

**A Study of Mindset: Better Understanding the Structure of Mindset and how Growth
Mindset Interventions are Delivered**

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Abstract

Mindsets (MS) (i.e., beliefs about the malleability of traits) exist in many diverse domains, such as intelligence, creativity, emotions, and anxiety. With such a diversity of mindset domains, it is reasonable to question whether a general underlying factor influences all mindsets similarly. For example, if one believes intelligence is malleable, does one also believe creativity, musical ability, and athletic ability are malleable? In study 1, we conducted factor analysis on nine self-report mindset measures to determine if a general mindset factor exists. The nine mindsets studied clustered into three underlying factors: 1) Skills (intelligence, creativity, musical and athletic ability); 2) Personality (personality and morality); and 3) Emotions (emotions and anxiety). Stress did not load onto any of the three factors. In addition, we investigated ways to improve the efficacy of growth mindset interventions. Though growth mindset interventions show positive outcomes, the effect sizes are generally small. Actively engaging in material by applying the information to one's life, or teaching others, improves retention of that material over passively listening to the material being taught. In study 2, we sought to determine whether an active vs. passive growth mindset intervention is more effective for improving exam scores. We found no significant difference in exam score improvement between the control, active, or passive groups. It is possible that the active intervention was not engaging enough to alter one's mindset beliefs in only one exposure. Targeting general mindset factors rather than individual mindset domains may improve intervention efficacy.

Keywords: mindset, domain specificity, domain general, factor analysis, growth mindset, intervention, active learning, academic achievement

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Be it in sports, business, or even romantic relationships, we love the story of the ‘natural’. We hear it all the time, “You can’t teach that kind of speed”; “Business is just in her DNA”; “It was love at first sight”. As romantic as these ideas are, they miss (and dismiss) the importance of effort and our ability to learn and adapt to challenges and setbacks. This is not to deny that talent exists; however, the biggest success stories often incorporate some form of growth mindset belief (i.e., the belief that attributes are changeable with effort and that challenges and setbacks are not threats but rather are opportunities for growth). Whether it’s Michael Jordan or Wayne Gretzky and their relentless work ethic, making them the greatest in sport, or the 13-year-old kid entering junior high and successfully making the transition without suffering a decline in grades or psychological well-being, growth mindset can help people to achieve success, deal with stress, increase well-being, and improve academic and life outcomes.

Historical Background on Mindset

Implicit Theories

Early ideas about mindset began with research looking at implicit theories that inform how people choose the goals they have and understanding their motivations to pursue those goals. An implicit theory (as it pertains to mindsets) is an amalgamation of Kelly's (1955) theory of personality and Heider's (1958) field theory of social perception. According to Dweck et al. (1995), implicit theories can be understood as the implicit assumptions one holds as a framework to guide how information about the self and other people is processed and understood. In this first era of mindset research, early studies showed that looking at one’s implicit theory about how they viewed their intelligence predicted what type of goal the person would pursue. If they

viewed intelligence as a fixed entity (entity theory), they were more likely to adopt the performance goal of documenting that entity (i.e., looking intelligent), whereas if one viewed their intelligence as a malleable quality (incremental theory), they were more likely to pursue a learning goal (i.e., developing that quality) (Bandura & Dweck, 1985; Dweck, Tenney, & Dinces, 1982; Leggett, 1985). It is important to note that incremental theories are called theories because they were potentially falsifiable ideas about what intelligence is and how it might work (Dweck and Yeager, 2019).

Continuing their research on implicit theories, Dweck and Leggett (1988) presented a research-based model that attempted to account for the adaptive and maladaptive patterns arising from the psychological processes underlying the motivations to choose particular goals. Their proposed model specified how one's implicit theories would orient them toward particular goals (i.e., performance or learning/mastery goals) and the different primary concerns in relation to those goals. For example, within a performance goal, the individual's primary concern is measuring their ability and answering the question, "Is my ability adequate or inadequate?". Within such a binary categorical framework, outcomes are a primary source of information that the holder of the performance goal uses to measure success or failure. Therefore, failure may readily elicit the helpless attribution that one's ability is inadequate. In contrast, within a learning goal, the individual's primary concern is not with the outcome but with increasing one's ability with a focus on mastery (Dweck & Leggett, 1988). This focus leads individuals to pose the question, "What is the best way to increase my ability or achieve mastery?" In the case of learning goals, outcomes provide information as to whether one is pursuing an optimal course for achieving mastery. If they are not achieving mastery, they ask, "What else might be necessary?".

Failure indicates the efficacy of one's current strategy and not simply a threat to one's adequacy (Dweck & Leggett, 1988).

Other external attributes are connected to each of the two implicit theories. Someone holding an entity theory tends to show behavioural patterns of helplessness (e.g., avoiding risk and low persistence) and low initiation of and persistence toward change. Cognitively, they tend toward rigid, oversimplified thinking. In contrast, someone holding an incremental theory tends to show behavioural patterns of mastery orientation (e.g., seeking challenges and high persistence), and they more often seek to tackle and rectify a problematic situation in their environment. Cognitively, they show process analysis (i.e., analysis of the efficacy of one's strategy; Dweck & Leggett, 1988). One's incremental theory is also predictive of one's perception of control. For instance, in the entity theorist (i.e., someone who views attributes as fixed or uncontrollable), research has shown that when the perceived attribute is high, they see their control as high. Whereas, if the perceived attribute is low, control is not possible, and outcomes will be negative or determined by chance. In contrast, in the incremental theorist (i.e., someone who views attributes as malleable and within one's control), when the perceived attribute is high, they also see their control as high. However, the contrast lies in when the perceived attribute is low. Here, the incremental theorist still believes control is possible, although it requires more time and effort (Dweck & Leggett, 1988; Dweck, Chui, & Hong, 1995). Dweck and others are proposing a new understanding of how our beliefs predict the way we understand the world.

Implicit beliefs act as one's core assumptions about how the world works. These core assumptions are not rigidly determined; but rather, they cultivate a framework that influences one's judgements and reactions (Dweck, Chui, & Hong, 1995). Dweck, Chui, & Hong (1995)

also contend that there is no “correct” theory to hold; these theories are just ways of constructing reality. Entity theorists tend to understand outcomes and actions in terms of fixed traits. In contrast, incremental theorists tend to believe that attributes are more dynamic, malleable, and developable. An incremental theorist tends to focus less on broad traits, and instead tends to understand outcomes and actions in terms of more specific behavioural or psychological mediators (Dweck, Chui, & Hong, 1995).

To better understand implicit theories, a shift to focusing on specific attributes rather than the broader discussion of performance vs mastery goals was made. This focus led Dweck et al. to contend that people's implicit theories about human attributes also structure the way they understand and react to human actions and outcomes (Dweck, Chui, & Hong, 1995). To better understand these two belief frameworks, Dweck, Chui, & Hong (1995) developed measures to assess implicit theories in three areas: intelligence, morality, and personality. Examples of the items included in these measures are: "You have a certain amount of intelligence, and you really can't do much to change it" (implicit theory of intelligence); "A person's moral character is something fundamental about them, and it can't be changed very much"(implicit theory of morality); and "People can do things differently, but the important parts of who they are can't really be changed" (implicit theory of personality). Participants indicated how much or little they agreed with these statements on a six-point scale from one (strongly agree) to six (strongly disagree). It was with these scales that Dweck and her colleagues further refined the concept of mindset that we know today (Dweck et al., 1995).

Understanding implicit theories as a meaning framework was the next step in the cultivation of our contemporary conception of mindsets. Implicit theories create the meaning framework in which attributions occur and are important for understanding those attributions and

motivation. For example, believing one's intelligence was malleable predicted and created attributions of effort and ability. These attributions then mediated mastery-oriented coping (Dweck et al., 1999). Interestingly, although both entity and incremental theorists make strong attributions about ability, these attributions seem to have different meanings for the two groups. For example, when faced with the challenging situation of receiving negative feedback, incremental theorists were more likely than entity theorists to attribute the failure to effort (Dweck et al., 1999). One explanation for this difference is the way that entity and incremental theorists define ability. Entity theorists define ability in terms of fixed intellectual qualities, while incremental theorists see outcomes as an indication of their current level of mastery (i.e., ability) on the task, mastery that could be improved through effort. The implicit theories one holds may influence students as they progress in school and are faced with increasing challenges. Dweck et al. (1999) point out that research findings have indeed revealed that as students progress in school and challenges increase, there is a relatively long-term negative effect on achievement. This negative effect is likely to cause elevated levels of stress and anxiety.

Different conceptions of the relationship between effort and ability within the entity and incremental frameworks shed light on how effort is viewed from each of these different frameworks. For instance, for those holding an entity theory, if one needs effort, this means that one does not have the ability; in an attempt to prove that one has the ability, one should invest less effort in the task. However, within an incremental theory, effort and ability are positively related, meaning that to promote one's competence, one should try harder to solve challenging problems. A better understanding of these meaning frameworks further expands the implicit theories model, reiterating that entity theorists are focused on the fixed, immutable quality of

ability, and incremental theorists are focused on the malleability of ability with effort (Hong et al., 1999).

The Etiology of Implicit Theories

An important question in the study of implicit theories is: Where do implicit theories come from? How is it that one comes to hold the beliefs they do regarding the fixed or malleable nature of one's characteristics? According to Mueller and Dweck (1998), the cause of one's implicit incremental or entity beliefs is rooted in the praise parents give their children. For example, after a success, if parents praised their child for intelligence or the outcome (i.e., person praise), the child was more likely to manifest a fixed mindset compared to if parents praised their child for effort (i.e., process praise). Consequently, holding a fixed mindset predicted the pursuit of performance goals, low-ability attributions for failure, and impaired performance (due to helpless reactions) following failure (Mueller & Dweck, 1988).

Moving from Implicit Theories to Mindsets

The linguistic shift from implicit theories to mindsets was first described in Carol Dweck's (2006) book, *Mindset: The New Psychology of Success*. The terms fixed mindset (i.e., entity theory) and growth mindset (i.e., incremental theory) were introduced by Dweck to make the concept of implicit theories more accessible to the general population (Dweck, 2006). Growth and fixed mindsets can also be thought of in terms of either proving one has the ability (fixed mindset) or improving one's ability (growth mindset). A fixed mindset about a characteristic, trait, or attribute is the belief that that characteristic, trait, or attribute cannot be developed. In contrast, a growth mindset is the belief that characteristics, traits, or attributes can be developed, for example, through personal effort, good learning strategies, and lots of mentoring and support from others (Dweck & Yeager, 2019).

Study I

Explosion of Mindset Domains

Early in the history of mindset research, the focus was almost entirely on the mindset of intelligence (Dweck, 2006; Dweck and Yeager, 2019). More recently, there has been a veritable explosion of research into mindset domains concerning different specific characteristics, traits, and attributes. What follows is a chronicling of the diverse mindset domains used in the current study (which is not an exhaustive list).

Intelligence Mindset. Intelligence mindset is defined as one's belief about the malleability of their intelligence. A fixed mindset about intelligence is the belief that intelligence cannot be developed, while a growth mindset is the belief that intelligence can be developed through personal effort, good learning strategies, mentoring, and support (Dweck & Yeager, 1999). An updated version of the intelligence mindset scale from the original three-item scale (Dweck et al., 1995) contains eight items (four growth items and four fixed items; De Castella & Byrne, 2015).

Research investigating intelligence mindset has highlighted significant differences in the likelihood of entity (fixed) versus incremental (growth) theorists taking remedial action in the face of failure. Entity theorists whose skills were unsatisfactory were not as inclined to take remedial action to improve, even when they knew that the skills in question were essential for their future success. In contrast, incremental theorists were more likely to take remedial action to improve their performance upon realizing that their skills in an important subject were unsatisfactory. Incremental intelligence theorists also show a willingness to take on challenges not shown by entity theorists (Hong et al., 1999; Yeager, Romero, et al., 2016; Yeager, Hanselman, et al., 2018).

Musical Mindset. Musical ability mindset is defined as one's belief about the malleability of their ability to learn/play music (Burgoyne et al., 2019; Holochwost et al., 2021). Burgoyne et al. (2019) adapted the intelligence mindset measure (Dweck et al., 1995; De Castella & Byrne, 2015) to assess musical ability mindset by substituting *music ability* for *intelligence* (e.g., "You can always substantially change how much music ability you have" or "You can learn new pieces of music, but you can't really change how good you are at music.").

It may be the case that through the cultivation of a musical mindset, at risk children, particularly those facing poverty and racism that inculcate patterns of learned helplessness, may more easily cultivate an intelligence mindset and all the benefits that are associated with it (Holochwost et al., 2021). In a demographically diverse sample of 497 students enrolled in one of 12 programs of orchestral music education for one year (24%), two years (17%), or three years (21%), Holochwost et al. (2021) found that musical growth mindset scores increased over the course of the program year regardless of the number of years that students were enrolled in orchestral music education. They also reported that gains in students' musical growth mindset prompted corresponding changes in students' intelligence mindsets (reported as "overall" mindset) (Holochwost et al., 2021).

Creativity Mindset. Creativity mindset is defined as beliefs about the stable versus malleable character and nature of creativity in terms of the perceived genesis of creative abilities and the possibility of developing creativity (Karwowski, 2014). Karwowski (2014) adapted the intelligence mindset measure (Dweck et al., 1995; De Castella & Byrne, 2015) to assess creativity mindset by substituting *creativity* for *intelligence* (e.g., "You have a certain amount of creativity, and you really can't do much to change it" or "You are stuck with whatever amount of

creativity you are born with.”). Karwowski (2014) added two more items (one growth and one fixed) to the eight-item intelligence mindset scale. Karwowski (2014) found that growth creative mindset correlated substantially with a malleable theory of intelligence ($r = .59$). They also found that endorsement of a creativity entity theory translated into a lower interest in creative thinking and lower self-reported creativity and divergent thinking production. Exploratory factor analysis (EFA) suggested that fixed and growth creative mindsets constituted two separate factors, rather than two ends of one continuum; this finding may be due to the complexity of how people think about creativity. For instance, creativity may be viewed as Big-C creativity (i.e., great creative accomplishments, such as Michelangelo’s David) or little-c creativity (i.e., small creative accomplishments, such as do-it-yourself projects or home decoration). The complexity of types of creativity suggests that experts may hold both a fixed mindset (i.e., perceiving the creative person as an artist type) and a growth mindset (i.e., viewing creativity as a multifaceted phenomenon consisting of both Big-C and little-c) simultaneously (Karwowski et al., 2019). Karwowski (2014) also reported that when it comes to insightful problem solving, a fixed creativity mindset correlated negatively with the effectiveness of insight-problem solving, whereas a growth creativity mindset was positively associated with insight-problem solving.

