How and Why Our Eating Decisions Neglect Infrequently Consumed Foods

ABIGAIL B. SUSSMAN
ANNA PALEY
ADAM L. ALTER

Forthcoming, *Journal of Consumer Research*
Author Note:

Abigail B. Sussman (abby@chicagobooth.edu) is associate professor of marketing, Booth School of Business, University of Chicago. Anna Paley (a.paley@tilburguniversity.edu) is assistant professor of marketing, Tilburg School of Economics and Management, Tilburg University. Adam L. Alter (aalter@stern.nyu.edu) is professor of marketing, Stern School of Business, New York University. The first two authors contributed equally. Correspondence: Abigail Sussman and Anna Paley. This work was supported by the Beatrice Foods Co. and the True North Communications Inc. Faculty Research Funds at The University of Chicago Booth School of Business and the NYU Stern School of Business Center for Sustainable Business. The authors thank Oleg Urminsky and conference participants at ACR, SCP, and SJDM for useful comments and suggestions and Halley Bayer, Nicholas Herzog, and Abigail Bergman for outstanding research assistance. The authors are especially grateful to Art Middlebrooks at Booth for helping source the calorie tracking app data as well as to the company for sharing it. Supplementary materials are included in the web appendix accompanying the online version of this article. All experimental data and study materials are available on the Open Science Framework: https://bit.ly/InfrequentFoods.
ABSTRACT

This paper introduces a novel distinction between foods as a function of the frequency with which consumers eat them, and investigates how this distinction influences dietary beliefs and decisions. It compares food types perceived to be consumed relatively infrequently (i.e., infrequent foods) to those perceived to be consumed relatively frequently (i.e., frequent foods). Across an analysis of archival data from a popular calorie tracking app and five experiments examining hypothetical consumption decisions, findings support the conclusion that infrequent foods provide unique challenges for consumers. All else equal, consumers select larger portions of infrequent (vs. frequent) foods. Further, consumers are less likely to compensate (i.e., eat less) after consuming equal amounts of infrequent versus frequent foods. This pattern of results arises because consumers erroneously believe that infrequent foods have a smaller impact on their weight than frequent foods do, even in the presence of caloric information. Optimistically, participants can be taught to overcome this bias through a brief informational intervention.

Keywords: lay beliefs, consumption decisions, frequency, dietary compensation
Imagine that you're generally trying to maintain your weight, but today there are cookies from your local bakery in the faculty lounge. Since you rarely eat cookies, you decide to eat not one, but three cookies. The following week, you find some pizza in the lounge and, since you rarely eat pizza, decide to have not one, but two slices. In each case, you may find yourself eating larger portions of these foods in part because you eat each food type only occasionally and believe that infrequently consumed foods do not play a large role in shaping your overall weight. As a result of this belief, you may be less likely to compensate for eating extra calories in the afternoon by eating less later in the day.

In this paper, we introduce a novel distinction between infrequently and frequently eaten foods, and investigate the impact of this distinction on dietary beliefs and decisions. For simplicity, we refer to food types perceived to be consumed only infrequently as “infrequent foods” and those perceived to be consumed relatively frequently as “frequent foods”. We operationalize frequency as falling along a continuum that is subjective and influenced by individual consumption patterns. For example, someone who frequently eats pizza and rarely eats cake is likely to consider pizza more frequent and cake more infrequent, whereas someone who frequently eats cake and rarely eats pizza is likely to consider cake more frequent and pizza more infrequent.

While each infrequent eating occurrence is rare, by definition, consumers may eat many infrequent foods in aggregate. To better understand how often consumers encounter infrequent foods, we asked consumers to identify when a food feels infrequent (vs. frequent; N = 48; see study 2 for a summary and the web appendix for complete study details). On average, participants reported that they considered foods they eat less than twice a month to be infrequent foods ($M_{\text{INFREQ}} = 1.76$ times a month, $SD = 3.61$). We turned to archival data from consumers (N
who tracked their consumption using a popular calorie tracking app, described in detail in study 1, to form a back of the envelope calculation estimating how often consumers eat infrequent foods (see web appendix for details). We found that, on average, approximately 40% of foods eaten by each person would be considered infrequent foods by this consumer-driven definition. This rough approximation sheds light on the magnitude of infrequent consumption and underscores the importance of understanding how frequency shapes consumption decisions.

Across an analysis of this archival calorie tracking data, and five controlled experiments, we find that consumers select larger portions of infrequent (vs. frequent) foods and are less likely to compensate for eating equal amounts of these foods (i.e., less likely to select smaller portions in subsequent meals). This pattern of results arises based on beliefs that infrequent foods have less impact on consumers’ weight. Further, alerting participants to the presence of this bias can attenuate its impact on consumption decisions.

Our research makes key contributions to several literatures. First, we contribute to the growing literature on food choice (Chandon and Wansink 2007; Hagen 2020; Howlett et al. 2009; Scott et al. 2008; Zlatevska, Dubelaar, and Holden 2004) by demonstrating a novel bias affecting consumer decisions. Specifically, we show that the frequency of a given food type influences both immediate and subsequent consumption decisions above and beyond nutritional content. Second, we add to our understanding of how consumers form beliefs about foods (Chernev and Gal 2010; O’Brien et al. 2018; Miles and Scaife 2003; Raghunathan, Naylor, Hoyer 2006; Salerno and Sevilla 2019) by identifying a novel lay belief that infrequent foods have a smaller impact on consumers’ weight. Finally, we add to our knowledge of how to improve overall consumer welfare by identifying informational interventions as a possible path towards helping consumers overcome their biased beliefs, thereby helping consumers achieve
their dietary goals (Cornil and Chandon 2016; Hawley et al. 2013; Van De Veer, Van Herpen, and Van Trijp 2016; Woolley and Fishbach 2016).

LAY THEORIES OF FOOD CONSUMPTION

Past research has shown that consumers’ understanding of the world around them often originates from common-sense theories and explanations of how people and the world work (referred to as lay theories or intuitions; Furnham 1988; Schwarz 2015). Lay theories are particularly likely to arise when information is ambiguous or missing (Broniarczyk and Alba 1994; Deval et al. 2013; Haws, Reczek, and Sample 2017; Kardes, Posvac, and Cronley 2004). The difficulty of finding and recalling precise nutritional content, conflicting messages around healthiness, and the complicated relationship between food, exercise and health all create opportunities for lay beliefs to shape consumption patterns and dietary decisions (Gomez 2013; O’Brien et al. 2018).

When misapplied, lay theories can lead to systematic biases and errors in judgment (Furnham 1988, Schwarz 2015). These biases can be particularly problematic when consumers hold self-regulatory goals, including those related to weight. To accomplish their goals, consumers must monitor these goals and take actions when they recognize that their current state falls short of their standards (Baumeister and Heatherton 1996; Carver and Scheier 1981, 1982). When consumers adjust their behavior in response to gaps between their current and desired state (e.g., eating less to lose weight), they can rely on objective information as well as their subjective understanding of how their behaviors will affect goal-related outcomes. Consumers may struggle
to achieve their goals when they misunderstand the relationship between their actions and the consequences of those actions (Baumeister and Heatherton 1996).

In the context of food consumption, implicitly or explicitly held lay theories can interfere with the self-regulatory process (Campbell and Warren 2015; Chernev 2011; Cornil, Gomez, and Vasiljevic et al. 2020; Haws et al. 2017; Mukhopadhyay and Johar 2005; Raghunathan et al. 2006). For example, overgeneralized inferences from a food’s health claims (Andrews, Netemeyer, and Burton 1998; Schuldt and Schwarz 2010), price information (Haws et al. 2017) and tastiness (Raghunathan et al. 2006) all lead to biased beliefs which may threaten consumers’ ability to accomplish health-related goals. In the current work, we posit that lay theories of how infrequent versus frequent foods influence one’s weight provide a foundation for false beliefs, which can increase caloric consumption.

**WHY CONSUMERS NEGLECT INFREQUENT FOODS AND WHY IT MATTERS**

We propose that the belief that infrequent foods have less impact on consumers’ weight is rooted in an overgeneralization of a strategy that is often useful for forming accurate judgments. When forming *global* judgments that reflect an overall evaluation of the influence of a particular variable on an outcome, consumers appropriately rely on the frequency of that variable as a key input. Consumers may turn to similar strategies (i.e., reliance on global judgments) when making *singular* judgments that reflect an individual instance. Much of the time, this strategy is effective.

