RUNNING HEAD: THEORIES OF WEIGHT AND EATING BEHAVIOR

Incremental theories of weight and healthy eating behavior

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Abstract

We examined whether a belief in weight as malleable (an incremental theory) leads to healthier eating than a belief that weight is fixed (an entity theory). Participants with incremental theories of weight consumed fewer calories from high-calorie foods in a lab-based taste test than did those with more entity theories of weight. This pattern held correlationally, with naturally-occurring theories of weight (Study 1), and when we experimentally manipulated participants' theories of weight (Study 2). A third study provided evidence that differences in self-efficacy regarding food mediate the relationship between theories of weight and eating behavior (Study 3). One way to encourage healthy eating might be to develop interventions that encourage more incremental views of weight.

Keywords: *incremental theory, entity theory, implicit theories, eating behavior, self-efficacy, growth mindset, self-regulation*

Incremental Theories of Weight and Healthy Eating Behavior

Dweck's self-theories approach suggests that people hold beliefs regarding the malleability of personal attributes such as intelligence, personality, and morality on continuums ranging from strong incremental theories, suggesting that these attributes are changeable over time, to strong entity theories, 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 suggest 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 also predicted striving for goals using mastery more than helpless-oriented strategies and remaining optimistic when facing challenges. These goal-setting, operating, and monitoring strategies mediated a positive affect 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 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 work, 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 an 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 increase in 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 temptations.

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 that, 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 will respond with more effortful and less avoidant strategies if they face a dieting setback more than entity theorists (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).

The present 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 foods and, insodoing, 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. More specifically, Dar-Nimrod, Cheung, Ruby, & 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 a high-calorie food than control participants. Although participants' naturally-occurring implicit theories of weight was 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 food 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. They were 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). Not surprisingly, participants' eating behavior was also 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, and 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 teaching 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 for 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, contributors 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 Weight Implicit Theories 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 2, 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 = 1.965) was corrected through log-transformation. Because log-transformation was insufficient, positive skew in M&M (skewness = 3.225) and raisin (skewness = 2.502) calories consumed were corrected through square-root transformation.

There was no significant relationship between participants' demographic variables (gender, age, and log-transformed BMI) and either their theories of weight or their caloric consumption, all ps > .32, with one exception. Men consumed significantly more calories from raisins, Mean = 33.70 (SD = 7.28), than did women, Mean = 20.65 (SD = 6.39), $t(100) = 2.44$, $p= .02$. 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, $r(103) = .19$, $p = .06$. To determine the effect of participants' theories of weight on eating behavior independent of the effect of their preferences for each snack, we included participants' rated liking of 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, specifically 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 (H_1). 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 (H_2). Most importantly, we expected the relationship between theories of weight and eating behavior to be mediated by participants' nutrition self-efficacy (H_3).

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

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).

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 latter 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 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 (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.

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. Contrary to H_1, 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, in testing our third hypothesis.

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 (H_2). Consistent with our 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 higher feelings of self-efficacy regarding food.

Most importantly, the PROCESS analysis also provided support for our hypothesis that nutrition self-efficacy mediates the relationship between theories of weight and eating behavior (H_3). 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

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 (See Supplemental Material, Table 9).

Across three studies, we demonstrated that people's 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 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 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 mechaniams that underlie the benefits of incremental theories, broadly construed. With respect to health-related behaviors, the present research extends an exciting body of work suggesting that implicit theories of mallability 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 controllability 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 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 domain 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 some of the concerns of 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.

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.

However, 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.

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Appendix A

Implicit Theories of Weight Scale

All responses given on a scale from 1 (strongly agree) to 6 (strongly disagree).

