ABSTRACT

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Obesity is a worldwide public health concern, with 73 countries doubling their obesity prevalence since 1980. Health problems related to obesity affect more than 2 billion people, thus driving increased healthcare costs (GBD 2015 Obesity Collaborators, 2017). In addition to presenting negative consequences to physical health, mental health concerns are also associated with obesity (Scott et al., 2008). In response to this global issue, researchers aim to find ways to encourage individuals to hold healthier cognitions and to participate in healthy behaviors that can prevent and treat obesity – such as exercise and healthy eating habits. The manuscripts included in this dissertation add to the growing body of work exploring mechanisms that underlie health behavior change. Specifically, the research presented here investigates how mindsets influence engagement in healthy cognitions and behaviors. Organized across three related topics and manuscripts, this dissertation includes: 1) assessing and manipulating implicit theories (mindsets) of weight and the relation to healthy eating, 2) assessing and manipulating implicit theories (mindsets) of fitness and the relation to exercise frequency, and 3) testing the feasibility and acceptability of a health mindset intervention with children and adolescents from obesity prevention programs. The findings from this research present a potential new avenue—namely, mindsets—for combating obesity.

Mindsets: Implications for Healthy Cognitions and Behaviors

by
Kasey Jo Orvidas

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APPROVED BY:

_____	_____
Dr. Jennifer Burnette Chair of Advisory Committee	Dr. Laura Widman
_____	_____
Dr. Anne McLaughlin	Dr. Lynsey Romo

BIOGRAPHY

Kasey Orvidas was born in Rochester, Minnesota where she was raised by her parents Mark Orvidas and Laura Orvidas. She has one younger brother, Jacob Orvidas. She attended the University of Minnesota and there she received her Bachelor's of Arts in Psychology and her Bachelor's of Arts in Sociology in Spring 2015 before moving to North Carolina that Fall to pursue her Doctorate degree in Psychology at North Carolina State University.

In addition to being a graduate student, Kasey worked as a nutrition coach for her own business and for Heat Studios in Raleigh. She was also an academic advisor in the psychology department.

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CHAPTER 1

Background

Obesity affects approximately 107.7 million children and 603.7 million adults worldwide. From 1980 to 2015, obesity prevalence doubled in more than 70 countries and continues to rise in most countries. As the global prevalence of obesity and overweight continues to increase, so does the concern regarding associated health risks (Roberto, 2015). Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health is linked to numerous chronic diseases and cancers (Lauby-Secretan et al., 2016). Thus, it is associated with steep health care costs. For example, the United States spends, on average, 149.4 billion dollars annually on obesity-related medical spending (Kim & Basu, 2016). In addition to health care costs, obesity presents mental health costs as well. There is a strong stigmatization against obese and overweight individuals, with implications for mental health concerns such as low self-esteem, mood disorders, eating disorders, and poor body image (Pi-Sunyer, 1991, Scott et al., 2008).

Considering the toll of rising obesity rates, it is perhaps not surprising that interest in finding empirically-supported mechanisms for offsetting the condition is increasing. And, this focus is often on health behavior change—usually increasing exercise and improving eating habits. Further, engaging in healthy behaviors on a consistent basis provides benefits beyond obesity prevention. Evidence suggests that regular exercise and healthy eating can reduce symptoms of depression, anxiety, and stress and can enhance concentration, sleep, and energy (O'Dea, 2003; Strauss, Rodzilsky, Burack, & Colin, 2001; Warburton, Nicol, & Bredin, 2006). Considering the benefits of healthy behaviors, interventions often seek to increase exercise and healthy eating habits (for meta analyses see: Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Stice, Shaw, & Marti, 2006) with evidence pointing to the importance of self-efficacy

(Kalavana, Maes, & De Gucht, 2010; Sniehotta, Scholz, & Schwarzer, 2005), identification (Dunn, Mohr, Wilson, & Wittert, 2011; Strachan, Woodgate, Brawley, & Tse, 2005), social support (Trost, Owen, Bauman, Sallis, & Brown, 2002), habits (Dishman, Sallis, & Orenstein, 1985), self-monitoring (Michie, et al., 2009), and other psychological constructs (Biddle, Goudas, & Page, 1994).

In my programmatic stream of research, I extend the existing literature on health behavior change by drawing upon a longstanding theoretical approach to understanding motivation and self-control—namely, a mindset perspective (also known as implicit theory; Dweck, 2000; Molden & Dweck, 2006). An individual's mindset regarding a particular human attribute or skill contributes to whether they put forth the effort to undertake the necessary self-regulatory actions that ultimately lead to engagement in certain behaviors. Mindsets are not explicitly pronounced in the mind of the person, but instead are known to be implicit knowledge structures that determine an individual's belief regarding the changeable nature of a specific attribute, and thus create a belief system for making meaning of outcomes related to the attribute (Ross, 1989). The general idea that an individual's belief system is often responsible for their actions is not a novel assumption; Piaget described the significance of personal beliefs as being just as important in influencing behavior as logical, conscious thinking (Piaget, 1964). In regard to the work presented here, I investigate the power of individuals' mindsets, or beliefs, about the malleable nature of health and fitness in predicting health-related cognitions and behaviors.

Mindset Theory

A fixed mindset is the belief in the static nature of human attributes, such as intelligence or athletic ability, and a growth mindset is the belief in the changeable nature of human attributes (Dweck & Leggett, 1988). It is important to keep in mind that these attributes are domain specific, rarely correlate with personality constructs such as the big five and can be shifted with

one-shot laboratory experiments or longer-term interventions (Blackwell, Trzesniewski, & Dweck, 2007; Dweck, Chiu, & Hong, 1995; Spinath, Spinath, Riemann, & Angleitner, 2003; Schleider & Weisz, 2016; Tabernero & Wood, 1999). Regardless of domain or assessment, these mindsets matter for self-regulatory processes. Individuals with a fixed mindset see failure as an indication of an innate deficiency and are more likely to take criticism negatively and shy away from challenges or situations in which they are uncertain of their ability to be successful. These individuals also respond with helpless-oriented strategies and are more concerned with their performance or how others judge their competence. If obstacles arise in the pursuit of goals – as they typically do –helpless-oriented strategies can impede future success. In contrast, individuals with a growth mindset tend to see failure and setbacks as an opportunity to learn, are more likely to take criticism constructively, and persist in the face of challenges and setbacks. These individuals are more likely to employ mastery-oriented strategies to reach their goals and to focus on increasing their competence in a given skill. In turn, these mastery-oriented responses usually result in improved goal achievement (for a review see Burnette et al., 2013). Combining mindset theory with the self-control literature, the SOMA model (Burnette et al., 2013) outlines how mindsets matter for goal setting, operating, monitoring and ultimately goal achievement. In summary, an individual's mindset steers important self-regulatory processes that play a crucial role in goal achievement.

Mindsets and Health Behaviors

The majority of previous mindset research is the context of academics, as it originated with the goal of understanding when students persist despite obstacles (Dweck, 2000). However, recently, researchers have extended findings to the domain of health. For example, in the context of weight-loss, inducing a growth mindset about body weight served as a buffer against weight-gain following severe dieting setbacks (Burnette, 2010; Burnette & Finkel, 2012). There is also

evidence for the importance of mindsets about body types for exercise habits. In a sample of college women, those with stronger growth mindsets of body weight exercised more on a weekly and yearly basis (Lyons, Kaufman, & Rima, 2015). An individual's mindset of athletic coordination also predicted exercise behavior. In one study, researchers exposed participants to a novel exercise task. During the experiment, participants first followed an easy exercise video and then completed a much more difficult exercise video. Participants induced to hold a growth mindset of athletic coordination relative to those induced to hold more of a fixed mindset reported greater motivation and self-efficacy and less negative affect following completion of the difficult exercise. Additionally, participants holding a growth, relative to fixed, mindset of athletic ability reported being more motivated and enjoying their physical education classes (Biddle, Wang, Chatzisarantis, & Spray, 2003).

Although research is beginning to determine how mindsets predict health behavior, such as with the studies pertaining to weight loss and athletic ability reviewed above, but there are still unanswered questions. With obesity presenting worldwide concerns for mental health, physical health, and economic costs, there is a pressing need to better understand how to help individuals adopt healthier lifestyles. The work presented here extends the current mindset literature as it relates to healthy habits and behaviors, mainly focusing on healthy eating practices and physical activity. For example, I identify a key theoretical mechanism linking mindsets of fitness to engagement in physical activity—namely, self-efficacy and value (Orvidas, Burnette, & Russell, 2018). Understanding the mechanisms underlying change present an avenue to target in interventions, and although previous growth mindset interventions have been successful (e.g. Blackwell, Trzesniewski, & Dweck, 2007; Burnette & Finkel, 2012; Schleider & Weisz, 2016), there is room for application to health behavior change intervention work; here I address this gap and apply mindset theory to an intervention for obese youth.

Overview of Research Chapters

In these studies, I focus on the importance of an individual's mindset in regard to body weight, fitness, and general health for engagement in health behaviors. More specifically, across three related topics and manuscripts, this dissertation includes: 1) assessing implicit theories (mindsets) of weight and the relation to healthy eating, 2) assessing and manipulating implicit theories mindsets) of fitness and the relation to exercise frequency, and 3) testing the feasibility and acceptability of a health mindset intervention for obese children and adolescents from existing obesity treatment clinics.

CHAPTER 2

Introduction

Dweck's implicit approach (also known as mindsets) suggests that people hold beliefs regarding the malleability of personal attributes such as intelligence, personality, and morality on continuums ranging from strong incremental theories (or growth mindsets), suggesting that these attributes are changeable over time, to strong entity theories (or fixed mindsets), suggesting that the characteristics are fixed and unchangeable (e.g., Dweck, 1999; Dweck & Leggett, 1988). These beliefs can be measured explicitly but are referred to as implicit theories in that they likely are not consciously formed and are rarely consciously considered. Three decades of research suggests that people hold implicit theories regarding a range of attributes across, for example, academic (e.g., Dweck, 1999), social (e.g., Beer, 2002), and athletic (e.g., Wang & Biddle, 2003) domains.

Across domains, people's implicit theories of attributes have important implications with respect to motivation, goal setting, and achievement. In a recent meta-analysis, Burnette and colleagues (2013) demonstrated that incremental, relative to entity, theories of attributes predicted the endorsement of goals focused on learning rather than performance. Incremental theories (growth mindsets) also predicted striving for goals using mastery more than helpless-oriented strategies and remaining optimistic when facing challenges. These goal-relevant strategies mediated a positive effect of incremental theories of ability on goal achievement across a range of contexts, suggesting that incremental theories may help people self-regulate their behavior to be consistent with their goals. Experimental research suggests that the relationship between incremental theories (or growth mindsets) of attributes, goal striving and goal achievement is likely to be causal. For example, people randomly assigned to a condition in which they are taught a malleable view of intelligence adopt goals to improve their intellectual

abilities more often, and show greater persistence on difficult intellectual tasks, relative to those assigned to a condition in which they are taught a fixed view of intelligence (Dweck & Leggett, 1988). Similarly, experimental studies have shown that incremental theories of intelligence lead to more positive views of effort and higher grades compared to control participants (Blackwell, Trzesniewski, & Dweck, 2007).

In the current investigation, we extend research on implicit theories regarding the malleability of personal attributes to the domain of weight and examine the effect of these beliefs on healthy eating behavior. Specifically, we explore whether people's beliefs about the degree to which weight is malleable influence their consumption of unhealthy foods—foods that are high in calories and fat.

Implicit Theories of Weight

Until recently, limited research had investigated the impact of implicit beliefs about malleability in health-relevant domains. Recent work finds that incremental theories within health-relevant domains predict motivation and achievement in ways comparable to academics and other domains (e.g., Lyons, Kaufman, & Rima, 2015). We argue that examining the effect of implicit beliefs on people's eating behavior is particularly important. Obesity is correlated with a range of negative health (e.g., Kenchaiah et al., 2002) and psychological (Puhl & Heuer, 2009) consequences. Unhealthy diets play a central role in the size of waistlines and in the etiology of life-threatening diseases (e.g., O'Donnell et al., 2010; Stampfer et al., 2000; Voorrips et al., 2000). Despite public health recommendations to limit the consumption of high-calorie, high-fat foods (e.g., Flock & Kris-Etherton, 2011), people often struggle with resisting tempting foods in the service of long-term health and appearance-based goals (e.g., Junger & Van Kampen, 2010; Fishbach, Friedman, & Kruglanski, 2003). Thus, maintaining a healthy diet requires self-regulation in the face of tempting high calorie foods.

Drawing upon work suggesting that incremental theories of personal attributes benefit goal striving and achievement (see Burnette et al., 2013 for review), we suggest that views of weight as malleable are likely to help individuals resist tempting high-calorie foods and, thereby, help them maintain healthy eating habits. Past research suggests just as people differ in the degree to which they view intelligence and personality to be malleable, people also differ in the degree to which they view weight as malleable (Burnette, 2010). Some people view weight as changeable, perhaps through diet and exercise—an incremental view of weight. Others hold more of an entity view of weight, characterized by the belief that one's weight is largely fixed and unchangeable, perhaps due to genetics or health issues. Implicit theories of weight are consequential, with incremental theorists predicting that they would respond to a hypothetical dieting setback with more effortful and less avoidant strategies (e.g., Burnette, 2010). Additionally, an intervention designed to encourage an incremental theory of weight helped dieters avoid weight-gain in the wake of dieting setbacks (Burnette & Finkel, 2012).

Our investigation extends this research to examine the relationship between implicit theories of weight, self-efficacy and healthy eating behavior. Specifically, we examine whether a view of weight as malleable predicts greater nutrition self-efficacy than does a fixed view of weight. Further, we examine whether this difference in self-efficacy predicts reduced consumption of a high-calorie, high-fat food. In the same way that a view of intelligence as malleable inspires motivation and persistence within academic environments (e.g., Dweck, 1999), we expect that a view of weight as malleable will inspire motivation to resist tempting high-calorie, high-fat food and, in so doing, maintain healthy eating practices.

To our knowledge, the relationship between implicit theories of weight and eating behavior has yet to be explored. One recent study provides preliminary support that such beliefs might be consequential. Dar-Nimrod, Cheung, Ruby, and Heine (2014) found that participants

who read a message suggesting that obesity is genetically caused (consistent with an entity theory of weight) tended to consume more of high-calorie food than control participants. Although participants' naturally-occurring implicit theories of weight were not measured in the above study, the finding is consistent with our argument that perceptions of weight as malleable should relate to healthy eating behavior as evidenced by lower consumption of unhealthy foods.

The Present Investigation

The current investigation directly examines whether stronger incremental, relative to entity, theories of weight predict reduced consumption of high-calorie, high-fat foods (Studies 1 and 2). Study 1 examines the correlation between implicit theories of weight and a behavioral measure of unhealthy eating. In Study 2, we examine the causal effect of an incremental theory of weight on eating behavior by experimentally manipulating participants' theories of weight and measuring their eating behavior. We predict that participants with more incremental views of weight, whether naturally-occurring (Study 1) or experimentally manipulated (Study 2), will eat less of the high-calorie, high-fat snack than those with more entity theories of weight. In Study 3, we examine a proposed mechanism underlying the effect of implicit theories of weight on healthy eating. Specifically, we examine whether an incremental theory of weight predicts greater feelings of self-efficacy regarding nutrition and, in turn, reduced consumption of high-fat foods, compared to more entity theories of weight.

Study 1

Study 1 examined the relation between participants' implicit theories of weight and their eating behavior. We introduce a new measure of implicit theories of weight in this study that differs from that used in past research (e.g., Burnette, 2010) by asking about perceptions of malleability in weight within the context of people's beliefs about the specific ways in which weight might be malleable (e.g., diet and exercise) or fixed (e.g., due to genetics). This measure

also differs from the pre-existing measure by focusing on whether weight is malleable in the long run, reflecting the fact that some weight loss attempts might only be temporary (e.g., Jeffery et al., 2000). This new measure was developed independent of the pre-existing measure and, as such, differences between measures were not by design or to correct for perceived inadequacies in the previously published measure.

We examined the effect of participants' theories of weight on their consumption of a high-calorie, high-fat snack and a lower-fat, healthier snack. We surreptitiously measured caloric intake through a laboratory taste-test task by weighing the snack containers before the start of the experimental session and, again, after the end of the session. We chose this behavioral, surreptitious measure of eating behavior in Studies 1 and 2 to assess consumption free from the self-presentation bias that can introduce error into self-report measures (e.g., Hebert, Clemow, Pbert, Ockene, & Ockene, 1995).

We predicted that, relative to more entity views of weight, stronger endorsement of an incremental theory of weight would predict healthier eating, as measured by lower consumption of the high-calorie, high-fat snack. In contrast, we expected that theories of weight would not significantly predict consumption of the healthier snack, which would require less self-regulation to resist overeating.