However, consumers may struggle to assess singular instances in isolation from their broader context, even when it is appropriate to do so. For example, in the context of stereotypes,
generalizations about the characteristics of a group (global judgments) can continue to influence
evaluations of a single individual (singular judgments) even among people who consciously seek
to avoid reliance on judgments about the group (Macrae et al. 1994; Monteith, Sherman, and
Devine 1998; Wegner 1994). This difficulty evaluating events in isolation and corresponding
emphasis on frequent instances can lead consumers to overlook infrequent occurrences (Erev and

Consequently, consumers may judge equivalent events as less significant when they are
less frequent. For example, Isaac and Brough (2014) held a lottery in which 90% of tickets were
blue and 10% were yellow. Each ticket had an equal probability of winning irrespective of color.
However, participants believed that a single ticket was less likely to win when it was yellow than
when it was blue. In this instance, participants correctly inferred that the relatively rare yellow
tickets were less likely to win overall. Participants then took the additional step of incorporating
this global judgment into their evaluations of the likelihood that a single ticket would be selected.
The overall distributional information was irrelevant for this individual judgment. Despite this,
participants allowed their global judgment to contaminate their assessments of how likely an
individual ticket was to be drawn.

Consumers’ environments reflect this tendency to rely on global judgments, with explicit
rules favoring frequent events as the basis of evaluations while underweighting individual
exceptions. For example, in a legal context, sentencing is often more lenient when the illegal act
is considered out of character (Branham 2017; Pfaff 2016). In other words, the magnitude of the
punishment for the same crime is smaller when it is considered an exception, consistent with the
notion that less compensation is required for the act. Following a similar intuition, in an
accounting context, businesses are instructed to identify unusual and infrequent expenses on their
income statements (Accounting Principles Board 1973, opinion 30). Since these specific expenses are considered unlikely to recur, the norm is for financial analysts to disregard these expenses when evaluating earnings reports and projecting future earnings. When consumers budget for themselves, similar tendencies appear, in which consumers underestimate the impact of exceptional purchases on their budget, leading to overspending (Sussman and Alter 2012; Sussman, Sharma, and Alter 2015).

This combination of personal experience (i.e., correctly using global information to form evaluations), and environmental forces (e.g., legal and business rules) may contribute to an over-emphasis on more frequent events, which are more represented in global judgments. In the context of food, these patterns may lead consumers to over-emphasize food type (e.g., all cookies eaten) when evaluating the impact of a specific food (e.g., a particular cookie eaten) on their weight. Consequently, consumers may conclude that individual consumption episodes have less impact when they occur infrequently.

In other words, when evaluating the dietary impact of various food types, a consumer may accurately believe that a single food type that she eats infrequently has a smaller overall impact on her weight than a comparable food type that she eats frequently. However, she may overgeneralize this global belief when assessing the impact of specific consumption occurrences on her weight. That is, she may erroneously believe that a single portion of an infrequent food matters less for her weight than a single portion of an otherwise comparable frequent food. These beliefs may have consequences for consumption decisions, such that beliefs about weight impact form a key input into portion size and compensation decisions, as depicted in Figure 1.
Lay theories have been shown to influence a range of consumption decisions, including portion size and the extent to which people compensate for prior consumption by eating fewer calories subsequently (Haws et al. 2017; O’Brien et al. 2018). Building on prior research showing that lay beliefs about the consequences of eating a food can influence the amount consumed (Provencher, Polivy, and Herman 2009), the current research examines the consequences of the aforementioned lay belief on consumption decisions. If people believe that infrequent foods have a smaller impact on their weight, they may choose to eat larger portions of these foods.

Beliefs about weight impact can influence not only consumption within a meal, but also the dynamics of consumption over time. Because consumers tend to manage their caloric intake over the course of a day (Khare and Inman 2009), they tend to compensate for food consumption in one meal with food choices in the next meal (Dhar and Simonson 1999; Khare and Inman 2009; O’Brien et al. 2018). As such, infrequent foods may influence consumption choices beyond the eating occasion containing the focal food. Given known tendencies for daily caloric balancing, we predict that the consequences of underweighting the impact of infrequent foods can persist across the day. Specifically, controlling for amount and nutritional profile of foods consumed at one point in time, we propose that consumers will choose to eat more (i.e., compensate less) later in the day following consumption of an infrequent food.

The current research examines differences in consumers’ reactions to a food’s perceived frequency. Specifically, it investigates whether consumers eating infrequent foods choose larger
portion sizes. Further, it examines whether a food’s frequency can impact not only food choices in the current consumption episode, but also subsequent eating decisions: consuming infrequent (vs. nutritionally equivalent frequent) foods may lead consumers to choose larger portion sizes in subsequent meals (i.e., compensate less). Finally, it addresses the underlying psychological drivers of these proposed patterns by examining consumers’ beliefs that infrequent foods have less impact on their weight, and the relationship between this belief and consumption patterns.

As an example, imagine two people who eat foods with similar health profiles, but Bob rarely eats popcorn and Jim regularly eats popcorn. Popcorn as a food type is less impactful for Bob’s overall weight versus Jim’s overall weight. However, eating a single 16 ounce portion of popcorn has the same impact on Bob’s weight as on Jim’s. Nonetheless, Bob (Jim) is likely to believe that the 16 ounce portion of popcorn is relatively less (more) consequential for his weight. Bob (versus Jim) may be more likely to eat another serving of popcorn as part of the same snack. If both consumers eat the same size serving of popcorn, Bob (vs. Jim) may eat a larger dinner later that evening.

Formally, we propose the following hypotheses:

**H1:** Consumers choose larger portions of a food when they perceive it as infrequent versus frequent.

**H2:** Consumers are less likely to reduce subsequent caloric intake (i.e., compensate) after eating a food when they perceive that food as infrequent versus frequent.
**H3:** Beliefs that infrequent (vs. frequent) foods have a smaller impact on one’s weight underlie the consumption patterns described in H1 and H2.

**THE CURRENT RESEARCH**

We provide evidence for these hypotheses across six studies and an additional study in the web appendix. Across studies, we measure actual frequency of consumption and manipulate perceived frequency of consumption through hypothetical scenarios and product packaging. In study 1, we analyze a large archival dataset of consumers who track their consumption using a popular calorie tracking mobile app. We find that people consume more calories when eating infrequent versus frequent foods (hypothesis 1). Further, after controlling for the number of calories consumed, eating infrequent foods earlier in the day correlates with higher caloric consumption later in the day (hypothesis 2). These patterns are robust to a variety of alternative specifications.

As an alternative to our proposed process, these results may arise from systematic differences between foods that consumers tend to eat frequently versus infrequently. For example, infrequent foods might be more indulgent, premium, or scarce than ordinary foods, which could lead to differences in consumption. Food-related characteristics such as these could increase consumers’ motivation to consume infrequent foods. In turn, this motivational bias might lead consumers to perceive infrequent foods as less impactful (e.g., optimism bias; Miles and Scaife 2003). As another example, prior research has shown that scarcity can influence perceptions of caloric content (Salerno and Sevilla 2019). Further, consumers may be less familiar with foods that they eat infrequently. In turn, they might be more likely to misestimate
the caloric content of these foods and believe that infrequent foods have fewer calories. We address these possibilities and other alternatives by isolating frequency as an antecedent of consumption decisions with experimental data that cleanly identifies causal evidence. We find no evidence that caloric content or other food-related characteristics play a role (studies 3 and 5, web appendix study).

Further, we demonstrate the presence of implicit (using the Implicit Associations Test, IAT, in study 4) and explicit (studies 2, 3 and 5) lay beliefs that infrequent foods have less impact on one’s overall weight. We implicate this belief in driving differential consumption decisions as a function of perceived frequency through mediation (studies 2-3) and moderation (studies 5-6; hypothesis 3). We further show that consumers’ beliefs about foods’ perceived frequency do not affect consumption decisions when an information intervention limits the diagnosticity of the lay belief (study 6; hypothesis 3). In each of these studies, we observe consumers stating that they would eat larger portions (hypothesis 1) or compensate less later in the day (hypothesis 2) when foods are perceived as infrequent versus frequent. Notably, we report relative differences rather than benchmarking these results against a normatively correct level of consumption or compensation (as discussed in greater detail in the General Discussion).

We determined the sample size for all experiments (studies 2-6) in advance of data collection, and we used all available data in study 1. We uniformly excluded participants who failed the instructional manipulation checks (IMC, Oppenheimer, Meyvis, and Davidenko 2009) from studies 2-6. However, in each study, results remain consistent when including these participants. All dependent variables are reported in the main text. All experimental data and study materials are available on the Open Science Framework: https://bit.ly/InfrequentFoods.
STUDY 1: ARCHIVAL ANALYSIS OF INFREQUENT FOODS

We began by examining portion size (hypothesis 1) and compensation (hypothesis 2) outcomes using records from a popular calorie tracking app. Consumers use this app to monitor their weight-related goals by tracking the foods they eat and corresponding caloric estimates. We operationalized frequency as a function of the number of times a consumer logged a particular food type. We then assessed the relationship between the frequency of foods eaten in a given meal and caloric intake both in that meal and in the following meal.