Athletic Mindset. Athletic mindset, or sport ability beliefs, are beliefs that athletic ability is stable and a gift (entity theory) or that improvement is possible and one’s sports ability can be developed through learning and effort (incremental theory; Biddle et al., 2003). The sport ability beliefs measure is a 12-item scale derived by Biddle et al. (2003) from the Conceptions of the Nature of Athletic Ability Questionnaire (CNAAQ) first created by Sarrazin et al. (1996). Sarrazin and colleagues (1996) studied children 11–12 years old and found support for the relationship between one’s beliefs concerning the nature of their athletic ability and the adoption

of different physical activity goals (specifically related to sports). Those choosing a ‘learning’ (i.e., task) goal were more likely to endorse incremental beliefs about sports ability than those adopting performance (i.e., ego) goals. This research parallels Dweck and Leggett's (1988) work on implicit beliefs described above.

Biddle et al. (2003) showed that amotivation is predicted directly and indirectly by beliefs. Specifically, holding an entity belief about one's athletic ability was a strong predictor of amotivation in physical education and sport, regardless of perceived competence. This finding indicates that believing one's athletic ability is a gift and is stable appears to be motivationally maladaptive (Biddle et al. 2003), even for those individuals confident in their own ability. For example, the entity theorist is primarily interested in ‘looking good’ on a physical task to prove the adequacy of their stable, ‘God-given’ talent. This concern in turn leads one away from improving because the primary focus is on showing that one has the ability, not on mastery (Dweck & Leggett, 1988). It has also been shown that students who endorsed an entity belief about their athletic ability employed reduced effort strategies and made excuses when facing potential athletic failure. An example of a reduced effort strategy can be seen in self-handicapping. Although the use of self-handicapping may protect or enhance perceived competence, and may even increase self-worth in the short term, previous studies investigating self-handicapping in academic contexts indicate that it has a maladaptive effect on learning, leading to lower persistence, poorer self-regulation (Martin, Marsh, & Debus, 2003), and effort withdrawal (Pyszczynski & Greenberg, 1983). In contrast, those who believed their athletic ability was changeable with effort did not reduce effort when encountering uncertainty (Chen et al., 2008).

Anxiety Mindset. Anxiety mindset, or “theory of anxiety”, is defined as the degree to which individuals believe anxiety is malleable. For example, a fixed anxiety mindset is the belief that one’s anxiety cannot be changed. In contrast, a growth anxiety mindset is the belief that one’s anxiety is malleable and can be changed through personal effort (Schroder et al. 2015). The “theory of anxiety” scale was adapted from the Dweck et al. (1995) and De Castella & Byrne (2015) intelligence mindset scale by Schroder et al. (2015). Schroder and colleagues (2015) found that implicit theories of anxiety were uniquely related both to cognitive reappraisal and to emotional suppression, where holding an incremental theory of anxiety predicted more frequent reappraisal and less frequent suppression. Growth beliefs of anxiety are also negatively related to psychological distress (Schroder et al., 2015; Schroder et al., 2016; Yalch, Schroder, Dawood, & Donnellan, 2017). Research has further shown that when one holds a growth mindset about anxiety, it buffers the link between a history of stressful life events, psychopathology, and maladaptive coping strategies (Schroder et al., 2017). In contrast, it was found that patients with social anxiety disorder endorsed more of an entity theory both about their emotions and about their social anxiety, compared to non-clinical participants (De Castella et al., 2015). In addition, those holding a fixed mindset about anxiety tend to employ many avoidance-based emotion regulation strategies rather than more adaptive cognitive reappraisal strategies. These avoidance-based emotion regulation strategies most frequently include alcohol use, substance use, self-injury, and expressive suppression (Schroder et al., 2015; Schroder et al., 2017). For example, those holding fixed beliefs about anxiety reactively use methods like suppression or avoidance to attempt to change the uncomfortable feelings associated with anxiety after they have had the emotion (Tamir et al. 2007). This response seems to make sense, as entity theorists believe they

cannot change their anxiety, but can only attempt to suppress or avoid the negative feelings associated with it.

Emotion Mindset. Emotion mindset, or “theory of emotion”, is defined as the degree to which individuals believe their emotions are malleable (Tamir et al. 2007). The “theory of emotion” scale was modified from the Implicit Theories of Intelligence Scale (Dweck, 1999) to refer to beliefs about the fixed versus malleable nature of emotion (Tamir et al. 2007). Implicit theories of intelligence and emotion are related but are clearly separable from one another (Tamir et al., 2007). As with growth mindset about anxiety, growth mindset about emotions is positively correlated with cognitive reappraisal (De Castella et al. 2013; Ford et al. 2019; Kneeland et al. 2016; Schroder et al. 2015) and negatively related to maladaptive emotion regulation strategies, such as avoidance (De Castella et al. 2018). Research has shown that students entering college with a fixed emotion mindset experienced more depressive symptoms by the end of their first year (Tamir et al. 2007; De Castella et al. 2013; Romero et al. 2014) compared to students who were growth-minded about their emotions. These findings were later replicated in a larger adolescent sample (Ford et al. 2019). In addition, other studies showed that holding more malleable beliefs about emotions appears to predict decreased negative affect both overall during the day and specifically in response to upsetting daily events (Kneeland, Dovidio, Goodman, 2016).

Morality Mindset and Person/Personality Mindset

The scales used to assess both morality mindset and person mindset were developed by Dweck, Chiu, and Hong (1995) in the same study in which the original intelligence mindset scale was developed. Dweck, Chiu, and Hong (1995) found that people holding entity theories of personality and morality had a greater tendency than those holding incremental theories of these

constructs to make dispositional trait inferences from preliminary behavioural information. They also found that incremental theorists of personality or morality tended to focus more often on the specific psychological factors that mediate social and moral behaviours (e.g., what the other person might be thinking or feeling), whereas the entity theorists had a greater tendency to make global trait judgments of others, both positive and negative, from initial information about their social and moral behaviour.

Morality Mindset. Morality mindset is defined as one's belief about the malleability of their moral character (Dweck, Chiu, and Hong 1995). A study by Scirocco & Recchia (2021) looking at the between and within-person differences in adolescents' endorsement of moral essentialism (i.e., the belief that morality is a fixed part of our nature) and moral incrementalism (i.e., the belief that morality is malleable and can be cultivated) across various types of morally-relevant situations found that the majority of the variance for essentialism and incrementalism was linked to within-person differences across contexts. Adolescents endorsed moral essentialism more in prosocial contexts and incrementalism more in antisocial contexts. In prosocial situations, holding an essentialist belief about morality was linked to likability, acceptability, person attributions and consequence judgments. Whereas antisocial situations elicited higher unlikability ratings. This finding highlights the flexible endorsement of moral essentialism and incrementalism and shows that adolescents' judgments are responsive to the unique features of events (Scirocco & Recchia, 2021). Implicit theories of morality also have an effect on prosocial behaviour. Holding a growth morality mindset was found to positively influence motivation across various domains of personality and social behaviour. For instance, believing that one's moral character is malleable and improvable through effort influenced people to engage in more prosocial behaviour (Han et al., 2018).

Person/Personality Mindset. Person/personality mindset is defined as one's belief about the malleability of the person as a whole (i.e., one's personality; Dweck, Chiu, and Hong, 1995). Core beliefs or belief systems can organize and shape people's goals, strivings, interpretations of, and reactions to the environment, creating consistent patterns of experience and actions (i.e., personality; Dweck, 2008). Regarding the malleability of personality, in a meta-analysis looking at the patterns of mean-level change in personality traits across the life course, Roberts, Walton, & Viechtbauer (2006) found that personality traits show a clear pattern of normative change across the life course. People become more socially dominant, conscientious, and emotionally stable mostly in young adulthood (age 20 to 40), but in several cases also in middle and old age. The most noteworthy finding reported by Roberts, Walton, & Viechtbauer (2006) is that personality traits changed more often in young adulthood (age 20 to 40) than any other period of the life course, including adolescence. In mindset interventions, changes cut across many of the broad traits thought to be relatively stable, such as openness to experience (e.g., challenge-seeking), conscientiousness (e.g., hours studied), sociability (e.g., reaching out to others), and negative affectivity (e.g., resilience vs. negative reactions to setbacks; Dweck, 2008). Finally, Miu and Yeager (2014) found that students entering high school showed increasing depressive symptoms over the nine-month academic period; however, a brief (30 min) growth mindset intervention teaching the incremental theory of personality reduced the students' incidence of clinically elevated depression by 40% (also see Yeager and Walton 2011).

Stress Mindset. Finally, a stress mindset, as measured by the scale we used in this study, is slightly different from the other implicit theories. Stress mindset in this context is defined as the extent to which one holds the belief that stress is either enhancing for various stress-related outcomes (e.g., performance and productivity, health and wellbeing, and learning and growth), or

has debilitating consequences for those outcomes (Crum et al., 2013). The construct of stress mindset is not an appraisal. Whereas appraisal of stress refers to the evaluation of a particular stressor as more or less stressful, Crum et al. (2013) describe stress mindset as referring to the evaluation of the nature of stress itself as enhancing or debilitating. For example, one may view a particular stressor (e.g., an upcoming final exam) as highly stressful, but hold a stress-is-enhancing mindset and believe that experiencing the stress will result in enhancing outcomes (e.g., “the stress will help me perform my best”). Conversely, one may also appraise the upcoming final exam as highly stressful, but instead hold a stress-is-debilitating mindset, expecting the stressor to worsen academic performance (Crum et al., 2013). Research into stress mindset has shown that those holding an enhancing mindset reported improved psychological symptoms and better work performance, whereas those holding a debilitating mindset did not. In addition, individuals who endorsed a stress-is-enhancing mindset had a stronger desire to receive feedback and a more adaptive cortisol profile under acute stress than those who endorsed a stress-is-debilitating mindset (Crum et al., 2013). Interventions have targeted optimizing stress responses with reappraisal by integrating the stress-is-enhancing mindset approach. This approach does not directly target performance contexts and associated appraisal processes, but rather seeks to shape meta-level beliefs about the nature of stress. So, one completing a stress mindset intervention could adopt a mindset that stress is enhancing, yet still have difficulties implementing this belief system to improve performance and functioning. However, by incorporating stress reappraisal themes in interventions, one could assist people in applying higher-level stress mindsets to specific performance contexts by presenting stress responses as resources (Jamieson et al., 2018).

The Domain-Specific Versus Domain-General Debate

A question germane to the study of mindset that is currently debated in the literature is the question of domain generality versus domain specificity of the mindset construct. Is the construct of mindset made up of disparate, related, but separate categories? Is there one overarching construct that mediates all beliefs about individual traits related to the different mindsets studied? Or is it perhaps somewhere in between, where groupings of individual mindsets load onto a set of distinct factors?

Dweck and colleagues proposed that although some people may hold one very generalized theory about the malleability of traits, others may hold different theories about different attributes. For instance, one might believe that intelligence is a fixed characteristic, but then also hold the belief that moral character is malleable. In this latter case, the person's entity theory would provide the framework for their thoughts and actions in the intellectual domain; however, when considering one's moral character (their own, and perhaps others), the incremental theory would provide the framework that structures their thinking and behaviour relating to moral character. Dweck et al. (1995) contend that what is at work in the latter case is not a generalized cognitive style, but rather a domain-specific conceptual framework (Dweck et al., 1995). In an even further dissection of the mindset construct, but still in line with Dweck et al.'s (1995) proposed structure, Karwowski, Royston, and Reiter-Palmon (2019) sought to determine whether individuals can hold both fixed and growth creative mindsets *simultaneously*. Previous studies (Hass et al., 2016; Karwowski, 2014; Tang et al., 2016) consistently demonstrated a two-factor, rather than a one-factor, structure of creative mindset. This finding has led researchers to conclude that it may indeed be possible to hold both a fixed and growth mindset, at least in the domain of creativity (Karwowski et al., 2019). In addition, the usually weak negative correlations found between fixed and growth mindsets of creativity strengthen

Karwowski, Royston, and Reiter-Palmon's (2019) conclusions of a two-factor structure of creative mindset. Karwowski et al. (2019) contend that, although people can take either a fixed or growth perspective while perceiving the sources of creativity, their finding of two independent factors suggests that holding both a fixed and growth creative mindset is possible.

On the other side of the domain-specific, domain-general debate is Cheng & Hau (2003). In an investigation of mindset specificity looking at elementary and high school students, their finding suggests that there is one general underlying mindset. Cheng & Hau (2003) suggest that, based on the findings of high correlations ($r = .56$) among beliefs across different personal attributes, and their adequate representation by a second-order factor model, there is generality of implicit beliefs across different attributes. These findings are in stark contrast to Dweck et al.'s (1995) findings of low correlations (i.e., less than $r = .26$) among implicit theories of three personal attributes (intelligence, morality, personality). A closer look at the factor correlations among the beliefs of different personal attributes in Cheng & Hau's (2003) study shows a range from $r = .38$ to $.67$. To explain this range, the researchers proposed that there may be a closer resemblance among particular attributes (e.g., personality and creativity are both unchangeable), while other attributes are more distinct (e.g., personality is unchangeable, while morality is malleable). However, students' implicit beliefs about the changeability of intelligence, personality, creativity, emotional intelligence, and morality tend to be very similar and do not differ substantially between elementary and high school students (Cheng & Hau, 2003).

