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The Strategic Mindset Model: An Integrative Approach to Motivation and Performance

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THE STRATEGIC MINDSET MODEL: AN INTEGRATIVE APPROACH TO MOTIVATION AND PERFORMANCE

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Abstract

The Strategic Mindset Model: An Integrative Approach to Motivation and Performance

Sara G. Goodman

Existing research differentiates beliefs about success and intelligence into two categories: fixed and growth mindset. This popular categorical view aims to account for differences in performance, success and failure, but does not address the influences of task parameters. To better explain nuanced performance differences as a result of individual beliefs and task parameters, the current set of experiments proposes the Strategic Mindset Model as an alternative. This model posits that (1) fixed mindsets may be adaptive in some circumstances, (2) mindset interacts with task parameters to influence performance and (3) that mindset is malleable and can be influenced by experience. The experiments presented here provide evidence for all three tenets of the Strategic Mindset Model, suggesting that mindset may be a strategic choice that exists on a continuum, and that participants may select a degree of fixed or growth orientation dependent on task parameters and objectives. Results from these experiments call into question some of the assumptions made in Mindset Theory, and may be used in practice by educators, coaches, and researchers to elicit improved performance in the face of varying task parameters.

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The Strategic Mindset Model: An Integrative Approach to Motivation and Performance

It is common practice to quantify ability in a domain as a performance outcome. Such outcomes are measured using time (e.g. response time, task completion time), accuracy (e.g. correct responses, overall proportion of task completion), and efficiency (i.e. proportion of accuracy to task time). In classrooms, students are frequently evaluated using their ability to correctly complete a task in a given period of time. Social scientists conducting human subjects research, particularly those focusing on cognition, often ask participants to engage in a task over the course of a research session and draw conclusions about ability based on the performance measured within those sessions. Employees are often assessed in the same way, whereby their worth to the company is determined by the efficiency with which their assigned tasks are completed. Existing research regarding performance identifies several parameters and factors that may influence these outcomes.

Factors Influencing Performance

In any given domain, performance may be subject to variability as a result of several task-specific factors. These parameters include the nature of the task, difficulty, goals or performance expectations, type and frequency of feedback, and the nature of task instructions (Bell & Kozlowski, 2002; Chaikin, 1971; Huber, 1985; Locke & Latham, 2006; Kluger & DeNisi, 1996). Each of these factors has been shown to influence performance across a wide variety of tasks. For example, performance tends to be better when participants are given a goal, and worse when the participant is asked to do his or her best without a performance target (Huber, 1985; Locke, Shaw, Saari & Latham, 1981). Further, participants demonstrate better performance on a task when provided with an attainable goal rather than a goal that is outside the realm of achievability (Huber, 1985; Locke et al., 1981; Locke & Latham, 2006; Locke, Frederick, Lee & Bobko, 1984a; Locke, Frederick, Buckner & Bobko, 1984b). Thus, performance is easily altered by manipulating the factors inherent to the task, regardless of individual differences across participants.

Separately, motivation stands as an influential metafactor contributing to performance differences. For example, students demonstrate better academic performance in difficult tasks when employing motivation regulation strategies to improve engagement (Wolters, 2003; Wolters, 1998). Several theories provide differential explanations regarding how motivation arises, changes, or is manifested (see Bandura, 1986; Deci & Ryan, 1985; Dweck, 2000; Sansone & Smith, 2000). Some theories, such as Self Determination Theory, center around the origin of motivation (Deci & Ryan, 1985). Other theories, including self regulation theory, focus on the regulatory processes involved in motivation (Sansone & Smith, 2000). A third class of theories maintains an individual beliefs-based approach (Dweck, 2000).

A popular and traditional model, Self Determination Theory, suggests that motivation may either be intrinsic, arising from personal enjoyment, or extrinsic, in service of reaping an external reward (Deci & Ryan, 1985). This dual-process account of motivation addresses separate kinds of variability in engagement due to individual differences as well as task factors. However, Self Determination Theory does not account for any possible interaction between the two types of motivation, instead suggesting that motivation for a given task may be intrinsic or extrinsic, but never both. Thus, Self Determination Theory takes a highly limited view of the ways that motivation may affect performance. For example, this approach would posit that a student may engage in coursework either because it is interesting (i.e. for intrinsic reasons) or because of the desire to earn a high grade (i.e. for extrinsic reasons) but not for both reasons. As evidenced by Lepper, Green and Nisbett (1973), students who were intrinsically motivated to engage in a task are unable to maintain such motivation in the face of an extrinsic reward, and that future engagement in the task only occurs as a result of extrinsic motivation. These findings provide support for Self Determination Theory, indicating that these two forms of motivation are categorical and mutually exclusive.

Alternatively, Sansone and colleagues argue that motivation is a self-regulatory process that relies on one's appraisal of both the importance and likelihood of goal achievement (Sansone, Thoman & Smith, 2000). In self-regulation theory, the individual is of central importance; thus, the model accounts for interactions between the individual's expectations or beliefs and the context of the task, including task factors. However, the self-regulation approach neglects to address the importance of performance outcomes for motivation and continued engagement. Under self-regulation theory, a student may be continually weighing the likelihood of receiving an A in the course against several factors. These factors may include the amount of time spent studying, rapport with the professor, and level of busyness in her or his schedule in the near future. The student thereby regulates engagement and motivation to earn the high grade based on a cost-benefit analysis that incorporates these many factors, but does not weigh recent performance very heavily as a predictor of future performance.

As another alternative, Dweck and colleagues have proposed a different theory of motivation that accounts for both intrinsic and extrinsic factors separately, the interactions between one's beliefs and extrinsic influences, and the importance of performance as both an outcome and a regulator of motivation. This Mindset Theory emphasizes the importance of "self theories" or "mindsets", which are comprised of individual beliefs about ability, growth and improvement (Dweck, 2000; Dweck, 2006; Dweck & Leggett, 1988; Mueller & Dweck, 1998; Dweck, Mangels, Good, Dai & Sternberg, 2004; Licht & Dweck, 1984). Because this model addresses some of the shortcomings of other motivation models, the current study utilizes this unique approach to investigate interactions between motivation, task factors and performance. The following section describes Mindset Theory in further detail.

Mindset Theory: An Overview

According to Dweck's Mindset Theory, individuals can be sorted into one of two mindset categories characterized by psychological and behavioral hallmarks related to performance, success, and response to feedback. Mindsets are founded on individual beliefs regarding the nature of ability (Bandura & Dweck, 1985; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Licht & Dweck, 1984;

Mangels, Butterfield, Lamb, Good & Dweck, 2006; Mueller & Dweck, 1998). The first of these mindsets is based on a fixed or entity view, and emphasizes the belief in the static and stable nature of ability. Those who view ability as fixed tend to evaluate it as an inborn trait that cannot be changed over any period of time (Bandura & Dweck, 1985; Dweck & Leggett, 1988; Mueller & Dweck, 1998). Individuals maintaining these *fixed mindsets*[1] tend to shy away from activities in circumstances where failure is likely, and prefer to partake in tasks where there is opportunity to display high proficiency (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). In contrast to individuals with fixed mindsets, others believe that ability is malleable or incremental, and can change as a function of time, experience and effort (Bandura & Dweck, 1985). These individuals maintain *growth mindsets* and are likely to engage in activities that may provide growth and learning opportunities, even if failure or mistakes are probable (Dweck, 2006; Dweck & Grant, 2008).

According to this approach to motivation, individuals with fixed mindsets tend to believe that the need to put forth effort is indicative of low ability. Thus, if success in a task becomes less likely, these fixed mindset individuals decrease their engagement and minimize effort on the task (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Licht & Dweck, 1984; Dweck et al., 2004;

[1] In earlier literature, fixed and growth mindset orientations are referred to as *entity* and *incremental* theories, respectively (Mueller & Dweck, 1998). Prior to these terms, fixed and growth mindsets were referred to as *performance* and *mastery* orientations (Dweck & Leggett, 1988).

Mangels et al., 2006, Mueller & Dweck, 1998). This presents in the same way as the canonical learned helplessness response, during which the individual ceases to find an alternative to the situation and simply accepts the circumstances, regardless of the severe conditions or discomfort incurred (Seligman & Maier, 1967). In addition to this disengagement, individuals with fixed mindsets also demonstrate substantial performance decrements during subsequent trials following a single experience of poor performance, confusion, or failure on a task (Dweck & Leggett, 1988; Licht & Dweck, 1984). In contrast, individuals with growth mindsets tend to readily contribute effort in any circumstance that may result in mastery or betterment, and are shown to outperform individuals with fixed mindsets on difficult tasks despite some instances of failure or poor performance (Dweck, 2000; Dweck & Leggett, 1988; Licht & Dweck, 1984). Thus, beliefs about growth and resilience in the face of failure or difficulty are strongly related to one's perspectives on the nature of ability and performance (Bandura & Dweck, 1985; Dweck, 2000; Dweck & Leggett, 1988).

Research suggests that individuals tend to *naïvely* subscribe to one mindset based on life experiences (Dweck, 2006; Mueller & Dweck, 1998). These naïve mindsets can be discerned using Event Related Potential (ERP) measures, suggesting that a person's natural inclination toward a mindset is relatively robust (Mangels et al., 2006). Specifically, growth mindset-oriented individuals show neural indications of attention or interest in a task until after feedback regarding the correct answer has been provided, whereas individuals of the fixed orientation only show such indicators until the initial verdict about the quality of performance is delivered. This indicates that growth-oriented learners maintain a clear preference for information acquisition in order to improve in a task rather than mere interest in outward displays of performance. The origins of naïve mindsets are also tightly linked to experiences of self-efficacy, or one's perception of her or his own ability and resilience (Bandura, 1993; Bandura, 2013; Schunk, 1984; Weiner, 1979). Individuals who believe that they are resilient to failure or difficulty and can persevere through challenging tasks tend to demonstrate better performance than individuals who doubt or question their resilience (see Stajkovic & Luthans, 1998 for meta-analysis). These effects have been consistently replicated in samples of children (Licht & Dweck, 1984), adolescents (Dweck & Leggett, 1988) and adults (Dupeyrat & Marine, 2005) across a variety of tasks.

Shifting Mindsets

Although much of the previous literature suggests that fixed and growth mindsets are stable over time and difficult to change, there is also evidence suggesting that mindsets are malleable. Some changes in mindset can occur as a result of development (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Meece, Anderman & Anderman, 2006). In instances where a mindset shift is organic, it is common for certain developmental trajectories to result in a shift from one mindset to another. Specifically, the transition from elementary to middle school often results in an individual's reevaluation of mindset due to increased exposure to fixed mindset oriented messages in school. As a result, it is common for students entering middle school to adopt an alternative mindset (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Meece et al., 2006). Messages about success and failure that are put forth by teacher-crafted learning environments have strong influences in shifting fixed and growth mindsets for students entering middle school. These implicit messages contribute to the mindsets students carry with them throughout high school and young adulthood (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Meece et al., 2006). Because these shifts in mindsets are readily observed when subtle or underlying messages about success, worth, and performance in the current context change drastically, it is likely that the benefit of mindsets is to optimize performance given the specific parameters of one's environment (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Roeser, Midgley & Urdan, 1996). Thus, these observed shifts in mindset seemingly occur as a response to an environmental change that requires an alternate motivational approach to ensure that performance meets the contextually accepted definition of success.

Changes in mindset have also been demonstrated when deliberately imposed by a researcher, practitioner or supervisor (Aronson, Fried & Good, 2002; Blackwell, Trzesniewski & Dweck, 2006; Yeager & Dweck, 2012; Yeager & Walton, 2011). Several experimental manipulations have also been shown to effectively induce shifts in mindsets. In one study, participants were primed with passages outlining examples of fixed or growth mindset-oriented individuals before engaging in a task of interest (Dweck & Leggett, 1988). These priming sessions were effective in temporarily influencing individuals to adopt an alternative mindset. Intervention training is another effective method for manipulating mindsets. This method involves several sessions that include lectures, readings, videos and other materials that distinguish between the two mindsets and strongly emphasize the benefits of adopting a growth perspective (Yeager & Dweck, 2012; Yeager & Walton, 2011). At times, participants are asked to complete exercises emphasizing the use of a growth mindset to approach problems or difficult situations (Aronson et al., 2002; Blackwell et al., 2007; Yeager & Dweck, 2012). These interventions have been used in universities and colleges to improve retention, academic achievement, and wellbeing among students (Yeager & Dweck, 2012; Yeager & Walton, 2011). However, these intervention practices are time consuming and may not be entirely necessary in order to impact individual task performance. New research has shown that mere suggestion via the framing of goals for a given task can cause people to demonstrate performance patterns typical of each of the mindset groups, regardless of naïve mindset. Goodman and Seymour (under review) found that task performance can be shifted through the use of goal framing whereby the participant is asked to compete against oneself to improve performance, suggestive of growth mindset, or to compete against other participants to outperform all others, priming a fixed mindset. A simple one-sentence goal emphasizing self-improvement results in improved performance on multiple tasks when compared to participants asked to demonstrate competence (i.e. fixed mindset; Goodman & Seymour, under review).

Theoretical Contention

Purposefully imposing growth mindsets can be useful for improving performance, engagement and achievement across a variety of tasks. By using one of the many available methods for shifting mindsets, researchers, educators, employers and supervisors can spur motivational changes in order to procure improved performance outcomes in an attempt to boost morale and productivity amongst participants, students, or employees. Since task factors have already been shown to affect performance, it is likely that mindset interacts with task factors to influence performance outcomes as well (Dolcos & Albarracin, 2014; Erez, Gopher & Arzi, 1990; Huber, 1985; Locke et al., 1984a; Locke et al., 1984b; Senay, Usak & Prokop, 2014; Wolters, 2003). However, existing literature does little to address the ways that task factors interact with mindset to influence performance.

The perspective put forth by the existing literature presents a major theoretical contention with emerging research. According to canonical Mindset Theory, imposing a mindset is highly effortful, requiring extensive time, training and involvement (Blackwell et al., 2007; Dweck, 2000; Dweck, 2006; Yeager & Dweck, 2012; Mangels et al., 2006; Yeager & Walton, 2011). Further, Mindset Theory takes a singular, isolated approach that does not account for the potential involvement or interaction of task factors. Finally, this traditional view places extreme emphasis on the benefits of growth mindsets over fixed mindsets, failing to account for circumstances where a performance-focused approach may be of greater benefit than self-improvement (Dweck, 2000; Dweck, 2006).

As an alternative, the following experiments were designed to evaluate the validity of a new *Strategic Mindset Model* that repositions mindset as a dynamic interaction between one's beliefs and the parameters of the targeted task. The Strategic Mindset Model posits that adoption of a fixed mindset may be strategic and dependent upon certain task factors and circumstances. Second, the Strategic Mindset Model argues that performance can be influenced in subtle but predictable ways due to the interaction between mindset and the parameters of the task at hand. Finally, the Strategic Mindset Model posits that mindset is malleable, meaning that one's mindset can be influenced by perceived competence and ongoing performance appraisals for a specific task. A critical analysis and thorough comparison of Mindset Theory and the Strategic Mindset Model are warranted to test the validity of assumptions and inferences made regarding mindsets, task factors, and performance. Implications from this study may allow for development of a new set of best practices for suggesting fixed and growth mindsets across a wide array of domains, including education, human subjects research, athletics, and employee management. The following sections provide rationale for each of the proposed experiments.

Assessing Task Factor Interactions and Mindset Shifts

Goals. The use of goals in research on mindsets and performance is extensive, but has not been systematically investigated. It is common for investigators to ask participants to select from a learning-based goal, designed to help the individual improve and grow, or a performance-based goal, intended to motivate the participant to demonstrate ability or aptitude (Dweck, 2006; Dweck et al., 2004;

Dweck & Leggett, 1988; Midgley, Kaplan & Middleton, 2001; Mueller & Dweck, 1998; Schunk, 1984). In this regard, goals are simply used as a proxy for confirming one's naïve mindset orientation such that fixed mindset individuals tend to select performance goals and growth mindset individuals choose learning goals. However, subtle framing of goals can be used to elicit a shift in mindset (Goodman & Seymour, under review). Further, several studies argue that goals are complex in the way that they influence performance and should not simply be relegated to use as confirmatory factors for comparing mindsets or methods for shifting mindsets (see Locke et al., 1981 for review).

The relationship between manipulation of orientation and goal setting is of particular importance in domains concerned with achievement and productivity, including education, human subjects research, and workplaces. In these environments, individuals are often provided with a performance target or goal. In some cases, the individual instead may be asked to establish his or her own goal, although this may be less common in circumstances where performance is expected to meet a non-negotiable threshold. Although educators, researchers and managers may not consider the importance of differences between assigned and self-set goals, Locke and colleagues (Locke et al., 1984a; Locke et al., 1984b) have shown that the effects of goal setting are sensitive to the origins of the goal (i.e. assigned or self-set). Specifically, goals that are assigned by another person tend to result in better performance than self-set goals (Locke et al., 1981; Locke et al., 1984a). When goals are self-set, participants report a diminished feeling of commitment or obligation to achieve the goal than in cases when the goal is assigned (Locke et al., 1981; Locke et al., 1984a). It is possible that the difference in achievement is due to the influence of low or modest self-efficacy. The adoption of a given mindset is strongly related to an individual's reported self-efficacy (Bandura, 1993; Bandura, 2013; Bandura & Wood, 1989; Schunk, 1984; Weiner, 1979). An imposed growth mindset may promote increased self-efficacy while an imposed fixed mindset may undermine it. Because of this, allowing individuals to set their own goals while using prescribed framing to emphasize either a fixed or growth mindset should result in different performance when compared to asking participants to achieve assigned goals. That is, by mere suggestion of goal adoption, it is possible to encourage a shift in mindset that produces either a synergistic or adversarial interaction with goal origin (i.e. assigned or self-set) for affecting performance.

This proposition stands in opposition to the currently held view that mindsets are not easily influenced by suggestion, and instead brings goals to the forefront as important task factors. Published studies addressing Mindset Theory do not distinguish between self-set and imposed goals, nor do they address the importance of self-efficacy as a shared factor between mindset and goal setting. As an alternative to Mindset Theory, the Strategic Mindset Model argues that suggestion via goal framing is an effective method for inducing a shift in mindset, and that task-centered goals are essential contributors to performance differences.

Self-Focus. Variance in levels of self-awareness has been shown to influence performance outcomes (Dolcos & Albarracin, 2014; Senay et al., 2014). Self-awareness of performance is a critical component in mindset orientation, as the individual must use current performance as a comparison point to assess relative progress and regulate future engagement. The Strategic Mindset Model posits that both mindset and task instructions may vary in levels of self-focus, and that the interactions between self-focus contributed by each source may influence performance in a way that is unaccounted for by Mindset Theory. Growth and fixed mindsets are differentiable by the way that performance is compared. In growth mindsets, the individual compares his or her current performance to his or her past performance whereas in fixed mindsets, the individual compares current performance to the performance of others (Bandura & Dweck, 1985; Dweck, 2000; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). In this way, motivation generated as a function of fixed mindsets can be considered extrinsic due to the focus on external reward in the form of acknowledgement by others (Wolters, 1998; Wolters, 2003). To that same end, growth mindsets are considered intrinsic in nature, whereby performance is merely a by-product of one's engagement in the task for the sake of improvement (Wolters, 1998; Wolters, 2003).

When engaging in a task, individuals may utilize different references for success: task-focused for growth mindsets, and self-focused for fixed mindsets (Dweck, 2000; Dweck, 2006; Mueller & Dweck, 1998). Related to this, recent research suggests that extreme levels of self-focus can affect performance negatively, while task-focus is beneficial for performance (Dolcos & Albarracin, 2014; Senay et al., 2014). For example, emphasizing self-focus by setting goals using first person language (e.g. “I will do it”) results in worse performance than third person language (e.g. “it will be done”) because of a resultant heightened task focus, such that the individual believes that success on the task is entirely within his or her control (Senay et al., 2014). Combining these findings from Senay and colleagues (2014) with the tenets of Mindset Theory (Dweck, 2000; Dweck; 2006), a shift from growth mindset to fixed mindset would result in increased levels of self-focus, and would interact with high self-focused first person goals (e.g. “I will do better than other people”, “I will show that I am great at this task”) to result in performance decrements. Conversely, an imposed shift from fixed mindset to growth mindset may reduce the amount of self-focus, dampening the effects of first person language on task performance (e.g. “I will do better than I did the last time”, “I will learn a new strategy from this task”). The effects of self-focus on performance may be enhanced by compounding one’s inherent level of self-focus, stemming from mindset, and the degree of self-focus brought about by the task.

Such results would provide further evidence in support of two central tenets of the Strategic Mindset Model: that mindset shifts can be easily induced, and that task factors interact with mindset to subtly influence performance. None of the previously discussed proponents of Mindset Theory explore the importance of careful selection of appropriate phrasing in performance-based tasks, nor do they suggest a need to account for these clearly intertwined factors (see Dweck, 2000, Dweck, 2006 for reviews). Though potentially important, Mindset Theory does not distinguish between effects of first- and second person framing. The Strategic Mindset Model suggests that subtle differences in self-focus can underscore the same factors that drive performance differences across mindsets, providing another piece of evidence for the interdependent nature of task factors, mindset and performance outcomes.

Metacognitive Mediators of Performance. A further point of inquiry regarding the boundaries of mindsets arises at the intersection of motivation and classic cognitive psychology research. While most work in this arena tends to disregard motivation as an important construct intertwined with performance, it is difficult to argue against the consistent findings demonstrating that engagement affects performance on a wide array of tasks (see Dweck, 2006 for review; Goodman & Seymour, under review). Some of these canonical cognitive paradigms present scenarios that may be at odds with what is effective for growth or fixed mindsets. For example, introducing deliberate challenge or difficulty in learning tasks, referred to as *desirable difficulties* or *productive failures*, have been shown to result in improved long-term performance and learning (Bjork & Bjork, 2011; Bjork & Storm, 2011; deWinstanley & Bjork, 2002; deWinstanley & Bjork, 2004; Kapur & Bielaczyc, 2012; Kapur & Rummel, 2012; Warshauer, 2015).

A critical factor ensuring successful outcomes on desirable difficulties tasks is preliminary failure or struggle with the task at hand. Because a hallmark of individuals orienting toward a fixed mindset is disengagement resulting from fear-of-failure, it logically follows that fixed mindset individuals would demonstrate a different pattern of responses in the face of desirable difficulties or productive failure than growth mindset individuals, who thrive in the face of a challenge (DeCaro,

DeCaro & Rittle-Johnson, 2015). For example, DeCaro and colleagues (2015) show that children who maintain a fixed mindset orientation are less likely to engage in exploratory, error-prone learning opportunities when presented with a novel set of arithmetic problems as compared to growth mindset-oriented children. This ultimately leads to a reduction in development of adaptive problem solving strategies. This finding suggests that productive failure is interpreted differently across mindsets, and that the introduction of such a factor may not produce the desired outcome across all participants. Further investigation into this possible interaction, with a focus on performance outcomes in an adult sample may call into question the strength of the effects derived from desirable difficulties, or may simply explain why some participants in these studies may demonstrate qualitatively different responses than originally predicted (deWinstanley & Bjork, 2004). As existing research has shown such strong similarities between naïve and imposed mindset orientations (Dweck & Leggett, 1988; Yeager & Walton, 2011), it is crucial that the influence of mindset orientation on performance in the face of desirable difficulties be investigated across both naïve and imposed mindset groups.