Methods

Participants

Seventy-three students (34 Female, 39 Male) at a large public university participated in exchange for partial course credit. Participants ranged in BMI from 18 to 37 kg/m^2, Mean = 22.93 (*SD* = 3.55) and in age from 18 to 30, Mean = 19.99 (*SD* = 2.38). Due to a programming error, race and ethnicity data were not collected. No participant exclusions were made.

Procedure

Participants completed a brief "health beliefs" survey that included questions regarding participants' height and weight and the Implicit Theories of Weight scale (α = .86). This scale was developed for the present investigation and was pretested in a separate sample (*n* = 199) to demonstrate validity (See Supplemental Material for full pretest details). The scale consists of 15 statements expressing that weight is either largely changeable (e.g., "Regardless of their genes, people can always lose weight through diet and exercise") or that it is fixed (e.g., "Although people can gain or lose a few pounds through dieting and exercising, how heavy people are is determined largely by genetics and cannot be changed"). Participants were asked to rate their agreement with each statement on a scale from 1 (strongly agree) to 6 (strongly disagree). After reverse-scoring relevant items, responses were averaged to compute a Theories of Weight score for each participant ranging from 1 (strong endorsement of an entity theory) to 6 (strong endorsement of an incremental theory of weight).

Next, participants were asked to complete a 20-minute questionnaire study that was unrelated to the present investigation in order to reduce the likelihood that participants would become suspicious about a connection between the health beliefs survey and the subsequent taste-testing task. In the questionnaire study, participants answered questions regarding their academic motivation and self-beliefs.

Finally, participants were asked to take part in a brief taste testing study that was described as unrelated to the previous two studies. They were presented with a container of M&M candies, a container of raisins, scoops and plates for each snack, and a taste-test survey. Participants were asked to serve themselves enough M&Ms and raisins to allow them to make informed ratings of each product. Just before beginning the taste-test, they selected one of six response categories indicating when they last ate: "less than 30 minutes ago," "30-60 minutes

ago," "1-2 hours ago," "3-4 hours ago," "5-6 hours ago," or "I have not eaten yet today." They were then instructed to taste each product even if they had eaten both products in the past so that the flavor would be fresh in their minds. After explaining the task, the experimenter left each participant alone in a room to privately serve him or herself and complete the taste-test survey. For the taste test survey, participants were asked to rate each snack on a series of dimensions related to taste and texture (e.g. salty, sweet, crunchy).

Upon completion of the taste test, participants were debriefed and dismissed. Both snack containers had been weighed prior to the arrival of the participant. The experimenter also weighed both snack containers as well as any food left on the plates after the conclusion of the experimental session to determine the weight of each snack consumed by each participant. We then calculated the number of calories consumed by each participant, for each snack, by multiplying the weight values for snacks consumed by the published number of calories per ounce (M&M calories per ounce = 142, Raisins calories per ounce = 92).

Results and Discussion

Descriptive Statistics

We corrected for positive skew in participants' BMI (skewness = 1.42) with log-transformation. Because log-transformation was insufficient to correct for skew in calories consumed, we corrected for positive skew in the number of M&M calories eaten (skewness = 2.46) and the number of raisin calories eaten (skewness = 2.97) with square-root transformations.

As predicted, stronger incremental theories of weight correlated with less consumption of calories from M&Ms, $r(73) = -.34$, $p = .003$, but were uncorrelated with consumption of raisins. Theories of weight were also uncorrelated with participants' age, gender, and BMI, all ps $> .14$ (see Supplemental Material for further descriptive statistics). There was not a significant correlation between participants' implicit theories of weight and when they last ate, $r(72) = -.18$,

p = .13. There was also no significant relationships between when participants last ate and their consumption of either M&Ms, $r(72) = .07$, $p = .55$, or raisins, $r(73) = -.12$, $p = .32$, in our taste-testing task. For this reason, we did not include recency of eating as a covariate in our analyses.

Not surprisingly, participants' eating behavior was strongly predicted by their ratings of how much they liked the snacks. In particular, participants' rated liking of M&Ms significantly predicted the number of calories consumed both from M&Ms, $r(73) = .34$, $p = .003$, and raisins, $r(73) = .28$, $p = .016$. In this study, participants' rated liking of raisins did not significantly predict consumption of either snack, all ps >.12. Because participants' liking of M&Ms significantly predicted consumption of both snack foods, we control for this variable in subsequent analyses.

The Effect of Theories of Weight on Eating Behavior

We predicted that participants with more incremental theories of weight would eat fewer calories and, in particular, fewer calories from the less healthy M&Ms snack than those with more fixed theories. To test this prediction, we conducted a linear mixed-effect model to test whether participants' implicit theories of weight predicted the number of calories consumed from M&Ms and raisins, controlling for their rated liking of M&Ms. The full model included fixed effects of implicit theories of weight, snack type (unhealthy or healthy), the interaction between theories of weight and snack type, rated liking of M&Ms, as well as a random intercept for each participant. Not surprisingly, higher reported liking of M&Ms correlated with more calories consumed, on average, $t(71) = 3.02$, $p = 0.004$, $\beta = .27$, 95% CI [0.09, 0.45]. The analysis also revealed a significant main effect of theories of weight, $t(71) = -2.42$, $p = 0.018$, $\beta = -.218$, 95% CI [-0.39, -0.04], suggesting that participants with stronger incremental theories of weight consumed fewer calories than those with more entity theories of weight. This main effect was qualified by the predicted interaction with the snack type, $t(71) = 2.15$, $p = 0.03$, $\beta = 0.22$, 95%

CI [0.02, 0.41], see Figure 1. Post hoc analyses revealed that participants with more incremental theories of weight consumed fewer calories from M&Ms than those with more entity theories, $t(71) = -2.85$, $p = 0.006$, $\beta = -0.30$, 95% CI [-0.52, -0.09]. The model predicted value for more incremental participants (i.e., one SD above the mean) was 66.90 calories consumed from M&Ms, 95% CI [44.60, 93.70], while the model predicted value for participants with more entity theories of weight (i.e., one SD below the mean) was nearly twice as much at 126.15 M&M calories consumed, 95% CI [94.70, 162.20]. In contrast, theories of weight did not predict consumption of the healthier snack food, +1 *SD* = 34.70 raisin calories consumed, 95% CI [21.60, 50.90] vs. -1 *SD* = 49.00 calories consumed, 95% CI [33.10, 67.90], $t(71) = -1.25$, $p = .22$, $\beta = -0.14$, 95% CI [-0.37, 0.08]. In sum, this study provides preliminary evidence that more incremental theories of weight predict lower consumption of high-calorie, high-fat foods, in particular, while having no influence on consumption of a healthier snack option.

Study 2

If, as argued, an incremental theory of weight helps people successfully resist eating unhealthy high-calorie foods, an experimental manipulation that teaches people that weight is changeable might lead to lower consumption of high-calorie, high-fat foods compared to a condition that teaches people that weight is fixed. To test this prediction, we randomly assigned Study 2 participants to watch one of two videos designed to promote either an incremental or a fixed theory of weight.

We randomly assigned participants to watch one of two videos consisting of actual news footage presenting more of an entity or a more incremental message regarding weight to experimentally manipulate their implicit theories of weight. As in Study 1, participants' eating behavior was surreptitiously measured through a taste-testing task later in the experimental session that featured a high-calorie, high-fat snack and a second healthier snack option. We

predicted that participants randomly assigned to the incremental video condition would consume less of the high-calorie snack than those assigned to the entity video condition. In contrast, we expected that participants' video condition would have little effect on their consumption of the healthier snack option.

Method

Participants

One hundred and fourteen undergraduate students received course credit in exchange for their participation. We excluded 10 participants because of suspicion (n = 6) or errors in food measurement (n = 4). The remaining sample of 104 participants (55 Female, 48 Male, 1 unspecified gender) ranged in BMI from 16.9 to 43.8 kg/m^2, Mean = 23.92 (SD = 4.07) and in age from 18 to 23, Mean = 19.36 (SD= 1.31). Race and ethnicity data were not collected due to a programming error.

Procedure

Participants were told that we wanted them to evaluate the suitability of a video for high school students. Participants were randomly assigned to watch either the incremental or the entity video, both of which were 2-3 minutes long and included actual news footage describing scientific research regarding weight. The entity video featured a news story describing genetic contributions to obesity. It included interviews with a woman who had repeatedly struggled with losing weight and scientists in white lab coats who described genetic factors contributing to fixed weight. Through interviews with scientists, the video explained that there are more than 30 genes that affect body weight, including genes that influence levels of ghrelin and leptin (hormones that contribute to feelings of hunger). According to one scientist in this video, weight is "like your eye color, height and your blood pressure—all instances of genetic predispositions."

In contrast, the incremental video featured a news story that highlighted the degree to which weight is changeable through diet and exercise. This video also featured interviews with individuals who had attempted to lose weight and scientists discussing recent research. However, the two dieters interviewed for this story both were successful in losing weight and maintaining weight-loss. The scientists interviewed described a study that explored the effect of four different diet plans on weight loss and concluded that all four plans helped people lose weight, with some participants maintaining their weight loss when they were contacted 2 years after the start of the study. The scientists in this video emphasized that multiple approaches to sustained weight loss have shown to be effective.

To support the cover story, participants completed a short questionnaire after viewing the video, in which they were asked to summarize the main message in the video, describe the proposed relationship between genetics and a person's weight, and evaluate the extent to which the video explained research in a way that would be easily accessible to high school students. As a manipulation check, participants were also asked to rate their agreement with item 1 of the Implicit Theories of Weight scale—"Just like people are genetically programmed to grow to a certain height, people are genetically programmed to be a more or less a certain weight and they cannot change that," on a scale from 1 (*strongly disagree*) to 6 (*strongly agree*). We did not ask participants to complete the full Implicit Theories of Weight scale in order to avoid arousing suspicion. However, an analysis of Study 1 data suggests that (reverse-scored) responses to item 1 correlate highly with theory of weight scores based on all 15 items, $r(73)=.54$, $p < .001$.

As in Study 1, participants were next asked to complete a 20-minute questionnaire study unrelated to the current investigation. Lastly, participants completed a taste test identical to that described in Study 1.

Results and Discussion

Descriptive Statistics

As in Study 1, a positive skew in participants' BMI (skewness = 1.97) was corrected through log-transformation. Because log-transformation was insufficient, positive skew in M&M (skewness = 3.23) and raisin (skewness = 2.50) calories consumed were corrected through square-root transformation.

As one might expect given random assignment to condition, there was no relationship between participants' implicit theories of weight condition and any individual difference variable (gender, age, last time participants ate, and log-transformed BMI), all *p*s > 0.32. Furthermore, there was not a condition difference in the degree to which participants reported liking raisins (M = 3.16, SD = 1.17 vs. M = 2.85, SD = 1.11), $t(102) = -1.38$, $p = .17$. For these reasons, these variables were not used as covariates. There was, however, an unexpected tendency for participants randomly assigned to the incremental video condition to report liking M&Ms marginally more (M = 3.80, SD = 0.83) than those in the entity condition (M = 3.50, SD = 0.97), $t(102) = -1.69$, $p = .09$. Further, as in Study 1, the degree to which participants reported liking the snacks correlated highly with snack consumption. In particular, participants' rated liking of raisins positively correlated with their consumption of raisins, $r(103) = .45$, $p < .001$, and negatively correlated with consumption of M&Ms, $r(103) = -.20$, $p = .04$. In addition, participants' rated liking of M&Ms correlated marginally with their consumption of M&Ms, $r(103) = .19$, $p = .06$. For these reasons, we included participants' rated liking of both M&Ms and raisins as covariates when testing our Study 2 hypotheses.

Manipulation Check

We reverse-scored responses to the manipulation check item so that higher numbers correspond to a more incremental theory of weight. We next conducted a t-test to examine

whether the video manipulation successfully influenced participants' implicit theories of weight. Participants randomly assigned to the incremental video condition responded in a manner more consistent with an incremental theory of weight, Mean = 3.96 (*SD* = 1.32), than participants assigned to the entity video condition, Mean = 3.08 (*SD* = 1.16), $t(101) = -3.61$, $p < .001$, $d = .71$, suggesting that the videos were effective in manipulating participants' theories of weight.

The Effect of Video Condition on Eating Behavior

We hypothesized that participants randomly assigned to a video condition in which they were taught an incremental view of weight would consume less of a high-calorie, high-fat snack than participants assigned to a condition that taught an entity theory of weight. To test this hypothesis, we examined the effect of video condition on calories consumed through a repeated-measures ANCOVA predicting M&M calories and raisin calories consumed, controlling for the degree to which participants liked each snack. This analysis revealed a marginally significant main effect of experimental condition, such that participants who watched the entity video consumed marginally more calories than participants who viewed the incremental video, $F(1,99) = 2.88$, $p = .09$, $\eta_p^2 = .03$. This main effect was qualified by the predicted interaction between video condition and snack type, $F(1,99) = 4.11$, $p = .045$, $\eta_p^2 = .04$. Post hoc analyses revealed that participants in the entity condition consumed more calories from M&Ms than did participants in the incremental condition, $F(1,99) = 4.49$, $p = .04$, $\eta_p^2 = .04$. In contrast, there was no difference between conditions in the number of calories consumed from raisins, $F(1,99) = .003$, $p = .96$, $\eta_p^2 = .00$ (see Table 1).

Together, the first two studies show that an incremental theory of weight predicts less consumption of a high-calorie, high-fat food than a view of weight as fixed. These studies provide evidence that an incremental theory of weight not only correlates with healthier eating (Study 1) but, perhaps, has a causal impact on people's ability to resist tempting high-calorie,

high-fat snacks. In this way, Study 2 suggests that one possible strategy for interventions that promote healthy eating might be to present evidence that weight is changeable in order to teach more incremental views of weight and, consequently, encourage healthy eating by highlighting available evidence suggesting weight is malleable.

Study 3

Study 3 was designed to satisfy two goals. First, this study explored a potential mechanism underlying the effect of theories of weight on eating behavior. Specifically, we propose that an incremental theory of weight predicts higher efficacy beliefs regarding food than does an entity theory, and that this difference in self-efficacy might explain the difference in eating behavior observed in Studies 1 and 2. Past work has shown that incremental theories of intelligence correlate with self-efficacy in academics (Tabernero & Wood, 1999). Closer to the current focus, incremental theories of weight have been shown to correlate with high nutrition self-efficacy (Burnette, 2010). Drawing upon past work on implicit theories, we argue that this relationship between incremental theories and self-efficacy exists because entity theorists tend to view failures as an indication of a personal deficiency, which might erode their sense of efficacy. In contrast, incremental theorists tend to view failure as part of the learning process (see Burnette et al., 2013 for review). If, for example, an incremental theorist regarding weight responds to failures (e.g., overindulging in an unhealthy food) by thinking of them as learning experiences (e.g., "I should put less on my plate next time"), we expect such experiences might increase self-efficacy regarding food. This is important because nutrition self-efficacy is a robust predictor of healthy eating (e.g., Schwarzer & Renner, 2000; Strachan & Brawley, 2009). Thus, one goal in Study 3 is to test the hypothesis that the relationship between incremental theories of weight and lower consumption of unhealthy foods is mediated by self-efficacy.

A second goal of Study 3 was to replicate and extend the findings of the earlier studies in a study that did not share some of the weaknesses. First, to balance the college student samples of Studies 1 and 2, participants in Study 3 were drawn from Amazon's Mechanical Turk service, which offers a more diverse sample. Second, the data for Studies 1 and 2 were collected several years ago, at a time when normative sample sizes were smaller. To balance the smaller sample sizes of Studies 1 and 2, we preregistered a sample size of 200 for the current study. Relatedly, we publicly preregistered our planned stopping rule, exclusion criteria, materials, and planned analyses on Open Science Framework (https://osf.io/59mvj/).

Finally, the behavioral measure of eating behavior used in Studies 1 and 2 is limited to a single occasion of snacking behavior. For that reason, in Study 3, we used a brief self-report measure of eating behavior developed by the National Cancer Institute. Although this measure requires self-report, it also is more trustworthy than other brief self-report consumption measures because it was developed in a manner well informed by a wealth of consumption data based on in-depth and longitudinal consumption measures. In addition, this measure has shown adequate convergent validity with more in-depth and longitudinal consumption measures for the purposes of the present study (e.g., Thompson, Midthune, Subar, Kipnis, Kahle, & Schatzkin, 2007; Thompson et al., 2008).

We had three predictions for Study 3. First, in a conceptual replication of Study 1, we expected that those with stronger incremental beliefs would report eating behavior consistent with a lower percentage of energy coming from fat. Next, replicating past research, we expected that participants with more incremental theories of weight would report higher self-efficacy regarding nutrition than those with more entity beliefs. Most importantly, we expected the relationship between theories of weight and eating behavior to be mediated by participants' nutrition self-efficacy.

