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In Control of Variety: High Self-Control Reduces the Effect of Variety on Food Consumption

Abstract

The presence of variety increases the quantity of food a person wants and consumes. A recent review of past literature (Remick, Polivy, & Pliner, 2009) concludes that although external factors influence this effect of variety, internal factors do not seem to affect it. We identify general self-control as an internal factor that moderates the effects of variety in food. A series of three studies demonstrates that lower trait self-control makes one more susceptible to the variety effect, showing both greater increases in choice regarding the quantity of consumption and desire for more food in the presence of variety. Compared to those with low self-control, people with high self-control experience reduced enjoyment for a variety of foods following consumption of one food. This increased satiation would serve to diminish the variety effect and facilitate positive health outcomes over time.

Keywords: Variety, Self-Control, Dietary Intake, Hedonic Consumption, Satiation

There always seems to be room for dessert. Because desserts are highly desirable and offer sensory properties quite different from the main course, people often "find room" to consume them even if their meal has already led them to experience "fullness". In fact, beyond tempting desserts, variety increases food intake even for less dramatic shifts in food types such as different flavors of yogurt (Rolls, van Duijvenvoorde, & Rolls, 1984), or colors of M&M's (Kahn & Wansink, 2004). A recent comprehensive review of the effects of variety on food intake refers to this general phenomenon as the *variety effect* (Remick et al., 2009). Our research explores whether individuals with low trait self-control show greater susceptibility to the effects of variety.

We suggest that those higher in self-control are both more sensitive to total consumption, and enjoy the variety of other foods less after eating a particular food. As such, introducing variety is less likely to lead to detrimental consumption patterns for those with higher self-control. Identifying this moderator is insightful for theory, as well as the development of interventions to combat obesity, given variety is a contributing factor to excessive consumption and weight gain (Levitsky, 2005). Our research proposes trait self-control as a component that contributes to the variety effect. Therefore, we provide contributions to previous research on both the effects of variety, as well as a deeper understanding of how self-control plays a role in the influence of the environment on eating behavior.

The Variety Effect

The effect of variety on food consumption has been well established both within and across meals. Raynor and Epstein (2001) review prior literature to support a simple yet pervasive finding: humans consume more when different foods are available in a meal than when only one

food is available. This phenomenon is often attributed to sensory-specific satiety whereby eating a food decreases liking for that food (and others with similar sensory aspects) more so than for foods not consumed (Rolls, Rolls, Rowe, & Sweeney, 1981). This sensory-specific satiety occurs within a few minutes of eating (Hetherington, Rolls, & Burley, 1989) and contributes to the amount of food consumed (Rolls et al., 1981). Although sensory-specific satiety occurs during a meal, its lingering effects can also still affect the amount eaten a week later (Epstein, Carr, Cavanaugh, Paluch, & Bouton, 2011), and the flavors and brands subsequently purchased (Inman, 2001). Individuals even learn to anticipate the effects of variety in meal planning by decreasing the meal size for two courses of the same food versus two different foods (Wilkinson, Hinton, Fay, Rogers, & Brunstrom, 2012). In sum, to the extent that greater variety reduces experienced or expected satiation, it promotes greater consumption.

Remick et al. (2009) examined potential moderators of the variety effect and concluded that although there are reliable external moderators (e.g., food properties and environmental cues), internal individual moderators were not supported. The one exception was some evidence that the variety effect diminishes with age (Hollis & Henry, 2007), which accords with the fact that older people exhibit slower sensory-specific satiety (Rolls & McDermott, 1991). Of specific relevance to our research, past work has not found that the variety effect depends on one's body weight, body mass index (BMI), or efforts at eating restraint (Remick et al., 2009). This is somewhat surprising in that these theoretical constructs would seemingly predict an increased susceptibility to the variety effect for those with higher BMI or lower eating restraint, yet the empirical evidence has not supported them as moderators. For example, Brunstrom and Mitchell (2006) found that dieters and non-dieters, assessed using the Herman and Polivy (1980) Restraint Scale, were equally affected by variety. These authors also found that restrained eating, as

captured by the Dutch Eating Behavior Questionnaire (van Strien, Frijters, Bergers, & Defares, 1986), similarly did not moderate the variety effect. More generally, eating-related constructs that reflect restraint and dieting do not seem to make a difference in how much variety increases food consumption (Remick et al., 2009).

Why might prior research have shown that eating-related constructs such as eating restraint do not moderate the variety effect? We suggest that the lack of findings for these eating-related constructs reflects the abnormal behaviors often engaged in by those who feel a need to restrain their food consumption. In fact, there is significant debate about what measures of eating restraint capture, as many seem to assess failed dieting more than anything else (Lowe, 1993, 1995). For instance, both normal weight and obese participants can score high on eating restraint (Herman & Mack, 1975), and yet clearly the former is likely better at limiting the effects of environmental cues on how much they eat. Heatherton et al. (1988) suggest that, in fact, dieters were as often characterized by their lapses in restraint as their successful restraint, and the type of person identified by such restrained eating measures remains ambiguous. Thus, at times a given dieter may be less susceptible to the effects of variety (when successfully displaying restraint), and other times be more susceptible to variety (when having a lapse in restraint). The same logic also applies to body weight (or BMI) in that overweight individuals have a greater need for restrained eating, but they are also likely to have more frequent problems with overeating. Thus, perhaps it is not surprising that past research found that body weight and BMI did not influence the effect of variety on food consumption (Pliner, Polivy, Herman, & Zakalusny, 1980; Spiegel & Stellar, 1990). Even so, many researchers still expect that these differences *should* impact responses to variety (Remick et al., 2009).

Self-Control and the Variety Effect

Past work has reported that several internal factors including gender, BMI, and dietary restraint did not influence the variety effect (Remick et al., 2009). However, it still seems plausible that some individuals would be more susceptible to the influence of variety than others. We propose that general trait self-control is such a moderator in that those who have naturally higher levels of self-control are influenced by variety less than those lower in self-control. Self-control as an individual difference variable has been linked with numerous long-term positive life outcomes including better grades and job performance, increased impulse control, and higher self-esteem (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Duckworth & Seligman, 2005; Tangney, Baumeister, & Boone, 2004). Part of the reason why those high in trait self-control experience such adaptive outcomes is because they are able to recognize threats (Hofmann, Baumeister, Förster, & Vohs, 2012), and disregard cues that conflict with their goal (Haws, Bearden, & Nenkov, 2012). In fact, individuals who are more effective self-regulators automatically activate counteractive control processes when encountering a potential threat, leading them to effortlessly increase focus on their goals (Fishbach, Friedman, & Kruglanski, 2003). However, prior research has not examined the ability of general self-control to limit the effect of variety in the food domain. Of course, given the pervasiveness of variety in our daily food options, successful self-control would seem to require one to temper the effect of variety.