Method

We obtained anonymized records from a leading calorie tracking mobile app containing all food items logged by a sample of 926 users ($M_{age} = 44.41$, $SD = 14.26$; $M_{BMI} = 27.78$, $SD = 5.64$, 1 missing; 63% female). These users were randomly selected from those who were active for at least 70 days in 2015 and had data in August or September of both 2014 and 2015. The data contained records from August 1, 2014 to September 30, 2015, for a total of 2,635,899 observations. Each observation included the name of the food, the consumption date, the food category (breakfast, lunch, snack, or dinner), and the number of calories consumed. The data additionally contained information about each user’s height, weight, age, and gender.

We examined consumption within a given meal as well as compensation across meals. When we considered whether someone compensates for overeating in one meal by eating less in the subsequent meal, we focused on consumption in the course of a single day. Specifically, we examined the extent to which calories consumed earlier in the day affected calories consumed
later in the day since prior research has shown that most consumers budget according to a narrow
day-to-day perspective and compensate for prior caloric intake by eating less later (Khare and
Inman 2009). In considering compensation, our primary model specification predicts the calories
consumed at dinner based on the number of calories consumed earlier in the day (during
breakfast, lunch, and snacks), and the infrequent versus frequent nature of those calories.

Although snacks could be consumed before or after dinner, we included them as part of the pre-
dinner calculation in our main analysis for simplicity, and because snacks are traditionally eaten
throughout the day. To confirm the robustness of the results, we describe a variety of alternative
specifications briefly below (e.g., excluding snacks), with additional detail in the web appendix.

Data cleaning. We began by eliminating responses that were unusable. We removed
items that users themselves had deleted from the app (N = 132,809; 5%), instances where users
logged 0 or -1 calories (e.g., notes to themselves about medical conditions; N = 50,814; 2%), and
a single instance where an individual noted consuming 660,000 calories in a single sitting. The
remaining sample included 2,452,275 observations.

Computing infrequency. We considered each individual’s unique consumption behavior
and computed the total number of times each food type was consumed by each individual. To
control for variations in posting amount, we divided this total by the overall number of food
entries logged by each individual. Thus, for each item, this measure represented the percent
incidence of each particular food out of the total number of foods logged by each individual.
This within-subject frequency score was then standardized and multiplied by -1 so that higher
numbers reflected less frequent foods, consistent with the theoretical construct of interest. Thus,
this value corresponded to an infrequency score. Next, we aggregated these item-specific infrequency scores to calculate the infrequency of entire meals, equally weighting each food. We aggregated these data by computing the mean infrequency for two periods: pre-dinner consumption (i.e., breakfast, lunch, and snacks) and dinner consumption. We tested alternative specifications of this variable as robustness checks, reported in the web appendix.

Computing caloric content and additional data cleaning. To examine caloric content, we first summed and then standardized the number of calories consumed during the pre-dinner and dinner periods for each individual. Since we were interested in predicting the number of calories consumed during dinner while controlling for pre-dinner consumption, we could only use data where a single individual logged at least a single item pre-dinner and at least a single item during dinner. After eliminating cases that could not be paired in such way, the data contained 192,856 recorded days and 2,184,442 individual food items. We performed this step of data cleaning after computing the infrequency score to allow for as much meaningful data as possible to be included in the infrequency measures. For example, a meal entry that users themselves deleted likely contained an error of some kind and was therefore excluded from our infrequency metric. In contrast, a person who has logged only one meal in a given day has not provided evidence of a mistake and therefore we incorporate their data when computing the infrequency metric.

Results and Discussion

Summary statistics. On average, each participant logged at least one item prior to dinner and one item during dinner on 208.27 days (SD = 112.54; median = 180 days) out of a possible
426 days with an average of 11.33 items (SD = 4.91; median = 11 items) per day. Items averaged 145.55 calories each (SD = 151.97; median = 102.48 calories); thus, participants logged an average of 1,648.62 calories per day (SD = 614.95; median = 1,564.20 calories). The overall database contained 158,456 unique foods. On average, each recorded food was consumed 13.33 times (SD = 5.33; median = 13 times; 38.5% of foods consumed only once).

Within-meal results. First, we sought to establish the relationship between frequency and caloric consumption within the same meal (hypothesis 1). A series of linear regressions including individual-specific random effects showed a positive within-meal association such that higher infrequency (i.e., lower frequency) was associated with increased caloric consumption; breakfast: $B = .309$, $SE = .003$, $z = 95.64$, $p < .001$; lunch: $B = .100$, $SE = .003$, $z = 31.96$, $p < .001$; dinner: $B = .074$, $SE = .003$, $z = 21.59$, $p < .001$ (see table 1). This simple correlation might be explained by a host of extraneous factors that may vary in parallel with the frequency of foods consumed (e.g., a limited opportunity to try a particular infrequent food). However, these factors are less likely to also covary with consumption in a subsequent meal. Consequently, we focused on caloric consumption during subsequent meals in the analysis that follows. We additionally controlled for the frequency of the subsequent meal to account for day-specific effects (e.g., eating on vacation). Further, examination of the across-meal effects allowed us to test whether infrequent foods have a consequential impact lasting beyond a single consumption setting.

Insert table 1 about here
Across-meal results. We performed a series of linear regressions including individual-specific random effects to test hypothesis 2, that consumption in subsequent meals is higher for foods that are eaten relatively less frequently (table 2). We first considered a basic model with two main effects (model 1). As expected, results showed a negative main effect of pre-dinner calories, such that the consumption of more calories prior to dinner corresponded to a reduction in calories consumed during dinner, $B = -.272$, $SE = .002$, $z = -109.90$, $p < .001$. Importantly, there was a main effect of frequency after controlling for pre-dinner calories consumed, such that individuals consumed more calories at dinner if the calories consumed earlier that day were less frequent, $B = .011$, $SE = .003$, $z = 3.51$, $p < .001$. This is consistent with differential treatment of foods as a function of their frequency. Specifically, these data suggest a failure of users to fully incorporate the effect of infrequent (vs. frequent) foods on subsequent consumption.

In model 2, we added an interaction term to examine whether the consequences of eating infrequent foods varied as a function of their caloric content. In addition to a negative main effect of pre-dinner calories, $B = -.273$, $SE = .002$, $z = -109.83$, $p < .001$, and a positive main effect of infrequency, $B = .015$, $SE = .003$, $z = 4.63$, $p < .001$, the results revealed a significant interaction, $B = .011$, $SE = .002$, $z = 5.03$, $p < .001$, consistent with this possibility. The effect of frequency on caloric compensation was more extreme for larger meals. This pattern sheds light on recent findings that consumers under-compensate for dietary splurges by suggesting that these recent findings may be particularly relevant for infrequent foods (O’Brien et al. 2018).

Finally, models 3 and 4 included additional controls. Results of these analyses were consistent with the previous models such that all key variables of interest remained significant when (1) controlling for the frequency of calories consumed at dinner (model 3), and (2)
additionally controlling for an individual’s age, gender, and BMI (model 4). The robustness of the effect after controlling for the frequency of the calories consumed during dinner demonstrates that the effect is unlikely to be driven by day-specific consumption habits (e.g., overconsumption while on vacation).

Robustness checks. To further examine the robustness of these results, we conducted a series of robustness checks (see web appendix for additional details). First, since we cannot observe when snacks were consumed, we removed the snack category. An analysis of the four models described previously revealed that excluding the snack category did not substantially change the magnitude or interpretation of the results (web appendix table 2).

Second, we examined whether the patterns hold for narrower specifications of sequential meals. We performed the same analysis described above to test the impact of breakfast frequency affecting caloric consumption during lunch, as well as lunch frequency affecting caloric consumption during dinner. This analysis yielded largely consistent results, though the impact of breakfast on lunch was weaker (web appendix tables 3-4).

Next, we divided the sample by weekdays and weekends. In addition to serving as a robustness check, this analysis could provide insight into the mechanism at play. In particular, if effects were limited to weekends, that would provide evidence that the current findings may be
related to characteristics of weekend meals (e.g., more indulgent). However, we found consistent magnitudes of results on both weekends and weekdays (web appendix tables 5-6).

Fourth, we wanted to test whether the results were driven by outliers. We winsorized the calories measure from pre-dinner consumption that was more than three standard deviations from the mean (equivalent to 2,444 calories). This analysis did not materially change the results, neither within-meal nor across-meal (web appendix table 7-8).

