Seeing More and Eating Less: Effects of Portion Size Granularity on the Perception and Regulation of Food Consumption

Neil A. Lewis, Jr. and Allison Earl
University of Michigan

Overeating and resulting obesity is a public health concern in the United States, and portion size is a factor that contributes to these problems (Zlatevska, Dubelaar, & Holden, 2014). The present research demonstrates that the granularity of labels used to describe portions also influences food consumption, independent of previously documented portion size effects. Across 6 studies and 7 different food items, we find a robust and reliable effect of portion size granularity labels on consumption intentions and food consumption. Having people think about food using fine-grained labels leads them to decrease their consumption intentions (Study 1, $n = 80$) and ultimately eat less food (Study 2a, $n = 79$; Study 2b, $n = 79$). This process operates by shifting people's perceptions of the size of foods (rather than changing levels of construal) whereby portions described with fine-grained labels (e.g., "15 gummy candies") are perceived to be bigger than portions described with gross-grained labels (e.g., "one serving;" Study 3, $n = 200$). In addition, granularity facilitates self-regulation of consumption for individuals with a weight-loss goal both when self-regulation is measured (Study 4, $n = 160$) and when we manipulate that mediator (Study 5, $n = 300$). Finally, a high-powered registered report replicated effects of granularity on consumption via shifts in perception and intentions with a diverse community sample (Study 6, $n = 323$). Implications for theory and practice are discussed.

Keywords: granularity, self-regulation, goal pursuit, judgment, obesity

Supplemental materials: http://dx.doi.org/10.1037/pspp0000183.supp

Obesity rates in the United States have increased over time, and today more than one third of adults and 17% of youth in the U.S. are obese (Ogden, Carroll, Kit, & Flegal, 2014). This obesity epidemic (Centers for Disease Control and Prevention [CDC], 2011) has enormous consequences for health and well-being (National Institutes of Health [NIH], 1998), and has immense economic costs—the estimated annual medical cost of obesity in the U.S. was $147 billion dollars in 2008, and the annual medical costs for people who are obese were $1,429 higher per person than those of normal weight (Finkelstein, Trogdon, Cohen, & Dietz, 2009). Much attention has been devoted to understanding the contributing factors to this problem, and portion size is a factor that consistently emerges as a contributor (for meta-analytic review, see Zlatevska et al., 2014) whereby people consume more from larger portions than smaller portions (Chandon & Wansink, 2011; Rolls, 2003; Wansink, 2004; Young & Nestle, 2002).

One explanation for the effect of portion size on consumption is that people generally engage in *mindless eating* (Wansink, 2006); in other words—we eat without much thought or consideration of how much food is in front of us. At mealtime, whatever is in front of us is presumed (sometimes incorrectly) to be one serving, and therefore we just eat it. Our default mindless eating practices explain why simply changing portion sizes influences how much people consume (Wansink, 2004; Wansink, Painter, & North, 2005), even though people are unaware of these changes in their consumption. These findings suggest that people's judgments of how much they are eating may be affected, not only by internal cues of satiety, but also by environmental cues signaling the amount one should eat.

A Novel Mechanism for the Impact of Information Granularity on Behavior

If consumption judgments are indeed driven by external cues of portion size as previous research suggests, then perhaps changing

Neil A. Lewis, Jr. and Allison Earl, Department of Psychology, Research Center for Group Dynamics, Institute for Social Research, University of Michigan.

Neil A. Lewis, Jr. is now at the Department of Communication, Cornell University.

We thank Julia Briskin, Chloe Sprague, Jonathan Mullinix, Ryan Foley, and Andrew Moore for their efforts in collecting data for these studies. We also thank Ethan Kross, Rich Gonzalez, Denise Sekaquaptewa, Stephanie Preston, and members of the Health Attitudes and Influence Lab and Media Psychology Lab for comments on various aspects of the studies and drafts of the article. These studies were internally funded by the University of Michigan Department of Psychology. Some of the analyses presented in this article were included in a data-blitz presentation at the Attitudes Pre-Conference to the Society for Personality and Social Psychology, 2015 Annual Meeting (February 2015). However, these data have neither been published nor are under review for publication at any other outlet, nor have the findings been posted online.

Correspondence concerning this article should be addressed to Neil A. Lewis Jr., Department of Communication, Cornell University, 467 Mann Library Building, Ithaca, NY 14853 or Allison Earl, Department of Psychology, University of Michigan, 530 Church Street, Ann Arbor, MI 48109-1043. E-mail: nlewisjr@cornell.edu or anearl@umich.edu

Journal of Personality and Social Psychology, 2018, Vol. 114, No. 5, 786–803
 http://dx.doi.org/10.1037/pspp0000183

the granularity of portion size descriptors (another external cue) rather than the portion size itself may be another route to shift consumption judgments. In other words, holding portion size constant, describing portions using fine-grained (e.g., "16 gummy candies") versus gross-grained (e.g., "one serving of gummy candies") labels may shift consumption judgments. Why might this be? Fine grained versus gross grained labels may operate by implying partitions of portion size. In this case, partitioning may psychologically distinguish one large unit (e.g., "one serving") from several smaller units (e.g., "16 pieces"). Prior research on partitioning suggests that the unit labels used to describe portions (e.g., Geier, Rozin, & Doros, 2006) and other partition cues (e.g., red potato chips; Geier, Wansink, & Rozin, 2012) can dramatically decrease consumption. Partitioning effects have been proposed to operate by increasing transaction costs associated with consumption, whereby smaller partitions rather than larger aggregates provide more decision-making opportunities that enable people to better constrain their consumption (Cheema & Soman, 2008). Other accounts suggest partitions change eating norms, and break the automaticity and mindlessness of eating (Geier et al., 2012).

In the present research, we propose an alternative mechanism for why portion size partitioning influences consumption behavior and suggest that the granularity of portion size descriptors plays an important role in the partition-to-consumption process. We predict that partitioning as a function of granularity of portion size will shift consumption intentions (i.e., how much people plan to eat in a given sitting, how much people feel they need to eat in order to feel satisfied), and these consumption intentions, will subsequently impact consumption (i.e., how much they actually eat in a given sitting). Consumption intentions, in turn, may be impacted by perceptual judgments of the amount of food present (e.g., calorie estimates, weight, cost, time to eat). Specifically, we predict that describing portion sizes using fine-grained ("16 gummy candies") rather than gross-grained ("one serving of gummy candies") labels will decrease the amount people plan to consume, which will impact the actual amount they consume. This would occur because fine-grained portion size labels will lead people to believe that the portions are actually larger, and thus people would need to eat less to feel satiated.

This prediction was constructed based on our consideration of prior research on unit granularity (Burson, Larrick, & Lynch, 2009; Lewis & Oyserman, 2015; Zhang & Schwarz, 2012, 2013) and Grice's logic of conversation (Schwarz, 1996, 2014). This literature demonstrates that although the same quantity can be expressed with different units (e.g., 16 gummy candies = 1 serving of gummy candies), people pay attention to the units chosen (e.g., servings vs. pieces) to communicate information and draw inferences from those units that influence their judgments and behavior. This occurs for three reasons. First, people differentially process and attend to decision-relevant information based on the level of granularity with which the information is presented, whereby fine-grained information influences judgments more strongly than gross-grained information (Zhang & Schwarz, 2012, 2013). Second, due to conversational norms, people assume that the specific details of information presented are relevant for their judgments (Schwarz, 1996, 2014). Third, once on the mind, details are incorporated into our mental representations (Bless & Schwarz, 2010) and presumed to be useful information for current judgments and decisions (Higgins, 1998; Schwarz, 2011). Overall, the more fine-grained the details presented, the more people pay attention and take action (Lewis & Oyserman, 2015).

How granularity influences action however depends on its effect on people's perceptions of the judgment object, the domain of the judgment, and people's lay theories about that domain. For instance, labeling consumer products in fine-versus gross-grained units may signal increased value. For example, Zhang and Schwarz (2013) told participants that the retail price for a DVD drive was either \$29.75 or \$30, and asked participants to estimate what the retailers paid for the drive. Participants who were told that the price of the drive was \$29.75 estimated that the drive cost retailers an average of \$3.25 more than participants who were told it cost \$30 (Zhang & Schwarz, 2013, Study 1). This effect occurred because the fine-grained label implied that more thought and precision went into the pricing of the DVD drive (an electronic product) and in the domain of electronics greater precision implies greater value; thus, fine-grained prices shifted perceptions of the drive's value.

Lewis and Oyserman (2015) found similar effects in their series of experiments on temporal granularity. First, participants who were told that preparatory action was underway for a variety of future events believed the future events would occur significantly sooner when considered in fine-grained time metrics (e.g., days) rather than gross-grained time metrics (e.g., months, years; Lewis & Oyserman, 2015, Studies 1–2). Next, they found that fine-grained versus gross-grained metrics also influenced people's plans and behavior. People considering future events in fine-grained time metrics (e.g., their child going to college in 6,570 days or their own retirement in 10,950 or 14,600 days) planned to start saving four times sooner (Studies 3–5), and chose larger delayed rewards (rather than smaller immediate rewards, Study 7) than those considering the future in gross-grained time metrics (e.g., 18, 30, or 40 years; Lewis & Oyserman, 2015). Those effects occurred because people have a lay theory about time as distance, and the granularity of time metrics implied temporal distance, or when the future would begin (i.e., days are sooner than years), and hence when they should take action. Lewis and Oyserman (2015) hypothesized that those effects occurred because granularity bridges the gap between present and future. However, one untested possibility is whether or not granularity might have made it easier for people to regulate their planning behavior (e.g., start saving). In a food context, this may imply that framing portion sizes in more versus less granularity may facilitate self-regulation by making a self-regulatory struggle more manageable.

Granularity Effects as a Consumption Regulation Strategy

Synthesizing and translating this prior research to the context of food consumption suggests that the granularity of labels used to describe portion sizes may play an important role in consumption judgment and decision making due to effects on perceptions of portion size and people's lay theories of consumption. Specifically, we predict that portions described with fine-grained labels will be perceived as larger or weightier than portions described with gross-grained labels. Additionally, because people's lay theory about consumption is that they should eat until they are satiated, and external cues are a signal of that satiation (Chandon, 2009), people should intend to eat less of foods described with fine-grained descriptors than gross grained descriptors. Specifically, if fine-grained descriptors make portions seem larger or more calorically dense, people should need less to be satiated.

If portion size granularity is indeed changing perceptions of size, and thus, satiety, it stands to reason that these shifts, in turn, may facilitate regulation of consumption. This hypothesis is derived from work highlighting that self-regulation can be facilitated as a function of goal size and proximity to completion. For instance, prior work on subgoals suggests that breaking larger goals into smaller component goals facilitates self-regulation (Carver & Scheier, 1998; Emmons, 1992; Locke & Latham, 1990; Vallacher & Wegner, 1987). Furthermore, proximity to a desired end-state facilitates persistence toward the target (Bandura & Schunk, 1981)—in the context of food consumption, the target being to satisfy one's hunger. Whether or not these self-regulatory strategies are likely to be effective, however, may depend on individual differences, such as whether or not one is currently facing a self-regulatory struggle. Indeed, prior research documents that self-regulatory resources are more likely to be recruited when a self-regulatory struggle emerges (Kross & Ayduck, 2009; Kross, Gard, Deldin, Clifton, & Ayduk, 2012; Oyserman, 2015). Thus, individuals who are motivated to reduce food consumption (e.g., dieters) might be particularly sensitive to portion-size granularity, especially if granularity facilitates self-regulation. One reason why losing weight is hard is because reducing food consumption, although a viable pathway (McFerran & Mukhopadhyay, 2013), requires self-regulation (Baumeister & Heatherton, 1996), in particular reduced consumption of calorically dense foods (i.e., junk food; Klem, Wing, McGuire, Seagle, & Hill, 1997). Thus, one possibility is that granularity of portion size might be particularly effective at reducing food consumption for individuals with a weight loss goal. Furthermore, because a regulatory struggle is more likely to emerge for dieters in the face of calorically dense foods, consumption of these foods in particular may be more impacted by changes in self-regulation.

Finally, to the extent that people's intentions predict their behavior (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; for reviews see Nisson & Earl, in press; Sheppard, Hartwick, & Warshaw, 1988), changes in consumption intentions resulting from changes in the granularity of portion size descriptors should also influence the amount that people actually consume. However, the intentions-behavior link includes documented decay (Webb & Sheeran, 2006). As such, the effect of granularity on behavior may be attenuated compared with the effect of granularity on intentions. These possibilities, however, have not yet been tested. The present research aims to address this gap in the literature. Our goal is to test whether a small change, such as reframing portion size units, can influence food consumption by influencing people's consumption intentions. We hypothesize that this process operates by changing people's perceptions of portion size, which in turn, facilitates self-regulation.