Another critical aspect of successful self-control is enhanced monitoring of one's behavior (Baumeister, 2002). For example, Redden and Haws (2013) demonstrated that people with greater self-control attend more to the quantity of unhealthy foods consumed, which in turn led to faster satiation while eating a single snack. We propose that people with higher self-control will more readily utilize their superior monitoring to realize that the intake of one food

should affect their satiety of other foods compared to those with lower self-control. As a result, they will satiate more in the presence of variety, and accordingly adjust their enjoyment of the different foods. Relatedly, Poynor and Haws (2009) show that motivated categorization leads people with higher trait self-control to rely on more inclusive categorizations of unacceptable options. That is, they seem to readily recognize that a broader range of potential alternatives are counterproductive to their goal pursuit. Thus, various snacks seen as unhealthy would be more likely to be mentally grouped together by those higher in self-control. We predict that these differences lead those higher in self-control to have greater expected and actual satiation across a variety of foods, and greater spreading of satiation across the variety of foods. The net result is our prediction that variety increases the desire to have more food for those with low self-control more than those with high self-control.

Overall, we predict that a general assessment of self-control over one's behaviors is more likely to reveal the influence of variety, as compared to one's BMI or responses to restrained eating questions. In a series of three studies, we tested our predictions and consistently find that the effects of food variety attenuate as people have greater general self-control. Study 1 shows this basic moderation effect for choice in planned consumption quantities. Study 2 extends the findings by using an alternative approach to assess the desired consumption quantity, and also demonstrates the role of anticipated satiation in driving these differences. Finally, Study 3 examines in more detail the underlying process contributing to differences in the variety effect by investigating the effects of variety on enjoyment. Specifically, we demonstrate that consumption of a single food decreases liking for other foods more for those higher versus lower in self-control. This underscores the importance of satiation in understanding differences in the variety effect.

Study 1: Quantity Choice

Study 1 provides a first look into our core predicted interaction between food variety and self-control. Participants are asked to choose how many hedonic snacks (potato chips) they want to consume. We predict that the variety effect on planned consumption will be stronger for those low versus high in trait self-control.

Method

Members (n = 245) from Amazon's Mechanical Turk online panel completed this study in exchange for $0.25 by responding to a "Decision Making Study" posting for all U.S. members over the age of 18. This panel has been shown to be a demographically diverse population that provides data that is at least as reliable as that from traditional methods (Buhrmester, Kwang, & Gosling, 2011). Participants were asked to imagine that it was early in the afternoon and they were hungry for a snack. They were then randomly assigned to one of two treatments. Participants in the *Variety* condition were presented with photos and names of three different chips (Doritos, Lay's Classic Potato Chips, and Cheetos). Participants in the *No Variety* condition were presented only one of these three chips (counterbalanced). All participants indicated the total number of pieces they would eat of the available snack assortment. Participants then completed the 13-item general trait self-control scale (Tangney et al., 2004). This scale includes items such as "I am good at resisting temptation" and "I refuse things that are bad for me".

Results

We first created an index of general self-control ($\alpha = .88$) by averaging the 13 items after appropriate reverse coding. To test our predictions, we performed an ANCOVA on the total quantity desired with the presence of variety as a between-subjects factor and self-control (mean centered) as a continuous covariate. There was an unsurprising main effect of variety, $F(1, 241) = 4.71$, $p < .04$, $\eta^2 = .02$, as participants given a variety of chip snacks indicated they would eat more. There was also a main effect of self-control, $F(1, 241) = 10.20$, $p < .01$, $\eta^2 = .04$, as those with higher self-control indicated that they would eat fewer of the chips. More importantly, there was the predicted interaction of variety and self-control, $F(1, 241) = 4.37$, $p < .04$, $\eta^2 = .02$.

We used a spotlight analysis on self-control ($M = 4.34$, $SD = 1.09$) to confirm our specific predictions (see Figure 1). As suggested by Irwin and McClelland (2001) and Fitzsimons (2008), the spotlight method reveals the nature of an interaction by running separate regression models at different levels of interest for the continuous variable (typically +/- 1 SD). At a self-control score one standard deviation below the mean, the presence of variety increased the desired quantity by 10.26 for those with low self-control ($M_{NoVariety} = 19.8$ vs. $M_{Variety} = 30.1$), $t(241) = 2.99$, $p < .01$, $\eta^2 = .04$. There was no such difference for those with higher self-control scores one standard deviation above the mean ($M_{NoVariety} = 17.2$ vs. $M_{Variety} = 17.3$), $t < 1$, *ns*. As such, those low in self-control were the only participants to demonstrate the variety effect.

--Insert Figure 1--

As an additional test of our theory, we also performed separate regression analyses for each treatment condition. For participants presented with only a single chip snack, there was no relationship between the quantity chosen and self-control, $\beta = -1.22$, $t < 1$, *ns*. In contrast, for those given a variety of chips, the quantity chosen decreased with greater self-control, $\beta = -5.86$, $t(122) = 3.30$, $p < .01$, $\eta^2 = .08$. This pattern of results confirms our predictions as high self-

control people had more consistent planned consumption quantities whether there was variety or not, and the differences between this group and those with low self-control emerged only when variety was present.

Discussion

Overall, Study 1 provided clear evidence for the anticipated effect of variety such that the presence of variety increased the chosen consumption quantity, consistent with past research (Remick et al., 2009; Rolls et al., 1981). Beyond this well-known result, we demonstrated that this variety effect was moderated by differences in underlying trait self-control. Those lower in self-control were more susceptible to the consequences of variety than those with higher self-control.

Study 2: Quantity Choice and Expected Satiation

Study 2 was designed to extend the results of Study 1 in several important ways. First, this study included the restraint component of the Dutch Eating Behavior Questionnaire (van Strien et al. 1986), which is a commonly used measure of eating restraint. Each participant also reported their height and weight so we could calculate their Body Mass Index (BMI). This allowed us to simultaneously test our prediction that general trait self-control would moderate the variety effect even though the DEBQ and BMI might not. Second, this study added a measure of expected satiation to better understand the underlying process. We posit that expected satiation will mediate the effects we find as participants with higher self-control better recognize the satiation that will arise as they consume multiple snacks. Third, to further generalize our findings, this study used a conservative test of the effect of variety by always presenting each

participant their favorite snack in the no variety condition. We also extended the number of options available in the variety condition from three (as in Study 1) to five to rule out any idiosyncratic effects related to three options. Finally, we collected gender and age information to ensure that these did not systematically influence our results.