Lastly, we tested whether a different definition of frequency produced a similar pattern of results. Thus, instead of examining how frequently each food was consumed by each individual, we examined how frequently each food appeared in the data overall. These analyses using the overall frequency of each food (rather than the within-subject measure) revealed similar results to those reported above for both the within- and across-meal analyses. Importantly, the robustness of our findings to this population-wide definition of frequency suggests that individual variability in consumption due to liking is not the primary driver of the effect. More information about both the computation of the overall infrequency measure and the results of this analysis are available in the web appendix (tables 9-10).

*Discussion.* Field data from users of a popular calorie tracking app provided initial evidence that consumption decisions vary as a function of a food’s frequency. Consistent with prior research, we found that the number of calories consumed during the day, before dinner, was inversely correlated with the number of calories consumed at dinner (Khare and Inman 2009). However, this relationship was attenuated when the calories consumed before dinner were infrequent. Our results (based on the analysis reported in table 1, model 1) indicate that, on average, someone who eats a meal made up of foods they eat once a year instead of once a day
will consume approximately 60 additional calories in their subsequent meal. These data support the hypothesis that consumption of infrequent foods carries consequences across multiple meals (hypothesis 2). Further, the effect was similar in magnitude on weekends and weekdays, indicating that systematic differences in consumption throughout the week (e.g., more indulgent consumption on weekends) are unlikely to be driving the effect.

In sum, we find evidence consistent with our theorizing that calories consumed from infrequent foods are not incorporated into the decision of how many calories to eat in a subsequent meal to the same degree as calories from frequent foods. It is noteworthy that this pattern emerged among consumers who were actively engaging in self-regulation by monitoring the foods that they ate. While goal monitoring is often considered an effective strategy for weight management (Burke et al. 2011; Harkin et al. 2016), our findings indicate that the effect of frequency on consumption persists even in this context. This finding aligns with prior research revealing biases that emerge in the process of goal monitoring (Campbell and Warren 2015).

One question is whether these results may be a function of a reporting bias since we are only able to analyze data that users have entered. While reporting may not map directly onto consumption, prior research suggests that infrequent foods may be more difficult to track (e.g., less calorie labeling in less familiar contexts), and consumers may see them as less necessary to track (Sussman and Alter 2012). If this were the case, then any findings consistent with our hypothesis would be understated. For example, if a consumer eats some infrequent foods for lunch that she does not record, her relative overconsumption at dinner would be registered as following a more frequent meal.

**STUDY 2: PORTION SIZE DECISIONS**
In study 1, we presented archival data demonstrating a positive relationship between infrequency and calories consumed (hypothesis 1, hypothesis 2). This study captured correlational relationships in a real-world context with strong ecological validity and a highly relevant population. However, these patterns may have arisen from unobserved associations between food frequency and other variables that we were not able to identify.

Study 2 used a hypothetical design to manipulate the perceived frequency of a food while holding the target food (M&Ms) constant, thereby isolating the role of frequency as a causal force influencing portion size. Further, the current study aimed to understand the mechanism driving observed effects. We examined whether beliefs about the weight impact of infrequent versus frequent foods drives portion size decisions.

Method

*Participants.* Two hundred and two participants completed this study through Positly, a screening and recruitment platform for Amazon’s Mechanical Turk (MTurk) workers, in exchange for financial compensation. Fifteen participants failed the IMC (described below) resulting in a final sample of 187 participants ($M_{age} = 37.24$, $SD = 10.74$, 1 missing; 39% female, 1% other).

*Design and Procedure.* Upon entering this study, all participants were first presented with two questions establishing their individual portion size range for the focal food: M&Ms. Participants were asked to imagine that they were hungry in the afternoon and decided to eat some M&Ms. They indicated the smallest and largest number of M&Ms they would eat in this
situation. This self-generated consumption range was used to create individual anchors displayed in the portion size dependent measure. This method was used so that the values displayed to participants would be representative of ranges that they would actually consume (Katz, Kan, and Sussman 2020).

Participants were randomly assigned to one of two conditions (frequent vs. infrequent; see appendix A). All participants were shown a similar calendar displaying their consumption of M&Ms over the course of the month, with a red box highlighting the 31st of the month (i.e., the current day). In the frequent condition, the calendar showed images of M&Ms on 18 days, and participants were asked to imagine that they ate M&Ms 18 times over the course of the month. In the infrequent condition, the calendar showed an image of M&Ms on one day, and participants were asked to imagine that they ate M&Ms once over the course of the month. The frequency of frequent and infrequent consumption was based on the pretest from the introduction. This pretest showed that participants believe that foods they eat about 1.76 times per month (SD = 3.61) are infrequent foods, and foods they eat 18.42 times a month are frequent foods (SD = 12.02; see web appendix for more details). All participants, across conditions, were informed that they eat the same number of calories each day.

Participants then responded to the dependent measure. This measure asked: “Now, you're deciding how many M&Ms to eat as a snack on the 31st of the month. How many M&Ms would you eat in this situation?” Participants selected their desired portion size using a 100-point sliding scale which displayed the low and high values provided by each participant in the introductory questions as the range. This measure represented each participant’s preferred portion size as a percentage of their self-reported portion size range. Participants then answered a question about the weight impact of M&Ms. Participants imagined that they “ate 1 serving of
M&Ms (32 M&Ms) as a snack on the 31st of the month.” They indicated: “How much impact would eating this 1 serving of M&Ms have on your weight?” on a scale from (1) Eating this has a very small impact on my weight to (7) Eating this has a very big impact on my weight.

Participants then responded to a manipulation check asking how often they eat M&Ms, based on the information seen in the survey, on a scale from (1) Not often at all to (7) Very often. Participants then responded to an IMC asking them to perform a simple math calculation based on a short scenario. Age and gender were appended to the data by Positly.

Results and Discussion

*Manipulation check and baseline consumption.* An ANOVA was used to compare the perceived consumption frequency of M&Ms between frequent and infrequent conditions. Results showed a significant difference between conditions such that M&Ms were perceived to be eaten more often in the frequent (vs. infrequent) condition ($M_{FREQ} = 5.74$, SD = 1.39; $M_{INFREQ} = 2.43$, SD = 1.49), $F(1, 185) = 247.12, p < .001, \eta^2 = .57$.

In the initial statement of their typical consumption patterns, participants indicated that they would eat, on average, between 13.37 (SD = 11.91) and 49.12 (SD = 76.34) M&Ms. This amount did not vary by condition ($F$s < 1).

*Portion size.* An ANOVA using the measure of portion size relative to an individual’s provided range as the dependent variable revealed that participants in the infrequent condition indicated a preference for larger portions. On average, participants in the frequent condition selected a portion at the 44.38th percentile of their range (SD = 33.25), while participants in the
infrequent condition selected a portion at the 66.56th percentile of their range (SD = 29.40; $F(1, 185) = 17.34, p < .001, \eta^2 = .09$). When translated from the relative measure to M&Ms consumed, this equates to a more than 20 percent increase in selected portion size, from 30 M&Ms in the frequent condition to 37 M&Ms in the infrequent condition.

Weight impact and mediation. An ANOVA using the weight impact measure as a dependent variable revealed that M&Ms were perceived as having a lesser impact on one’s weight when participants were in the infrequent (vs. frequent) condition ($M_{FREQ} = 3.13, SD = 1.68; M_{INFREQ} = 2.21, SD = 1.48; F(1, 185) = 15.78, p < .001, \eta^2 = .09$).

We examined whether weight impact can be used as a meaningful mediator using the procedures outlined in Pieters (2017). Weight impact and portion size were significantly correlated ($r(185) = -.225, p = .002$). A “sweetspot analysis” indicated that these parameters fall into the region of statistically meaningful mediation, according to the strict criteria (Pieters 2017). A bootstrapping technique with 95% confidence intervals and 5000 samples was used to test for mediation (Hayes 2013, model 4). Results revealed a significant indirect effect of frequency on portion size through weight impact ($B = 1.43, [LLCI: .0638, ULCI: 3.1239]$). The remaining direct effect was significant ($B = 8.16, [LLCI: 3.266, ULCI: 12.826]$).

Discussion. We replicated results from the archival data in study 1 in a controlled experimental setting using a scenario study, and provided causal evidence for the relationship between frequency and portion size intentions. Specifically, this study demonstrated that consumers indicate a preference for larger portions of the same food when they perceive to consume it infrequently (vs. frequently; hypothesis 1). These results were driven by beliefs about
weight impact. Consumers believe that a single portion of a food has less impact on their weight when it is consumed infrequently (vs. frequently). These results emerged when consumers considered an identical food (M&Ms), suggesting that our results cannot be explained by naturally occurring differences between foods that people tend to eat frequently versus infrequently (e.g., scarcity, premiumness, indulgence, etc.).

