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Reports

"It's ok — Not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students

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ABSTRACT

Can comforting struggling students demotivate them and potentially decrease the pool of students pursuing math-related subjects? In Studies 1–3, instructors holding an entity (fixed) theory of math intelligence more readily judged students to have low ability than those holding an incremental (malleable) theory. Studies 2–3 further revealed that those holding an entity (versus incremental) theory were more likely to both comfort students for low math ability and use "kind" strategies unlikely to promote engagement with the field (e.g., assigning less homework). Next, we explored what this comfort-oriented feedback communicated to students, compared with strategy-oriented and control feedback (Study 4). Students responding to comfort-oriented feedback not only perceived the instructor's entity theory and low expectations, but also reported lowered motivation and lower expectations for their own performance. This research has implications for understanding how pedagogical practices can lock students into low achievement and deplete the math pipeline.

Introduction

The idea that people's areas of weakness should be accepted, as long as they focus on developing and maximizing their strengths, has become a prevalent one in American society. One frequently encounters students embodying this idea when they claim, "I'm just not a math person" or "I'm a fuzzy, not a techie." How do people come to simply accept themselves as having low ability in important fields of study? Although a focus on cultivating strengths is not problematic per se, it may become so if one takes individual instances of performance as an index of strengths and weaknesses and views those strengths and weaknesses as fixed. We propose that implicit theories of intelligence (Dweck, 1999) – beliefs about whether intelligence is fixed or malleable – can illuminate this practice. We chose to examine this idea from the perspective of teaching and in the context of math given how important it is for teachers to help students persevere through difficulty in the process of learning math and how critical it is to understand factors that may contribute to the shortage of students pursuing math-related careers in the U.S. (National Science Foundation, 2010).

Research shows that adults holding an entity (or fixed) theory of ability are more oriented toward diagnosing people's stable traits, often from preliminary information, whereas those holding an incremental (or malleable) theory tend to be more open to information about change over time (Butler, 2000; Heslin, Latham, & VandeWalle, 2005; Plaks, Stroessner, Dweck, & Sherman, 2001). Research has also shown that students' implicit theories of ability affect their motivation, learning, and achievement outcomes. Those holding an entity (or fixed) theory are particularly likely to draw conclusions about their ability (vs. effort) from setbacks and to give up more readily when faced with difficulty, as compared with those holding an incremental (or malleable) theory (Blackwell, Trzesniewski, & Dweck, 2007; Dweck, 1999; Heine et al., 2001, see also Dweck & Leggett, 1988).

However, research has not yet examined how implicit theories of ability play out in the pedagogical practices that instructors use when students confront difficulty. We hypothesize that the "appropriate" response to students who exhibit initial low performance in a course, from the perspective of an instructor with an entity theory, will be to conclude that they have low ability and to console them for this lack of aptitude (e.g., by suggesting not everyone can be good at every subject). These adults may be well-intentioned and believe they are acting in students' best interests. However, to the extent that such comforting statements communicate that students have stable low ability, they might demotivate students and relegate them to a future of low achievement. The present studies represent, to our knowledge, the first systematic investigation of whether an entity (versus incremental) perspective leads those in a teaching role to spontaneously focus more on comforting students for low ability following failure and on using practices that could lock students into long-term low achievement.

In addition to examining the pedagogical practices preferred by entity versus incremental theorists when confronting a struggling

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student, we also asked what such practices would communicate to students. Previous research has illustrated that communicating high standards when students perform poorly can be conducive to greater effort and engagement (Cohen, Steele, & Ross, 1999). Here, we considered the possibility that comfort feedback stemming from an entity perspective would do the opposite. We propose that comforting students for their (perceived) low ability might represent a subtle way in which teachers' theories of intelligence and their low expectations are communicated to students. Previous research has shown that perceiving a more entity (versus incremental) theory to be dominant in one's context can lead people to experience changes in their self-concept (Murphy & Dweck, 2010) and can lead to decrements in students' performance and sense of belonging (Good, Rattan, & Dweck, in press). Therefore, we also hypothesized that these pedagogical practices might both communicate an entity theory of intelligence to students (along with low expectations) and lead students to lose motivation and lower their own expectations for their future performance.