Method

Members (n = 149; 51% female; M_{age} = 33.4, *range* = 18 to 75) from Amazon's Mechanical Turk completed this study in exchange for $0.50. They did so by responding to a "Decision Making Study" posting for all U.S. members over the age of 18. The gender and age factors had no effect in our analyses, all $p > .52$, so we do not discuss them further. Participants began by indicating their favorite of five options among three different sets of food or beverage options (favorite chip, candy bar, and soft drink). Of particular note, the candy question assessed their favorite candy bar out of a set of five candies subsequently used in this study. Participants were then automatically redirected to what was ostensibly a different study.

Participants were next asked to imagine that it was early in the afternoon and they were hungry for a snack. They were then presented with the candies available to them along with a photo of each candy next to its description. Participants were randomly assigned to one of two treatments. Participants in the *Variety* condition were presented five different candies (Hershey Kisses, Kit Kat Miniatures, Reese Miniatures, Twix miniatures, and Snickers miniatures) that were each approximately the same size and weight. Participants in the *No Variety* condition were presented only one of the five candies, specifically, the one that they had previously indicated was their favorite. The use of their favorite provides a more conservative test for the variety effect as participants without variety will likely want to eat the most when the candy is their

favorite. Participants then indicated the number of pieces they would eat of the available candy for their afternoon snack.

To capture expected satiation, we asked participants to also indicate how much they wanted to eat more of their snack (1 = *not at all*; 9 = *very much so*). Participants provided this rating at two points in time: after imagining they had eaten the first and the fifth piece[1]. This allowed us to calculate a change in desire after eating a fixed quantity, which can serve as our measure of expected satiation in that larger declines from the same quantity reflect greater expected satiation. This measure of satiation was based on past research on the variety effect that has asked participants to rate their enjoyment after imagining a single bite of food ((Redden & Haws, 2013; Wilkinson et al., 2012), and scenarios studies in satiation research that have asked the desire to continue at multiple points in time (Galak, Kruger, & Loewenstein, 2011; Nelson & Meyvis, 2008; Redden, 2008). After a brief unrelated task in which participants evaluated a set of five nature pictures, participants finished by providing their height and weight, the 13-item short form of Tangney et al.'s (2004) general self-control scale, and the ten items from the restraint component of the DEBQ (van Strien et al., 1986).

Results

We first created a self-control index ($\alpha = .89$) as the mean of the 13 items on the self-control scale after appropriate reverse coding, and a restraint index ($\alpha = .94$) as the mean of the ten DEBQ items. We also computed each participant's BMI as 703 multiplied by their weight in pounds divided by the square of their height in inches.

[1] We chose five pieces because this was the mean response in a pretest (n = 58) that asked how many pieces of miniature candy bars would make a reasonable snack.

To test our predictions, we performed an ANCOVA on the total quantity desired with the presence of variety as a between-subjects factor and self-control (mean centered) as a continuous covariate. There was a main effect of self-control, $F(1, 148) = 13.18$, $p < .01$, $\eta^2 = .08$, as participants with higher self-control indicated that they would eat less of the candy. There was only marginal evidence of a main effect of variety, $F(1, 148) = 2.69$, $p < .11$. More importantly, there was the predicted interaction of variety and self-control, $F(1, 148) = 11.09$, $p < .01$, $\eta^2 = .07$.

--Insert Figure 2--

Figure 2 uses a spotlight analysis on self-control ($M = 4.36$, $SD = 1.09$) to show the nature of the interaction. At low self-control scores one standard deviation below the mean, the presence of variety increased the desired quantity by 4.8 ($M_{NoVariety} = 3.4$ vs. $M_{Variety} = 8.2$), $t(148) = -3.21$, $p < .01$, $\eta^2 = .07$. In contrast, at high self-control scores one standard deviation above the mean, variety failed to have a statistically significant effect on quantity ($M_{NoVariety} = 4.7$ vs. $M_{Variety} = 4.2$), $t(148) = 1.26$, $p > .21$.

To more directly test our predictions, we also performed separate regression analyses for each of the two treatment conditions. For participants presented with only a single candy, there was no relationship between the quantity chosen and self-control, $\beta = .11$, $t < 1$, *ns*. In contrast, for those given a variety of candies, the quantity chosen decreased with greater self-control, $\beta = -2.28$, $t(74) = -4.42$, $p < .01$, $\eta^2 = .21$. This pattern of results confirms our prediction as participants with greater self-control were affected less by the presence of variety than those with low self-control. In fact, self-control affected the desired quantity only when variety was present, and not when there was a single type of candy.

We also performed the previous analysis using the DEBQ eating restraint measure (*M* = 5.00, *SD* = 1.01) instead of self-control. The ANCOVA on the quantity desired found no significant effects for eating restraint as a main effect, $t < 1$, *ns*, or as an interaction with the variety condition, $t < 1$, *ns*. Next, we conducted the same analysis using BMI (*M* = 25.2, *SD* = 6.14, *range* = 14.12 to 46.80) as an independent factor, and we again found no evidence that BMI interacted with the variety condition, $t < 1$, *ns*. Not surprisingly, there was a main effect of BMI, $t(148) = 2.98$, $p < .01$, $\eta^2 = .06$, such that participants with a higher BMI tended to request more candy. Even so, we found no evidence that the measures of eating restraint or BMI moderated the effect of variety on the desired consumption quantity, though self-control was negatively correlated with both eating restraint, $r = -.26$, $p < .01$, and BMI, $r = -.28$, $p < .01$. Trait self-control captured a susceptibility to the variety effect that these other constructs did not.

We next examined whether, as we have proposed, expected satiation could help account for our findings. We specifically tested the effect on desired quantities for mediated moderation in which the interaction between self-control and variety condition would be mediated by expected satiation. We calculated expected satiation as the rated desire for more of the candy after eating the first bite minus the rated desire after the fifth bite (i.e., the drop in desire) (Redden & Haws, 2013) (Redden

& Haws, 2013) (Redden & Haws, 2013). This change in liking resembles the measure typically found in sensory-specific satiety research (Rolls et al., 1981). We next performed a regression to verify that the interaction of the self-control and variety factors influenced expected satiation, and it did, $t(148) = -2.17$, $p < .03$, $\eta^2 = .03$. We then used bootstrapping and the PROCESS macro (Preacher & Hayes, 2004) to test whether expected satiation indeed mediated our findings for the desired quantity. The analysis included the interaction between self-control and the variety condition as the independent variable, self-control and the variety condition as covariates, expected satiation as the mediator, and the desired quantity as the dependent variable. The total effect of the interaction between self-control and the variety condition was attenuated when controlling for expected satiation. The overall model bootstrap estimate was .33, 95% CI [.05, .69], which differed from zero to establish the presence of mediation. As we proposed, participants with higher trait self-control showed less of a variety effect because they expected to get more satiated than those with low self-control.