Method

Participants

As outlined in the preregistration for this study, participants were recruited through Amazon's Mechanical Turk web service. Participation was restricted to "Master" workers who were U.S. citizens and at least 18 years of age. We stopped data collection at 200 complete responses. Eight additional respondents had responded to at least one question but discontinued participation before the final page of the study. With these incomplete respondents the sample size was 208.

This study featured two attention check items. The first attention check was designed to be the same length as nearby Theories of Weight items and read, "Although people can gain weight, please disregard the start of this sentence and select the word yes as your answer to show that you are carefully reading the questions." This item was paired with a drop down menu featuring 7 possible responses—the 6-point Theories of Weight scale ranging from *strongly agree* to *strongly disagree* followed by a seventh response option with the word "yes." Participants who did not follow instructions received an error message upon attempting to advance to the next page. They were unable to advance to the next page until they had selected the response specified in the instructions.

We excluded participants who failed a second attention check item, which was placed in a matrix of questions regarding how frequently participants had consumed different foods. Matching the length of nearby items, the item read simply "Select two plus times per day for this item to show you are reading." No error message was shown for participants who failed to follow instructions.

Data from 6 participants were excluded[1] for failing the second attention probe. Data was excluded from an additional 3 participants because they did not provide sufficient data for any analysis involving more than the variable first measured (Theories of Weight) before discontinuing participation.

Thus, the final sample was 199 participants (109 Female, 89 Male, 1 person did not report gender). Participants ranged in age from 21 to 69, Mean = 38.67 (*SD* = 10.85), and in Body Mass Index (BMI) from 17.65 to 63.06, Mean = 28.05 (*SD* = 7.76). Fourteen percent of participants were Hispanic or Latino, 92.5% were non-Hispanic, and .5% did not report their ethnicity. The sample was 84.92 % White, 9.05% Black, 6.03% Asian, 1.51% Alaskan Indian or Alaskan Native, and 1.01% Native Hawaiian or other Pacific Islander. An additional .5% of participants selected "other" as their race.

Procedure

Participants completed the Implicit Theories of Weight scale (α = .94) by rating their agreement on the 6-point scale described above, presented within drop down menus. Participants also completed the Nutrition Self-Efficacy Scale (α = .93; Schwarzer & Renner, 2000). This 5-item measure asked participants to rate their certainty that they could stick to eating healthful foods when facing challenges (e.g., "even if I have to try several times until it works" and "even if I have to make a detailed plan"). They answered these questions on a 4-point scale ranging from 1 (*Very certain*) to 4 (*Very uncertain*).

We examined the degree to which participants maintained a healthy diet through the

1. In the preregistration, we specified one additional exclusion criterion—to exclude data for participants who took fewer than 5 minutes to complete the study. Applying this exclusion criterion would have resulted in the exclusion of 31.7% of our sample, leaving us with only 136 participants. The median time to complete the study was 366 seconds, range: 150-4175 seconds, Mean = 515.15 (*SD* = 490.31). Because an important goal of this study was to have a large sample, we chose not to not exclude any participants on the basis of time taken to complete the study. This decision did not change the pattern of significance (see Supplemental Material, Table 9).

National Cancer Institute Percent Energy from Fat Screener (Thompson et al, 2007). This measure asked participants to indicate the frequency with which they had consumed 15 specific foods (e.g., butter, bacon) over the past week using a 6-point scale ranging from "*Never*" to "*2 or more times per day*." During scale development, food-items were selected on the basis of their predictive value for dietary practices within a nationally representative sample (Thompson et al., 2008). For each participant, we used published scoring guidelines to calculate an estimate of the percentage of fat from each participant's overall diet. Finally, participants reported demographic information including their height and weight.

Results and Discussion

Descriptive Statistics

In contrast to the earlier studies, we found correlations between participants' theories of weight and demographic variables in the present study. In particular, more incremental (higher) theories of weight correlated negatively with age, $r(197) = -.26$, $p < .001$, and BMI (log-transformed to correct for positive skew), $r(197) = -.18$, $p = .01$. In addition, female participants reported marginally more incremental theories of weight, Mean = 4.89 ($SD = .79$) than male participants, Mean = 4.70 ($SD = .74$), $t(196) = 1.72$, $p = .07$. Participants' estimated percentage of energy from fat did not differ by gender, $t(196) = .85$, $p = .85$, nor did it correlate with age, $r(197) = -.07$, $p = .31$. There was, however, a significant correlation between BMI and participants' estimated percentage of energy from fat, $r(197) = .16$, $p = .01$, such that participants with higher BMI reported eating behavior consistent with a higher percentage of calories from fat (see Supplemental Material for further descriptive statistics and analyses with and without controlling for BMI).

The Effect of Theories of Weight on Eating Behavior through Self-Efficacy

We first examined whether participants' theories of weight predicted their eating behavior through simple regression. We did not find a significant negative effect of more incremental theories of weight on the estimated percentage of fat in participants' diets, $\beta = -.10$, $t(194) = -1.42$, $p = .16$. Considering the fairly robust findings in Studies 1-2, we were surprised to not see a significant total effect of theories of weight on eating behavior. That said, there is general agreement in the field that less emphasis should be placed on the significance of total effects and that it is entirely appropriate to analyze indirect effects in the absence of a significant total effect (e.g., Rucker, Preacher, Tormala & Pett, 2011; Zhao, Lynch Jr., & Chen, 2010). We do exactly that, below.

We next used Hayes' (2013) PROCESS bias-corrected bootstrapping Model 4 based on 10,000 samples. Before turning to the indirect effect of theories of weight on eating behavior through self-efficacy, we will discuss what this model revealed about our second prediction. In particular, we predicted that stronger incremental theories would predict higher self-efficacy than entity theories. Consistent with this second hypothesis, this model revealed a significant effect of participants' theories of weight on their nutrition self-efficacy, $B = .44$, $t(199) = 7.31$, $p < .001$; 95% CI [.32, .56], such that participants who view weight as more malleable report greater feelings of self-efficacy regarding food.

Most importantly, the PROCESS analysis also provided support for our central hypothesis that nutrition self-efficacy mediates the relationship between theories of weight and eating behavior. Specifically, the analysis revealed the predicted indirect effect of theories of weight on eating behavior through self-efficacy, $B = -.52$, 95% CI [-.96, -.17]. This indirect effect suggests that participants with stronger incremental, relative to entity, theories of weight reported greater nutrition self-efficacy which, in turn, predicted reports of eating a diet with

lower estimates of calories from fat, B = -1.17, $t(199)$ = -2.86, p = .005; 95% CI [-1.98, -.36] (see Figure 2).

After controlling for this significant indirect effect, the direct effect of theories of weight on participants' eating behavior remained nonsignificant, B = .01, $t(199)$ = .03, p = .98, 95% CI [-.76, .78]. These findings support our hypothesis that an incremental, relative to an entity, theory of weight predicts greater self-efficacy that, in turn, predicts healthier eating, as evidenced by an estimated lower percentage of fat in one's diet.[2]

General Discussion

Across three studies, we demonstrated that people's implicit theories of weight predict healthy eating behavior. Studies 1 and 2 examined consumption of a high-calorie, high-fat food in a controlled laboratory taste test. Study 1 demonstrated that an incremental theory correlated with greater consumption of a higher calorie, higher fat food. In Study 2, participants randomly assigned to an incremental view of weight subsequently consumed less of a high-calorie, high-fat food than those assigned to the other condition, who were taught that weight is fixed. Thus, Study 2 provided evidence that an incremental, relative to fixed, theory of weight caused participants to consume less of the unhealthy snack. In both Studies 1 and 2, theories of weight had no effect on consumption of the healthier snack food, suggesting that an incremental view of weight contributes specifically to the ability to resist eating high-calorie, high-fat foods. Finally, Study 3 provided insight as to precisely *why* an incremental view of weight predicts reduced consumption of high-calorie, high-fat foods. Incremental theorists reported greater feelings of

2. Although log-transformed BMI did not correlate significantly with participants' theories of weight in Studies 1 and 2, it did correlate with both theories of weight and our measure of eating behavior in the current study. We tested whether our findings held when controlling for BMI through a second PROCESS model 4 analysis and found no difference in the pattern of significance (Supplemental Material, Table 9).

self-efficacy regarding nutrition than did entity theorists, and this difference, in turn, predicted a lower estimated percentage of fat in their diets.

Theoretical Implications

The present studies have important implications for both understanding the relation between people's belief systems and their health-related behavior and for advancing the field's understanding of the mechanisms that underlie the benefits of incremental theories. With respect to health-related behaviors, the present research extends an exciting body of work suggesting that implicit theories of malleability have important consequences within health domains. Ours is the first investigation to explore how implicit theories of weight might influence eating behavior but it is consistent with correlational work suggesting that incremental theories of weight management predict reports of greater physical exercise, compared to more entity views (Lyons, Kaufman, & Rima, 2015). In related work, older individuals often hold less positive views of the ability to control cognitive decline stemming from age. However, a belief that this decline is controllable has been shown to increase the use of effective strategies for delaying cognitive decline and to increase physical activity (see Lachman, 2006 for review). We see this as an exciting means of understanding the importance of belief systems, including implicit beliefs regarding malleability, for motivating health behaviors.

In addition, our findings have theoretical implications for research on implicit theories of personal attributes, broadly construed, in that self-efficacy mediated the relationship between an incremental theory of weight and healthy eating behavior, as defined by resisting tempting high-calorie foods. We suggest that self-efficacy might be an important and possibly understudied mechanism underlying some of the positive benefits of incremental theories of attributes. The bulk of the research on implicit theories of attributes has focused on factors such as mastery goals and helpless attributions as the primary mechanisms underlying achievement success (see

Burnette et al., 2013 for review). However, self-efficacy has been found to at least partially mediate positive relationships between incremental theories of attributes and positive outcomes in domains such as eating behavior in the present study, emotion (Tamir, John, Srivastava, & Gross, 2007), athletics (Kasimatis, Miller, & Marcussen, 1996), and management (Tabernero & Wood, 1999). We suggest that one important avenue for future research is to use experimental designs to further understand the degree to which incremental theories of malleability promote self-efficacy and, in turn, positive outcomes.

Limitations

Despite consistent evidence that naturally-occurring (Study 1) and experimentally manipulated (Study 2) incremental theories predict reduced consumption of high-calorie, high-fat food, there are some important limitations to the conclusions that can be drawn. For example, the first two studies examined eating behavior in relatively small samples of college students, a group that tends to lack diversity (Henrich, Heine, & Norenzayan, 2010). Future work should seek to replicate these effects with larger and more diverse samples. A second limitation of the first two studies is that we investigated in-the-moment consumption—consumption at one particular point, rather than over time. People may intend to exert self-control later, allowing for a small indulgence now. However, this seems unlikely, as people overestimate their capacity for successful self-control at a later time (Nordgren, van Harreveld, & Pligt, 2009). Thus, although people may respond to entity messages with intentions to consume more 'now' and less 'later,' research suggests people are unlikely to adequately limit their later consumption. Nonetheless, future work should examine a multitude of eating behavior outcomes. The third study helps to assuage this concern in the first two studies by examining self-reported eating behaviors across one week using a standardized measure well-validated with longer-term consumption data. In

Study 3, we found evidence that incremental theories of weight predict lower consumption of high-fat foods indirectly through nutrition self-efficacy.

A final limitation of the current research is that participants' BMI was calculated on the basis of their self-reported height and weight in all three studies. There are well-known tendencies for people to not be entirely honest when asked to self-report their height and weight (e.g., Gorber et al., 2007; Stommel & Schoenborn, 2009). Thus, there is reason to think that, on average, the BMI of our participants is a bit higher than reported and, for our underweight participants, a bit lower. Although this is problematic for research in which BMI is of central interest, BMI was measured in the current investigation primarily for descriptive purposes. Although BMI did correlate with our variables of interest in Study 3, the pattern of results remained unchanged independent of whether this variable was added into the model. Thus, we think the self-report nature of this variable less troubling than it could have been were BMI more central to our research questions.

Applied Implications and Future Directions

Despite some limitations, findings from the three studies suggest that one promising way to encourage people to adopt a healthier diet might be to teach them that weight is changeable. Interventions designed to teach an incremental view of personal attributes have met with great success (e.g., Blackwell, Trzesniewski, & Dweck, 2007). Health messages that teach an incremental view of weight show benefits in terms of helping to avoid weight gain in the face of dieting challenges (Burnette & Finkel, 2012) relative to control messages. Future intervention research could examine effects of teaching an incremental view of weight on healthy eating behavior. Recent research suggests that it might also be important to consider people's implicit theories in even greater detail. For example, McFerran and Mukhopadhyay (2013) found that believing weight is malleable primarily through managing one's diet correlated with lower BMI

than believing that additional exercise is the key way to change one's weight. It would also be exciting to explore how implicit theories of weight influence participants' nutritional practices in general. The current investigation focused on the relationship between participants' beliefs and their consumption of fat. Future studies should extend this research to examine how peoples' implicit theories of weight predict other healthy eating practices, including the consumption of fresh fruits and vegetables and/or the avoidance of added sugar.

Before such incremental theory-based interventions to encourage healthier eating are implemented, there are some areas for future inquiry. For example, investigators should explore the potential negative consequences of an incremental theory of weight both for anti-fat prejudice and, among those who are overweight, internalized stigma. Prejudice against people on the basis of their weight is pervasive, even among individuals who are obese (Puhl & Heuer, 2009). Researchers found that 46% of people would rather give up a year of their life than be obese (Schwartz et al., 2006). Further, anti-fat bias can be counterproductive for promoting public health as overweight individuals who internalize the stigma engage in unhealthy eating behaviors (Puhl, Moss-Racusin, & Schwartz, 2007). One might expect that an incremental view of weight would lead people to discriminate against those who are obese because they assume that those individuals are fully capable of changing their weight but have just not chosen to do so. Consistent with this prediction, research on discrimination has shown that viewing a stereotyped group as responsible for their status is significantly correlated with opposing programs designed to help the group (Reyna, Tucker, Korfmacher, & Henry, 2005).

However, to date, we know little about how theories of weight relate to anti-fat bias and internalized stigma. Preliminary evidence suggests that the relationship between incremental theories of weight and stigma is complicated. For example, a recent study showed no effect of an incremental weight message on anti-fat prejudice compared to a control condition

(Thorsteinsson, Loi, & Breadsell, 2016). This lack of direct effect might be explained by new work illustrating a double-edged sword effect of incremental theories of weight on fat stigma. More specifically, Hoyt and colleagues (2016) recently found that incremental, relative to entity, theorists are more likely to blame individuals for being overweight, which predicts *stronger* anti-fat attitudes. However, incremental, relative to entity, theorists are also more likely to think that being overweight is a defining and essential feature of the individual, which predicts *weaker* anti-fat attitudes (Hoyt, Burnette, Auster-Gussman, Blodorn, & Major, 2016). Further research is needed to ensure that any intervention designed to encourage healthy eating through incremental messages regarding weight does not also carry negative consequences.

Conclusion

The present investigation suggests that an incremental theory of weight carries significant benefits with respect to nutrition self-efficacy and, as a consequence, healthier eating behavior. Further, this investigation offers evidence that targeted messages can change people's beliefs about weight, at least temporarily, and that doing so affects the degree to which people engage in healthier eating behaviors. More broadly, the present research provides further evidence that a view of personal attributes as malleable is an important motivational variable for predicting positive behaviors across domains.

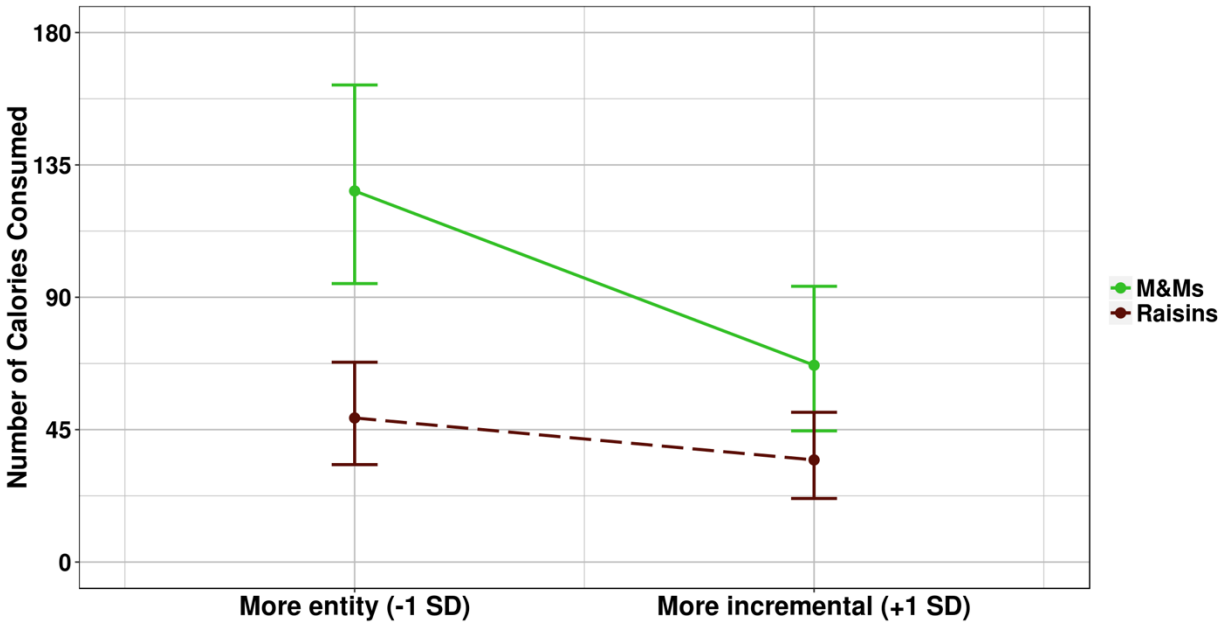

Figure 1

Theories of weight and snack consumption (Study 1).