Current Studies

The University of Michigan Institutional Review Board Health Sciences and Behavioral Sciences determined that all studies in this paper were exempt from IRB Oversight (HUM 00077560). In the current studies we test four core hypotheses derived from our consideration of fine-grained versus gross-grained portion size framing. First, people thinking about portions described with fine-grained labels will have reduced consumption intentions compared with people thinking about food described with gross-grained labels. Second, changes in consumption intentions will produce changes in food consumption. Third, people thinking about portions described with fine-grained labels ("x pieces") will estimate that the food is larger (contains more calories, weighs more, costs more, will take longer to eat) than people thinking about portions described with gross-grained labels ("one serving"). We refer to this as the *perceptual hypothesis* for the effects of granularity on consumption intentions. However, we also examine if the effects of granularity on consumption intentions may be driven by shifts in construal level, referred to as the *construal hypothesis*. In particular, the construal hypothesis would suggest that fine-grained versus gross-grained labels may differentially influence the level at which we process information (abstract to concrete). Indeed, prior research on construal level theory (Trope & Liberman, 2010) would predict that fine-grained descriptors would be processed more concretely, whereas gross-grained descriptors would be processed more abstractly, and that level of construal could influence judgments and behavior. For instance, labeling food as "one serving" may activate an abstract level of construal, whereby participants may eat less food because consumption is easier to regulate than when food is labeled at a concrete level "16 pieces" (Fujita & Roberts, 2010). Finally, we investigate if portion size granularity impacts consumption intentions by facilitating self-regulation. We approach this question in two ways. First, we measure self-reported self-regulation to see if granularity impacts perceptions of one's ability to control consumption. Second, to verify the impact of granularity on self-regulation, we manipulated of self-regulation by shifting people's interpretation of difficulty (Oyserman, 2015). Theoretically, if granularity is impacting self-regulation, the impact of the interpretation of difficulty manipulation should be diminished after the fine-grained, but not the gross-grained granularity manipulation. Finally, we test for a direct effect of granularity on consumption. We test these hypotheses across three field experiments, three online experimental surveys, and one laboratory experiment.

Study 1: Fine-Grained Portion Size Labels Decrease Consumption Intentions

Method

Sample and procedure. Our goal in the first study was to test the hypothesis that presenting people with fine-grained (x pieces) rather than gross-grained (one serving) portion size labels would decrease their food consumption intentions. To test this prediction, undergraduate research assistants approached adults (N = 80; 50% male; ages 18–53, M = 20.54, SD = 5.10) in public areas around the University of Michigan campus and asked them if they were willing to participate in a taste test of tortilla chips. Our goal was to obtain approximately 40 participants per condition in order to ensure that our cell sizes were above the minimum recommended by Simmons, Nelson, and Simonsohn (2011). To fit the cover story of a taste test, participants were first given a "pretasting survey" on which they reported on measures of ostensible interest including: their current level of hunger, when was the last time they ate, what types of snacks they typically consume, on average how many full meals do they usually eat each day, on average how many snacks do they usually eat each day, and what times during the day they usually snack. We were not actually interested in these responses—the questions were asked merely to fit the cover story; nevertheless, the exact measures are included in the online supplemental materials for interested readers.

After completing the pretasting survey, participants were randomly assigned to one of two tasting conditions. In both conditions, participants were given a Ziploc® bag with 11 tortilla chips; this value was selected based on the recommended serving size provided by the manufacturer. In the fine-grained (gross-grained) condition, participants were told "*Here are 11 chips (one serving of chips); you can eat as much as you want, and after you're done eating, there is just one very brief survey for you. Just let me know when you're done eating.*"

Post-taste test questionnaire. After participants finished tasting, they filled out a brief "post-tasting survey" on which they answered our dependent measures of interest as well as other filler items. The main dependent measures are as follows.

Consumption intentions. To test the effect of information granularity on consumption intentions, participants were asked "How many servings (pieces) of these chips would you need to eat in order to feel satisfied? _____ serving(s)/piece(s)" and "How many servings (pieces) of these chips would you likely eat in one sitting? _____ serving(s)/piece(s); $\alpha = .66$.

Additional measures. In addition to our core measures of interest, to fit the cover story of a taste test, we also asked participants other questions about the chips they just tasted. This includes asking participants "Do you think you've had these chips before? (Y/N); How tasty are the chips you just sampled? (1= *not at all*, 7 = *extremely*); How enjoyable was eating the chips? (1= *not at all*; 7= *extremely*; How likely are you to buy these chips? (1= *not at all*, 7= e*xtremely*); and How many calories do you think are in each serving (each piece) of these chips? ____ calories per serving/per chip." Finally, we asked participants about demographic characteristics including their age and gender, whether or not they are currently trying to modify their weight (either gain or lose), and whether or not they have ever tried to modify their weight (either gain or lose). These additional measures could serve as potential individual differences that could moderate effects of granularity on consumption intentions. We test for this possibility in our analyses.

Analytic strategy. First, to create common metrics for analysis of the dependent measures, responses were transformed to their gross-grained equivalents (one serving). That is, participant responses from the fine-grained (x pieces) condition were converted to gross-grained units (e.g., consumption intentions for each chip were multiplied by 11 to arrive at the per serving estimate).

Second, we examined the distribution of the dependent variable (consumption intentions) to ensure it met the normality and homogeneity of variance assumptions for our planned analytic strategy—analysis of variance (ANOVA). We found the distribution to be positively (right) skewed (consumption intentions: $skewness = 2.94$, $SE = .27$, $kurtosis = 11.75$, $SE = .54$) and thus we transformed it to the natural logarithm scale to achieve normal distributions for analysis. Means are presented in the original units for ease of interpretation.

Third, we checked to verify that randomization was successful in eliminating demographic differences across conditions. Randomization was successful in eliminating differences in age ($p = .95$), gender ($p = .92$), and weight loss goal ($p = .16$).

Results and Discussion

Fine-grained portion size labels reduce consumption intentions. ANOVA revealed the predicted main effect of portion size granularity on consumption intentions $F(1, 73) = 16.54$, $p < .001$, $\eta_p^2 = .19$. Participants who were given a fine-grained label "11 tortilla chips" intended to eat less food ($M = 0.85$ servings, $SD = 1.12$, $n = 40$) than participants who were given a gross-grained label "one serving of tortilla chips" ($M = 1.67$ servings, $SD = 1.13$, $n = 37$).

Moderation by individual differences. In addition to testing for the predicted main effect of granularity on consumption intentions, we conducted supplemental analyses to determine whether or not the additional measures collected (e.g., food attitude ratings and demographics) moderated the main effect.[1] The only significant moderator to emerge from these analyses was the extent to which participants found the chips appetitive (granularity by appetitive rating interaction), $F(1, 63) = 7.04$, $p = 0.01$, $\eta_p^2 = .10$. The effect of the granularity manipulation was largest for those who did not find the chips appetitive (i.e., 1 *SD* below the mean on appetitive rating, mean difference = 1.11, $p < .001$), moderate for those who found the chips moderately appetitive (i.e., mean on appetitive rating, mean difference = 0.65, $p = .001$), and nonsignificant for those who found the chips to be highly appetitive (i.e., 1 *SD* above the mean on appetitive rating, mean difference = 0.18, $p = 0.45$). This result was unpredicted, and thus we will not overinterpret it.

Results thus far demonstrate that overall, the granularity of labels used to describe quantities of food has a large (Cohen, 1988) effect on the amount of food people plan to consume, but that this effect varies by at least one individual difference. More specifically, holding the quantity of food constant, participants who were give "11 tortilla chips" planned to eat substantially (49.1%) fewer chips in one sitting than participants given "one serving of tortilla chips," and this was particularly true for those who did not find the chips to be particularly appetitive, or found them to be moderately appetitive; granularity had no impact on those who found the chips to be highly appetitive. These findings support the predicted effect of fine-grained portion size labels on consumption intentions, and revealed an interesting individual difference that moderates that effect.

Prior research on the relation between attitudes and behavior has documented that a very strong predictor of people's behavior is their behavioral intentions (for reviews, see Glasman & Albarracin, 2006; Nisson & Earl, in press; Sheppard, Hartwick, & Warshaw, 1988). That is, one way to predict how people will behave is to ask what they intend to do. In Study 1 we found that having people consider portion sizes with fine-grained labels detailing the precise quantity of food in front of them led people to shift their intentions toward eating less food. Given this finding and the prior literature on the intention to behavior link, we next wondered whether this shift in consumption intentions may actually influence actual consumption behavior. Taking the results of Study 1 and prior research on intentions-behavior consistency into account (Webb & Sheeran, 2006), we predict a mediated effect of fine-

[1] We thank an anonymous reviewer for proposing these supplemental analyses.

grained portion size labeling on food consumption such that participants asked to consider portion sizes with fine-grained labels will intend to eat less food, and actually eat less food than participants asked to consider "one serving" of food. We test this proposed process model in Studies 2a and 2b.

Studies 2a and 2b: Does the Impact of Portion Size Granularity on Consumption Intentions Translate to Actual Consumption?

Method

Sample and procedure. Studies 2a and 2b follow procedures nearly identical to Study 1. Undergraduate research assistants approached adults (Study 2a: $N = 79$; 46.8% male; ages 18–52, $M = 21.37$, $SD = 5.21$; Study 2b: $N = 79$; 50.6% male; ages 18–38, $M = 21.27$, $SD = 3.34$) in public areas around the University of Michigan campus and asked them if they were willing to participate in a taste test of gummy candies (Study 2a) or rice cakes (Study 2b). We selected a variety of food options to ensure that any results would generalize across a variety of dimensions including savory and sweet, as well as healthy and unhealthy. Participants were first given the same "pretasting survey" from Study 1. After completing the pretasting survey, participants were randomly assigned to one of two tasting conditions. In both conditions, participants were given a Ziploc® bag with 15 gummy candies (Study 2a), or nine mini rice cakes (Study 2b); the values were selected based on the recommended serving size of the food provided by the manufacturers. In the fine-grained (gross-grained) framing condition participants were told "Here are fifteen gummy candies/ nine rice cakes (one serving of gummy candies/rice cakes); you can eat as much as you want, and after you're done eating, there is just one very brief survey for you. Just let me know when you're done eating." In addition to the measures used in Study 1, in Studies 2a and 2b, the number of items consumed during the taste test was recorded by a research assistant as a measure of consumption.

Post-taste test questionnaire. After participants finished tasting, they filled out a brief "post-tasting survey" on which they answered our dependent measures of interest as well as other filler items. The main dependent measures are as follows.

Consumption intentions. To test the effect of information granularity on consumption intentions, participants were asked "How many servings (pieces) of these [gummy candies/rice cakes] would you need to eat in order to feel satisfied? ____serving(s)/ piece(s)" and "How many servings (pieces) of these [gummy candies/rice cakes] would you likely eat in one sitting? ___serving(s)/ piece(s)" (Study 2a, $\alpha = .73$; Study 2b, $\alpha = .80$).

Consumption. To test the effect of portion size granularity on consumption, at the end of the study, research assistants documented how many pieces of food participants consumed.

Additional measures. In addition to our core measures of interest, as in Study 1, to fit the cover story of a taste test, we also asked participants other questions about the gummy candies and rice cakes they just tasted, in addition to other process variables that could test alternative hypotheses. This included asking participants parallel questions from Study 1: "Do you think you've had these gummy candies/rice cakes before? (Y/N); How tasty are the gummy candies/rice cakes you just sampled? (1= *not at all*, 7 = *extremely*); How enjoyable was eating the gummy candies/rice cakes? (1= *not at all*; 7= *extremely*); How likely are you to buy these gummy candies/rice cakes? (1= *not at all*, 7= *extremely*); and How many calories do you think are in each serving (each piece) of these gummy candies/rice cakes? ____calories per serving/per gummy candy/rice cake." Furthermore, to account for other individual differences participants also answered Wansink, Painter, and North's (2005) consumption monitoring questions, and two questions to assess participants' motivation to regulate their consumption. We measured two components of regulation—initiating consumption: "How easy would it be to eat (15, nine, one serving) of these [gummy candies, rice cakes]? (1= *not at all*, 7 = *very easy*)" and inhibiting consumption: "How difficult would it be to eat *only* (15, nine, one serving) of these [gummy candies, rice cakes]? (1= *not at all*, 7 = *very difficult*)." Finally, we asked participants about demographic characteristics including their age and gender, whether or not they are currently trying to modify their weight (either gain or lose), and whether or not they have ever tried to modify their weight (either gain or lose). We tested the possibility that these variables moderate effects of granularity on consumption intentions and consumption.

Analytic strategy. First, as in Study 1, to create common metrics for analysis of the critical dependent measures, responses were transformed to their gross-grained equivalents (one serving).

Second, for ease of interpretation and comparison across studies, the behavioral measure (food consumption) was standardized to the percent participants ate of what they could have eaten (i.e., [amount eaten/amount possible] $\times$ 100); in other words, a participant who ate five of the 15 gummy candies/nine mini rice cakes would have amount eaten percentages of 33% or 56%, respectively.

