The Implications of Mindsets for Learning and Instruction

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Abstract

Believing that your abilities are fixed or malleable (*entity* versus *incremental* theory of intelligence; herein: *fixed mindset* versus *growth mindset*) has measurable impacts on academic performance, self-concept, and intelligence beliefs. This literature review is a thematic and topical synthesis of 51 peer-reviewed, empirical journal articles from 2009 to February 2016. Reviewed articles consider mindset alongside various aspects of learning and instruction. Overall, the literature indicates that mindsets are a recurring predictor of numerous facets of academic well-being and success, with growth mindsets almost universally being connected to more useful beliefs and superior outcomes. Mindset interventions, recommendations, limitations, and suggested research practices are discussed.

Keywords: mindsets, educational interventions, implicit theories of intelligence, self-theories, learning, instruction, academic achievement, teacher beliefs, effort, ability, praise

The Implications of Mindsets for Learning and Instruction

This literature review will explore topical and thematic issues relating to implicit theories of intelligence (*mindsets*) and education. This is intended to be a comprehensive review of the relevant peer-reviewed journal articles from 2009 to February 2016.

Underpinnings

Problem Statement

Mindsets are important because of their consistent explanatory power for academic performance, behaviors, and intelligence beliefs (e.g., Burnette et al., 2013). Growth mindsets may be especially helpful during challenging periods such as the transition to high school (e.g., Blackwell, Trzesniewski, & Dweck, 2007). Unfortunately, recent mindset research lacks rigorous literature reviews. While this lack exists for consumer behavior and other disciplines, learning and instruction is where much of the research is focused, and where interventions may have lifelong, beneficial effects such as greater educational achievement, happiness, and higher income. Burnette et al.'s (2013) meta-analysis is insufficient, being five years out-of-date and having a primarily quantitative view. This review will fill this gap, synthesize the latest empirical research, and help new people understand the field.

Terminology

In this review, implicit theories of intelligence will be called *mindsets,* incremental theories of intelligence will be called *growth* mindsets, and entity theories of intelligence will be called *fixed* mindsets. Consistent with Yan, Thai, and Bjork (2014), incremental theorists will be referred to as *growth theorists* and entity theorists will be referred to as *fixed theorists*. The use of the term "mindsets" in this context was popularized by Dweck (2006), is more concise, and has become better known than "implicit theories" or "self-theories" among laypersons. A small

but important distinction will be made between *academic performance* and *academic achievement*. Here, academic performance will include more than grades—academic effort (Sriram, 2013), well-being and emotional adjustment (Romero, Master, Paunesku, Dweck, & Gross, 2014), and avoidance of self-handicapping behaviors (Rickert, Meras, & Witkow, 2014) will be included. Academic achievement, on the other hand, will be defined based on grades.

Background

Dweck (1986) articulated the underpinnings for the mindset model, characterizing them as "adaptive and maladaptive motivational patterns" within the "social–cognitive framework" (p. 1040). These underpinnings were later crystallized in Dweck and Leggett (1988). While building on the base of achievement goal theory (for a contemporary overview, see Senko, Hulleman, & Harackiewicz, 2011), "mindsets," as they became known in Dweck (2006), are distinct from achievement goals. Typically, they are quite stable after adolescence (Martin, 2015), and serve as a lens through which attributions are made and self-beliefs are constructed. Having a growth mindset means one believes abilities—and even intelligence—can be increased through diligent efforts (Dweck, 2006). In a fixed mindset, individuals believe their abilities are primarily based on raw talent, innate ability, or natural gifts. They do not believe they can get better, no matter how hard they try, and will often try to conceal or compensate for their lack of ability through superficial methods. Believing one is not a "math person" is a common example of fixed mindset (Rattan, Good, & Dweck, 2012). Mindset is a simple concept that can be effectively summarized as: growth mindset—good; fixed mindset—bad.

Measurement

Measuring mindsets is typically done with as few as the following three questions on a six-point Likert-type scale ranging from "Strongly Agree" to "Strongly Disagree": "You have a

certain amount of intelligence, and you really can't do much to change it," "Your intelligence is something about you that you can't change very much," and "You can learn new things, but you can't really change your basic intelligence" (Dweck, 2000, p. 177). While additional questions are sometimes used, these three questions alone have demonstrated a high degree of reliability and validity (Dweck, Chiu, & Hong, 1995). Agreement with these questions is indicative of fixed mindset, while disagreement is indicative of growth mindset.