Reverse scored items – 4, 5, 9, 10, 11, 12, 14, 15

1. Just like people are genetically programmed to grow to a certain height, people are genetically programmed to be more or less a certain weight and they cannot change that.
2. Although people can try dieting and exercising, they cannot significantly change their body type (e.g. very thin, average, athletic, overweight, obese).
3. Eating right and getting exercise are good for people's health, but they do not lead to permanent changes in body type or weight.
4. After dieting, people can make the weight loss permanent if they are willing to make the appropriate life changes.
5. When done correctly, dieting and exercising can lead to significant changes in a person's body type.
6. People are born with either fast or slow metabolisms, and there's nothing they can do to change that.
7. Because a person's body type is largely determined by genetics, dieting and exercising can only result in minimal changes in how a person looks.
8. Changes in weight that result from dieting and exercising are temporary at best. People always return to the weight determined by their genetics.
9. Although people may blame their weight on genetics, being overweight is really the result of inactivity and over-eating.

10. Regardless of their genes, people can always lose weight through diet and exercise.
11. Although genetics may contribute to how difficult it is for someone to lose weight, people can always change the shape of their body through diet and exercise.
12. Whether people succeed at losing weight is determined almost entirely by their commitment to the program, not their genetics.
13. 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.
14. Although many people re-gain lost weight, people can make a permanent change to their weight if they are committed to maintain a healthy lifestyle.
15. People's weight is largely a result of their lifestyle. They can always change their weight by changing their diet and physical activity.

Figure 1: The effect of theories of weight on consumption of unhealthy and healthier snacks (Study 1)

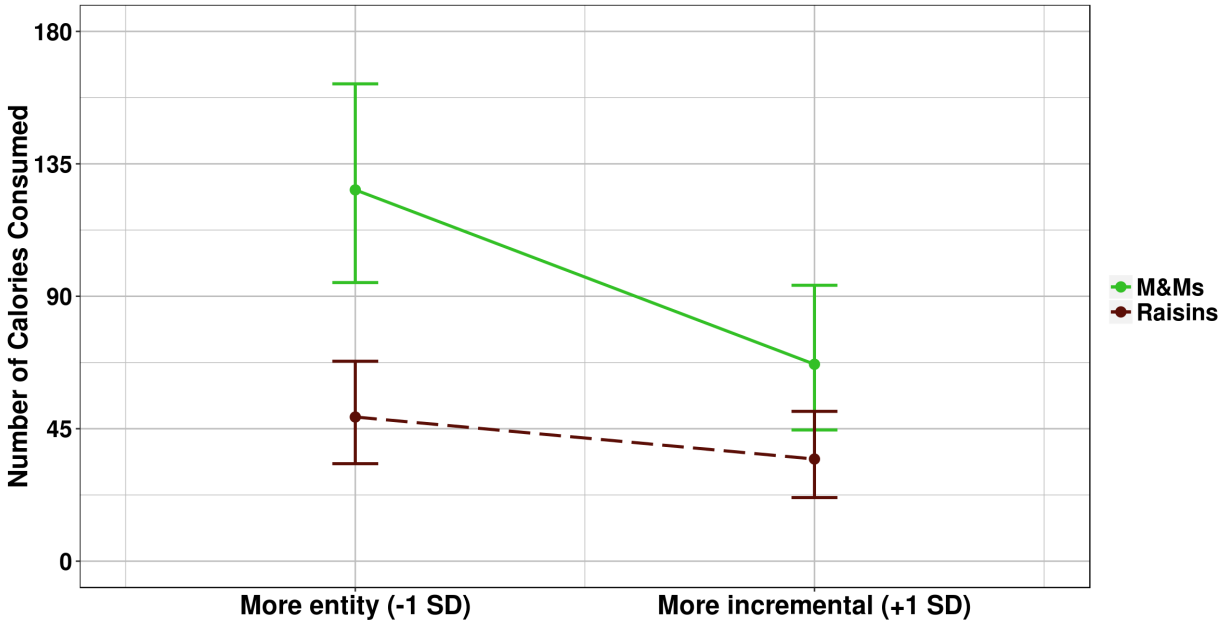

Table 1: How experimentally manipulated theories of weight influence eating behavior (Study 2)

	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	$F(1,99) = .00, p = .96$ $\eta_p^2 = .00$

Figure 2: Incremental theories of weight predict lower reported calories from fat, indirectly, via nutrition self-efficacy (Study 3)