Discussion

This study replicated our previous findings as trait self-control moderated the effect of variety on the chosen quantity. This key result held even when participants were given their

favorite snack in the single case condition, and the extent of variety was nearly doubled from the previous study. We found that general self-control successfully moderated the variety effect, but we failed to find any moderating effects of either BMI or the restraint component of the DEBQ.

We propose that these other measures may not act as moderators because they do not discriminate between high restrainers who successfully restrain themselves on a regular basis, or try to do so now because of a tendency to fail in the past. In contrast, general trait self-control unambiguously reflects one's ability to consistently exhibit self-control in their behavior and not be overly influenced by environmental factors, such as the presence of variety. In addition, this study provided initial evidence that high self-control people show less susceptibility to the variety effect because they appreciate the satiation that will inevitably come with eating more food even if it is varied. In contrast, those lower in self-control did not seem to recognize that increasing the quantity of consumption would still lead to satiation in the presence of variety. In our final study, we used a different set-up to more explicitly examine the underlying role of satiation for the moderation of the variety effect based on differences in self-control.

Study 3: Responses to Variety with Consumption

Study 2 provided initial evidence that expected satiation contributes to differences in how people respond to variety. This study sought to provide further evidence for the proposed role of satiation in attenuating the variety effect for those higher in trait self-control. In particular, participants rated their liking of a variety of foods as they ate them. Our theory predicts that satiation will spread more across a variety of foods for people with high self-control versus those with low self-control. Such a finding would suggest that the presence of variety increases the desired quantity less for those higher in self-control as they experience greater satiation

compared to those lower in self-control. Our prediction is rooted in prior work showing that those higher in self-control better monitor their intake of unhealthy foods ((Redden & Haws, 2013) as well as group together items inconsistent with their goals to encourage a broader general view (Poynor & Haws, 2008). As a result, those higher in self-control will attend more to the overall consumption experience, which can increase satiation ((Brunstrom & Mitchell, 2006; Higgs & Woodward, 2009; Redden & Haws, 2013), thereby lessening the effects of variety.

Study 3 tested our predictions using the standard setup in sensory-specific satiety research (Rolls et al., 1981). Here, participants first taste a focal food and multiple non-focal foods, and then indicate how much they like each food. They then eat enough of the focal food to induce satiation before re-sampling and re-rating their liking of the same set of foods as before. This setup allows us to gauge satiation separately for the focal food apart from a more general set of non-focal foods. The notion is that satiation will not reflect a general hunger, rather it will be greatest for the focal food (that has been eaten more). Consistent with sensory-specific satiety research, rather than focusing on the desired quantity as our previous studies have done, this study kept the quantity consumed roughly equivalent for everyone to focus on the drop in liking as the critical dependent measure.

Method

Participants (n = 81; 75% Male; M_{BMI} = 24.96, *range* = 17.75 to 45.72) completed this study for undergraduate course credit. No effects of gender or BMI were found in the analyses, all factors had $p > .05$, so we do not discuss them further. Participants were told they would eat snacks and evaluate them. They were then given a plate with small samples of seven common snack foods. In order to test the effects of variety, we used a much wider range of snacks than the

two previous studies that included chocolate chip cookies, animal crackers, pretzels, goldfish crackers, cheese balls, gummy bears, and M&M's candies. We chose those snack foods because they were commonly available, generally well liked, and not perceived to be particularly healthy by our participant population in pretesting[2]. Participants were then instructed to eat each sample one at a time and rate how much they enjoyed it, how tasty it was, and how much they wanted more of it on three scales (1 = *not at all*; 9 = *very much so*). They repeated this for each of the seven snacks in an order randomized for each participant.

After sampling the last snack, participants received a plate with three chocolate chip cookies to eat, and we encouraged them to eat as many of the cookies as possible. Our goal was to ensure similar levels of consumption across participants, such that changes in liking could not be solely attributable to differences in quantity of consumption of the eaten food. Participants were told to enjoy these cookies while watching an animated cartoon video for approximately five minutes. After the video finished, the plate of cookies was removed and participants received another plate with the same seven snacks that they previously tasted. Participants then tasted each snack again and rated it on the same three nine-point scales previously used. Participants finished by completing the 13-item short form of Tangney et al.'s (2004) general trait self-control scale.

Results

Before testing our predictions, we removed any participant (n = 5) who did not eat a single one of the cookies as satiation largely emerges only with some consumption. We found

[2] A separate sample (n = 124) rated these snacks for general liking on a 1 "would not enjoy at all" to 7 "would enjoy very much" scale, and the means ranged from 5.35 (2.39) for cheese balls to 7.43 (1.79) for chocolate chip cookies. Similarly, perceptions of healthiness were assessed on a 1 "very unhealthy" to 7 "very healthy" scale, and the means ranged from 1.76 (1.44) for the M&M's to 4.16 (1.21) for the pretzels.

that 58% of the participants ate all of the cookies, and the average quantity eaten was 73%. Therefore, the participants consumed most of the snack as we intended, and this did not differ by self-control, $r = -.08$, $t < 1$, *ns*.

We next created several indices. After appropriate reverse coding, we calculated a self-control index that had acceptable consistency ($\alpha = .87$). We then created an index of initial liking for each of the six non-focal foods as the mean of the three scale ratings taken before eating the cookies. We similarly created an index of final liking for each of the six non-focal foods using the ratings taken after eating the cookies. Satiation was then calculated for the six non-focal items, as well as the focal cookies, as the change in liking (final minus initial rating) such that a more negative number indicates greater satiation. The index for the non-focal foods showed acceptable consistency across the six foods ($\alpha = .75$) so we collapsed them for analysis, but we still report the individual means in Figure 3.

The indices of satiation for the focal and the non-focal foods were then submitted to a repeated-measures ANCOVA with the snack type (focal snack; non-focal snacks) as a within-subjects factor, and self-control (mean centered) as a continuous covariate.[3] The model indicated a main effect of food type, $F(1, 74) = 7.77$, $p < .01$, $\eta^2 = .10$, as participants became more satiated on the chocolate chip cookies they had eaten, consistent with sensory-specific satiety. There was no evidence of a main effect of self-control, $F < 1$, *ns*. Rather, as predicted, there was a marginal interaction between snack type and self-control, $F(1, 74) = 3.45$, $p < .07$, $\eta^2 = .04$.

--Insert Figure 3--

[3] We also analyzed the results with the quantity consumed as a covariate and no factors with it were significant, all $t < 1$, *ns*. The quantity consumed was also not correlated with satiation on the focal food, $r = .02$, $p > .85$, or non-focal foods, $r = -.04$, $p > .74$. This is likely because most people could not differ on the quantity consumed because they ate everything they were given (as part of our intended control to keep the quantity consumed similar across participants).