Preceding Literature Reviews

Burnette, O'Boyle, VanEpps, and Pollack (2013) have produced a comprehensive meta-analytic review examining the relationship between mindsets and self-regulation. They reviewed 85 sources, mainly from 1988 to October 2010. Synthesizing mindsets with achievement goal theory, Burnette et al. conclude that individuals with fixed mindsets are more likely to be performance- rather than mastery-oriented, with deleterious results. Promisingly, the meta-analysis revealed positive, statistically significant relationships of small to moderate effect sizes between growth mindsets and optimistic outlooks, reduced negative emotions regarding goals, and a bias for mastery orientation. However, the authors' review did not focus singularly on mindsets nor academics—many mindset articles were excluded if they did not also focus on self-regulation, and 32% of articles were from other disciplines such as marketing. Also, compelling evidence has emerged since 2010, which will be explored in this paper.

No relevant, peer-reviewed literature reviews were found that included articles from 2011 and beyond. While several foundations have put out literature reviews (e.g., Farrington et al., 2012; Snipes, Fancsali, & Stoker, 2012), none have been comprehensive or rigorous.

The Present Review

Overview. This literature review of recent mindset research (2009 to February 2016) will examine intelligence mindsets (growth vs. fixed) in the contexts of learning and instruction. Results and implications will be synthesized. The work of Burnette et al. (2013), along with seminal articles and books (Dweck, 1986; Dweck & Leggett, 1988; Dweck, 2000; Dweck, 2006), will serve as underpinnings. Other mindsets, such as belongingness and sense of purpose, will not be covered. However, these mindsets have less research and seem unimportant to the present review, given that almost all the reviewed articles focused on intelligence mindsets without including other mindsets. Paunesku et al. (2015) is an exception, having included both growth mindset and sense-of-purpose mindset interventions, but combining the two was no more successful than implementing only a growth mindset intervention.

Search methods and inclusion criteria. Peer-reviewed articles, published between January 2009 and February 2016, with full text available, were searched for in ERIC and PsycINFO, using this "All Text" search query: ("implicit theor*" OR "growth mind*" OR "fixed-ability mind*" OR "fixed mind*"), returning over 350 results. These databases were selected because they include our target areas of education and psychological research. This query was searched as "All Text" due to an observed lack of consistency in "Subject Terms" between articles; it was feared that using subject terms would exclude relevant articles. The query has partial wildcards to pick up verbiage variations. The titles, abstracts, and subject terms of over 350 articles were individually examined to determine whether they 1) were empirical articles, 2) focused on growth- and fixed-ability mindsets, and 3) focused on academic performance or intelligence beliefs. Overall, 51 empirical articles met these criteria and were included.

Themes and Issues

Sociocultural Issues

Cross-cultural validity. Mindset research is being conducted in many nations and several cultural contexts. While 26 (51%) of articles contained only U.S. samples, studies in Brazil, China, India, the Philippines, Russia, and Taiwan replicated the mindset phenomenon. Western culture was over-represented, with three studies from Australia, and one or two studies from Canada, Germany, and many more western European countries. Several studies replicated mindset findings in populations with low socioeconomic status that were not primarily Caucasian (e.g., Esparza, Shumow, & Schmidt, 2014; McCutchen, Jones, Carbonneau, & Mueller, 2016; Paunesku et al., 2015), while others were less generalizable due to consisting of mostly wealthier whites (e.g., Davis, Burnette, Allison, & Stone, 2011; Haimovitz, Wormington, & Corpus, 2011; Kornilova, Kornilov, & Chumakova, 2009). Blackwell et al. (2007) made a large contribution to cross-cultural validity by performing a rigorous, multi-year experimental study on New York City students in two diverse middle schools. Overall, while mindset research could use more diversity, its cross-cultural validity is fairly robust.