Rather than each mindset domain being specific to one characteristic or attribute, or residing within one general, all-informing overarching mindset factor, it may be the case that particular mindsets group together into different factors. Mental health-related mindsets, or mindsets of emotion (e.g., emotion mindset, anxiety mindset), are psychometrically separable

from mindsets of intelligence and personality. In other words, the mindsets of anxiety and emotion are not superfluous with the mindsets of intelligence and personality (Schroder, 2021). Items assessing these different mindsets loaded onto separate factors, suggesting they tap into largely distinct beliefs regarding anxiety, intelligence, and emotion (Schroder et al. 2015). Furthermore, Schroder et al. (2016) found that mindsets are represented by different latent factors and by a ‘generic mindset factor’. That is to say, mental health-related mindsets (e.g., anxiety and emotion) are distinguishable from one another, but also interrelated by a general dimension that cuts across domain-specific mindsets. For example, the implicit theory of anxiety measure was most predictive of psychological symptoms, and both anxiety and emotion mindsets each predicted unique variance in symptoms of worry, physiologic anxiety, anhedonic and general depression, and perfectionism (Schroder et al., 2015). In addition, through exploratory (Schroder et al., 2015) and confirmatory (Schroder et al., 2016) factor analyses on all 12 implicit theory items from the TOA (anxiety), TOI (intelligence), and TOE (emotion) scales, Schroder et al (2015, 2016) found that the items loaded cleanly onto three separate factors. However, TOA and TOE were related and distinct from TOI (Schroder et al. 2015, 2016). What Schroder et al. (2016) have shown is that there is both specificity and generality in the construct of mindset.

When investigating the debate around understanding the structure of mindset, it is prudent to consider how different mindsets might group under different factors in different cultures. Several studies have looked at the structure of mindset in Chinese participants. Zhu et al. (2020) aimed to test the hypothesis of a domain-general mindset. They found that there was satisfactory internal consistency for four (i.e., cognition, behaviour, emotion, and feelings) of the six subscales they studied. Zhu et al.’s (2020) results showed that the domains of cognition,

behaviour, feeling, and emotion constituted an underlying general factor cutting across these specific domains. The intelligence and personality subscales were the exception; intelligence and personality were independent of the general factor.

More evidence in favour of the distinct factors structure of mindset, with multiple domains sharing a common factor, can be found in Zhu, Zhuang, and Lee's (2021) study looking specifically at mental health-related mindsets. The researchers showed that Mindsets of Depression, Anxiety, and Stress (MDASS) produced a clear three-factor structure with unidirectional items, and the three subscales had good inter-item and item-total correlations. Higher fixed MDASS predicted higher scores of depression, anxiety, and perceived stress level in both young adult and adolescent cohorts of two large Chinese samples of participants. However, the story may be more complex. Among adolescents, the results did not fit the three-factor model as they did in university students. Zhu, Zhuang, and Lee (2021) suggest that the scales with unidirectional fixed mindset items improved comprehension of the meaning of the statements. This suggestion is in line with Dweck et al.'s. (1995) model of meaning statements underlying one's implicit beliefs. How items are framed (i.e., either in fixed or growth mindset wording) might have influenced respondents' comprehension and choice selection, which may be the leading cause of the distorted factor structure (Zhu, Zhuang, and Lee, 2021). Young people are developing emotional intelligence in early and middle adolescence and may not be able to clearly differentiate the feelings of depression, anxiety, and stress (Chen, 2008; Krettenauer et al., 2008), suggesting that the MDASS should be used with unidirectional items among adolescents to measure their beliefs about the malleability of the general negative emotion states.

In an attempt to examine other general factors distinct from emotional mindsets, Chan et al. (2021) assessed four domains (intelligence, ability, personality, and relationship). To further

explore the issue of domain-specificity of growth mindsets, the authors conducted confirmatory factor analyses on adolescents' (10-17 years old) item responses to the Growth Mindset Rating Form (GMRF), a collection of implicit theory items from the domain-specific areas of intelligence, ability, personality, and relationship. The authors contend that implicit beliefs about these four domains can be regarded as distinct and specific. Mean responses indicated that adolescents regarded ability to be the most changeable, followed by intelligence and relationship, with personality regarded as the least malleable. However, although the four domain-specific growth mindsets were found to be distinct, their intercorrelations were moderately high and significant (r s between .45 and .66, $p < .001$). These findings suggest that there may be distinct domain-specific mindsets; however, there are also strong correlations between these mindsets, suggesting perhaps a broad general factor that cuts across all mindset domains.

Historical research investigating the structure of mindset (e.g., Cheng & Hau, 2003; Dweck et al., 1995) has contributed important findings to the domain-specific – domain-general debate. However, current research (e.g., Chan et al., 2021; Schroder et al., 2015, 2016; Schroder, 2021; Zhu, Zhuang, and Lee, 2021; Zhu et al., 2020) findings suggest that instead of studying mindsets specific to one domain at one time, or searching for an all-encompassing domain-general mindset, studying the more general factors underlying multiple mindset domains could not only lead to a greater understanding of the structure of mindset, but may also hold important implications for growth mindset interventions.

We conducted this study to better understand the structure of mindset. In study I, we aim to add clarity to the debated question of domain generality versus domain specificity of the mindset construct. Past and current research into the structure of mindset specificity has, to the best of our knowledge, only compared six or fewer mindset domains at once. In our study, we

investigated nine different mindset domains (intelligence, musical ability, creativity, athletic ability, anxiety, emotion, morality, personality, and stress). Based on current research findings (e.g., Chan et al., 2021; Schroder et al., 2015, 2016; Schroder, 2021; Zhu, Zhuang, and Lee, 2021; Zhu et al., 2020), it appears that the structure of mindset cannot be fully understood through isolated, specific mindsets, or through an all-encompassing domain-general mindset. We therefore predict that the structure of mindset lies somewhere between disparate domains and one overarching construct, where groupings of individual mindsets load onto a set of distinct factors.

Using the results of the exploratory factor analysis, we also sought to determine if the growth mindset factors were predictive of one's level of state anxiety, perceived stress, neuroticism, perfectionism, optimism, and psychological flexibility. Based on past research indicating the negative association of growth mindset with stress (Crum et al., 2013) and anxiety (Schroder et al., 2019; Tamir et al., 2007), and positive associations with well-being (Howell, 2017), we predicted that higher scores on growth mindset factors would be predictive of lower levels of state anxiety, perceived stress, neuroticism, and perfectionism. Conversely, we predicted that growth mindset factors would positively correlate with the personality measures of psychological flexibility and optimism.

Methods

Participants

The original sample of participants for this study included 909 people. Participants could sign up if they were enrolled in a Psychology course at MacEwan University. There were no other inclusion or exclusion criteria. We recruited participants through SONA, MacEwan University's online research participant pool. Participants in this study received 2% course credit

for their participation. Participants were excluded for missing or incomplete data (43 participants) or for a survey completion time that was under 499 seconds (17 participants). The final sample of participants used in the analyses consisted of 849 participants (577 females (68%); 256 males (30%); 11 nonbinary (1.3%); 5 preferred not to answer (0.6%). Ages ranged from 17 to 43 years ($M = 20.9$, $SD = 4.13$). Participants also reported their current year of study ($M = 1.7$, $SD = 1.14$), psychology classes currently enrolled in (e.g., PSYC 104, PSYC 233, etc.), and their current GPA (range: 0.77 to 4.0, $M = 3.32$, $SD = 0.51$). For those participants that had not yet received a GPA (i.e., first semester of university), we converted their reported high school average to a GPA based on MacEwan's 4.0 GPA scale (see Appendix A).

Materials

Mindset Measures. We used nine different mindset scales to assess different domains of mindset. These scales included intelligence, musical ability, creativity, athletic ability, anxiety, emotion, morality, personality, and stress.

Implicit Theories of Intelligence Scale. Students' theories of intelligence were measured using the eight-item Implicit Theories of Intelligence Scale (Dweck et al., 1995; De Castella & Bryne, 2015). Four items assess the extent to which intelligence is viewed as stable or enduring (e.g., "You have a certain amount of intelligence, and you can't really do much to change it") and four items assess the extent to which intelligence is viewed as malleable (e.g., "You can change even your basic intelligence level considerably"). All items were rated from one (strongly disagree) to six (strongly agree). Total scores were summed across entity and incremental items after reverse-scoring entity items. Scores can range from 8-48. Higher scores indicate greater incremental beliefs (i.e., intelligence growth mindset). This measure has well-

established psychometric properties, showing high internal reliability (Cronbach's $\alpha = .98$; Dweck et al., 1995).

Implicit Theories of Music Ability Scale. Participants completed a questionnaire designed to measure mindset of musical ability adapted from Dweck et al. (1995). The Implicit Theories of Music Ability Scale (Burgoyne et al., 2019) is an eight-item measure of one's beliefs regarding the malleability of musical ability. Participants rated four fixed mindset statements (e.g., "Your musical ability is something about you that you can't change very much.") and four growth mindset statements (e.g., "You can always substantially change how much music ability you have.") on a six-point scale from one (strongly disagree) to six (strongly agree). The four fixed-minded items were reverse-scored and all items were summed to obtain the music ability mindset score. Scores could range from 8-48. Higher scores reflect a greater endorsement that musical ability is malleable (i.e., a growth music mindset).

Creative Mindset Scale. Creative mindset is defined as beliefs about the stability or malleability of the character and the nature of one's creativity (Karwowski, 2014). We used the ten-item Creative Mindset Scale (CMS; Karwowski, 2014) to measure participants' creative mindsets. Five items measure participants' level of creativity growth mindset (e.g., "Anyone can develop his or her creative abilities up to a certain level.") and five items measure participants' level of creativity fixed mindset (e.g., "You either are creative or you are not—even trying very hard you cannot change much."). Participants indicated their agreement with these statements on a five-point scale ranging from one (strongly disagree) to five (strongly agree). CMS scores were obtained by reverse-scoring the five fixed items and then calculating the sum of all ten items. Scores could range from 10-50. Higher scores on the CMS reflect a greater endorsement that creativity is malleable (i.e., creativity growth mindset).

Implicit Theories of Athletic Ability Scale. Twelve items from the English version of the Conception of the Nature of Athletic Ability Questionnaire (CNAAQ; Sarrazin et al., 1996) were used to examine participants' implicit theories about athletic ability (Biddle et al., 2003). To assess fixed athletic mindset and growth athletic mindset, the 12-item measure was divided into two subscales. The fixed-mindset subscale contained six items, three focused on the stability of athletic ability (e.g., "You have a certain level of ability in sport and you cannot really do much to change that level") and three items focused on athletic ability as a gift (e.g., "To be successful in sport you need to be born with the basic qualities which allow you success"). The growth-mindset subscale contained six items, three focused on athletic ability as being learned (e.g., "You need to learn and to work hard to be good at sport") and three items focused on athletic ability improving with effort (e.g., "How good you are at sport will always improve if you work at it"). Participants indicated their agreement with these statements on a five-point scale from one (definitely no) to five (definitely yes). Participants' athletic mindset scores were obtained by reverse-scoring the six fixed items and then calculating the sum of all items. Scores could range from 12-60. Higher scores reflect a greater belief that athletic ability is malleable.

Theories of Anxiety Scale (TOA). The Theories of Anxiety Scale (TOA; Schroder et al., 2015) is a four-item measure (two growth items and two fixed items) of implicit theories of anxiety. Participants rated statements (e.g., "No matter how hard you try, you really can't change the level of anxiety that you have") on a six-point scale from one (strongly disagree) to six (strongly agree). Fixed mindset items were reverse-scored and then items were summed to arrive at an anxiety mindset score. Scores could range from 4-24. Higher scores on the TOA are associated with greater endorsement of the belief that levels of anxiety can be changed.

Theories of Emotion Scale (TOE). The Theories of Emotion Scale (TOE; Tamir et al., 2007) is a four-item measure of implicit theories of emotion. Participants rated two fixed mindset statements (“No matter how hard they try, people can’t really change the emotions that they have.”) and two growth mindset statements (e.g., “Everyone can learn to control their emotions.”) about the extent to which they believe emotions are changeable on a six-point scale from one (strongly disagree) to six (strongly agree). The two fixed-minded items were reverse-scored, and all items were summed to achieve an overall emotion mindset score. Scores could range from 4-24. Higher scores on the TOE reflect greater emotion growth mindset endorsement.

Implicit Theories of Morality Scale. We measured theories of morality using the three-item Implicit Theories of Morality Scale (Dweck et al., 1995). This scale has the same format and scoring method as the Implicit Theories of Intelligence Scale. All items in this scale assess the extent to which morality is viewed as stable or enduring (e.g., "A person's moral character is something very basic about them and it can't be changed very much."). Participants indicated their agreement with these statements on a six-point scale from one (strongly disagree) to six (strongly agree). To score this questionnaire, all items were reversed-scored, then scores on the three items were summed to form an overall morality growth mindset score. Scores could range from 3-18. Higher scores indicate a stronger morality growth mindset endorsement. This measure has well-established psychometric properties, showing high internal reliability (Cronbach’s $\alpha = .94$; Dweck et al., 1995).

Theories of Person Scale (TOP). The Theories of Person Scale (TOP; Chiu et al., 1997) is a three-item measure of implicit theories of the person. All items in this scale assess the extent to which one views the person (i.e., one’s overarching personality) as stable or enduring (e.g., "The kind of person someone is is something very basic about them and it can't be changed very

much."). Participants indicated their agreement with these statements on a six-point scale ranging from one (strongly disagree) to six (strongly agree). To score this questionnaire, all items were reversed-scored, and then scores on the three items were summed to form an overall person growth mindset score. Scores could range from 3-18. Higher scores indicate a stronger endorsement that one's overarching personality is malleable (i.e., person growth mindset). This measure has well-established psychometric properties, showing high internal reliability (Cronbach's $\alpha = .96$; Dweck et al., 1995).