**STUDY 3: COMPENSATION DECISIONS**

Study 3 aimed to build on findings from prior studies in several ways. First, this hypothetical study examined the causal effect of frequency on compensation decisions (hypothesis 2), and included a test of mediation through perceptions of weight impact (hypothesis 3). Results supporting our hypotheses would suggest that the influence of perceived frequency on perceptions of weight impact has consequences not only for consumption in the moment, but also downstream consequences for intended consumption later in the day.

Second, the study examined decisions for another person, rather than decisions for oneself. This distinction is particularly relevant for identifying whether motivational forces drive previously observed findings (e.g., optimism bias; Miles and Scaife 2003). It is possible that consumers’ lay beliefs and consumption decisions in studies 1 and 2 reflected a heightened desire to consume infrequent foods. If the effect persists when evaluating another person’s consumption decisions, this would suggest that the results do not arise primarily based on one’s desires or overly optimistic perceptions of one’s own consumption.

Third, this study provided objective caloric information about the focal foods, and tested whether beliefs about frequency continued to affect perceived impact and compensation. If
effects persist in light of this information, it would suggest that differences in caloric estimation are unlikely to be driving the effect.

Method

Participants. Two hundred and three participants completed study 3 through Positly in exchange for financial compensation. Nineteen participants failed the IMC (described below) resulting in a final sample of 184 participants ($M_{age} = 37.09$, $SD = 11.58$; 37% female, 1% other).

Design and Procedure. This study used a two-cell (frequent vs. infrequent) between-subjects design with counterbalanced stimuli. Upon entering this study, participants were presented with a calendar similar to that used in study 2, which displayed consumption for another person over the course of a month (see appendix B). Specifically, participants saw that someone named Bob ate a baseline food (popcorn vs. Doritos; counterbalanced between subjects) 17 times between the 1st and 30th of the given month. Each day’s snack was clearly displayed on the calendar, along with a statement of the caloric content (370 calories for each snack). Participants were then instructed to consider the highlighted food consumed on the 31st of the month (the focal food), and were randomly assigned to see either popcorn or Doritos as the focal food. In the frequent condition, the baseline food and the focal food were identical (e.g., popcorn throughout the month and popcorn on the last day of the month). In the infrequent condition, the baseline food and the focal food were different (e.g., popcorn throughout the month and Doritos on the last day of the month).
Participants were asked to consider only the food that Bob ate on the last day of the month, and responded to two variables of interest. First, participants indicated how impactful eating this portion of [popcorn/Doritos] was for Bob’s overall weight, on a scale from (1) Eating this has a very small impact on Bob's weight to (7) Eating this has a very big impact on Bob's weight. Next, participants were told that Bob maintains his weight by eating less at dinner if he eats a lot during the day. They were asked: “Should Bob eat less during dinner in order to make up for eating the serving of [popcorn/Doritos]?” on a scale from (1) Bob definitely should not eat less for dinner to (7) Bob definitely should eat less for dinner.

Participants then responded to a manipulation check asking how often Bob ate the focal food on a scale from (1) Not at all often to (7) Very often. Participants then responded to an IMC asking them to perform a simple math calculation based on a short scenario. Finally, participants reported their age and gender.

Results and Discussion

*Manipulation check.* An ANOVA was used to compare the perceived consumption frequency of the focal food between frequent and infrequent conditions, controlling for counterbalancing. Results showed a significant difference between conditions such that frequent foods were perceived as more frequently consumed compared to infrequent foods ($M_{FREQ} = 6.03$, SD = .89; $M_{INFREQ} = 1.42$, SD = 1.02), $F(1, 180) = 1056.81$, $p < .001$, $\eta^2 = .85$. Neither the counterbalancing factor, nor the interaction between the counterbalancing factor and condition were statistically significant ($F$s < 1). Results remain consistent irrespective of controlling for the counterbalancing factor.
Compensation. An ANOVA using the compensation measure as a dependent variable, controlling for counterbalancing, revealed that participants believed that others should compensate less after eating an infrequent (vs. frequent) food ($M_{FREQ} = 5.02$, SD = 1.48; $M_{INFREQ} = 4.37$, SD = 1.97), $F(1, 180) = 6.35, p = .013, \eta^2 = .03$. Neither the counterbalancing factor, nor the interaction between the counterbalancing factor and condition were statistically significant ($Fs < 1$). Results remain consistent without controlling for the counterbalancing factor.

Weight impact and mediation. An ANOVA using the weight impact measure as a dependent variable, and condition and counterbalancing as predictors, revealed that infrequent foods were perceived as having a lesser impact on one’s weight (vs. frequent foods; $M_{FREQ} = 4.11$, SD = 1.71; $M_{INFREQ} = 2.79$, SD = 1.76), $F(1, 180) = 26.21, p < .001, \eta^2 = .13$. Neither the counterbalancing factor, nor the interaction between the counterbalancing factor and condition were statistically significant ($Fs < 1$). Results remain consistent without controlling for the counterbalancing factor.

We examined whether weight impact can be used as a meaningful mediator using the procedures outlined in Pieters (2017). Weight impact and compensation were significantly correlated ($r(182) = .433, p < .001$). A “sweetspot analysis” indicated that these parameters fall into the region of statistically meaningful mediation according to the lenient criterion (Pieters 2017). A bootstrapping technique with 95% confidence intervals and 5000 samples was used to test for mediation, including the counterbalancing factor as a covariate (Hayes 2013, model 4). Results revealed a significant indirect effect of frequency on compensation through weight
impact (B = 0.263, [LLCI: .1403, ULCI: .4176]) when controlling for the counterbalancing factor. The remaining direct effect was no longer significant (B = 0.0618, [LLCI: -.1607, ULCI: .2852]). These results remain consistent when excluding the counterbalancing factor as a covariate.

Discussion. In this scenario study, the same foods were deemed less consequential for another’s weight and viewed as requiring less dietary compensation when they were perceived as infrequent versus frequent (hypothesis 2, hypothesis 3). Importantly, these patterns emerged when participants evaluated identical foods in a counterbalanced design, further supporting the conclusion that food-related characteristics other than frequency did not drive differences between conditions. Further, since this study examined judgments about another person’s consumption, it suggests that motivational forces, such as optimism bias (Miles and Scaife 2003), are unlikely to be driving the observed effects.

Additionally, we prominently displayed information about the identical caloric content of snacks to participants, and held overall monthly consumption constant. The persistence of differences across conditions in light of this information about caloric content suggests that caloric misestimation is unlikely to be a main driver of our results. Further, these results speak to the ongoing debate about the efficacy of nutritional labeling (Cecchini and Warin 2016; Hawley et al. 2011) by demonstrating that certain biases regarding food consumption can persist despite the explicit presence of caloric information.

STUDY 4: IMPLICIT ASSOCIATIONS BETWEEN FREQUENCY AND WEIGHT IMPACT
In studies 2 and 3, participants reported believing that infrequent foods were less consequential for their weight than comparable frequent foods. In study 4, we explored whether this belief is also held implicitly. If consumers implicitly associate infrequent foods with reduced impact of consumption, it would be consistent with the possibility that infrequent (vs. frequent) foods pose a threat to self-regulation on an implicit level. We tested whether, on average, consumers hold a mental association between the frequency of foods and their impact using the IAT (Greenwald, McGhee, and Schwartz 1998; Greenwald, Nosek, and Banaji 2003). Specifically, we compared the perceived impact on weight of foods that consumers come across frequently (i.e., different types of candy) with identical but less frequently consumed foods (i.e., yoked candy in holiday-themed packaging).

Method

Participants. A total of 204 MTurk workers were recruited through Positly to complete this study in exchange for monetary payment. We excluded participants who failed the IMC (N = 13, described below). We used an IAT analysis tool (Carpenter et al. 2019) that removed an additional 33 participants after applying standard protocols for analyzing the IAT (Greenwald et al., 1998; Greenwald et al., 2003; described below). The final sample included 157 participants (38% female, 1% other; $M_{age} = 37.39.35$, $SD = 10.72$).

IAT Procedure. This study used the IATGEN program to execute the IAT (Carpenter et al. 2019). Participants were first told they would perform a timed task where they categorized
items by pressing keys on their keyboard. The stimuli consisted of phrases or images from one of four categories: images of frequent candy (e.g., packages of mini-sized M&Ms, Reese’s, candy variety packs, etc.), images of yoked infrequent candy (e.g., holiday-themed packages of mini-sized M&Ms, Reese’s, candy variety packs, etc. from different holidays throughout the year), phrases associated with high weight impact (e.g., impacts my weight, consequential for my weight), and phrases associated with low weight impact (e.g., DOES NOT impact my weight, NOT consequential for my weight). For a full list of stimuli, see the web appendix.