Gender gap. Particularly for math and science, girls seem more likely than boys to hold fixed mindset. Lüftenegger et al. (2015) found that gifted Austrian girls were more likely than boys to have a fixed mindset for math. Rickert et al. (2014) observed that 9th grade girls in the Pacific Northwest were more likely than boys to be fixed theorists, resulting in self-handicapping behaviors and negative emotions for school. Among math and physics students in German gymnasiums (secondary schools that prepare students for university), Ziegler and Stoeger (2010) saw that boys earned better grades and had more adaptive achievement behavior. The evidence is somewhat mixed—Shively and Ryan (2013) found no gender effects for fixed mindset in

undergraduate remedial math students in the Midwestern U.S. Overall, however, females seem more likely to have fixed mindsets for math, with deleterious effects. In the Southeastern U.S., Sriram (2013) found that a mindset intervention significantly improved the "academic self-confidence, general determination, and study skills" (p. 527) of at-risk, first-year female undergraduates. Mindset interventions may be a powerful tool in closing the gender gap for academic performance and achievement.

Teaching and Learning Issues

Academic achievement. Paunesku et al. (2015) offers the most compelling recent evidence that mindset interventions can improve academic achievement. In a sample of 1,594 high school students from 13 diverse high schools across the U.S., a simple online mindset intervention resulted in a 6.0% increase in satisfactory grades (C or higher), while a control group did not improve. Romero et al. (2014) followed 115 students from a U.S. middle school over a two-year period, finding that growth theorists not only earned significantly higher grades, but enrolled in challenging math courses and had better well-being. In three studies of California 9th graders, Yeager, Johnson, et al. (2014) found that fixed theorists received lower grades and were less resilient to social adversity. Other evidence is mixed: two studies observed a positive correlation between growth mindset and achievement (De Castella & Byrne, 2015; Diseth, Meland, & Breidablik, 2014), while Shively and Ryan (2013) found only a marginal correlation and Ziegler and Stoeger (2010) explained their results through other variables. Kornilova et al. (2009), in a study of 300 Russian undergraduates, found no relationship between mindset and achievement using Dweck's (2000) questionnaires, but did find that peer-reported intelligence predicted achievement. Conversely, a very recent study by McCutchen et al. (2016) examined underprivileged elementary students (65% black, 19% Hispanic) in a southern U.S. city, finding

that growth theorists performed significantly better on the Iowa Test of Basic Skills, Form C (reading and math), a standardized achievement test. While growth mindset and academic achievement are often positively correlated, evidence is mixed, and self-efficacy can be a more powerful predictor (e.g., Komarraju & Nadler, 2013).

Educator beliefs. García-Cepero and McCoach's (2009) purposive direct-mail campaign received 372 responses from K–12 teachers (45%) and professors (55%), revealing that U.S. educators unfortunately appear to hold a neutral mindset on average, but endorse multiple measures for giftedness determination. Through vignettes, Gutshall (2013) found that teachers in a southeastern school district frequently had no discernable mindset and did not perceive their students malleability differently based on gender or learning disability. While Jones, Bryant, Snyder, and Malone (2012) found 78% of preservice teachers had growth mindsets, theirs was a convenience sample (82% white) using only two, self-report based measures. Overall, the proportion of U.S. educators who endorse growth mindset does not appear to be larger than the American public. This is unfortunate, because students may benefit if educators convey growth mindsets (e.g., Rattan, Good, & Dweck, 2012). U.S. educators may be deficient compared to social science high school and preservice teachers in Sweden (Jonsson & Beach, 2010; Jonsson, Beach, Korp, & Erlandson, 2012), where growth mindset was more frequently observed. However, in these studies, fixed mindset was much more common among Swedish math and science teachers. Similarly, on an implicit-association test, French male science teachers negatively associated the terms "intelligence" and "modifiable," while female science teachers and liberal arts teachers of both genders did not have this result (Mascret, Roussel, & Cury, 2015). Combined, these results imply that fixed mindset is more pervasive in math and science,

which is unsettling because skipping math and science courses precludes many careers (Romero et al., 2014).