This current investigation presents yet another opportunity to assess task factors that may affect the influences of mindset on performance. Metacognitive awareness of the effects of desirable difficulties has been shown to improve performance, indicating that consideration of metacognitive awareness as a task factor is both warranted and critical (Bjork, deWinstanley & Storm, 2007; deWinstanley & Bjork, 2004). By introducing metacognitive feedback regarding the task in a way that can be used immediately, awareness of the benefits of failure may become readily apparent to participants, and thereby reduce the fear-of-failure responses observed in fixed mindset individuals. This feedback may help enhance the beneficial effects of desirable difficulties in individuals who characteristically disengage from error-prone situations. If metacognitive feedback regarding the relationship between early failure and later success in a desirable difficulties paradigm leads to improved performance and engagement across fixed-mindset individuals, the Strategic Mindset Model would be further supported. Since fear-of-failure responses may be shown to be selectively and strategically minimized to facilitate performance on the task, such findings would further emphasize the importance of accounting for task factors when considering the influences of naïve and imposed mindsets on performance and engagement. Finally, these findings will provide a critical commentary regarding the lack of emphasis placed on motivation and engagement in traditional cognitive research.

Strategic Shifts in Mindset. As was described earlier, the majority of extant work on manipulating mindsets uses a priming paradigm or extensive intervention to encourage participants to adopt a targeted mindset (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 2000; Dweck, 2006; Dweck et al., 2004; Yeager & Dweck, 2012). However, in naturalistic settings, naïve mindsets tend to arise due to an individual's response to feedback regarding performance (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Roeser et al., 1996). This suggests that a bottom-up approach to manipulating mindset orientations is both possible and more representative of the organic mindset shift process than using top-down techniques. In educational settings, these organic, bottom-up mindset shifts have been observed repeatedly. However, the timescale for such shifts is much lengthier than is common in experimental settings, thereby resulting in more exposure to the subtle cues that provoke revaluation of mindset (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Roeser et al., 1996). Although Mindset Theory does not explicitly argue against the possibility of top-down influences of mindset shift, it does not definitively account for the possibility of bottom-up influences. In contrast, the Strategic Mindset Model argues that utilizing bottom-up processes to shift mindsets can be effective. Given the success of top-down experimental manipulation of mindsets over a brief period of time, it is reasonable to predict that a bottom-up manipulation of mindset can be exacted with similar ease.

Further, because mindset shifts may be highly influenced by performance feedback, there are circumstances in which adopting a fixed mindset may be more suitable than a growth mindset. Although Mindset Theory repeatedly suggests that growth mindsets are always preferred to fixed mindsets (see Dweck, 2006 for review), there are circumstances where strategic disengagement from a task leads to more favorable outcomes than simple persistence. A growth mindset may be most beneficial in the preliminary stages of learning a new skill in order to avoid disengagement. However, a fixed mindset may provide a clearer opportunity for cost-benefit analyses of engagement when the stakes of performance outcomes are high (Midgley et al., 2001). In cases where a task is easy, fixed mindset-type behavior has been shown to be adaptive (Elliot & Church, 1997; Midgley et al., 2001). In situations where the stakes of the task are high and the feedback suggests repeated poor performance, individuals should strategically adopt a fixed mindset and opt to disengage from the task in order to curb future losses. For example, repeated engagement with an unsolvable puzzle may lead to a proliferation of potential strategies, but will never result in task success regardless of the intensity of one's commitment to persistence (DeCaro et al., 2015). Thus, displaying characteristics of a fixed mindset may be beneficial in some circumstances, challenging the canonical Mindset Theory point that growth mindsets are always best for performance. Such demonstration of a task-induced strategic shift in mindset would provide support for the Strategic Mindset Model by plainly showing that task factors including high levels of difficulty and substantial consequences for poor performance will interact with feedback to engender a strategic decision to change mindsets.

Mindset Theory is the major theoretical approach driving previous studies. However, the effectiveness of mindset imposition has not been sufficiently evaluated. To date, experimental studies utilizing Mindset Theory are merely focused on demonstrating the benefits of imposing growth mindsets to improve performance (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 2000; Dweck, 2006; Dweck et al., 2004; Yeager & Dweck, 2012). Similarly, there has been no systematic assessment of the potential carryover of fear-of-failure responses from naïve fixed mindsets to imposed growth mindsets. This leaves a gap in the literature that is commonly misinterpreted as a positive effect, which suggests that extensive interventions are required in order for imposed growth mindsets to overwrite existing naïve mindsets in entirety. In support of Mindset Theory, ERP evidence has demonstrated clear differences in attentional responses to feedback regarding failure and learning, demonstrating that there is an identifiable neural component to naïve mindset orientation (Mangels et al., 2006).

However, the Strategic Mindset Model counters this with recent findings demonstrating that mere suggestion of a mindset-specific goal is sufficient to reap performance benefits of a growth mindset (Goodman & Seymour, under review). Thus, additional investigation is necessary to determine the depth of the effect of imposing mindsets rather than merely accepting the findings that show positive effects of imposing growth mindsets at face value. The presence of characteristic failure responses in fixed mindset-imposed individuals and elimination of fear of failure in growth mindset-imposed groups would provide strong support for the Strategic Mindset Model. If carryover effects are eliminated, it is likely that the shift in mindset by way of suggestion is not merely a surface-level performance facilitator, but rather a rapid remapping of one's motivational frame of reference, providing further support for the Strategic Mindset Model. However, if carryover effects from naïve mindsets exist, the suggestion that imposing mindsets require more extensive interventions and cannot be strategically and temporarily shifted for the task at hand (Dweck, 2006) can be confirmed.

Clearly, there are several possible consequences of manipulating mindset orientation that have yet to be evaluated. Given the existing implications of this area of research in education, work environments, and situations where performance-bound tasks are central, it is important to understand the full extent of the effects of shifting mindsets. Despite the many studies that suggest mindsets can be changed, the existing work comparing naive fixed and growth mindsets takes on an overly entity-oriented tone, implying that the shift from one mindset to another may not be authentic without lengthy or in-depth intervention (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 2000; Dweck, 2006; Dweck et al., 2004; Yeager & Dweck, 2012). By determining the depth, breadth and legitimacy of the assignment of mindsets through the proposed experiment, we can begin to endorse a less deterministic approach to alternate mindset adoption, and therefore provide evidence for the alternative Strategic Mindset Model. Because the extent of the effects of imposed mindset on performance have yet to be determined, clarifying these limits can help move social scientists, educators, coaches, supervisors, and other overseers of performers toward a set of best practices for the use of mindset suggestion techniques. Ultimately, by identifying the limits of the effective use of mindset manipulation, this practice can then be employed more readily in interventions for individuals who aim to improve performance in a specific domain, rather than being relegated to in-depth intervention as advocated by Mindset Theory (Dweck, 2006; Yeager & Dweck, 2012; Yeager & Walton, 2011). The new model brings to light many of the shortcomings of canonical Mindset Theory, and aims to present a contemporary view of mindset while accounting for task factor effects that can be used strategically to improve performance and engagement.

Experiment 1: Self-Set Goals and Imposed Mindset Framing

Researchers investigating the effects of mindset orientation on performance use a subset of manipulations to impose alternative mindsets, including in-depth intervention (Aronson et al., 2002; Blackwell et al., 2007; Dweck et al., 2004; Yeager & Dweck. 2012), priming via passage reading (Dweck & Leggett, 1988) and suggestion of orientation shift through goal framing (Goodman & Seymour, under review). However, in such studies assessing the relationship between mindset orientation and performance, expectations for performance are exclusively communicated as assigned or imposed goals. Imposed goals affect performance, engagement and related factors differently than self-set goals (Locke et al., 1981; Locke et al., 1984a; Locke et al., 1984b). Existing research shows that self-set goals lead to worse performance than goals provided by an outside assigner, likely due to a decreased commitment to achieving the goal. Mindset Theory does not attempt to account for the additional or interactive effects of goals and goal origin. Rather, goals are sometimes imposed, but without regard for the potentially confounding influence that is inadvertently introduced. Because imposed goal orientation can reliably influence performance, the orientation imposition must be disambiguated from the effects of goal assignment in order to ensure that the effects of one factor are not being facilitated or diminished by the other. In contrast, the Strategic Mindset Model recognizes the importance of goals in performance-bound scenarios, and aims to account for the contributions of assigned and self-set goals as separate factors.

Method

Participants. Participants were 122 students (80 female, 41 male, 1 unreported) at a large public university in California. Participants ranged in age from 18 to 23 (M = 19.53, SD = 1.23). All participants were compensated with course credit for their involvement.

Materials. Participants utilized a dual-task paradigm that administers a pair of visual-motor and auditory-verbal response tasks simultaneously (c.f. Schumacher et al., 2001). The task was presented using an overarching Air Traffic Control theme, whereby participants acted as trainees. The visual-motor task, instructions, and feedback were presented on a ViewSonic VA2702w computer monitor measuring 23.5-inches wide by 13.25-inches high and 27-inches diagonally, with a resolution of 1024 by 768 pixels. Responses were collected using the center row of keys on a Targus AKP10US USB-connected number pad. Numbers were obscured using masking tape. Task stimuli and responses were managed using E-Prime 2.0 stimulus presentation software (Psychology Software Tools, Pittsburgh, PA).

Beliefs about mindset were assessed using the Implicit Theories of Intelligence Questionnaire (Dweck, 2000; Appendix A). The questionnaire contains 8 Likert-rated items regarding individual beliefs about the malleability of intelligence and ability. Beliefs about goal orientation were assessed using the Button, Mathieu and Zajac’s (1996) goal orientation questionnaire (Appendix B). This questionnaire contains 16 Likert-rated items regarding individual tendencies to adopt goals that either emphasize challenge and learning or performance and demonstrations of competence.

Air Traffic Control Task. The visual-motor air traffic control task consisted of a single visual stimulus, an image of an airplane, presented randomly at one of four locations centered horizontally across the computer screen (Figure 1). The stimulus remained on the screen until the participant made a response by pressing a button on the number pad.

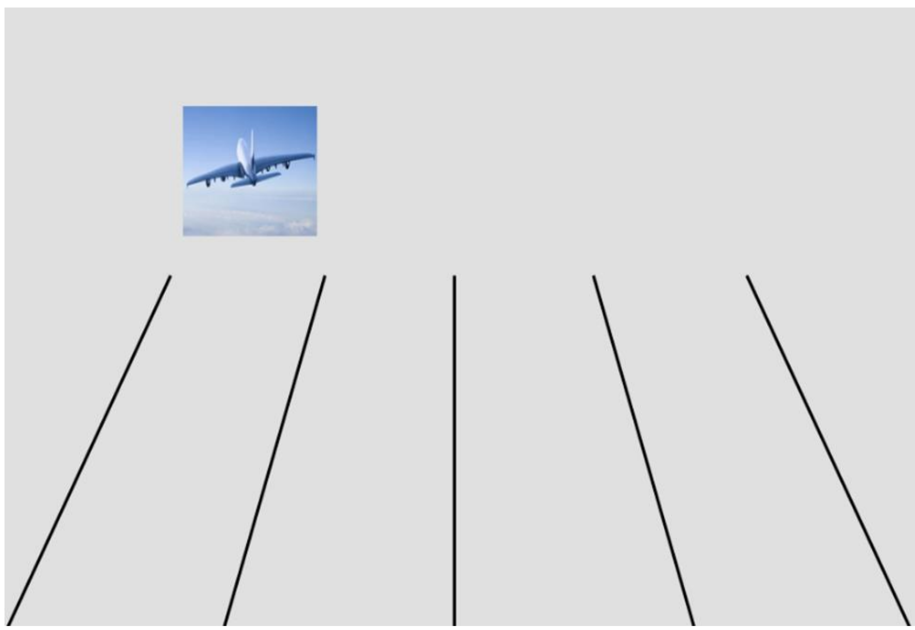


Figure 1. Air Traffic Control Paradigm. Participants were instructed to use the keypad to select the appropriate runway depending on the position of the airplane.

Participants were told that each button corresponded to one of the four runways presented on the lower half of the stimulus screen. Response mappings were incongruent and incompatible with the stimulus locations, such that the stimuli, from left to right, were mapped to the ring, index, little and middle fingers respectively (Figure 2). Participants were told that their job was to land the plane on the correct runway by making the appropriate response to the location of the stimulus. Stimulus presentation delays varied randomly from 200 to 800 milliseconds to prevent rhythmic or anticipatory responses.

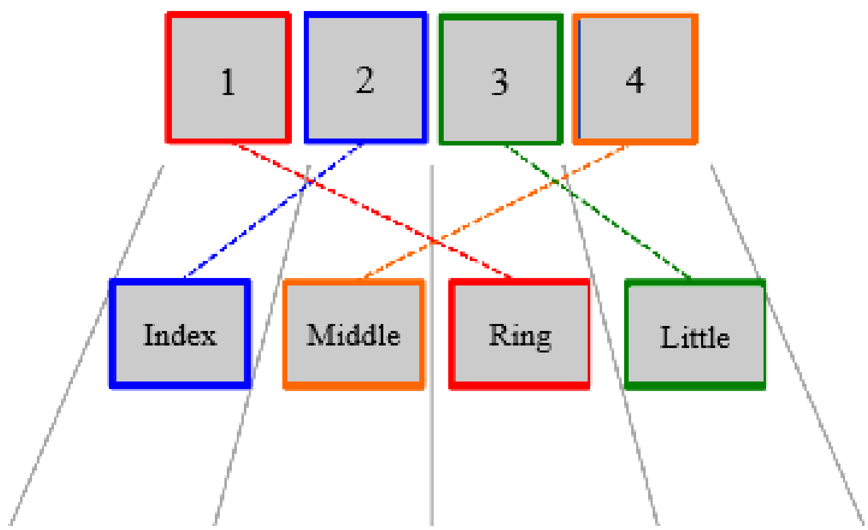


Figure 2. Stimulus-response mappings for the Air Traffic Control task. These mappings are non-intuitive. Participants were given step-by-step instructions regarding these mappings prior to each practice block.

Digit Task. Participants were trained on a secondary task that required auditory monitoring of a continuous digit stream. Digits, ranging from one to nine, were read by a computerized male voice at a rate of one digit per 1500 milliseconds. Participants were told that their job was to monitor the air traffic control radio, and detect and report specific patterns of vectors. Participants were asked to listen to the entire digit stream, and report the number of instances in which three consecutive odd digits were heard. At the end of each block, participants verbally reported the number of instances to the researcher. Correct responses could range from “one” to “four” (Figure 3).

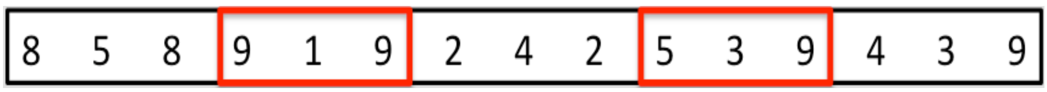


Figure 3. Visual representation of auditory stimulus. Participants heard these numbers aloud and were asked to keep track of the number of instances in which three consecutive odd digits were presented. The correct response for this digit stream is “two”; the two sets of three odd digits are outlined in red.

Procedure. This multi-phase experiment includes a pre-task self-report questionnaire, Air Traffic Control task instructions and practice, Digit Task instructions and practice, combined task practice, test blocks, and a post-task questionnaire.

Pre-Task Questionnaire. Participants were first asked to rate their level of agreement to all 24 Likert-type items to assess naive mindset and naive goal orientation. All questions were presented on the monitor with response options presented in a horizontal array across the bottom of the screen. Participants used the mouse to select their response for the question, then clicked an additional button to advance to the next question. The order of the questions was randomized between participants. Upon conclusion of the self-report portion of the experiment, participants were moved into the training portion of the air traffic control task.

Air Traffic Control Practice. A representation of the air traffic control task is shown in Figure 4.

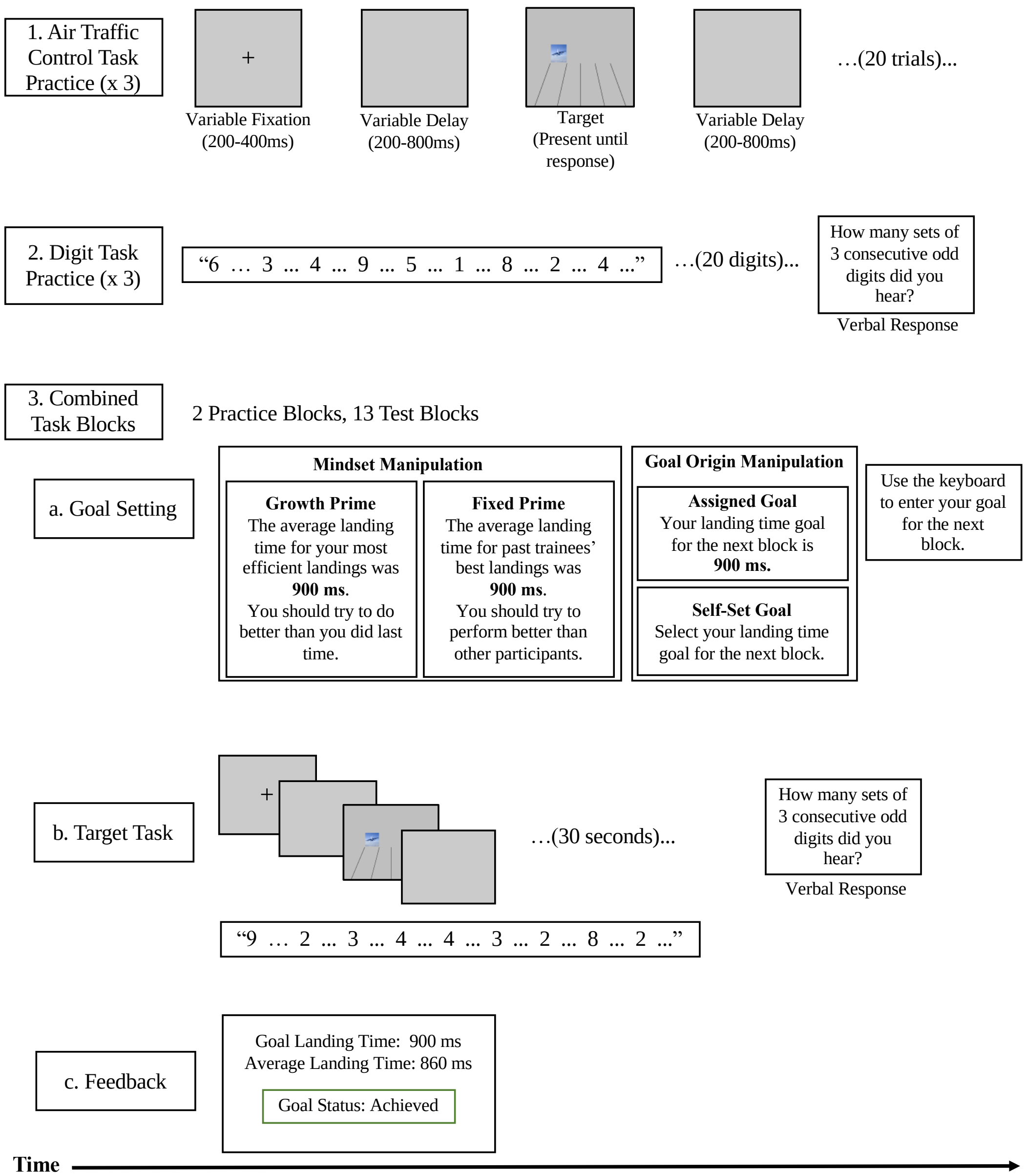


Figure 4. Diagram representation of the Air Traffic Control task.

Participants were provided with instructions explaining that they would be engaging in an Air Traffic Controller training session. The Air Traffic Control task was described as reported previously, and participants used the number pad to practice each of the four mappings shown in Figure 2. Participants engaged in three blocks of Air Traffic Control task practice, during which they used the number pad to select their response for each stimulus (Figure 4, Step 1). During each trial, participants saw a fixation cross for a variable amount of time, followed by a variable stimulus delay. The target location was randomly selected and presented until the participant selected a response using the number pad. This was followed by another variable stimulus delay of 200-800ms. Participants engaged in three blocks of 20 primary task-only trials. Following each block, participants received feedback regarding the total number of correct responses, or plane landings, as well as their average response time (RT).

Digit Task Practice. After three blocks of Air Traffic Control practice, participants were presented with the Digit Task, as described above (Figure 4, Step 2). Participants listened to a stream of 20 digits read by a computerized male voice. At the conclusion of the digit stream, participants saw a screen that asked them to report the number of sets of 3 consecutive odd digits they detected. Participants responded verbally to the researcher, and the researcher entered the response. Once the response was entered, participants were presented with a feedback screen indicating their accuracy as well as the correct response. After three blocks of Digit Task practice, participants moved into the Combined Task Phase.

Combined Task Phase. After completing both the Air Traffic Control and Digit Task training sessions, participants engaged in combined task blocks. In these combined task blocks, participants were first presented with a goal screen that introduced both the imposed mindset manipulation and the goal origin manipulation (Figure 4, Step 3a), followed by a block of combined task trials (Figure 4, Step 3b), and concluding with a feedback screen (Figure 4, Step 3c).

Imposed Mindset Assignment. Participants were assigned to one of two imposed mindset conditions, growth or fixed Mindset. Assignment was counterbalanced. In the Growth Mindset condition, self-improvement was emphasized by providing participants with the following goal: *Your goal is to land planes faster than you did last time. The average landing time for your most efficient landings was [ms] milliseconds. Try to improve your average landing time!* In the Fixed Mindset condition, competition against other Air Traffic Controller trainees was emphasized by providing a goal framed in the following terms: *Your goal is to land planes faster than previous trainees. On this block, past trainees' average landing time was [ms] milliseconds. Be faster than the past trainees!*

Goal Origin Assignment. Participants were also assigned to one of two goal origin conditions, assigned or self-set. Condition assignment was counterbalanced. In the assigned goal condition, participants were provided with new goal values for each task block. These values were determined by calculating the 25th percentile of the participant's response times for the preceding block when rank-ordered from fastest to slowest. Thus, each goal was presented as an attainable challenge based on the participant's past performance, and was individually tailored to the individual's ability level while remaining structurally constant across participants. In the self-set goal condition, participants were provided with this same benchmark as a reference point, but were asked to select their own RT goal for the next block. All participants were asked to use the keyboard to enter their goals on the goal-setting screen prior to starting the next block of trials regardless of whether the goal was assigned or self-set.

Combined Task Block. After entering the goal information, participants were presented with a combined task block. The Digit Task began simultaneously, as the stimuli for the Air Traffic Control task were presented as described previously. Participants engaged in both tasks simultaneously until the auditory stimulus for the Digit Task was complete (Figure 4, Step 3b). At the end of the auditory stream, they were shown a screen requesting a report of their response for the auditory task. Participants responded verbally to the researcher, who recorded the response.

Block Feedback. Following each block, participants were shown a feedback screen specifying average RT and accuracy for the Air Traffic Control task. They were permitted to observe the feedback screen for as long as they wished. After the feedback screen, participants were again shown the goal screen for the next block with new goal values reflective of their most recent performance. Participants completed 2 blocks of practice, followed by 13 test blocks.

Post-Task Questionnaire. At the conclusion of the dual task paradigm, participants were asked to respond again to the self-report questions presented at the beginning of the task. They again used the mouse to select their response, and then clicked an additional button to advance to the next question screen. Question order was randomized across participants.