Figure 3 shows the nature of the interaction using a spotlight analysis on self-control (M = 3.90, SD = .97). At lower self-control scores one standard deviation below the mean, there was a difference in satiation across the two snack types, $t(74) = 3.28$, $p < .01$, $\eta^2 = .13$. Those with low self-control experienced satiation on the chocolate chip cookies they had eaten (M = -1.09), $t(74) = 3.22$, $p < .01$, $\eta^2 = .12$, but not the other non-focal snacks (M = -.11), $t < 1$, *ns*. In contrast, at high self-control scores one standard deviation above the mean, there was a non-significant difference in satiation across the two snack types, $t < 1$, *ns*. Enjoyment dropped a similar amount for both the focal chocolate chip cookies (M = -.87), $t(74) = 2.55$, $p < .02$, $\eta^2 = .08$, as well as the other non-focal snacks (M = -.67), $t(74) = 3.92$, $p < .001$, $\eta^2 = .17$. Those with high self-control seem to transfer their satiation for the cookies onto all of the variety of foods sampled, while those with low self-control satiated only on the food they consumed an entire serving of.[4] The net result was that self-control influenced satiation only on the non-eaten foods, $\beta = -.29$, $t(74) = 2.32$, $p < .03$, and not the focal food, $\beta = .12$, $t < 1$, *ns*.

Discussion

This study provides evidence that people with high self-control show greater spreading of satiation to a range of other non-focal snacks after eating a focal snack. Importantly, while low self-control people expressed the expected reduced liking for the food they had just eaten (cookies), this decrease in liking did not transfer over to the non-focal foods. In contrast, for those with high self-control, the decrease in liking extended to the non-focal foods as well, which would presumably also reduce subsequent intake of those foods.

[4] The cheeseballs showed an increase in liking for those with low self-control scores, but this result was not significantly different from zero, $t = 1.61$, $p > .11$. We conducted the analyses without cheeseballs and the conclusions did not change. At low self-control levels, satiation was greater on the focal food than the non-focal food, $t = 2.98$, $p < .01$. At high self-control levels, satiation did not differ between the two snack types, $t < 1$, *ns*.

General Discussion

Although variety may add spice to life, in the domain of food consumption, it can also add inches to one's waistline. Remick et al. (2009) noted that "It is only in the current environment that the variety effect has become a threat to humans' health," (p. 447), and Rolls et al. (1982) suggest that it is variety that leads us to still want dessert after we are satiated with a main meal. As such, identifying populations most susceptible to the effects of variety is important for understanding how to combat the variety ever-present in our homes, restaurants, and grocery stores. Our research establishes general trait self-control as one important factor that moderates the influence of variety on patterns of food selection. Three empirical studies, using both choice of the quantity to eat and satiation measures during actual consumption, demonstrate that variety promoted increased food quantities less for people with high self-control, and that this was driven by differences in expected or experienced satiation in the presence of variety. These effects may help explain positive health outcomes over time, as those with higher self-control are less susceptible to dramatically increasing their consumption in the presence of variety, a seemingly ubiquitous reality in today's society.

Our findings are significant for several reasons. First, past work has found little evidence of internal moderators of the variety effect (Remick et al., 2009), including measures of eating restraint. We provide empirical evidence that trait self-control is a moderator, underscoring the importance of being less susceptible to environmental conditions like variety that are counterproductive to one's healthier behavioral intentions. Specifically, people with low self-control responded to variety by choosing a larger quantity to consume, expecting less satiation, and indeed satiating less across the variety of foods as they ate. Our studies either had participants choose a quantity to consume or fixed the quantity consumed to gain a purer

measure of satiation. However, it is easy to imagine these effects would lead to the greater intake that is often part of variety effect studies ((Wansink, 2004; Wilkinson et al., 2012). Future research could test this extension of our findings when participants are instructed to eat a variety of foods. In addition, future research should examine whether differences in self-control similarly moderate other environmental and perceptual effects documented in the literature that include: vertical-horizontal illusion (Wansink & van Ittersum, 2003); size and shape (P. Chandon & Ordabayeva, 2009); background music (Stroebele & de Castro, 2006); and serving size (Pierre Chandon & Wansink, 2006; Scott, Nowlis, Mandel, & Morales, 2008; Wansink, 1996). We expect that self-control may prove fruitful in better understanding these phenomena, as it did for the variety effect in the present studies.

Second, theories of self-control generally predict that those with high self-control should be able to better monitor their consumption and limit intake in the presence of variety. We suggest that this linkage did not emerge in prior work because it often focused on eating restraint (which may increase with poor restraint in the past) rather than general self-control. As suggested by Remick et al. (2009), restrained eating can lead to strange food behaviors, and it is not necessarily linked to overall healthy consumption patterns. Our results using a measure of eating restraint in Study 2 further support the lack of a link between restrained eating and responses to variety. It could be that a restrained eater has now become restrained precisely because self-control attempts have chronically failed in the past. In contrast, as we theorized and the results subsequently confirmed, the general self-control construct was unambiguously linked to a reduced effect of variety on the quantity people chose to eat as well as the rate at which they satiated. Future research should more carefully examine the types of behaviors that restrained

eating is associated with versus those that might be more clearly linked to a general level of self-control.

We show that higher self-control diminishes the effect of variety for a set of foods. However, it may be noted that the decrease in liking while eating M&M's in Study 3 seemed to happen regardless of self-control (see Figure 3), and this food was most similar to the focal chocolate chip cookies. The decrease in liking here did in fact seem to spread to the M&M's to some degree even for those low in self-control. Ostensibly, the shared sensory property of chocolate might account for this effect, but further research is needed to understand what types of variety will require greater self-control. As well, although people may prefer more variety for multiple reasons, seemingly one of these would be a belief that they will enjoy the variety more. Yet, as shown in Study 3, whether this belief holds true partially depends on one's inherent level of self-control. Future research will need to explore how well predictions of enjoyment from variety accurately reflect experienced enjoyment during subsequent consumption, and how this relates to differences in individuals.