Participants completed seven blocks of trials, including the four focal blocks used for analysis. In the focal trials, participants were exposed to a phrase or image in the middle of their screen. They pushed a key on their keyboard as quickly as possible to categorize the stimuli as belonging to one of two sets of category labels, presented on the top right (two labels) and top left (two labels) of their screen. In two focal blocks, the paired labels were compatible with our hypothesized lay theory. Specifically, participants categorized stimuli as belonging to: “regular candy OR impacts weight” versus “holiday candy OR DOES NOT impact weight”. In the remaining two focal blocks, the paired labels were incompatible with our hypothesized lay theory. In these blocks, participants categorized stimuli as belonging to: “regular candy OR DOES NOT impact weight” versus “holiday candy OR impacts weight”. The order of the blocks (e.g., compatible trials followed by incompatible trials) was counterbalanced, as was the presentation of the categories on the left or right of the screen. If participants were faster to sort words into category pairs compatible (vs. incompatible) with the lay theory, it would suggest participants hold an implicit mental association between food frequency and weight impact. After the IAT procedure, participants responded to two manipulation check questions asking about the frequency of consuming the non-holiday foods and the holiday foods shown on scales
from (1) Not at all frequently to (7) Very frequently. Lastly, participants responded to an IMC asking them to perform a simple math calculation based on a short scenario. Participants’ age and gender was appended to the data by Positly.

Results and Discussion

We used the IATGEN program for analysis (Carpenter et al. 2019). The program removed 33 participants using the criteria set forth by the IAT scoring algorithm (i.e., those with trial response latencies greater than 10,000 milliseconds and those whose response times were less than 300 milliseconds on more than 10% of the critical block trials; Greenwald et al. 2003).

*Manipulation check.* A paired samples t-test confirmed that holiday foods were consumed less frequently compared to non-holiday foods ($M_{\text{FREQ}} = 3.48$, $SD = 1.74$; $M_{\text{INFREQ}} = 2.85$, $SD = 1.74$), $t(156) = 6.09$, $p < .001$, $d = .48$.

*IAT D-Score.* Participants were faster to categorize stimuli when exposed to category labels congruent (vs. incongruent) with the proposed lay theory. The validated IAT scoring metric (i.e., D-score; Greenwald et al. 2003) showed a significant difference (i.e., a D-score significantly different from 0), such that response times were faster on trials compatible (vs. incompatible) with the lay theory ($M_{\text{D-score}} = -0.15$, $SD = 0.41$, $t(156) = -4.51$, $p < .001$; $d = 0.36$). Over 62% of participants had negative D-scores, suggesting an implicit belief in the lay theory.
Discussion. These findings revealed that participants held an implicit association between a food’s frequency and its impact on weight. That is, infrequently consumed foods were associated with beliefs that these foods are inconsequential for one’s weight (vs. frequently consumed foods). In this study, we used holiday packaging to manipulate frequency. This study design is well-suited to the IAT, which requires automatic responses to visual stimuli. Furthermore, the real-world importance of understanding how consumers react to food packaging increases the contribution of this design. However, one consequence of using these stimuli is that multiple factors may co-vary alongside frequency. Importantly, our effects persist in earlier studies (2 and 3) in the paper, which hold the target foods and presentation identical.

**STUDY 5: MODERATION BY BELIEFS**

In study 4, we presented evidence of an implicit association between weight impact and frequency, an association which was also held explicitly (studies 2 and 3). Further, explicit beliefs that a particular infrequent food had less weight impact than a matched frequent food mediated the relationship between food frequency and compensation decisions (studies 2 and 3; hypothesis 3). We theorized that the belief that specific foods are less consequential for weight when they are infrequent emerges as a result of a more general belief that food types that one does not eat frequently are inconsequential when considering one’s overall diet. That is, consumers may judge a single cookie as less impactful for one’s weight when cookies in general are not particularly impactful for one’s weight overall.

The current study used a hypothetical scenario to examine whether consumers hold a general belief that infrequent foods are less consequential for one’s weight. Further, it tested
whether consumers who hold this general belief were more likely to indicate a preference for decreased compensation following the consumption of infrequent (vs. frequent foods) relative to those who do not hold this general belief. We hypothesize that the extent to which participants hold the general belief that infrequent foods have less impact will moderate the observed relationship between frequency and compensation decisions. Since we would expect that one could only misapply a belief that they hold, this moderation would provide evidence of overgeneralization.

Method

Participants. Six hundred and six workers from MTurk were recruited through Positly to participate in a short survey in exchange for financial compensation. Twenty-two participants failed the IMC (described below) resulting in a final sample of 584 participants ($M_{age} = 39.24$, $SD = 12.56$, 1 missing; 45% female, 1% other).

Design and Procedure. This two-cell (frequent vs. infrequent) between-subjects design with a measured moderator presented participants with a hypothetical scenario about their consumption over the course of a month. This study design was similar to studies 2 and 3, in which all participants saw a calendar with images of the snacks they had eaten throughout the month (see web appendix). All participants imagined eating the same focal food on the last day of the month (two chocolate chip cookies), and answered questions about the consequences of eating this focal food. Participants were randomly assigned to one of two conditions. In the frequent condition, the focal food was additionally consumed on 17 days throughout the month.
In the infrequent condition, a different food (a package of potato chips) was consumed on 17 days throughout the month.

Participants were asked to focus on the snack they consumed on the last day of the month (two chocolate chip cookies), which was held constant between conditions. Participants read that they were concerned about gaining weight and were considering making up for eating the focal food by eating less during their next meal. They were instructed to exclusively consider their consumption on the last day of the month, and were asked: “How likely are you to eat less during your next meal in order to make up for eating two chocolate chip cookies?” on a scale from (1) Not at all likely to eat less to (7) Very likely to eat less. Participants then estimated the number of calories in the cookies shown previously. As a manipulation check, participants indicated how often they eat chocolate chip cookies, given the information in the study, on a scale from (1) Not at all often to (7) Very often. Participants then responded to a question measuring explicit beliefs about the general impact of infrequent foods: “I believe that foods that I only eat once in a while do not influence my weight very much,” on a scale from (1) Strongly disagree to (7) Strongly agree. Lastly, participants responded to an IMC asking them to perform a simple math calculation based on a short scenario. Participants’ age and gender was appended to the data by Positly.

Results and Discussion

---

1 Participants also answered a question about the timeframe they considered when completing the study. Since we do not have a clear prediction for or interpretation of this question, we do not analyze it further. Details and data for this question are available on OSF.
Manipulation check. An ANOVA was used to compare the perceived consumption frequency of the focal food between the frequent and infrequent conditions. Results showed a significant difference between conditions such that the focal food was perceived as more frequently consumed in the frequent (vs. infrequent) condition ($M_{FREQ} = 5.53$, $SD = 1.54$; $M_{INFREQ} = 2.08$, $SD = 1.60$), $F(1, 582) = 706.33$, $p < .001$, $\eta^2 = .55$.

Compensation. An ANOVA using the compensation measure as a dependent variable revealed a significant effect of condition ($M_{FREQ} = 5.45$, $SD = 1.60$; $M_{INFREQ} = 5.02$, $SD = 1.77$), $F(1, 582) = 9.40$, $p = .002$, $\eta^2 = .02$. Consumers were less likely to compensate for eating an infrequent (vs. frequent) food.

Caloric estimation. First, we removed four outliers whose estimates were greater than three standard deviations from the mean, defined within each condition. Results remain consistent when these participants were included. An ANOVA using the caloric estimates as a dependent measure and condition as an independent factor revealed no difference in caloric estimates for the two chocolate chip cookies ($M_{FREQ} = 254.02$, $SD = 121.96$; $M_{INFREQ} = 257.00$, $SD = 121.05$, $F < 1$).

Beliefs. Overall, participants held the belief that infrequent foods are not impactful for their weight ($M = 4.59$, $SD = 1.70$), with reported beliefs significantly above the midpoint of the scale, one-sample t-test versus 4: $t(583) = 8.35$, $p < .001$, $d = 0.64$. Further, these beliefs did not differ between the infrequent and frequent conditions ($M_{FREQ} = 4.59$, $SD = 1.65$; $M_{INFREQ} = 4.58$, $SD = 1.74$, $F < 1$). This consistency across conditions suggests that the question measured
general beliefs, as intended by the experimental design (vs. beliefs specific to the impact of one particular food).