Measures. Task performance was quantified as a measure of average RT improvement for each trial block. This RT improvement measure is simply the difference between the average RT for a given trial block and the average RT across the second and third practice blocks. Large positive RT improvement values indicate that participants are getting faster when executing motor responses. Performance slope was measured as the arithmetic change in RT improvement over the course of the 13 valid trial blocks. Goal achievement likelihood was computed as the percentage of RT goals successfully met or surpassed over the course of the test blocks. Task accuracy was quantified as the total number of correct responses per block. Naive mindset bias was quantified as the difference between the average agreement ratings for fixed mindset and growth mindset questions on the Theories of Intelligence assessment. Naive mindset category was then determined using a median split of the resultant values. Scores falling below the median were classified as fixed mindset-oriented, and those above the median were considered growth-oriented. Naive goal orientation bias and naive goal orientation category were determined via the same method, and utilized self-report responses from Button and colleagues' (1996) goal orientation assessment.

Hypotheses

In accordance with predictions from the Strategic Mindset Model, it was expected that self-set goals will affect performance differently than assigned goals, thus demonstrating the importance of accounting for goals as task factors. In particular, participants in the assigned-goal condition will have a higher likelihood of goal achievement than participants in the self-set goal condition. This prediction stems from Locke and colleagues (1981, 1984a, 1984b), who have suggested that assigned goals impose a greater sense of commitment and a higher likelihood of achievement than self-set goals. Further, we expected to find an interaction between mindset and goal assignment, such that participants in the fixed mindset condition will demonstrate a larger performance difference between the self-set and assigned goal conditions than participants in the growth mindset condition. Because a central characteristic of fixed mindset is the demonstration of competence, it was expected that participants assigned to this mindset will attempt to demonstrate better performance when a goal is assigned by an outside party rather than in cases where it is self-set. Finally, based on previous findings in the motivation and performance literatures (Dweck & Leggett, 1988; Goodman & Seymour, under review; Licht & Dweck, 1984; Mueller & Dweck, 1998), it was expected that participants assigned to growth framing will select more challenging goals in terms of RT and accuracy when compared to participants assigned to the fixed mindset condition. To that same end, participants in the fixed mindset condition were expected to self-assign smaller or less challenging goals to ensure achievement and demonstration of competence.

Results

All analyses were conducted using $p < .05$ as the level of statistical significance. Effect sizes for statistically significant main effects are presented using Cohen's *d*, and effect sizes for statistically significant interactions are described using η^2.

Task Performance. A 2 x 2 between-subjects Analysis of Variance (ANOVA) was used to analyze the influence of goal origin (assigned vs. self-set) and imposed mindset (fixed vs. growth) on RT improvement (Figure 5).

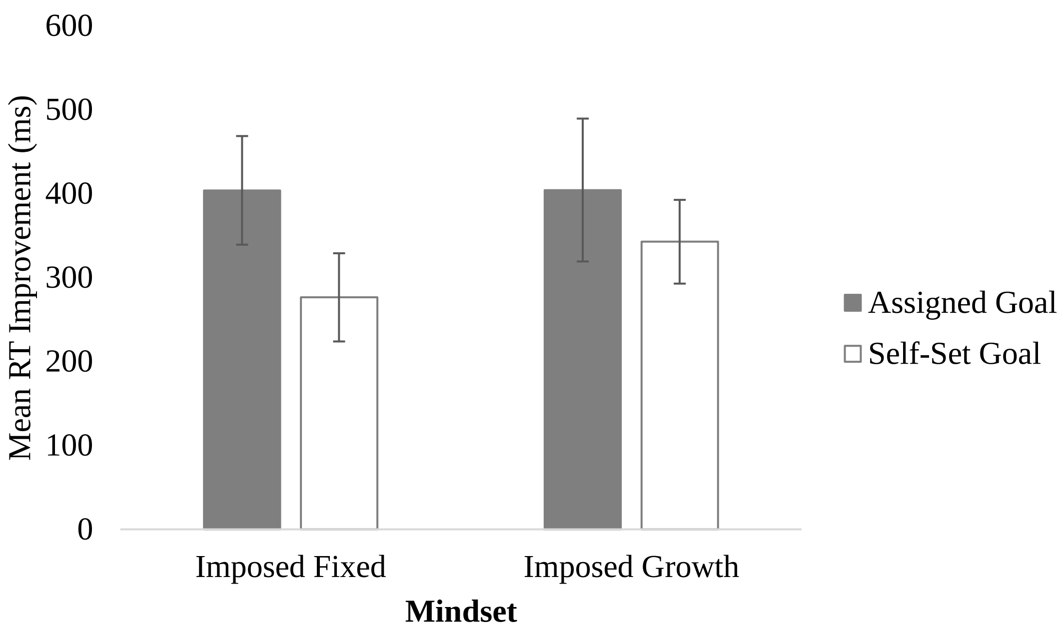


Figure 5. Mean RT improvement (ms) by imposed mindset and goal origin.

Goal origin did not lead to a difference in average RT improvement during the task, $F(1,118) = 2.08$, $p = .15$, suggesting that that the specific values presented in this goal setting process do not have any measurable influence on task performance. Mindset framing did not invoke differences in RT either, $F(1,118) = 0.26$, $p = .61$, indicating that goals that are crafted to emphasize the demonstration of competence do not yield meaningful performance differences compared to goals that emphasize growth and self-improvement.

A 2 x 2 between-subjects ANOVA was also used to analyze the influence of goal origin (assigned vs. self-set) and imposed mindset (fixed vs. growth) on the average number of accurate motor responses per block (Figure 6). Goal origin did not contribute to a difference in average number of accurate motor responses, $F(1,118) = .47$, $p = .49$. Average accuracy did not differ across imposed mindset groups, $F(1,118) = 1.70$, $p = .19$.

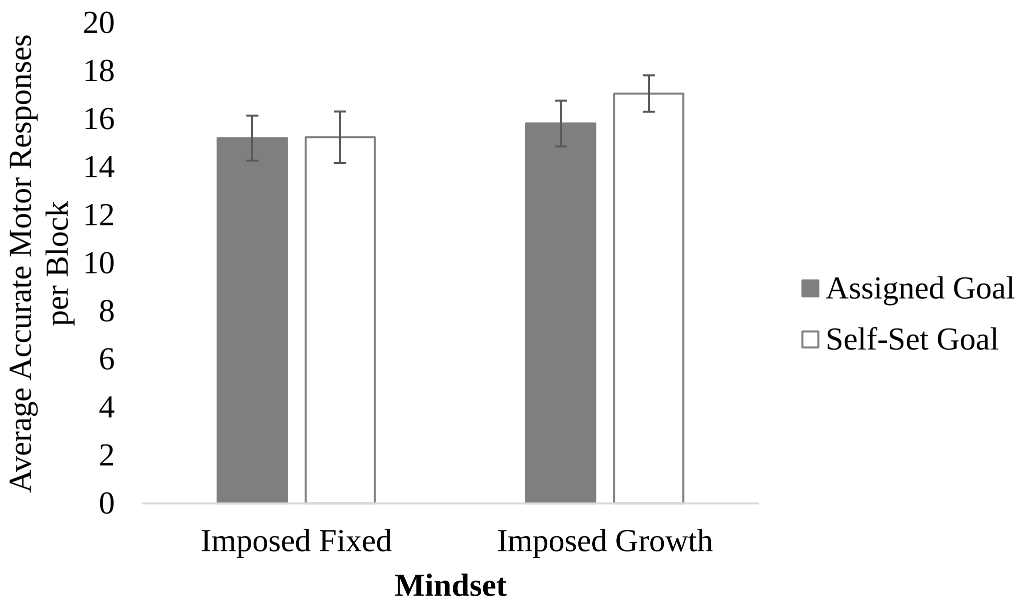


Figure 6. Mean accurate motor responses per block by imposed mindset and goal origin.

Goal Setting. A 2 x 2 between-subjects ANOVA was used to analyze the influence of goal origin (assigned vs. self-set) and imposed mindset (fixed vs. growth) on the average goal RT established at the start of each block (Figure 7). Participants who set their own goals produced significantly slower goal times (M = 1122.81, SD = 1077.25) than the assigned, computer-generated standard (M = 778.49, SD = 316.58), $F(1,118) = 5.76$, $p = .02$, $d = 0.43$. Contrary to our hypothesis, the average magnitude of goals did not differ across imposed mindset framing, $F(1,118) = 0.07$, $p = .80$.

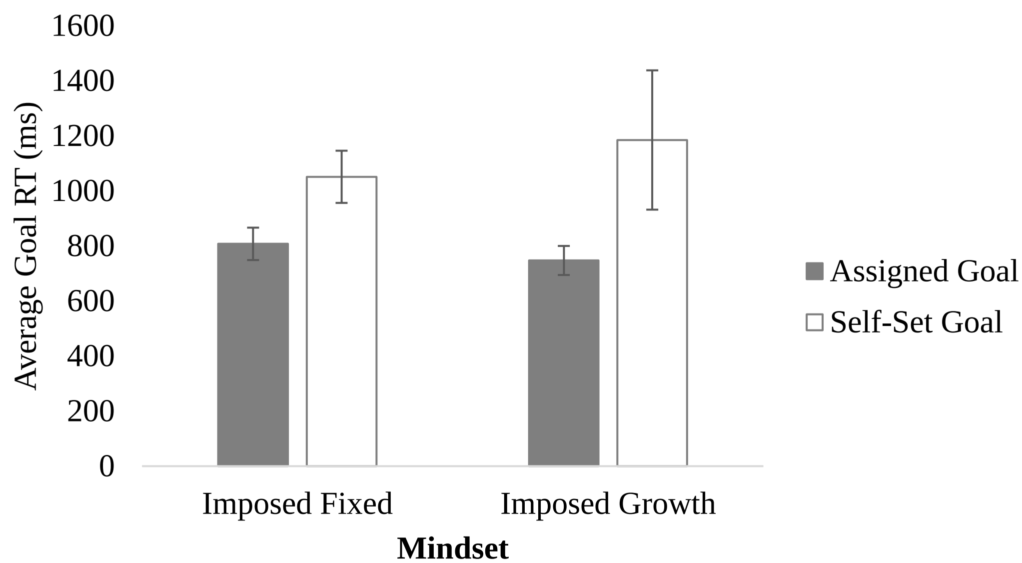


Figure 7. Mean goal RTs per block by imposed mindset and goal origin.

An additional 2 x 2 between-subjects ANOVA was used to analyze the influence of goal origin (assigned vs. self-set) and imposed mindset (fixed vs. growth) on total number of goals achieved during the task (Figure 8). Participants who received assigned goals achieved significantly fewer goals (*M* = 2.23, *SD* = 1.32) than participants who set their own goals (*M* = 6.76, *SD* = 2.69), *F*(1, 118) = 143.71, *p* < .001, *d* = 2.14. Imposed mindset had no effect on goal achievement, *F*(1, 118) = 1.11, *p* = .29. Participants receiving fixed mindset priming achieved the same number of goals (*M* = 4.47, *SD* = 3.12) as participants receiving growth mindset priming (*M* = 4.31, *SD* = 3.05).

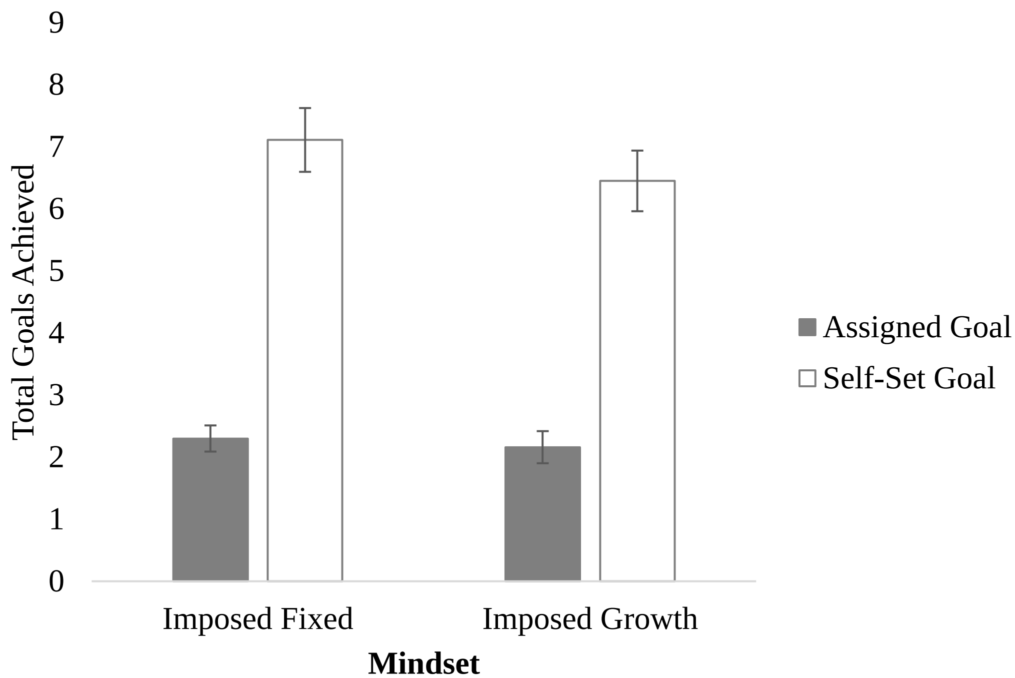


Figure 8. Mean total goals achieved by imposed mindset and goal origin.

A one-sample t-test indicates that the size of the difference between self-set goal RTs and actual task RTs (*M* = -155.02, *SD* = 947.10) was not significantly different from 0, indicating that self-generated goals were typically set near the participant's expected performance level, rather than being used as a source of challenge, $t(57) = -1.25$, $p = .22$, 95% CI [-404.05, 94.01].

Naive Mindset Effects. A 2 x 2 between-subjects ANOVA was used to analyze the influence of goal origin (assigned vs. self-set) and naive mindset (fixed vs. growth) on the average RT improvement (Figure 9). Participants' independently-held beliefs about mindset interacted with goal origin to influence performance, $F(1,118) = 4.76$, $p = .03$, $\eta^2 = .02$. Individuals subscribing to inherent growth mindsets showed greater RT improvement in the face of assigned goals ($M = 500.17$, $SD = 458.73$) than participants who set their own goals ($M = 269.67$, $SD = 261.59$). These growth-oriented participants who received assigned goals also outperformed participants reporting fixed mindsets. Participants who report fixed mindset orientations were not differentially influenced by the self-set ($M = 351.16$, $SD = 286.09$) or assigned goals ($M = 301.80$, $SD = 355.93$). RT improvement was not significantly influenced by goal origin, $F(1,118) = 1.994$, $p = .16$, or naive mindset alone, $F(1,118) = 0.830$, $p = .36$.

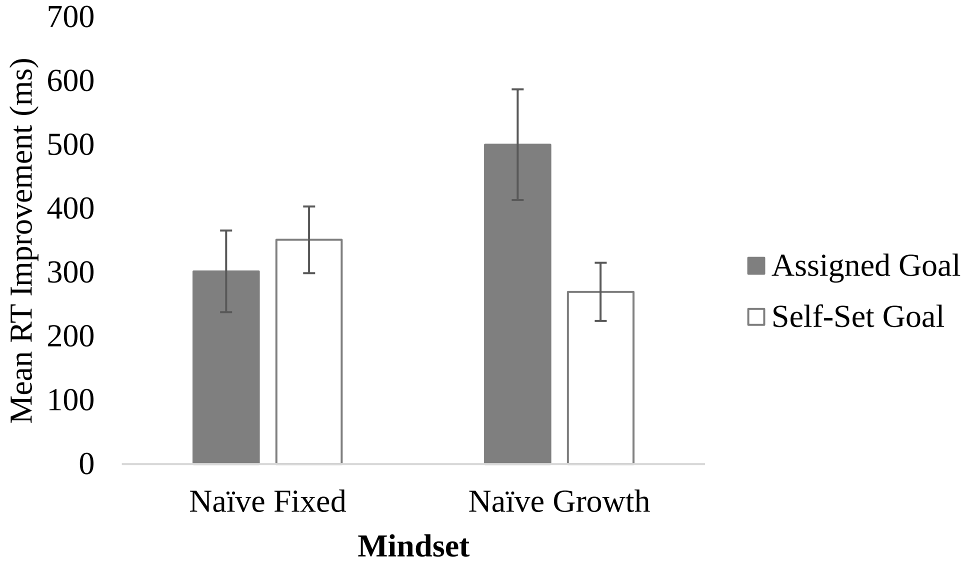


Figure 9. Mean RT improvement (ms) per block by naive mindset and goal assignment.

Two 2 x 2 between subjects ANOVA were used to compare goal RT and achievement counts across origin (assigned vs. self-set) and naive mindset (fixed vs. growth). As noted previously, participants who set their own goals selected significantly slower target RTs than participants who were assigned goals, $F(1,118) = 5.78$, $p = .018$, $d = 0.43$, and achieved significantly more goals than participants who received assigned goals, $F(1,118) = 141.36$, $p < .001$, $d = 2.14$. Neither goal RT, $F(1,118) = 1.21$, $p = .27$, nor goal achievement count, $F(1,118) = 1.30$, $p = .26$, was influenced by naive mindset.

Goal Orientation. A 2 x 2 between-subjects ANOVA was used to analyze the influence of goal origin (assigned vs. self-set) and naive goal orientation (performance vs. learning) on the average RT improvement (Figure 10).

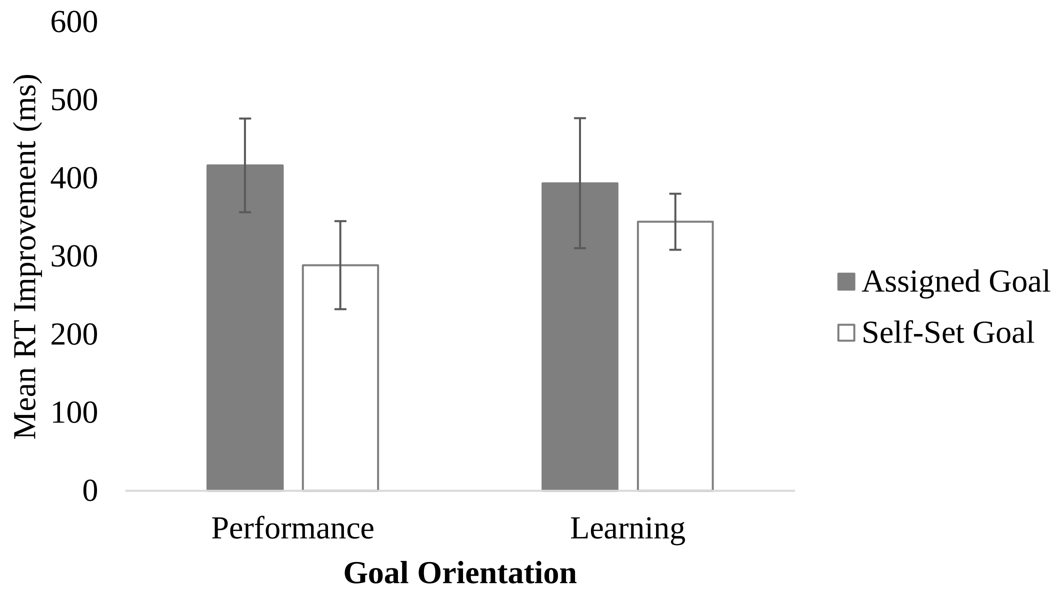


Figure 10. Mean RT improvement by naive goal orientation and goal origin.

RT improvement did not differ between participants who reported subscribing to performance-oriented goals (*M* = 347.62, *SD* = 329.65) and participants who report subscribing to learning-oriented goals (*M* = 373.67, *SD* = 393.52), $F(1,118) = 0.06$, $p = .81$. As previously reported, participants who received assigned goals did not perform differently than participants who set their own goals, $F(1,118) = 1.79$, $p = .18$.

A 2 x 2 between subjects ANOVA compared goal RTs across goal origin (assigned vs. self-set) and naive goal orientation (performance vs. learning; Figure 11). Confirming previous findings, participants who set their own goals used significantly slower target RTs than participants who received assigned goals, $F(1,118) = 6.20$, $p = .01$, $d = 0.43$. Goal RTs did not differ between naive learning goal orientation (*M* = 970.50, *SD* = 1051.93) and naive performance goal orientation (*M* = 915.66, *SD* = 436.19), *F*(1,118) = 0.49, *p* = .48.

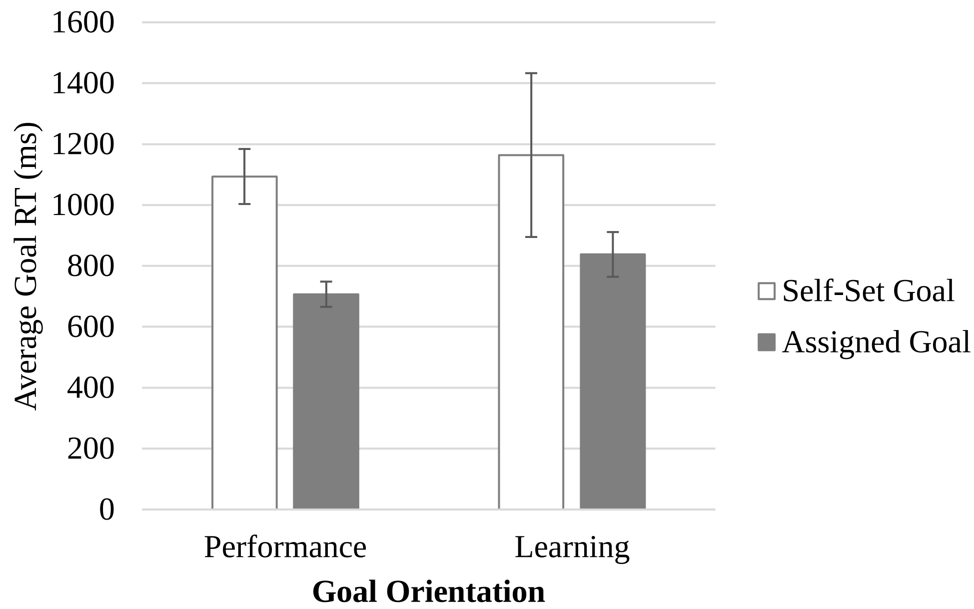


Figure 11. Average goal RT (ms) by goal origin and naive goal orientation.

Despite these comparable goal times across naive goal orientations, goal orientation contributed to a significant difference in goal achievement (Figure 12). A 2 x 2 between-subjects ANOVA assessed differences in goal achievement counts across goal origin (assigned vs. self-set) and goal orientation (performance vs. learning). Performance-oriented participants achieved more goals throughout the task (*M* = 5.03, *SD* = 3.39) when compared to learning-oriented participants (*M* = 3.69, *SD* = 2.55), *F*(1,118) = 4.24, *p* =.04, *d* = 0.45**.** As observed in previous analyses, participants who set their own goals demonstrated greater achievement than participants who received assigned goals, $F(1,118) = 136.64$, $p < .001$.

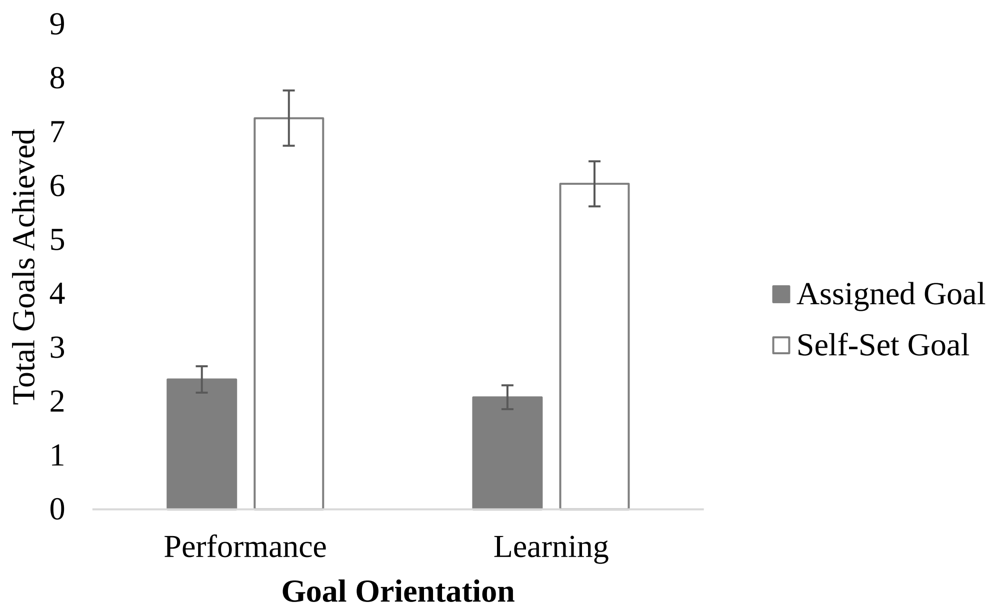


Figure 12. Goal achievement count by goal origin and naive goal orientation.