We examined these hypotheses in four studies. Study 1 investigated whether adults holding more of an entity (vs. incremental) theory would be more likely to diagnose students' math ability from a single score on the first test of the year. In Study 2, we manipulated participants' implicit theories of math ability and asked whether an entity theory also leads to potentially problematic pedagogical practices, such as comforting students for their presumed lack of aptitude in the subject. Study 3 again examined the diagnosis of ability and preferred pedagogical practices, but with actual math/science instructors at the college level. In Study 4, we explored the additional hypothesis that these practices would convey an instructor's entity theory and low expectations and would lead students to report less motivation and lower expectations for their own future performance.

Study 1

Although some past research has shown that those who hold an entity theory may be more oriented toward rapidly diagnosing ability (Butler, 2000; Plaks et al., 2001), we thought it was important to show that people placed in a teaching role would also exhibit such behaviors, given that being in a teaching role might, in itself, orient individuals toward fostering learning and improvement.

Method

Participants

Forty-one undergraduates at a competitive private university on the West coast (14 males, 27 females; 2 African-Americans, 18 Asian-Americans, 12 European-Americans/Whites, 8 Latino-Americans, 1 Native American; *mean age* = 20.05, *SD* = 1.64) participated for course credit or pay.

Procedure

Participants completed an online study about math education beginning with a “general math attitudes” survey. An implicit theory of math intelligence scale was embedded in the survey. Participants were asked to agree or disagree with four statements that portrayed math ability as fixed (e.g., “You have a certain amount of math intelligence and you can't really do much to change it,” $\alpha = 0.94$; Good et al., in press). To ensure that any differences based on implicit theories were not due to differences in how participants perceive or value math, we also included four items assessing their sense of belonging to math (e.g., “When I am in a math setting, I feel that I belong to the math community,” $\alpha = 0.97$; Good et al., in press), four items assessing enjoyment of math (e.g., “In general, I enjoy math,” $\alpha = 0.92$), and twelve items asking about their belief in the usefulness of math (e.g., “I study math because I know how useful it is,” $\alpha = 0.91$; Fennema & Sherman, 1976). These measures used six-point scales ranging from strongly disagree (1) to strongly agree (6).

Next, participants were instructed to imagine themselves as a 7th grade math teacher, meeting with students individually to discuss their performance on the first test of the year. We indicated that the next student (Jennifer) had received a 65% score on the test. We then asked participants about their attributions for her performance: “How much do you believe that she got a 65% on the test because she is not smart enough in math?” (1 “do not believe at all” – 8 “believe very much”) and, “Her grade on the test = __% lack of hard work + __% lack of math intelligence” (sum = 100%).

Results and discussion

In the following analyses, the variable of interest was regressed on mean-centered implicit theories of math intelligence scores (Aiken & West, 1991). Analyses of participants' sense of belonging to math, enjoyment of math, and perceived usefulness of math showed that math was equally valued by participants with different implicit theories of math intelligence (*ps* > .4).

As hypothesized, the more participants endorsed an entity (vs. incremental) theory, the more they agreed that the one instance of a student's poor performance occurred “because she is not smart enough in math,” $B = 0.40$, $t(39) = 2.13$, $p < .05$. Moreover, the more participants endorsed an entity (vs. incremental) theory, the greater percentage of her grade was attributed to a “lack of math intelligence” as opposed to a “lack of hard work” $B = 6.74$, $t(39) = 2.0$, $p = .05$. Estimating entity and incremental theories at one standard deviation above and below the scale mean, those endorsing an entity theory attributed 42.3% of her math score to a lack of math intelligence, whereas those endorsing an incremental theory attributed only 30.7% to a lack of math intelligence (see Fig. 1).

Will beliefs about the malleability of intelligence also lead to differential treatment? This question was addressed in the next study.

Study 2

In Study 2, we manipulated implicit theories of math intelligence to address whether these beliefs play a causal role in participants' inferences about students' ability and in their preferences for certain pedagogical practices.