Additional explanations for our effects should also be considered. For instance, prior research has demonstrated that restrained eaters are more likely to have hedonic goals activated in the presence of palatable food primes (Papies, Stroebe, & Aarts, 2007). Those high in self-control may similarly show less responsiveness to the appetitive effects of a variety of palatable food cues. They may also have a stronger association between food and the dieting goal similar to restrained eaters who show this relationship more than unrestrained eaters (Papies, Stroebe, & Aarts, 2008). Here, variety may cue the dieting goal more for those with high self-control, making them more aware that they need to carefully monitor the quantity to be consumed. Although we have suggested that people with high self-control may better incorporate the overall

quantity of food being eaten, other work on restrained eating suggests that selective attention may be particularly strong for hedonic foods (Papies et al., 2008). This suggests our effects may grow stronger as the foods become more palatable and unhealthy, which future research will need to test. Of course, such unhealthy foods typically pose a greater threat to one's health and BMI, so they are likely of more interest to consumers, researchers, and policy makers. As well, our findings hint that variety in unhealthy foods may hurt people much more than unhealthy food itself, but future research will need to further test this notion.

In the current studies, we always assessed self-control after the snack choice or liking ratings. We used this order because of concern that asking self-control questions first would bias the results by explicitly highlighting the need for controlling one's behavior, while our chosen quantity and liking measures would have less influence on a subsequent trait measure of general self-control. Although we included distractor tasks in some studies to reduce concerns about the order of our measures, future research should collect the dependent measures and self-control scale at two different points in time (ideally separated by several days or even weeks). Future research should also explore the moderation of the variety effect across a range of consumption scenarios. Our studies employed pictures of food and desired consumption as in previous research on the variety effect (Wilkinson et al., 2012), as well as the sampling paradigm typical in sensory-specific satiety research (Rolls et al., 1981). Future research could further extend our findings to other common consumption contexts.

Although we generally used related foods in our studies, we broadened the snack selection considerably in Study 3. The result was novel evidence that the liking of a variety of foods decreased more for those higher in self-control, as compared to those lower in self-control, following consumption of a tempting food. This intriguing finding not only helps to explain the

process underlying our present results, it also suggests that people high in self-control may naturally extend satiating properties of snack foods more broadly beyond the food consumed with significant implications for overall consumption patterns. Further research should test the boundaries of this spreading of satiation effect, especially over time and across contexts.

In conclusion, although prior research has found little evidence of internal moderators of the variety effect (Remick et al., 2009), we demonstrated that general self-control is likely an overlooked moderator of this relationship. Our findings indicate that those lower in self-control are more likely to increase their planned consumption in response to variety, compared to those with higher self-control, and mediation evidence shows that anticipated satiation contributes to this effect. Understanding these relationships may help illuminate how those with high self-control successfully manage their food consumption, and how others can do the same.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. London: Sage.

Baumeister, R. F. (2002). Yielding to temptation: Self-control failure, impulsive purchasing, and consumer behavior. *Journal of Consumer Research, 28*(4), 670-676.

Brunstrom, J. M., & Mitchell, G. L. (2006). Effects of distraction on the development of satiety. *British Journal of Nutrition, 96*(4), 761-769.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's mechanical turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6*(1), 3-5.

Chandon, P., & Ordabayeva, N. (2009). Supersize in one dimension, downsize in three dimensions: Effects of spatial dimensionality on size perceptions and preferences. *Journal of Marketing Research, 46*(6), 739-753.

Chandon, P., & Wansink, B. (2006). Can “low-fat” nutrition labels lead to obesity? *Journal of Marketing Research, 43*(4), 605-617.

de Ridder, D. T. D., Lensvelt-Mulders, G., Finkenauer, C., Stok, F. M., & Baumeister, R. F. (2012). Taking stock of self-control. *Personality and Social Psychology Review, 16*(1), 76-99.

Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science, 16*(12), 939-944.

Epstein, L. H., Carr, K. A., Cavanaugh, M. D., Paluch, R. A., & Bouton, M. E. (2011). Long-term habituation to food in obese and nonobese women. *The American Journal of Clinical Nutrition, 94*(2), 371-376.

552 Fishbach, A., Friedman, R. S., & Kruglanski, A. W. (2003). Leading us not unto temptation:
553 Momentary allurements elicit overriding goal activation. *Journal of Personality and*
554 *Social Psychology, 84*(2), 296-309.
555 Fitzsimons, G. J. (2008). Death to dichotomizing. *Journal of Consumer Research, 35*(1), 5-8.
556 Galak, J., Kruger, J., & Loewenstein, G. (2011). Is variety the spice of life? It all depends on the
557 rate of consumption. *Judgment and Decision Making, Forthcoming*.
558 Haws, K. L., Bearden, W. O., & Nenkov, G. Y. (2012). Consumer spending self-control
559 effectiveness and outcome elaboration prompts. *Journal of the Academy of Marketing*
560 *Science, 40*(5), 695-710.
561 Heatherton, T. F., Herman, C. P., Polivy, J., King, G. A., & McGree, S. T. (1988). The
562 (mis)measurement of restraint: An analysis of conceptual and psychometric issues.
563 *Journal of Abnormal Psychology, 97*(1), 19-28.
564 Herman, C. P., & Mack, D. (1975). Restrained and unrestrained eating. *Journal of Personality,*
565 *43*(4), 647-660.
566 Herman, C. P., & Polivy, J. (Eds.). (1980). *Restrained eating*. Philadelphia: Saunders.
567 Hetherington, M., Rolls, B. J., & Burley, V. J. (1989). The time course of sensory-specific
568 satiety. *Appetite, 12*(1), 57-68.
569 Higgs, S., & Woodward, M. (2009). Television watching during lunch increases afternoon snack
570 intake of young women. *Appetite, 52*(1), 39-43.
571 Hofmann, W., Baumeister, R. F., Förster, G., & Vohs, K. D. (2012). Everyday temptations: An
572 experience sampling study of desire, conflict, and self-control. *Journal of Personality and*
573 *Social Psychology, 102*(6), 1318-1335.

574 Hollis, J. H., & Henry, C. J. K. (2007). Dietary variety and its effect on food intake of elderly
575 adults. *Journal of Human Nutrition and Dietetics, 20*(4), 345-351.
576 Irwin, J., & McClelland, G. (2001). Misleading heuristics for moderated multiple regression
577 models. *Journal of Marketing Research, 38*, 100-109.
578 Kahn, Barbara E., & Wansink, B. (2004). The influence of assortment structure on perceived
579 variety and consumption quantities. *Journal of Consumer Research, 30*(4), 519-533.
580 Levitsky, D. A. (2005). The non-regulation of food intake in humans: Hope for reversing the
581 epidemic of obesity. *Physiology & Behavior, 86*(5), 623-632.
582 Lowe, M. R. (1993). The effects of dieting on eating behavior: A three-factor model.
583 *Psychological bulletin, 114*, 100-100.
584 Lowe, M. R. (1995). Restrained eating and dieting: Replication of their divergent effects on
585 eating regulation. *Appetite*.
586 Nelson, L. D., & Meyvis, T. (2008). Interrupted consumption: Disrupting adaptation to hedonic
587 experiences. *Journal of Marketing Research, 45*(6), 654-664.
588 Papies, E., Stroebe, W., & Aarts, H. (2007). Pleasure in the mind: Restrained eating and
589 spontaneous hedonic thoughts about food. *Journal of Experimental Social Psychology,*
590 *43*(5), 810-817.
591 Papies, E., Stroebe, W., & Aarts, H. (2008). Healthy cognition: Processes of self-regulatory
592 success in restrained eating. *Personality and Social Psychology Bulletin, 34*(9), 1290-
593 1300.
594 Pliner, P., Polivy, J., Herman, C. P., & Zakalusny, I. (1980). Short-term intake of overweight
595 individuals and normal weight dieters and non-dieters with and without choice among a
596 variety of foods. *Appetite, 1*(3), 203-213.