Table 1

How experimentally manipulated theories of weight influence eating behavior (Study 2)

	Incremental Video Condition Mean (SD)	**Entity Video Condition Mean (SD)**	**Difference**	**Test Statistic**
Unhealthy snack calories consumed	88.12 (38.57)	116.92 (36.45)	**28.80***	$F(1,99) = 4.49$, $p = .04$ $\eta_p^2 = .04$
Healthier snack calories consumed	26.04 (12.16)	27.05 (11.46)	-1.01	$F(1,99) = .00$, $p = .96$ $\eta_p^2 = .00$

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CHAPTER 3

Introduction

As recommended by the U.S. Department of Health and Human Services, vigorous exercise for 75 minutes a week or moderate exercise for 150 minutes per week puts individuals at a much lower risk for a variety of chronic diseases and illnesses, many of which are considered leading causes of death, such as cancer and cardiovascular disease (Murphy, Kochanek, & Xu, 2015; U.S. Department of Health and Human Services, 2008). Additionally, regular exercise reduces symptoms of depression, anxiety, and stress (Strauss, Rodzilsky, Burack, & Colin, 2001; Warburton, Nicol, & Bredin, 2006). Despite these benefits, 80% of individuals in the United States fail to comply with the recommendations (Ward, Clarke, Nugent, & Schiller, 2015; U.S. Department of Health and Human Services, 2008). Considering the lack of adherence to these recommendations, it is perhaps not that surprising that understanding how to increase motivation to exercise is a common interest in psychological research. Literature on the topic points to the importance of self-efficacy (Sniehotta, Scholz, & Schwarzer, 2005), identification (Strachan, Woodgate, Brawley, & Tse, 2005), social support (Trost, Owen, Bauman, Sallis, & Brown, 2002), habits (Dishman, Sallis, & Orenstein, 1985), self-monitoring (Michie, Abraham, Whittington, McAteer, & Gupta, 2009), and other psychological constructs (Biddle, Goudas, & Page, 1994).

In our current work, we seek to extend this literature by drawing upon a longstanding theoretical approach to understanding motivation and self-control—namely, a mindset perspective (also known as implicit theory; Dweck, 2000; Molden & Dweck, 2006). Adopting lifestyle changes that allow for consistent physical activity requires self-control (Hoyle & Davisson, 2016). For example, one must create the time in one's schedule to get to the gym (initiation), resist the temptation to just go home and relax after a long day (inhibition), and

continue to be consistent in these efforts day after day despite obstacles to these goal behaviors (continuation). In order to self-regulate successfully, we suggest that it is important to first believe you can change your fitness as this will contribute to confidence in one's capacity to engage in the exercise when challenges arise and will foster interest in exercising. These psychological processes (mindsets, efficacy, value) contribute to whether you put forth the effort to undertake the necessary self-regulatory actions and ultimately engage in exercise. More specifically, we suggest that to understand whether people engage in physical activity, you need to first understand their mindset about the malleable nature of fitness.

Mindsets

The implicit theory, or mindset, approach differentiates between a fixed mindset (a belief in the static nature of human attributes) and a growth mindset (a belief in the malleable nature of human attributes; Dweck & Leggett, 1988). Individuals with a fixed mindset see failure as an indication of an innate deficiency and are more likely to take criticism negatively and shy away from challenges or situations in which they are uncertain of their ability to be successful. In contrast, individuals with a growth mindset regarding a particular human attribute (e.g., intelligence) tend to see failure and setbacks as an opportunity to learn, are more likely to take criticism constructively, and persist in the face of challenges and setbacks. Although similar patterns of self-regulation emerge across domains, it is important to note that implicit theories are domain specific, meaning that individuals can have a growth mindset in a certain domain (e.g., athletic ability) but a fixed mindset in another (e.g., math ability).

Although the majority of mindset work is within the context of academics (Dweck, 2000), recent work has extended findings to the domain of health (e.g., weight; Burnette, 2010). For example, inducing a growth mindset about weight serves as a buffer against weight-gain following severe dieting setbacks (Burnette & Finkel, 2012) and predicts healthier food choices

(Ehrlinger, Burnette, Park, Harrold, & Orvidas, 2017). Additionally, growth mindsets regarding athletic ability predict motivation and enjoyment of physical education classes (Biddle, Wang, Chatzisarantis, & Spray, 2003). In the current work, we extend this work, suggesting that individuals also develop implicit theories of their general ability to become a fit person. Just as mindsets of weight predict food choices and mindsets of athletic ability predict participation in physical education classes, we also suggest that mindsets of fitness matter for exercise behaviors. We recognize that fitness, like many other human attributes studied in the mindset literature (e.g., intelligence, weight, athleticism) is due to a multitude of factors including genetics (Bouchard & Malina, 1983) and individual choices (e.g., practice, persistence; Peralta, Jones, & Okely, 2009; Trank, Ryman, Minagawa, Trone, & Shaffer, 2001). However, our primary interest is in how incremental differences in beliefs about the fixed vs. malleable nature of fitness affects health behaviors—in this case, exercise. More specifically, our first prediction (Hypothesis 1) is that stronger growth mindsets of fitness will positively relate to past exercise frequency and future intentions to engage in exercise.

Expectancy-Value

Why do growth mindsets contribute to healthier habits? To understand why an individual might engage in regular exercise, we merge a mindset perspective with the long-standing achievement motivation literature. Achievement motivation theory (Wigfield & Eccles, 2000) highlights the importance of evaluations of expectancy and value in predicting not only lasting motivation and performance but also choice behaviors (e.g., classroom participation, exercise participation). Expectancy refers to people's beliefs about their competence, efficacy, and expectations (e.g., "I can study even when distractions arise"; Eccles & Wigfield, 2002). Whereas expectancy captures evaluations for potential success, the value component incorporates self-relevance, including evaluations of general enjoyment (intrinsic value),

potential usefulness (utility value), and significance to the self (Eccles & Wigfield, 2002). Value at a more general level is about how much one identifies with a particular domain (i.e., self-value). When people answer the questions, “can I do this task?” (expectancy) and, “is it an important part of who I am?” (self-value) affirmatively, they are much more interested and motivated to pursue the task.

We suggest that people who hold more positive expectancy-value evaluations regarding exercise are more likely to engage in it. And, we contend that one’s mindset about the potential to develop one’s ability within a particular domain is a key component of expectancy-value evaluations, as these knowledge structures organize the way people ascribe meaning to events. Namely, growth mindsets imply that everyone has the capacity to learn, grow and develop even when challenges arise and also send a potent and implicit message that such growth is valuable. In support of this claim, in a meta-analysis linking mindsets to self-control (Burnette at al., 2013), growth mindsets related to greater expectations for success (r = .16; a significant effect size, albeit small). Support for the link between self-efficacy and mindsets has also been evidenced in past research regarding implicit theories of emotion (Tamir, John, Srivastava, & Gross, 2007).

In support for the link between growth mindset and value, the meta-analysis (Burnette et al., 2013) also highlighted a link between growth mindsets and learning approach goals (r = .14; a significant effect size, albeit small)—goals that emphasize the importance of focusing on learning and the value placed on skill development—a construct similar to values within achievement motivation theory. Furthermore, correlational and experimental studies demonstrate that students with growth, relative to fixed, mindsets report greater motivation to learn, value learning more, and are more engaged with their coursework (Dweck, 2000). Additionally, undergraduate students in a growth mindset intervention, relative to students in control

conditions, reported more positive attitudes regarding their academic endeavors (Aronson, Fried, & Good, 2002). Recent research also highlights the importance of growth mindsets for self-schema and identity—namely academic belonging (Murphy & Dweck, 2010; Good, Rattan, & Dweck, 2012). Academic belonging is linked to the self-value in that it highlights self-relevance and identity (e.g., I feel like I am part of the computer science community; Good et al., 2012).

Overall, existing research suggests that growth mindsets are important for predicting expectations about the capacity to engage in activities even when challenges arise, as well as the value and self-relevance of such activities. Extending this work to the context of fitness and exercise, we hypothesize (Hypothesis 2) that growth mindsets foster a belief in one's capacity to overcome obstacles (e.g., going to the gym despite having had a bad day at work; self-efficacy) and foster relevance and identification (self-value).

These expectancy-value beliefs are critical for health habits. For instance, in a large sample of 1,152 participants, self-efficacy regarding physical activity predicted intentions to engage in exercise in the near future (Hagger, Chatzisarantis, & Biddle, 2001). Further, self-efficacy for overcoming barriers to exercise and expecting benefits from exercise predicted exercise frequency (Winters, Petosa, & Charlton, 2003). Additionally, past work illustrates the importance of self-identification for physical activity behavior. For example, stronger physical activity identity is linked to more vigorous physical activity and better adherence to physical activity (Miller, Ogletree, & Welshimer, 2002). Thus, we suggest (Hypothesis 3**)** that self-efficacy and self-value will predict past exercise frequency and future intentions to exercise (self-reported past frequency and future intentions). Integrating all the preceding theoretical analyses, we also propose and test an overall process model (Hypothesis 4) which posits a positive indirect effect of growth mindsets on past exercise frequency and future intentions via more positive physical exercise self-efficacy and fitness self-value evaluations (see Figure 1).

To test the feasibility of our hypothesized mediation model, we conducted a survey (Study 1) to first test relations among mindsets of fitness, expectations (measured as physical exercise self-efficacy), value (measured as fitness self-value), and self-reported past exercise frequency. Then, we sought to replicate and extend the relationships found in Study 1 by manipulating fitness mindsets to examine if we could reliably shift mindsets and to garner causal evidence regarding the impact of fitness mindsets on future exercise intentions.

Methods and Materials

We recruited 117 undergraduate students from sections of an Introduction to Psychology course at a large public university to participate for course credit. Students completed an online survey via Qualtrics in which they completed measures of mindsets of fitness, self-efficacy, self-value, and past exercise frequency assessments. The institutional review board approved all procedures.

Measures

We assessed all measures using a Likert-type scale. We randomized the items within each measure and the measures within the survey to avoid order effects.

Mindset Fitness Scale. We used an adapted version of an established scale that assesses individuals' implicit theories of weight (Burnette, 2010). Specifically, we replaced the word "weight" with the word "fitness." This scale reflects the degree to which an individual believes his or her fitness level and ability to become more fit are changeable attributes (e.g., "Your ability to be fit is something about you that you can't change very much"). For this four-item scale, higher scores indicate a stronger growth mindset regarding fitness [1 = "strongly disagree" to 5 = "strongly agree" (α = .67)].

Physical Exercise Self-Efficacy. We assessed expectancy using an established self-efficacy measure (Schwarzer & Renner, 2000), which assesses the degree to which an individual

expects to continue towards physical activity-related goals, even in the face of obstacles and setbacks. All items start with the following prompt, “How certain are you that you could overcome the following barriers?” An example item following this prompt would be, “I can manage to carry out my exercise intentions even when I have worries and problems.” For this five-item scale, higher scores indicate higher levels of self-efficacy regarding physical activity [1 = “very uncertain” to 5 = “very certain” (α = .85)].

Fitness Self-Value. To assess value, we focused on importance to the self, adapting existing self-concept and identity scales to the context of exercise and fitness (e.g. Team Identity Scale; Heere & James, 2007). We assessed how much an individual identifies as an active and fitness-oriented individual (e.g., “When I think about who I am, being active is an important part of my identity”). For this four-item scale, higher scores indicate stronger self-value with 1 corresponding to “not at all true for me” and 5 corresponding to “completely true for me” (α = .89).

Past Exercising Frequency. This established measure (Verplanken & Melkevik, 2008) assesses the amount of exercise the individual retrospectively reports to have engaged in over the past week, month, six months, and year. For this four-item scale, higher scores indicate more frequent exercise. This scale ranges from 1 (never) to 5 (almost everyday; α = .90).

Results

To test all hypotheses, we used Hayes’s (2013) PROCESS macro. This add-on for SPSS (and the specific model within it used for the following analyses) is an observed variable path analysis modeling tool that can estimate direct and indirect effects in multiple mediator models. In this case, we used PROCESS Model 4 (Hayes, 2013) to test the parallel mediators of self-efficacy and self-value. For all the measurement scales, we calculated scores based on the number of items that have been responded to by each individual. Thus, participants who omitted

responses to individual questions still receive a mean score based on the questions they do answer for that measure. We handled missing data using, listwise deletion in SPSS. See Table 1 for means, standard deviations, alphas, and correlations between scales.

In support of hypothesis 1, the total effect suggests that stronger growth mindsets of fitness predict greater past exercising frequency, b = .32, $t(115) = 2.60$, $p = .01$, 95% CI [0.08, 0.56]. Furthermore, in support of hypothesis 2, stronger growth mindsets of fitness significantly predicted self-efficacy, b = .31, $t(115) = 3.83$, $p < .001$, 95% CI [0.47, 2.0]; and self-value, b = .34, $t(115) = 2.92$, $p = .004$, 95% CI [0.11, 0.58]. Additionally, in support of hypothesis 3, self-efficacy significantly predicted past exercise frequency, b = .55, $t(113) = 4.55$, $p < .001$, 95% CI [0.31, 0.79]; as did self-value, b = .47, $t(113) = 5.72$, $p < .001$, 95% CI [0.31, 0.17]. Finally, in support of hypothesis 4, stronger growth mindsets of fitness significantly indirectly predicted past exercising frequency via self-efficacy, b =.17, 95% CI [0.08, 0.29]; and self-value, b =.16, 95% CI [0.06, 0.31]. With physical exercise self-efficacy and self-value in the model, there is not a significant direct effect of mindsets of fitness on past exercising frequency, b = -.01, $t(115) = -.12$, $p = .91$, 95% CI [-0.20, 0.17].

Study 1 Discussion

Study 1 provided initial support for the idea that stronger growth mindsets regarding fitness predict greater past exercising frequency, and do so at least, in part, via physical exercise self-efficacy and fitness self-value. We next sought to replicate the findings from Study 1 and extend them by evaluating the potential for manipulating mindsets of fitness and to see if this has implications for future exercise intentions.

Study 2 Methods and Materials

We pre-registered the procedures and analyses for this study on Open Science Framework (osf.io/ch6e8) prior to collecting any data. The institutional review board approved all research.

We recruited a total of 338 participants, however we incorporated attention checks to identify and remove careless responders. We excluded participants (n = 24) if they missed the attention checks (e.g. "Please answer 'not at all true for me' for this question" and "Are you currently using a computer?") or failed to adequately answer the article comprehension question (i.e. when asked to summarize the theme of the article, one participant wrote "student conflicts", which was incorrect and warranted removal from analyses). Careless responding can negatively impact research by adding unwarranted error variance to the results. Thus, we pre-registered that we would delete participants who failed attention checks.[3] After excluding those participants, we had a final sample size of 314.

Of the final sample (N = 314), 194 participants were recruited from Amazon's Mechanical Turk (M-Turk) and 120 participants were undergraduate introductory psychology students (49.7% female, n = 156) ranging in age from 17 to 72 (M = 28.84, SD = 11.74) with a racial composition as follows: 7.3% Asian, 1% American Indian or Alaskan Native, 5.4% African American, 3.8% Hispanic, 79% White, and 3.5% reporting two or more races. For their participation, students received course credit and M-Turk workers received $0.40. Mechanical Turk (M-Turk), is a crowdsourcing internet marketplace run by Amazon.com, that provides quick, easy, and inexpensive access to online research participants. Recruiting participants from M-Turk has been touted as a credible method and specifically beneficial for social science research (Buhrmester, Kwang, & Gosling, 2011).

[3] Results remain the same if we include the participants who failed attention checks in the analyses but we exclude them to adhere to our preregistration.