Third, we examined the distribution of each measured variable (consumption intentions, consumption) to ensure they met the normality and homogeneity of variance assumptions for our planned analytic strategy—analysis of variance (ANOVA). We found the distributions of each of these variables in both studies to be positively (right) skewed (Study 2a consumption intentions: $skewness = 8.17$, $SE = .27$, $kurtosis = 69.69$, $SE = .54$; Study 2a consumption: $skewness = 3.75$, $SE = .27$, $kurtosis = 16.32$, $SE = .54$; Study 2b consumption intentions: $skewness = 2.37$, $SE = .27$, $kurtosis = 7.46$, $SE = .54$; Study 2b consumption: $skewness = 3.46$, $SE = .27$, $kurtosis = 15.51$, $SE = .54$) and thus, we transformed them to the natural logarithm scale to achieve normal distributions for analysis.

Fourth, we checked to verify that randomization was successful in eliminating demographic differences across conditions. In Study 2a, randomization was successful in eliminating differences in age ($p = .15$) and weight loss goal ($p = .23$), but was unsuccessful in eliminating gender differences, $\chi^2(1, N = 79) = 4.56$, $p = .033$—there were substantially more women than men in the gross-grained servings condition (65% vs. 35%, respectively) and substantially more men than women in the fine-grained pieces condition (59% vs. 41%, respectively). We will control for gender in the main analyses in Study 2a. In Study 2b, randomization was successful in eliminating differences in gender ($p = .58$) and weight loss goal ($p = .81$), but was unsuccessful in eliminating differences in age ($p = .017$)—participants in the gross-grained servings condition were an average of 2 years older ($M = 22.12$ years old, $SD = 3.80$, $n = 41$) than participants in the fine-grained pieces condition ($M = 20.34$ years old, $SD = 38$, $n = 38$). We will control for age in the main analyses in Study 2b.

Results and Discussion

Replicating consumption intentions effect. To verify that the consumption intentions effect found in Study 1 replicated, we tested the effects of fine-grained versus gross-grained portion size framing on consumption intentions using ANOVA. Replicating Study 1, controlling for gender ($p = .16$), participants in Study 2a who received "15 gummy candies" reported intentions to eat fewer gummy candies ($M = 0.55$ servings, $SD = 1.13$, $n = 38$) than participants who were given "one serving of gummy candies" ($M = 1.47$ servings, $SD = 1.12$, $n = 40$) $F(1, 75) = 33.53$, $p < .001$, $\eta_p^2 = .31$. The same patterns replicated in Study 2b. Controlling for age ($p = .60$), participants who received "nine mini rice cakes" reported intentions to eat fewer rice cakes in one sitting ($M = 0.41$ servings, $SD = 1.11$, $n = 36$) than participants who were given "one serving of mini rice cakes" ($M = 1.34$ servings, $SD = 1.10$, $n = 41$) $F(1, 74) = 65.74$, $p < .001$, $\eta_p^2 = .47$.

Moderation by individual differences. In addition to testing for the predicted main effect of granularity on consumption intentions, we conducted supplemental analyses to determine whether or not the additional measures collected (e.g., food attitude ratings, and demographics) moderated the main effect. For gummy candies (Study 2a), the significant moderators that emerged from these analyses were Wansink et al.'s (2005) consumption monitoring index (granularity by consumption monitoring interaction $p = .019$) and our measure of consumption inhibition—how difficult participants thought it would be to eat *only* 15 gummy candies (granularity by consumption inhibition interaction $p = .02$). These interactions revealed the following patterns of results. First, the effect of granularity on consumption intentions was stronger for those who closely monitor their consumption (i.e., 1 *SD* above the mean on consumption intentions, mean difference $= 1.37$, $p < .001$) than for those who do not closely monitor their consumption (i.e., 1 *SD* below the mean on consumption intentions, mean difference $= .59$, $p = .014$). Second, the effect of granularity on consumption intentions was stronger for participants who found it more difficult to inhibit their consumption of gummy candies (i.e., 1 *SD* above the mean on consumption inhibition, mean difference $= .96$, $p < .001$) than for participants who found it easier to inhibit their consumption (i.e., 1 *SD* below the mean on consumption inhibition, mean difference $= .73$, $p = .002$). For mini rice cakes (Study 2b), the only significant moderator to emerge was the measure of consumption initiation—how easy participants thought it would be to eat nine rice cakes in one sitting (granularity by consumption initiation interaction $p = .001$). This interaction revealed that the effect of granularity on consumption intentions was stronger for participants who found it easier to initiate consumption of rice cakes (i.e., 1 *SD* above the mean on consumption initiation, mean difference $= 1.07$, $p < .001$) than for participants who found it difficult to initiate consumption (i.e., 1 *SD* below the mean on consumption initiation, mean difference $= 0.83$, $p < .001$). Taken together, these findings provide preliminary evidence that the effects of the granularity manipulation on consumption intentions are exacerbated when participants are focused on food consumption. In particular, increased consumption monitoring, as well as difficulty stopping intake of unhealthy foods, and ease of initiating consumption of healthy foods all facilitate the effects of the granularity manipulation on consumption intentions.

Results thus far have replicated the effects of portion size granularity on consumption intentions, demonstrating that the effect of fine-grained portion size labels reduce the amount of food people intend to consume across three different food types (tortilla chips, gummy candies, and mini rice cakes). In addition, supplemental analyses revealed that the size of the effect varies by the interaction of individual differences in consumption monitoring, self-regulation, and food type. Specifically, when participants were in a situation in which they were tasting highly appetitive (gummy candy, $M_{\text{Appetizing Rating}} = 4.85$, $SD = 1.19$) unhealthy food (gummy candy, $M_{\text{Health Rating}} = 2.36$, $SD = 1.23$), the effect of granularity on consumption intentions was moderated by the extent to which participants monitor their consumption and are motivated to resist/inhibit consumption of that food. On the other hand, when participants were in a situation in which they were tasting unappetitive (rice cakes, $M_{\text{Appetizing Rating}} = 3.68$, $SD = 1.33$) healthy food (rice cakes, $M_{\text{Health Rating}} = 5.22$, $SD = 1.21$), the effect of granularity on consumption intentions was moderated by their motivation to begin/initiate consumption of that food.

Consumption intentions mediate effects of portion size granularity on consumption. The following analyses tests the proposed mediational pathway examining the effects of portion size granularity on actual consumption via consumption intentions. In these analyses, granularity (fine-grained vs. gross-grained) is the independent variable, food consumption (percent of food eaten) is the dependent variable, and consumption intentions is the mediator. To have sufficient statistical power to detect a mediated effect, we pooled responses from Studies 2a and 2b for the mediation analysis. For these analyses we used PROCESS for SPSS v2.13.2 Model 4 with 10,000 bootstrap samples (Hayes, 2013).

Before presenting results of the mediation analyses, we feel it is important to acknowledge that there was not a significant direct effect of granularity on consumption in the current studies (Study 2a servings: $M = 19.5\%$, $SD = 20.11$, $n = 40$; pieces: $M = 17.95\%$, $SD = 10.61$, $n = 39$; $p = .72$; Study 2b servings: $M = 12.26\%$, $SD = 5.52$, $n = 41$; pieces: $M = 11.99\%$, $SD = 5.85$, $n = 38$; $p = 0.98$), though the patterns are in the predicted direction (those presented with fine-grained labels consumed less than those presented with gross-grained labels). Readers familiar with the Baron and Kenny (1986) tradition of mediation model testing may wonder why then, in the absence of direct effects, we would continue to test for mediation because there are "no effects to be mediated." Our rationale is guided by (a) theories of behavior change and (b) modern theories and empirical evidence of necessary conditions for mediation analysis.

First, given the large body of research suggesting that many factors combine to influence behavior (i.e., theory of planned behavior and theory of reasoned action, for a recent review, see Nisson & Earl, in press) we would not expect such a small change (labeling a portion "one serving" vs. "x pieces") to have a large direct effect on behavior. In fact, the dominant psychological models of behavior change, most notably the theories of reasoned action and planned behavior, have consistently demonstrated that there are many individual level and situational factors that combine to influence behavior. Systematic and meta-analytic reviews of that research show that it is rare for one to get a direct effect on behavior that is not mediated by factors such as people's subjective perceptions and intentions (Ajzen, 1985; Nisson & Earl, in press; Sheppard et al., 1988). Furthermore, the link between intentions and behavior often decays (Webb & Sheeran, 2006). Thus, the null direct effect of granularity on behavior found in the current study is consistent with prior research on behavior change. We might only expect an indirect effect on behavior through prior documented pathways such as intentions (in this case, food consumption intentions). However, one possible limitation is that the current studies were underpowered to detect a small behavioral effect. To address this issue, we propose an adequately powered study to examine the direct link between granularity and food consumption in Study 6.

Second, modern theoretical and empirical work on mediation model testing has demonstrated that the Baron and Kenny (1986) rule of thumb claiming that mediation is only possible and thus should only be tested after finding a direct effect is more of a myth than a statistical truth (see Hayes, 2009, 2013; Preacher & Hayes, 2008; Zhao, Lynch, & Chen, 2010). For a variety of reasons, explained most clearly by Zhao et al. (2010), the sole criterion of mediation is documentation of an indirect effect; if such an indirect effect is found, that provides evidence in support of mediation, even in the absence of a direct effect. For these theoretical and empirical reasons, we proceeded to test our predicted mediational pathways.

Mediation analyses support the predicted pathway from granularity to consumption via consumption intentions as evidenced by the bias corrected 95% confidence interval for the indirect effects excluding zero (95% CI [−.1361, −.0129]; see Figure 1 for point estimates from the mediation model). Participants presented with fine-grained portion size labels intended to eat less food, and did in fact eat less than participants presented with gross-grained portion size labels. These results demonstrate that although the granularity of portion size labels may not have a direct effect on consumption, granularity does indirectly influence consumption by *nudging* people to eat less (fine-grained labels) or more (gross-grained labels) food. That is, the granularity of portion size labels changes people's intentions to consume. Those intentions then guide people's behavior, consistent with prior research on behavior change (Nisson & Earl, in press). One alternative possibility is that the direct effect exists, but we did not have sufficient statistical power to detect it. We test for this possibility in Study 6.

Study 3: Investigating Mechanisms by Which Granularity Influences Consumption Judgments

What is the mechanism by which granularity triggers this cascade that leads to consumption behavior change? Considering findings from prior research on informational granularity (e.g., Lewis & Oyserman, 2015; Zhang & Schwarz, 2012, 2013), two processes seem plausible, but have not yet been tested in previous studies on granularity. On one hand, the granularity of labels used to describe objects (food in this case) could influence our perceptions of the size of objects similarly to how other situational factors influence perceptions of size (e.g., Draw a Quarter Study; Bruner & Goodman, 1947). We propose these potential differences in size perception as a *perceptual hypothesis* which may explain the current granularity effects.

On the other hand, a *construal hypothesis* would suggest that fine-grained versus gross-grained labels may differentially influence the level at which we process information (abstract to concrete). Specifically, in contrast to the perceptual hypothesis, changing portion size descriptions may influence consumption by operating through shifts in psychological distance (Trope & Liberman, 2010). Either process—perceptual or construal—could plausibly explain variance in the granularity effects found in these (and potentially other) studies, but research to date has not directly tested these possibilities. The goal of Study 3 is to address this gap in the literature, and explain the underlying psychological mechanism driving the present granularity effects.

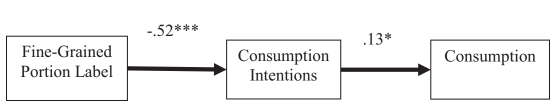

Figure 1. Studies 2a and 2b. Mediation model depicting the process by which portion size granularity influences consumption intentions. Coefficients are unstandardized regression coefficients from the PROCESS model. * $p < .05$. *** $p < .001$.

Pilot Testing

To test the perceptual hypothesis, we created and piloted a measure to capture the construct "food size." For this measure, participants evaluated several intentionally disparate metrics that seemed related to the construct (i.e., weight, consumption time, cost, price, and calorie estimates). We chose a variety of size metrics to increase the validity of our construct. This would give us confidence in the measure, as prior research demonstrates that multiple measures are a more valid approach to measuring latent constructs than using single items (Fabrigar, MacDonald, & Wegener, 2005; Schwarz & Oyserman, 2001).

To test whether these metrics all indeed capture the same underlying construct, we recruited 81 participants from Amazon's Mechanical Turk to view images of gummy candies and baby carrots and make several estimates of food size by answering the following questions: "How much do you think these gummy candies [baby carrots]? weigh ___ oz.; How much would you pay for these gummy candies [baby carrots]? $___; How long would it take you to finish eating these gummy candies [baby carrots]? ___ minute(s); How much do you think these gummy candies [baby carrots] cost? $___; and How many calories do you think are in each serving [piece] of these gummy candies [baby carrots]?" We conducted a reliability analysis on the responses to these questions, which confirmed that these items did measure the same underlying construct as evidenced by a high level of internal reliability (Cronbach's alpha = .78). This gave us confidence that these items could be combined to create an index of food size, which could serve as a measure to test the perceptual hypothesis in Study 3.