Shim, Cho, and Cassady (2013), in their K–12 sample of schoolteachers in the Midwestern U.S., found that fixed mindset for students' intelligence often went hand-in-hand with a performance-avoidance goal orientation for teaching. In two case studies, Schmidt, Shumow, and Kackar-Cam (2015) found that imparting growth mindsets on students requires frequent reinforcement and is aided by internalization of the belief. The cost of educators' fixed mindsets may be quite high—Rattan, Good, and Dweck (2012) found that fixed-mindset educators are apt to harshly judge student intelligence based on a single exam score; moreover, they give comforting feedback that derails self-efficacy and stymies student motivation, rather than orienting students toward the strategies that would improve academic performance. The importance of getting educators onboard with growth mindset cannot be overstated, but many educators, such as Celia from Schmidt et al.'s (2015) case study, believe they are holding and imparting growth mindsets, despite doing just the opposite.

Helplessness and help-seeking behaviors. When Davis et al. (2011) told undergraduates they would be competing in a math contest against MIT students, fixed theorists gave questionnaire responses indicative of helplessness, while growth theorists had higher self-efficacy and were action-oriented. On manipulated anagram tasks in a public classroom, Marshik, Kortenkamp, Cerbin, and Dixon (2015) failed to corroborate, which may be due to lack of statistical power—they used only 71 subjects in a 2 × 2 between-subjects design. Shively and Ryan (2013) longitudinally assessed mindset and help-seeking behaviors for undergraduate remedial and college algebra students, finding that growth theorists sought help more, spent more hours in the lab, and had marginally better grades. In studies of 7th and 10th graders in

urban Chinese schools, Wang and Ng (2012) established fixed mindsets for intelligence and fixed mindsets for school performance as distinct predictors for feelings of helplessness. Sadly, for Taiwanese students with gelotophobia—a fear of being laughed at—Lin, Chiu, Chen, and Lin (2014) found growth mindset showed no positive correlation with challenge-confronting tendencies, although the correlation was present for low-gelotophobia students. From these five articles, growth mindset emerges as a useful tool, but not a panacea.

Giftedness. Gifted learners are not necessarily growth theorists, but the ones who are seem to have better outcomes. Lüftenegger et al. (2015) compared high- and lower-achieving mathematically gifted high school students in Austria, based on actual standardized test scores and course grades. The 66 high-achieving gifted students scored significantly higher on growth mindset, mastery goals, and academic self-concept, self-efficacy, and interest than the 144 lower-achieving gifted students. Esparza et al. (2014) applied Brainology to 80 gifted 7th grade science students in the U.S., finding not only that growth mindset was high to begin with, but it dramatically increased with the intervention (the mean score of 4.5 increased to 5.19 on a four-item instrument using a 1–6 Likert-type scale). Giftedness and growth mindset appear a powerful duo—gifted students with fixed mindsets seem to fall short of their potential. In contrast, Ziegler and Stoeger (2010) argued that fixed mindsets can be adaptive or even protective, because academic beliefs might be explained through various combinations of other predictors. However, their sample was not generalizable, consisting of German gymnasium students who typically have high socioeconomic status. Overall, research lends support to the claim that mindset may play a primary or mediating role between giftedness and achievement.

Perfectionism. Having high standards for personal performance can be empowering for growth theorists, but debilitating for fixed theorists. Chan's (2012) study of 251 gifted students

in China (grades 5–12) revealed that fixed mindset was correlated with unhealthy perfectionism, including decreased happiness and life satisfaction. As defined by Chan (2012), unhealthy perfectionists may be performance-avoidant, to such an extent that they fail to even get started on important tasks. On the other hand, healthy perfectionists are successful at completing work, though they may exceed the point of diminishing returns in the amount of effort they exert. However, this is typically a better outcome than completing no work at all. More research is needed to determine whether mindset plays a causal role in perfectionism style.