Importantly, these beliefs moderated the relationship between frequency and compensation. A linear regression that included condition (-1 = infrequent, 1 = frequent), mean centered beliefs, and the interaction between these two measures revealed no significant main effect of condition, $B = -.309, SE = .200, t = -1.54, p = .124$, and no significant main effect of beliefs, $B = -.048, SE = .041, t = -1.17, p = .244$. The data revealed a significant interaction, $B = .114, SE = .041, t = 2.78, p = .006$. A bootstrapping analysis (Hayes 2013, Model 1) using the Johnson-Neyman technique sheds further light on this relationship and revealed significant moderation when beliefs were above 3.98, reflecting over 72% of the sample.

Discussion. These results conceptually replicate findings from studies 1 and 3, and use a scenario study to show that intentions of how much to eat following the imagined consumption of a focal food is greater when that focal food is perceived as infrequent versus frequent. Importantly, these results were qualified by an interaction with general beliefs. That is, the difference in reported compensation likelihood for infrequent versus frequent foods was larger for participants who explicitly held the general belief that infrequent foods have less impact on their weight. Together, these findings support the hypothesis that consumers’ beliefs that infrequent foods have less impact drive the relationship between foods’ perceived frequency and stated compensation decisions (hypothesis 3). Further, this study provides additional support for the conclusion that the effect is unlikely to be driven by differences in caloric estimates since participants do not report differences in caloric estimates across conditions.
In the current study, we aimed to help consumers overcome biases associated with consuming infrequent foods by using a brief informational intervention. This intervention was intended to undermine the diagnosticity of participants’ lay beliefs. According to the accessibility-diagnosticity framework, consumers will only apply a particular lay theory when it is both accessible and perceived to be diagnostic (Feldman and Lynch 1988; Herr, Kardes, and Kim 1991; Menon, Raghubir, and Schwarz 1995; Zane, Smith, and Reczek 2020). When making consumption decisions, our results suggest the belief that infrequent foods have less impact on consumers’ weight is both accessible and perceived to be diagnostic (i.e., sufficient to draw a conclusion). If consumers are led to question the diagnosticity of this lay theory, they should be less likely to rely on it when making consumption decisions. As such, communicating that this lay theory leads to inaccurate assessments when evaluating a single consumption episode may mitigate or eliminate differences in consumption decisions across infrequent and frequent foods.

In the current study, we informed participants of the widespread tendency to neglect infrequent foods.

While this intervention may appear straightforward, informing people about many behavioral biases does not eliminate them. For example, base-rate and conjunction fallacies (Kahneman and Frederick 2002), overconfidence (Besharov 2004), the curse of knowledge (Camerer, Loewenstein, and Weber 1989), and projection biases (Camerer et al. 2003), can all persist or increase in light of information about the biases. To maximize the external validity of our manipulation, participants self-generated foods that they themselves considered to be
infrequent versus frequent. As in study 2, the current study examines hypothetical portion size decisions for infrequent versus frequent foods.

Method

Participants. Four hundred MTurk participants were recruited through Positly in exchange for financial compensation. Fourteen participants were eliminated for failing the IMC (described below) and one additional person was removed for not naming a food resulting in a final sample of 385 participants ($M_{age} = 38.48$, $SD = 11.83$, 2 missing; 44% female, 1 missing).

Design and Procedure. This study used a 2 (food: infrequent vs. frequent) x 2 (debias: control vs. debias) between-subjects design. Upon entering the survey, participants were randomly assigned to name either a frequently consumed or infrequently consumed food that they enjoyed eating. Participants randomly assigned to the debiasing condition were asked to read a passage about current academic research, which explained that “people underestimate the dietary impact of foods that they don't eat often”. This passage included the recommendation that “we should not let the frequency with which we eat a certain food affect our judgments about eating that food” (see web appendix for full text). To encourage participants to read the text provided, participants were asked to complete the following sentence, which appeared directly below the text: “When judging the impact of foods, people...” (1) Shouldn’t consider how often they eat foods, (2) Should consider how often they eat foods, (3) I’m not sure.

All participants imagined that they were planning to eat their self-generated food during the next meal. Participants were asked “What size portion would you plan to eat?” on a scale
from (1) Much smaller than usual to (7) Much larger than usual. Participants then responded to a manipulation check about the frequency of consumption of their self-generated food on a scale from (1) I don’t eat it often at all to (7) I eat it very often. Finally, participants responded to an IMC that asked participants to perform a simple math calculation based on a short scenario. Age and gender were appended to the data by Positly.

Results and Discussion

Manipulation check. An ANOVA including the food condition (infrequent vs. frequent) and debiasing condition (control vs. debiasing) was used to test the impact of the manipulations on the perceived frequency of eating the self-generated food. Results revealed only a main effect of food condition such that participants in the frequent condition indicated eating their self-generated food more frequently than participants in the infrequent condition ($M_{FREQ\ CONTROL} = 5.63, SD = 1.06; M_{FREQ\ DEBIAS} = 5.75, SD = 1.26; M_{INFREQ\ CONTROL} = 2.37, SD = 1.37; M_{INFREQ\ DEBIAS} = 2.11, SD = 1.21), F(1, 381) = 742.91, p < .001, \eta^2 = .66. Neither the main effect of debiasing, $F < 1$, nor the interaction between food condition and debiasing condition, $F(1, 381) = 2.27, p = .132, \eta^2 = .01$, were significant.

Portion size. An ANOVA using the portion size measure revealed significant differences between conditions ($M_{FREQ\ CONTROL} = 4.24, SD = .94; M_{FREQ\ DEBIAS} = 4.16, SD = .90; M_{INFREQ\ CONTROL} = 5.07, SD = 1.17; M_{INFREQ\ DEBIAS} = 4.39, SD = 1.09, see figure 2). There was a main effect of the food condition such that participants reported larger portion size preferences for infrequent (vs. frequent) foods, $F(1, 381) = 25.12 p < .001, \eta^2 = .06$. There was also a main
effect of the debiasing manipulation such that participants reported smaller portion size preferences in the debiasing (vs. control) condition, $F(1, 381) = 12.75, p < .001, \eta^2 = .03$. These main effects were qualified by a significant interaction, $F(1, 381) = 8.15, p = .005, \eta^2 = .02$.

Decomposing this interaction into simple effects revealed that participants in the control condition indicated a preference for larger portion sizes for infrequent (vs. frequent) foods, $F(1, 381) = 31.27, p < .001, \eta^2 = .07$. In contrast, the portion size preferences of participants in the debiasing condition did not differ for infrequent (vs. frequent) foods, $F(1, 381) = 2.30, p = .130, \eta^2 = .01$. The opposite simple effects yielded a pattern of results consistent with our theorizing.

Participants in the infrequent condition indicated a preference for larger portion sizes in the control condition (vs. debiasing), $F(1, 381) = 20.34, p < .001, \eta^2 = .05$. In contrast, the portion size preferences of participants in the frequent condition did not differ as a consequence of the debiasing manipulation, $F < 1$. All results remain consistent when excluding participants who did not correctly answer the comprehension check following the debiasing manipulation. However, this analysis differentially excludes participants between conditions and is not discussed further.

**Discussion.** In this scenario study, participants indicated a preference for larger portion sizes of infrequent foods; however, a debiasing manipulation attenuated this effect. When participants read a short passage explaining that frequency is not diagnostic for evaluating the impact of foods on one’s weight, differences in portion size preferences between infrequent versus frequent foods were no longer significant. This study provides initial support for the possibility that consumers can learn to overcome this bias, and offers informational interventions as a launching point that policy-makers seeking to promote healthier eating can explore further.
GENERAL DISCUSSION

All foods can be characterized on a continuum from frequent to infrequent. In the current work, we provided evidence that frequency is a critical factor in consumption decisions. When participants encountered foods perceived as infrequently consumed, they tended to select larger portions of these foods and planned to compensate less in subsequent consumption decisions (studies 1-3, 5 and 6; hypothesis 1, hypothesis 2). These patterns held in the context of both real (study 1) and hypothetical (studies 2, 3, 5 and 6) consumption. We proposed that these decisions are driven by consumers’ beliefs about the weight impact of infrequent foods (hypothesis 3). Consistent with this theorizing, our results identified participants’ tendency to implicitly (study 4) and explicitly (studies 2-3, 5) believe that infrequent foods do not matter as much for their weight. Participants then misapplied this belief to reported consumption decisions (studies 5 and 6). Finally, we found that a straightforward informational intervention to alter the diagnosticity of participants’ beliefs could mitigate biased choices. Specifically, when participants learned that frequency was not relevant for identifying the impact of a specific consumption occurrence on weight, they chose equal portion sizes of frequent and infrequent foods (study 6; hypothesis 3).