Method

Participants

Ninety-five undergraduates at a public college on the East coast participated for course credit (8 male; 87 females; 4 African-American, 12 Asian-American, 65 European-American, 10 Latino-American, 3 mixed-race, and 1 unreported; age unreported).

Procedure

Participants first read an article that manipulated implicit theories of math intelligence. The article presented expert evidence indicating that math intelligence was either fixed, (e.g., “…up to 88% of a person's math intelligence results from genetic factors”) or malleable, (e.g., “…up to 88% of people's math intelligence is a direct result of their willingness to develop it”).

Next, they read the scenario described in Study 1, taking the role of a 7th grade math teacher about to meet with a student who scored 65% on the first test of the year. We also manipulated gender through the student's name (Jennifer/Jason) to examine whether our hypothesized effects might differ, given the stereotypes associated with math.

The same two items used in Study 1 assessed perceptions of the test score as diagnostic of ability. Participants then indicated how

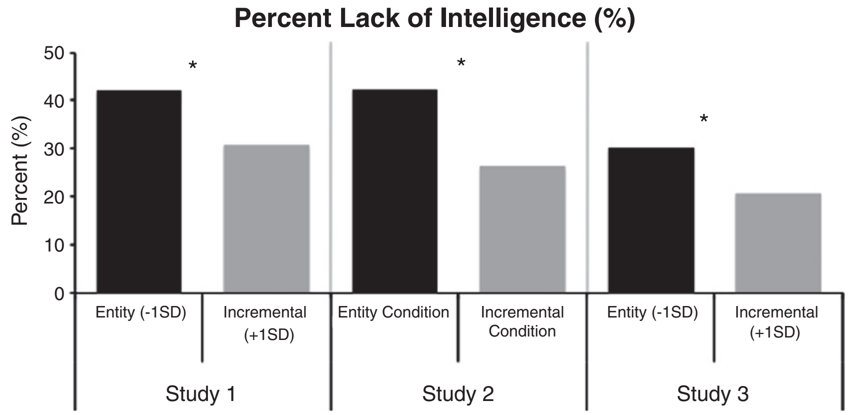

Fig. 1. Percent of performance attributed to math intelligence as predicted by implicit theories in Studies 1, 2, and 3.

they would respond to the student. We provided them with a 7-item index measuring the degree to which they would choose to comfort students for their low ability and enact potentially unhelpful pedagogical practices, which together achieved adequate reliability ($\alpha = 0.61$). We also split this overall scale into two subscales of items that represented (a) consoling the student for her poor performance (e.g., "Explain that not everyone has math talent—some people are 'math people' and some people aren't," 3 items, $\alpha = 0.49$) and (b) using teaching strategies that could reduce engagement and future achievement in the subject (e.g., "Assign less math homework," 4 items, $\alpha = 0.46$). Although these subscales had lower reliability than the full scale, we were interested in the effects of the implicit theories manipulation on both types of items. We embedded these within a larger set of items, and all measures used eight-point scales ranging from extremely unlikely (1) – extremely likely (8).

After these measures, participants completed a manipulation check to ensure the effectiveness of the implicit theory manipulation. Participants rated how much they agreed or disagreed with an entity theory (e.g., "You have a certain amount of math intelligence and you can't really do much to change it," $\alpha = .92$) on a scale from strongly disagree (1) – strongly agree (6).

Results and discussion

On the manipulation check, those in the entity theory condition ($M = 3.66$, $SD = .89$) endorsed a significantly more fixed belief about math intelligence than those in the incremental theory condition ($M = 2.46$, $SD = .81$), $t(93) = 6.81$, $p < .01$.

We also found that participants in the entity theory condition, compared to those in the incremental theory condition, agreed significantly more that their student was "not smart enough in math," $M\_{entity} = 4.07$, $SD = 1.45$, $M\_{incremental} = 2.67$, $SD = 1.43$, $t(90) = 4.01$, $p < .01$, and attributed performance significantly more to a "lack of math intelligence" as opposed to a "lack of hard work," $M\_{entity} = 42.46$, $SD = 19.48$, $M\_{incremental} = 26.35$, $SD = 17.55$, $t(90) = 4.17$, $p < .01$ (see Fig. 1).