Motivation. Motivation's relationship with mindset has a storied history. In a study of 650 French-Canadian high school students, Renaud-Dubé, Guay, Talbot, Taylor, and Koestner (2015) endeavored to establish the four types of extrinsic motivation from self-determination theory (Ryan & Deci, 2000) as mediators between mindset and school persistence intentions, but failed miserably. In fact, direct effects were found between growth mindset and both school persistence intentions and intrinsic motivation, with no support for external, introjected, identified, nor integrated regulation as mediators. Haimovitz et al.'s (2011) rigorous study of Oregon students in grades 3–8 points toward fixed mindset being a significant damper on intrinsic motivation. It would appear mindset has a fairly direct impact on motivation; fixed mindset has even failed to correlate with performance-avoidance goals in several studies (De Castella & Byrne, 2015; Dinger, Dickhäuser, Spinath, & Steinmayr, 2013; Howell & Buro, 2009), though others have found a relationship (Chen & Pajares, 2010; Shim et al., 2013). Because motivation is so important to outcomes in academics and elsewhere, finding a direct relationship between mindsets and motivation greatly elevates the importance of mindsets. However, locus of control may deserve more research because, in the present review, only Bodill

and Roberts (2013) considered it. They studied Western Australia undergraduates and found support for external locus as a mediator between fixed mindset and fewer study hours per week.

Self-handicapping behaviors. Results for Brazilian university students of pedagogy (da Silva Marini & Boruchovitch, 2014) suggest mindset may be a mediator between motivation and self-handicapping, though intrinsic motivation was a much stronger factor. However, in a large sample (n = 680) of Australian high school students (De Castella & Byrne, 2015), fixed mindset predicted a host of deleterious outcomes including self-handicapping, helpless feelings, disengagement, and lower self-reported grades, especially when fixed mindset was directed inwardly rather than outwardly. For U.S. 9th graders, self-handicapping, procrastination, and feeling bad about school were predicted by fixed mindset (Rickert et al., 2014). Habitual procrastination (Howell & Buro, 2009) and other self-handicapping behaviors may also be a product of fixed mindset.

Students' math and writing perceptions. While we have established that educators may be more likely to hold fixed mindsets for math and science ability (e.g., Jonsson & Beach, 2010; Mascret et al., 2015), we have not yet looked at student perceptions and interventions. In a study by Limpo and Alves (2014), Portuguese middle-school students wrote longer and higher-quality essays after a 12-week, fairly intensive growth mindset intervention. Typically, fixed mindset has been particularly common and deleterious for math intelligence beliefs (Shively & Ryan, 2013) and course enrollment decisions (Romero et al., 2014)—in fact, fixed mindset for math ability may cut off entire career paths that require courses like College Algebra or Calculus I. Endorsing a growth mindset appears to improve math and writing outcomes (e.g., Lüftenegger et al., 2015). Therefore, mindset interventions may be valuable for students' perceptions, performance, and overall career trajectories, particularly for math and writing abilities.

Emotion and well-being. When it comes to coping with exams, seeking social support, self-esteem, positive affect and emotions, and relationship harmony, growth mindset has yielded better results among French undergraduates (Doron, Stephan, Boiche, & Le Scanff, 2009) and in Filipino secondary schools (King, 2012). In U.S. middle- and high-school students, growth theorists have been found to enjoy higher well-being, well-adjusted emotions, better health, less stress, greater achievement, and more adaptive reactions to social adversity, as compared to fixed theorists (Romero et al., 2014; Yeager, Johnson, et al., 2014). Clearly, the benefits of growth mindset go far beyond academic achievement.

Self-regulation. Paradoxically, among a U.S. sample of 450 adults solicited online via Amazon Mechanical Turk, growth theorists were even *more* deadline-driven than entity theorists, though both types reported poor self-regulation (Yan et al., 2014). This is particularly distressing given that 52% reported having Bachelor's degrees or higher, yet still had not developed effective self-regulation strategies. However, this sample was based on self-report and was highly vulnerable to self-selection bias. Other research has been less discouraging: among Portuguese 5th and 6th graders, Limpo and Alves (2014) used a mindset intervention rooted in self-regulated strategy development to produce robust writing improvement. In U.S. undergraduate psychology students, fixed mindset has been predictive of mastery-avoidance goals and frequent procrastination (Howell & Buro, 2009). More research is needed, since mindsets' relationships with self-regulation are not clear-cut. For instance, Dinger et al. (2013), in their rather rigorous study of 524 German gymnasium 11th and 12th graders, found that while mindsets predicted perceived competence, achievement motives, and intrinsic motivation, there was no connection to performance-avoidance goals, which may be a key component of self-regulation for high-stakes tasks.

