A Closer Look at Growth Mindset Research

1. Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology, 75*(1), 33–52.

Abstract
Praise for ability is commonly considered to have beneficial effects on motivation. Contrary to this popular belief, six studies demonstrated that praise for intelligence had more negative consequences for students' achievement motivation than praise for effort. Fifth-graders praised for intelligence were found to care more about performance goals relative to learning goals than children praised for effort. After failure, they also displayed less task persistence, less task enjoyment, more low-ability attributions, and worse task performance than children praised for effort. Finally, children praised for intelligence described it as a fixed trait more than children praised for hard work, who believed it to be subject to improvement. These findings have important implications for how achievement is best encouraged, as well as for more theoretical issues, such as the potential cost of performance goals and the socialization of contingent self-worth.

General Discussion (abridged)
Taken together, the findings from the six studies provide striking evidence for the differential effects that praise for intelligence and praise for hard work have on children's achievement behaviors and beliefs. These effects became apparent when children were asked to choose between performance and learning goals for their future problem-solving tasks. Children praised for intelligence after success chose problems that allowed them to continue to exhibit good performance (representing a performance goal), whereas children praised for hard work chose problems that promised increased learning. This finding was further supported by the interest that children showed in different types of information after they worked on the experimental tasks. Children praised for intelligence preferred to find out about the performance of others on the tasks rather than to learn about new strategies for solving the problems, even when these strategies might have improved their future performance. Children praised for effort, on the other hand, demonstrated their continued interest in mastery by preferring to receive strategy-related information. Thus, praise for intelligence seemed to teach children to value performance, even when following their own information-seeking interests, whereas praise for hard work seemed to lead children to value learning opportunities.

Further, children who received ability feedback appeared to learn to measure their intelligence from their performance in a way that children who received effort feedback did not. After they faced failure, these children used low-ability—rather than low-effort—attributions to account for their poor performance more than did children praised for hard work, who preferred to ascribe their failures to low effort. Thus, the children who were explicitly told that they were smart after success were the ones who most indicted their ability on the basis of poor performance.

2. Mangels, J. A., Butterfield, B., Lamb, J., Good, C., & Dweck, C. S. (2006). Why do beliefs about intelligence influence learning success? A social cognitive neuroscience model. *Social Cognitive and Affective Neuroscience*, *1*(2), 75–86.

Abstract
Students' beliefs and goals can powerfully influence their learning success. Those who believe intelligence is a fixed entity (entity theorists, also known as students with a fixed mindset) tend to emphasize 'performance goals,' leaving them vulnerable to negative feedback and likely to disengage from challenging learning opportunities. In contrast, students who believe intelligence is malleable (incremental theorists, also known as students with a growth mindset) tend to emphasize 'learning goals' and rebound better from occasional failures. Guided by cognitive neuroscience models of top-down, goal-directed behavior, we use event-related potentials (ERPs, or brain waves) to understand how these beliefs influence attention to information associated with successful error correction. Focusing on the brain waveforms associated with conflict detection and error correction in a test of general knowledge, we found evidence indicating that entity theorists oriented differently toward negative performance feedback, as indicated by an enhanced anterior frontal P3 that was also positively correlated with concerns about proving ability relative to others. Yet, following negative feedback, entity theorists demonstrated less sustained memory-related activity (left temporal negativity) to corrective information, suggesting reduced effortful conceptual encoding of this material—a strategic approach that may have contributed to their reduced error correction on a subsequent surprise retest. These results suggest that beliefs can influence learning success through top-down biasing of attention and conceptual processing toward goal-congruent information.

Discussion (abridged)
The findings from the present study are consistent with the view that entity and incremental theorists (students with fixed and growth mindsets, respectively) differ in how they appraise performance-relevant information and attend to learning-relevant information. To the extent that entity theorists (students with fixed mindsets) may have viewed negative feedback as a threat to self-perceptions about ability, rather than as a challenge to improve, they may have engaged less effort in 'deep' semantic processing of the learning-relevant feedback, ultimately compromising their ability to correct as many errors on the subsequent retest. Thus, these findings complement a recent longitudinal study in which a positive relationship between learning goals and final course grade was mediated by self-reported deeper processing of course material; conversely, performance goals were negatively correlated with deeper processing and associated with poorer course outcome (Grant & Dweck, 2003). Nonetheless, whereas self-reports provide introspective insight into task-general strategies, the ERPs used in the present study provided covert measurement of how beliefs influenced attention on a moment-to-moment basis, providing support for a neurocognitive model of the mechanism underlying a relationship between beliefs about ability and achievement success. This model can serve as a basis for future work that seeks to foster learning in vulnerable students.

3. Rattan, A., Good, C., & Dweck, C. S. (2012). "It's ok—not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students. *Journal of Experimental Social Psychology, 48*, 731–737.

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 or growth mindset) 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 lower 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.

General Discussion (abridged)
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 have therefore 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.

4. Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*, 246–263.

Abstract
Two studies explored the role of implicit theories of intelligence in adolescents' mathematics achievement. In Study 1, with 373 grade 7 students, the belief that intelligence is malleable (incremental theory or growth mindset) predicted an upward trajectory in letter grades over the two years of junior high school, while a belief that intelligence is fixed (entity theory) predicted a flat trajectory. A mediational model including learning goals, positive beliefs about effort, and causal attributions and strategies was tested. In Study 2, an intervention teaching an incremental theory to grade 7 students (N = 548) promoted positive change in classroom motivation, compared with a control group (N = 543). Simultaneously, students in the control group displayed a continuing downward trajectory in grades, while this decline was reversed for students in the experimental group.

General Discussion (abridged)
Past research suggested that a student's theory of intelligence is a key belief—one that sets up contrasting patterns of achievement motivation. The present research demonstrates these relations in a real-world achievement setting and begins to show just how these variables may influence academic outcomes over a challenging transition. This research confirms that adolescents who endorse more of an incremental theory of malleable intelligence also endorse stronger learning goals, hold more positive beliefs about effort, and make fewer ability-based, ''helpless'' attributions, with the result that they choose more positive, effort-based strategies in response to failure, boosting mathematics achievement over the junior high school transition. Furthermore, this motivational framework at the beginning of junior high school was related to the trajectories of students' math achievement over the two years of junior high school: Students who endorsed a more incremental theory framework increased in math grades relative to those who endorsed a more entity theory framework, showing that the impact of this initial framework remained predictive over time.

The present research addresses a central question about the longevity of the achievement differences associated with implicit theories of intelligence (Henderson & Dweck, 1990), showing that students' theories when they made the transition to junior high school were related to their grades during the next two years of their junior high school experience. Furthermore, these findings support the idea that the diverging achievement patterns emerge only during a challenging transition. Before junior high school, students who endorsed more of an entity theory seemed to be doing fine. As noted in previous research, motivational beliefs may not have an effect until challenge is present and success is difficult (Dweck, 2002; Grant & Dweck, 2003). Thus, in a supportive, less failure-prone environment such as elementary school, vulnerable students may be buffered against the consequences of a belief in fixed intelligence. However, when they encounter the challenges of middle school, these students are less equipped to surmount them.