The manipulated implicit theories of math intelligence also translated into strikingly different preferred pedagogical practices. As hypothesized, participants in the entity theory condition were significantly more likely to endorse the overall index of comfort-oriented strategies and strategies that could reduce engagement and future achievement in math, $M\_{entity} = 3.18$, $SD = .89$, $M\_{incremental} = 2.53$, $SD = .69$, $t(88.48) = 4.03$, $p < .01$. Deconstructing this scale into comforting strategies and the other potentially unhelpful strategies revealed that those in the entity theory condition were significantly more likely to endorse both consoling their student for poor performance, $M\_{entity} = 3.7$, $SD = 1.37$, $M\_{incremental} = 2.62$, $SD = .85$, $t(78.88) = 4.62$, $p < .01$, and using teaching strategies that could reduce engagement and achievement, $M\_{entity} = 2.79$, $SD = .94$, $M\_{incremental} = 2.45$, $SD = .74$, $t(93) = 1.95$, $p = .05$, as compared with those in the incremental theory condition (see Fig. 2). None of these effects differed for the male versus female student.

Study 2 showed that implicit theories of math intelligence play a causal role in the early diagnosis of ability and pedagogical practices that follow. However, in Study 2, the participants were undergraduates imagining themselves in a teaching role. Would participants engaged in the actual teaching of math make similar judgments and recommend similar pedagogical practices?

Study 3

Study 3 addressed this question by recruiting graduate students in math-related areas who were instructors or teaching assistants in undergraduate courses in their field of study.

Method

Participants

Forty-one graduate students who were instructors or teaching assistants at a competitive private university on the West coast participated for pay (35 males, 6 females; 9 Asian/Asian-Americans, 30 European-Americans/Whites, 2 unidentified; *mean age* = 26.3, $SD = 2.91$). All participants were Ph.D. candidates in a math-related field (29 computer science, 10 math, 2 statistics). In each of these graduate programs, Ph.D. candidates are required to serve as either an instructor or teaching assistant for an undergraduate course for multiple quarters during their graduate program (ranging from 4 mandatory quarters of teaching to every quarter post candidacy)[1].

Procedure

Participants completed the 4-item implicit theories of math intelligence measure, as described in Study 1 ($\alpha = 0.94$, Good et al., in press), followed by an 8-item questionnaire asking about their attitudes toward teaching (e.g., In general, I enjoy teaching, $\alpha = 0.72$). These measures used six-point scales ranging from strongly disagree (1) – strongly agree (6).

[1] Only 5 participants in the sample had not yet served as a teaching assistant or instructor for a course in their department. Excluding these participants, the pattern of results and the level of significance are unchanged.

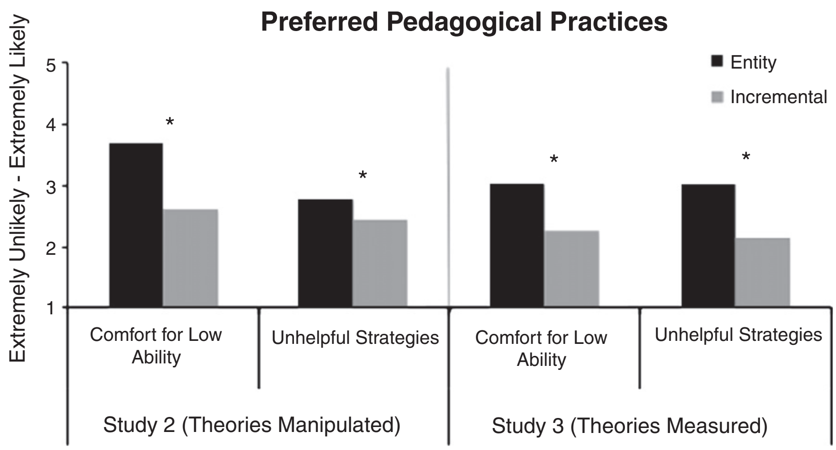

Fig. 2. Comfort and unhelpful practices as predicted by implicit theories in Studies 2 and 3.

