximizing outcomes that indicate high teaching ability (i.e., high student test scores) or minimizing outcomes that indicate low teaching ability (i.e., low student test scores; see Butler, 2007). These goals may, in turn, be positively associated with their increased use of restrictive instructional practices.

Most pertinent to the present work, it also seemed plausible that these factors would interact to predict instructional practice use. Specifically, teachers may only perceive low-ability students as being less likely than high-ability students to benefit from instructional practices allowing them to direct their own learning and more likely to benefit from practices meant to ensure they will meet the minimum performance standards for the class if they believe that intelligence or ability cannot be substantially improved. In contrast, teachers who believe all

students are capable of intellectual growth (i.e., those with stronger growth mindsets) may be less likely than teachers with weaker growth mindsets to differentiate between students based on their current levels of academic ability. Relatedly, teachers who believe that intellectual ability is largely fixed may adopt performance goals especially when working with low ability students, as it is these students who are in danger of bringing down the class average.

However, as noted, this student ability level $\times$ teacher growth mindset $\times$ instructional practice type interaction did not emerge in this study. Still, there are some potential limitations to the present work that could provide insight for future work examining this potential interactive relationship. Most notably, there were important differences in how the high- and low-ability student scenarios were framed that may have influenced teachers' responses to both the open-ended and closed-ended measures. Specifically, for the low-ability student scenario, teachers were asked what they would say to a student who was "very discouraged in math class... kept getting low grades... [and] would still get things wrong, even after practicing." This wording may have led teachers to feel compelled to employ a number of instructional practices to encourage and assist the struggling student. By contrast, for the high-ability student scenario, teachers were asked what they would say to a student who was "doing very well in math class... getting really high grades... [and] isn't confused by very much." Teachers may have thus felt less compelled to employ numerous instructional practices, since this student was not struggling.

These framing differences could therefore have led to differences in teachers' overall use of instructional practices—regardless of practice type—with each student. Supporting this possibility, as discussed, we found that teachers were more likely to use both supportive and restrictive practices with low- versus high-ability students (see Table 1). This conflicts with studies that have employed scenarios that were more similar regardless of student ability (e.g.,

where both the high- and low-ability students were described as struggling on a specific assignment; Miele, Perez, Butler, Browman, O'Dwyer, & McNeish, 2019). Furthermore, we found that teachers wrote significantly more when responding to the low-ability student scenario ($M = 63.32$, $SD = 37.34$) than when responding to the high-ability student scenario ($M = 44.33$, $SD = 23.52$), $t(290) = -10.42$, $p < .001$, suggesting that they may have felt compelled to provide more instructional assistance to the low-ability student than to the high-ability student. Future research should therefore continue to explore the student ability level $\times$ teacher growth mindset $\times$ instructional practice type interaction with more balanced high- and low-ability student scenarios.

Another limitation is that this relied on hypothetical scenarios and self-reported instructional practices: teachers were asked to *imagine* interacting with a student in their class and to self-report the types of instructional practices that they would likely use. A next step would be to see if teachers' mindsets predict the kinds of instructional practices they use in real classrooms. An observational study by Stipek et al. (2001) suggests that these practices can be reliably measured via classroom observation. In addition, we may actually find that the effects that emerge in actual classrooms are stronger than the effects that emerge through self-report, due to a reduction in social desirability bias.

Furthermore, the current study *measured* teachers' mindsets and, thus, cannot make claims about the causal effect of mindsets on teachers' practices. Future studies involving manipulations of teachers' mindsets are needed to establish this causal link. Such studies will be useful in guiding translational research aimed at increasing teachers' use of constructive instructional practices with both high and low ability students.

Finally, additional research is needed to determine whether instructional practice used resulting from teachers' growth mindsets and students' ability levels can influence students' outcomes over time, potentially increasing gaps between students who are initially perceived to be low versus high in ability. As the NSLM included student-level outcomes, the next phases of this research will examine how teachers' mindsets and self-reported instructional practice preferences influence their students' outcomes over the course of the academic year.

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