Changes in Belief. A 2 x 2 mixed-model ANOVA was used to compare changes in self-reported mindset over time (pre-task vs. post-task) and across goal orientation framings (imposed fixed vs. imposed growth; Figure 13). Participants' self-reported endorsements in favor of growth mindsets diminished from pre-task ($M = 2.25$, $SD = 1.93$) to post-task ($M = 2.01$, $SD = 2.10$), $F(1,120) = 6.87$, $p = .01$, $d = 0.12$, such that beliefs regarding the benefits of maintaining a growth mindset weakened. These beliefs were not influenced by the imposed mindset provided through goal framing, $F(1,120) = 3.51$, $p = .06$.

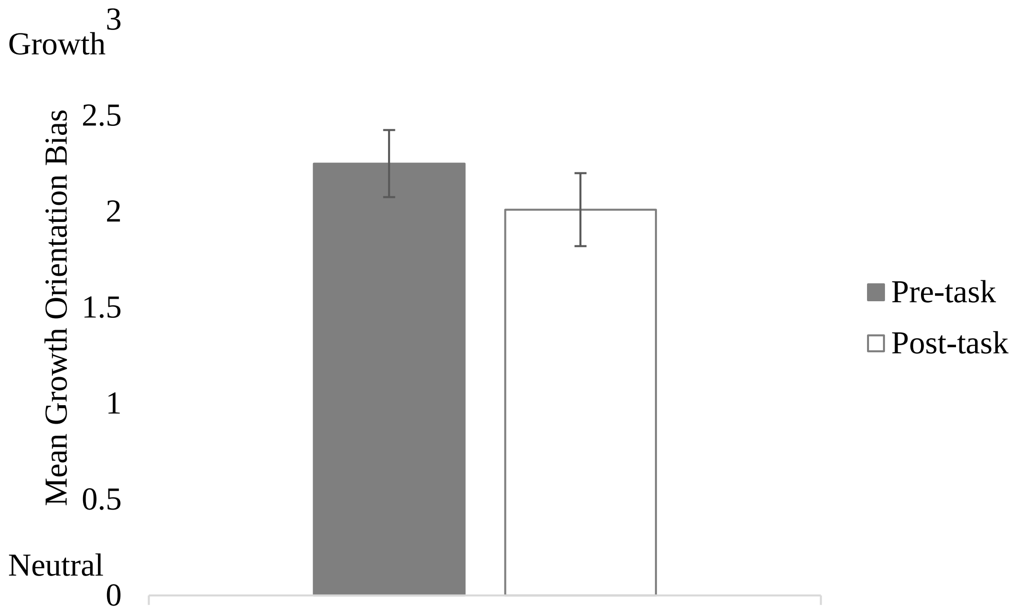


Figure 13. Self-reported bias toward growth mindset orientation during pre-task and post-task questionnaires.

An additional 2 x 2 mixed-model ANOVA analyzed changes in self-reported goal orientation over time (pre-task vs. post-task) and across goal orientation framings (imposed fixed vs. imposed growth). Self-reported beliefs about goal orientation did not change over time, $F(1,120) = 0.69$, $p = .41$, or across goal framing, $F(1,120) = 0.915$, $p = .34$.

Discussion

Overall, task performance is not affected by the origin of one's goals (i.e. self-set or assigned). Participants who were provided with assigned goals, as is commonplace in many educational and research-based settings, performed no differently than those who were permitted to set their own performance benchmarks.

In stark contrast to existing research surrounding the influence of goal difficulty on performance outcomes, participants in this task performed consistently across goal groups despite a large difference in goal difficulty. Participants who set their own goals opted for goals that were significantly more lenient than those that were automatically assigned by the task despite being presented with the same feedback content. When setting their own goals, participants tended to select target RTs that were comparable to their average block RTs rather than electing to challenge themselves by setting more difficult goals. In this way, the opportunity to set one's own goals provided an opportunity for participants to guarantee repeated goal achievement, as was evident in the 34.8% success rate difference between self-set and assigned goal conditions. As such, this improvement in goal achievement likely contributes to an increase in motivation and engagement during the task, and potentially contribute to a larger disparity between groups in terms of performance over the course of the task. Interestingly, this strategy and subsequent inflation of success did not alter the slope of performance over the duration of the task. The slope of task improvement over time was not steeper for participants who set their own goals than for those who received goals via the typical assigned method.

The lack of a clear relationship between goal permissiveness, achievement, and overall task performance as driven by the origin of the goal is incongruent with existing literature regarding goal setting. In this experiment, all goals were deliberate and highly specific, characteristics which Locke, Latham, and others argue are necessary to reap the performance benefits of goal setting (Locke & Latham, 2006;

Locke et al., 1984a; Locke et al., 1984b). However, participants in the current experiment did not readily benefit from the increased likelihood of goal achievement. Given these new findings, it can be argued that specific RT values associated with performance benchmarks may not significantly influence performance. Rather, the mere presence of a specific achievement target may be sufficient to elicit this goal-directed performance benefit.

Performance is not easily influenced by assigned mindset through goal framing. Attempting to impose mindset orientation by deliberate framing of goals has no effect on average improvement in RT, nor does it influence the magnitude of self-set goals. However, participants who were exposed to a fixed mindset orientation over the course of the task showed a marginal improvement in the slope of average RT improvement. This modest gain is indicative of a small shift in performance outcomes as a result of imposed mindset despite the lack of overarching mean differences in task performance. It is possible that extended exposure to different mindsets via goal framing, beyond the level shown in this experiment, may produce measurable differences in other performance outcomes.

Regardless of the imposed mindset manipulation a given participant received, individual participants' preexisting beliefs regarding the nature of intelligence clearly interact with goal origin to affect task improvement. RT improvement is markedly better when individuals subscribing to a growth orientation receive assigned goals. These individuals showed an average task improvement of more than 110 ms when compared to growth-oriented participants who were permitted to set their own goals.

Contrary to our original predictions, the combination of growth-oriented beliefs and assigned goals produces a synergistic effect that may potentially be driven by willingness to accept a challenge in the form of increased goal difficulty. When naive growth mindset is paired with the opportunity to set one's own goals, performance improvements are identical to those produced by individuals reporting fixed mindsets. Given this contrast, in cases of growth mindset, the hallmark quality of resilience may not necessarily be derived from a desire to approach challenge, but may instead be a matter of challenge receptivity. This distinction is subtle, yet critical, particularly due to the widespread popularity, public promotion, and suggested cultivation of growth mindset (Dweck, 2000; Dweck, 2006; Yeager & Dweck, 2012; Yeager & Walton, 2011). In attempting to cultivate a growth mindset, interventionists may be less likely to detect meaningful change in motivation and engagement if the target task requires an individual to deliberately select a challenging set of circumstances, rather than if the task simply assesses engagement and investment in a difficult task. This interaction between naive mindset and goal origin emphasizes one major tenet of the Strategic Mindset Model: that the relationship between mindset and performance-based outcomes must be considered in conjunction with task parameters and other influences. In this case, these findings demonstrate that mindset is related to differential performance in a specific subset of circumstances.

In addition to the maintenance of a set of beliefs regarding mindset, individuals can be categorized based on their goal orientation tendencies. Individuals who report a strong preference for completing familiar tasks and for demonstrating competence can be classified as maintaining a performance orientation, whereas people who report a desire to learn new tasks and expand their abilities by challenging themselves are classified as learning-oriented (Dweck & Leggett, 1988; Heyman & Dweck, 1992; Licht & Dweck, 1984). Over the course of the current task, participants who self-identified as being performance-oriented were more likely to achieve their goals than participants who reported a learning goal orientation. It is likely that participants who maintain a performance orientation are regulating their motivation and effort to ensure goal achievement, whereas participants who maintain learning orientations are less concerned with outward displays of ability and instead regulate their efforts toward overall task improvement.

In contrast with existing Mindset Theory research, the current experiment suggests that mindset can be shifted over a short period of time as a result of experience with a task. Participants reported significantly lower growth mindset-endorsing beliefs at the conclusion of the experiment than at the start. Some previous research suggests that such bottom-up shifts are possible, and have been observed in classroom settings (Anderman & Anderman, 1999; Anderman & Midgley, 1997). However, the current findings demonstrate that a change in beliefs about intelligence and ability can occur in a shorter timeframe. This pattern of self-report suggests that participants' experience in a challenging, error-prone task likely contributes to dampened beliefs regarding the adaptive value of failure, difficulty, and resilience.

In further support of the Strategic Mindset Model, these results clearly show that naive fixed mindset orientation is adaptive for skill acquisition. This is counter to the strong body of literature that heralds the value of growth mindset orientation for learning and task performance. When provided with a goal by an outside assigner, it is possible that competition and demonstrated competence are stronger motivators than the desire to improve on one's own. In the case of skill acquisition for very difficult tasks, it becomes clear that motivation spurred by the drive to exhibit competence is not a downfall, and may ultimately contribute to a long-term improvement in task performance (Elliot & Church, 1997; Midgley et al., 2001).

Experiment 2: Self-Focus and Imposed Mindset Framing

Instructions for tasks in laboratory settings, classrooms, workplaces and other performance-based settings are almost exclusively worded as prescriptive "you"-based statements. Alternatively, self-initiated goal setting and self-talk can take the form of first person "I" statements. Researchers argue that first person goal setting motivates higher degrees of self-focus, which is harmful to performance (Senay et al., 2014). Preliminary comparisons of first- and second person focus show that second person self-talk is beneficial to performance, as it emphasizes focus on the task rather than high degrees of self-focus (Dolcos & Albarracin, 2014). Given the importance of self-awareness in growth and fixed mindset orientation, it is possible that presenting goals in first- or second person wording may moderate the effectiveness of imposed mindset framing. For example, emphasizing the self through the use of "I" in conjunction with a fixed mindset-framed goal may lead to further performance decrements, as both competition with others and self-focus are emphasized.

Alternatively, first- and second person wording may not be differentiable in a growth-oriented framing condition, as the comparison points for improvement are always focused on one's own mastery of the task rather than demonstrating competency. Mindset Theory accounts for the importance of self-efficacy for motivation, which is related to self-focus. However, this canonical approach does not deliberately or exclusively address the effects of self-focus on performance or engagement. As an alternative, the Strategic Mindset Model again allows for the incorporation of task factors, including heightened levels of self-focus, as critical components that interact with mindset to cause changes in performance outcomes. By assessing the combined effects of self-focus through goals and self-focus resulting from mindset, the Strategic Mindset Model can account for substantial variance in performance.

Method

Participants. Participants were 253 students from a large public university (172 female, 76 male, 5 unreported). Participants ranged in age from 18 to 36 years (M = 20.08, SD = 2.34). All participants were compensated with course credit for their participation.

Materials. Participants utilized the same dual-task paradigm described in Experiment 1. This paradigm requires that participants engage in a pair of visual-motor and auditory-verbal response tasks simultaneously (see Schumacher et al., 2001). The task was again presented using an Air Traffic Control trainee theme. The visual-motor task, instructions, and feedback were presented on a ViewSonic VA2702w computer monitor measuring 23.5-inches wide by 13.25-inches high and

27-inches diagonally, with a resolution of 1024 by 768 pixels. Responses were collected using the center row of keys on a Targus AKP10US USB-connected number pad. Numbers were obscured using masking tape. Task stimuli and responses were managed using E-Prime 2.0 stimulus presentation software (Psychology Software Tools, Pittsburgh, PA). As in Experiment 1, participants' beliefs about mindset were assessed using the Theories of Intelligence questionnaire (Dweck, 2000; Appendix A), and beliefs about goal orientation were assessed using Button and colleagues' (1996) goal orientation assessment (Appendix B).

Air Traffic Control Task. In the visual-motor air traffic control task, a single visual stimulus was presented randomly at one of four locations centered horizontally across the computer screen, remaining on the screen until a response was made by pressing a button on the number pad (Figure 1). Participants were told that each button corresponded to one of the four runways presented on the lower half of the stimulus screen. As previously noted, response mappings were incongruent and incompatible with the stimulus locations (Figure 2). Participants were told that their job was to land the plane on the correct runway by making the appropriate response to the location of the stimulus. Stimulus presentation delays varied randomly from 200 to 800 milliseconds to prevent rhythmic or anticipatory responses.

Digit Task. Participants were trained on the auditory-verbal Digit Task, whereby a single digit between one and nine was read by a computerized male voice every 1500 milliseconds. Participants were told that their job was to monitor the air traffic control radio, and detect and report the number of instances in which three consecutive odd digits were heard for each digit stream (Figure 3). At the end of each stream, participants verbally reported the number of instances to the researcher. Correct responses could range from “one” to “four”.

Procedure. As explained regarding Experiment 1, this experiment includes a pre-task self-report questionnaire, Air Traffic Control task instructions and practice, Digit Task instructions and practice, combined task practice, test blocks, and a post-task questionnaire. This experiment utilized a 2 x 3 between subjects factorial design. Participants were assigned to one of two self-talk conditions (first person vs. second person). Participants were also assigned to one of three goal-framed imposed mindset conditions (control, growth mindset, or fixed mindset).

Pre-Task Questionnaire. Participants were first asked to rate their level of agreement to all self-report items to assess naive mindset and naive goal orientation. All questions were randomly ordered, and presented on the monitor with response options presented in a horizontal array across the bottom of the screen. Participants used the mouse to select their response for the question, then clicked an additional button to advance to the next question. Participants then engaged in the training portion of the air traffic control task.

Air Traffic Control Practice. A representation of the air traffic control task is shown in Figure 14.

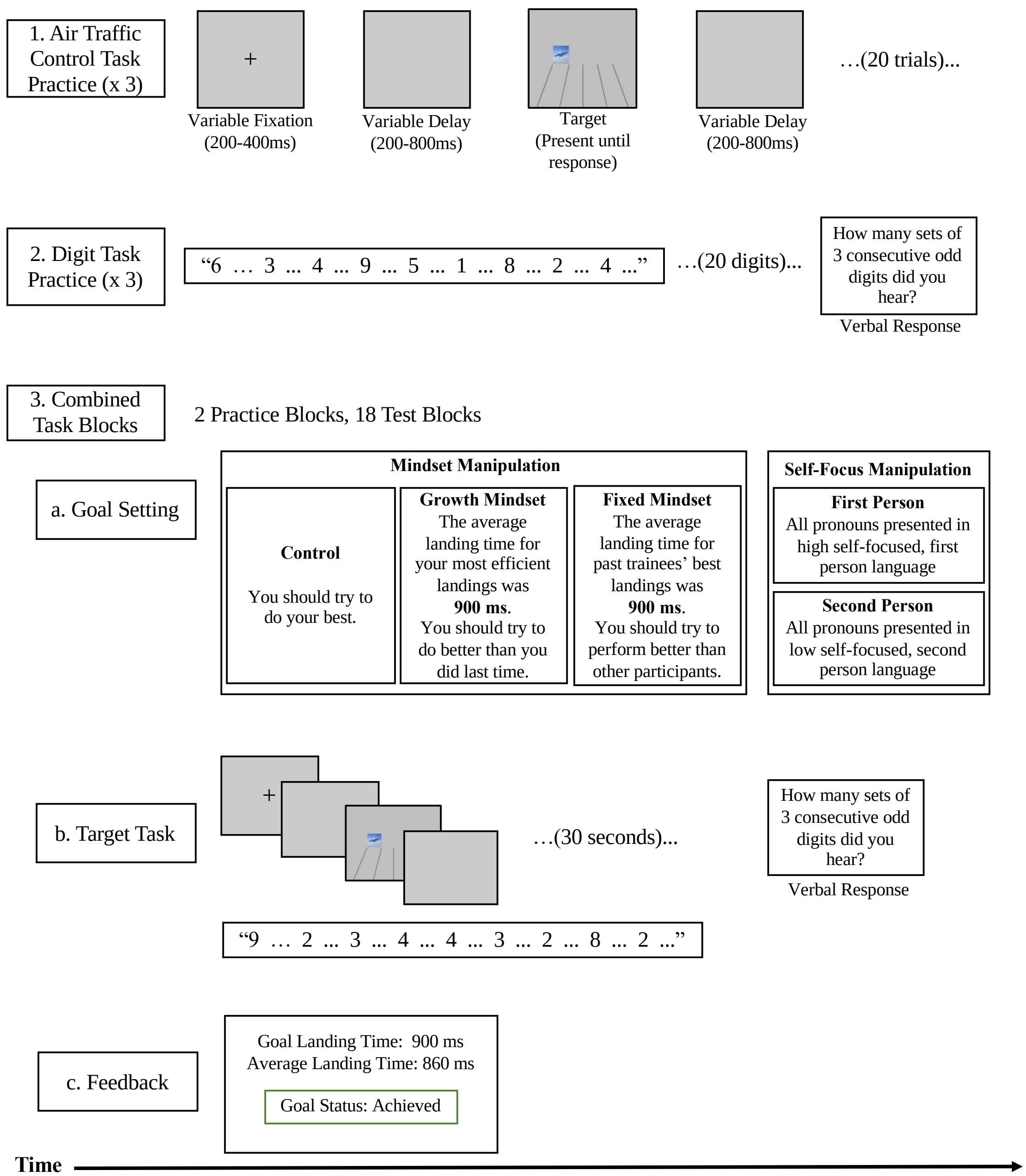


Figure 14. Diagram representation of the Air Traffic Control task.

Participants were provided with instructions explaining the Air Traffic Controller training. The Air Traffic Control task was explained as previously described, and participants used the number pad to practice each of the four mappings shown in Figure 2. In the Air Traffic Control Task practice, a fixation cross appeared for a variable amount of time, and the stimulus was presented in a randomly selected location following a variable stimulus delay (Figure 14, Step 1). The target remained on the screen until the participant selected a response using the number pad. Another variable stimulus delay of 200-800ms occurred, and then a new fixation cross was presented. Participants engaged in three blocks of 20 Air Traffic Control task-only trials. At the conclusion of each block, feedback was presented regarding the total number correct plane landings, as well as average RT.

Digit Task Practice. Participants were then presented with the same Digit Task described in Experiment 1. Participants listened to a stream of 20 digits read by a computerized male voice (Figure 14, Part 2). After all 20 digits were read aloud, participants were presented with a screen that asking them to report the number of sets of 3 consecutive odd digits they detected, which was recorded by the researcher. Participants received immediate feedback on the monitor indicating both their accuracy and the correct response. After three blocks of Digit Task practice, participants began the Combined Task Phase.

Combined Task Phase. After completing both single task trainings, participants engaged in combined task blocks (Figure 14, Part 3). The first screen displayed goal information, and introduced both the imposed mindset manipulation and the self-talk manipulation (Figure 14, Part 3a). Next, participants engaged in a block of combined task trials (Figure 14, Part 3b), and concluded with a feedback screen (Figure 14, Part 3c).

Imposed Mindset Assignment. Participants were assigned to one of three imposed mindset conditions, Do Your Best, Growth, or Fixed Mindset. Assignment was counterbalanced. In the Do Your Best condition, participants were simply asked to perform to the best of their ability. These instructions were described by stating: *Land the planes as quickly and accurately as you can. Do your best!* Participants in the growth mindset condition were given the following goal: *Your goal is to land planes faster than you did last time. The average landing time for your most efficient landings was [n] milliseconds. Try to improve your average landing time!* In the fixed mindset condition, competition was emphasized with the following phrasing: *Your goal is to land planes faster than previous trainees. On this block, past trainees' average landing time was [n] milliseconds. Be faster than the past trainees!*

Self-talk Condition Assignment. Participants were also assigned to one of two self-talk conditions, assigned or self-set. Condition assignment was counterbalanced. In the first person self-talk condition, all pronouns on the goal and feedback screens were presented in first person language (e.g. "I will…", "My goal is…"). In the second person self-talk condition, all pronouns on the goal and feedback screens were presented in second person language (e.g. "You will…", "Your goal is…").

Goal Values. As described in Experiment 1, participants were provided with new goal values for each task block, determined by calculating the 25th percentile of the participant's RTs for the preceding block when rank-ordered from fastest to slowest.

Combined Task Block. After viewing the goal screen, participants engaged in a combined task block. The Digit Task began while the stimuli for the Air Traffic Control task were presented on the screen. Participants engaged in both tasks simultaneously until the auditory stimulus was finished (Figure 14, Part 3b). Participants were shown a screen requesting their response for the Digit Task, which was then entered by the researcher.

Block Feedback. At the end of each block, participants were shown a feedback screen displaying average RT and accuracy for the Air Traffic Control task (Figure 14, Part 3c). Participants viewed the feedback screen for as long as they wished. Participants were shown the goal screen for the next block with new goal values. The participant completed 2 blocks of practice, followed by 18 test blocks.

Post-Task Questionnaire. At the conclusion of the combined task blocks, participants were presented with the same self-report questions shown at the beginning of the task. Participants used the mouse to select their responses. Question order was randomized across participants.

Measures. Task performance was quantified as a measure of average RT improvement for each trial block, calculated as the difference between the average RT for a given trial block and the average RT across the second and third Air Traffic Control practice blocks. Large positive values are indicative of greater task improvement. Performance slope was measured as the arithmetic change in RT improvement over the course of the 18 combined task blocks. Task accuracy was quantified as the total number of correct responses per block. Naive mindset bias and naive goal orientation biases were quantified using the same method described in Experiment 1. A median split was used to assign naive mindset and naive goal orientation category membership to all participants. Scores falling below the median were classified as fixed mindset-oriented or performance-oriented, and those above the median were considered growth-oriented or learning-oriented.

Hypotheses

In accordance with Mindset Theory, participants assigned to a growth mindset were expected to demonstrate better performance on the task than participants assigned to a fixed mindset. Further, participants in both the imposed fixed and imposed growth conditions were predicted to outperform participants in the control condition, as the fixed and goal mindset manipulations are presented in the form of specific, concrete goals rather than a general statement about overall task performance (Locke & Latham, 2006; Locke et al., 1984a; Locke et al., 1984b). In opposition with Mindset Theory and in congruence with the integrative approach of the Strategic Mindset Model, the magnitudes of high and low self-focused language goals for growth mindset-imposed participants were not expected to differ because the growth mindset requires an already heightened sense of self-focus in order to compare current and past performance.

In contrast, first person or high self-focused goals were expected to emphasize the negative performance effects associated with a fixed mindset because of the deep emphasis on demonstration of competence from both mindset and goal assignment sources, again demonstrating a cumulative set of effects that is not accounted for by Mindset Theory. Finally, the imposition of low self-focused goals was expected to dampen the negative performance effects of a fixed mindset by decreasing the self-focus of the assigned goal, resulting in slightly improved performance when compared to the high self-focused fixed mindset group. By demonstrating the interactional nature of mindset and self-focus via goal framing, the limited perspective of Mindset Theory is again challenged, and we provide support for the interactional effects of task factors and mindset.