Method

Sample and procedure. To test whether the effects of granularity documented in the first three studies operate by changing perceptions of food size or levels of construal, we recruited adults ($N = 200$; 52.5% male, ages 19–69 $M = 32.4$, $SD = 9.03$) from Amazon's Mechanical Turk to take a "snack rating survey." Participants viewed images containing 16 gummy candies in a 2 (Fine-Grained, Gross-Grained) × 2 (Construal First, Construal Last) between-subjects randomized factorial design. All participants saw the same images, but in the fine-grained condition, the images were labeled "16 Gummy Candies" whereas in the gross-grained condition, the images were labeled "One Serving of Gummy Candies." The order of the construal measure was also manipulated such that half of the participants saw their image of gummy candies (with either a fine or gross-grained label) then immediately filled out the construal measure, whereas the other half saw their image and answered questions about the image then later completed the construal measure. This order was manipulated as our second factor to ensure that failure to find a construal effect could not be attributed to the measure being too far away from the prime (Kanten, 2011; Maglio & Trope, 2011).

To test the perceptual hypothesis, participants answered the same questions described above in the pilot: "How much do you think these gummy candies weigh? ___ oz.; How much would you pay for these gummy candies? $___; How long would it take you to finish eating these gummy candies? ___minute(s); How much do you think these gummy candies cost? $___; and How many calories do you think are in each serving [piece] of these gummy candies?" These questions again formed a reliable index of food size (Cronbach's alpha = .64).

To test the construal hypothesis, participants completed the Behavioral Identification Form (BIF; Vallacher & Wegner, 1989). The BIF is a 25-item scale designed to distinguish between two types of construals of different behaviors. Low-level construals emphasize how to do the action, the means of achieving the action, and the details of the action whereas high-level construals emphasize why the action is performed, the motives behind the action, and the meaning of the action. For example, "making a list" could be construed as writing things down (low level construal) or as getting organized (high level construal). The sum of the high-level construal choices serves as the measure of construal, with higher sums indicating high level of construal and lower sums indicating low level of construal. Participants always completed the BIF after the granularity manipulation, and either before or after answering questions about the food image.

Participants also answered the consumption intentions questions ("how many servings/pieces of these gummy candies would you need to eat in order to feel satisfied; how many servings/pieces of these gummy candies would you likely eat in one sitting"; $\alpha = .82$) that were asked in the first three studies. Finally, participants answered demographic questions.

Analytic strategy. First, to create common metrics for analysis of the dependent measures, we transformed responses to their gross-grained equivalents (one serving), consistent with the prior three studies. That is, we converted participant responses from the fine-grained (x pieces) conditions to gross-grained units (e.g., consumption intentions for each gummy candy were multiplied by 16 to arrive at the per serving estimate).

Second, we examined the distribution of each variable to ensure that they met the normality and homogeneity of variance assumption for our planned analytic strategy (ANOVAs and mediation model testing). We found the distributions of each variable to be positively (right) skewed (perceived weight: *skewness* = 6.64, *SE* = .17, *kurtosis* = 65.87, *SE* = .35; willingness to pay: *skewness* = 7.26, *SE* = .17, *kurtosis* = 63.59, *SE* = .34; estimated time to consume: *skewness* = 14.04, *SE* = .17, *kurtosis* = 197.90, *SE* = .34; perceived cost: *skewness* = 12.32, *SE* = .17, *kurtosis* = 163.16, *SE* = .34; perceived calories: *skewness* = 6.43, *SE* = .17, *kurtosis* = 47.38, *SE* = .34; consumption intentions: *skewness* = 3.06, *SE* = .17, *kurtosis* = 11.69, *SE* = .34) and thus we transformed them to the natural logarithm scale to achieve normal distributions for analysis.

Third, we checked and found that patterns are consistent with or without demographic controls, thus for the interest of parsimony, we exclude demographic controls from the main analyses presented. Results with controls are presented in the online supplemental materials for interested readers.

Results and Discussion

Replicating consumption intentions effect. To verify that the consumption intentions effects found in the first three studies replicated in this new sample, we tested the effects of fine-grained versus gross-grained portion size framing on consumption intentions using ANOVA. Replicating the first three studies, participants who saw the image of gummy candies with the label "16 Gummy Candies" reported intentions to eat fewer gummy candies ($M = 0.74$ servings, $SD = 1.93$, $n = 100$) than participants who saw the same image with the label "One Serving of Gummy Candies" ($M = 2.05$ servings, $SD = 1.84$, $n = 100$) $F(1, 196) = 125.72$, $p < .001$, $\eta_p^2 = .39$. There was no effect of the order in which participants answered questions ($p = .47$), nor did order interact with granularity ($p = .99$). Given that this effect replicated from the prior studies, we next tested the effects of granularity on the proposed mediators—perceived food size and level of construal.

Fine-grained portion size labels increase perceived food size. ANOVA revealed the predicted main effect of portion size granularity on perceived food size, $F(1, 196) = 14.67$, $p < .001$, $\eta_p^2 = .07$. Participants who saw the image of gummy candies with the label "16 Gummy Candies" perceived it to be larger than participants who saw the same image with the label "One Serving of Gummy Candies" (see Figure 2). Perceived size was not influenced by the order in which participants answered questions ($p = .65$), nor did order interact with granularity to influence perceived size ($p = .71$). These results suggest that seeing food with fine-grained portion size labels leads people to perceive the food as larger—to see it as weighing more, taking longer to consume, costing more, being a higher price, and being more calorie dense than seeing the same food with gross-grained labels. This implies that changes in perceived size could plausibly mediate effects of granularity on consumption intentions. What about construal?

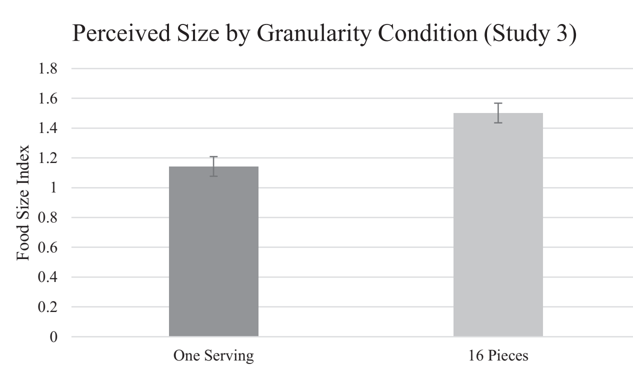

Figure 2. Perceived food size by granularity condition. Dark gray bars indicate the gross-grained "serving" condition in each study whereas light gray bars indicate the fine-grained "pieces" condition. Error bars indicate plus and minus one standard error of the mean.

Granularity does not change level of construal. ANOVA revealed that portion size granularity had no effect on participants' level of construal ($p = .78$). Question order also did not influence construal ($p = .56$), nor did the interaction between granularity and question order ($p = .31$).[2]

Mediation model testing: Perceived size mediates effects of granularity on consumption intentions. Results thus far replicated the effects of granularity on consumption intentions, and documented that granularity also influences perceived food size, but not level of construal. To test whether changes in perceived food size mediate the effects of granularity on consumption intentions, we conducted a mediation analysis using PROCESS for SPSS v2.13.2 Model 4 with 10,000 bootstrap samples (Hayes, 2013). In this analysis, portion size granularity was the independent variable, perceived size was the mediator, and consumption intentions was the dependent variable. Mediation analysis revealed that perceived food size mediated the effects of portion size granularity on consumption intentions as evidenced by the bias corrected 95% CI excluding zero [−.0663, −.0034]. As illustrated in Figure 3, seeing the fine-grained portion size label ("16 Gummy Candies") rather than gross-grained label ("One Serving of Gummy Candies") made people perceive the portion as larger. Because the fine-grained portion was perceived to be larger, participants intended to eat less of it.

Interim Discussion: Studies 1–3

Findings across the studies presented thus far document that the granularity of labels used to describe portion sizes influences people's consumption intentions and behavior by changing their perceptions of the size of the portion. Using fine-grained rather than gross-grained portion size labels leads people to perceive portions as larger, lowers their consumption intentions, and ultimately their consumption. These findings contribute to our basic understanding of the influence of information granularity on judgment and behavior (e.g., Lewis & Oyserman, 2015; Zhang & Schwarz, 2012, 2013) by highlighting a novel mechanism by which granularity effects can operate—by changing the perception of the size of objects.

One thing that remains unclear however is the utility of these findings for application. We began this article by discussing the obesity epidemic (CDC, 2011; NIH, 1998) and the need for understanding how cues like information granularity may contribute to it, yet our results thus far have made no statements about the connection between granularity and obesity. This is because we first needed to understand the basic relationship between portion size granularity and consumption and the underlying process that explains that connection. Having documented that process in the initial studies, we can now focus on the connection between granularity and obesity by examining the relationship between granularity and obesity related processes such as the self-regulation of consumption.

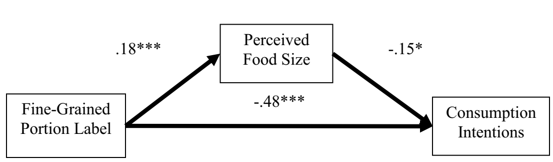

Figure 3. Study 3. Mediation model depicting the process by which portion size granularity influences consumption intentions. Coefficients are unstandardized regression coefficients from the PROCESS model. * $p < .05$. *** $p < .001$.

Studies 4 and 5: The Impact of Granularity on Self-Regulation

A large body of research suggests that struggles related to self-regulation are a major contributor to overeating and obesity (Baumeister & Heatherton, 1996; Graziano, Calkins, & Keane, 2010; Israel, Guile, Baker, & Silverman, 1994; Stroebe, 2008). That is, one reason people eat too much unhealthy food and become obese is that they struggle with inhibiting their consumption; once they start eating hedonic unhealthy food, it is difficult to stop (Wing & Pelan, 2005). This pattern of behavior occurs even for those who are motivated to lose weight (Stroebe, 2008). We wondered whether granularity may play a role in this self-regulatory process. Specifically, we were curious as to whether changing the granularity of portion size labels may change dieters' motivation to regulate their consumption, and whether such a shift in motivation might actually help individuals reduce their consumption of unhealthy foods.

Why would this occur? In their prior studies on the effects of temporal granularity on saving for long term goals, Lewis and Oyserman (2015) found that when people thought about the future in fine-grained time metrics (e.g., days), they planned to start saving for future events sooner (Studies 3–5) and discounted the future less (Study 7) than when people thought about the future in gross-grained time metrics (e.g., years). Planning and temporal discounting are suggestive of self-regulatory processes (Duckworth & Seligman, 2005), however, a pathway from granularity to behavior as a function of self-regulation has not yet been tested.

In the food domain, unhealthy packaged food often comes with labels that highlight the nutrition facts for "one serving" of food (U.S. Food & Drug Administration, 2014); that is, the default way of packaging unhealthy foods is to use labels with gross-grained portion size information. Given the findings of our initial studies documenting effects of granularity on consumption, the default gross-grained labeling of portion sizes, the findings by Lewis and Oyserman (2015) that gross-grained labels make it more difficult for people to plan, and the findings by obesity researchers that self-regulation is a major struggle in the fight against obesity, we next sought to investigate the links between these factors to understand what role portion size granularity may play in the obesity epidemic. Based on prior research examining self-regulation, we would expect that self-regulation should only be required under conditions of regulatory struggle (Kross & Ayduck, 2009; Kross et al., 2012; Oyserman, 2015). For this investigation, we sought to examine the influences of granularity in the context of a regulatory struggle (e.g., the presence of calorically dense foods) with the most relevant population (e.g., individuals who are currently trying to lose weight). For Studies 4 and 5, we recruited participants with current weight loss goals to test the granularity-to-self regulation pathways. In Study 4, we measured the regulatory pathway whereas in Study 5 we

[2] If we analyze instead as a repeated-measures ANOVA, we find essentially the same thing. Although the omnibus interaction between the measure (BIF, food size) and granularity is nonsignificant ($p = 0.93$), the simple effects replicate the findings reported. Granularity has an effect on perceived food size ($p = .004$) but not on level of construal ($p = .60$).

manipulated self-regulation to test the causal link between granularity and self-regulation.

Study 4: Fine-Grained Portion Size Labels Facilitate Self-Regulation

Method

Sample and procedure. We recruited adults with weight loss goals ($N = 160$, 52% male, age range 18–71, $M = 32.23$, $SD = 10.84$) from Amazon's Mechanical Turk to take a "snack rating survey." After screening to ensure that participants were currently trying to lose weight, we randomly assigned participants to one of two rating conditions (fine-grained, gross-grained). All participants saw and rated images of 16 gummy candies and 16 baby carrots (order was counterbalanced) but the labels of those images varied depending on condition. Consistent with the prior studies, participants in the fine-grained condition saw the images with the labels "16 Gummy Candies" and "16 Baby Carrots" whereas participants in the gross-grained condition saw the images with the labels "One Serving of Gummy Candies" and "One Serving of Baby Carrots." After viewing the images, participants answered the questions detailed next.