Using the Qualtrics system, we randomly assigned participants to either a growth mindset condition or fixed mindset condition. To manipulate mindsets, we used procedures incorporated into past implicit theory work (e.g., Burnette, 2010; Hoyt, Burnette, & Auster-Gussman, 2014). Specifically, we created news articles that more strongly depicted the changeable nature of fitness (growth mindset message) or the static nature of fitness (fixed mindset message). Participants read these news articles and provided reports on the comprehensibility and clarity of the article.

Measures

Fitness Mindsets. To increase the reliability of the fitness mindset measure, we added two items to the 4-item measure of fitness mindsets used in Study 1. Specifically, we added, "To be honest, you can't really change your ability to be fit" and "You can substantially change your fitness level". As in Study 1, higher scores indicate stronger growth mindset regarding fitness, with responses ranging from 1 (strongly disagree) to 6 (strongly agree; $\alpha = .94$).

Expectancy-Value. We used the same physical exercise self-efficacy ($\alpha = .90$) and fitness self-value ($\alpha = .95$) measures from Study 1.

Intentions to Exercise. We used the Exercising Frequency Intentions scale (Verplanken and Melkevik, 2008). For this two-item scale, higher scores indicate intention to exercise more frequently with response options ranging from 1 (never) to 5 (almost everyday; $\alpha = .94$).

Exercise Experience. To assess experience with exercise and account for it as a covariate in analyses, we created a short measure. For this 3-item scale, higher scores indicate more experience with exercise. The first question, "I know a lot about exercise and fitness" was answered with options ranging from 1 (strongly disagree) to 7 (strongly agree). The remaining two questions, "How would you rate your experience with fitness and exercise?" and "How

would you rate your experience with the ability to become a more fit individual?" were answered with options ranging from 1 (no experience) to 7 (very much experience; $\alpha = .80$).

Results

See Table 2 for means, standard deviations, alphas, and correlations. We first confirmed that our manipulation of mindsets worked. Individuals randomly assigned to the growth mindset condition ($M = 5.51$, $SD = 0.66$) reported significantly stronger growth mindsets of fitness than students in the fixed mindset condition ($M = 4.71$, $SD = 1.26$), $t(312) = -7.05$, $p < .001$. We note that the average score of those in the fixed mindset condition ($M = 4.71$) is relatively high, given that the mindsets of fitness measure is scored on a 1-6 scale. Although condition significantly predicted differences in mindsets, those in the fixed condition still reported what is more appropriately defined as a weak growth mindset rather than a fixed mindset. Thus, from here on out, we refer to weak versus strong growth mindsets.

In line with pre-registered analyses, we ran the same PROCESS Model 4 (Hayes, 2013) with parallel mediators as the model examined in Study 1 replacing assessed implicit theories with our condition variable (growth vs. fixed). Counter to hypothesis 1, there was a total effect of condition on exercise intentions, but in the opposite direction, b = -.27, $t(312) = -2.17$, $p = .031$, 95% CI [-0.51, -0.02].This total effect suggests that participants in the fixed, relative to growth mindset condition reported greater exercise intentions. And, hypothesis 2 was not supported; condition did not significantly predict self-efficacy, b = -.10, $t(312) = -1.14$, $p = .254$, 95% CI [-0.26, 0.07]; or self-value, b = -.14, $t(312) = -1.14$, $p = .256$, 95% CI [-0.39, 0.10]. However, in support of hypothesis 3, self-efficacy significantly predicted exercise intentions, b = .43, $t(310) = 5.31$, $p < .001$, 95% CI [0.27, 0.59]; as did self-value, b = .42, $t(310) = 7.61$, $p < .001$, 95% CI [0.31, 0.53]. Because condition did not predict the mediators, condition also did not indirectly

predict exercise intentions via self-efficacy, b= -.04, 95% CI [-0.12, 0.03]; and self-value, b= -.06, 95% CI [-0.16, 0.05].

We also preregistered that we would examine exercise experience as a covariate in the above PROCESS analysis.[4] Results remain the same when controlling for exercise experience. There is still a significant negative total effect but no direct effect or link between condition and mediators. Exercise experience positively predicts efficacy and value, but not exercise intentions when both mediators are in the model. However, the correlation table suggests there is a bivariate relation, $r(314) = .27$, $p < .001$.

Replication analyses. We ran an additional, pre-registered analysis using participants' self-reported implicit theory of fitness as the predictor in PROCESS Model 4 (Hayes, 2013), this time also controlling for condition, to see if we could replicate effects from Study 1. In support of hypothesis 1, participants reporting stronger growth mindsets of fitness also reported stronger intentions to exercise more frequently, b = .40, $t(311) = p < .001$, 95% CI [0.29, 0.52]. In support of hypothesis 2, those reporting stronger growth mindsets of fitness also tended to report greater physical exercise self-efficacy, b = .329, $t(311) = 7.37$, $p < .001$, 95% CI [0.21, 0.37]; and fitness self-value, b = .30, $t(311) = 4.91$, $p < .001$, 95% CI [0.18, 0.42]. Hypothesis 3 was also supported. Physical exercise self-efficacy significantly predicted intentions to exercise, b = .34, $t(309) = 4.12$, $p < .001$, 95% CI [0.18, 0.51]; as did fitness self-value, b = .41, $t(309) = 7.65$, $p < .001$, 95% CI [0.31, 0.52]. And finally, in support of hypothesis 4, mindsets of fitness significantly indirectly predicted intentions to exercise via physical exercise self-efficacy, b=.10, 95% CI [0.05, 0.16]; and fitness self-value, b = .12, 95% CI [0.07, 0.20]. With physical exercise self-efficacy and fitness self-value in the model, mindsets of fitness directly predicted intentions

[4] We also pre-registered we would look at sample (M-turk vs. student) as a covariate if it had an effect on outcomes. It only related, with a small effect to fitness self-value. Thus, we did not include it in analyses.

to exercise, b = .18, $t(311) = 3.66$, p=.0003, 95% CI [0.08, 0.28]. Overall, the hypothesized model was supported with self-reports of mindsets of fitness as the predictor.

Exploratory Analyses

We conducted two additional exploratory analyses, not pre-registered but suggested by reviewers. First, one question raised was whether there is a positive indirect effect of mindset manipulations on intentions to exercise via a shift in mindsets. With condition as the predictor, self-reported mindsets as the mediator, and intentions to exercise as the outcome, we get a positive indirect effect, b =.32, 95% CI [0.20, 0.47]. Second, we ran a parallel mediation model in which we entered mindsets, physical exercise self-efficacy and fitness self-value as mediators, condition as the predictor, and intentions to exercise as the outcome. In this model, the only significant indirect effect of the mindset manipulation on intentions to exercise is via mindsets, b = .15, 95% CI [0.06, 0.25]. These two findings combined with the correlations between self-reported mindsets, physical exercise self-efficacy, and fitness self-value suggest that a serial process model may be a better fit, although this is beyond the scope of the current paper.

Study 2 Discussion

Study 2 demonstrated that mindsets of fitness could be successfully manipulated with a simple strategy – reading a news article that more strongly stressed a message of the malleable nature of fitness or the fixed nature of fitness. However, despite these mean group differences, participants in both conditions still reported growth-oriented mindsets. Future work could examine, by adding a control condition, which mindset the articles are strengthening the most. The main goal of the current work is to increase exercise frequency and to garner initial evidence of the potential for growth mindsets to do so. However, despite our ability to manipulate mindsets, condition failed to predict the mediators and the total effect was in the opposite

direction than what we expected. Perhaps this is an indication of reactance on part of the participants—especially since this is self-reported intentions and not exercise behavior.

General Discussion

We first demonstrated that people's mindsets of fitness relate to past exercising frequency. In Study 1, stronger growth mindsets of fitness predicted more frequent self-reported exercise behaviors in the recent past. Physical exercise self-efficacy and fitness self-value mediated this link. The findings from Study 1 support the hypothesized parallel mediation model. In Study 2, although condition failed to predict mediators, we find the same pattern of results as Study 1, when using intentions to exercise, self-reported mindsets of fitness, and controlling for condition. Additionally, Study 2 supports the potential to foster stronger growth mindsets using low-cost methods—although more work is needed to see if we can more strongly shift growth mindsets and to confirm this finding.

In general, our results build on and extend existing research regarding mindsets and health behaviors. Previous research examining the implications of mindset perspectives touches on similar contexts such as athletic coordination (Kasimatis, Miller, & Marcussen, 1996), body appearance (Lyons, Kaufman, & Rima, 2015), healthy eating (Ehrlinger et al., 2017), and weight-loss (Burnette & Finkel, 2012). However, we also know that these mindsets are domain specific. For example, within intelligence, some students might believe that this broader construct is malleable but that at specific levels, such as math, they are just "not a math person"—a fixed mindset. Similarly, it is important within health to understand not just general theories of health but specific mindsets about behaviors that contribute to health such as those regarding weight or fitness. The current research adds a novel component to the existing implicit theory literature by focusing on mindsets of fitness, which relate to a vital health behavior—exercise.

Practical and Theoretical Implications

This is an area of timely importance due to the rise of obesity rates (Flegal, Carroll, Ogden & Curtin, 2010) and lack of physical activity amongst the American population (Ward et al., 2015; U.S. Department of Health and Human Services, 2008). Further insight into individuals' motivation to partake in beneficial health behaviors, such as exercise, is crucial in understanding how to increase these behaviors. Understanding the importance of mindsets for exercise frequency and intentions has implications for health behavior professionals (e.g. personal trainers and health behavior coaches). For example, strengthening individuals' growth mindset about fitness in the coach-to-client realm can help the individuals seeking help from these professionals be more successful when it comes to exercise frequency and intentions to exercise. Further, the findings from the present studies can inform future intervention research. Namely, such an intervention should not only seek to foster stronger growth mindsets, but should also incorporate strategies that improve self-efficacy and highlight the value of exercising, including shifting self-identity. However, based on the unexpected results of Study 2, it is important to note that future intervention work should first discern what methods will lead to a stronger, lasting change in fitness mindsets in order to shift self-efficacy and self-identity.

Limitations

The current work is built on two strong psychological theories: the implicit theory approach (mindsets; Dweck & Leggett, 1988) and expectancy-value theory (Wigfield & Eccles, 2000). Both theories can inform health behavior change research. However, prior to putting theory into practice, some limitations are worth noting. First, although existing research has established the utility of considering past behavior and future intentions in order to predict behavior, self-report data is not as reliable as collecting behavioral data (e.g., Ouellette & Wood, 1998; Webb & Sheeran, 2006). Future work should seek to replicate these findings using actual

exercise behaviors as the outcome (e.g., time spent running on the treadmill). Second, the results of Study 2 using experimental condition as the predictor failed to support the hypothesized model. Rather, we see a surprising negative total effect. However, follow-up exploratory analyses show expected indirect effects via a shift in mindsets. Future research should investigate the implications of the finding that a growth mindset manipulation exerts a positive effect on exercise intentions, if and only if, the manipulation successfully shifts growth mindsets. At an applied level, this suggests that practitioners should ensure that their growth mindset message did indeed instigate the intended focus. Methodologically, researchers should not only confirm the manipulation worked but also consider ways to strengthen the shift in growth mindsets. For example, recent work offers empirical insight into how to teach a growth mindset more effectively (Yeager et al., 2016). Alternatively, or additionally, interventions could also seek to simultaneously increase growth mindsets and weaken fixed mindsets by de-emphasizing genetic limitations on fitness. Third, with our focus on exercise intentions within the context of fitness, it is possible that this work is most relevant for participants who exercise primarily for the purpose of becoming more fit. However, individuals often exercise for a variety of reasons including improving health, reducing stress, or other quality of life reasons. Thus, future research in this area should aim to obtain more information about participants' specific reasons for exercise in order to gain a better understanding of how fitness mindsets and self-value relate to exercise behaviors across a range of motivations for engaging in exercise.

Conclusion

Physical inactivity is the fourth leading risk factor of global mortality, causing an estimated 5.3 million deaths each year (Lee et al., 2012). Thus, identifying predictors of participation in regular exercise is an important endeavor. Our work contributes to the growing body of research by highlighting the role of mindsets of fitness and linking this theoretical

approach to the longstanding research on expectancy-value theory. Specifically, we find that a stronger growth mindset of fitness relates to exercise frequency and intentions via physical exercise self-efficacy and fitness-value. Future research should continue to explore mindsets of fitness to understand the strategies needed to stimulate a stronger, lasting change in order to foster the utilization of these findings for health behavior change.[5]

[5] This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

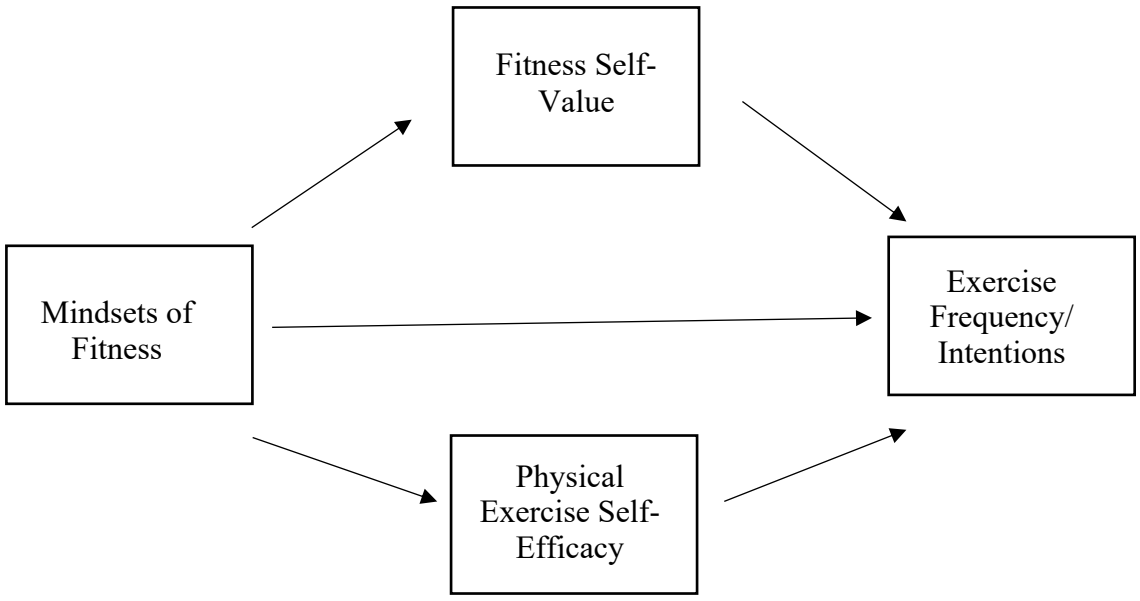

Figure 1. Hypothesized mediation model.

Table 1
Means, standard deviations, alphas and correlations between scales (N = 117)

Variables	M	SD	α	1	2	3	4
1. MF	4.82	0.76	.67	-	-	-	-
2. FSV	3.66	0.10	.89	.26**	-	-	-
3. PESE	2.72	0.69	.85	.34***	.57***	-	-
4. PEF	3.37	1.03	.90	.24*	.66**	.63***	-

MF = mindsets of fitness, FSV = fitness self-value, PESE = physical exercise self-efficacy, PEF = past exercising frequency. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 2
Means, standard deviations, alphas and correlations between scales (N = 314)

Variables	M	SD	α	1	2	3	4	5	6
1. COND	-----	-----	-----	-	-	-	-	-	-
2. MF	5.11	1.08	.94	.40***	-	-	-	-	-
3. FSV	3.66	1.12	.94	-.06	.23***	-	-	-	-
4. PESE	2.76	0.76	.90	-.07	.33***	.64***	-	-	-
5. EI	3.72	1.10	.94	-.12*	.30***	.62***	.57***	-	-
6. EE	4.14	0.72	.80	-.06	.01	.40***	.27***	.27***	-

COND = condition (coded as 0 = fixed mindset condition and 1 = growth mindset condition), MF = mindsets of fitness, FSV = fitness self-value, PESE = physical exercise self-efficacy, EI = intentions to exercise, EE = exercise experience. *$p < .05$. **$p < .01$. ***$p < .001$.

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CHAPTER 4

Introduction

Obesity affects nearly 20% of children and adolescents in the United States and approximately 124 million children worldwide, with no signs of decreasing trends (Hales, Carroll, Fryar, & Ogden, 2017; Yanovski, 2018). And, obesity is associated with steep health care costs; the United States spends, on average, 149.4 billion dollars annually on obesity-related medical spending (Kim & Basu, 2016). In addition, individuals who are categorized as obese or overweight are often strongly stigmatized, with implications for mental health, including low self-esteem, mood disorders, eating disorders, and poor body image (Pi-Sunyer, 1991, Scott et al., 2008). Considering the physical, societal, and mental toll, researchers are seeking novel approaches to preventing and reducing obesity.