Self-efficacy and challenges. Another study of U.S. undergraduate psychology students found that students with high self-efficacy scores were more likely to exhibit growth mindset, learning goals, mastery goals, and higher grade-point averages (Komarraju & Nadler, 2013). In a study of Norwegian 6th- and 8th-graders (Diseth et al., 2014), no negative relationship was found between fixed mindset and "evaluative components of self-beliefs" (p. 7), but growth mindset correlated positively with self-efficacy, self-esteem, and academic achievement. Similar results have been found among Spanish university students in group settings (Beckmann, Wood, Minbashian, & Tabernero, 2012). When Davis et al. (2011) presented undergraduates with a math competition scenario, self-efficacy was the same for "topdogs," but the self-efficacy of "underdogs" was significantly worse for fixed theorists. These results suggest that while either mindset may serve in favorable academic conditions, growth mindset becomes particularly valuable during academic challenges. In support, Blackwell et al. (2007) found growth mindset predicted math achievement beginning only in 7th grade, coinciding with the transition to junior high. Also, in a qualitative science task, Braasch, Bråten, Strømsø, and Anmarkrud (2014) found that Norwegian students with growth mindset identified more scientific tasks and made better intertextual references, but fixed mindset was not a negative predictor (prior knowledge and working memory span was controlled for among all participants). They concluded that fixed mindset may only be detrimental under challenging, high-stakes conditions.

Intelligence and epistemological beliefs. Regarding science beliefs among 6th grade middle-school students in the southeastern U.S., Chen and Pajares (2010) found that growth mindset correlated with "sophisticated" epistemological beliefs such as development and justification of scientific knowledge, while fixed mindset correlated with "naïve" beliefs based on source and certainty (p. 80). Rattan, Savani, et al. (2012) compared college students in

California and India, finding Indians more likely to endorse the universal potential for high intelligence, and that this belief correlates significantly, albeit weakly, with growth mindset. Intelligence mindsets are domain-specific—Furnham (2014) applied Gardner's multiple intelligences to mindsets, finding that Londoners had a strong growth mindset for verbal and naturalistic intelligences, while creative and musical domains were seen as fixed. From a performance standpoint, the objective degree of intelligence fixedness, universally or in specific domains, may be a non-issue. Far more often, individual potential may be limited by fixed mindset than lack of raw materials.

Neuropsychological evidence. Even interventions as simple as reading a two-page article that endorses brain plasticity has been shown to encourage mastery performance orientations on a Flankers task, with measurable changes in EEG readings (Schroder, Moran, Donnellan, & Moser, 2014). In this task, participants were asked to evaluate whether the middle character in a displayed, five-letter string was the same or different from the others (e.g., MMMMM or NNMNN). Those who read a growth-mindset article allocated more attention to task-relevant stimuli and recovered from errors more quickly than those who read a fixed-mindset article. From results on another experiment with Flankers tasks, Kappes, Stephens, and Oettingen (2011) concluded that imagining academic successes can aid performance for growth theorists, while entity theorists may be more motivated by picturing setbacks. Dyczewski and Markman (2012) echoed these remarks—from U.S. undergraduates' performance on an imagination task, they found that imagining upward counterfactuals motivated growth theorists, whereas downward counterfactuals motivated fixed theorists. Overall, growth mindset may produce significant improvements in visual search performance and measurable changes in brain activity. This is important because visual search performance is of clear value to common tasks

such as reading and driving. More research is needed to determine how imagining good versus bad outcomes relates to holding growth versus fixed mindset, however.

Mindset Interventions

Process praise. Praising the *process* of learning rather than the *person* can lead to growth theorizing. In a groundbreaking, seven-year longitudinal study of 53 Chicago-area parent–child dyads, Gunderston et al. (2013) found that parent praise at ages 1–3 predicted mindset at ages 7–8. Children who frequently received praise such as “you’re so smart” and “good girl” at 1–3 were more likely to endorse fixed mindsets at 7–8, while receiving praise such as “you’re doing a good job” and “good throw” predicted growth mindsets (p. 1533). This study was a longitudinal validation of Mueller and Dweck’s (1998) seminal findings, where 5th graders assigned to receive person praise become discouraged and demotivated with difficult tasks; consistent with a fixed mindset, they preferred easy tasks with low risk of failure. Parents and educators alike can promote growth mindsets by giving process praise for desired behaviors.