One concern may be that because the platform is set up to complete tasks, Mechanical Turk participants often complete multiple tasks and hence can be "non-naïve" participants, who have already completed similar studies and received debriefing feedback. This can alter results, usually by suppressing effect sizes (Chandler, Mueller, & Paolacci, 2014; Chandler, Paolacci, Peer, Mueller, & Ratliff, in press). Capture-recapture analysis suggests that the effective size of the active Mechanical Turk population that a typical laboratory can access is about 7,300 and it takes about 7 months for half of workers to leave the Mechanical Turk pool and be replaced by new ones (Stewart et al., 2015). This means that if researchers are not careful, they could end up sampling the same participants over and over, diminishing their data quality. To avoid this problem, we use Mechanical Turk's built in "qualification" system to restrict participants from completing related studies. For the current case, that means that each participant could only have completed one of the four studies that make up the pooled dataset (pilot to Study 3, as well as Studies 3–5), because all four contained the same granularity manipulation. For more details on how to employ this screening method, see Paolacci, Chandler, and Ipeirotis (2010).

To test the effects of information granularity on self-regulation, participants were asked "How difficult would it be to eat only one serving (16 pieces) of gummy candies/ baby carrots?" on 1 (*not at all difficult*) to 7 (*very difficult*) scales.

Participants also answered the same consumption intentions ("How many servings/pieces of these gummy candies/baby carrots would you need to eat in order to feel satisfied; how many servings/pieces of these gummy candies/baby carrots would you likely eat in one sitting"), and demographic questions that were asked in the prior studies.

Analytic strategy. First, to create common metrics for analysis of the dependent measures, we transformed relevant responses (consumption intentions) from the fine-grained (x pieces) conditions to gross-grained units (e.g., consumption intentions for each gummy candy were multiplied by 16 to arrive at the per serving estimate).

Second, we examined the distribution of each variable to ensure that they met the normality and homogeneity of variance assumption for our planned analytic strategy (ANOVA and mediation model testing). Consistent with the prior studies, consumption intentions were positively skewed (consumption intentions—gummy candies: *skewness* = 12.60, $SE = .19$, *kurtosis* = 159.78, $SE = .38$; consumption intentions—baby carrots: *skewness* = 12.35, $SE = .19$, *kurtosis* = 154.57, $SE = .38$) and thus we transformed it to the natural logarithm scale to achieve normal distributions for analysis.

Third, we checked to verify that randomization was successful in eliminating demographic differences across conditions. Randomization was successful in eliminating differences in age ($p = .43$), gender ($p = .43$), education ($p = .28$), income ($p = .69$), and race ($p = .08$).

Fourth, we checked and found that patterns were consistent with or without demographic controls, and thus for the interest of parsimony we exclude demographic controls from the main analyses presented. Results with controls are presented in the online supplemental materials for interested readers.

Finally, in a check at the end of the survey, six participants indicated that they were either not currently trying to modify their weight or were trying to gain weight. We excluded them from our analysis and thus our final $n = 154$.

Results and Discussion

Replicating consumption intentions effect. To verify that the consumption intentions effects found in the initial studies replicated with this new population of dieters, we tested the effects of fine-grained versus gross-grained portion size framing on consumption intentions using ANOVA. Replicating the earlier studies, for both gummy candies, $F(1, 152) = 25.02$, $p < .001$, $\eta_p^2 = .14$; and baby carrots, $F(1, 152) = 56.74$, $p < .001$, $\eta_p^2 = .19$, participants who saw images of the foods with fine-grained labels reported intentions to eat less ($M_{\text{Gummy Candies}} = 1.67$ servings, $SD = 1.06$, $n = 76$; $M_{\text{Carrots}} = 1.59$ servings, $SD = 1.04$, $n = 76$) than participants who saw the same images with gross-grained labels ($M_{\text{Gummy Candies}} = 2.49$ servings, $SD = 1.06$, $n = 78$; $M_{\text{Carrots}} = 2.43$ servings, $SD = 1.04$, $n = 78$).

For dieters, granularity facilitates inhibiting consumption of unhealthy, but not healthy, food. To test the self-regulation hypothesis, we used ANOVA to assess the effects of portion size granularity on the regulation of both unhealthy (gummy candies) and healthy (baby carrots) food for people with weight loss goals. The first ANOVA revealed a main effect of granularity on regulation of unhealthy (gummy) food consumption, $F(1, 152) = 6.05$, $p = .015$, $\eta_p^2 = .04$, whereby participants found it easier (less difficult) to eat *only* 16 pieces of gummy candies (fine-grained) than to eat *only* one serving of gummy candies (gross-grained), despite those being the same amount. No such effect was revealed in the second ANOVA which tested the same effect with baby carrots ($p = .12$).

Mediation model testing: Self-regulation mediates effects of granularity on consumption intentions. Results thus far have replicated the effects of granularity on consumption intentions for both the healthy and unhealthy food, and documented that granularity also influences self-regulation for unhealthy (but not healthy) food. To test whether changes in self-regulation mediate effects of granularity on intentions to consume unhealthy food (gummy candies), we conducted a mediation analysis using PROCESS for SPSS v 2.13.2 Model 4 with 10,000 bootstrap samples (Hayes, 2013). In this analysis, portion size granularity was the independent variable, self-regulation was the mediator, and consumption intentions was the dependent variable. Mediation analysis revealed that self-regulation mediated the effect of portion size granularity on consumption intention of unhealthy food as evidenced by the bias corrected 95% CI excluding zero [−.0747, −.0074]. We did not test for the indirect effect for the healthy food (carrots) because the granularity manipulation had no effect of our proposed mediator of self-regulation for the healthy food.

Seeing the fine-grained ("16 gummy candies") rather than gross-grained ("one serving of gummy candies") portion size label made it easier for participants to inhibit their consumption of the unhealthy food, and thus they intended to eat less of it. These results provide preliminary evidence that in addition to changing people's perceptions of portion sizes (Study 3), another process by which granularity may impact consumption is by enabling individuals to better regulate their consumption behavior. To verify that granularity does in fact interact with self-regulation in this way, we decided to conduct another experiment in which we manipulate (rather than measure) self-regulation directly to obtain causal evidence for the granularity-to-regulation link.

Study 5: Fine-Grained Portion Size Labels Eliminate the Need for Additional Consumption Regulation Strategies

Method

Another way of examining mediation, in addition to the correlation measures presented in Study 4, is to directly manipulate the proposed mediator (Spencer, Zanna, & Fong, 2005). In Study 5, we manipulated self-regulation by changing participants' interpretation of experienced difficulty. Interpretations of experienced difficulty (as importance or impossibility) are mindsets that can be shifted to promote or undermine persistence toward desired end states (Lewis & Oyserman, 2016; Oyserman, 2015; Smith & Oyserman, 2015). Experimentally guiding (priming) people to interpret difficulty as importance has been shown to enhance self-regulatory behaviors, increasing persistence toward difficult goals (Aelenei, Lewis, & Oyserman, 2017), whereas guiding people to interpret difficulty as impossibility does the opposite—it undermines persistence (Smith & Oyserman, 2015). In line with previous work on interpretation of difficulty, the effect of the manipulation should only be observable under conditions of regulatory struggle (Oyserman, 2015). That is, to the extent that the granularity manipulation is facilitating self-regulation, the impact of the interpretation of difficulty manipulation should be weakened or nonsignificant. If, however, portion size granularity is not facilitating self-regulation, the impact of the interpretation of difficulty manipulation should be equivalent across both fine-grained and gross-grained conditions.

Sample and procedure. We recruited adults with weight loss goals ($N = 300$, 54.7% male, age range 18–74, $M = 34.13$, $SD = 11.66$) from Amazon's Mechanical Turk to take a "snack rating survey." After screening to ensure that participants were currently trying to lose weight, we randomly assigned participants to view and rate images of 16 gummy candies in one of six conditions in a 3 (Difficulty Means Importance, Difficulty Means Impossibility, Control) × 2 (Fine-grained, Gross-Grained) between-subjects factorial design.

Self-regulation was manipulated by priming people to interpret difficulty in one of two ways (or control; Aelenei et al., 2017; Oyserman, Novin, Smith, Elmore, & Nurra, 2016; Smith & Oyserman, 2015). To prime interpretation of difficulty, participants rated their agreement with four statements on scales from 1 (*strongly disagree*) to 7 (*strongly agree*). In the difficulty means importance condition, participants rated their agreement with the following four statements: "Some weight loss tasks feel easy and some feel difficult. My gut tells me that if it feels difficult, it is important for me; I know in my gut that if a weight loss task feels difficult it is really important for me; I know that weight loss tasks that feel difficult are the important ones for me; A feeling of difficulty means that it's probably important." In the difficulty means impossibility condition, participants rated their agreement with the following four statements: "Some weight loss tasks feel easy and some feel difficult. My gut tells me that if it feels difficult, it is impossible for me; I know in my gut that if a weight loss task feels difficult it is not possible for me; I know that weight loss tasks that feel difficult are the impossible ones for me; A feeling of difficulty means that it's probably impossible." Participants in the control condition rated their agreement with four statements unrelated to interpretation of difficulty: "I think breakfast is an important meal; I like to eat a hot meal on a cold day; Eating a balanced diet should be easy to do; The saying 'early to bed, early to rise, makes a person healthy, wealthy, and wise' is a good way to live my life."

After being primed with their respective interpretations of difficulty (or control), participants were then randomly assigned to view and rate images of 16 gummy candies presented with either fine-grained ("16 gummy candies") or gross-grained ("one serving of gummy candies") labels, consistent with the prior studies. After viewing the images, participants answered the same perceived satiety and consumption intentions questions asked in the prior studies.

Analytic strategy. First, to create common metrics for analysis of the dependent measures, we transformed responses from the fine-grained (x pieces) conditions to gross-grained units consistent with the prior studies.

Second, we examined the distribution of each variable to ensure that they met the normality and homogeneity of variance assumption for our planned analytic strategy (ANOVA). Consistent with the prior studies, perceived satiety and consumption intentions were positively skewed and thus we transformed them to the natural logarithm scale to achieve normal distributions for analysis.

Third, we checked to verify that randomization was successful in eliminating demographic differences across conditions. Randomization was successful in eliminating differences in age ($p = .07$), gender ($p = .81$), and body mass index ($p = .14$).

Fourth, we checked and found that patterns were consistent with or without demographic controls, and thus in the interest of parsimony we excluded demographic controls from the main analyses presented. Results with controls are presented in the online supplemental materials for interested readers.

Finally, in a check at the end of the survey three participants indicated that they were currently trying to gain weight. We excluded them from our analysis and thus our final $n = 297$.

Results and Discussion

If our hypothesis that granularity facilitates self-regulation is correct, we should only find effects of interpretation of difficulty under conditions of a regulatory struggle—in the gross-grained condition. That is precisely what we found. Interpretation of difficulty influenced consumption intentions when participants were presented with a gross-grained label, $F(2, 291) = 5.88$, $p = .003$, $\eta_p^2 = .04$, but not when participants were presented with a fine-grained label ($p = .89$). Conversely, effects of granularity were significant at all levels of interpretation of difficulty—difficulty means impossibility, $F(1, 291) = 42.17$, $p < .001$, $\eta_p^2 = .13$; difficulty means importance, $F(1, 291) = 11.78$, $p = .001$, $\eta_p^2 = .04$; control, $F(1, 291) = 44.31$, $p < .001$, $\eta_p^2 = .13$. These findings provide causal evidence demonstrating that granularity facilitates self-regulation in the presence of a regulatory struggle.

Internal Minimeta Analysis of Studies 1–5

In five studies, we measured the impact of granularity on intentions to consume food during a taste test ($n = 892$). Furthermore, we measured the impact of granularity on consumption in two studies ($n = 158$). To examine the aggregate effects of granularity on both intentions and behavior, we conducted a minimeta analysis of the first five studies. To examine change in consumption intentions and consumption as a function of granularity, we calculated weighted mean effect sizes (d). Weighted mean effect sizes provide an estimate of the magnitude of change on a given outcome, and were calculated by subtracting gross- from fine-grained labels, and dividing by the pooled standard deviation. For d, effect size magnitude of 0.20, 0.50, and 0.80 correspond to small, medium, and large effect sizes, respectively (Cohen, 1988). In addition, mean effect sizes were corrected for sample-size bias using Hedges and Olkin's (1985) procedures, which were then used to calculate weighted mean effect sizes. Results of this mini meta-analysis suggest that the effect of granularity on intentions is a quite large effect ($d = 1.11$; $n = 892$). In contrast, the effect of granularity on behavior is a quite small effect ($d = .04$; $n = 158$).

Study 6: Registered Report

Thus far, we have documented a reliable and robust effect of granularity on consumption intentions, as well as a mediated effect of granularity on consumption via consumption intentions. In addition, we have demonstrated that granularity operates by shifting perceptions of food size, which in turn impacts consumption intentions. Furthermore, granularity facilitates self-regulation for dieters facing a regulatory struggle. However, two remaining questions are whether granularity directly impacts consumption, and whether these effects vary by subgroups of the population. As such, Study 6 was designed to be adequately powered to detect a small behavior effect, and to test whether such an effect is moderated by individual or group level differences. In this way, Study 6 will test if granularity directly impacts consumption, or if the effects of granularity operate indirectly by shifting consumption intentions.