Results

All analyses were conducted using $p < .05$ as the level of statistical significance. Effect sizes for statistically significant main effects are presented using Cohen's *d*, and effect sizes for statistically significant interactions are described using η^2.

Self-Talk & Imposed Mindset. A 2 x 3 between-subjects ANOVA was used to analyze the influence of self-talk (first person vs. second person) and imposed mindset (do your best vs. fixed vs. growth) on RT improvement (Figure 15). The interaction between imposed mindset and self-talk was significant, $F(2, 253) = 3.25$, $p = .04$, $\eta^2 = .01$. When using first person self-talk, RT improvement was better for participants who received fixed mindset framing ($M = 661.25$, $SD = 552.70$) and growth mindset framing ($M = 667.25$, $SD = 610.93$) than when asked to do their best

(M = 454.18, SD = 273.57). Significant effects were not detected for self-talk, $F(1, 253) = 3.16$, $p = .08$, or imposed mindset alone, $F(2, 253) = 0.44$, $p = .65$.

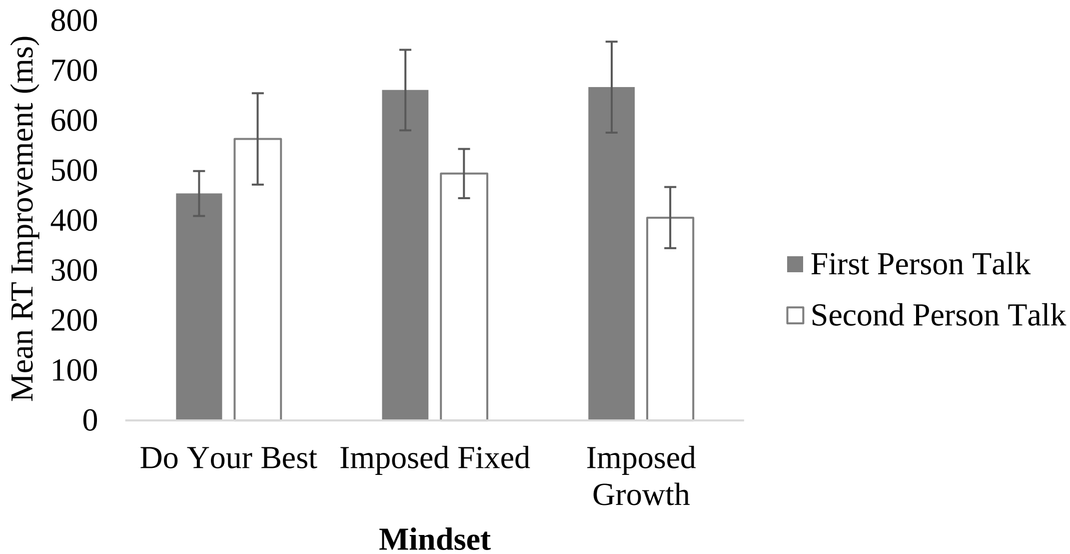


Figure 15. Mean RT improvement (ms) by imposed mindset and self-talk type.

Self-Talk & Naïve Mindset. A 2 x 2 between-subjects ANOVA was used to analyze the influence of self-talk (first person vs. second person) and naive mindset (fixed vs. growth) on skill acquisition, as measured by change in accuracy over the duration of the task (Table 1). The interaction between self-talk and naive mindset was significant, $F(1, 251) = 5.49$, $p = .02$, $d = 0.42$. Self-talk does not influence skill acquisition for naive growth-oriented learners. In individuals reporting naive fixed mindset orientations, second person self-talk significantly decreased the rate of skill acquisition when compared to first person self-talk. Statistical significance was not detected for simple main effects of self-talk, $F(1, 251) = 0.54$, $p = .46$, or naive mindset, $F(1, 251) = 0.31$, $p = .58$.

Table 1

Change in Accuracy Over Time By Self-Talk Type and Naïve Mindset

	Naive fixed mindset		Naive growth mindset	
Self-Talk Type	*M*	*SD*	*M*	*SD*
First person	0.11	0.16	0.11	0.26
Second person	0.08	0.22	0.15	0.16

Speed-Accuracy Tradeoff. Pearson's correlations were computed to determine the strength of the relationship between task accuracy and RT improvement. Participants who utilized first person self-talk displayed a strong negative relationship, indicating a speed-accuracy tradeoff whereby accuracy decreases as improvement in RT increases, r(128) = -0.39, $p < .001$. The speed-accuracy relationship for participants engaging in second person self-talk was not significant, $r(123) = 0.09$, $p = .35$. To compare the relative strengths of these correlations, Fisher's z transformation and test were used. Participants engaging in first person self-talk displayed a significantly stronger speed-accuracy tradeoff for than participants engaging in second person self-talk, $z = -3.91$, $p < .001$.

Pearson's correlation tests were used to assess the same relationship between RT improvement and accuracy for participants receiving imposed mindset manipulations. Participants exposed to imposed fixed mindsets displayed a strong, statistically significant speed-accuracy tradeoff, r (88) = -0.35, $p = .006$. Participants exposed to growth mindset information displayed a weak, non-significant relationship between RT improvement and accuracy, r (91) = -0.17, $p = 0.11$. To compare the relative strengths of these correlations, Fisher's z transformation and test were used. This relationship between speed and accuracy did not differ between imposed fixed and growth mindset groups, $z = -1.25$, $p = .20$.

Changes in Self-Reported Mindset. A 2 x 3 mixed-model ANOVA was used to compare changes in self-reported mindset over time (pre-task vs. post-task) and across goal orientation framings (do your best vs. imposed fixed vs. imposed growth; Figure 16). Participants' tendencies to report endorsements of growth mindset-oriented beliefs diminishes over time during exposure to a challenging, high-error task, F (1, 249) = 29.17, $p < .001$, $d = 0.17$. This attenuation is not influenced by mindset intervention, F (2, 249) = 0.20, $p = .82$. Self-reported goal orientation does not differ over the course of the task, F (1, 249) = 1.26, $p = .26$.

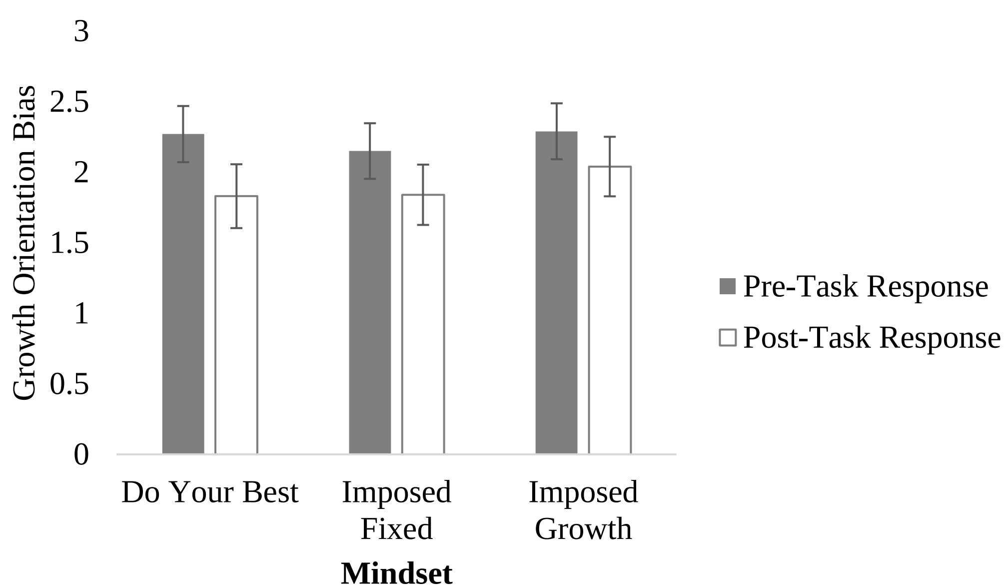


Figure 16. Self-reported endorsements of growth mindset beliefs before and after the Air Traffic Control task.

Discussion

Previous research shows that the assignment of specific goals is advantageous for performance outcomes when compared to the typical default of "doing one's best". In cases where these specific goals are set, first person self-talk facilitates skill acquisition. The Strategic Mindset Model posits that mindset may be imposed through goal framing, and should lead to discernable performance differences. These results suggest that the framing of these goals alone is not sufficient to influence performance by way of imposed mindset, indicating that mindset may not be as susceptible to top-down manipulation as previously presumed (Aronson et al., 2002; Blackwell et al., 2006; Dweck & Leggett, 1988; Yeager & Dweck, 2012). However, this framing can be combined with varying forms of self-talk to yield performance differences. Contrary to Mindset Theory, these findings show that the combined influence of various task factors (i.e. self-talk) and imposed mindset framing can contribute to differences in task performance. Specifically, participants who receive explicit growth or fixed instructions perform better than participants who are asked to do their best in situations where first person self-talk is emphasized. Specific goals, in combination with highly self-focused wording, may offer an opportunity for the learner to establish a clearer representation of the task demands than when a "do-your-best" goal is presented (Huber, 1985; Locke et al., 1981). This more specific representation of the task may allow the individual to harness their motivation in a more effective manner, leading to measurable improvements in performance (Locke & Latham, 2006; Locke et al., 1984a; Locke et al., 1984b).

These findings clearly demonstrate the importance of accounting for participants' individual beliefs regarding success and failure when establishing the instructions, demands, and expectations for a task. Participants maintaining naïve fixed mindsets demonstrate diminished skill acquisition in the face of second person self-talk, whereas the type of self-talk did not affect skill acquisition in growth-oriented learners. Through encouraging the use of "you"-framed goals, participants may be receiving an implicit message suggesting the presence of an outside observer or audience, leading to compromised performance. Emphasis on "I"-framed goals may minimize this suggestion, as well as encourage participants to accept agency and increase self-efficacy while engaging in the task.

Across both of these sets of findings, the interaction between individual differences and task factors provides clear support for a major pillar of the Strategic Mindset Model. Specifically, the influence of mindset on task performance does not exist as an isolated function. Performance and skill acquisition are influenced in nuanced ways depending on implicitly held views of intelligence, suggestions about mindset, and techniques for self-talk. This historic tendency to discount the importance of interactions between individual differences and task factors has likely contributed to a muted understanding of subtle performance differences. Whereas Mindset Theory does not outwardly acknowledge the intersection between such factors, these findings support the Strategic Mindset Model, and emphasize a flexible view of the individual differences and task parameters that contribute to differences in performance outcomes.

Strong negative correlations between RT improvement and task accuracy indicate that participants tend to shift their efforts toward improving accuracy or maximizing speed, rather than attempting to optimize both (see Heitz, 2014 for review). This speed-accuracy tradeoff (SAT) is a common strategy observed in performance-bound tasks. When presented with a task that requires time-bound correct responses, participants must tailor their approach to the task in order to strike the desired balance between speed and accuracy. Participants use task factors to guide their strategy shifts along the speed-accuracy continuum in order to produce desirable performance outcomes (Heitz, 2014). First person self-talk may contribute to a RT-focused strategy shift, whereby participants may feel an increased sense of agency and thus an elevated level of motivation to achieve the goals set prior to the test blocks. Because goal achievement in this paradigm is dictated by speed, these participants may strategically sacrifice accuracy in order to increase the likelihood of goal achievement and resultant success. No such tradeoff is observed in participants who were given second person self-talk framing, possibly indicating that the presence of an implied audience may mitigate the preference to concede accuracy in service of response speed. In any case, this speed-accuracy tradeoff observed in participants who utilized first person self-talk is indicative of a clear difference in one's approach to a task as a result of simple manipulation of an individual task parameter (Fitts, 1954). In addition, the speed-accuracy tradeoff is apparent for individuals receiving the fixed mindset priming, further suggesting that this strategy shift is likely tied to circumstances under which outward demonstration of competence is prioritized.

As observed in Experiment 1, change in mindset occurs as a function of task exposure, whereby participants report an overall decrease in inclination to endorse growth mindset principles. This again suggests that a bottom-up mindset shift is occurring due to repeated exposure to certain failure. The classic view of mindset would argue that this experience-driven modification of beliefs is unlikely (Dweck, 2006), but these current results suggest otherwise. This observed shift further supports the Strategic Mindset Model, and indicates that one's self-reported beliefs about success and development are not rigid, and can be easily biased by simple exposure to difficult circumstances. Changes in self-reported mindset don't necessarily yield complete overhauls in mindset orientation, but do present as reliable and clear differences in self-reported beliefs over time. This is indicative of both the ease with which one's mindset may be biased and the task-dependent nature of these shifts, views that are not supported by Mindset Theory.

Participants who engaged in first person self-talk generally performed better than participants who engaged in second person self-talk. This finding counters existing literature, which suggests that shifting focus away from oneself and onto the task by using second person self-talk is more beneficial to performance (Dolcos & Albarracin, 2014; Senay et al., 2014). The limited existing research in this domain presents this self-talk manipulation at one single time point at the initiation of the task, whereas the current experiment offers repeated opportunities for exposure to the self-talk manipulation. Although each participant is repeatedly reminded of this suggested pronoun at the start of each trial block, there is no guarantee that mental self-talk occurring within the block adheres to the assigned style. However, it is possible that participants in this current experiment were more likely to adopt the primed form of self-talk due to repeated exposure when compared to the single instance of priming used in previous research (Dolcos & Albarracin, 2014; Senay et al., 2014). Future research may consider requiring participants to articulate their self-talk aloud in order to confirm adoption of the prescribed pronoun.

As observed in the previous experiment, self-reported endorsement of growth-oriented views attenuates over the course of the task. This attenuation was not affected by the imposed mindset framing presented at the beginning of each task block, nor was it influenced by the type of self-talk the participant was primed with. The lack of influence of the intervention and self-talk manipulations indicate that rapid, short term changes in self-reported mindset can be produced by task exposure. In the same way that participants in the previous experiment were exposed to repeated failure, this task is inherently rich in opportunities for failure and difficulty. These current participants tended to report less challenge oriented views at the end of the task, suggesting that bottom-up mechanisms are more meaningful for mindset shifts than imposition via top-down intervention. This finding, in accordance with prior classroom based research, should be considered in context as supervisors and educators aim to engender growth orientations in their various organizations (Anderman & Anderman, 1999; Anderman & Midgley, 1997; Yeager & Dweck, 2012; Yeager & Walton, 2011). These mindset shifts appear to be driven by experience rather than instruction, and the probability of failure in the target task may begin to sway self-reported beliefs about intelligence and ability (Anderman & Anderman, 1999; Anderman & Midgley, 1997, Meece et al., 2006).

Self-talk is a common means of regulating motivation to maintain task engagement and improve performance outcomes (c.f. Wolters, 2003). However, there are very few studies that address how self-talk influences self-focus for a specific task. This current experiment is unique in its investigation of the interaction between mindset, differential self-focus via self-talk, and performance outcomes. Mindset Theory neglects to account for these relationships, whereas the current study shows that these factors can clearly influence performance. These relationships are of prime importance to the Strategic Mindset Model, which is centered upon interactions of this nature. In general, these findings provide grounding to further questions the efficacy of standard instructions in performance-bound environments. Motivating people to engage in first person self-talk may contribute to advantages in task performance, goal achievement, and skill acquisition over time.

Experiment 3: Effects of Imposed Mindset Framing on Desirable Difficulty Outcomes

Several studies have demonstrated the importance of introducing desirable difficulty as a component of a given task in order to improve learning and performance (see Bjork & Bjork, 2011 for review). In most cases, and as evidenced by the name itself, tasks involving desirable difficulties require a struggle that results in preliminary failure or poor performance in order to incite subsequent lasting improvement (Bjork

& Bjork, 2011; Bjork & Storm, 2011; deWinstanley & Bjork, 2002; deWinstanley & Bjork, 2004). Additionally, research in educational settings has demonstrated benefits of productive failures on complex and transfer-related tasks, further demonstrating the potential advantages provided by preliminary struggle or difficulty (Kapur & Bielaczyc, 2012; Kapur & Rummel, 2012; Warshauer, 2015). By generating a variety of possible representation and solution methods, a student may reap a conceptual understanding of a problem space as a result of failure. Such an opportunity is not readily available in instances of unimpeded success (Kapur & Bielaczyc, 2012; Kapur & Rummel, 2012; Warshauer, 2015).

Given the prevalence of fear of failure responses in fixed mindset individuals, it is possible that the benefits of exposure to desirable difficulties and productive failures are less likely to be experienced by naïve fixed mindset-oriented learners, as these performance-focused individuals are likely to prematurely disengage from the task following preliminary poor performance (DeCaro et al., 2015). Conversely, this challenge-driven effect should be strongest in naïve growth mindset individuals who tend to electively approach difficult scenarios. In addition, imposing fixed and growth mindsets via suggestion and then assessing performance and outcomes of engagement in tasks involving desirable difficulties allows for comparisons to be made between top-down imposition of mindset and one's inherently held point of view. By demonstrating that imposed and naive mindsets produce the same responses to desirable difficulties, further support for the Strategic Mindset Model may be accumulated, as authentic fixed and growth mindset responses may be observed after a brief mindset-priming manipulation.

This line of inquiry also presents an opportunity to assess the influences of metacognitive awareness of the benefits of failure on mindset-related outcomes (Bjork et al., 2007; deWinstanley & Bjork, 2004). This paradigm presents a clear opportunity for participants to learn about the downstream benefits of failure, rather than simply disengage due to frustration or concern regarding the outward demonstration of competence. The influence of metacognitive awareness on persistence, performance, and self-reported mindset may reveal that participants initially reporting a fixed orientation can implicitly learn to appreciate the value of challenge and difficulty for later skill acquisition through engagement in a structured productive failure environment.

Experiment 3A: Naive Mindset

Despite the overwhelming popularity of research regarding productive failure and desirable difficulties over several decades, investigations into the relationship between individual differences and desirable difficulty-based outcomes have been largely overlooked. This experiment aims to clarify the potential influences of one's inherent beliefs about success and failure in a widely used desirable difficulties paradigm. In this experiment, a word generation task was used (Jacoby, 1978; Slamecka & Graf, 1978). In a word generation task, participants read a passage and report one target word per sentence. Some target words are simply read, while others are fragmented and must be completed, or generated, before reporting. Participants are later tested on their memory of these targets. The generation effect is a robust psychological phenomenon in which participants recall generated items more accurately than items they simply read (Jacoby, 1978). Existing research using the generation effect paradigm has not yet accounted for one's beliefs regarding difficulty and failure in relation to these outcomes. In this way, researchers may be bypassing an opportunity to demonstrate an even more robust effect among a subset of participants, simply by accounting for implicit approaches to challenge.

Method

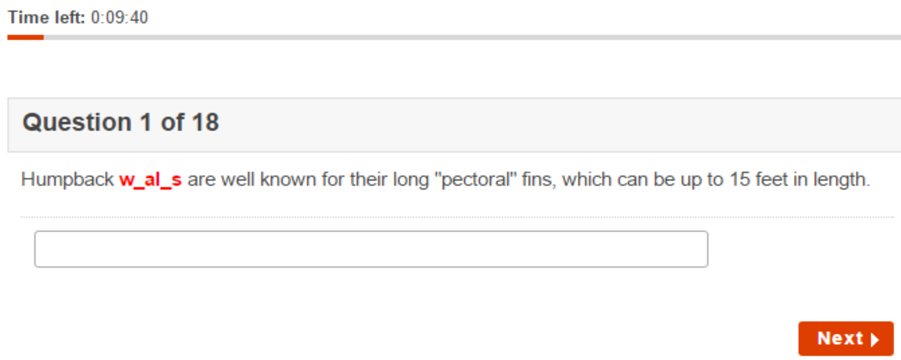
Participants. Participants were 94 adult volunteers (55 female, 39 male, 2 unreported) recruited from internet-based social media sites Reddit and Facebook. In some cases, referral sampling was used whereby current participants solicited engagement from acquaintances. Participants ranged in age from 18 to 76 (M = 30.52, SD = 12.69). Compensation was not offered to participants in exchange for engagement with this study.

Materials. Participants engaged in this task through a proprietary test management website, ClassMarker (www.classmarker.com). All participation occurred online via the participant's personal web-connected device.

Generation Effect Task. The generation effect task was used to introduce desirable difficulties (deWinstanley & Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978). Participants were presented with a passage consisting of 18 sentences, each containing one specified target word. In this task, the passage was presented one sentence at a time. Each sentence contained either a highlighted complete word (e.g.

“porcupine”) or a highlighted incomplete word (e.g. po_c_ pi_e; deWinstanley & Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978). For each sentence, participants were instructed to type the complete version of the target word in the answer field (Figure 17). Incomplete words, referred to as *generate* items, required that participants generate the correct version of the fragmented targets (Figure 17A). Complete words, referred to as *read* items, simply required that participants reiterate the targets (Figure 17B). After entering the answer, participants moved on to the next sentence. Participants had 10 minutes to complete all 18 items. A timer was presented at the top of the screen displaying the remaining time available to complete the task. After 10 minutes, the task automatically concluded. Participants were provided with feedback regarding their total score on the task, as well as their performance for each item. The correct answer for each item was also displayed.

A.



B.

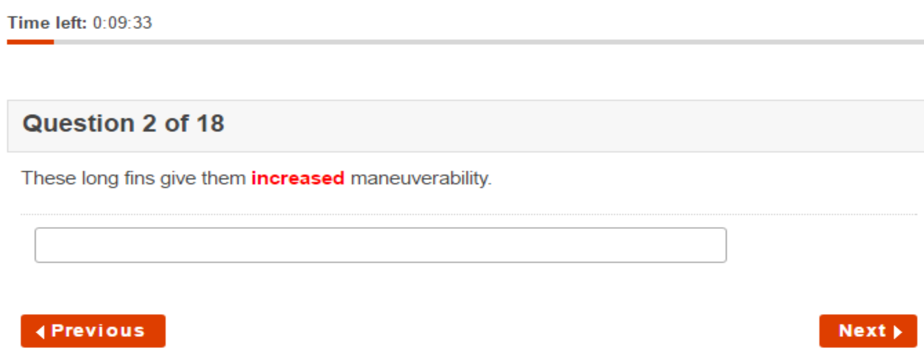


Figure 17. Generation task screen displayed via the ClassMarker interface. Section A shows a generate item, whereas Section B displays a read item.

Creativity Task. Participants engaged in a distractor task resembling the Alternative Uses Task (Guilford, Christensen, Merrifield & Wilson, 1960). Participants were shown a picture of an item, either a plunger or a hubcap, and were asked to produce as many unique uses as possible for the item. Participants were instructed to enter their answers in the on-screen text box, and to continue producing responses for 2 minutes.

Retrieval Task. The retrieval task was used to assess participants' recall for target items from the generation task. Participants were shown the original 18 sentences from the read task, one sentence at a time, in the original presentation order. All target words had been removed, and were replaced with blank spaces (Figure 18). Participants were asked to fill in each missing word as quickly as possible by typing the correct answer in the text box. At the conclusion of the memory task, participants received feedback regarding their overall accuracy, as well as retrieval success for each item.

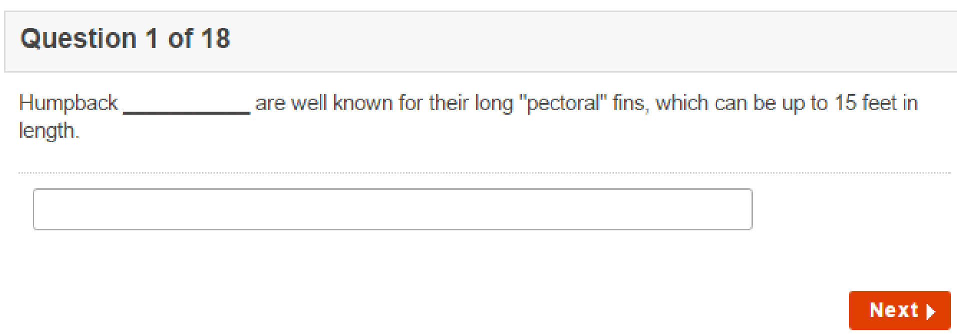


Figure 18. Retrieval task item presented in ClassMarker interface.