Next, participants read a scenario similar to the one described in Study 1, but adapted for the undergraduate teaching context. They were told to imagine that they were teaching a 20-student section as the TA for an introductory course in their department and that they were meeting with students individually during office hours to discuss each student's performance on the first test of the year. We indicated that the next student (Jason) had received a failing grade on the test.

As in Study 2, we then asked participants about how they would respond to this student. We used one item to assess perceptions of the test score as diagnostic of ability, "His grade on the test = __% lack of hard work + __% lack of math intelligence" (sum = 100%). Additionally, two items assessed participants' expectations about whether the student's performance would change (e.g., "In your opinion, what is the likelihood that he will improve his grade substantially on the next test?" reverse-coded, $\alpha = 0.77$). These items were included in order to directly measure the idea that teachers' potentially negative pedagogical practices are accompanied by low expectations for their student's future success. These measures used seven-point scales ranging from not at all (1) – extremely (7).

We again provided participants with a series of items measuring the degree to which they would choose to comfort students for their low ability and enact potentially unhelpful pedagogical practices, adapted for the college context. Together, these items achieved adequate reliability (6 items, $\alpha = 0.77$). We also separately assessed the degree to which participants would comfort the student for his presumed lack of ability (e.g., "Console him for his grade by telling him that plenty of people have trouble in this field but go on to be very successful in other fields," "Explain that not everyone is meant to pursue a career in this field," 4 items, $\alpha = 0.75$) or use teaching strategies that could reduce engagement with the subject or compromise future achievement (e.g., "Talk to him about dropping the class," 2 items, $\alpha = 0.52$). Again, we embedded these within a larger set of items. These measures used seven-point scales ranging from extremely unlikely (1) – extremely likely (7).

Results and discussion

In the following analyses, the variable of interest was regressed on mean-centered implicit theories of math intelligence scores (Aiken & West, 1991). There were no differences by theory on endorsement of the teaching-related filler items ($p > .1$).

Even among these actual instructors, the more participants endorsed an entity (vs. incremental) theory, the greater percentage of the student's grade was attributed to a "lack of math intelligence" as opposed to a "lack of hard work," $B = 4.24$, $t(36) = 2.25$, $p < .05$ (see Fig. 1). Estimating entity and incremental theories at one standard deviation above and below the scale mean, those endorsing a more incremental theory attributed 20.68% of his math score to a lack of math intelligence, whereas those endorsing a more entity theory attributed 30.11% to a lack of math intelligence. We also found that instructors who held a more entity theory readily expressed significantly lower expectations for this students' future performance based on just one low test score, compared with those who held a more incremental theory, $B = .45$, $t(36) = 3.04$, $p < .01$.

The pattern of pedagogical responses among the graduate student instructors replicated that of Study 2: Those holding a more entity theory spontaneously endorsed the comforting and potentially unhelpful practices, endorsing this index to a greater degree than those holding a more incremental theory, $B = .36$, $t(36) = 2.54$, $p < .05$. Examining the specific subscales, we again found that instructors who endorsed a more entity theory were significantly more likely to comfort the student for his supposed lack of math ability than those who endorsed a more incremental theory, $B = .34$, $t(36) = 2.15$, $p < .05$. They also anticipated using teaching strategies that could reduce engagement to a greater degree than did those who held a more incremental theory, $B = .39$, $t(36) = 2.26$, $p < .05$ (see Fig. 2).

Our findings thus far show that among both college students imagining themselves as teachers and actual graduate student instructors, those holding a more entity (versus incremental) theory of intelligence are more likely to diagnose a student as having low ability based upon a single test score, more likely to opt to comfort students for their (presumed) low ability, and more likely to use teaching strategies that are less conducive to students' continued engagement with the field. How would students respond to receiving such feedback? We explored this question in the next study by creating vignettes from the items associated with the entity pattern of pedagogical practices and examining students' responses to hearing such feedback from a professor.