Pilot

Preliminary tests of the hypothesis that granularity directly impacts consumption were underpowered to detect the observed small effect. From these studies (2a and 2b), the average effect size on behavior was $d = .04$. To address this issue, we conducted a pilot study of 64 community members located in downtown Ann Arbor, Michigan, to estimate the effect size of the granularity manipulation on consumption using a better powered repeated-measures design. Adding an additional measure of consumption with a different food (gummy candies and baby carrots) as a within-subjects factor reduced variance in the estimation of consumption. Results of this pilot study provide an estimate of the direct effect of the granularity manipulation on consumption as $d = .23$, which would be classified as a small effect using Cohen's (1988) guidelines, and slightly smaller than the average finding within social and personality psychology (overall $r = .21$; Richard, Bond, & Stokes-Zoota, 2003). It is important to note that this estimated effect size with the two-level repeated measures design ($d = .23$) could be inflated due to the relatively small sample ($n = 64$) in the pilot. Indeed, there is a body of research suggesting that early studies give (on average) inflated estimates of effects (for review, see Ioannidis, 2008). However, the reduction in variance in the estimation of consumption and increased power from taking a within-subjects approach is consistent with prior literature, including prior research on granularity (Lewis & Oyserman, 2015; Studies 1–2). Therefore, in Study 6 we will take a within-subjects approach with a sufficiently large sample to detect a direct effect on granularity.

Study 6 Registered Report: Does Portion Size Granularity Directly Affect Consumption?

Method

Sample and procedure. Study 6 followed procedures nearly identical to Studies 2a and 2b with five key differences. First, enough participants were recruited to sufficiently power a test of the direct effect of granularity on consumption (see registered report supplement for a more detailed peer-reviewed power analysis and sample size determination). Three-hundred and 23 adults (31.3% male, age range 18–76 $M = 34.62$, $SD = 16.66$) were recruited from the University of Michigan's UM Health Research Portal. The UM Health Research pool consists of community participants from across Southeastern Michigan who are willing to participate in research studies for monetary compensation; the current study paid participants $10 for a 30-min session. Recruiting community participants through this portal allows us to test whether our findings generalize to a more diverse sample.

The second change was to include six food options (carrots, gummies, potato chips, plain M&Ms, roasted and salted almonds, and seedless green grapes) as a six-level repeated measures factor. These are foods that prior consumption research has shown have sufficient variability in consumption intentions and consumption (see Studies 1–5 of the current article; also, Nisson & Earl, in press).

Third, because of the changes in recruitment procedures, participants did not complete the "taste test" outdoors in public areas, but instead completed the study in a psychology laboratory on campus at the University of Michigan. This procedural change allowed the research assistant to leave the room while the participant is completing the "taste test," to minimize the impact of impression management concerns on consumption.

Finally, additional measures were included to assess whether effects on granularity on consumption might be mediated or moderated by other factors not previously considered in the prior studies (e.g., individual differences in food addition, trait impulsivity).

After completing informed consent, participants were given the same "pretasting survey" from Studies 1, 2a, and 2b. After completing the pretasting survey, participants were randomly assigned to one of two tasting conditions. In both conditions, participants were given a tray with six styrofoam bowls, each containing one of the six foods (gummy candies, baby carrots, seedless green grapes, roasted and salted almonds, potato chips, and chocolate candies); the values were selected based on the recommended serving size of the food provided by the manufacturers. In the fine-grained (gross-grained) framing condition participants were told via computer instructions "Here are 15 gummy candies/16 baby carrots/32 seedless green grapes/28 roasted and salted almonds/fifteen potato chips/20 chocolate candies (one serving of gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies); you can eat as much as you want, and after you're done eating, there is just one very brief survey for you. Just let me know when you're done eating." The order in which participants were instructed to taste the foods was randomized.

Post-taste test questionnaire. After participants finished tasting, they filled out brief "post-tasting surveys" on which they answered our dependent measures of interest as well as other potential mechanism and filler items. The main dependent measures are as follows.

Consumption intentions. To test the effect of information granularity on consumption intentions, participants were asked "How many servings (pieces) of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies] would you need to eat in order to feel satisfied? ____ serving(s)/piece(s) and "How many servings (pieces) of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies] would you likely eat in one sitting? ___ serving(s)/piece(s).

Consumption. To test the effect of portion size granularity on consumption, at the end of the study research assistants documented how many pieces of food participants consumed, as well as the number of grams of food consumed, measured with a food scale. Finally, total caloric consumption was assessed by multiplying the weight of each of the foods consumed by the caloric content of the food. Caloric content was sourced from packaging provided by the manufacturer in the case of processed foods (gummy candies, roasted and salted almonds, potato chip, chocolate candies) or from the USDA in the case of unprocessed foods (baby carrots, seedless green grapes). The calories per gram estimates used for each of the foods was the following: gummy candies, 3.59; baby carrots, 0.35; seedless green grapes, 0.69; roasted and salted almonds, 6.07; potato chips, 5.71; chocolate candies, 4.76.

Additional measures. In addition to our core measures of interest, as in Studies 1, 2a, and 2b, to fit the cover story of a taste test, we asked participants other questions about the foods they just tasted, in addition to other process variables that could test alternative hypotheses. This included asking participants parallel questions from earlier studies: "Do you think you've had these gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies before? (Y/N); How tasty are the gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies you just sampled (1= *not at all*, 7 = *extremely*); How enjoyable was eating the gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies (1= *not at all*; 7= *extremely*; "How much do you think these gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies weigh?___ oz.; How much would you pay for gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies? $___; How long would it take you to finish eating these gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies? ___minute(s); How much do you think these gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies cost $___; and How many calories do you think are in each serving [piece] of these gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies?" Furthermore, to account for other individual differences participants also answered Wansink, Painter, and North's (2005) consumption monitoring questions, and two questions to assess participants' motivation to regulate their consumption. We measured two components of regulation—initiating consumption: "How easy would it be to eat (15, 16, 32, 28, 15, 20, one serving) of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies]? (1= *not at all*, 7 = *very easy*)" and inhibiting consumption: "How difficult would it be to eat *only* (15, 16, 32, 28, 15, 20, one serving) of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies]? (1= *not at all*, 7 = *very difficult*)."

Additionally, we further explored the direct consumption-to-behavior link by including additional items that may affect this relation. In particular, to account for differences in impression management concern and identity congruence, we asked participants "While completing the taste test, how concerned were you that someone would judge how much you ate" (1 = *not at all*, 7 = *extremely*), as well as "How many of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies] should someone like you eat in one sitting?" Furthermore, we assessed other factors known to affect food consumption directly, including mood, food addiction, and impulsivity (Christensen, 1993; Gearhardt, Corbin, & Brownell, 2009; Nasser, Gluck, & Geliebter, 2004). Specifically, we asked participants to report how happy/sad/tired/bored/angry they are (1 = *not at all*, 7 = *extremely*), as well as to complete the Yale Food Addiction Scale (Gearhardt et al., 2009) and the Barratt Impulsivity Scale (Barratt, Patton, & Stanford, 1975).

Finally, we asked participants about demographic characteristics including their age, body mass index, and gender, whether or not they are currently trying to modify their weight (either gain or lose), and whether or not they have ever tried to modify their weight (either gain or lose). We test the possibility that these variables moderate the effects of granularity on consumption intentions and consumption.

Analytic strategy. First, as in Studies 1, 2a, and 2b, to create common metrics for analysis of the critical dependent measures, responses were transformed to their gross-grained equivalents (one serving).

Second, for ease of interpretation and comparison across studies, the behavioral measure (food consumption) were standardized to the percent participants ate of what they could have eaten (i.e., [amount eaten/amount possible] × 100); in other words, a participant who ate five of the 15 gummy candies/sixteen baby carrots will have amount eaten percentages of 33% or 31%, respectively.

Third, we examined the distribution of each measured variable (consumption intentions, consumption) to ensure they meet the normality and homogeneity of variance assumptions for our planned analytic strategy—analysis of variance (ANOVA). Consistent with the prior studies, consumption intentions were positively skewed and thus we transformed them to the natural logarithm scale to achieve normal distributions for analysis. However, consistent with the prior studies, results are reported in original units (i.e., back-translated by taking the exponential) for ease of interpretation.

Fourth, we checked and found that randomization was successful in eliminating demographic differences across conditions (age, $p = .48$; gender, $p = .27$).

Predicted Results and Discussion

Replicating consumption intentions effect. To verify that the consumption intentions effects found in the initial studies replicated with this new population of community participants, we tested the effects of fine-grained versus gross-grained portion size framing on consumption intentions using Repeated-Measures Analysis of variance (RM-ANOVA), with granularity as a two-level between subjects factor and food type as a six-level within subjects factor. Replicating the earlier studies, participants who saw foods with fine-grained labels reported intentions to eat less ($M = 0.64$ servings, 95% CI [0.58, 0.71]) than participants who saw the same foods with gross-grained labels ($M = 1.72$ servings, 95% CI [1.55, 1.92]), $F(1, 266) = 175.23$, $p < .001$, $\eta_p^2 = .40$. In addition, there was an effect of food type, such that participants reported greater intentions to eat some foods over others, $F(5, 266) = 65.58$, $p < .001$, $\eta_p^2 = .20$. Finally, there was an interaction between the granularity manipulation and food type, $F(5, 266) = 4.39$, $p = .001$, $\eta_p^2 = .02$, suggesting the effect of the granularity manipulation on intentions was stronger for some foods than others. Specifically, in order from largest to smallest difference, granularity reduced consumption intentions by 1.28 servings for grapes, 1.25 for almonds, .97 for gummy candies, .96 for carrots, .75 for chocolate candies, and .71 for chips. Overall, granularity strongly influenced participants' intentions, but the strength of the effect of granularity varied by food type, consistent with prior research suggesting that granularity has heterogeneous effects on judgment (Lewis & Oyserman, 2015).

Moderation by individual differences. In addition to testing for the predicted main effect of granularity on consumption intentions, we conducted supplemental analyses to determine whether the additional measures collected moderated the main effect of granularity on consumption intentions. The only significant moderator of consumption intentions was our measure of consumption initiation from the previous studies in this article: "How easy would it be to eat (15, 16, 32, 28, 15, 20, one serving) of these [gummy candies/baby carrots/seedless green grapes/roasted and salted almonds/potato chips/chocolate candies]? (1= *not at all*, 7 = *very easy*)" (granularity by consumption initiation interaction $p = .001$). The effect of granularity on consumption intentions was stronger for participants who found it difficult to initiate consumption (i.e., 1 *SD* below the mean on consumption initiation, mean difference = .1.08, $p < .001$) than for participants who found it moderately difficult (i.e., at the mean on consumption initiation, mean difference = .89, $p < .001$) or participants who found it easy to initiate consumption (i.e., 1 *SD* above the mean on consumption initiation, mean difference = .70, $p < .001$).

Test of direct effect of granularity on consumption. We next tested for a direct effect of fine-grained versus gross-grained portion size framing on consumption using RM-ANOVA, with granularity as a two-level between subjects factor and food type as a six-level within subjects factor. Granularity had no direct effect on consumption ($p = .69$), nor did granularity interact with food type to directly influence consumption ($p = .55$).

Replicating mediation of granularity on consumption via perception and consumption intentions. We also tested for replication of the mediated effect of granularity on consumption via consumption intentions, and simultaneously tested the parallel mediated effect of granularity on consumption via shifts in perceptions (the prior study with perceptual measures—Study 3—could only assess effects of perception on intentions, but not actual behavior). In these analyses, granularity (fine-grained vs. gross-grained) was the independent variable, food consumption (percent of food eaten) was the dependent variable, and consumption intentions was the mediator. For this analysis we used PROCESS for SPSS v2.16.3 Model 4 with 10,000 bootstrap samples (Hayes, 2013). Mediation analysis revealed that, controlling for participant level of hunger, perceived food size (95% CI [−.0125, −.001]) and consumption intentions (95% CI [−.0507, −.0077]) mediated the effects of portion size granularity on consumption. This indirect effect on consumption replicates when using calories consumed rather than percent of food consumed as the dependent measure of consumption (mediation via perception: 95% CI [−1.2056, −.0224]; mediation via intentions 95% CI [−6.7476, −1.7923]; see Figures 4 and 5). It is also worth noting that these processes remain significant when controlling for individual differences in consumption monitoring, impulsivity, or food addiction. Seeing the fine-grained portion size labels (e.g., "16 Gummy Candies") rather

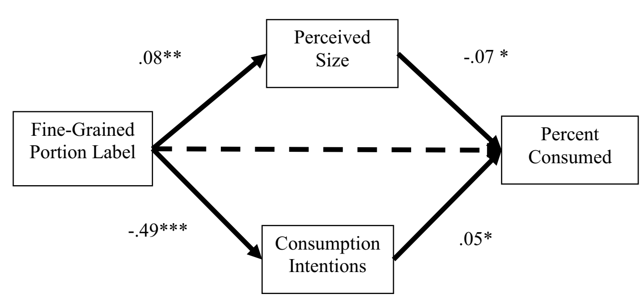

Figure 4. Study 6. Mediation model depicting the process by which portion size granularity influences consumption. Coefficients are unstandardized regression coefficients from the PROCESS model. * $p < .05$. ** $p < .01$. *** $p < .001$.