Stress Mindset Measure–General (SMM-G). There are two versions of the eight-item Stress Mindset Measure (SSM; Crum et al., 2013). One version refers to beliefs about the nature of stress in *general* (i.e., SMM-G) and one refers to beliefs about the nature of stress in the context of a *specific stressor* (i.e., SMM-S). In this study, we used the general measure (SMM-G), as we wanted to assess beliefs regarding the nature of stress in general, rather than any one specific stressor (e.g., finances). Stress mindset is a construct measuring whether one holds a stress-is-debilitating (i.e., fixed) mindset or a stress-is-enhancing (i.e., growth) mindset. The primary motivation of someone with a fixed stress mindset is to avoid or manage stress to prevent debilitating outcomes. On the other hand, the primary motivation of someone with a growth stress mindset is to accept and utilize stress for achieving enhancing outcomes. Participants indicated the extent to which they agreed with each item on a five-point scale, ranging from one (strongly disagree) to five (strongly agree). SMM-G scores were obtained by reverse-scoring the four debilitating items and then taking the sum of all eight items. Scores could range from 8-50. Higher scores on the SMM-G represent the mindset that the effects of stress are enhancing (i.e., stress growth mindset).

Other Measures. We used six other scales to assess different aspects of personality and levels of perceived stress and anxiety.

Acceptance and Action Questionnaire (AAQ-II). The Acceptance and Action Questionnaire II (AAQ-II; Bond et al., 2011) measures psychological inflexibility and the interrelated process of experiential avoidance. Psychological flexibility is a broad, higher-level construct that consists of overlapping and intercorrelated processes derived from Hayes' Acceptance and Commitment Therapy (ACT), such as experiential avoidance, acceptance, cognitive defusion, present-moment awareness, and value-based committed action (Hayes et al., 2006; Hayes, Strosahl, & Wilson, 1999). Psychological flexibility can be defined as the ability to contact the present moment more fully as a conscious human being, as well as an ability to change or persist in one's behaviour when the current behaviour (or non-behaviour) is maladaptive (i.e., to respond to what is needed in the given situation; Hayes et al. 2006). Experiential avoidance is an unwillingness to remain in contact with particular private experiences (e.g., bodily sensations, emotions, thoughts, memories), and taking steps to alter the frequency and existence of these experiences (Hayes et al. 1996). The AAQ-II contains ten items, seven inflexibility items (e.g., "My painful experiences and memories make it difficult for me to live a life that I would value.") and three flexibility items (e.g., "It's OK if I remember something unpleasant"). Participants rated items from one (always true) to seven (never true). The flexibility items were reverse-scored and then all items were summed to obtain a psychological inflexibility score. Scores could range from 10-70. Higher scores indicate higher psychological inflexibility. The AAQ-II has good reliability, with a Cronbach's α ranging from .84 to .92 (Bond et al., 2011).

State Trait Anxiety Inventory (STAI). The State-Trait Anxiety Inventory (STAI; Spielberger et al., 1970) is composed of 40 questions that measure two types of anxiety: state anxiety, or anxiety about an event (STAI-S), and trait anxiety, or anxiety level as a personal characteristic (STAI-T). The 20-item STAI-S was used in the current study to assess state anxiety. We only used the STAI-S measure as we used the neuroticism subscale of the NEO-FFI-3 as a measure of trait anxiety (see below). Items (e.g., “I feel nervous or restless”, “I feel inadequate”) were rated by participants on a five-point scale ranging from one (not at all) to four (very much). Participants’ STAI-S scores were obtained by reverse-scoring the ten non-anxious items and then taking the sum of all items. Scores could range from 20-80. Higher scores indicate higher levels of state anxiety. The STAI is a reliable and valid measure of state and trait anxiety. It is commonly employed in anxiety research with clinical and non-clinical populations (Spielberger et al., 1983).

NEO-FFI-3 Big Five Personality Scale (Neuroticism subscale). Neuroticism was measured using the 12-item Neuroticism subscale of the NEO-FFI-3 (McCrae and Costa, 2010). The NEO-FFI-3 consists of 60 items, with 12 items for each of the big five personality factors (i.e., openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism). This scale is a revision of the NEO-FFI (Costa and McCrae, 1992), in which 15 of the 60 items have been revised to improve readability and psychometric properties. Participants responded to items (e.g., “When I’m under a great deal of stress, sometimes I feel like I’m going to pieces”) on a five-point scale ranging from one (strongly disagree) to five (strongly agree). Total scores were summed after reverse-scoring non-neurotic items (e.g., “I rarely feel fearful or anxious”). Scores could range from 12-60. Higher scores indicate higher neuroticism.

Perceived Stress Scale (PSS-10). Perceived stress was measured using the ten-item Perceived Stress Scale (PSS-10; Cohen et al., 1983), which measures the extent to which current life situations are perceived as stressful. Participants responded to items (e.g., “In the last month, how often have you felt nervous and “stressed”?”) on a five-point scale from zero (never) to four (very often). The PSS-10 was scored by reverse-scoring items indicating less stress (e.g., “In the last month, how often have you felt that you were on top of things?”) and computing the sum of all items. Scores could range from 0-40. Higher scores indicate higher levels of baseline perceived stress. The PSS-10 exhibits good internal consistency (Cronbach’s $\alpha = .88$; Cohen et al., 1983).

Life Orientation Test - Revised (LOT-R). We measured participants’ dispositional optimism using the Life Orientation Test - Revised (LOT-R; Scheier et al., 1994). The LOT-R contains ten items. Three items assess optimism (e.g., “In uncertain times, I usually expect the best”), three items assess pessimism (e.g., “If something can go wrong for me, it will”), and there are four filler items (e.g., “I enjoy my friends a lot”). Respondents are asked to indicate the degree to which they agree with the items on a five-point scale ranging from one (strongly disagree) to five (strongly agree). The scores of the Optimism subscale and Pessimism subscale (reverse-scored) are summed to obtain an overall optimism score. Scores on this scale can range from 6-30. Higher scores indicate higher levels of optimism.

Frost Multidimensional Perfectionism Scale (FMPS). Participants' perfectionism was measured using the Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990). We modified this scale by including only parts of the original FMPS scale (Frost et al., 1990). We administered 20 items (3 subscales), which included: 1) Concern over Mistakes subscale (e.g., “If I fail at work/school, I am a failure as a person.”); 2) Personal Standards subscale (e.g., “If I

do not set the highest standards for myself, I am likely to end up a second-rate person.”); and 3) Doubts about Actions subscale (e.g., “I usually have doubts about the simple everyday things I do.”). The Concern over Mistakes, Personal Standards, and Doubts about Actions subscales were included in an effort to focus on one’s beliefs about oneself. Primarily, Concern over Mistakes is the most central component of perfectionism (Frost et al., 1990). The Parental Expectations, Parental Criticism, and Organization subscales were excluded, as they did not focus on participants’ theory of self. Participants responded to items on a five-point scale ranging from one (strongly disagree) to five (strongly agree). Perfectionism scores were calculated by summing participants’ scores on all items across all three subscales. Scores on this scale can range from 20-100. Higher scores indicate elevated levels of perfectionism.

Procedure

This study was conducted entirely online. Data were collected from September 2020 through December 2021. All measures intended for participants to complete were posted in Qualtrics, which is an online survey database that the MacEwan University Psychology Department uses to conduct online research. Informed consent was obtained from participants via an online consent form delivered through Qualtrics. In this study, we used deception to mitigate demand characteristics. Under the guise of a personality study (“Who Are You? An Investigation into the Personality Characteristics of University Students.”), students were told that we were investigating relationships between different personality traits in university students. We used deception to prevent the students from guessing what the study was actually about (i.e., understanding the structure of mindset). After reading the study description, participants were able to choose “consent and continue” or “end study now”. If a participant chose “end study now”, thereby choosing not to consent to participate, they were immediately

directed to the thank you page in Qualtrics. Once the participants consented to participate in the study, they were directed to the questionnaires in Qualtrics. These questionnaires assessed: 1) demographic information (i.e., age, gender, year of study, current GPA, and psychology courses completed); 2) nine domain-specific mindsets (i.e., intelligence, morality, anxiety, emotion, personality, stress, creativity, musical ability, and athletic ability,); 3) perceived stress; 4) psychological flexibility; 5) state anxiety; 6) neuroticism; 7) optimism; and 8) perfectionism. Once all the questionnaires were completed, participants were presented with the debrief message, which informed them of the true purpose of the study. After participants completed the study, they were awarded 2% course credit. Participation in this study took an average of 25 minutes.

Ethics Statement

Study I involved human participants and was reviewed and approved by the MacEwan Research Ethics Board (REB approval File No: 101847).

Statistical Analyses

All statistical analyses were performed using SPSS (SPSS Inc., Chicago, Ill., USA). In study I, to explore the structure of mindset, we conducted principal axis exploratory factor analysis on nine domain-specific mindset measures. We then used Pearson correlations to examine the relationships between the factor scores and perceived stress, state anxiety, psychological flexibility, neuroticism, optimism, and perfectionism.

Results

Internal Reliability of Scales

The internal reliability for each scale was assessed using Cronbach's alpha. All scales showed good internal reliability within the study, with Cronbach's alpha values ranging from .616 to .942 (Nunnally and Bernstein, 1994; see Table 1).

Mindset Structure

To assess the structure of mindset beliefs, we subjected the nine domain-specific mindset scales (i.e., intelligence, musical ability, creativity, athletic ability, anxiety, emotion, morality, personality, and stress) to exploratory factor analysis using SPSS. A Kaiser Meyer-Olkin value of .787 and significant Bartlett's Test of Sphericity ($X^2 = 1612.59, p < 0.001$) indicated the dataset was suitable for factor analysis. Principal axis factoring with oblimin rotation revealed the existence of 3 factors, which explained 60.1% of the total variance (see Table 2). The first factor reflects Skills (intelligence mindset, musical ability mindset, creativity mindset, athletic ability mindset). This factor had an Eigenvalue of 3.1 and explained 34.5% of the variance in the data. The second factor reflects Personality (morality mindset, personality mindset). This factor had an Eigenvalue of 1.3 and explained 14.6% of the variance. The third factor reflects Emotions (anxiety mindset, emotion mindset), had an Eigenvalue of 0.99, and explained 11.0% of the variance. Table 3 presents the factor loadings and descriptive statistics for the final factor solution. Stress mindset did not have a factor loading above 0.3 and was therefore excluded from the final factor structure. When examining the correlations among factors, Skills and Emotions were not strongly correlated, while Personality was moderately positively correlated with both Skills and Emotions (see Table 4). People that tended to believe in the malleability of traits falling into the Personality factor also tended to believe that traits falling into the Skills factor

and Emotion factor were more malleable. This finding suggests that, although there are distinct groupings of closely related mindsets into factors, there are also somewhat general consistent beliefs about the malleability of traits across the different factors.

Relationships Between Mindset Factors, Stress, Anxiety, and Personality Variables

After determining the factor structure of the nine domain-specific mindsets included in our study, we examined whether those mindset factors were related to stress, anxiety, and the personality variables of psychological flexibility, neuroticism, optimism, and perfectionism. Table 4 shows the correlations between the mindset factors and stress, anxiety, and personality variables. We found the same pattern of correlations for all three factors. Specifically, people higher in growth mindset, regardless of factor, perceived less stress in their lives, reported lower levels of state anxiety, had higher psychological flexibility, were less neurotic, were more optimistic, and suffered from less perfectionism. Except for psychological flexibility, across all variables the pattern was the same, with the strongest relationships between the Emotion factor and the other variables, and the weakest relationships between the Skills factor and the other variables. All effect sizes were small to moderate, with correlation coefficients ranging from .022 to .309.

Discussion

In study I, we examined the structure of mindset through exploratory factor analysis of nine domain-specific mindsets (intelligence, musical ability, creativity, athletic ability, personality, morality, anxiety, emotion, and stress). We found that these nine mindsets loaded onto three distinct factors: 1) Skills (intelligence, musical ability, creativity, and athletic ability); 2) Personality (personality and morality); and 3) Emotion (anxiety and emotion). Stress mindset did not load onto any of these distinct factors.

Skills Mindset Factor

Intelligence, musical ability, creativity, and athletic ability could be argued as having an underlying connection through the intentional creative act. These four constructs can be thought of as skills, which people often view as able to improve with practice. Indeed, in our study we found that the mean score on each of these four mindset measures was above the midpoint (i.e., more towards the growth end of the continuum). Perhaps these constructs may also be viewed as forms of different intelligences. In Gardner's multiple intelligences theory, each person possesses at least eight intelligences (Gardner, 1999b). Of Gardner's multiple intelligences, five correspond to the mindset domains examined in our study. 1) Verbal-linguistic intelligence, defined as well-developed verbal skills and sensitivity to the sounds, meanings, and rhythms of words; 2) Logical-mathematical intelligence, defined as the ability to think conceptually and abstractly, and capacity to discern logical and numerical patterns; 3) Musical intelligence, defined as the ability to produce and appreciate rhythm, pitch, and timber; 4) Spatial-visual intelligence, defined as the capacity to think in images and pictures, and to visualize accurately and abstractly; and 5) Bodily-kinesthetic intelligence, defined as the ability to control one's body movements and to handle objects skillfully (Gardner, 1999b). These five intelligences could be argued as pairing with specific mindsets within the Skills mindset factor. For example, verbal-linguistic intelligence and logical-mathematical intelligence correspond with intelligence mindset, musical intelligence with musical ability mindset, spatial-visual intelligence with creativity mindset, and bodily-kinesthetic intelligence with athletic ability mindset. Another of Gardner's intelligences may also be related to one of the mindset factors we found: Intrapersonal intelligence, defined as the capacity to be self-aware and in tune with inner feelings, values, beliefs and thinking processes could be related to the Emotion factor.