Childhood and adolescence is a critical time for intervention, as habits and behaviors developed early have implications for obesity and obesity-related morbidity and mortality in adulthood (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). These interventions typically seek to increase physical activity and/or improve eating behaviors; those targeting both exercise and diet are typically more successful than those targeting just one of these components (Johns, Hartmann-Boyce, Jebb, Aveyard, & Group, 2014). Other components of successful interventions include elements such as improving parent involvement, increasing knowledge about living a healthy lifestyle, and teaching specific skills and strategies to increase engagement in healthy behaviors (Hoelscher, Kirk, Ritchie, Cunningham-Sabo, & Academy Positions Committee, 2013). Additionally, previous work points to the importance of self-efficacy (Sheeran et al., 2016), self-regulation skills (Teixeira, 2015), as well as what individuals value (Brouwer & Mosack, 2015).

Although often effective in the short-term, these interventions are rarely successful long-term especially when the intervention components are no longer present (Gonzalez-Suarez, Worley, Grimmer-Somers, & Dones, 2009). According to a recent systematic review, for such efforts to be successful over long periods of time, intense, lengthy, multi-component interventions appear to be required (Rajjo et al., 2017). Yet, the elements that have predicted short-term success are costly and difficult to implement widely. In the current work, to help address issues related to long-term success at lost-cost, we suggest that interventions designed to instill a growth mindset of health—the belief that health behaviors can change via personal effort—may offer a theoretically-driven, novel approach that may complement existing obesity prevention programs. Growth mindset interventions are categorized in recent literature as "wise interventions" (Walton & Wilson, 2018). Wise interventions operate by altering people's characteristic inferences about setbacks; in turn, these new and more adaptive inferences may lead individuals to adjust their behaviors to produce positive, lasting gains (Walton, 2014). Although not yet empirically tested within obesity programs, we suggest that fostering a *growth mindset of health* presents a promising avenue for intervention.

Mindset Theory. Individuals are theorized to hold one of two types of "mindsets" about a given trait, attribute, or ability, which are understood as two ends of a continuum; individuals hold either a fixed mindset (believing that a specific attribute in unchangeable) or a growth mindset (believing that an attribute is changeable; Dweck & Leggett, 1988). When an individual holds a stronger fixed mindset about a given ability, they are more likely to give up in the face of challenges and see failure as evidence of their innate deficiency in this domain. Conversely, individuals with a growth mindset are more likely to persist through challenging situations and perceive failure as an opportunity to learn and develop (Dweck & Leggett, 1988). Although the mindset perspective has yet to be integrated into obesity prevention and treatment research,

related work highlights the importance of mindsets for outcomes such as dieting success after setbacks (Burnette & Finkel, 2012), healthy eating (Ehrlinger, Burnette, Park, Harrold, & Orvidas, 2017), and exercise frequency (Orvidas, Burnette, & Russell, 2018). Mindset interventions specifically targeting adolescents have improved perceived control and physiological stress recovery (Schleider & Weisz, 2016) and reduced levels of depression and anxiety symptoms (Schleier & Weisz, 2018; Schleider, Burnette, Widman, Hoyt, & Prinstein, 2019). Remarkably, it is often the case that the results of these interventions are accomplished with a single-session program and last well beyond the intervention's conclusion. Indeed, based on a meta-analysis of 50 randomized trials, single-session interventions—including those that are *self-administered* by youths—have resulted in significant reductions in a variety of emotional and behavioral problems, with greater scalability and cost efficiency than traditional multi-session treatments (for meta-analysis see Schleider & Weisz, 2017). Despite this evidence, researchers have yet to test a single-session intervention designed to be integrated into programs for obese adolescents. Additionally, the development of single-session interventions has not applied user-centered designs. Without the assurance that these interventions are fitting for the communities for whom they are built, they may fail to reach their full potential in effectiveness.

In the current work, we seek to address these gaps in the literature. We describe the development, feasibility and acceptability of a growth mindset intervention (*Healthy Body, Healthy Mind*) for obese children and adolescents that are enrolled in obesity treatment clinics. Specifically, we had three aims. First, considering the lack of user-centered design practices as well as any inclusion of usability and user experience testing in previous mindset and health behavior interventions, we emphasized these elements prior to implementing the intervention (Study 1). Health behavior researchers have increasingly endorsed the importance of formative usability testing, especially for technology-based interventions (Dweck & Yeager, 2019; Searl,

Borgi, & Chemali, 2010). Second, we assessed the acceptability of the program and feasibility of recruiting participants from obesity treatment clinics (Study 2). Third, we tested if the intervention significantly increased growth mindsets of health in participants from baseline to post-intervention. Finally, as an initial, exploratory test of the intervention's short-term effects, we examined whether youths completing the intervention reported changes from pre- to immediately post-intervention in health-related beliefs and cognitions (growth mindset of health behaviors, self-efficacy, perceived control, body dissatisfaction, and self-blame; Study 2). The information gleaned from these two studies may guide future adaptations of the intervention and inform other single-session, online health behavior change interventions for youth. Before detailing our procedures and results, we begin with an overview of the intervention itself.

Intervention Description

The *Healthy Body, Healthy Mind* intervention builds on a previously successful online mindset intervention that reduced symptoms of depression and anxiety in adolescents aged 12-15 via encouraging a growth mindset of personality (Schleider & Weisz, 2016; Schleider & Weisz, 2018). The current intervention mirrors the previous intervention in style of delivery and basic structure, as well as the targeted age range of participants, but deviates in terms of targeted attribute—namely, health rather than personality. Dr. Jessica Schleider served as a consultant on the development of the *Healthy Body, Healthy Mind* intervention and provided feedback on the intervention content and design. The *Healthy Body, Healthy Mind* intervention was adapted to encourage participants to adopt a growth mindset regarding healthy habits and behaviors (see Figure 1 for sample images of the intervention).

The intervention consists of short sections of text for the participant to read, with the option to read along with a narrated voice recording. To incorporate the intervention into established programs or clinics aimed at preventing or treating childhood obesity, the entirety of

the intervention can be completed in less than an hour and requires minimal resources for implementation (i.e., it may be self-administered by youths and does not require staff oversight). The *Healthy Body, Healthy Mind* program includes previously validated strategies and content designed to promote a growth mindset. For instance, reiterating the idea to participants that even if they do not currently live a healthier lifestyle, they are not stuck with those habits; with effort and the right strategies they can change their habits and behaviors. Further, we incorporated additional components recognized to strengthen mindset interventions, such as using teenagers as role models to tell success stories, "brain science" to describe how one can change their brain connections, describing previous research, and "saying is believing" writing exercises that ask participants to apply the information they just learned to situations in their own lives (Burnette, Russell, Hoyt, Orvidas, & Widman, 2018; Dweck & Yeager, 2019; Miu & Yeager, 2015; Yeager, et al., 2016).

The current intervention includes additional components and design processes to further bolster the effectiveness of the intervention. First, we included compensatory messages throughout the *Healthy Body, Healthy Mind* intervention. For example, we explained, "It's okay if you haven't changed your habits *yet*, these things can take time and the right strategies for you." This compensatory messaging aims to shift participants' mindsets to be more growth-oriented while also strengthening self-efficacy and reducing self-blame (Burnette, Hoyt, Dweck, & Auster-Gussman, 2017). Compensatory messaging has been successfully utilized in previous mindset work in stigmatized domains to address the "double edge sword" effect that links growth mindsets to feelings of blame for one's current status that they wish to change. Second, also unique to the *Healthy Body, Healthy Mind* intervention, is the assistance provided by the staff of the clinics in crafting components of the intervention. Prior to implementation, staff provided feedback on the intervention to assure the language closely mirrored what participants were

accustomed to seeing in the obesity treatment clinics. Finally, we incorporated two iterations of usability testing prior to implementation.

Structure of Current Studies

The first study constitutes formative usability research focused on improving the usability, user experience, and acceptability of the intervention prior to implementation. In this stage, we first tested the intervention with undergraduate students before testing it with children of similar age to those at the obesity clinics. In the second study, participants from the obesity treatment clinics completed the *Healthy Body, Healthy Mind* intervention. In Study 2, we tested the acceptability of the program and feasibility of recruiting participants and implementing the study. Additional analyses regarding the relationship between mindsets of health and health-related outcomes and evaluations from baseline to post-intervention were also completed during this second study using a pre-to-posttest design.

Study 1: User Centered Design and Usability Testing Procedures

A think-aloud exercise was incorporated for usability testing. During a think-aloud, researchers ask participants to provide feedback and verbalize their thoughts throughout the completion of a task – an online intervention, in this case (Nielsen, Clemmensen, & Yssing, 2002). Investigators draw participant feedback to identify problems, points of confusion, or inconsistencies; this knowledge was leveraged to adapt and enhance the intervention. Think-aloud techniques have a validated presence in usability research and are one of the most frequently employed methods for usability studies (Mcdonald, Edwards, & Zhao, 2012). This usability testing technique was chosen based on previous literature with children and adolescents suggesting that think-aloud exercises uncover more usability issues than questionnaires or structured interviews (Donker & Markopoulos, 2002). This, it is argued, is because participants are reporting on tasks and information as they encounter them, rather than having to recall what

they had done and read previously (Donker & Markopoulos, 2002). However, given that we were asking participants to point out things that are "wrong" with the intervention, we were also aware of the possibility of social-desirability bias (Fisher, 1993) and the potential for participants to feel uncomfortable noting dislikes or problems with the *Healthy Body, Healthy Mind* program directly to the researcher. Youth, in particular, may be motivated to please experimenters in the context of think-aloud exercises (Donker & Markopoulos, 2002). To help counteract this possibility, participants were urged to point out confusing components and that their job was to be a "co-evaluator" with the researcher; they were encouraged to help the researcher determine how the program can be improved. This user-centered approach acts to mitigate social-desirability bias in the context of think-aloud paradigms (Wright & Monk, 1991).

Participants

We conducted our first round of usability testing with undergraduate students. Although university students are not our target population, they are a convenient sample to target first and help identify general issues or confusion in the intervention prior to testing with children. We informed the participants (n = 6) that the intervention is designed for obese children and adolescents age 8-12 and that they should keep this target group in mind. As participants worked through the pre-test survey, the intervention, and the post-test survey we asked them to share any content that is unclear and to "think aloud" as they worked. To ensure that participants provided feedback regularly, we asked them to stop working periodically and share their thoughts with the researcher. For example, we asked, "What do you think was the main idea of this last section?", "Was there anything confusing about what you just read?", and "What did you like and dislike about the last section you just worked through?" Intervening in the think-aloud exercise with specific questions like these is not the original or conventional think-aloud method. However, this usage of periodic questioning is defined in the usability literature as an active intervention

method, often termed “coaching”. This type of think-aloud protocol is used in a variety of usability testing studies, however it is also argued that active intervention methods allow users to perform better and more efficiently, thus potentially taking away from the ability of the researcher to see the participant interact with the program as if they were truly on their own (Olmsted-Hawala, Murphy, Hawala, & Ashenfelter, 2010). Further, due to the wide variety of think-aloud protocols and methods (and the subsequent straying from the original theoretical basis, such as the methods promoted by Ericsson & Simon, 1998) it’s recommended that researchers adjust their techniques based on their own specific goals for the usability testing (Boren & Ramey, 2000). Although we did want to test the usability of the intervention interface, it is not a very technical or complex program, therefore we concentrated on receiving feedback about the content and experience of the user. Hence the decision to utilize a more obtrusive think-aloud protocol.

Once participants worked through all components (pre-test, intervention, and post-test), we completed a short semi-structured interview with the participants. During this portion, the researcher asked a few more questions regarding the *Healthy Body, Healthy Mind* program as a whole. For instance, we asked, “Did you find any portion of the program boring? If so, what part and how would you improve it?” and “Did you think that the program was too long?” Further, we wanted the participants to provide feedback on the manner in which the content is presented; we asked if they liked having the option to listen to the voice recordings, if it felt like too much reading, and if including other forms of media, such as videos would make the program more or less engaging and enjoyable.

Next, we tested the *Healthy Body, Healthy Mind* intervention with child participants who are similar in age to those at the obesity treatment clinics (*M* age = 11.5 of participants in the clinic): A necessary step toward determining intervention effectiveness and validity (Currie,

McGrath, & Day, 2010). Child participants were recruited via an email posting to faculty members in the Psychology department. The email stated that we were looking for children or adolescents aged 8-12 to participate in a usability study to help improve an online intervention promoting healthy behaviors. Faculty members interested and willing to have their child participate were provided with consent forms and full study descriptions. Each child participant (n = 3, M age = 8) completed an online assent form and were also given a detailed description of the purpose of the study verbally by the researcher prior to beginning the study. Then, the researcher engaged with the participant in the same think-aloud exercise and semi-structured interview questions that were implemented with the undergraduate participants. We ran our first usability testing within our own lab with undergraduate research assistants as part of a classroom assignment. To test with child and adolescent participants, we received approval from the university institutional review board prior to recruitment.

Results and Discussion

After first testing the intervention with the undergraduate participants, we compiled and assessed the information collected. The feedback from the undergraduate students was used to improve the *Healthy Body, Healthy Mind* intervention prior to the usability testing in with child participants. This cycle of design-evaluation-redesign greatly aids in reducing usability problems, making it an important component in intervention development prior to implementation (Kushniruk, Patel, & Cimino, 1997). See Table 1 for the main findings from the think aloud exercises and the changes made to the intervention in response to the feedback.

Both undergraduate and child participants provided us with feedback that resulted in changes made to the intervention. Had we not included this first study to evaluate the usability and experience of the user, we would have missed an important opportunity to make the content and layout of the intervention more comprehensible, relatable, and engaging. Further, the

importance of including participants similar in age to those that the intervention is built for was exemplified. For instance, undergraduate participants both liked and understood the analogies used in the intervention, however the child participants did not understand them.

A primary limitation of this study is the distinct differences in the participants compared to those for whom the intervention is built. Undergraduate participants are much older and at a different stage of their lives than the 8-15 year-olds that the intervention is targeting. Even though we briefed the students on the target audience for the intervention, it is possible that their responses were not suitable. Indeed, this was evidenced by the child participants providing feedback that was in direct opposition to that of what the undergraduate participants had said. Further, the child participants that we were able to recruit represented only the youngest side of the targeted age range. This also poses a limitation in that the feedback acquired was potentially not comprehensive enough. In addition to the issue of age, neither the undergraduate or child participants were attending doctor-referred obesity treatment programs, such as those that are receiving the intervention. Another limitation of Study 1 is the sample size (n = 6 and n = 3), which was quite small. However, previous literature indicates that 3-20 participants are needed to detect most usability issues in "discovery" type studies (e.g. when not comparing one interface to another), with more participants needed as the complexity of the interface increases (Macefield, 2009). The *Healthy Body, Healthy Mind* intervention is extremely simple to navigate, assuring us that even with a small sample size, we were able to detect a good amount of usability issues. More importantly, with this user-centered approach to the design of the intervention, we can be more confident that the intervention is well understood and engaging for the participants, as noted from previous work on health behavior change interventions with adolescents (Thompson, Cullen, Boushey, & Konzelmann, 2012).

Study 2: Intervention Implementation

The first aim of Study 2 was to examine the intervention feasibility, acceptability, and usability in a clinic setting with obese youth. In general, if an intervention is difficult and burdensome for staff to implement, then the likelihood of the intervention being utilized will quickly diminish. In developing an intervention that is intended to be scalable, understanding whether it can be easily implemented is a crucial first step. Second, as in Study 1, we again assessed the acceptability and usability of the intervention within the Study 2 sample. Doing so clarified how and whether the intervention is accepted by those for whom the intervention was built: obese children and adolescents enrolled in an obesity treatment program. Lastly, we assessed within-group changes in and the correlations between a variety of health-related variables from baseline to immediate post-intervention. The institutional review board approved all research prior to study recruitment.

Participants

A total of 48 participants completed the study. Participants ranged in age from 9-17 (M = 12.6, SD = 2.79; 54.17% female) with a racial/ethnic composition as follows: 27.08% African American, 54.17% Hispanic, 16.67% White, and 2.08% reporting two or more races/ethnicities. Per advice from clinic staff, we did not collect anthropometric measurements due to concerns of inaccurate reporting by participants' parents. However, the most recent BMI data from all children and adolescents attending the obesity treatment clinics reports that all attendees fell into the 95th percentile or greater – placing them in the obese category.

We implemented the single-session *Healthy Body, Healthy Mind* intervention with 48 youths over the course of three months (Spring/Summer 2019). All children and adolescents enrolled in the obesity treatment clinics (Brenner FIT and the ECU Healthy Weight Clinic) during this time frame were invited to participate in the study and complete the intervention

study. Staff of the treatment and prevention programs used a script provided by the researchers for recruiting participants, which detailed the purpose and process of the study. Staff also obtained consent from parents and child/adolescent assent prior to their enrollment in the study. A target number of participants was not determined prior to implementation due to the exploratory nature of the study, our short project timeline, and the partner clinics' preferences.