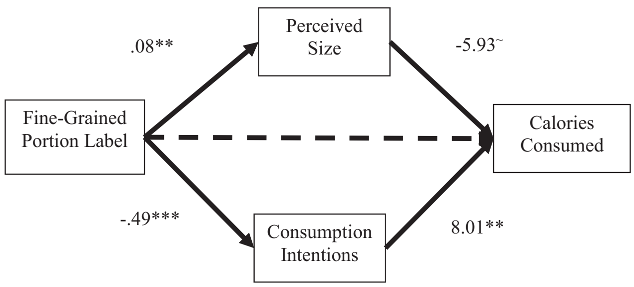

Figure 5. Study 6. Mediation model depicting the process by which portion size granularity influences consumption. Coefficients are unstandardized regression coefficients from the PROCESS model. $\sim p = .066$. $^{*} p < .05$. $^{**} p < .01$. $^{***} p < .001$.

than gross-grained labels (e.g., "One Serving of Gummy Candies") led people to both perceive the foods as larger and reduce intentions to eat, and these processes in turn decreased food consumption overall.

General Discussion

Across six studies and seven different food items, we find a robust and reliable effect of portion size granularity labels on consumption intentions and food consumption. Having people think about food using fine-grained labels leads them to decrease their consumption intentions (all studies) and ultimately eat less food (Studies 2a,2b, 6). Further, this process operates by shifting perceptions of the size of foods whereby portions described with fine-grained labels are perceived to be bigger than portions described as with the gross-grained label "one serving" (Studies 3 and 6). Finally, granularity facilitates self-regulation of consumption, particularly when self-regulation would be most beneficial (e.g., individuals facing a regulatory struggle; Studies 4–5).

As a society, we have a vested interest in improving the health and well-being of the population, and one approach to achieving this goal is to pay close attention to how much food we consume. Prior research has meta-analytically demonstrated that portion size contributes substantially to our consumption (Zlatevska et al., 2014), and suggests that our tendency to mindlessly eat (Wansink, 2006) exacerbates a growing problem of overeating that can result in obesity (CDC, 2011; NIH, 1998). We wondered what could be done to combat this problem, taking these well documented consumption biases into account. The possibility we focused on is that the consumption process can be influenced by the granularity of labels used to describe the quantity of food present in a portion, because these labels provide heuristic cues or *nudges* (Thaler & Sunstein, 2008) that could influence consumption via consumption intentions. These predictions were developed by integrating prior research on Grician conversational logic (Schwarz, 1996; Zhang & Schwarz, 2012), effects of situational forces on perception (Bruner & Goodman, 1947), and granularity effects on judgment, motivation and behavior (Lewis & Oyserman, 2015; Zhang & Schwarz, 2013).

Implications for Theory

This work contributes to a growing body of research on informational granularity, a literature demonstrating that the units used to represent information have important implications for people's judgments and behaviors (Lewis & Oyserman, 2015; Zhang & Schwarz, 2012, 2013), and operates by capitalizing on the inferences people make from the details present in information they receive (Bless & Schwarz, 2010; Higgins, 1998; Schwarz, 1996, 2011). The current studies contribute a novel mechanism by which granularity effects can operate—by changing perceptions of the size of judgment objects. Although much past work had demonstrated the existence of granularity effects, to our knowledge, this is the first work to examine shifts in perception as a mechanism for understanding why the effects occur. We also tested whether granularity operates by shifting individuals' level of construal (Trope & Liberman, 2010). However, the current studies provide no support for the construal hypothesis as an explanation for the cascading effects of granularity on consumption intentions and consumption. Additionally, the current data contributes to the granularity literature by generalizing effects to another domain (health decision making), suggesting the pattern of effects found in this literature are evidence of a domain-general psychological process by which information influences motivation and behavior.

The present research also contributes to the literature on self-regulation, suggesting that the effects of granularity are not monolithic. In contrast, the self-regulatory benefits of granularity are more likely to emerge for individuals under conditions of a regulatory struggle. This pattern is consistent with prior work on the activation of self-regulatory strategies (Kross & Ayduck, 2009; Kross et al., 2012; Oyserman, 2015; Oyserman et al., 2017). In addition, portion size granularity contributes to a growing body of literature that demonstrates an interaction between individual differences and contextual cues to regulate food consumption (Stroebe, 2008; Thomas, Desai, & Seenivasan, 2011; Vartanian, Kernan, & Wansink, 2016). We hope that portion size granularity can be one way in which small changes can have cascading effects on behavior (Resnicow & Page, 2008), ultimately contributing to improved health.

The results can also contribute to the goals and motivation literatures. In these studies, the impact of the situational granularity manipulation was exacerbated for individuals who were more motivated to attend to food stimuli. This finding is consistent with prior literature on the interaction of dispositional and situational cues on behavior (Hart & Albarracin, 2011; Lewin, 1935), and suggests that individual differences in susceptibility to environmental cues are modulated by goal relevance (Higgins, 1998). Furthermore, goals might change the meaning people ascribe to granularity. This differential susceptibility may change the threshold of perception of the situational cue as a signal of relevance. In line with work on Gricean norms, this relevance in turn, may modulate the impact of the situational cue of granularity on judgments and behavior (Schwarz, 2014).

Further, these results build on prior theories of effective interventions—specifically identity-based motivation theory (for reviews, Lewis & Oyserman, 2016; Oyserman, 2015; Oyserman & Lewis, 2017; Oyserman, Lewis, et al., 2017). Identity-based motivation theory posits that people are willing to act in goal consistent ways if the goal-relevant information facilitates action (Lewis & Oyserman, 2016; Oyserman, Lewis, et al., 2017). This implies that generally bringing information to mind is not enough; considering the right kind of information—information that people can easily translate into action—is more likely to result in behavior change. The current results reinforce this pattern of findings; across all studies, information about self-regulation implied that one has control over how much food he or she consumes when considering the precise quantity of food present, and considering this information did indeed influence consumption.

Implications for Practice

This work also has important implications for health practitioners. Given the current obesity epidemic, perhaps one way to invoke a desired change in consumption might be to give people fine-grained information about how much to consume, at least for unhealthy foods. For these foods, it might be beneficial to highlight for consumers the concrete number they should consume—11 chips or 15 gummy candies. Our data suggests this should decrease consumption of those unhealthy foods. On the other hand, it may be fruitful to do the opposite for healthy foods that people struggle to begin eating. For these, our data suggest it may be best to describe the portions in gross-grained units, for example, as one serving of rice cakes, or one serving of baby carrots. Describing healthy food in terms of servings versus pieces may decrease perceived size, which may, in turn, increase consumption of those healthier foods by making it easier to initiate consumption. Future work should investigate this possibility.

Replicability and Constraints on Generalizability

Before closing, we want to take a moment to discuss the strength of the evidence for the various effects and processes examined in this paper by considering the extent to which findings replicated. Our hope is that this discussion might be useful for future researchers and practitioners who may wish to extend this work. First, the strongest and most replicable effect from this work is the effect of granularity on consumption intentions; in all studies, fine-grained portion size metrics decreased consumption intentions. Second, in all three studies that contained behavioral measures of consumption (including the preregistered report, Study 6), we found an indirect effect of granularity on consumption via changes in consumption intentions; in none of those studies did we find a direct effect on consumption. Third, in the two studies that measured perception of food size (Studies 3 and 6), granularity had a direct effect on perceived size whereby participants perceived food to be larger when presented with fine-grained rather than gross-grained labels. In one case, this shift in perception mediated changes in consumption intentions (Study 3) and in another case it mediated effects on consumption behavior (Study 6 registered report). Finally, the finding that seem most context and sample dependent is the effect of granularity on self-regulation. Here it seems that granularity facilitates self-regulation, but only for dieters facing a regulatory struggle (i.e., faced with unhealthy, but not healthy, food); outside of those samples and contexts, the effects of granularity on self-regulation are less clear.

With respect to generalizability, we feel that it is important to highlight the limits of the current research (see also Simons, Shoda, & Lindsay, 2017). What we currently know is that when people presented with food with fine-grained rather than gross-grained portion size labels, they intend to, and as a result, actually, eat less. Those patterns replicate across university students (Studies 1, 2a, 2b), adults on Mechanical Turk (Studies 3–5), and a community sample (Study 6), and in short outdoor field studies (Studies 1, 2a, 2b), online (Studies 3–5), and laboratory settings (Study 6). Given those findings, we expect our results to generalize to those populations in similar contexts. What we do not yet know, which is a limitation for practical application, is whether a granularity intervention would be effective for sustained (intention to) behavior change in more applied settings like cafeterias and dining halls. From the data we have gathered thus far, it seems plausible that providing fine-grained portion labels could lead to decreased consumption of unhealthy foods, and providing gross-grained portion size labels could lead to increased consumption of healthy foods in those settings. However, it is also plausible that such an intervention could have immediate effect, but then fade once the novelty of those frames dissipates. As such, before deploying granularity interventions into more applied settings, we strongly recommend conducting (preregistered) randomized control trials in field (e.g., cafeteria or dining hall) settings to test the efficacy of such interventions, as well as the necessary conditions for the intervention to scale effectively for broader dissemination (see also Horowitz, Sorensen, Yoder, & Oyserman, 2017; Turnwald, Boles, & Crum, 2017).

References

Aelenei, C., Lewis, N. A., Jr., & Oyserman, D. (2017). No pain, no gain? Social demographic correlates and identity consequences of interpreting experienced difficulty as importance. *Contemporary Educational Psychology, 48,* 43–55. http://dx.doi.org/10.1016/j.cedpsych.2016.08.004

Ajzen, I. (1985). *From intentions to actions: A theory of planned behavior*. Berlin, Germany: Springer Berlin Heidelberg.

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A., & Schunk, D. H. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41,* 586–598. http://dx.doi.org/10.1037/0022-3514.41.3.586

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182. http://dx.doi.org/10.1037/0022-3514.51.6.1173

Barratt, E. S., Patton, J., & Stanford, M. (1975). *Barratt impulsiveness scale*. Austin, TX: University of Texas.

Baumeister, R. F., & Heatherton, T. F. (1996). Self-regulation failure: An overview. *Psychological Inquiry, 7,* 1–15. http://dx.doi.org/10.1207/s15327965pli0701_1

Bless, H., & Schwarz, N. (2010). Mental construal and the emergence of assimilation and contrast effects. *Advances in Experimental Social Psychology, 42,* 319–373. http://dx.doi.org/10.1016/S0065-2601(10)42006-7

Bruner, J. S., & Goodman, C. C. (1947). Value and need as organizing factors in perception. *Journal of Abnormal Psychology, 42,* 33–44. http://dx.doi.org/10.1037/h0058484

Burson, K. A., Larrick, R. P., & Lynch, J. G. (2009). Six of one, half dozen of the other: Expanding and contracting numerical dimensions produces preference reversals. *Psychological Science, 20,* 1074–1078.

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139174794

Centers for Disease Control and Prevention. (2011). *The obesity epidemic*. Retrieved from http://www.cdc.gov/cdctv/ObesityEpidemic/

Chandler, J., Mueller, P., & Paolacci, G. (2014). Nonnaïveté among Amazon Mechanical Turk workers: Consequences and solutions for behavioral researchers. *Behavior Research Methods, 46,* 112–130. http://dx.doi.org/10.3758/s13428-013-0365-7

Chandler, J., Paolacci, G., Peer, E., Mueller, P., & Ratliff, K. (in press). Non-naïve participants can reduce effect sizes. *Psychological Science*.

Chandon, P. (2009). Estimating food quantity. In A. Krishna (Ed.), *Sensory marketing: Research on the sensuality of products* (pp. 323–343). New York, NY: Routledge.

Chandon, P., & Wansink, B. (2011). Is food marketing making us fat? A multi-disciplinary review. *Foundations and Trends in Marketing, 5,* 113–196. http://dx.doi.org/10.1561/1700000016

Cheema, A., & Soman, D. (2008). The effect of partitions on controlling consumption. *Journal of Marketing Research, 45,* 665–675. http://dx.doi.org/10.1509/jmkr.45.6.665

Christensen, L. (1993). Effects of eating behavior on mood: A review of the literature. *International Journal of Eating Disorders, 14,* 171–183. http://dx.doi.org/10.1002/1098-108X(199309)14:2<171::AID-EAT2260140207>3.0.CO;2-U

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences,* 2nd ed. Hillsdale, NJ: Erlbaum.

Duckworth, A. L., & Seligman, M. E. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science, 16,* 939–944. http://dx.doi.org/10.1111/j.1467-9280.2005.01641.x

Emmons, R. A. (1992). Abstract versus concrete goals: Personal striving level, physical illness, and psychological well-being. *Journal of Personality and Social Psychology, 62,* 292–300. http://dx.doi.org/10.1037/0022-3514.62.2.292

Fabrigar, L. R., MacDonald, T. K., & Wegener, D. T. (2005). The structure of attitudes. In D. Albarracin, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes* (77–125). London, UK: Psychology Press.