Brainology. Brainology is a for-profit, online mindset intervention program (http://www.mindsetworks.com). Through four, 40-minute animated units, it aims to teach middle- and high-school students that ability and intelligence are malleable. Esparza et al.’s (2014) application of Brainology to gifted students was a success, increasing their pre-existing growth mindsets to higher levels. Schmidt et al.’s (2015) teacher–classroom case studies revealed that Brainology’s effectiveness may require teachers to habitually support growth mindset in the classroom. Donohoe, Topping, and Hannah (2012) deliver a repudiation of Brainology. In a sample of 33 Scottish 13–14 year olds, the 18 students in the experimental group had higher growth mindset a week after the four-week intervention, but not three months

later. However, this sample was small, and Donohoe was the teacher of the class, potentially confounding the results. Nevertheless, Brainology requires more empirical study.

Brain Awareness. Fitzakerley, Michlin, Paton, and Dubinsky (2013) studied the Brain Awareness campaign, a longstanding program where neuroscientists speak about the functions and plasticity of the human brain. In a two-year qualitative and quantitative analysis that surveyed 4,805 students and 147 teachers in 4th–6th grade Minnesota science classrooms, this one-hour intervention was well-received by teachers and resulted in higher science enjoyment and growth mindset among students. Workshops like Brain Awareness are an exciting and evidently efficacious way to spread growth mindset.

Inducing fixed mindset. Jonnson and Beach (2010) successfully induced fixed mindset in a sample of 102 Swedish preservice teachers. The experimental group was assigned to read an article about the *g* factor psychometric construct, which conceptually advocates an entity theory of intelligence. Subjects exposed to *g* factor exhibited greater fixed mindset on subsequent instruments. Schroder et al. (2014) induced fixed mindset by having undergraduates read a short article presenting intelligence as a matter of good genes, leading to a performance- rather than mastery-orientation in a Flankers task. These studies imply that educators and other leaders may induce fixed mindset as easily as growth mindset, depending on their behaviors. Awareness and rigorous self-analysis may be necessary to ensure one is not conveying a fixed mindset.

Strategy-oriented feedback. Giving comforting but demotivating feedback such as “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’” (Rattan, Good, & Dweck, 2012, p. 735) can have horrifying results—it can lead to students withdrawing from early math courses, completing cutting off many majors and career paths that require higher math. Moreover, in Rattan et al.’s study, even

instructors at a competitive university endorsed fixed mindset and gave comfort-oriented feedback, despite their students being highly intelligent even from an entity theorist's perspective. The antidote is strategy-oriented feedback, which encourages students to try different approaches to problems and assignments, as well as pursuing help such as tutoring and supplemental instruction. Consistently giving strategy-oriented feedback encourages growth mindset and resilience.

Mindset Kit. Mindset Kit is a free, online knowledge base developed by Stanford University's PERTS Lab (http://www.mindsetkit.org), aimed at educating teachers, parents, and mentors on mindset research and methods for imparting growth mindset. Paunesku et al. (2015) adapted Mindset Kit into two 45-minute sessions applied to high school students, where it significantly improved grades for at-risk students. Mindset Kit may be an excellent intervention for educators, who may incorporate growth mindset in their lessons and share it with their colleagues.

Implications. Providing process feedback that suggests strategies may aid students' performance and encourage them to view their intelligence and abilities as malleable. It is possible to induce both growth and fixed mindsets. Educators might unknowingly induce fixed mindsets through their actions, such as not giving enough time to solve problems. Interventions such as Brainology and the Mindset Kit may be useful for students and educators, given their strong results in studies such as Paunesku et al. (2015). Changing the beliefs and practices of educators may be very important because of their direct influence on students.

Discussion

Summary

The results are clear and have been replicated repeatedly in diverse cultures, age groups, and contexts: growth mindsets predict adaptive intelligence beliefs and better academic performance. On the other hand, fixed mindsets predict detrimental outcomes, especially when individuals are stressed or challenged. Therefore, adopting a growth mindset is frequently a statistically powerful predictor of academic performance, achievement, and a host of other beneficial learner outcomes, typically with small to medium effect sizes (Burnette et al., 2013).