Study Design and Procedures

We first acquired approval from the university institutional review board prior to implementation. Once we obtained consent from parents, the study began with an electronic assent form, which youths signed prior to proceeding through the study. Subsequently, a parent completed demographic questions about their child (e.g. age, race, gender, and length of time going to the obesity clinic). Parents completed this section per recommendations from program staff. Participants first completed the pre-test survey, then the intervention, and finally the post-test survey in one sitting. We administered identical surveys at pre- and immediate post-intervention and included assessments of mindsets, health, and health-related variables. The post-test survey included an additional usability and user experience assessment (see all measures detailed below). In an attempt to mitigate issues of practice effects due to pre-test and post-test being completed so close to each other, we randomized measures within each survey period. We compensated participants with a $20 gift card upon completion of the study.

Measures

In addition to the few demographic questions listed above, prior to the pre-test measures, we also asked participants where they completed the study [at home (n = 47) or at the clinic (n =1)] and what device they used to complete the intervention [computer (n =30), iPad/tablet (n = 8), or smartphone, n = 9].

Participant Acceptability Measures.

System Usability Scale (SUS). The SUS is a frequently used, reliable scale that evaluates the user satisfaction of web-based applications and other technologies (Brooke, 1996). Some wording was changed from the original SUS scale for the young participants. For instance, the word "system" was replaced with "program" and certain words, such as "cumbersome", were replaced with synonyms (e.g. "awkward") that were easier to understand for children and adolescents (example item: "I found the program very awkward to use"). Participants were asked to rate the program on various dimensions using a five-point scale [1 = "strongly disagree" to 5 = "strongly agree"]. Higher scores on this measurement scale indicate better usability.

Open-Ended Questions. To add to the richness of the user experience feedback, participants were also asked two questions requiring short written responses. We asked what they liked and disliked about the program, as well as asked them to provide feedback on various aspects of the program and what they might do to improve it.

The SUS along and the open-ended questions were used in combination to assess acceptability based on previous research that tested a health behavior promotion website for adolescents (Starling et al., 2015).

Implementation Feasibility Measures. Based on guiding questions and objectives for feasibility studies outlined in previous work, the feasibility of implementing the current intervention was documented through feedback and survey data from clinic staff. Additionally, study enrollment and completion rates were evaluated (Orsmond & Cohn, 2015).

Staff Survey. Upon completion of data collection, we recruited staff members involved in the implementation of the intervention to partake in an online survey. The survey included an 11-item scale that measures the acceptability of intervention, intervention appropriateness, and the feasibility of intervention. This assessment was designed to investigate implementation outcomes

and also provide future indication of other feasibility-related outcomes, such as adoption (Weiner et al., 2017). Previous health intervention work for children also utilized this measure to determine implementation outcomes (Nathan et al., 2019). Higher scores indicate stronger feelings of intervention acceptability, appropriateness, and feasibility [1 = "completely disagree" to 7 = "completely agree"]. At the end of the survey, an open-ended response option was provided to ask staff participants to provide any further feedback.

Participant Health Outcome Measures. We then assessed a variety of mindset and health-related outcomes at baseline and post-intervention. Although interpretation of intervention outcomes is typically reserved for pilot studies and larger-scale implementation, previous feasibility research recommends preliminary analysis of outcomes in order to determine if proceeding to utilize the intervention in the current setting is advised (Orsmond & Cohn, 2015). The pre-test and post-test surveys were identical, except that the post-test survey also included assessments of usability.

Mindsets of Health. This 4-item scale assesses one's mindset about health and is used previous mindset research (Thomas, Burnette, & Hoyt, 2019). It reflects the degree to which an individual believes their health is changeable (e.g., "Your ability to be healthy is something about you that you can't change very much"). Higher mean scores indicate stronger growth mindsets of health [1 = "strongly disagree" to 7 = "strongly agree"] (baseline $\alpha = .71$, post-intervention $\alpha = .73$).

Self-Efficacy. We used two established measures of self-efficacy to assess the degree to which an individual believes that they can continue to work towards their nutrition and physical activity-related goals, even in the face of obstacles and setbacks (Schwarzer & Renner, 2000). All items start with the following prompt, "How certain are you that you could overcome the following barriers?" An example item following this prompt would be, "I can manage to stick to

healthful foods even if I have to try several times until it works" (nutrition self-efficacy). In the current work, these two separate scales are combined to reflect an overall measure of health behavior self-efficacy. Higher scores on this 10-item scale indicate higher levels of self-efficacy [1 = "very uncertain" to 4 = "very certain"] (baseline α = .84, post-intervention α = .89).

Value of Health Behaviors. This 9-item measure has been used in previous research to assess the degree to which an individual values engagement in health behaviors for reasons of utility (e.g. "Learning about different ways to eat a healthy diet is useful to me"), intrinsic value (e.g. "I find that exercise makes me feel good"), and/or attainment (e.g. "Working to improve my eating behaviors is worth it to me") (Thomas, Burnette, & Hoyt, 2019). For this scale, higher scores indicate stronger beliefs of valuing health behaviors [1 = "strongly disagree" to 7 = "strongly agree"] (baseline α = .85, post-intervention α = .90).

Blame for Current Health and Body Weight. The extent to which participants feel that they are to be blamed for their current health status and body weight was assessed via two separate prompts: "How responsible are you personally for your health? That is, how much do you feel that your health is a result of choices you make, rather than something you can't control?" and "How responsible are you personally for your body weight? That is, how much do you feel that your body weight is a result of choices you make, rather than something you can't control?" Scores on these two items are averaged; higher scores indicate stronger feelings of blame [1 = "not at all responsible" to 7 = "entirely responsible"] (baseline α = .83, post-intervention α = .88).

Body Dissatisfaction. Two items from the Eating Disorder Examination Questionnaire were used to assess body dissatisfaction (Fairburn, & Beglin, 1994). These two items have been used in previous work as a quick and valid assessment of body dissatisfaction (Griffiths et al., 2016). The two items are as follows: "How dissatisfied have you felt about your weight?" and

"How dissatisfied have you felt about your shape?". Higher scores on this measure indicate stronger body dissatisfaction [1 = "not at all dissatisfied" to 6 = "very dissatisfied"] (baseline α = .83, post-intervention α = .85).

Perceived Primary Control Scale for Children – Health Behaviors. This measurement scale was adapted from its original version to reflect health-related statements, for example: "I can choose to eat healthy foods if I really try" (Weisz, Southam-Gerow, & McCarty, 2001). This 8-item scale is designed to assess beliefs about one's ability to exert control over situations pertaining to healthy behaviors. Higher scores on this scale indicate stronger perceived control [1 = "very false" to 4 = "very true"] (baseline α = .60, post-intervention α = .66).

Results

Participant Acceptability. Results from the System Usability Scale (SUS) indicate that the *Healthy Body, Healthy Mind* intervention was generally accepted by the participants. SUS scores range from 0 to 100, where a score of 68 is classified as an average usability rating (Sauro, 2010). Participants completing the *Healthy Body, Healthy Mind* intervention reported an average SUS score of 71. According to previous research, a score of 71.4 is considered "good" by usability metrics (Bangor, Kortum, & Miller, 2009).

The additional open-ended questions indicated general acceptance with and enjoyment in completing the program. Although participants did provide some negative feedback as well, the overwhelming majority of comments were positive in nature. For example, participants mentioned, *"I think the program is good especially for kids who don't know a lot about nutrition", "I liked everything about it and would use something like this again to help further understanding of the human body",* and *"I like that this program had a lot of information and it makes connections with us".* When asked about likes and dislikes of the program, negative comments were all related to wording of the content. However, there were also comments

praising the comprehensibility of the intervention content. For instance, one participant said *"everything was well-worded"*, whereas another participant said, *"some of the words were hard to understand"*.

Participants were also asked how they liked the option to "read along" with the narrated audio function. All participants mentioned either enjoying this function or simply liking the availability of it even if they preferred to read the content themselves. For instance, one participant states, *"I liked to listen in, it gave the story more depth"* and another mentioned, *"It was a good idea, but I did not use it because I like reading."* Some participants noted how having the option to listen to the content was helpful for knowing how to pronounce more difficult words: *"I did not use the audio function, but I liked that if I didn't know how to pronounce or didn't want to read, I always had that option".* Finally, when asked what participants would change to the intervention to improve it for other kids, desires for "less writing", "less big words", and "more pictures" were mentioned frequently. Although many participants indicated that they would not change anything about the program, more interactive components (e.g. games, "hands-on" activities, and animation) were suggested by some as potential methods for making the intervention more engaging.

Implementation Feasibility. The original plan for implementation was to insert the *Healthy Body, Healthy Mind* intervention into the previously existing program structure of the obesity clinics. We thought that this would be the most feasible approach, rather than recruiting participants from the clinic to complete the intervention separately. However, the opposite was quickly discovered. Even with offering to provide laptops, the clinics did not have the resources available (e.g. separate computer room to run multiple participants at a time, necessary furniture, staff to facilitate) to efficiently run the intervention this way. Further, children and adolescents coming to the clinic were already spending time on appointments, classes, and activities; adding

in the *Healthy Body, Healthy Mind* intervention to this time was believed by the clinic staff to be too burdensome.

Instead, children and adolescents were recruited to participate in the intervention when they came to the clinic for other appointments. Those who were interested in participating in the study were given the option to complete the intervention on site before they left the clinic or provided directions to complete the intervention on a computer at home. In regard to the option for participants to complete the study at home, one staff member said:

"I think having them do it all at home has been a real bonus for us as far as ease of the study on our end. It only takes us a few minutes to share with the family about the study."

At the end of the study, clinic staff were recruited to complete an online survey to assess feasibility and experience implementing the intervention. Between the two obesity clinics, a total of 7 clinic staff members were recruited to provide feedback after they identified themselves as having played an active role in the intervention implementation processes. Participants first completed a measure assessing intervention implementation. Using this measure, staff members reported the *Healthy Body, Healthy Mind* program to be acceptable, appropriate, and feasible to implement in the clinic, but with preference for participants completing the intervention at home (M = 5.36, range: 1-7; higher scores indicate more favorable ratings).

Following the quantitative feedback, staff were asked their opinions on the intervention content, the implementation process, and any ideas for improvement:

Staff member A: *"I believe that the program was too long to keep the attention of all the kids in the age range that it was offered. I got feedback from multiple kids that they did not enjoy doing it because of the length and the way the content was presented. However, they still did it because they got $20. The money was the real driving force of completion of the study."*

Staff member B: *"I loved the online education, easy to use and give to patients. Not a great percentage completed it even with easy access."*

In regard to completion rates, a total of 125 children and adolescents were invited to participate in the study over a 3-month timeframe. Of those invited, 8 immediately declined to participate. The declined invitations were due to parents expressing that they did not have time or were not interested in their child participating in university research. A total of 48 followed through with participating, making for a 38% completion rate.

Immediate Intervention Effects on Health-Related Variables. We assessed correlations between health outcomes reported in the pre-test and post-test surveys (see Table 2). We first report simple correlations. Then, utilizing paired samples *t* tests, we conducted analyses comparing mean scores from baseline to post-intervention.

Pre-test Correlations. At baseline, growth mindsets of health only correlated significantly with health value and perceived control. These correlations were positive – thus, growth mindsets were associated with reports of greater value and control. For all correlations among constructs, see Table 2.

Post-test Correlations. At post-test, growth mindsets of health correlated significantly with self-efficacy, blame, and perceived control, which are also all correlated with each other (for all correlations, see Table 2). These correlations were positive – thus, growth mindsets at post-intervention were associated with greater self-efficacy, blame, and perceived control.

Paired Samples t Tests. Participants who completed the intervention reported stronger growth mindsets of health, greater self-efficacy, more blame, and greater perceived control at post-test relative to baseline. And, participants reported a significant reduction in body satisfaction from pre- to post-test. No differences in value were obtained (For means, SD, and t-values, see Table 3).

Discussion

This study presents important findings in regard to the usability, feasibility, and efficacy of a novel mindset intervention for obese youth. Overall, the *Healthy Body, Healthy Mind* intervention is rated as enjoyable and engaging by participants. First, in terms of usability, according to the results from the System Usability Survey, the intervention is considered suitable when compared to usability standards. Qualitative feedback outlined issues with literacy, with kids under the age of 10 noting this issue. When asked how they might improve the program for future kids, participants suggested the addition of more interactive features. Future research and intervention development should consider using variable content for different ages, shorten the overall length, and determine how important interactive components might be for improving effectiveness. Second, in terms of feasibility, the length of the intervention was a main concern among program staff. The intervention itself is rather short (25-30 minutes), but with the inclusion of a pre-test and post-test survey, the entirety of the study becomes much longer (45 minutes - 1 hour). If the program is disseminated without the surveys, then it might be more manageable to include within the curriculum of a clinic. Additionally, a low percentage of recruited participants completed the study. If the intervention is incorporated directly into the curriculum of the clinic, rather than being treated as an external program, this could aid in completion rates. Future research should consider developing shorter intervention studies that can be implemented directly into clinic programs.

Third, in terms of efficacy, the primary tests of interest are those that examine intra-individual change from pre to post-test. The *Healthy Body, Healthy Mind* intervention successfully fostered stronger growth mindsets in addition to greater self-efficacy and perceived control. This work replicates and extends past research showing a positive link between growth mindsets and self-efficacy for health behaviors (Orvidas, Burnette, & Russell, 2018) and with

perceived control (Doron, Stephan, Boiché & Scanff, 2009). Furthermore, past mindset intervention research demonstrates significant increases in perceived control from baseline to post-intervention (Schleider & Weisz, 2016; Schleider & Weisz, 2018). Both self-efficacy (Sheeran et al., 2016) and perceived control (Godin & Kok, 1996) are well-established in the literature as mechanisms responsible for influencing health behavior change. Our findings present avenues for future research to use randomized controlled trials and longer-term assessments to further establish if growth mindset interventions shift self-efficacy and perceived control surrounding healthy behaviors.

Blame also increased significantly from baseline to post-intervention despite compensatory messaging, which has successfully reduced blame in past work (Burnette et al., 2018). Considering the costs of blame for mental health via internalization of stereotypes (e.g., internalizing weight-based stigma: Puhl, Moss-Racusin, Schwartz, & Brownell, 2007), future mindset intervention research should make a point to determine best practices for increasing growth mindsets without simultaneously increasing feelings of blame. Interestingly, although the intervention increased blame, it had an opposing effect on body dissatisfaction; a significant decrease from pre- to post-test was revealed. Although a small effect, this is something that future researchers should consider when building interventions related to healthy behaviors and for overweight participants as body dissatisfaction is associated with negative outcomes such as stress, low self-esteem, and depression (Johnson & Wardle, 2005).

In summary**,** we tested the acceptability, feasibility, and immediate effects on health-related cognitions of a single-session, online intervention encouraging growth mindsets of health in obese youth enrolled in obesity treatment clinics. Overall, the *Healthy Body, Healthy Mind* intervention demonstrated acceptability and feasibility, with areas for improvement including shortening the length, including additional multi-media, and stronger integration into the clinic's

service flow. Participants who completed the intervention reported immediate increases growth mindsets of health, greater self-efficacy, and stronger perceived control over health behaviors, relative to baseline levels. Each of these constructs has shown relevance for health behaviors and outcomes (Godin & Kok, 1996; Orvidas, Burnette, & Russell, 2018; Sheeran et al., 2016). Participants did not report changes in perceived value of health behaviors from pre- to post-intervention, and levels of self-blame for health significantly increased from pre- to post-intervention. This may be in part because blame is assessing personal responsibility, whereas the compensatory messaging addressed issues related more to shame such as body-dissatisfaction. Future work should seek to develop a clear growth mindset message that has the benefits without increasing self-blame. We hope this study provides initial insight into how to start to accomplish this task.

Limitations

Despite applications, this study is not without its limitations. The first is the lack of random assignment with an attention-matched control. We are unable to confidently conclude that the changes observed are due to the intervention being studied, rather than to other factors. Although the intervention is based on a previous mindset intervention that did use a control group, we cannot assume these interventions to be analogous. Second, the overall sample size is relatively small. Future research would benefit from testing a similar intervention with a larger sample and a control group to see if results still hold. Third, we recognize that the measurement scale used to assess perceived control displayed lower than desired reliability scores. This raises concerns of underestimation in interpreting the relationship between perceived control and other variables (Schmitt, 1996). A final limitation is the lack of follow-up. The results of this study may not hold beyond immediate post-test. The *Healthy Body, Healthy Mind* intervention was modeled after a previous mindset intervention that retained significant differences in youth

depressive symptoms and perceived control 9 months following the intervention (Schleider & Weisz, 2016; Schleider & Weisz, 2018), but given the differences in context and outcomes of the current study we cannot assume similar long-term results for the current study.