Study 4

We hypothesized that comfort-oriented feedback, which was more associated with the entity pedagogical style in the previous studies, would lead students both to perceive their professor as having a more entity theory about math ability and to feel less supported, encouraged, and motivated — even when the professor expressed support for the students and complimented their strengths. We compared comfort-oriented feedback to feedback more focused on concrete strategies and with control feedback that contained only the statements of support present in all three conditions.

Method

Participants

Fifty-four students at a competitive private university on the West coast participated for pay (26 males, 28 females; 8 African-Americans, 15 Asian-Americans, 21 European-Americans/Whites, 6 Latino-Americans, 2 Native Americans, 2 Biracial; *mean age* = 20.2, *SD* = 2.36).

Procedure

Participants completed an online study in which they imagined being in a calculus course at their university. They read a scenario in which, after the first calculus test of the year, they met with their professor to learn their grade and receive their test. All participants first read that they received a low score on the test (65%) and were given some initial feedback: "Your professor notices that you are not happy with your grade and says, 'I can understand that you are probably disappointed by your grade.'" They then received the feedback manipulation, reading either comfort-oriented feedback (that focused on their strengths), strategy-oriented feedback (that provided concrete suggestions), or control feedback (that contained two statements of caring that were present in the other conditions):

Comfort Feedback "I want to assure you that I know you are a talented student in general — it's just not the case that everyone is a "math person." I want you to remember how great you do in other subjects. I want you to know what I'm going to do too — I'm going to make a point not to call on you as much in class because I don't want you to have the added pressure of putting you on the spot and I'm going to give you some easier math tasks to work on so you can get more comfortable with those skills. I want to assure you that I really care, so let's stay in contact about how you're doing in the class."

Strategy Feedback "I want to assure you that I know that you are a talented student in general. I want you to change your study strategies and consider working with a tutor. I want you to know what I'm going to do too — I'm going to make a point to call on you more in class and I'm going to give you more challenging math tasks. I want to assure you that I really care, so let's stay in contact about how you're doing in the class."

Control Feedback "I want to assure you that I know you are a talented student in general, and I want to assure you that I really care, so let's stay in contact about how you're doing in the class."

Though the feedback did not explicitly communicate a theory of math intelligence, we hypothesized that a professor's more comfort-oriented feedback would communicate more of an entity theory to students as compared with strategy-oriented or control feedback. Thus, participants completed a 4-item Perceptions of an Environmental Entity Theory (PEET) scale (Good et al., in press; e.g., "My professor believes that I have a certain amount of math intelligence, and I can't really do much to change it," $\alpha = 0.96$, strongly disagree "1" – strongly agree "6,").

Participants then responded to four items that assessed the degree to which they felt their professor had low expectations and little investment in their future in the field (e.g., "How would you characterize your professor's assessment of your math ability?" My professor thinks I have very little ability in math "1" – My professor thinks I have a great deal of ability in math "7;" "How much do you feel that your professor is invested in your success in math?" not at all "1" – extremely "7," $\alpha = 0.87$). We also investigated whether the feedback conditions would have differential effects on students' motivation using 2 items, "How encouraged in math do you feel by your professor's feedback?" and "How motivated to try to improve in math do you feel by your professor's feedback?" (not at all "1" – extremely "7," $\alpha = 0.82$). Finally, we asked whether students would anticipate differential performance outcomes for themselves by asking, "What do you think your final grade in this math class will be at the end of the semester?" (1 "35%" – 2 "50%" – 3 "65%" – 4 "80%" – 5 "95%").

Results and discussion

As predicted, the feedback manipulation led participants to hold strikingly different perceptions of their professor's beliefs about the malleability of math intelligence, $F(2, 51) = 15.95$, $p < .01$. Planned contrasts revealed that participants in the comfort feedback condition ($M = 4.73$, $SD = .997$) viewed their professor as having a significantly stronger entity theory than participants in either the strategy feedback condition ($M = 2.69$, $SD = 1.43$, $t(51) = 5.02$, $p < .01$) or the control feedback condition ($M = 2.86$, $SD = 1.14$, $t(51) = 4.75$, $p < .01$). There was no difference between the strategy and control feedback conditions ($p > .5$) on this measure (see Fig. 3).