The Skills mindset factor was significantly positively related to optimism and significantly negatively related to perfectionism, albeit with small effect sizes. We found no statistically significant relationship between the Skills mindset factor and participants' levels of stress, neuroticism, or psychological flexibility. However, we did find a marginally significant negative relationship between the Skills mindset factor and participants' levels of state anxiety, again with a small effect size.

The positive correlation between the Skills mindset factor and optimism and negative correlation with perfectionism are consistent with the research on both optimism and perfectionism. People high in optimism are open to experience and change, holding the belief that if things are bad now, they can improve (Seligman and Csikszentmihalyi, 2000). Also, people high in optimism tend to have an internal locus of control. It then makes sense that they would have stronger growth mindset beliefs, because they believe their actions can change things, even themselves (Boullion et al., 2021; Dweck, 2006; Schroder et al., 2015, 2016). As for those high in perfectionism, they tend to hold a more rigid, binary view of the world as *all* good or *all* bad (Mofield and Parker, 2019; Schwartz et al., 2002; Yeager and Dweck, 2012), which is consistent with the global, fixed, and rigid beliefs of the entity theorist (e.g., "If I fail at 'X', then I must not have that ability, and there's nothing that can be done about it"; Biddle et al., 2003; Dweck et al., 1995; Karwowski, 2014). The finding that students lower in growth mindset on the Skills factor had higher state anxiety may be related to seeing challenges and setbacks as threats rather than opportunities for growth. As we assessed University students, who are constantly receiving judgments about their skills in the form of grades, a fixed view of skills may be particularly stressful, as it may have broader implications for success in the stressful atmosphere of university.

Personality Mindset Factor

Personality and morality logically loaded together on a single factor, as one could argue that these constructs are both viewed as describing fundamental aspects of a person. This idea is consistent with early mindset findings, as implicit theories of morality and personality appear to be closely related (i.e., those holding entity theories of morality also tend to hold entity theories of personality; Dweck et al., 1995). Further, people holding a growth view of either personality or morality both tend to focus more often on the specific psychological factors that mediate social and moral behaviors. In contrast, people holding a fixed view of either of these constructs tend to focus more on meting out appropriate punishments given the trait judgments of the target they have made (Dweck et al., 1995). Dweck et al. (1995) also found that entity theorists of personality and morality have a greater tendency than their incremental counterparts to make dispositional trait inferences from preliminary behavioural information. The similar attributions and behaviours of people holding similar beliefs about the malleability of personality and morality support the finding that these constructs are closely related.

The Personality mindset factor was significantly negatively correlated with self-reported levels of stress, anxiety, neuroticism, and perfectionism, and significantly positively correlated with optimism. These results are consistent with the research on fixed mindset and helplessness-oriented thinking (Dweck et al., 1995). A view of oneself as helpless and unable to change (i.e., a fixed mindset), particularly with respect to fundamental aspects of oneself as a person (i.e., personality and morality), leads to higher negative affect (Tamir et al., 2007; Schroder, 2021), which is closely related to stress, anxiety, and neuroticism. We found no statistically significant relationship between the Personality mindset factor and participants' levels of psychological flexibility (see discussion of psychological flexibility below).

Emotion Mindset Factor

Anxiety and emotion are similar psychological constructs; anxiety is an emotion. So, it makes sense that people would have similar beliefs about the malleability of these closely related constructs. Emotion regulation strategies have been shown to correlate with implicit theories of both emotion and anxiety. Cognitive reappraisal (i.e., changing the way one thinks about a particular event) strategies are positively associated with a growth mindset about both emotion (Tamir et al., 2007) and anxiety (Schroder et al., 2015). Likewise, emotional suppression (i.e., attempting to hide any sign of outward emotional expression) strategies are positively associated with a fixed mindset about both emotion (Tamir et al., 2007) and anxiety (Schroder et al., 2015).

The Emotion mindset factor was significantly negatively correlated with self-reported levels of stress, anxiety, neuroticism, and perfectionism, and significantly positively correlating with optimism. These results are consistent with the research on anxiety and emotion growth mindset. Growth beliefs of anxiety are negatively related to psychological distress (Schroder et al., 2015; Schroder et al., 2016; Yalch, Schroder, Dawood, & Donnellan, 2017), and a growth mindset of anxiety is positively correlated with the use of cognitive reappraisal (Schroder et al., 2015). Cognitive reappraisal is also an emotion regulation strategy more often employed by people higher in optimism (Schuurmans-Stekhoven, 2018). In addition, holding more malleable beliefs about emotions appears to predict decreased negative affect both overall during the day, and specifically in response to upsetting daily events (Kneeland, Dovidio, & Goodman, 2020). The belief that one can change their emotions and level of anxiety is directly connected to constructs such as stress, anxiety, and neuroticism (Boullion et al., 2021; Yeager and Dweck, 2012). This finding makes sense, as believing that one's anxiety and emotions are malleable may give one confidence that even though things are bad right now (e.g., one is anxious about a test

or depressed about the death of a friend), these feelings are not permanent because anxiety and emotions are malleable. In addition, believing that emotions and anxiety are malleable may motivate people to employ coping strategies to actually change their emotions and anxiety, thus reducing their negative affect.

We found no statistically significant relationship between the Emotion mindset factor and participants' levels of psychological flexibility. This lack of a statistically significant finding is somewhat puzzling, as previous research on psychological flexibility has shown negative correlations with stress, anxiety, and other indicators of psychological distress (Kashdan and Rottenberg, 2010; Hayes, Pistorello, and Levin, 2012). There does, however, appear to be some controversy in the literature regarding how psychological flexibility should be measured (Rolffs, Rogge, and Wilson, 2018). Rolffs, Rogge, and Wilson (2018) have shown that the Multidimensional Psychological Flexibility Inventory (MPFI) appears to be a more accurate measure than the AAQ-II at assessing the six-factor construct of psychological flexibility as proposed by Hayes, Strosahl, & Wilson (1999) (i.e., acceptance, contact with the present moment, self as context, defusion, committed action, and values). This discrepancy may be due to the focus on experiential avoidance in the AAQ-II. Future investigations looking at mindset and psychological flexibility should consider using the MPFI in order to fully capture the construct of psychological flexibility.

Stress Mindset

In our study, stress mindset did not load onto any of the three distinct mindset factors. This result is reasonable, as stress mindset as conceptualized by Crum et al. (2013) appears to be a different construct from the other mindset domains examined in this study. Stress mindset in this context is not a belief regarding whether stress levels are malleable; but rather, Crum et al.'s

(2013) Stress Mindset Measure scale assesses the extent to which one holds the belief that stress is either enhancing (i.e., related to outcomes of performance, productivity, health and wellbeing, and learning and growth) or debilitating (i.e., stress is damaging and dangerous; Crum et al., 2013). The result that stress mindset assessed with Crum et al.'s (2013) scale does not load onto a factor with the other mindsets provides further confidence that those mindsets are closely related constructs. It is not simply that any assessment of emotions like stress or anxiety load together; but rather, specifically assessments measuring belief in the malleability of those traits load together. An alternative stress mindset measure that measures one's implicit beliefs about stress (i.e., the malleability of one's stress) is the 15-item Stress Control Mindset Measure (SCMM; Keech et al., 2018). If we had used this scale, we would expect it to load on the emotions factor with emotion and anxiety mindsets.

Effect Sizes

Effect sizes for all the correlations of the mindset factors with the personality measures we examined were relatively small. One explanation for these small effect sizes may be due to the complexity of each factor. Psychological constructs such as intelligence, emotion, stress, and personality are vastly complex, with an extraordinary number of contributing factors in their outward manifestation. It seems likely that even a factor containing a group of mindset domains will have only a modest contribution to any outcome. Secondly, individual differences in definition and classification of the concepts examined may play a role in the smaller effect sizes. For example, in the Skills mindset factor alone there are several contributing factors (i.e., intelligence, musical ability, creativity, and athletic ability). Although these constructs may all be viewed as buildable skills, each participant's definition of intelligence, musical ability, creativity, and athletic ability may vary.

Compared to the correlations seen with the other mindset factors, the Emotion factor showed moderate effect sizes. The larger effect sizes seen with this factor may be due to the reciprocal influence of the constructs of anxiety mindset and emotion mindset and their relation to one's levels of stress, anxiety, neuroticism, and optimism. Perfectionism still shows a smaller effect size when correlated with the Emotion factor, which is perhaps due to the complex nature of perfectionism (Gilman and Ashby, 2003; Mofield and Parke, 2019). For example, perfectionism involves nuanced factors tied to self-worth and self-esteem (Chan et al., 2016; Maroiu et al., 2016).

Study II

Advantages of a Growth Mindset

There is no shortage of research on the advantages of holding a growth mindset and the disadvantages of holding a fixed mindset. Examples of areas of study include wellbeing, resilience, amelioration of psychological distress at both the sub-clinical and clinical level, and years of research devoted to the relationship between growth mindset and academic achievement.

Few would argue against the importance of happiness and well-being in one's life. Research looking at how one's mindset influences well-being found that students who held incremental beliefs (i.e., a growth mindset) about emotions, and had lower initial levels of well-being when starting school, showed more improved well-being over time compared to their peers who held entity beliefs (i.e., a fixed mindset) about emotions (Romero et al., 2014). It has also been reported that implicit theories of well-being are predictive of one's level of well-being (Schroder et al., 2017). Relative to a fixed mindset, the endorsement of a growth mindset of well-being predicted greater hedonic and eudaimonic well-being (Howell, Passmore, and Holder

2016) and greater flourishing (a combination of emotional well-being, psychological well-being, and social well-being; Howell, 2009). Further, research has shown that holding a fixed theory of emotion is negatively associated with positive indicators of well-being (i.e., life satisfaction and positive emotions) and positively associated with negative indicators of well-being (i.e., negative emotions, depression, and anxiety; King and dela Rosa, 2019). Tamir et al. (2007) showed that implicit theories of emotions were not only linked to both emotional and social adjustment during the transition to college, but that those holding a fixed mindset experienced fewer positive and more negative emotions (i.e., lower well-being).

Resilience is another area of study in which research has shown how having a growth mindset is advantageous. Resilience is a facet of psychological adjustment applied to someone who is doing well or does not exhibit the typical negative outcomes after experiencing some adversity (Rutter, 2006). Research has identified that one's anxiety mindset is a mediator between adverse experiences and later life outcomes, including coping and psychological adjustment (Schroder et al., 2017). Even concerning adversity as severe as childhood maltreatment, growth mindsets have been shown to mediate the association between childhood maltreatment and resilience. Higher scores of childhood maltreatment and emotional neglect (i.e., deprivation of emotional support and inattentiveness to emotional needs; Bernstein et al., 1997) indirectly predicted lower resilience scores, a relationship that was partially mediated through holding a fixed mindset. High scores of emotional abuse (i.e., swearing, insulting, and putting a child down verbally; Chamberland et al., 2011) also indirectly predicted low resilience scores, a relationship which was fully mediated by holding a fixed mindset (Boullion, Withers, and Lippmann, 2021).

Holding a growth mindset has also been shown to aid in the amelioration of psychological distress. Interventions designed to induce a growth mindset about personality demonstrated decreases in depression (Miu & Yeager, 2015; Schleider and Weisz, 2018), stress (Yeager, Lee, & Jamieson, 2016), and anxiety (Schleider and Weisz, 2018). Yeager and Dweck (2012) found that students who believed, or were taught, that intellectual abilities can be developed (i.e., intelligence growth mindset) tended to show higher achievement across challenging school transitions and greater rates of course completion in challenging math courses. In addition, believing, or being taught, that social attributes can be developed lowered adolescents' aggression and stress in response to peer victimization and exclusion (Yeager and Dweck, 2012).

Research on the effectiveness of holding a growth mindset in reducing psychological distress is not merely limited to the convenience samples of high school and undergraduate students. Recently, an examination of anxiety mindset in a sample of 274 patients presenting to an intensive behavioural-based partial hospital treatment program found that a growth mindset about anxiety predicted fewer anxiety symptoms after the program ended (an average of 12 days after admission), after controlling for psychiatric hospitalization history and baseline psychiatric and anxiety symptoms (Schroder et al., 2019). Interventions targeting clinical populations are limited; however, past research indicates that addressing one's incremental beliefs through a growth mindset intervention could be advantageous to those suffering from psychological distress at the clinical level (Schroder, 2021).

Finally, the advantages of holding a growth mindset for academic achievement have been well documented. A short (i.e., under one hour) online growth mindset intervention improved grades among lower-achieving secondary students and increased overall enrolment (Yeager et

al., 2019). Research on implicit theories of intelligence indicates that growth mindset beliefs play an important role in students' goal choices (i.e., performance versus mastery goals), attributions of outcomes (i.e., trait versus effort), and a wide range of academic outcomes, including grades and achievement test scores (De Castella and Byrne, 2015). In addition, both correlational and experimental studies indicate that holding an incremental theory of intelligence predicts higher performance on standardized tests (Cury et al., 2008; Cury et al., 2006; Good et al., 2003) and higher grades in middle school (increased math grades; Blackwell et al., 2007) and college (higher grade point averages; Aronson et al., 2002).

Mindset Interventions

As seen in the above review of the advantages of holding a growth mindset, the literature is teeming with findings reporting that an increased growth mindset is related to a variety of positive traits and outcomes. The interest in helping to move people toward more growth beliefs has stoked an increased interest in growth mindset interventions. The aim of these interventions is to change one's beliefs from a fixed to a growth orientation. Although the results of the early mindset research (i.e., prior to the 2000s) showed useful results, more would need to be done to meet the rigorous standards of research in the 21st century. This meant larger sample sizes, more efficient and scalable delivery of mindset interventions, and greater attention to generalizability (Dweck and Yeager, 2019).