Summary

The *Healthy Body, Healthy Mind* intervention is entirely web-based, short, and low-cost program that has potential to be easily implemented in obesity treatment clinics and other similar settings for the treatment and prevention of obesity in youth on a large scale. The intervention is aimed to increase growth mindsets of health in obese children and adolescents. Holding a growth mindset of health has potential downstream effects for increasing engagement in healthy behaviors. Although the current work sets the stage, future work should consider the usability, feasibility, and additional outcomes (e.g., time spent exercising, food diaries, BMI), to further establish overall effectiveness and utility of an online mindset intervention for health behavior change.

Table 1
Study 1 usability findings (student participants (N = 6) and child participants (N = 3))

	Main Think Aloud Usability Findings	**Associated Changes Made**
Undergraduate Participants	Minor grammatical errors	Errors were fixed
	Unclear if there were right or wrong answers to the survey questions	Added statement to assure participants that responses should be personal opinions
	Thought the stories from "other kids" could be more believable	Updated stories (e.g. more specific examples in the stories)
	Confusion with some writing exercises	Adjusted the wording in writing prompts
Child Participants	Difficulty typing responses	Shortened length of responses
	Prefer audio to not auto-play so that they can decide whether or not they want to read-along with narrator	Auto-play turned off and audio requires that the participant press "play"
	Unsure what the usability measure was referring to when "the program" was mentioned	Added a short statement prior to the usability measure to make this more obvious
	Did not understand the analogies and some phrases (e.g. "set in stone")	Analogies and phrases removed

Table 2
Correlations of health outcomes at pre-test and post-test (N = 48)

Outcomes	1	2	3	4	5	6
1. MHpre	-					
2. MHpost	.52***	-				
3. BLpre	.22	.18	-			
4. BLpost	.26	.38*	.78***	-		
5. PCpre	.62***	.35*	.34*	.33*	-	
6. PCpost	.50***	.53***	.21	.36*	.57***	-
7. SFpre	.09	.29	.19	.21	.08	.09
8. SFpost	.24	.39**	.25	.40**	.11	.31*
9. VLpre	.32*	.20	.30**	.25	.23	.33*
10. VLpost	.14	.26	.11	.29	.03	.26
11. BDpre	.02	.21	.25	.18	.09	-.06
12. BDpost	.08	.06	.17	.14	-.00	.03

MHpre = mindsets of health at pre-test, MHpost = mindsets of health at post-test, BLpre = blame for current health and body weight at pre-test, BLpost = blame for current health and body weight at post-test, PCpre = perceived control over health behaviors at pre-test, PCpost = perceived control over health behaviors at post-test, BDpre = body dissatisfaction at pre-test, BDpost = body dissatisfaction at post-test, VLpre = value of health at pre-test, VLpost = value of health at post-test, SFpre = self-efficacy for healthy behaviors at pre-test, SFpre = self-efficacy for healthy behaviors at post-test. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3
Change in health outcomes from pre-test to post-test (N = 48)

Outcomes	*M* (SD) Pre-test	*M* (SD) Post-test	*t* test
1. MH	5.61 (1.14)	6.26 (.90)	4.21***
2. BL	4.73 (1.30)	5.54 (1.30)	6.57***
3. PC	3.20 (.44)	3.36 (.45)	2.51*
4. BD	3.40 (1.52)	3.14 (1.57)	-2.07*
5. VL	5.60 (.70)	5.60 (1.10)	0.13
6. SF	2.80 (.57)	3.00 (.66)	2.74**

MH = mindsets of health, BL = blame for current health and body weight, PC = perceived control of health, BD = body dissatisfaction, VL = value of health, SF = self-efficacy for healthy behaviors.

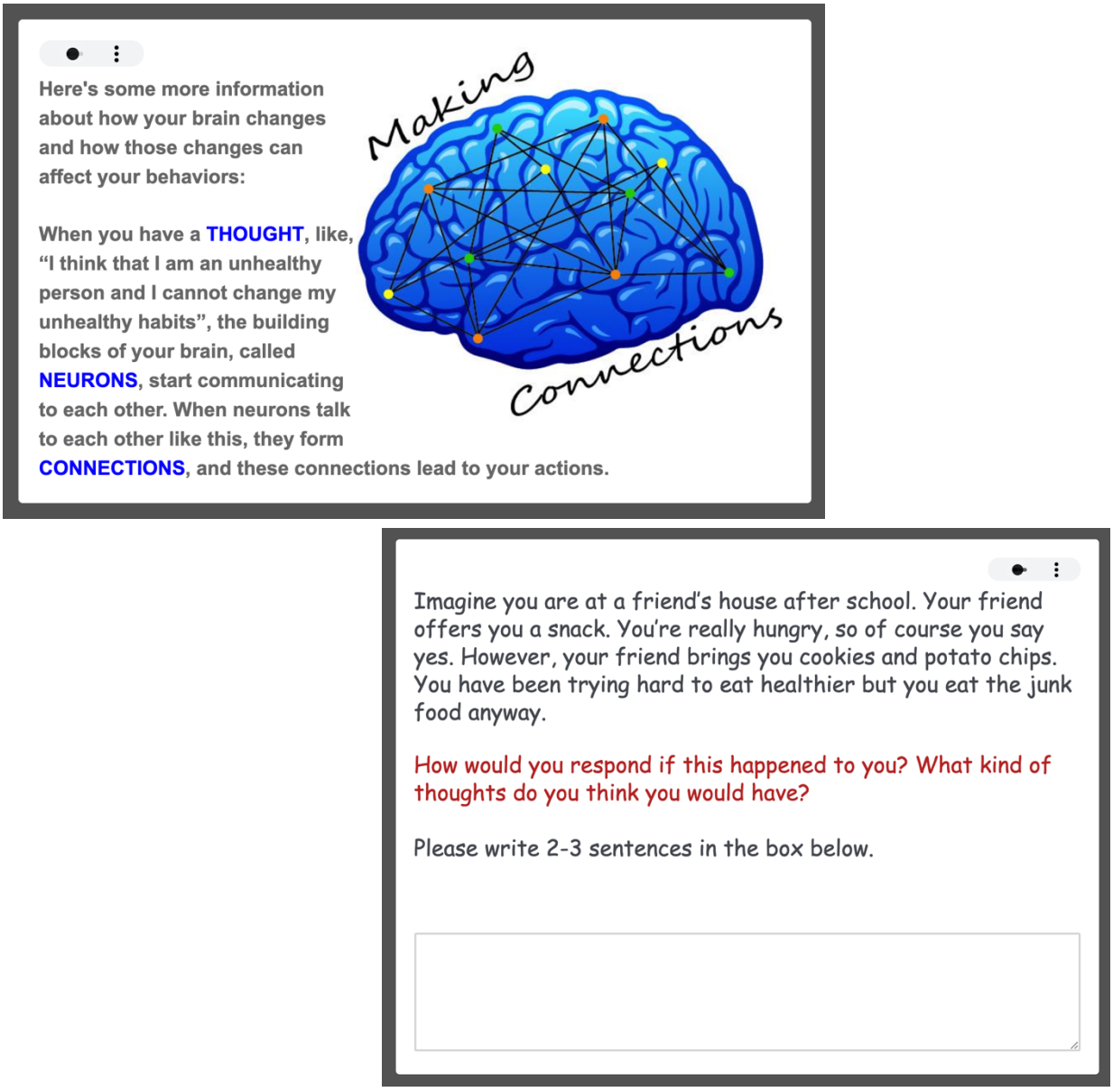

Figure 1. Samples of intervention content

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CHAPTER 5

Integrative Review

Obesity is a worldwide public health issue linked to numerous chronic diseases, mental health concerns, and steep economic costs (Kim & Basu, 2016; Pi-Sunyer, 1991; Scott et al., 2008). To combat this, researchers, practitioners, and policy makers are striving to uncover methods and points of intervention to promote engagement in healthy behaviors and encourage individuals to live healthier lifestyles. For instance, previous intervention efforts have evaluated various age groups and in a diverse range of settings from school districts to primary care clinics. However, the reported successes of these interventions are mixed and improved health (e.g. BMI, body fat percentage, body weight, etc.) is typically not long-lasting (Batsis et al., 2017; Sim, Lebow, Wang, Koball, & Murad, 2016; Wu, Gao, Chen, & Van Dam, 2009). Policies to encourage healthier behaviors, such as required nutrition labeling in restaurants and changes to school vending machine options, have also presented mixed findings on effectiveness, especially in the long-term (Mayne, Auchincloss, & Michael, 2015). Comprehensive reviews of the literature call for more research on how to leverage effective intervention components and determine best methods for embedding them into health, education and care systems in a manner that is impactful and sustainable (Waters et al., 2011). Further, these reviews call for innovative intervention strategies and methodologies that utilize robust behavioral theories to further understand mechanisms and avenues for health behavior change (Wang et al, 2013).

The studies included in this dissertation contribute to this research by leveraging mindset theory to further understand underlying mechanisms important for healthy behaviors and to describe the process of mindset intervention development and implementation for obesity treatment and prevention. In the following sections, I summarize the findings of each study and then discuss the implications for research, practice, and policy.

Summary of Findings

In the first manuscript (Ehrlinger, Burnette, Park, Harrold, & Orvidas), we examined mindsets of body weight and investigated whether holding a growth mindset about one's body weight leads to healthier eating. Participants reporting stronger growth mindsets of weight (Study 1) or that were placed into a growth mindset condition (Study 2) consumed significantly fewer calories from a high-calorie, high-fat snack option; these results did not hold for a healthier snack option. In the final study of this manuscript (Study 3), we discovered self-efficacy as a mediator. Participants with a growth, relative to fixed, mindset of weight reported significantly stronger self-efficacy, which in turn predicted reports of consuming fewer calories from fat. This is the first study to examine the link between mindsets of weight and eating habits with support from three studies using different assessments of mindsets and eating behavior.

The second manuscript presented in this dissertation explored the relationship between mindsets of fitness and exercise habits in combination with expectancy-value theory. The first study explored links between mindsets of fitness, physical activity self-efficacy, fitness self-value, and past exercise frequency. Results revealed that growth mindsets of fitness predicted stronger exercise self-efficacy and fitness self-value, which in turn predicted more reported exercise in the past. The second study included an experimental manipulation of participants' mindsets of fitness using mock news articles. With self-reported mindsets of fitness as the predictor, similar results from the first study emerged: stronger growth mindsets of fitness predicted greater exercise self-efficacy and fitness self-value, which in turn predicted greater intentions to exercise in the future. However, with condition as the predictor, the mediation model from the first study did not hold. This work demonstrated a significant relationship between mindsets of fitness and exercise habits. In addition, pulling from expectancy-value theory, results uncovered physical activity self-efficacy and fitness self-value as mediators in this

relationship. The findings also highlight the potential difficulty of shifting outcomes with a simple one-shot manipulation of fitness mindsets.

The final manuscript in this dissertation focused on the design and implementation of a single-session, web-based mindset intervention for obese children and adolescents. The usability and user experience data from the first study informed improvements to the intervention. The second study assessed the feasibility of implementing the intervention with a sample of youth from obesity treatment clinics. This study also evaluated the acceptability of the intervention and measured an array of health outcomes from baseline to post-intervention. Staff of the obesity clinics provided positive feedback regarding the appropriateness, acceptability, and feasibility of the intervention. However, they also voiced concerns about the length and low completion rates. Participants deemed the intervention enjoyable and acceptable, with only minor negative feedback noting difficulty in understanding some of the chosen vocabulary. From pre-test to post-test, mindsets of health, self-efficacy for health behaviors, self-blame for current health status and body weight, and perceived control all significantly increased from baseline to post-intervention. Conversely, body dissatisfaction significantly decreased, whereas value of health remained unchanged. The *Healthy Body, Healthy Mind* intervention is a low-cost, single-session program aimed to promote growth mindsets in children and adolescents with prospective downstream effects for increased healthy behavior adoption.

In sum, the first two manuscripts demonstrated significant relationships between growth mindsets and healthy behaviors, namely healthy eating practices and increased exercise frequency. These findings set the stage for future research to better understand the link between mindsets and engagement in healthy behaviors. The third manuscript detailed a single-session intervention – *Healthy Body, Healthy Minds*. Due to the acceptability, ease of implementation and scalability of the intervention, it has the potential to make a positive impact on a large scale.

However, it is important to note that these findings are not necessarily generalizable to all populations and settings – future research is required to determine generalizability.

Implications

The work presented in this dissertation has implications for future obesity and health behavior change interventions, as well as for health and wellness professionals. These findings also contribute to and expand the current mindset literature. Equipping individuals with knowledge regarding the benefits of engaging in healthy behaviors or the costs of engaging in frequent unhealthy behaviors is simply not enough to induce behavior change. Rather, motivational components are needed to inspire lasting change. The present work introduces mindset theory as a possible avenue for predicting engagement in healthy cognitions and behaviors. Specifically, the extent to which an individual believes in the changeable nature of health-related attributes – such as body weight, fitness, and health – predicts healthier self-regulatory processes. For example, the research presented here demonstrates the link between growth mindset and increased healthy behaviors, such as exercise and healthy eating. In addition, we describe the design and implementation of a mindset intervention for health behavior promotion. Future interventions and health initiatives can build on mindset theory to implement widely. On a smaller scale – coaches, personal trainers, and other health care professionals can apply this research in their practices to help their clients succeed in their health and wellness goals. Rather than highlighting knowledge alone, both large, scalable interventions and one-on-one interactions with individuals striving to improve their health could benefit from focusing on cultivating a growth mindset in regard to health-related attributes with implications for behavior change and ultimately goal success.

Although previous research applies mindset theory to a variety of domains, research designed to improve healthy cognitions and behaviors is burgeoning. The three manuscripts

presented here extend the current mindset literature by providing evidence for the relationship between growth mindsets of body weight and fitness for health-related outcomes, namely healthy eating practices and exercise frequency. Further, drawing on expectancy-value theory, this research uncovered significant mediating mechanisms that describe how mindsets affect health outcomes. Specifically, both self-efficacy and value play a mediating role, such that mindsets predict self-efficacy and value, which then influences health-related habits and behaviors. Further adding to the literature, this work applies mindset theory to a health behavior change intervention. This research addresses a real gap in mindset intervention research—the absence of user-centered design processes. This initial study can inform future growth mindset research seeking to design the post effective and powerful interventions.

Future Directions

Future work can extend findings from this initial line of work examining mindsets and healthy cognitions and behaviors. For example, the present work uncovered the importance of holding a growth mindset of body weight for lower consumption of high-calorie snacks, as well as growth mindsets of fitness for more exercise frequency. Future research should identify how growth mindsets might predict eating habits outside of a lab setting and for other nutritional habits, such as fruit and vegetable consumption. And, given that the findings concerning mindsets and exercise frequency presented here are based on self-report data, future research should examine behavioral outcomes to solidify these results and fill this existing intention-behavior gap. Additionally, the *Healthy Body Healthy Mind* intervention detailed in the current work presents a starting point for future intervention research that incorporates usability. Given the lack of a control group and long-term follow-up, the intervention work presented here cannot provide strong evidence regarding the effects of this single-session mindset program on health outcomes and ultimate behavior change. Therefore, future research should test the effectiveness

of a mindset intervention for promoting positive health outcomes using more robust methods and procedures, including incorporating the mechanisms outlined in the current work. For example, future intervention work could test the effectiveness of a combined intervention targeting all three attributes studied across the manuscripts presented here: mindsets of body weight, of fitness, and of health, and could also seek to enhance value and efficacy.

Conclusions

Understanding mechanisms and factors that influence healthy behavior engagement is crucial in efforts to combat obesity and the associated negative consequences. Current health behavior change research seeks to uncover these influential mechanisms and leverage them to promote healthier lifestyles. The first two manuscripts included in this dissertation investigate the role of mindsets in predicting healthy cognitions and behaviors. Results indicate that holding a growth mindset regarding body weight predicts healthier eating, and a growth mindset of fitness predicts more reported exercise frequency. In addition, self-efficacy mediated the relationship between mindsets and healthy eating. And, both self-efficacy and value acted as parallel mediators for the relation between mindsets and exercise behaviors. These first two manuscripts also provided evidence to support the capability of shifting mindsets of body weight and mindsets of fitness via experimental manipulation.

Following the discovery of significant findings from these studies, the third manuscript details the development, acceptability, feasibility, and initial efficacy of a mindset intervention for health behavior promotion. The *Healthy Body, Healthy Mind* intervention significantly increased growth mindsets of health, self-efficacy, perceived control, and blame, but decreased body dissatisfaction from pre-test to post-test. Conversely, value remained unchanged from pre- to post-test. Overall, the work presented in this dissertation draws on mindset theory to further understand engagement in healthy cognitions and behaviors. This dissertation advances the

current mindset and health behavior literature and provides a platform for future inquiry regarding how to best leverage mindsets to improve health.

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