Long-Term Recommendations

Self-transcendent purpose. Self-transcendent purpose goes beyond self-interest, perhaps involving service to others, commitment to ideals, or religiosity. It has been correlated with a host of beneficial beliefs and outcomes, including ability mindsets (Yeager, Henderson, et al., 2014). Sense-of-purpose mindsets are certainly a vector for long-lasting personal change, and require a focus on motives rather than outcomes, e.g., “helping people” instead of “being an engineer” (p. 560). When they practice and articulate their beliefs, educators who manifest self-transcendent purpose may serve as role models.

Policy recommendations. Rattan, Savani, Chugh, and Dweck (2015) have produced an excellent list of policy recommendations for American education, based primarily on large-scale implementation of the interventions put forth in the literature. Doing this within the strictures of the American education system is no easy task, given its many entrenched practices and divergent governance among the states.

Broad public awareness. Carol Dweck has been fantastic at bring mindsets into public awareness through books (Dweck, 2000; Dweck, 2006), popular articles (Dweck, 2007; Dweck,

2010), and efforts to apply mindsets to conflict resolution and reconciliation in the Middle East (Dweck, 2012). Given these efforts and the converging empirical evidence, it is no wonder that the U.S. Department of Education (2015) has announced $2 million in "Skills for Success" grants to support mindset research. Hopefully, more researchers, practitioners, and public figures will study, implement, and recognize mindsets. Regarding public awareness, it may be difficult to say that mindsets have “arrived” until they eclipse the debunked “learning styles” movement (Kirschner & van Merriënboer, 2013).

Limitations of the Present Review

Looking only at peer-reviewed journal articles from the past seven years presents a narrowed view that excludes many important findings from conference proceedings, dissertations, and other sources. However, a comprehensive evaluation of these sources would be far more labor intensive than reviewing 51 empirical journal articles. Limiting the scope of the literature review to a subset of academic or intelligence implications would be difficult, given that many sub-concepts have had limited study from a mindset perspective, and given the overlapping nature of the research. The strength of this review may lie in its panoramic view of the last seven years of peer-reviewed journal articles, which are arguably more putatively sound than other sources. While think tanks and organizations have put out reports and policy recommendations (e.g., Farrington et al., 2012; Snipes et al., 2012), many of these merely regurgitate the recommendations put forth in journal articles.

Suggested Research Practices

One potential challenge for mindset research is the fact that many individuals simply do not have a discernable mindset. This, along with the observation that growth and fixed mindsets may be distinct concepts rather than part of a unipolar scale, were major grievances voiced by

Tempelaar, Rienties, Giesbers, and Gijselaers (2015). Dweck has addressed this, recommending that individuals who score in the 3.1–3.9 range on six-point Likert-type scales be excluded from mindset data analyses—typically 15% of the population (Dweck et al., 1995). However, an argument can be made that this is essentially cherry-picking. Given that mindset interventions often have small effect sizes already (Burnette et al., 2013), if researchers included individuals with no clear mindset, significance might disappear in many studies. A solution may be to retain scores as continuous, rather than dichotomous, variables. It may be useful to specifically research lack of mindset, which might be labeled *neutral mindset*.

Mindsets are a very active research area—over 300 mindset articles covering non-education topics and fields were published in 2009–2016 alone. Developing a cohesive model that discerns relationships between the mindset model and other motivational concepts may help guide this burgeoning field. Moreover, it is very important that researchers not succumb to causal inferences. No amount of mindset research can prove that mindsets are a larger factor than innate ability. Finally, researchers should be careful not to adopt a dichotomous view of mindsets—they exist on continuums and can change over time and between tasks and domains.

Conclusion

Mindsets are an appealing concept. They are relatively easy to study, because they are quite vulnerable to manipulations and interventions. They can also be reliably assessed with short and simple questionnaires (Dweck, 2000). Combined with their stability and explanatory power for a wide variety of learning and performance processes and outcomes, they are a rare find in psychology. Given the current velocity of research, in the coming years, we can expect many replications and new applications of mindsets for educational psychology, social psychology, and other fields.

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