Early mindset interventions were a type of psychoeducation that taught participants that the brain is like a "muscle" that gets stronger with exercise and that the brain forms new or stronger connections with rigorous learning. These first interventions were targeted at adolescents (particularly students who were academically at risk) who are at a vulnerable age in which declines in achievement are common and can have important consequences for future life

success (Blackwell et al., 2007). These face-to-face interventions showed great promise; however, the time and expense of training facilitators for these interventions drastically limited any potential for larger-scale intervention and replication. In an effort to improve the reach of growth mindset interventions, online interventions were introduced (Dweck and Yeager, 2019). Randomized trials with tens of thousands of students (Paunesku et al., 2015; Yeager, Walton, et al., 2016) were conducted; this wave of research also included two pre-registered replications (Yeager, Hanselman, et al., 2018; Yeager, Romero, et al., 2016). The results of these online interventions showed that delivery of the intervention online could change mindsets and academic outcomes under certain conditions (Dweck and Yeager, 2019). However, the effects on academic outcomes were modest. Also, of the successful interventions, it was students at risk for academic underperformance (e.g., high school students who had lower grades before the intervention, especially if they were attending medium-to-low-achieving schools (Bettinger et al., 2018; Paunesku et al., 2015; Yeager, Hanselman, et al., 2018; Yeager, Romero, et al., 2016)) and post-secondary students who belonged to under-represented or stereotyped groups (e.g., students of colour, first-generation college students; Broda et al., 2018; Yeager, Walton, et al., 2016), that seemed to benefit the most from the online growth mindset interventions (Dweck and Yeager, 2019).

Yeager, Romero, Paunesku, and Dweck (2016) executed an extensive research project at the national level to assess mindset interventions. The purpose of this study was to determine a clear methodology for scaling up the mindset intervention to reach more people and lower the cost of in-person interventions. This National Study of Learning Mindsets targeted a nationally representative sample of students entering high school (i.e., 9th-graders). This group was chosen for its noted difficulty associated with the transition from junior high school to high school

(Yeager, Romero, et al., 2016). The authors found that an online two-session mindset program, which was user-centered and could be administered to entire classes, raised the grades of low performers and also increased 'learning-oriented' attitudes in both low and high performers. Yeager et al. (2016) contended that this scaled-up intervention was as effective as the original mindset face-to-face interventions but was able to reach more students with lower costs of training time.

As impressive as the above research is, there is some controversy as to the effect sizes of these growth mindset interventions. Some growth mindset interventions have shown promising outcomes, particularly for historically disadvantaged or at-risk student groups, whereas others have been ineffective (Mills & Mills, 2018). In a meta-analysis, Sisk et al. (2018) examined 43 effect sizes of the relationship between mindset, academic achievement, and potential moderating factors. Even when controlling for publication bias of effect sizes of growth mindset on academic achievement, they found that 37 of the 43 effect sizes (86%) were not significantly different from zero. In fact, one effect size was significantly different from zero in a *negative* direction, indicating that students who received the growth mindset intervention in that study had significantly worse academic achievement than students in the control conditions. In their meta-analysis, Sisk et al. (2018) found that only 12% of effect sizes were significant and positive. In addition, Mills and Mills (2018) found that, although their growth mindset intervention was statistically significant, the effect size was small ($r = .18$). They also found that there was a correlation between growth mindset and passing the course; however, there was no evidence to support a link between growth mindset and retention (Mills & Mills, 2018). Other studies also found no measurable benefits of the growth mindset intervention, either with typical students or under-represented or at-risk groups (McCabe et al., 2020). One suggestion is that perhaps

combining a variety of interventions with weak academic students is required to improve the effects of growth mindset interventions (Mills & Mills, 2018).

When considering the suggestion of combined interventions, one area to consider is research regarding active vs passive learning. Passive learning can be understood as the traditional lecturing format of the instructor-focused, “teaching by telling” approach (Freeman et al., 2014). Active learning is defined as any pedagogy that causes students to spend class time engaged in answering questions, solving problems, discussing solutions with their peers, or reasoning about the material they are studying, all while getting regular feedback from their teacher (Wieman, 2015). In research studying undergraduate student performance in science, engineering, and mathematics courses, active learning was found to increase student performance in STEM courses (Springer et al., 1999; Freeman et al., 2014). Some increases, on average, resulted in nearly a whole standard deviation of improvement. This meant that if a student was performing in the 50th percentile of a class based on traditional lecturing, they would, under active learning, move to the 68th percentile of that class (Freeman et al., 2014). In addition, Freeman et al. (2014) found that the passive learning environment increased the chance of failure rates by 55%.

In study II, we sought to determine if there are more effective ways to present growth mindset interventions to increase their effect sizes. More specifically, we looked to apply the advantages of using an active learning format to the typical psychoeducational growth mindset intervention. The purpose of this study was to answer the questions, does an active growth mindset intervention (i.e., using techniques in which the participant actively engages with the growth mindset material) improve the efficacy of the intervention over a passive growth mindset intervention (i.e., participants passively receive the growth mindset material through watching a

video). Our outcome of interest was academic achievement, as assessed through improvements in Introductory Psychology exam scores from the midterm to the final exam. When one actively engages in learning material, research shows greater motivation to learn and better recall of material (Springer et al., 1999; Freeman et al., 2014). Based on these findings, and the growth mindset intervention literature, we predicted that using an active learning strategy during the growth mindset intervention would improve the efficacy of the intervention. Specifically, we predicted that participants in the active intervention group would show greater improvement in their exam scores from the midterm to the final exam than students receiving the passive intervention. Furthermore, we predicted that students in either intervention group should show more improvement in exam scores compared to participants in the control group.

Method

Participants

The original sample of participants for this study included 339 people. Participants could sign up if they were enrolled in an Introductory Psychology course (PSYC 104 or PSYC 105) at MacEwan University. Students could only participate in the study once (i.e., in one semester). There were no other inclusion or exclusion criteria. Participants were recruited through SONA, MacEwan University's online research participant pool. Participants in this study received 2% course credit for their participation. Of the 339 participants, 52 did not consent to us using their exam scores. Participants were excluded for missing data, incomplete data, or failed validity items (111 participants) or if they were taking PSYC 104 and 105 in the same semester (10 participants). The final sample used in the analyses consisted of 166 participants.

Materials

Implicit Theories of Intelligence Scale. Students' implicit theories of intelligence were measured using the same 8-item Implicit Theories of Intelligence Scale (Dweck et al., 1995; De Castella & Bryne, 2015) used in study I.

Perceived Stress Scale. Students' perceived stress was measured using the same 10-item Perceived Stress Scale (PSS-10) (Cohen, S., Kamarck, T., and Mermelstein, R., 1983) used in study I.

The Big Five Inventory (BFI-44) Questionnaire. We assessed the Big Five personality traits of Extraversion (e.g., "Is talkative"), Agreeableness (e.g., "Is helpful and unselfish with others"), Conscientiousness (e.g., "Does a thorough job"), Neuroticism (e.g., "Is depressed, blue"), and Openness to Experience (e.g., "Is original, comes up with new ideas") using the English version of the 44-item Big Five Inventory (BFI-44; John & Srivastava, 1999).

Participants responded to items using a five-point scale ranging from one (disagree strongly) to five (agree strongly). Total scores were summed for each trait after reverse-scoring where appropriate. Higher scores on each of the Big Five traits indicates an elevated level of that trait.

Study Design

The current study used a between-groups experimental design. The independent variable was intervention group (control, passive, or active) and the dependent variable was exam score differences between participants' Introductory Psychology midterm and final exam. The Introductory Psychology course was delivered in an asynchronous online format. It was standardized, so the same content was presented the same way for all students regardless of professor. The class could have one of 4 different midterm or final exams. These exams were all standardized for difficulty level and only differed slightly in the short answer questions.

In addition to examining changes in exam scores across conditions, we examined whether providing a more in-depth response to the active intervention prompt influenced exam score differences within the active intervention group. In total, 33.7% ($n = 56$) of the participants were assigned to the control condition, 34.9% ($n = 58$) were assigned to the passive growth mindset intervention group, and 31.3% ($n = 52$) were assigned to the active growth mindset intervention group.

Procedure

As in Study I, all measures intended for participants to complete were posted in Qualtrics. Data were collected between October 2020 and December 2021. This study was made available to students only after the midterm of each semester (Fall 2020, Winter 2021, and Fall 2021). To begin the study, participants were directed to the online consent form, which contained a brief description of the study. Deception was used so the control group would not know the true purpose of the study. Students were told we planned to assess personality and stress factors, how these factors may impact students' final exam scores, and if certain personality factors (e.g., conscientiousness) correlated with stress levels for a person during situations like a final exam. After reading about the study, participants were able to choose "consent and continue" or "end study now". If a participant chose "end study now", they were immediately directed to the thank you page in Qualtrics. Once a participant chose "consent and continue", informed consent was implied, and the participant was directed to the questionnaires in Qualtrics. Qualtrics randomly assigned participants to one of the three conditions (i.e., control, passive, or active). All participants in each condition filled out three different scales: 1) The Implicit Theories of Intelligence Scale, which was used to assess participants' baseline growth mindset about intelligence (refer to study I); 2) The Perceived Stress Scale (PSS-10), which was used to

measure participants' perceived stress levels over the previous month (refer to study I); and 3) The Big Five Personality Inventory (BFI-44), which was used to assess participants' personality characteristics. The PSS -10 and BFI-44 were used as part of the cover story to reduce demand characteristics.

Intervention Groups. Our study had three groups, a control group, a passive intervention group, and an active intervention group.

Control Group. After completing the three scales, the control group watched a 4-minute video about the physiological effects of stress. After the video, the control group was directed to the grade access consent form.

Passive Growth Mindset Intervention Group. After completing the three scales, the passive growth mindset intervention group was directed to a 4-minute video that described what growth mindset is, information about the plasticity of the brain and the functioning of neurons, and student testimonials describing how a growth mindset helps them in their studies. After the video, the passive learning group was directed to the grade access consent form.

Active Growth Mindset Intervention Group. After completing the three scales, the active growth mindset intervention group was directed to the same 4-minute video as the passive intervention group. After the video, participants in this group were asked to write a summary of what growth mindset is, why it is useful, who in their life would most benefit from a growth mindset, and how they would teach the concept of growth mindset to that person. Participants were then directed to the grade access consent form.

Grade Access Consent Form. This form asked for permission to access participants' Introductory Psychology midterm and final exam grades for the purpose of this study. All participants were informed that they did not need to consent to allow us to access their exam

grades. If they did not consent, they would still be awarded their 2% research credit for participating in the study. Consent was implied when participants submitted their student ID numbers on the grade access consent page.

Debrief. All participants were told the true purpose of the study (i.e., that we were investigating the effect of a growth mindset intervention on exam scores) in an emailed debrief once all data were collected.

Ethics Statement

Study II involved human participants and was reviewed and approved by the MacEwan Research Ethics Board (REB approval File No: 101734).

Statistical Analyses

All statistical analyses were performed using SPSS (SPSS Inc., Chicago, Ill., USA). Exam score differences were calculated by subtracting the midterm exam score from the final exam score. Negative values indicate worse performance on the final exam compared to the midterm. We used one-way ANOVAs to assess the effect of the interventions on changes in exam scores between the midterm and final exam for Introductory Psychology students. Data were collected in three separate semesters (Fall 2020, Winter 2021, Fall 2021). Data from these semesters were analyzed separately as a type of replication of our study, as well as together in a combined analysis. We also used a one-way ANOVA to determine if there was a difference in exam score differences within participants in the active group based on the depth of their active written response during the intervention. This analysis was conducted on the combined data from all three semesters due to smaller sample sizes.

Results

Preliminary Analyses

The internal reliability for each scale was assessed using Cronbach's alpha. All scales showed good internal reliability within the study, with Cronbach's alpha values ranging from .682 to .947 (Nunnally and Bernstein, 1994; see Table 5). Exam score differences were calculated by subtracting the midterm exam score from the final exam score. A negative value indicates better performance on the midterm exam than the final exam. We conducted analyses on each of the three semesters of data collection (i.e., Fall 2020, Winter 2021, Fall 2021) separately to serve as replications of our study. The pattern of results is similar across semesters, so we also included an analysis of all three semesters combined.

Table 6 shows the mean and standard deviation for exam score differences across the three semesters of data collection, and for the three semesters combined, collapsed across groups. Exam score differences show the same pattern across all three semesters. Specifically, students performed slightly worse on the final exam compared to the midterm. This difference was most pronounced in Winter 2021, where participants scored an average of 2.5% worse on the final exam compared to the midterm.

Table 7 shows the mean and standard deviation of exam score differences for the control and intervention groups across the three semesters, as well as combined. In Fall 2020, only participants in the passive group scored on average better on the final exam ($M = 3.8\%$) compared to the midterm. In Winter 2021, only participants in the active group scored on average better on the final exam ($M = 0.76\%$) compared to the midterm. In Fall 2021, again only participants in the passive group scored on average better on the final exam ($M = 0.29\%$) compared to the midterm. Across all semesters, participants in the control group showed the

worst performance of the three groups, always performing worse on the final exam compared to the midterm.

Intervention Analyses

We conducted four one-way ANOVAs to determine the effect of the growth mindset intervention on the difference between participants' Introductory Psychology midterm exam and final exam scores. We analyzed each of the three semesters separately and also combined them into a single overall analysis.