Participants also perceived significantly different expectations and investment in their future in the field based on the feedback manipulation, $F(2, 51) = 12.83$, $p < .01$. Again, planned contrasts revealed that the comfort feedback condition led participants to perceive their professor as having significantly lower expectations and investment ($M = 3.86$, $SD = 1.38$) than did the strategy feedback condition ($M = 5.69$, $SD = .84$, $t(51) = -5.06$, $p < .01$) or the control feedback condition ($M = 4.68$, $SD = .9$, $t(51) = -2.34$, $p < 05$). Comparing the strategy and control feedback conditions also yielded a significant difference, $t(51) = -2.82$, $p < .01$, suggesting that concrete feedback leads to more positive perceptions of a professor's expectations and investment (see Fig. 3).

Students' own motivation also differed by feedback condition, $F(2, 51) = 6.33$, $p < .01$, with those who received comfort feedback ($M = 3.33$, $SD = 1.92$) feeling significantly less encouraged and motivated than participants who received strategy feedback ($M = 5.26$, $SD = 1.45$, $t(51) = -3.54$, $p < .01$) or control feedback ($M = 4.45$, $SD = 1.43$, $t(51) = -2.1$, $p < .05$). The strategy and control feedback conditions did not differ ($p > .1$; see Fig. 3). Finally, those in the comfort feedback condition had lower expectations for their own performance at the end of the year, $F(2, 51) = 5.25$, $p < .01$. Participants in the comfort feedback condition ($M = 3.39$, $SD = .92$) expected to receive a significantly lower final grade in the course than participants in either the strategy feedback condition ($M = 4.06$, $SD = .56$, $t(51) = -3.09$, $p < .01$) or the control feedback condition ($M = 3.89$, $SD = .32$, $t(51) = -2.4$, $p < .05$). Again, there was no difference between the strategy and control feedback conditions ($p > .4$). In other words, participants responding to comfort feedback estimated that their grade would remain close to the same low score (closer to a 65%), while those responding to strategy or control feedback expected their grades to improve significantly (closer to a B or 80%).

General discussion

People holding a more entity theory of math intelligence were significantly more likely to diagnose a student as having low ability based upon a single, initial poor performance (Studies 1–3). Moreover, in Studies 2–3, holding an entity theory led people to comfort students for their presumed low ability in the subject and to engage in pedagogical practices that could reduce engagement with the subject, as compared with participants who held a more incremental theory. In Study 3, instructors who held a more entity (versus incremental) theory were not only more likely to diagnose low ability

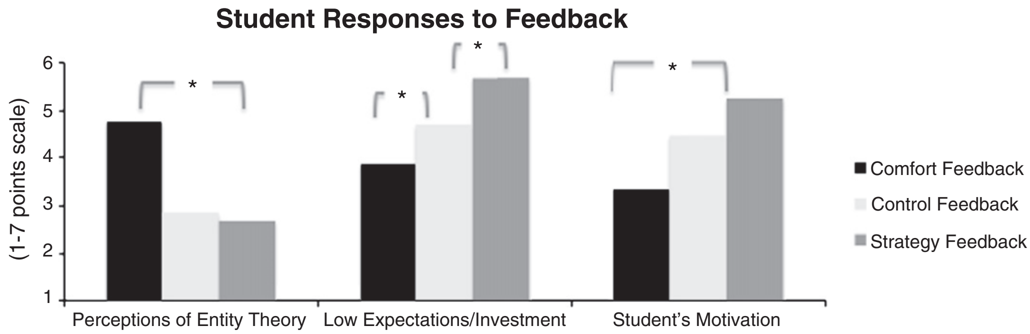

Fig. 3. Students' responses as a function of feedback condition in Study 4. Comfort feedback was significantly different from control and concrete feedback for each of the dependent variables.

and comfort students based on just one low initial performance, but they also directly reported that they did not expect as much future improvement for their student. Thus we replicated the relationship between an entity theory and these unproductive pedagogical practices across samples of both college students imagining themselves as teachers and actual graduate students tasked with teaching introductory courses in their department.