Poynor, C., & Haws, K. L. (2009). Lines in the sand: The role of motivated categorization in the pursuit of self-control goals. *Journal of Consumer Research, 35*(5), 772-787.

Preacher, K., & Hayes, A. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers, 36*(4), 717-731.

Raynor, H. A., & Epstein, L. H. (2001). Dietary variety, energy regulation, and obesity. *Psychological Bulletin, 127*(3), 325-341.

Redden, J. P. (2008). Reducing satiation: The role of categorization level. *Journal of Consumer Research, 34*(February), 624-634.

Redden, J. P., & Haws, K. L. (2013). Healthy satiation: The role of decreasing desire in effective self-control. *Journal of Consumer Research, 39*(February), 1100-1114.

Remick, A. K., Polivy, J., & Pliner, P. (2009). Internal and external moderators of the effect of variety on food intake. *Psychological Bulletin, 135*(3), 434-451.

Rolls, B. J., & McDermott, T. M. (1991). Effects of age on sensory-specific satiety. *The American Journal of Clinical Nutrition, 54*(6), 988-996.

Rolls, B. J., Rolls, E. T., Rowe, E. A., & Sweeney, K. (1981). Sensory specific satiety in man. *Physiology & Behavior, 27*(1), 137-142.

Rolls, B. J., Rowe, E. A., & Rolls, E. T. (1982). How sensory properties of foods affect human feeding behavior. *Physiology & Behavior, 29*(3), 409-417.

Rolls, B. J., van Duijvenvoorde, P. M., & Rolls, E. T. (1984). Pleasantness changes and food intake in a varied four-course meal. *Appetite, 5*(4), 337-348.

618 Scott, M. L., Nowlis, S. M., Mandel, N., & Morales, A. C. (2008). The effects of reduced food
619 size and package size on the consumption behavior of restrained and unrestrained eaters.
620 *Journal of Consumer Research, 35*(3), 391-405.
621 Spiegel, T. A., & Stellar, E. (1990). Effects of variety on food intake of underweight, normal-
622 weight and overweight women. *Appetite, 15*(1), 47-61.
623 Stroebele, N., & de Castro, J. M. (2006). Listening to music while eating is related to increases in
624 people's food intake and meal duration. *Appetite, 47*(3), 285-289.
625 Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good
626 adjustment, less pathology, better grades, and interpersonal success. *Journal of*
627 *Personality, 72*(2), 271-324.
628 van Strien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). The Dutch eating
629 behavior questionnaire (DEBQ) for assessment of restrained, emotional, and external
630 eating behavior. *International Journal of Eating Disorders, 5*(2), 295-315.
631 Wansink, B. (1996). Can package size accelerate usage volume? *Journal of Marketing, 60*(3), 1-
632 14.
633 Wansink, B. (2004). Environmental factors that unknowingly increase food intake and
634 consumption. *Annual Review of Nutrition, 24*, 341-378.
635 Wansink, B., & van Ittersum, K. (2003). Bottoms up! The influence of elongation on pouring
636 and consumption volume. *Journal of Consumer Research, 30*(3), 455-463.
637 Wilkinson, L. L., Hinton, E. C., Fay, S. H., Rogers, P. J., & Brunstrom, J. M. (2012). The
638 'variety effect'is anticipated in meal planning. *Appetite*.