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: Payer-and service-specific estimates. *Health Affairs, 28,* w822–w831. http://dx.doi.org/10.1377/hlthaff.28.5.w822

Fishbein, M., & Ajzen, I. (1975). *Belief, attitudes, intention, and behavior. An introduction to theory and research*. Boston, MA: Addison Wesley.

Fujita, K., & Roberts, J. C. (2010). Promoting prospective self-control through abstraction. *Journal of Experimental Social Psychology, 46,* 1049–1054. http://dx.doi.org/10.1016/j.jesp.2010.05.013

Gearhardt, A. N., Corbin, W. R., & Brownell, K. D. (2009). Preliminary validation of the Yale food addiction scale. *Appetite, 52,* 430–436. http://dx.doi.org/10.1016/j.appet.2008.12.003

Geier, A. B., Rozin, P., & Doros, G. (2006). Unit bias. A new heuristic that helps explain the effect of portion size on food intake. *Psychological Science, 17,* 521–525. http://dx.doi.org/10.1111/j.1467-9280.2006.01738.x

Geier, A., Wansink, B., & Rozin, P. (2012). Red potato chips: Segmentation cues can substantially decrease food intake. *Health Psychology, 31,* 398–401. http://dx.doi.org/10.1037/a0027221

Glasman, L. R., & Albarracin, D. (2006). Forming attitudes that predict future behavior: a meta-analysis of the attitude-behavior relation. *Psychological bulletin, 132,* 778–822.

Graziano, P. A., Calkins, S. D., & Keane, S. P. (2010). Toddler self-regulation skills predict risk for pediatric obesity. *International Journal of Obesity, 34,* 633–641. http://dx.doi.org/10.1038/ijo.2009.288

Hart, W., & Albarracin, D. (2011). Learning about what others were doing: Verb aspect and attributions of mundane and criminal intent for past actions. *Psychological Science, 22,* 261–266.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76,* 408–420. http://dx.doi.org/10.1080/03637750903310360

Hedges, L. V., & Olkin, I. (1985). Statistical methods for meta-analysis. New York: Academic Press.

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.

Higgins, E. T. (1998). The aboutness principle: A pervasive influence on human inference. *Social Cognition, 16,* 173–198. http://dx.doi.org/10.1521/soco.1998.16.1.173

Horowitz, E., Sorensen, N., Yoder, N., & Oyserman, D. (2017). *Creating a pathway to success: Teachers can change their students' identity-based motivation*. Manuscript submitted for publication.

Ioannidis, J. P. A. (2008). Why most discovered true associations are inflated. *Epidemiology, 19,* 640–648. http://dx.doi.org/10.1097/EDE.0b013e31818131e7

Israel, A. C., Guile, C. A., Baker, J. E., & Silverman, W. K. (1994). An evaluation of enhanced self-regulation training in the treatment of childhood obesity. *Journal of Pediatric Psychology, 19,* 737–749. http://dx.doi.org/10.1093/jpepsy/19.6.737

Kanten, A. B. (2011). The effect of construal level on predictions of task duration. *Journal of Experimental Social Psychology, 47,* 1037–1047. http://dx.doi.org/10.1016/j.jesp.2011.04.005

Klem, M. L., Wing, R. R., McGuire, M. T., Seagle, H. M., & Hill, J. O. (1997). A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *The American Journal of Clinical Nutrition, 66,* 239–246.

Kross, E., & Ayduck, O. (2009). Boundary conditions and buffering effects: Does depressive symptomology moderate the effectiveness of self-distancing for facilitating adaptive emotional analysis? *Journal of Research in Personality, 43,* 923–927. http://dx.doi.org/10.1016/j.jrp.2009.04.004

Kross, E., Gard, D., Deldin, P., Clifton, J., & Ayduk, O. (2012). "Asking why" from a distance: Its cognitive and emotional consequences for people with major depressive disorder. *Journal of Abnormal Psychology, 121,* 559–569. http://dx.doi.org/10.1037/a0028808

Lewin, K. (1935). *A Dynamic Theory of Personality: Selected Papers*. McGraw-Hill.

Lewis, N. A., Jr., & Oyserman, D. (2015). When does the future begin? Time metrics matter, connecting present and future selves. *Psychological Science, 26,* 816–825. http://dx.doi.org/10.1177/0956797615572231

Lewis, N. A., Jr., & Oyserman, D. (2016). Using identity-based motivation to improve the nation's health without breaking the bank. *Behavioral Science and Policy, 2,* 25–38. http://dx.doi.org/10.1353/bsp.2016.0013

Locke, E. A., & Latham, G. P. (1990). Work motivation and satisfaction: Light at the end of the tunnel. *Psychological Science, 1,* 240–246. http://dx.doi.org/10.1111/j.1467-9280.1990.tb00207.x

Maglio, S. J., & Trope, Y. (2011). Scale and construal: How larger measurement units shrink length estimates and expand mental horizons. *Psychonomic Bulletin & Review, 18,* 165–170. http://dx.doi.org/10.3758/s13423-010-0025-1

McFerran, B., & Mukhopadhyay, A. (2013). Lay theories of obesity predict actual body mass. *Psychological Science, 24,* 1428–1436. http://dx.doi.org/10.1177/0956797612473121

Nasser, J. A., Gluck, M. E., & Geliebter, A. (2004). Impulsivity and test meal intake in obese binge eating women. *Appetite, 43,* 303–307. http://dx.doi.org/10.1016/j.appet.2004.04.006

National Institutes of Health. (1998). *Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults*. Retrieved from http://www.nhlbi.nih.gov/guidelines/obesity/ob_gdlns.pdf

Nisson, C., & Earl, A. (in press). The theories of reasoned action and planned behavior: Examining the reasoned action approach to prediction and change of health behaviors. In K. Sweeny & M. Robbins (Eds.), *The Wiley Encyclopedia of Health Psychology*.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011–2012. *Journal of the American Medical Association, 311,* 806–814. http://dx.doi.org/10.1001/jama.2014.732

Oyserman, D. (2015). *Pathways to success through identity-based motivation*. New York, NY: Oxford University Press.

Oyserman, D., & Lewis, N. A., Jr. (2017). Seeing the destination AND the path: Using identity-based motivation to understand and reduce racial disparities in academic achievement. *Social Issues and Policy Review, 11,* 159–194. http://dx.doi.org/10.1111/sipr.12030

Oyserman, D., Lewis, N. A., Jr., Yan, V. X., Fisher, O., O'Donnell, S. C., & Horowitz, E. (2017). An identity-based motivation framework for self-regulation. *Psychological Inquiry, 28,* 139–147. http://dx.doi.org/10.1080/1047840X.2017.1337406

Oyserman, D., Novin, S., Smith, G. C., Elmore, K., & Nurra, C. (2016). *From difficulty to importance: Interpretation of experienced difficulty matters for identity, motivation and performance*. Manuscript submitted for publication.

Paolacci, G., Chandler, J., & Ipeirotis, P. G. (2010). Running experiments on Amazon Mechanical Turk. *Judgment and Decision Making, 5,* 411–419.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879–891. http://dx.doi.org/10.3758/BRM.40.3.879

Resnicow, K., & Page, S. E. (2008). Embracing chaos and complexity: A quantum change for public health. *American Journal of Public Health, 98,* 1382–1389. http://dx.doi.org/10.2105/AJPH.2007.129460

Richard, F. D., Bond, C. F., Jr., & Stokes-Zoota, J. J. (2003). One hundred years of social psychology quantitatively described. *Review of General Psychology, 7,* 331–363.

Rolls, B. J. (2003). The supersizing of America: Portion size and the obesity epidemic. *Nutrition Today, 38,* 42–53. http://dx.doi.org/10.1097/00017285-200303000-00004

Schwarz, N. (1996). *Cognition and communication: Judgmental biases, research methods, and the logic conversation*. Hillsdale, NJ: Erlbaum.

Schwarz, N. (2011). Feelings-as-information theory. *Handbook of theories of social psychology, 1,* 2898–2308.

Schwarz, N. (2014). *Cognition and communication: Judgmental biases, research methods, and the logic of conversation*. New York, NY: Psychology Press.

Schwarz, N., & Oyserman, D. (2001). Asking questions about behavior: Cognition, communication, and questionnaire construction. *The American Journal of Evaluation, 22,* 127–160. http://dx.doi.org/10.1177/109821400102200202

Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *The Journal of Consumer Research, 15,* 325–343. http://dx.doi.org/10.1086/209170

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science, 22,* 1359–1366. http://dx.doi.org/10.1177/0956797611417632

Simons, D. J., Shoda, Y., & Lindsay, D. S. (2017). Constraints on generality (COG): A proposed addition to all empirical papers. *Perspectives on Psychological Science, 12,* 1123–1128. Advance online publication. http://dx.doi.org/10.1177/1745691617708630

Smith, G. C., & Oyserman, D. (2015). Just not worth my time? Experienced difficulty and time investment. *Social Cognition, 33,* 85–103. http://dx.doi.org/10.1521/soco.2015.33.2.1

Spencer, S. J., Zanna, M. P., & Fong, G. T. (2005). Establishing a causal chain: Why experiments are often more effective than mediational analyses in examining psychological processes. *Journal of Personality and Social Psychology, 89,* 845–851. http://dx.doi.org/10.1037/0022-3514.89.6.845

Stewart, N., Ungemach, C., Harris, A. J., Bartels, D. M., Newell, B. R., Paolacci, G., & Chandler, J. (2015). The average laboratory samples of population of 7,300 Amazon Mechanical Turk workers. *Judgment and Decision Making, 10,* 479–491.

Stroebe, W. (2008). *Dieting, overweight, and obesity: Self-regulation in a food-rich environment*. Washington, DC: American Psychological Association. http://dx.doi.org/10.1037/11753-000

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

Thomas, M., Desai, K. K., & Seenivasan, S. (2011). How credit card payments increase unhealthy food purchases: Visceral regulation of vices. *The Journal of Consumer Research, 38,* 126–139. http://dx.doi.org/10.1086/657331

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review, 117,* 440–463. http://dx.doi.org/10.1037/a0018963

Turnwald, B. P., Boles, D. Z., & Crum, A. J. (2017). Association between indulgent descriptions and vegetable consumption: Twisted carrots and dynamite beets. *Journal of the American Medical Association Internal Medicine, 177,* 1216–1218. http://dx.doi.org/10.1001/jamainternmed.2017.1637

U.S. Food and Drug Administration. (2014). *Code of Federal Regulations Title 21*. Retrieved from http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?fr=101.12

Vallacher, P. R., & Wegner, D. M. (1989). Levels of personal agency: Individual variation in action identification. *Journal of Personality and Social Psychology, 57,* 660–671. http://dx.doi.org/10.1037/0022-3514.57.4.660

Vallacher, R. R., & Wegner, D. M. (1987). What do people think they're doing? Action identification and human behavior. *Psychological Review, 94,* 3–15. http://dx.doi.org/10.1037/0033-295X.94.1.3

Vartanian, L. R., Kernan, K., & Wansink, B. (2016). Clutter, chaos, and overconsumption: The role of mind-set in stressful and chaotic food environments. *Environment and Behavior*. Advance online publication.

Wansink, B. (2004). Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annual Review of Nutrition, 24,* 455–479. http://dx.doi.org/10.1146/annurev.nutr.24.012003.132140

Wansink, B. (2006). *Mindless eating—Why we eat more than we think*. New York, NY: Bantam Books-Dell.

Wansink, B., Painter, J. E., & North, J. (2005). Bottomless bowls: Why visual cues of portion size may influence intake. *Obesity Research, 13,* 93–100. http://dx.doi.org/10.1038/oby.2005.12

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of experimental evidence. *Psychological Bulletin, 132,* 249–268.

Wing, R. R., & Pelan, S. (2005). Long-term weight loss maintenance. *The American Journal of Clinical Nutrition, 82,* 222S–225S.

Young, L. R., & Nestle, M. (2002). The contribution of expanding portion sizes to the U.S. obesity epidemic. *American Journal of Public Health, 92,* 246–249. http://dx.doi.org/10.2105/AJPH.92.2.246

Zhang, C. Y., & Schwarz, N. (2012). How one year differs from 365 days: A conversational logic analysis of inferences from the granularity of quantitative expressions. *The Journal of Consumer Research, 39,* 248–259. http://dx.doi.org/10.1086/662612

Zhang, C. Y., & Schwarz, N. (2013). The power of precise numbers: A conversational logic analysis. *Journal of Experimental Social Psychology, 49,* 944–946. http://dx.doi.org/10.1016/j.jesp.2013.04.002

Zhao, X., Lynch, J. G., Jr., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *The Journal of Consumer Research, 37,* 197–206. http://dx.doi.org/10.1086/651257

Zlatevska, N. S., Dubelaar, C., & Holden, S. S. (2014). Sizing up the effect of portion size on consumption: A meta-analytic review. *Journal of Marketing, 78,* 140–154. http://dx.doi.org/10.1509/jm.12.0303

Received March 31, 2016
Revision received October 18, 2017
Accepted December 9, 2017 ■