Procedure. After completing a digital consent form, participants were asked to respond to the self-report measures assessing naive mindset, via the Theories of Intelligence scale (Dweck, 2000; Appendix A), and naive goal orientation, using Button and colleagues' (1996) goal orientation scale (Appendix B). Participants then began the desirable difficulties task. The task was executed in two blocks comprised of three phases each (Figure 19). Participants first engaged in the generation task, responding to all 18 sentences in 10 minutes or less (Figure 19, Part 1). Participants then received target-specific feedback for this initial phase, including a total accuracy score, and an item-by-item review of the participant's response and the correct response (Figure 19, Part 1a). Participants then began the distractor task, where they were instructed to provide as many uses as possible for the item presented in the image (Figure 19, Part 2). The distractor task lasted for 2 minutes. Participants then engaged in the retrieval task, where each of the original 18 sentences was presented with the target word omitted, and the participant attempted to retrieve the target (Figure 19, Part 3). Feedback was provided regarding their overall retrieval success, as well as the participant's response and the correct answer for each item (Figure 19, Part 3a). Before beginning the second test block, participants responded to 6 mid-task True/False questions (Figure 19, Part 4). These questions assessed the participant's interest and engagement with the task (Appendix C).

Following the completion of the midpoint questions, participants began the second task block by engaging in the generation task. In the second task block, participants were presented with a novel paragraph and a different distractor item. Paragraph presentation was counterbalanced across participants, such that half of participants responded to Paragraph A (Appendix D) first whereas the other participants engaged with Paragraph B first (Appendix E). Generate and read item order were counterbalanced across participants and task blocks as well. Half of participants generated the first target item in the generation task, and half of participants read the first target item. The order was switched within participants between task blocks. At the conclusion of this second block, participants were again asked to complete the assessments of naive mindset and naive goal orientation (Dweck, 2000; Button et al., 1996).

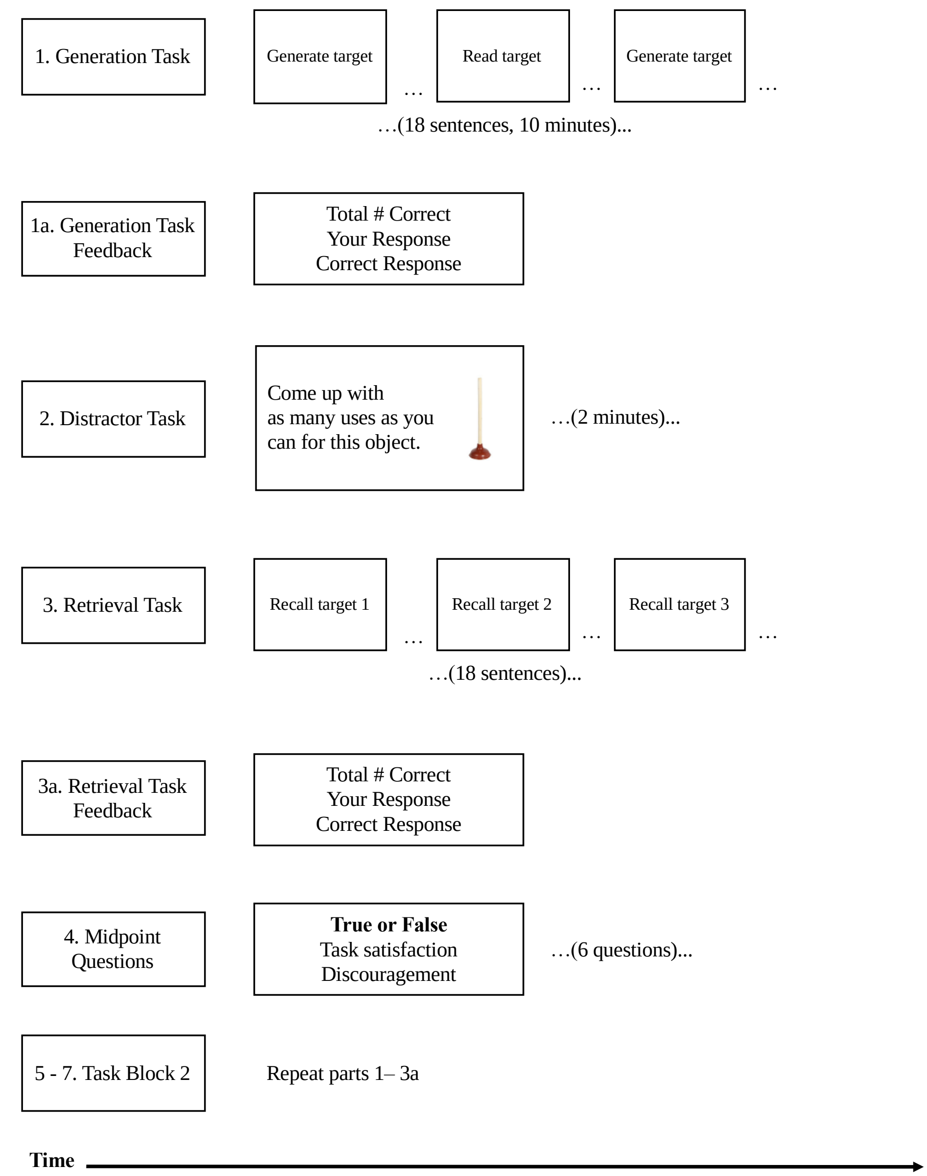


Figure 19. Task diagram for the generation effect paradigm.

Measures. Separate accuracy scores were calculated for read items and generate items across the generation and retrieval tasks for both blocks. Overall reading task performance and total memory task performance were calculated as the total count of correct responses out of 18. Naive mindset category membership was assigned as a result of mindset bias. Mindset bias was computed as the difference between the average rating response for all fixed-oriented survey items and growth-oriented survey items. Positive scores indicated responses in favor of growth orientation, and negative scores indicated response in favor of a fixed orientation. Mindset category membership was determined through a median split of mindset bias scores. Individuals above the median were categorized as growth-oriented, and individuals below the median were categorized as fixed mindset-oriented. Goal orientation category membership was assigned using the same procedure described for mindset. Goal orientation bias was computed by subtracting average responses for all performance goal-oriented items from all learning goal-oriented items. Positive scores were indicative of a bias toward learning goals. A median split of this bias measure provided the naive performance and learning goal orientation categories.

Hypotheses

Participants were expected to correctly retrieve more generate items than read items. Individuals reporting fixed mindset orientations were expected to demonstrate an overall performance disadvantage over time as a result of disengagement due to the characteristic fear-of-failure response. Due to the reportedly challenge-friendly characteristics of growth-oriented learners (Dweck, 2006; Dweck & Leggett, 1988; Mueller & Dweck, 1998), the generation advantage during memory testing was expected to be larger for growth-oriented individuals when compared to fixed-oriented participants. As was reliably observed in several previous studies involving this paradigm, we expected that the magnitude of the generation advantage will attenuate between the first and second task blocks (deWinstanley & Bjork, 2004; Storm, Hickman & Bjork, 2016). This was expected to occur as a result of strategy realignment due to failure-induced learning in the first block. Specifically, this weakening of effect should be driven by an increase in attention to the read items during the second task block, as was suggested in previous research (Bjork et al., 2007; deWinstanley & Bjork, 2004). Finally, participants were expected to demonstrate a self-reported shift toward growth-oriented mindsets after prolonged experience with the desirable difficulties paradigm. In accordance with the Strategic Mindset Model, participants were expected to implicitly learn that failure and difficulty are advantageous in this paradigm, and align their self-reported beliefs according to their experiences. A comparable shift in self-reported goal orientation was expected as well, whereby participants were expected to report changes in goal orientation that are biased toward learning rather than performance.

Results

All analyses were conducted using $p < .05$ as the level of statistical significance. Effect sizes for statistically significant main effects are presented using

Cohen's *d*, and effect sizes for statistically significant interactions are described using η^2.

Generation Task Outcomes. To assess the generation task performance across mindsets and task blocks, a 2 x 2 x 2 mixed-model ANOVA was used to compare total correct responses by target type (read vs. generate) and self-reported mindset (naive fixed vs. naive growth) over two task blocks (Figure 20). All means and standard deviations are presented in Table 2**.** Mindset did not influence differences in generation task success by target type over the course of the two blocks, $F(1,90) = 0.02$, $p = .88$ (Figure 20).

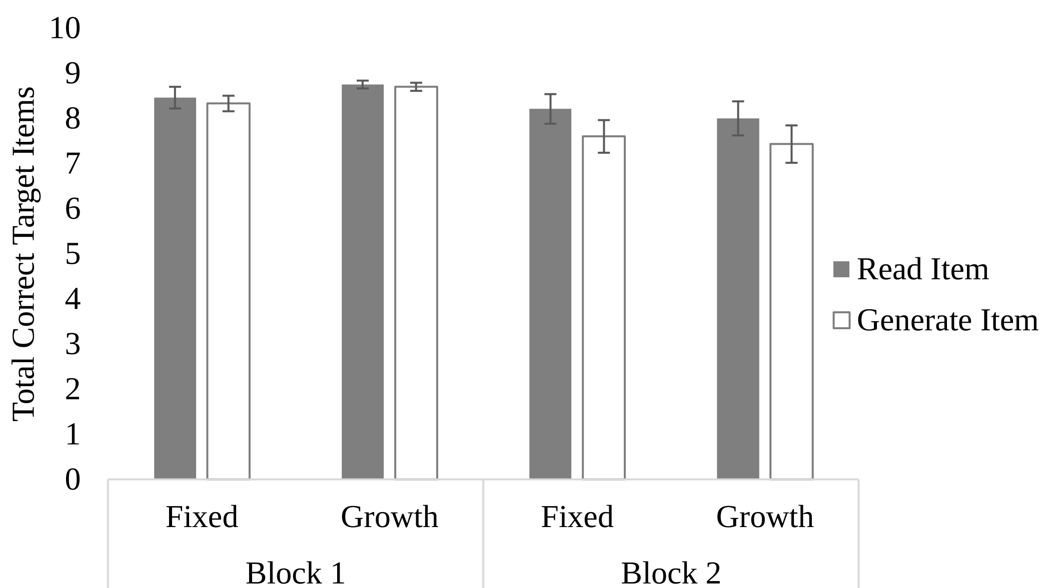


Figure 20. Generation task performance differences by block, target type and self-reported mindset.

The interaction between block and target type significantly influenced performance, *F*(1,90) = 11.34, $p = .001$, $\eta^2 = .01$. Generation task performance decreased from Block 1 to Block 2 for generate items, but remained the same for read items. Generation task performance was not influenced by the interaction between target type and mindset, *F*(1,90) = 0.13, $p = .72$. Performance on the generation task for both fixed and growth mindset-oriented participants remained constant across task blocks, *F*(1,90) = 0.95, $p = .33$.

Participants produced more correct responses for read items than for generate items, *F*(1,90) = 17.580, $p < 0.001$, $d = 0.19$. Overall, participants also performed better on the generation task in the first block than in the second block, *F*(1,90) = 7.85, $p = .006$, $d = 0.38$.

Table 2

Generation Task Performance by Self-Reported Mindset, Block, and Target Type

	Naive Fixed Mindset		Naive Growth Mindset		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Block 1						
Read	8.46	1.66	8.75	0.576	8.60	1.27
Generate	8.33	1.19	8.70	0.594	8.51	0.966
Block 2						
Read	8.21	2.27	8.00	2.51	8.11	2.37
Generate	7.60	2.51	7.43	2.75	7.52	2.61

Retrieval Task Outcomes. To assess retrieval success across mindsets and over time, a 2 x 2 x 2 mixed-model ANOVA was used to compare total correct responses by target type (read vs. generate) and self-reported mindset (naive fixed vs. naive growth) by task block (Figure 21). All means and standard deviations are presented in Table 3.

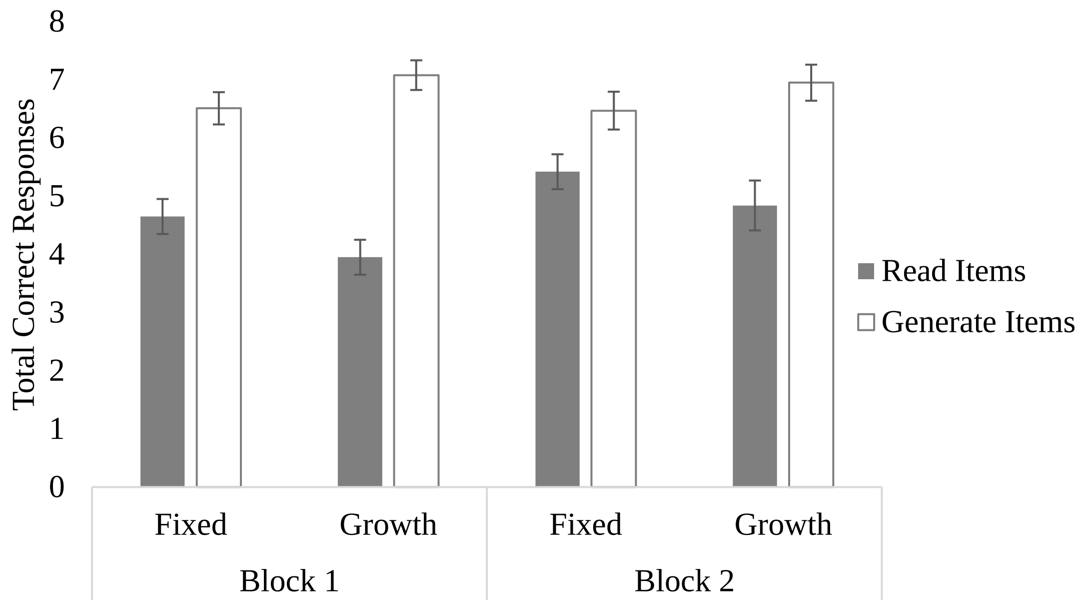


Figure 21. Retrieval performance differences by block, target type and self-reported mindset.

Mindset did not influence differences in retrieval success by target type over the course of the two blocks, $F(1,78) = 0.17$, $p = .68$. A significant interaction between target type and mindset indicates that read items were retrieved more successfully by participants reporting fixed mindsets, whereas generated items were retrieved more successfully by participants holding growth mindsets, $F(1, 78) = 14.10$, $p < 0.001$, $\eta^2 = 0.03$. A significant interaction between target type and task block indicates that retrieval for generate items remained constant across blocks whereas retrieval for read items improved from Block 1 to Block 2, $F(1, 78) = 12.47$, $p < 0.001$, $\eta^2 = 0.02$. The interaction between mindset and task block did not yield significant differences in overall retrieval task performance, $F(1,78) = 0.001$, $p = .97$.

Simple main effects of time and mindset were not significant. The total number of words correctly recalled did not differ between the first and second blocks of the task, $F(1,78) = 2.28$, $p = .14$, or between fixed and growth mindset, $F(1,78) = 0.04$, $p = .85$. Task performance differed significantly by target type, such that generated items were retrieved more successfully than read items, $F(1, 78) = 171.61$, $p < 0.001$, $d = 1.00$.

Table 3

Retrieval Task Performance by Self-Reported Mindset, Block, and Target Type

	Naive Fixed Mindset		Naive Growth Mindset		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Block 1						
Read	4.65	1.98	3.95	1.83	4.33	1.93
Generate	6.51	1.82	7.08	1.55	6.78	1.71
Block 2						
Read	5.42	1.97	4.84	2.61	5.15	2.29
Generate	6.47	2.13	6.95	1.89	6.69	2.02

Changes in Beliefs. Paired-samples t tests were used to assess changes in self-reported beliefs regarding mindset and goal orientation over the duration of the task. Participants did not show a significant shift in self-reported growth orientation over the course of the task, $t(74) = 1.68$, $p = .10$. However, participants were significantly more likely to endorse a learning goal orientation after extended exposure to a desirable difficulties paradigm, $t(74) = 2.39$, $p = .02$, $d = 0.35$ (Figure 22).

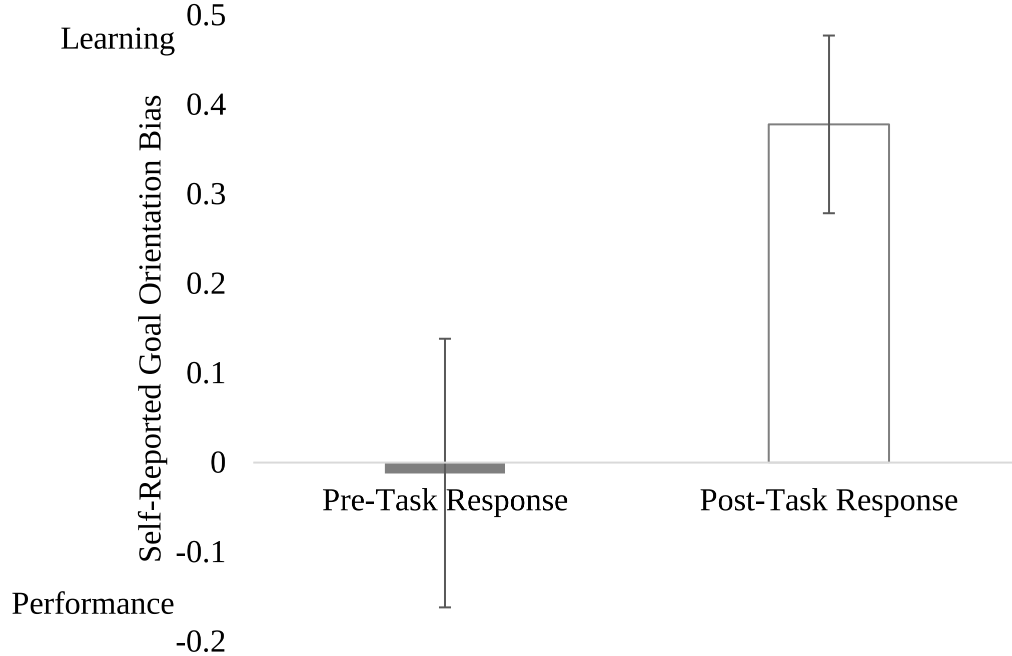


Figure 22. Self-reported goal orientations before and after engagement with a desirable difficulties task.

Attrition and Self-Reported Engagement. A chi-squared test confirms that fixed-oriented participants were no more likely to quit in the middle of the experiment than growth-oriented participants, $X^2 = 1.41$, $p = .24$ (Table 4).

Table 4

Attrition and Task Completion by Mindset

	Completed task		Did not complete task	
Mindset	*N*	%	*N*	%
Fixed	43	53.75%	6	37.5%
Growth	37	46.25%	10	62.5%
Total	80	100%	16	100%

An independent samples t-test confirms that self-reported engagement assessed between the task blocks did not differ as a function of mindset (Table 5), $t(94) = 0.39$, $p = .70$. An additional independent samples t-test indicates that overall discouragement did not differ as a result of self-reported mindset, $t(94) = 1.02$, $p = .31$.

Table 5

Self-Reported Task Engagement by Mindset

	Fixed Mindset		Growth Mindset			
	M	*SD*	*M*	*SD*	*t*	*p*
Task satisfaction	2.29	0.94	2.36	0.97	0.39	0.70
Overall discouragement	0.51	0.68	0.66	0.76	1.02	0.31

Discussion

Results from this experiment show that the generation effect can be replicated in a minimally controlled online environment with a unique sample of adult participants. The present results speak strongly to the robustness of the generation effect and to the reliability of desirable difficulties in general. In accordance with existing literature, the generation effect for memory retrieval in this experiment attenuates over time (Bjork et al., 2007; Bjork & Storm, 2011; deWinstanley & Bjork, 2004; Storm et al., 2016). This effect was driven by a shift in focus to retrieve more read items. During the second generation task, participants showed a significant increase in the number of correctly reported read items, approaching a near-perfect level. The benefits of this additional effort and engagement were reaped during the second memory retrieval task, as participants showed a significant increase in the successful retrieval of read items without compromising their retrieval of generate items.

This strategy shift had no bearing on the successful retrieval of generated items, indicating that participants may have identified their deficiencies in retrieval of read items, and upregulated effort during the word task to increase the likelihood of later retrieval success (Bjork et al., 2007; Bjork & Storm, 2011; deWinstanley & Bjork, 2004; Storm et al., 2016). Overall memory task performance was not affected by this difference, but the change in performance is evident when comparing the generation effect magnitude between the two task blocks. In short, the attenuation of the generation effect from Block 1 to Block 2 is directly related to a strategy shift, originally suggested by deWinstanley and Bjork (2004), whereby additional effort is placed on the less-successfully remembered read items without decreased retrieval success for generated items. The generation effect is robust across diverse motivational perspectives, but the effects may be exacted differently depending on one's naive mindset. It is possible that fixed oriented learners are less willing to embrace productive failure at the outset of the task, whereas growth oriented learners take to the challenge immediately. Fixed mindset-oriented learners do not disengage in the way that has been previously suggested (Dweck & Leggett, 1988; Heyman & Dweck, 1992). Regardless of attenuation of the generation effect over time, participants maintaining fixed orientations still show a stifled generation effect, compared to growth-oriented participants, suggesting that this preference for a challenge-free tasks is disadvantageous when introducing desirable difficulties.

As articulated by Bjork and Storm (2011), participants' experiences during the retrieval task may increase their metacognitive awareness of the retrieval advantages driven by generation. As participants engage in the task, they may be encoding additional information regarding the task demands. This newly acquired information may influence strategy formation and later approaches to target item encoding (Bjork & Storm, 2011; Storm et al., 2016). Awareness of these task demands and impending challenges may be differentially interpreted based on mindset. In addition to influencing strategy, metacognitive awareness of productive failure may be involved in a regulatory process for the participant's motivation for the task.

This experiment provides both a replication of existing findings (deWinstanley & Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978), and an extension of the collective understanding of desirable difficulties by incorporating the influence of naïve mindset. Mindset clearly affects the magnitude of the generation effect, such that individuals who maintain growth mindsets tend to produce a significantly larger initial retrieval advantage for generate items than participants who report holding a fixed mindset. This confirms our hypothesis and suggests that individuals who welcome challenge and difficulty by virtue of their growth-oriented beliefs are more receptive to the failure and struggle inherent within this paradigm than participants who hold fixed mindsets. Even in light of the decreasing magnitude of the generation effect between task blocks, this difference between mindset groups remains detectable.

Although existing research that employs desirable difficulties is sensitive to the nuanced changes in task parameters that may yield performance differences, it is presumed that these productive failure effects work comparably for all participants, and appears to overlook the importance of individual differences. As our findings indicate, the influences of desirable difficulties are certainly robust, but also clearly differ across individual differences in motivational style. Future research in this vein may assess the generation effect at a third time point to further investigate the attenuation pattern over time. This assessment of the relationship between mindset and desirable difficulties should be implemented in an alternative productive failure paradigm (Kapur & Bielaczyc, 2012; Kapur & Rummel, 2012; Warshauer, 2015) to further evaluate the nature of this relationship in regard to different tasks and contexts. This particular finding carries significant weight in regards to the way that educational institutions implement new teaching methodologies. Introducing desirable difficulties without first accounting for some fundamental differences in failure and challenge perception among students could unknowingly result in compromised learning experiences, and ultimately unfairly disadvantage students who do not maintain a growth-oriented perspective (DeCaro et al., 2015).