Fall 2020. The ANOVA revealed an overall significant difference ($F(2, 42) = 3.795, p = 0.031$) in exam score differences among the active, passive, and control groups (Table 8a). Inspection of the mean differences between the midterm and final exam scores across groups indicates that the control group performed worse on the final exam compared to the midterm and had the largest negative difference across the three groups, with an average decline in final exam scores of 4.08%. The two intervention groups performed better, on average, than the control group. Tukey's post-hoc tests (Table 8b) revealed that there was a significant difference between the passive and control group ($p = .027$). However, there was no significant difference between the passive and active intervention groups ($p = .158$). Although exam score differences in the intervention groups were not significantly different, the active group showed less of a decline in exam scores between the midterm and final exam (-1.70%) compared to the control group, and the passive group showed, on average, an improvement from their midterm to final exam scores (3.80%).

Winter 2021. The ANOVA revealed no statistically significant difference in exam score differences between the active, passive, and control groups in Winter 2021 ($F(2, 57) = 1.014, p = .369$; see Table 9). The control group again showed the largest decline in exam scores between

the midterm and final exam (-5.38%). Similarly, again the two invention groups performed better on average than the control group. The passive group showed less of a decline from the midterm than the control group (-2.17%) and the active group improved on their final exam score from their midterm (0.76%). This pattern is the opposite of that from Fall 2020, where the passive group showed improvement and the active group showed less decline.

Fall 2021. The ANOVA revealed no statistically significant difference in exam score differences between the active, passive, and control groups in Fall 2021 ($F(2, 48) = .473, p = .626$; see Table 10). Following the pattern of the previous two semesters, the control group showed the largest average decline in exam scores from the midterm to the final exam (-2.58%). Similar to Fall 2020, the active group showed a small decline in exam scores between the midterm and final exam (-0.35%), while the passive group showed a small increase in final exam scores compared to the midterm (.29%).

All Semesters Combined. The ANOVA examining all three semesters combined revealed no statistically significant difference in exam score differences between the active, passive, and control groups ($F(2, 153) = 2.644, p = .074$; Table 11). However, there was a trend towards a significant difference with a p -value of .074. As with each individual semester, the control group had the largest decline in exam scores between the midterm and final exam, with an average drop of 4.11%. The two invention groups performed better on average than the control group. The passive group improved on their final exam score by an average of 0.22% compared to their midterm, whereas the active group performed on average worse on their final exam compared to their midterm (-0.40%).

Active Group Written Intervention

After our analyses revealed that there was only a significant effect of the intervention in Fall 2020, and that in two semesters the passive group performed better, on average, than the active group (though not significantly), we further examined the written portion of the active intervention. Specifically, we scored the active written responses out of 3 based on depth of the response (see Methods).

The ANOVA revealed no significant difference in exam score differences between participants that provided more shallow or deeper responses to the active intervention prompt ($F(2, 44) = .685, p = .509$; see Table 12). This result suggests that the depth of the written response does not improve the efficacy of the active intervention on exam scores. However, the sample sizes in this analysis are very imbalanced, so the results should be treated with caution. The majority of participants (74%) provided in depth written responses addressing all facets of the prompt. Only 3 participants (6%) in the active condition provided shallow responses that only addressed one aspect of the writing prompt (see Table 13).

Discussion

The purpose of study II was to determine if growth mindset intervention effect sizes could be improved by incorporating an active component into the typical passive psychoeducational intervention. We looked at the outcome of academic achievement; specifically, improvement in exam scores between the midterm and final exam in Introductory Psychology classes. We ran three independent waves of data collection in three different semesters as a form of replication of our own study. We also looked at all semesters combined. We found that there was only a marginally significant difference between the intervention groups (passive or active) and the control group, with the control group consistently showing the worst

performance (i.e., always a decline) between the midterm and final exam. The passive and active groups were nearly identical in their effect for each semester and for all semesters combined, suggesting that adding an active writing component to the intervention did not increase effectiveness.

It is unclear precisely why our active intervention was not effective. It may be the type of active intervention used (i.e., a short writing prompt that the students responded to independently online). Active learning strategies in the realm of education vary widely in intensity and implementation (Freeman et al., 2014). Active learning strategies leading to better academic achievement should include considerations of population size and format of delivery; for instance, small-class tutorials, large lecture settings, or online spaces (Sinnayah et al., 2019). In small-classes, a process-oriented guided-inquiry (POGI) learning method seems to be most effective (Sinnayah et al., 2019). This method involves learning together and interacting with others. Peer-to-peer learning encourages students to engage in thinking processes and to develop their own explanations, metaphors, and associations as they help in the instruction of their peers. Engagement in these cognitive processes reinforces and consolidates the content (Deslauriers, Schelew, and Wieman, 2011; Rathner and Byrne, 2013; Smith et al., 2009). Sinnayah et al. (2019) suggest that tutorial-based activities improve student performance. In addition, group work fosters an active and participatory learning environment, allowing students and tutors to receive feedback during engagement with the material. Small groups provide an excellent environment to maximize interaction and discussion, which in turn allows students to “teach other students to think and to engage in their own and others' learning through the articulation of views and understanding” (Roller and Zori, 2017). This peer-to-peer guided-inquiry learning approach helps to get students engaged in discussions while learning content, and in doing so

they build a deeper understanding of the material (Sinnayah et al., 2019). Active learning in large lecture settings works best when some type of audience response is employed. Receiving immediate feedback on one's responses is a primary mechanism for determining one's progress within a learning task. Immediate feedback is important for learners to understand if there are gaps in their knowledge and informs them about their current level of competency with the material (Lucas and Stallworth, 2003; Efstathiou and Bailey, 2012). Finally, active learning in an online space is most effective with the use of pre-tutorial ungraded weekly quizzes before the weekly tutorials. These weekly online quizzes, usually 10 multiple-choice questions that range in difficulty, encourage students to test their knowledge of the material in a non-threatening way. These quizzes also establish some baseline knowledge students can use as reference during the lecture or tutorial and give an introductory framework to which the new knowledge can be applied (Lucas and Stallworth, 2003).

It is also important to note that the majority of these active learning strategies are implemented for at least an entire course length (i.e., typically 3-4 months) or longer (Jensen and Lawson, 2011; Martin, Rivale, and Diller, 2007; Springer, Stanne, and Donovan, 1999; Ruiz-Primo et al., 2011). Our intervention (i.e., a brief, one time exposure to the mindset material and a single writing prompt) may have been too brief, with too little exposure to the material, with no peer-to-peer interaction, and no immediate feedback to substantially impact the relatively difficult task of changing one's beliefs.

Additionally, due to the COVID-19 pandemic, the Introductory Psychology course was delivered entirely online in an asynchronous manner (i.e., students were entirely responsible for their own learning schedule and finding appropriate study space, as the campus was closed for most of this study). It is possible that our intervention would be more effective in an in-person

class, where the professors could remind students about growth mindset throughout the semester. Furthermore, the stress of living through, and attending university during, a once-in-a-lifetime pandemic is intense (Gundogan, 2022; Marcén-Román et al., 2021). It may be the case that an even more intense or salient growth mindset intervention is necessary when students are experiencing such heightened levels of stress from the pandemic and a drastic change to their typical learning environment.

General Discussion

Mindset Structure

The debate over the construct of mindset ranges from those who support a domain-specific explanation (e.g., Dweck et al., 1995) to those that advocate for a domain-general construct (e.g., Cheng & Hau, 2003). However, it appears from the most current research that the structure of mindset is somewhere in between. In our first study, we sought to meaningfully contribute to the debate regarding the question of domain specificity versus domain generality of the mindset construct. Our results are consistent with the most current research (Chan et al., 2021; Schroder et al., 2016; Zhu, Zhuang, and Lee, 2021; Zhu et al., 2020) that contends it is somewhere in between (i.e., groupings of individual mindsets that load onto a set of distinct factors). The construct of mindset is not a single global construct, and yet it is not entirely domain-specific either.

Our findings indicate that implicit theories about intelligence, musical ability, creativity, athletic ability, personality, morality, anxiety, and emotion are distinguishable from one another. However, there are also general underlying factors that align with the broader domains of skills, personality, and emotion. The factor groupings found in this study correspond with both current and past research regarding the close association of specific mindsets. Chan et al. (2021) found

that intelligence and ability loaded onto one factor, similar to our Skills factor (i.e., intelligence, musical ability, creativity, and athletic ability). Another example showing closely related mindsets grouping together are the results of Holochwost and colleagues (2021). These researchers showed that intelligence and musical mindset were related in students enrolled in orchestral participation. These students reported significantly higher levels of intelligence growth mindset as well as increases in musical growth mindset regardless of the number of years that they were enrolled in orchestral music education (Holochwost et al., 2021). These results support our finding of intelligence and musical mindset loading together onto the Skills factor. In addition, Schroder et al. (2016) found close associations with implicit theories of emotion and anxiety, grouping them into ‘mental health mindsets’, which is in line with our Emotion factor. Further, Dweck et al. (1995) reported the related nature of implicit theories of personality and morality, which is consistent with our Personality factor. Although we did find that specific mindsets grouped into larger factors, we also found that all three factors were positively correlated, suggesting that if someone believes mindsets that group on one factor are malleable, they may also be more likely to believe that mindsets on another factor are malleable, though perhaps not to the same degree. Our findings thus provide a more nuanced understanding of the structure of mindset from simply domain-specific or domain-general.

Improving Interventions

Early mindset interventions were generally face-to-face psychoeducation programs that taught participants that the brain is like a muscle that gets stronger with exercise and that the brain forms new or stronger connections with rigorous learning. These early interventions showed great promise, as they were in-person, conducted by a trained facilitator, and time intensive (i.e., 30mins). Because the time and expense of training facilitators for these face-to-

face interventions drastically limited the potential for scalability, online growth mindset interventions were developed (Dweck and Yeager, 2019). Examination of these online interventions showed that they could change mindsets and academic outcomes under certain conditions (i.e., medium-to-low achieving students; Bettinger, Ludvigsen, Rege, Solli, & Yeager, 2018; Paunesku et al., 2015; Yeager, Hanselman, et al., 2018; Yeager, Romero, et al., 2016); however, the effects on academic outcomes were modest at best.

A combination of intervention styles may be effective for improving the small effect sizes produced by the initial passive online growth mindset interventions. In our second study, we sought to apply the research on active vs passive learning to an online growth mindset intervention. Active learning has been found to increase student performance (Springer et al., 1999; Freeman et al., 2014) and passive learning seemed to hinder some students' success (Freeman et al., 2014). However, our active writing prompt did not increase the effectiveness of the passive video intervention.

There are many potential reasons why our active intervention did not lead to improvements in academic outcomes over the passive video intervention. Firstly, the intervention may have been too short. As stated above, most active learning strategies are implemented over the course of a semester (i.e., 3-4 months) or even an entire year. An example of an effective growth mindset intervention was a 2-year investigation into the cultivation of musical mindset. The length of the intervention clearly played a role in its efficacy, as the most robust effects were seen in the students that had been in the program the longest (Holochwost et al., 2021). Secondly, closely connected to the length of an intervention is the repeated exposure one gets, not only to the learned material, but also in repeated opportunities to work with the concepts in a variety of ways. The effective musical growth mindset intervention by Holochwost

and colleagues (2021) was repeated; our intervention was a brief, one-time exposure to the mindset material with a single writing prompt. Thirdly, our intervention did not include a peer-to-peer guided-inquiry learning approach, which would afford the learner an opportunity to learn and teach the growth mindset material, give and receive feedback, and allow the learner to build a deeper understanding of the material, thus possibly making the difficult task of changing one's (usually long-held) beliefs somewhat easier. Lastly, it is important to consider the effects of the additional stress on students due to the COVID-19 pandemic and that nearly all university course work was entirely online and asynchronous, putting students in the heightened stressful situation of being responsible for their own learning schedule and finding appropriate study space. As mentioned earlier, this additional stress may necessitate more rigorous intervention.

Future Research

Beyond the above-mentioned potential reasons why our active growth mindset intervention was not effective, perhaps modifying interventions to better align with the emerging research about the structure of mindset will help to improve effectiveness. When it comes to growth mindset interventions, targeting the larger factors (i.e., Skills, Personality, Emotion) that encompass multiple mindsets, combined with longer and repeated active intervention strategies, may prove to be more effective than targeting each individual mindset through passive psychoeducation. By targeting a mindset factor rather than a single mindset domain, the intervention may be more effective as it would target multiple closely related beliefs (e.g., emotion, anxiety, and depression; Schroder, 2021). Targeting multiple mindsets with a single intervention may also help improve scalability of interventions as multiple interventions for each separate domain would not be necessary. Being able to provide large-scale, highly effective growth mindset interventions could lead to vast improvements in critical outcomes, such as

lower stress, anxiety, depression, and other indicators of psychological distress (Keech et al., 2019; Schroder et al., 2015; Schroder et al., 2016; Sung et al., 2020; Yalch, Schroder, Dawood, & Donnellan, 2017), improved wellbeing (Howell, 2017), and perhaps even enhanced academic achievement (Yeager et al., 2019)). These benefits would be particularly impactful for the undergraduate population, who are dealing with ever more academic competition, stress, and challenges to well-being.

In addition to integrating mindsets from different domains into a single intervention, uncovering the origins of mindsets (i.e., how does one come to believe that attributes are malleable or fixed) may also lead to more effective interventions. Little is known regarding the etiology of mindsets, particularly how mindsets are developed in children. Some research suggests that parental mindsets are not directly related to children's mindsets (Gunderson et al., 2013). This being said, there are data indicating that consistent messaging from parents about grades, failure, achievement, and intelligence may be a determining factor in which implicit beliefs children come to adopt (Gunderson et al., 2013; Haimovitz & Dweck, 2016; Pomerantz & Kempner, 2013). Thus, future interventions may look to target both parents' method of praise (e.g., outcome or effort) and children's currently held beliefs about the malleability of Skills, Emotion, Personality, and other mindset factors. Hans Schroder (2021) also suggests that messages about the consequences of certain actions (e.g., narratives about mental illness) may be a prime determinant in the development of mindsets among children and may contribute to the adoption of either growth or fixed beliefs.