The practical implications of Study 3 are particularly compelling. Undergraduates entering introductory courses are often just out of high school and have varying degrees of background experience and differing levels of study skills for the college setting. Thus, one might expect situational or effort-based attributions to be most likely for these students, and for encouragement and concrete suggestions for improvement to be most effective. Yet, instructors who held a more entity theory were more likely to downplay these contextual factors in their attributions and in their response to a struggling student. Even more striking, these instructors taught at a competitive private university, where undergraduates have already demonstrated a high level of competence upon admission. Thus one might expect the communication of high standards to be a given (e.g., Cohen et al., 1999). Nonetheless, instructors who held a more entity theory readily anticipated counseling such high-achieving students out of an introductory course in math-related subjects to a greater degree. Such actions at the college level can have immediate and far-reaching consequences. Not completing an introductory course likely prevents undergraduates from pursuing any related major, and therefore potentially closes off entire career paths related to math, science, and engineering for them. For this reason, our findings may suggest a critical point of intervention with instructors to prevent student attrition from math-related areas of study.

The results of Study 4 revealed that entity theorists' preferred pedagogical practices do, in fact, communicate the corresponding theory, diagnosis of ability, and low expectations to students. Students exposed to a comfort-oriented (versus strategy-oriented and control) message were also more likely to view their professor as having lower engagement in their learning. Moreover, the comfort feedback led students themselves to feel less motivated and to expect lower final grades than did the strategy or control feedback. It is important to note that caring statements alone (i.e., the control feedback) did not lead to the most negative outcomes. Instead, it was the addition of statements of consolation for low ability (even when phrased positively) that led to the negative outcomes for students. It will be important for future research to explore how actual feedback is communicated by entity-theory teachers, and whether in real-life interactions students perceive this feedback as comforting or dismissive. In a related vein, the same teachers who communicate negative messages to struggling students may be those who provide the most positive messages to successful ones, if they view early success as indicative of stable high ability. It would be interesting to determine in future research whether this is helpful to the successful students or whether it can backfire in a manner similar to praise for intelligence (Mueller & Dweck, 1998).

Taken together, these results contribute a greater richness to our understanding of people who hold an entity theory of math intelligence. It is not the case that instructors who believed math intelligence to be fixed failed to consider students' best interests. Instead, it appears that their fixed view of intelligence led them to express their support and encouragement in unproductive ways that ultimately backfired. These results illustrate the process through which well-intentioned individuals who are focused on making students feel good about their outcomes can communicate messages detrimental to students' long-term educational outcomes. As upsetting as poor performance may be to a student, receiving comfort that is oriented toward helping them to accept their presumed lack of ability (rather than comfort that is oriented toward helping them to improve) may be even more disturbing.

In this way, the present research connects with other lines of research in psychology illustrating that seemingly well-meaning behaviors can lead to highly negative outcomes for the recipient (e.g., benevolent sexism; Glick & Fiske, 1996). This also suggests that an educational system focused on accepting weaknesses (as long as one focuses on strengths) is not quite as positive as intended. It may lead to situations in which the forces pushing students to disengage from important fields of study are stronger than those encouraging them to persevere through difficulty. Thus, the popular practice today of identifying weaknesses and turning students toward their strengths may be another self-esteem-building strategy gone awry (e.g., Mueller & Dweck, 1998), and one that may contribute to the low numbers of students pursuing math and science.

Given this, research should directly examine whether such messages, over long periods of time, may contribute to the broader disengagement with math and science evident among many American students. Americans lag behind students from other nations in their math and science performance and are less likely to pursue advanced degrees in math and science-related fields (National Science Foundation, 2010). Particularly in these challenging fields of study, instructors have the opportunity to play a critical role in leading students to persist and maintain their engagement. However, when instructors are focused on quickly diagnosing and simply comforting those who they perceive as lacking ability, they may inadvertently contribute to this leaky pipeline.

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