It is inaccurate to represent the relationship between mindset and desirable difficulty outcomes as being unidirectional. Rather, the relationship may be circular and feedback-dependent. That is, participants apply their individual beliefs and expectations to the task at hand, but the experiences incurred as a result of exposure to desirable difficulties leads to a shift in some self-reported beliefs. Overall, participants report an increased endorsement of learning goals rather than performance goals. Learning goals are highly correlated with growth mindsets, and are characterized by the desire to learn and acquire new skills from challenging circumstances (Dweck & Leggett, 1988; Heyman & Dweck, 1992; Licht & Dweck, 1984). Conversely, performance goal orientations represent the tendency to approach tasks that will allow the individual to demonstrate competence and maintain a high-performing track record Dweck & Leggett, 1988; Heyman & Dweck, 1992; Licht & Dweck, 1984). This shift in goal orientation suggests that exposure to productive failure paradigms may implicitly teach individuals to appreciate the value of failure and difficulty within the task. However, the observed consistency of mindset orientation over time indicates that this shift in perspective may be task-specific and does not necessarily influence overarching beliefs regarding intelligence and ability.

Interestingly, and in clear opposition to typical characterizations of fixed mindset orientations, self-reported engagement and interest in the task did not differ by mindset. Although the fear of failure that tends to accompany fixed mindsets should yield a decrease in self-reported task enjoyment (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998), fixed and growth oriented participants all tended to report comparable levels of performance satisfaction, engagement, fun, and perceived difficulty. In addition, individuals maintaining fixed mindsets were no more likely to quit before completing the task than growth-oriented participants. Taken together, these findings suggest that the overarching self-reported experiences of fixed and growth mindset-oriented participants do not differ in the face of desirable difficulty, despite these groups holding allegedly disparate beliefs about the value of failure and challenge (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). Although this could be an instance of social monitoring, whereby participants feel inclined to report task enjoyment regardless of experience, it is also plausible that the effects of fixed mindset on overall engagement manifest more subtly than suggested by Mindset Theory.

Experiment 3B: Imposed Mindset

As shown in Experiment 3A, desirable difficulties are not interpreted identically across mindsets. The Strategic Mindset Model posits that mindset manipulation is possible through simple framing and suggestion. In this final experiment, the relationship between desirable difficulties and imposed mindsets is assessed.

Method

Participants. Participants were 116 adult volunteers (72 female, 39 male, 5 unreported) recruited from internet-based social media sites Reddit and Facebook. In some cases, referral sampling was used whereby current participants solicited engagement from acquaintances. Participants ranged in age from 18 to 65 (M = 31.34, SD = 12.27). Compensation was not offered to participants in exchange for engagement with this study.

Materials. Participants engaged in this task through a proprietary test management website, ClassMarker (www.classmarker.com). All participation occurred online via the participant's personal web-connected device.

Generation Effect Task. As described in Experiment 3A, participants engaged in the generation effect task used in prior research investigating desirable difficulties (deWinstanley Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978). Participants viewed an 18-sentence passage, one sentence at a time, with each sentence containing one specified target word presented in bold red font. The target word was either a highlighted complete word, referred to as a read item, (e.g. "porcupine") or a highlighted incomplete word, termed a generate item (e.g. po_c_ pi_e; deWinstanley & Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978). For each sentence, participants were again instructed to type the complete version of the target word in the answer field (Figure 17). After entering the answer, participants moved on to the next sentence. Participants had 10 minutes to complete all 18 items. A timer was presented at the top of the screen displaying the elapsed time. After 10 minutes, the task automatically concluded. Participants were provided with feedback regarding their total score on the task, as well as their performance for each item. The correct answer for each item was also displayed.

Creativity Task. Participants engaged in the same distractor task described in Experiment 3A, resembling the Alternative Uses Task (Guilford et al., 1960). Participants were shown a picture of an item, either a plunger or a hubcap, and were asked to produce as many unique uses as possible for the item. Participants were instructed to enter their answers in the on-screen text box, and to continue producing responses for 2 minutes.

Retrieval Task. The retrieval task was used to assess participants' recall for target items from the generation task. Participants were shown the original paragraph from the generation task, one sentence at a time, in the original presentation order. All target words had been removed, and were replaced with blank spaces (Figure 18). Participants were asked to fill in each missing word as quickly as possible by typing the correct answer in the text box. At the conclusion of the memory task, participants received feedback regarding their overall accuracy, as well as retrieval success for each item.

Imposed Mindset Manipulation. Participants were randomly assigned to one of two imposed mindset groups (fixed or growth). Mindsets were imposed using a priming method described in Dweck & Leggett (1988). Participants read a brief paragraph that explained and emphasized fixed mindset beliefs, while the other half of participants read a paragraph that outlined growth mindset beliefs (Appendix F). Participants were asked to answer a comprehension question confirming their understanding of the paragraph they read.

Procedure. After completing a digital consent form, participants were asked to respond to the self-report measures assessing naive mindset, via the Theories of Intelligence scale (Dweck, 2000; Appendix A), and naive goal orientation, using the goal orientation questionnaire (Button et al., 1996; Appendix B). Participants then read the imposed mindset manipulation paragraph, and answered the comprehension question (Figure 23, Part 1). Once the question was answered correctly, participants were able to move forward and begin the task described in Experiment 3A.

The task was again executed in two blocks comprised of three phases each (Figure 23). Participants first engaged in the generation task (Figure 23, Part 2). Participants received target-specific feedback for this initial phase (Figure 23, Part 2a). Participants then began the distractor task, where they were instructed to provide as many uses as possible for the item presented in the image in the 2 minute time frame (Figure 23, Part 3). Next, the participants engaged in the retrieval task, viewing all 18 sentences from the original passage (Figure 23, Part 4). Feedback was provided regarding their overall retrieval success, as well as the participant's response and the correct answer for each item (Figure 23, Part 4a). Before beginning the second test block, participants responded to 6 mid-task True/False questions to assess interest and engagement with the task (Figure 23, Part 5; Appendix C).

Following the completion of the midpoint questions, participants began the second task block by engaging in the generation task. As described previously, participants were presented with a novel paragraph and a different distractor item in the second task block. Paragraph presentation was counterbalanced across participants, such that half of participants responded to Paragraph A (Appendix D) first whereas the other participants engaged with Paragraph B first (Appendix E). Generate and read item order were counterbalanced across participants and task blocks as well. Half of participants generated the first target item in the generation task, and half of participants read the first target item. The order was switched between task blocks. At the conclusion of this second block, participants complete the assessments of naive mindset and naive goal orientation again (Dweck, 2000; Button et al., 1996).

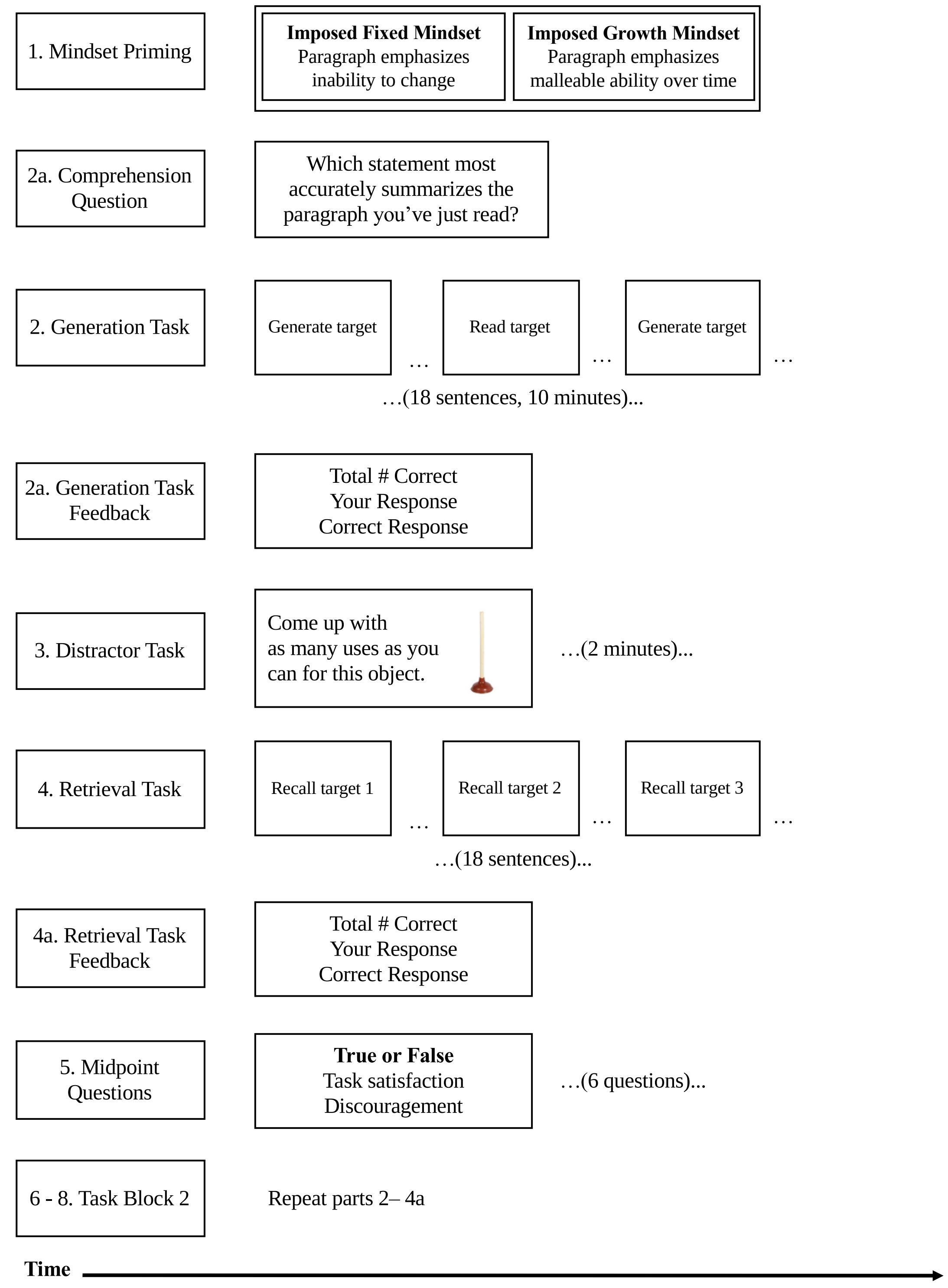


Figure 23. Task diagram for the generation effect paradigm.

Measures. Separate accuracy scores were calculated for read items and generate items across the generation and retrieval tasks for both blocks. Overall reading task performance and total memory task performance were calculated as the total count of correct responses out of 18.

Imposed mindset category membership was determined by the assigned mindset paragraph provided prior to the desirable difficulties task. Naïve mindset category membership was assigned as explained in Experiment 3A, through a median split of mindset bias scores. Individuals above the median were categorized as growth-oriented, and individuals below the median were categorized as fixed mindset-oriented. Naïve goal orientation category membership was assigned using the same procedure described in Experiment 3A. A median split of the learning goal bias measure provided the naive performance and learning goal orientation categories.

Hypotheses

The Strategic Mindset Model posits that mindset may be easily manipulated using suggestion or presentation of specific mindset-framed information. Therefore, participants who were provided with an imposed fixed mindset were expected display the predicted performance disadvantage over time that was suggested in the previous experiment. Participants provided with an imposed growth mindset were expected to retrieve more generate items than participants receiving a fixed mindset priming. The retrieval advantage for generate items was expected to diminish between the first and second task blocks, as reported in previous literature. As previously explained, this dampening was expected to be paired with an increase in generation task performance for read items during the second task block.

Results

All analyses were conducted using $p < .05$ as the level of statistical significance. Effect sizes for statistically significant main effects are presented using Cohen's *d*, and effect sizes for statistically significant interactions are described using η^2.

Generation Task Outcomes. To assess the generation task performance across mindsets and task blocks, a 2 x 2 x 2 mixed-model ANOVA was used to compare total correct responses by target type (read vs. generate) and self-reported mindset (naive fixed vs. naive growth) by task block (Figure 24). All means and standard deviations are presented in Table 6**.** Mindset did not influence differences in generation task success by target type over the course of the two blocks, $F(1,105) = 0.43$, $p = .51$.

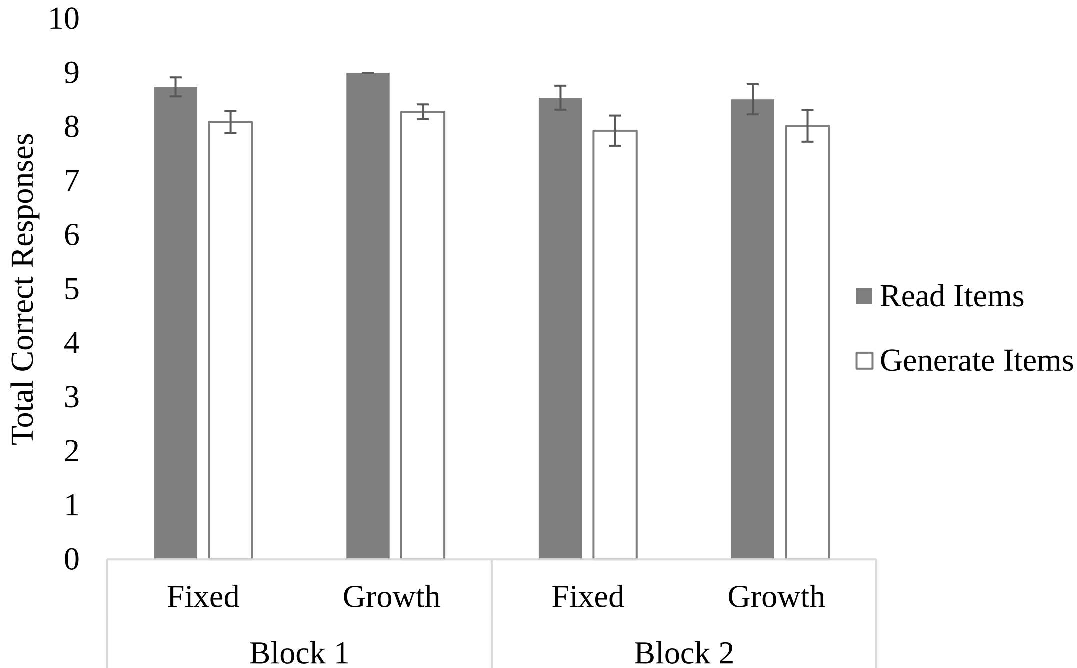


Figure 24. Generation task performance differences by block, target type and self-reported mindset.

Generation task performance between read and generate items did not differ over time, $F(1,105) = 0.84$, $p = .36$. Performance between read and generate items did not differ by imposed mindset type, $F(1,105) = 0.02$, $p = .88$. Imposed mindset did not influence overall generation task performance between blocks, $F(1,105) = 0.23$, $p = 0.64$.

In terms of simple main effects, overall performance did not differ significantly between blocks, $F(1,105) = 1.94$, $p = 0.17$, or across imposed mindset conditions, $F(1,105) = 0.40$, $p = 0.53$. Across both imposed mindset conditions and both task blocks, participants performed significantly better when reporting read items when compared to generate items, $F(1,105) = 48.96$, $p < .001$, $d = 0.41$.

Table 6

Generation Task Performance by Imposed Mindset, Block, and Target Type

	Imposed Fixed Mindset		Imposed Growth Mindset		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Block 1						
Read	8.74	1.29	9.00	0.00	8.87	0.922
Generate	8.09	1.51	8.28	0.99	8.19	1.28
Block 2						
Read	8.54	1.63	8.51	2.03	8.52	1.83
Generate	7.93	2.05	8.02	2.14	7.97	2.09

Retrieval Task Outcomes. To assess retrieval success across mindsets and over time, a 2 x 2 x 2 mixed-model ANOVA was used to compare total correct responses by target type (read vs. generate) and self-reported mindset (naive fixed vs. naive growth) by task block (Figure 25). All means and standard deviations are presented in Table 7. Mindset did not influence differences in retrieval success by target type over the course of the two blocks, $F(1,97) = 0.84$, $p = .362$.

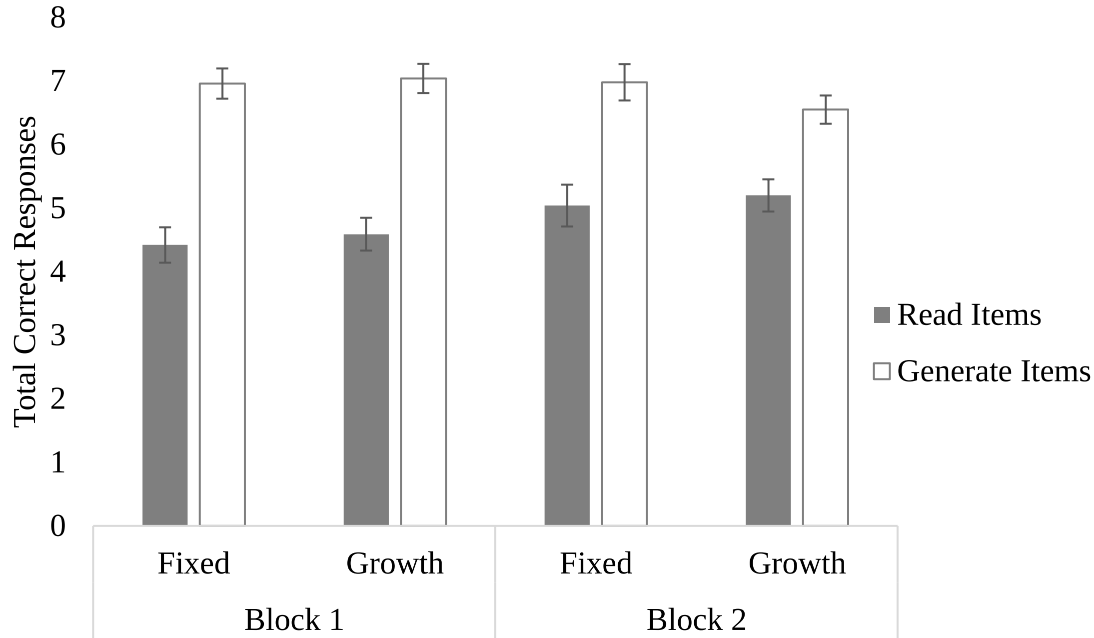


Figure 25. Generation task performance differences by block, target type and imposed mindset.

Performance for generate items did not change between blocks, but participants improved their retrieval for read items between blocks 1 and 2, $F(1, 97) = 9.99$, $p = .002$, $\eta^2 = .02$, showing that the generation effect attenuates over time. Performance between read and generate items did not differ by imposed mindset type, $F(1, 97) = 2.00$, $p = .16$. Imposed mindset did not influence overall generation task performance between blocks, $F(1, 97) = 0.48$, $p = 0.49$.

Participants retrieved significantly more generated items than read items, $F(1, 97) = 301.39$, $p = .49$, $d = 1.13$. Overall task performance did not differ as over time,

$F(1, 97) = 0.48$, $p = 0.49$. Imposed mindset did not influence overall retrieval, $F(1, 97) = 0.00$, $p = 0.98$.

Table 7

Retrieval Task Performance by Imposed Mindset, Block, and Target Type

	Imposed Fixed Mindset		Imposed Growth Mindset		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Block 1						
Read	4.42	1.93	4.59	1.84	4.51	1.88
Generate	6.96	1.65	7.04	1.64	7.00	1.64
Block 2						
Read	5.04	2.28	5.20	1.81	5.12	2.04
Generate	6.98	1.98	6.55	1.59	6.76	1.80

Changes in Belief Over Time. A 2 x 2 mixed-model ANOVA compared scores on the self-report mindset questionnaire across time (pre-task vs. post-task) and across imposed mindset conditions (imposed fixed vs. imposed growth). Results indicate that participants' views of mindset changed over time as a result of exposure to a pre-task mindset intervention, $F(1,96) = 4.94$, $p = .03$, $\eta^2 = .05$ (Figure 26). Individuals who received growth mindset priming were more likely to report an increase in growth-oriented beliefs over time, whereas participants who received fixed mindset priming tended to report a decreased preference for growth-oriented beliefs over time.

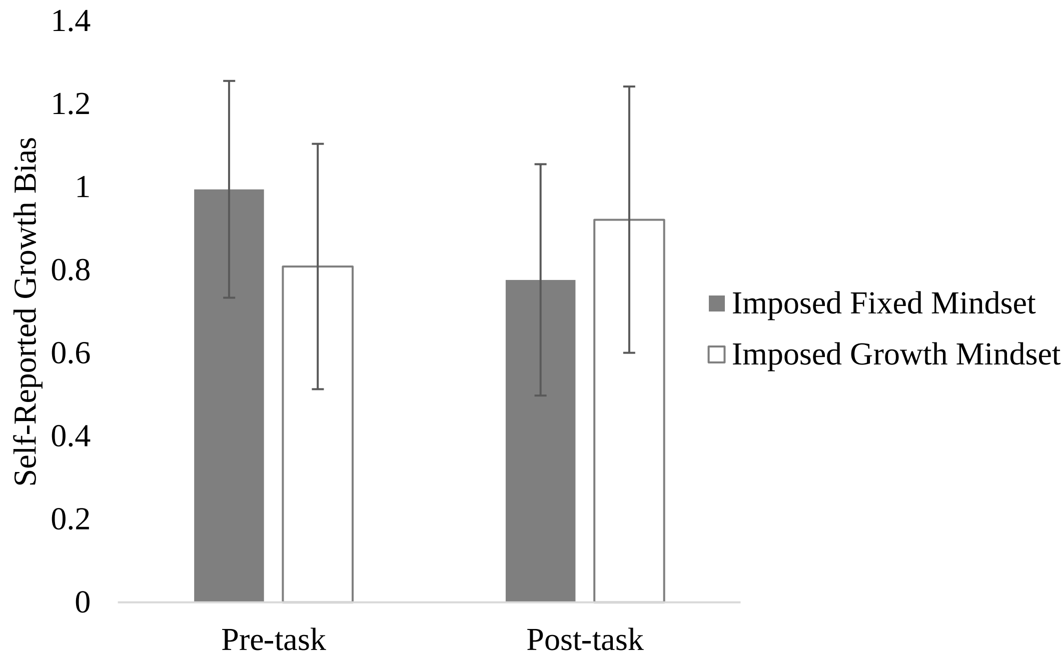


Figure 26. Changes in self-reported beliefs about mindset over time and by mindset manipulation.

Attrition and Self-Reported Engagement. Imposed mindset did not influence participants' willingness to quit in the middle of the task, X^2 (1) = 0.31, p = .58 (Table 8).

Table 8

Attrition and Task Completion by Imposed Mindset

	Completed task		Did not complete task	
Mindset	*N*	%	*N*	%
Fixed	48	48.48%	7	41.18%
Growth	51	51.52%	10	58.82%
Total	99	100%	17	100%

When asked about their interest and engagement at the midpoint of the experiment, participants assigned to fixed and growth mindset intervention groups did not differ in their reports of overall satisfaction with the task (Table 9), $t(111) = 0.10$, $p = .92$. Participants provided with an imposed fixed mindset priming were far less likely to report experiencing discouragement than participants who received a growth mindset priming, $t(111) = 2.33$, $p = .02$.