Other considerations when assessing the origins of one's implicit theories are cognitive, developmental, social, and cultural influences (Haslam, 2017). An example of this is the role of one's own experience with anxiety (and attempts to change it) in the development of one's

mindset about anxiety. Initial studies suggest that patients tend to be more growth-minded after treatment (De Castella et al., 2015; Reffi et al., 2020; Schroder et al., 2019; Valentiner et al., 2013). For example, Valentiner et al. (2013) found that after assessing patients with anxiety disorders that were attending either an intensive exposure-based outpatient program or a partial hospital program (average treatment length was 3 weeks) for shyness mindsets, everyone in the study became more growth-minded about their shyness after treatment. Additionally, De Castella et al. (2015) examined changes in social anxiety mindsets of people with social anxiety disorder participating in 16 weekly CBT sessions compared with a waitlist control group. They found that post-treatment, patients in the CBT group had a greater endorsement of the growth mindset of social anxiety than people in the waitlist condition.

Elucidating factors important to the development of mindsets may ultimately lead to more targeted interventions. Earlier targeting of children's mindsets, while mindsets are initially forming, may make the push towards growth mindset easier and ultimately lead to improved well-being. As our results show, the growth mindset factors of Personality and Emotion were associated with less stress, anxiety, neuroticism, and perfectionism, as well as increased optimism. Based on these findings, it may be advantageous for future studies of growth mindset interventions to include outcomes such as well-being and reduced psychological distress rather than predominantly focusing on academic achievement. Studies looking at indicators of well-being and psychological distress generally show larger effects (e.g., Burnette et al., 2020; also see Hoyt et al., in press) than studies linking growth mindsets to academic performance (e.g., McCabe et al., 2020; Mills and Mills, 2018; Sisk et al., 2018). Further support for using well-being and reduced psychological distress as outcome measures is that the effects of mindset interventions are strongest when the intervention is targeted towards populations expected to

benefit most. For example, when looking at growth mindset intervention effects on grades, those who are at-risk, coming from disadvantaged backgrounds, or having low socioeconomic status had an increase of almost four times the effect, relative to the average (Sisk et al., 2018). When the goal is to enhance mental health, targeted mindset interventions would seek to help people who are experiencing stress, trauma, or poor mental health. However, still needed is empirical evidence that clearly describes who benefits most from growth mindset interventions when the goal is to reduce psychological distress and promote wellbeing.

Limitations

There were some important limitations to our investigation into understanding the structure of mindset and how growth mindset interventions are delivered. First, in study I, we only examined nine mindset domains, which is not an exhaustive list of the total number of mindset domains currently being studied (e.g., see empathy mindset (Gandhi, Dawood, and Schroder, 2021), addiction mindset (Sridharan et al., 2019), and depression mindset (Zimmermann et al., 2020)). Second, the stress mindset measure we included was fundamentally different from the other implicit theory measures included in our study. Future investigation should assess stress mindset using the 15-item Stress Control Mindset Measure (SCMM; Keech et al., 2018). Also, we delivered the growth mindset intervention immediately after the midterm, which left a large gap between the intervention and the final exam (i.e., nearly two months). However, this time gap was only true for some students, as some students participated in the study towards the end of the participation period, which was very close to the final exam. In this latter case, the intervention may have been too close to the final exam and there was not enough time to have an effect. Future research should aim to first determine the optimal time to deliver growth mindset interventions to best influence academic performance. Interventions should be

closer, but not too close, to the final exam to mitigate forgetting that might take place while giving adequate time for students to incorporate growth mindset ideas into their study habits. Finally, all data were collected through online self-report measures, and the participants were from a university convenience sample pool, which may have led to some demand characteristics and limit the generalizability of our study, respectively.

Conclusion

Despite these limitations, our study showed that eight domain-specific mindsets grouped into the three distinct factors of Skills, Personality, and Emotion. This research contributes additional evidence to the literature debate surrounding the construct of mindset. In addition, although we did not find a statistically significant effect of our active intervention, we did find a consistent difference between the mindset intervention groups and the control group in study II. This finding indicates that growth mindset interventions do work; however, there is still more work to be done to improve the efficacy of these interventions.

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Appendix A

Conversion Table GPA – Grade

4.0 - 95-100%

4.0 - 90-94%

3.7 - 85-89%

3.3 - 80-84%

3.0 - 76-73%

2.7 - 72-75%

2.3 - 68-71%

2.0 - 64-67%

1.7 - 60-63%

1.3 - 55-59%

1.0 - 50-54%

0.0 – 49%

Appendix B

Tables

Table 1

Study I Internal Reliability

| Scale | Cronbach's Alpha |
|---------------------|------------------|
| Intelligence MS | .856 |
| Musical ability MS | .929 |
| Creativity MS | .778 |
| Athletic ability MS | .727 |
| Anxiety MS | .942 |
| Emotion MS | .731 |
| Morality MS | .869 |
| Personality MS | .872 |
| Stress MS | .701 |
| PSS-10 | .873 |
| STAI | .935 |
| AAQ-II | .856 |
| Neuroticism | .815 |
| LOT-R | .616 |
| Perfectionism | .880 |

Note. This table demonstrates the internal reliability, as measured by Cronbach's alpha, for Study I measures. *M* = mean, *SD* = standard deviation, *N* = 849

Table 2
Total Variance Explained

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings |
|-------------|---------------------|---------------|---------------|-------------------------------------|---------------|--------------|-----------------------------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total |
| Skills | 3.104 | 34.491 | 34.491 | 2.613 | 29.033 | 29.033 | 2.070 |
| Personality | 1.316 | 14.619 | 49.110 | 0.737 | 8.194 | 37.227 | 2.043 |
| Emotion | 0.988 | 10.983 | 60.093 | 0.479 | 5.323 | 42.549 | 0.935 |

Note. This table presents the total variance per factor. $N = 849$. Extraction Method: Principal Axis Factoring.

Table 3
Results of Exploratory Factor Analysis

| | Skills | Personality | Emotion | <i>M</i> | <i>SD</i> |
|----------------------|--------|-------------|---------|----------|-----------|
| Creative Mindset | .668 | | | 38.26 | 5.6 |
| Musical Mindset | .660 | | | 35.15 | 7.6 |
| Athletic Mindset | .644 | | | 48.58 | 6.0 |
| Intelligence Mindset | .407 | | | 30.16 | 5.7 |
| Person Mindset | | .555 | | 11.00 | 3.2 |
| Morality Mindset | | .500 | | 11.72 | 3.4 |
| Emotions Mindset | | | .945 | 16.31 | 3.4 |
| Anxiety Mindset | | | .654 | 16.23 | 4.6 |
| Stress Mindset | | | | 20.57 | 5.1 |

Note. This table presents the results of the exploratory factor analysis of nine different mindset measures. *M* = mean, *SD* = standard deviation, *N* = 849.

Table 4
Mindset Factors and Personality Correlations

| | Skills | Personality | Emotion |
|---------------------------|---------|-------------|---------|
| Skills | - | | |
| Personality | .555** | - | |
| Emotion | .226** | .491** | - |
| Perceived Stress | -.037 | -.133** | -.309** |
| Psychological Flexibility | -.037 | -.022 | -.041 |
| State Anxiety | -.065 | -.081* | -.257** |
| Neuroticism | -.037 | -.097** | -.284** |
| Optimism | .111** | .114** | .239** |
| Perfectionism | -.118** | -.129** | -.162** |

Note. This table presents the results of the bivariate correlational analysis of the mindset factors and personality measures. $N = 849$.

* $p < 0.05$, ** $p < 0.01$

Table 5
Study II Internal Reliability

| Scale | Cronbach's Alpha |
|-----------------|------------------|
| Intelligence MS | 0.947 |
| PSS-10 | 0.868 |
| Extroversion | 0.869 |
| Agreeableness | 0.682 |
| Consciousness | 0.763 |
| Neuroticism | 0.877 |
| Openness | 0.740 |

Note. This table presents the internal reliability, as measured by Cronbach's alpha, for Study II measures.
N = 166

Table 6
Exam Score Difference Across Semesters

| Semester | <i>N</i> | <i>M</i> | <i>SD</i> |
|--------------------------|----------|----------|-----------|
| Fall 2020 | 45 | -0.66% | 8.53% |
| Winter 2021 | 60 | -2.51% | 13.09% |
| Fall 2021 | 51 | -0.86% | 8.99% |
| Three Semesters Combined | 166 | -1.45% | 10.43% |

Note. This table presents the descriptive statistics of exam score difference across semesters for Study II. Exam score differences were calculated by subtracting the midterm exam score from the final exam score. Negative values represent a decline in performance from the midterm to the final exam. *M* = mean, *SD* = standard deviation

Table 7
Exam Score Difference Across Groups by Semester

| Group | <i>N</i> | <i>M</i> | <i>SD</i> |
|---------------|----------|----------|-----------|
| Fall 2020 | | | |
| Control | 15 | -4.08% | 8.49% |
| Passive | 15 | 3.80% | 7.86% |
| Active | 15 | -1.70% | 7.74% |
| Winter 2021 | | | |
| Control | 21 | -5.38% | 17.78% |
| Passive | 23 | -2.17% | 10.23% |
| Active | 16 | 0.76% | 8.71% |
| Fall 2021 | | | |
| Control | 17 | -2.58% | 10.14% |
| Passive | 18 | 0.29% | 10.29% |
| Active | 16 | -0.35% | 5.91% |
| All Semesters | | | |
| Control | 53 | -4.11% | 13.19% |
| Passive | 56 | 0.22% | 9.81% |
| Active | 47 | -0.40% | 7.44% |

Note. This table presents the descriptive statistics of exam score difference across semesters for Study II. Exam score differences were calculated by subtracting the midterm exam score from the final exam score. Negative values represent a decline in performance from the midterm to the final exam. *M* = mean, *SD* = standard deviation.

Table 8a
 One-way ANOVA Comparing Experimental Groups in Fall 2020

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> |
|----------------|-------------------|-----------|-------------|----------|----------|
| Between Groups | 489.896 | 2 | 244.948 | 3.795 | .031* |
| Within Groups | 2710.811 | 42 | 64.543 | | |
| Total | 3200.707 | 44 | | | |

Note. This table presents the ANOVA analysis of the control, passive, and active growth mindset intervention groups for the Fall 2020 semester.

* $p < 0.05$

Table 8b
 Tukey's Post Hoc Test Fall 2020

| Intervention | Intervention | Mean Difference | <i>p</i> |
|--------------|--------------|-----------------|----------|
| Control | Passive | -7.88%* | .027* |
| | Active | -2.37% | .700 |
| Passive | Control | 7.88%* | .027* |
| | Active | 5.50% | .158 |
| Active | Control | 2.37% | .700 |
| | Passive | -5.50% | .158 |

Note. This table presents the Tukey's post-hoc analyses of the control, passive, and active growth mindset intervention groups for the Fall 2020 semester.

* $p < 0.05$

Table 9
One-way ANOVA Comparing Experimental Groups in Winter 2021

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> |
|----------------|-------------------|-----------|-------------|----------|----------|
| Between Groups | 347.438 | 2 | 173.719 | 1.014 | .369 |
| Within Groups | 9764.027 | 57 | 171.299 | | |
| Total | 10111.465 | 59 | | | |

Note. This table presents the ANOVA analysis of the control, passive, and active growth mindset intervention groups for the Winter 2021 semester.

Table 10
 One-way ANOVA Comparing Experimental Groups in Fall 2021

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> |
|----------------|-------------------|-----------|-------------|----------|----------|
| Between Groups | 78.171 | 2 | 39.085 | .473 | .626 |
| Within Groups | 3966.699 | 48 | 82.64 | | |
| Total | 4044.87 | 50 | | | |

Note. This table presents the ANOVA analysis of the control, passive, and active growth mindset intervention groups for the Fall 2021 semester.

Table 11

One-way ANOVA Comparing Experimental Groups for All Semesters Combined

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> |
|----------------|-------------------|-----------|-------------|----------|----------|
| Between Groups | 583.596 | 2 | 291.798 | 2.644 | .074 |
| Within Groups | 16885.741 | 153 | 110.364 | | |
| Total | 17469.337 | 155 | | | |

Note. This table presents the ANOVA analysis of the control, passive, and active growth mindset intervention groups for all three semesters combined (Fall 2020, Winter 2021, Fall 2021).

Table 12

One-way ANOVA Comparing Active Group Written Intervention Scores for All Semesters Combined

| | Sum of Squares | <i>df</i> | Mean Square | <i>F</i> | <i>p</i> |
|----------------|----------------|-----------|-------------|----------|----------|
| Between Groups | 76.979 | 2 | 38.49 | 0.685 | .509 |
| Within Groups | 2471.904 | 44 | 56.18 | | |
| Total | 2548.883 | 46 | | | |

Note. This table presents the ANOVA analysis of exam score differences based on the depth of written responses from participants in the active growth mindset intervention group for all three semesters combined (Fall 2020, Winter 2021, Fall 2021).

Table 13

Descriptive Statistics for Depth of Writing Score for Participants in the Active Group for All Semesters Combined

| Writing Score | <i>N</i> | <i>M</i> | <i>SD</i> |
|---------------|----------|----------|-----------|
| 1 | 3 | -5.29% | 1.97% |
| 2 | 9 | 0.14% | 6.05% |
| 3 | 35 | -0.12% | 7.99% |

Note. This table presents the descriptive statistics of exam score difference for participants in the active growth mindset intervention group based on depth of response to the writing prompt. Writing Score 1 = defined growth mindset, 2 = defined growth mindset and stated who in their life might benefit from having a growth mindset, and 3 = defined growth mindset, stated who in their life might benefit from having a growth mindset, and described how they would teach that person about growth mindset. Exam score differences were calculated by subtracting the midterm exam score from the final exam score. Negative values represent a decline in performance from the midterm to the final exam. Data are for all semesters combined. *N* = number of active written interventions, *M* = mean difference in exam scores, *SD* = standard deviation.