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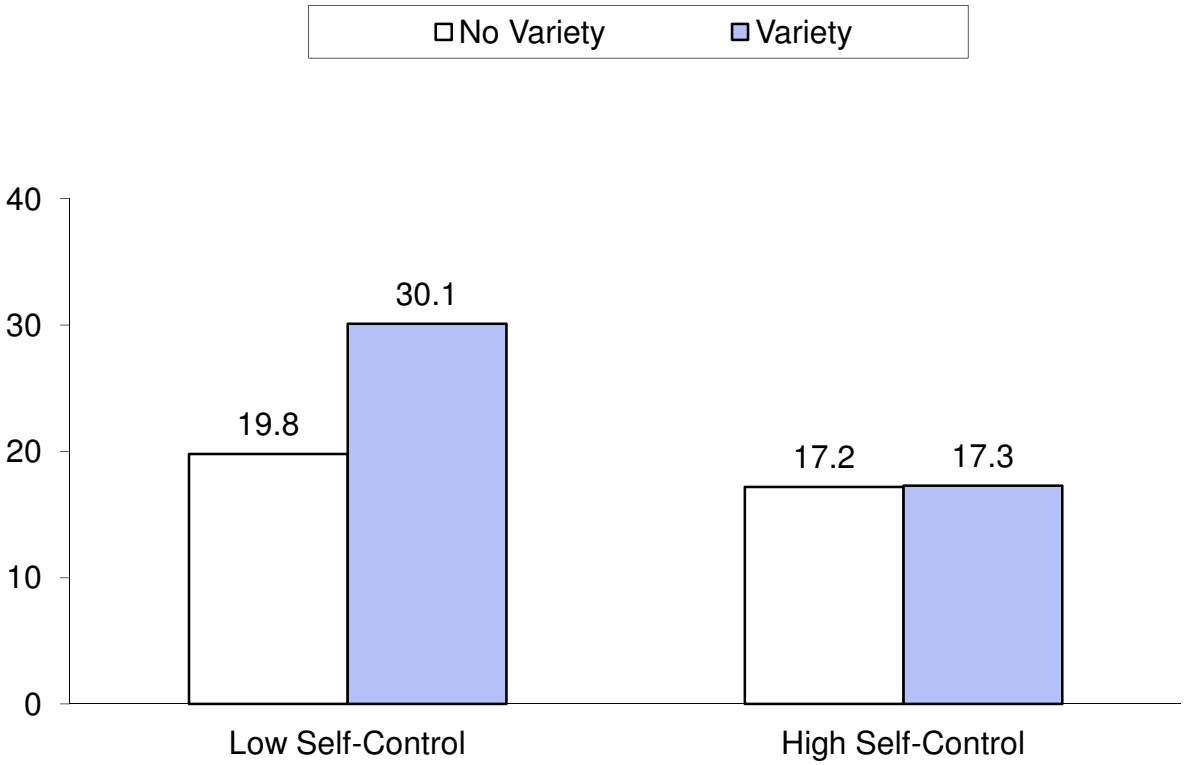
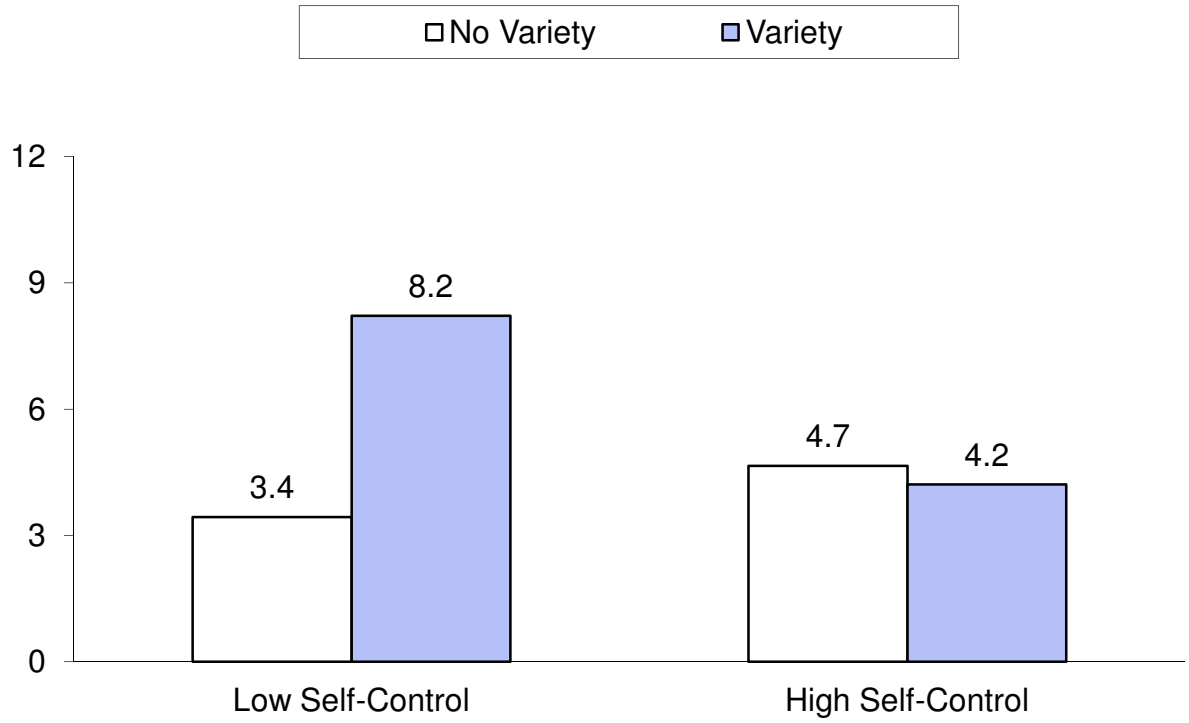
Figure 1. Total Quantity of Chips Chosen by Presence of Variety in Study 1.



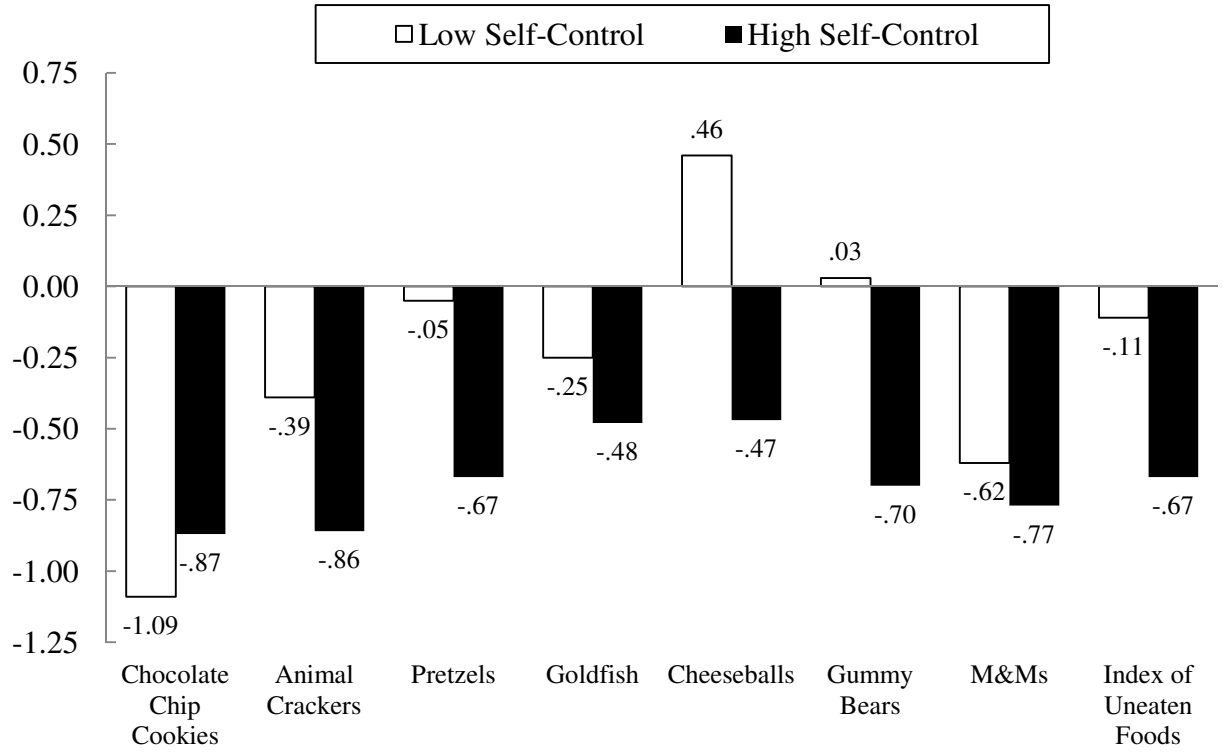
NOTE. — This figure (and subsequent figures) was created from analyses using continuous scores on the self-control measure. Self-control scores were graphed at one SD above the mean to represent high scores on the self-control measure, and one SD below the mean to represent low scores on the self-control measure (per procedures recommended in Aiken & West, 1991).

Figure 2. Total Quantity of Candies Chosen by Presence of Variety in Study 2



NOTE. — See note from Figure 1.

Figure 3. Change in Liking Index by Food Type and Self-Control in Study 3



NOTE. — See note from Figure 1.