Table 9

Self-Reported Task Engagement by Imposed Mindset

	Fixed Mindset		Growth Mindset			
	M	*SD*	*M*	*SD*	*t*	*p*
Task satisfaction	2.37	0.86	2.39	1.16	0.100	0.92
Overall discouragement	0.426	0.57	0.712	0.72	2.32	0.022

Discussion

As expected, participants in this experiment showed a robust retrieval advantage for generated rather than read items. This confirms earlier findings and again suggests that the generation effect is a robust phenomenon that can be elicited across a variety of contexts and with varying samples (deWinstanley & Bjork, 2004; Jacoby, 1978; Slamecka & Graf, 1978). The generation effect attenuates over time, and this decrease is driven by an improvement in the retrieval read items. As previously explained, this attenuation was not due to a disengagement with the challenging generated items. Rather, this mechanism is a clear strategic upregulation of engagement to focus on the subset of items that were less easily retrieved.

Contrary to findings presented by Dweck and Leggett (1988) in their research with elementary school children, the reading-based mindset intervention does not yield detectable performance differences in an adult sample. Participants in this study did not perform differently as a result of reading a growth or fixed-oriented passage. Although it is plausible that participants may simply have disregarded the short passage, there is also a possibility that adult participants are less susceptible to top-down mindset manipulation than school-aged children. This reduced malleability may occur as a result of experience, whereby adults have applied their preferred mindset to daily situations and thus solidified their beliefs about intelligence and ability over an extended period of time. As a result, adults may learn to consider new mindset perspectives as a function of experience rather than instruction. This can be confirmed by assessing the shift in self-reported mindset between the beginning and end of the task. Alternatively, these effects may be difficult to engender because of the growing popularity of growth mindset-related constructs amongst the general public (Dweck, 2000; Dweck, 2006; Yeager & Dweck, 2012, Yeager & Walton, 2011). The dissemination of information regarding the benefits of growth mindset orientations has increased dramatically in recent years, leading to an increased likelihood that participants are familiar with the constructs, and contributing to the possible reluctance to accept an alternative view of intelligence and ability.

As predicted and as evidenced by the previous experiments, self-reported mindset in adults does change over time. In conjunction with imposed mindset interventions, prolonged exposure to an error-prone task yields a detectable shift in self-reported mindset. It is possible that this imposition of a new mindset leads the learner to differentially interpret the task's inherent opportunities for error. Individuals who received fixed mindset priming may initially experience the effects of these desirable difficulties as blatant failure, whereas participants who were primed with growth mindset information may interpret these difficulties as challenging opportunities. The combination of task engagement and mindset priming may provide a lens through which individuals evaluate failure as either productive or detrimental, leading to an increased likelihood of endorsement of the assigned mindset at a later time.

Although participants did not differ in behavioral indices of engagement throughout the task, those who received the fixed mindset manipulation were significantly less likely to report feeling discouraged following the first task block. Taken at face value, this is contrary to the expected influence of a fixed mindset manipulation and is entirely orthogonal to what Mindset Theory would predict, as a strong fixed mindset orientation should spur feelings of frustration and discouragement in response to failure, challenge and difficulty (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). However, given the inherent growth orientation bias of the participants in this experiment, this lack of self-reported discouragement may be a strategy for regulating motivation and engagement in response to the fixed mindset intervention. These participants may be using their naive growth-biased perspectives to overcompensate for the effects of this imposed fixed mindset, thereby over-reporting their lack of discouragement. Alternatively, the fixed mindset intervention may have taken hold in these participants strongly enough that they are engaging in mindset-appropriate social monitoring. One of the hallmarks of fixed mindset orientations is the outward display of competence and control (Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). To report discouragement or frustration would be to suggest to an outside observer that one is struggling or frustrated, and ultimately compromise this display of ability and composure.

General Discussion

Carol Dweck's monumental contributions to the understanding of motivation through Mindset Theory have provided new perspectives regarding the ways that individuals' beliefs influence engagement (Bandura & Dweck, 1985; Dweck, 2000; Dweck, 2006; Dweck & Grant, 2008; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). However, the claims and conclusions drawn from Mindset Theory are limited and potentially over-interpreted in popular media, leaving much to be assessed in terms of interactions with task factors and resultant effects on cognitive processes. As a proposed alternative, the Strategic Mindset Model presents a more flexible view of mindset, and suggests that the relationships and interactions between mindset, task factors, and task performance are dynamic. The three major tenets of the Strategic Mindset Model posit that:

1. A fixed mindset is not necessarily detrimental to performance and learning.
2. The effects of mindset on performance and learning can be influenced by task parameters.
3. Mindset is malleable and can be influenced in a bottom-up manner by perceptions of competence and task-specific self-appraisals of performance.

These experiments demonstrate that performance is more readily influenced by task parameters than imposed mindset, naive mindset, or goal orientation. In the same way that self-reported learning styles may be preferential but not cognitively impactful (Pashler, McDaniel, Rohrer & Bjork, 2008), goal orientation and mindset may simply serve as preferences within a task space that do not reliably contribute to meaningful performance differences. Self-reported mindset orientations are malleable, and the changes in these views are linked to experiences in high-error scenarios. Across all three experiments, participants showed a significant decrease in self-reported endorsement of growth mindset orientation over the duration of the task.

In Experiments 1 and 2, the comparisons of self-reported mindsets before and after the task show that individually-held beliefs about the malleability of intelligence are susceptible to change over time when participants are engaged in challenging, high-error scenarios, regardless of exposure to a mindset reorienting intervention.

This method was an attempted improvement upon previous mindset-shifting paradigms, which simply present participants with one single exposure to the mindset-specific manipulation (Dweck & Leggett, 1988). In Experiments 1 and 2, participants were primed with this mindset information prior to every block. Despite repeated exposure to fixed- or growth-oriented verbiage, the imposition of mindset via goal framing is not as influential as the extended training discussed in previous research (c.f. Yeager & Dweck, 2012). However, this current observed shift does provide support for a revision to the existing view of the rigidity of mindset, particularly because this change over time is likely a result of task experience. This evidence for a bottom-up shift in mindset aligns with existing literature regarding environmentally-motivated mindset shifts (Anderman & Anderman, 1999; Anderman & Midgley, 1997), but demonstrates this organic shift on a much shorter timescale. Similar to existing findings regarding organic mindset shift as a result of classroom experience, participants in this experiment may have picked up on subtle task cues regarding the importance of maintaining a high level of performance, further emphasizing fixed mindset values (Anderman & Anderman, 1999; Anderman & Midgley, 1997).

Compared to the canonical view that suggests a need for detailed top-down intervention in order to bias mindset (Dweck, 2006; Yeager & Dweck, 2012; Yeager & Walton, 2011), Experiments 1 and 2 show that these bottom-up shifts can occur as a function of one's own ongoing performance appraisals. Further, there are some preliminary indications in Experiment 3B suggesting that the framing of goals to prime a specific mindset may also influence one's beliefs, suggesting that small, task-based influences may be effective as interventions as well. In entirety, these findings provide further preliminary support for all three tenets of the Strategic Mindset Model. At a minimum, the findings from this set of experiments can be used to call some components of Mindset Theory into question.

Results from Experiment 1 provide substantive evidence to support a critical commentary of Mindset Theory by suggesting that task factors are necessary components of the motivation regulation process, and should be considered in conjunction with mindset. Since task factors have been wholly overlooked in Mindset Theory, but goals have been used in mindset-related studies, these findings regarding goal characteristics begin to reconcile these effects via the new Strategic Mindset Model, resulting in a more thorough theoretical picture of the effects of mindset and task parameters on engagement and performance. Mindset clearly has some influence over task performance, but the characteristics of one's goal for the task exert far more leverage on performance outcomes. In support of the Strategic Mindset Model, findings from experiment 1 reify the importance of accounting for the compounding and interactive effects of individual differences and task parameters when assessing performance.

It is common for participants, students or employees to be asked to achieve their best performance, possibly leading to informal self-setting of goals (Bandura & Wood, 1989). These goals may take on a growth or fixed framing depending on the participant's existing beliefs and tendencies, making it difficult to discern the separate effects of goal characteristics and mindset on performance. By systematically assessing these effects alone and in conjunction with one another, the independent contributions of imposed mindset, naive mindset, goal orientation and goal origin (i.e. self-set or assigned) can begin to be disentangled. In the case of Experiment 1, it becomes clear that task parameters can influence goal setting behavior, but that performance is not readily affected by one's desired level of challenge in a goal-setting paradigm. However, elevated task performance can be motivated among growth-oriented learners by assigning a challenging goal. Beyond this theoretical contribution, further understanding of the influence of goals and mindset on performance is useful in many applied contexts. Given the advent of large-scale interventions to cultivate growth mindsets among students at the college level, it may behoove educators, researchers, employers and other practitioners to consider incorporating goal assignment in cases where tasks are challenging. As findings from this experiment indicate, this combination of naive growth orientation and assigned goal lead to improved performance in particularly difficult task environments. As there is no detrimental influence of assigned goals for individuals who continue to maintain a fixed mindset, the widespread use of assigned goals, as is commonplace, may continue to be the best practice for bolstering learning processes and resultant performance outcomes.

The benefits of desirable difficulty and productive failure paradigms are inherently dependent on challenge, struggle and preliminary failure, placing the paradigm at odds with any individual who is oriented toward a fixed mindset (DeCaro et al., 2015; DeWinstanley & Bjork, 2004; Kapur & Bielaczyc, 2012). By beginning to understand the interaction between mindsets and desirable difficulty effects, we are clarifying the degree to which motivational components contribute to or undermine cognitive processes. The generation effect is detected across both naïve mindset orientations, but there is still a clear difference in the magnitude of this effect depending on one's naively held beliefs about the value of failure. This may be driven by a hesitation or reluctance on the part of individuals holding fixed mindsets to fully engage with the task, which would generally align with Dweck and colleagues' views of fixed orientation (Dweck & Leggett, 1988; Licht & Dweck, 1984). However, attrition did not differ by mindset, suggesting that performance outcomes may be affected by mindset, but that overall responses to failure are more subtle than initially presumed. These findings add a new dimension to the otherwise fundamental conclusions drawn in the desirable difficulties literature. Rather than presuming that desirable difficulties influence learning and performance equally across all individuals, these experiments indicate that individual differences in motivation and engagement are central factors that explain a portion of the variance in these observed effects.

As proposed by the Strategic Mindset Model, these findings indicate that experience with difficult or error-prone tasks may modify beliefs about intelligence, indicating that changes in mindset can occur through a bottom-up mechanism. Even in circumstances where the experiences of failure are productive and beneficial for learning and later task performance, participants become increasingly likely to endorse fixed mindset views. Practitioners who are interested in facilitating a mindset shift may consider structuring new learning programs that build in regular opportunities for incremental success or achievement over time. In so doing, the learner may implicitly shift their beliefs to be biased toward a growth orientation.

The canonical view of mindset posits that growth-oriented individuals perceive failure and difficulty as an opportunity for learning (Bandura & Dweck, 1985; Dweck, 2000; Dweck & Leggett, 1988; Dweck et al., 2004; Mangels et al., 2006; Mueller & Dweck, 1998). The prioritization of lifelong learning over performance, which has value in many cases (specifically for children in school settings), provides the proper context for growth mindset to be preferred. This likely contributes to the success and acclaim of the existing research on mindset. However, many real-world scenarios yield problem spaces that are unsolvable or tasks that are unachievable. To maintain a strict growth mindset in these scenarios, the individual would certainly fall victim to one form of the sunk cost fallacy, ultimately pouring excessive resources into a futile task (Staw, 1976).

Rather than an inherent set of beliefs as Dweck and others have historically argued (Dweck, 2006), it is possible that mindset is simply an intelligence-framed assessment of one's own self-efficacy and locus of control for a task (Bandura, 2013; Rotter, 1966). To assess this, a future study may aim to track participants' self-reported mindset over the course of several tasks that vary in difficulty, rapidity of skill acquisition, and likelihood of goal achievement. If mindset is merely a reflection of one's context-specific beliefs about ability, the results should show a predictable pattern of mindset “shifting” in correlation with likelihood of success or skill acquisition. Arguably, individuals’ views of mindset may be relative to the perceived achievability of the performance benchmark. Mindset may occur on a continuum whereby one’s fixed or growth orientation is pushed further from the midline depending on the learner’s assessment of proximity to the desired performance level. The current categorical perspective of mindset may over-represent these orientations as wholehearted belief sets, rather than as contextualized strategy frameworks that lead to adaptive decisions about persistence in the face of difficulty, or quitting as a means of avoiding fruitless pursuits.

The findings from these current experiments not only provide support for the Strategic Mindset Model, but raise the question of whether a shift in the overarching narrative regarding mindset, success, failure and persistence is appropriate. Teaching people to identify their available resources, assess probability of desired outcomes, and execute a cost-benefit analysis of the situation would lead to a more dynamic, strategic approach for skill acquisition and task performance. Rather than perpetuating the existing persistence-bound perspective embodied in the adage "if at first you don't succeed, try try again", it may be more practical to endorse an even-keeled continuum-oriented view of mindset that emphasizes the importance of motivation regulation and strategic decision making during resource allocation and task engagement.

Across these experiments, participants voluntarily engaged with the tasks and tended to report growth-biased mindsets on average but were extremely conservative in their reports. This lack of extreme fixed or growth mindset orientation in these samples may stem from a few potential causes. First, it is possible that these individuals who would typically report highly fixed mindsets refuse to engage in the tasks at all, and elect to remove themselves before completing the initial mindset questionnaire. Although this would align with the canonical representation of fixed mindset (Dweck, 2006), such self-selection to avoid the possibility of demonstrating poor performance is unlikely in a no-risk laboratory or online environment. Alternatively, these participants may be inclined to bias their responses away from full endorsement of fixed mindset views due to a strong social bias suggesting that quitting and disengagement are unacceptable behaviors. The extant literature on mindset carries an implicit message that growth orientations are more adaptive and should be strived for, providing just one of many examples of a larger movement to step away from fixed mindset in service of cultivating a growth orientation (Dweck, 2006; Yeager & Dweck, 2012; Yeager & Walton, 2011).

This larger set of questions surrounding quitting and reluctance to re-engage in a task are heavily biased by an overarching stigma against such disengagement. In many cases, quitting is equated with failure, and the existing Mindset Theory perspective tends to convey this same message: that failure is acceptable, but quitting is not. In the growth mindset purview, trying until failure allows the learner to make more gentle attributions about task outcomes in order to carve out an environment that is accommodating of errors (Dweck, 2000; Dweck, 2006). This growth narrative holds quitting as the most undesirable outcome, as it is entirely oppositional to the growth orientation goal of self-improvement (Dweck, 2006). This perspective does not allow for the consideration of quitting as *strategic disengagement*. In instances where performance and absolute accuracy are prioritized, this deliberate decision to cease involvement may be a means of preserving resources that may be better invested elsewhere. For example, a person may be employed at a job that prioritizes performance and errorless outcomes, but the employee’s skill set is not developed enough to meet performance benchmarks, adequate training opportunities may be unavailable, or the scope of the job has changed over time to a degree that no longer includes the employee’s expertise. In a situation such as this, electing to quit and thus pursue a different and more fitting opportunity is a strategic, resource-oriented decision that may result in better long-term outcomes than sheer persistence. To simulate the possible outcomes of persistence and quitting in a given scenario, one can be strategic about regulating motivation and resource expenditure to ensure that blind persistence isn’t dictating the trajectory through the task space.

The construct of grit, related to persistence, has emerged as another individual difference that may predict performance outcomes (Duckworth & Gross, 2014; Duckworth, Peterson, Matthews & Kelly, 2007). As a general construct, grit centers on long-term achievement of a challenging goal rather than on skill acquisition in a task, but is seemingly driven by some of the same factors and attributes that underlay mindset (e.g. self-control, perseverance, beliefs about the possibility of success). Duckworth and Gross (2014) argue that grit is derived from “diverse psychological antecedents” (p. 6) that include locus of control and mindset, and that grit may potentially be modified or influenced through interventions that target these particular attributes. Grit appears to represent a rigid view of success, such that the best possible outcome is goal achievement regardless of cost. From a classroom standpoint, these attributes are rightly valued as being beneficial for ensuring that students engage with the foundational curriculum required to move through the formalized education system (Yeager & Dweck, 2012; Yeager & Walton, 2011). However, a lack of grit or the adoption of a fixed perspective for a specific task is certainly not a detriment, and can be a useful means of resource and effort conservation (Elliott & Church, 1997; Midgley et al., 2001). The overwhelming popularity of these constructs as a cure-all to issues in achievement is a slippery slope. Encouraging grittiness and growth mindset through intervention may be beneficial in the short term, but the rigidity inherent in these views sends an implicit message that these attributes are the keys to success. This is an overrepresentation of a complex relationship that depends on task factors and context, as well as larger cultural and societal influences. Hailing grit and growth orientation as preferred characteristics dismisses the importance of utilizing the option to quit as a strategic decision.

In acknowledging the importance of quitting as a deliberate decision rather than a character fault, the Strategic Mindset Model can again be applied as a variant perspective of motivation related to challenge. The Strategic Mindset Model suggests that people engage in continual self-monitoring of progress and performance in order to use this information to shift their perspective on the desired outcome and the importance of overall achievement. In situations where resilience, self-improvement, and development are valued, growth mindset is adaptive and preferred. However, many situations require reliable, steady, predictable levels of performance where error has less value. In these cases, a fixed mindset may be more appropriate for task-specific outcomes. As the Strategic Mindset Model emphasizes, the flexibility of mindset allows individuals to adapt to context and variant task spaces effectively.

Taken together, these experiments provide empirical evidence to substantiate the claims of the Strategic Mindset Model, thereby contributing to the understanding of the complex relationships between task factors, mindset and performance. The pervasiveness of performance assessments in several domains speaks to the importance of this kind of research, particularly because the existing literature on motivation takes a singular approach, yielding an impoverished view of motivation and performance. Thus, development of this detailed theoretical space allows for the formation of new, well-informed practices in education, athletics, workplaces and laboratories that account for mindset and task factors together to ensure increased motivation toward improved performance.

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Appendix A
Implicit Theories of Intelligence Questionnaire (Dweck, 2000)

Fixed Mindset Items

You have a certain amount of intelligence, and you can't really do much to change it.
Your intelligence is something about you that you can't change very much.
No matter who you are, you can significantly change your intelligence level.
To be honest, you can't really change how intelligent you are.

Growth Mindset Items

You can always substantially change how intelligent you are.
You can learn new things, but you can't really change your basic intelligence.
No matter how much intelligence you have, you can always change it quite a bit.
You can change even your basic intelligence level considerably.

Appendix B
Goal Orientation Questionnaire (Button, Mathieu & Zajac, 1996)

Performance Goal Items

I prefer to do things that I can do well rather than things that I do poorly.
I'm happiest at work when I perform tasks on which I know that I won't make any errors.
The things I enjoy most are the things I do the best.
The opinions other have about how well I can do certain things are important to me.
I feel smart when I do something without making any mistakes.
I like to be fairly confident that I can successfully perform a task before I attempt it.
I like to work on tasks that I have done well on in the past.
I feel smart when I can do something better than most other people.

Learning Goal Items

The opportunity to do challenging work is important to me.
When I fail to complete a difficult task, I plan to try harder the next time I work on it.
I prefer to work on tasks that force me to learn new things.
The opportunity to learn new things is important to me.
I do my best when I'm working on a fairly difficult task.
I try hard to improve on my past performance.
The opportunity to extend the range of my abilities is important to me.
When I have difficulty solving a problem, I enjoy trying different approaches to see which one will work.

Appendix C
Mid-Task Engagement Questions

This word completion game was difficult.*
This word completion game was fun.
I am happy with my performance on the word completion game.
I am happy with my performance on the fill-in-the-blank memory test.
I became discouraged while playing the word completion game.*
I would like to try the word completion game again.

*Items were reverse-scored.

Appendix D

Generation Task sentence stimuli with target words.

Sentences were presented in the order shown below for both the Generate Task and the Retrieval Task (ETS TOEFL ITP, 2017). Target words are presented in bold.

The Alaska pipeline starts at the **frozen** edge of the Arctic Ocean.
It stretches southward across the **largest** and northernmost state in the United States.
The pipeline ends at a remote ice-free **seaport** village nearly 800 miles from where it begins.
It is massive in size and extremely complicated to **operate**.
The steel pipe **crosses** windswept plains and endless miles of delicate tundra that tops the frozen ground.
It weaves through crooked canyons, climbs sheer mountains, and **plunges** over rocky crags.
It makes its way through thick forests, and **passes** over or under hundreds of rivers and streams.
The pipe is 4 feet in **diameter**, and up to 2 million barrels of crude oil can be pumped through it daily.
Resting on H-shaped steel racks called "bents," long **sections** of the pipeline follow a zigzag course high above the frozen earth.
Other long sections drop out of **sight** beneath spongy or rocky ground and return to the surface later on.
The **pattern** of the pipeline's up-and-down route is determined by the often harsh demands of the arctic and subarctic climate.
A little more than half of the pipeline is **elevated** above the ground.
The remainder is buried **anywhere** from 3 to 12 feet, depending largely upon the type of terrain and the properties of the soil.
One of the largest in the world, the pipeline cost approximately $8 **billion**.
The pipeline is by far the biggest and most expensive **construction** project ever undertaken by private industry.
No single **business** could raise that much money, so eight major oil companies formed a consortium in order to share the costs.
Each **company** controlled oil rights to particular shares of land in the oil fields.
Today, despite enormous **problems**, the Alaska pipeline has been completed and is operating.

Appendix E

Generation Task sentence stimuli with target words.

Sentences were presented in the order shown below for both the Generate Task and the Retrieval Task (National Oceanic and Atmospheric Association, 2017). Target words are presented in bold.

Humpback **whales** are well known for their long "pectoral" fins, which can be up to 15 feet in length.
These long fins give them **increased** maneuverability.
The fins can be used to slow down or even go **backwards**.
Similar to many whales, adult females are larger than adult males, reaching lengths of up to 60 feet.
Their body coloration is primarily dark grey, but individuals have a **variable** amount of white on their fins and belly.
This variation is so distinctive that the pigmentation pattern is used to identify **individual** whales, similar to a human fingerprint.
Humpback whales are the **favorite** of whale watchers, as they frequently jump out of the water.
In the summer, humpbacks are found in high latitude **feeding** grounds, such as the Gulf of Maine.
In the winter, they **migrate** to calving grounds in subtropical or tropical waters, such as the Dominican Republic.
Humpback whales travel great distances during their seasonal migration, the **farthest** migration of any mammal.
The longest **recorded** migration was 5,160 miles from Costa Rica to Antarctica.
During the summer months, humpbacks spend the majority of their time feeding and **building** up fat stores.
Humpbacks filter feed on small fish and can **consume** up to 3,000 pounds of food per day.
Several **hunting** methods involve using air bubbles to herd, corral, or disorient fish.
One highly complex hunting method called "bubble netting," is **unique** to humpbacks.
This hunting **technique** is often performed in groups with defined roles for each member.
Some group members **distract** the prey, while others scare it and herd it to the surface.
Once the prey are gathered near the **surface** of the water, the humpback whales lunge at and eat the prey.

Appendix F

Imposed Mindset Paragraphs & Comprehension Questions

Fixed Mindset Priming

People tend to naturally succeed or fail at certain tasks no matter how hard they try. People who make many mistakes and errors when they don't have the natural ability to do well at the task. Regardless of how much effort and practice a person contributes to the new task, they likely won't change their skill level by much. Because intelligence and ability are stable traits, people generally can't learn new things despite how hard they work.

Growth Mindset Priming

New skills are developed through practice. People do not start out doing a new task perfectly. Instead, they often make mistakes and errors. However, the more effort and practice a person contributes to the new task, the more they learn and grow. People can learn from their mistakes to perform better in the future. Because intelligence and ability can change, people can learn to do new things at any time in their lives simply by working hard.

Comprehension Question

Which of the following statements most accurately summarizes the paragraph you've just read?

I can change my intelligence if I try.
I cannot change my intelligence.