The robustness of these effects is underscored by our examination of when they occur. Overall, beliefs about frequency guided consumption decisions for identical foods that varied only in their perceived frequency (studies 2 and 3). However, we identified boundary conditions...
when considering different types of consumers. Specifically, a subset of consumers do not hold the lay belief that infrequent foods matter less for weight (approximately 28%-38% of our sample, implicitly in study 4 and explicitly in study 5). For this subset, reported consumption decisions were independent of a food’s frequency (study 5).

In addition to the studies reported in the paper, a study reported in the web appendix allowed participants to generate their own infrequent foods, which they then imagined eating either frequently or infrequently over the course of a month. The participant-generated stimuli in this study allowed us to test for the hypothesized patterns across a broad range of foods. The study measured participants’ beliefs about the impact of a single consumption episode on their weight; their planned consumption for later in the day; their weight loss goals; as well as perceptions of the target foods’ healthiness, premiumness, indulgence, scarcity, and caloric content. Results suggest that the influence of frequency on hypothetical consumption decisions is independent of each of the food-related factors measured. Specifically, we observe neither main effects nor interactions between these variables and condition in predicting hypothetical consumption decisions. This study, alongside the archival data presented in study 1, suggest that the effects examined generalize beyond the specific snacks (e.g., cookies, candy) used in studies 2-5. Further, despite varying self-regulatory goals, all participants held the belief that infrequent foods have less impact on consumers’ weight. However, the tendency to apply these beliefs to consumption decisions emerged primarily among consumers with weight-maintenance goals.

Our studies identify relative differences across frequent and infrequent foods, but they do not establish a clear baseline as a point of comparison for these differences. Given consumers’ varied goals, our research does not provide normative suggestions regarding the relationship between how much people consume and their overall well-being. Consumers may be under
consuming frequent foods in absolute terms, implying that the level of consumption of infrequent foods may be closer to correct. Individual differences, including current consumption habits and weight-related goals, are likely to interact in determining the best course of action. For example, a substantial portion of consumers may value an increase in consumption of hedonic foods. For these consumers, as well as those seeking to gain weight, the biased treatment of infrequent versus frequent calories may be helpful. In contrast, this bias may create an additional challenge for consumers with weight loss or weight maintenance goals.

Theoretical Implications

The current research adds to our theoretical understanding of biases that threaten the self-regulatory process. Prior research has identified a feedback loop involving three key stages required for self-regulation (Baumeister and Heatherton 1996). First, consumers must have a goal (i.e., standards). Second, consumers must monitor their progress by comparing their actual state to their standards. Finally, consumers must alter the current state when it falls short of their standards.

Since the judgment regarding the weight impact of a certain food is likely to occur in the monitoring stage, our bias is consistent with a breakdown of monitoring. Monitoring failures are commonly attributed to failures in tracking consumption (Heatherton and Baumeister 1991; Polivy 1976) either by omitting consumption occasions or recording biased caloric counts. However, our work documents biases in consumption conditional on foods that have been recorded (study 1). Further, we have shown that biased caloric perceptions are unrelated to this effect (studies 3, 5, web appendix study 1).
The bias in estimations of weight impact that we identified may correspond to perceptions of goal progress such that consumers may see themselves as closer to their goals after consuming an infrequent (vs. equally caloric frequent) food. In the current work, we limit our examination to portion size and compensation decisions. However, this work may have broader consequences for research on goal pursuit. For example, consumers may overestimate their progress towards goals after consuming a nutritionally identical infrequent (vs. frequent) meal.

The current research focuses on consumption frequency as an important dimension leading consumers to differentially weight the relevance of a given consumption episode for their diet. However, consumption frequency may be only one aspect of a broader construct leading a consumption experience to feel exceptional. While the current research controlled for other characteristics that may make a food feel exceptional, such as scarcity, indulgence, or premiumness, these characteristics may similarly have consequences for perceptions of weight impact and food choices. Additionally, a variety of factors may influence perceptions of consumption frequency. For example, a particular food eaten in an infrequent context (e.g., party, vacation) may be perceived as less frequent and therefore less impactful than the same food eaten in a frequently encountered context (e.g., a Tuesday night at home). Future research should examine whether findings relating to frequency in the current work may extend to other aspects of exceptionality and other sources of variation in perceived frequency.

Our work has implications for existing literature on how consumers compensate for deviations from quantities that they typically consume. For example, O’Brien and colleagues (2018) find that consumers do not adequately adjust consumption following a dietary splurge. While the authors control for the frequency of foods in their research, we show that consumers
are more likely to splurge on infrequent foods. Consequently, their effects may be particularly pronounced for infrequent foods. These two complementary effects may compound, further threatening achievement of consumers’ self-regulatory goals.

Practical Implications

Our research offers guidance to consumers, policy makers, and firms who seek to reduce overeating and obesity. Our work identifies a novel bias in food consumption, which may be particularly problematic for those with specific weight-related goals. The work suggests that dieters may not recognize that eating 400 calories of birthday cake at a party is as destructive for their weight-loss goals as eating a 400 calorie milkshake from their kitchen. This may lead them to overconsume infrequent foods, despite explicit efforts to manage their weight (study 1).

However, our research provides evidence that consumers can learn to overcome this bias. Specifically, we find that informing participants that the “infrequent foods don’t matter” lay belief is not diagnostic when evaluating a single consumption occasion led them to choose equal portions of frequent and infrequent foods in a hypothetical setting. As interventions to support healthy eating are gaining increased interest, we provide preliminary evidence of a simple and scalable method that could assist stakeholders in improving consumer welfare. Future research could consider using information interventions to mitigate this bias and assess the long-term impact of such interventions.

Our research also speaks to existing strategies that aim to help consumers manage their weight. For example, monitoring caloric consumption (i.e., tracking calories) is one common strategy (Burke et al. 2010; Harkin et al. 2016). However, we find that consumers continue to eat
larger portions and compensate differentially for infrequent consumption even when meticulously tracking foods using a calorie tracking app. Another strategy, widely adopted by policy-makers, is to provide nutrition labels informing consumers of a foods’ caloric content (Cecchini and Warin 2016; Hawley et al. 2011). Our research highlights limitations of these labels as well. In our research, we clearly present caloric information for participants (study 3). Nonetheless, a food’s frequency continues to drive beliefs and consumption decisions. Future research should explore whether alternative labeling of a food’s nutritional content (e.g., traffic light labels, Cecchini and Warin 2016) would be more effective.

While labeling calories may not be sufficient to overcome this bias, food packaging can influence consumer behavior. Our findings suggest that the information presented on packages may provide important cues that alter consumers’ evaluations of frequency with downstream consequences for consumption and sales. When the chocolate brand Toblerone replaced its brand name with the festive phrase ‘Ho Ho Ho,’ on its packaging in 2006, it saw sales increase by 400% (Industry Europe 2018). The current research suggests that, alongside other factors, perceptions of infrequency and subsequent beliefs about weight impact may have contributed to this sales growth. For example, as shown in study 4, presenting an identical food in holiday packaging automatically triggers perceptions of infrequency and corresponding implicit beliefs. Consequently, both marketers and policymakers should carefully consider the effects of packaging on frequency perceptions and consumption.
**Data Collection Paragraph**

Data for study 1 were received from a weight-loss app company, with records from summer 2014 to fall 2015. The data for study 2 and the pretest were collected using Positly in the winter of late 2020. The data for studies 3 and 4 were collected using Positly in the summer of 2020. The data for studies 5 and 6, as well as the data for the web appendix study, was collected using Positly in the spring of 2020. The first and second authors collected and analyzed the data for all studies.
APPENDIX A

Stimuli for Study 2: Portion Size

Frequent Condition:

```
<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
<th>SATURDAY</th>
<th>SUNDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>2</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>3</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>4</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>5</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>6</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>7</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
</tbody>
</table>
```

Infrequent Condition:

```
<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
<th>FRIDAY</th>
<th>SATURDAY</th>
<th>SUNDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>2</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>3</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>4</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>5</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>6</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
<tr>
<td>7</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
<td>🍎</td>
</tr>
</tbody>
</table>
```

Question marks indicate missing images for the Frequent Condition.
### APPENDIX B

Stimuli for Study 3: Controlled Foods (Popcorn as the baseline food)

<table>
<thead>
<tr>
<th>Frequent Condition</th>
<th>Infrequent Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MONDAY</strong></td>
<td><strong>MONDAY</strong></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>TUESDAY</strong></td>
<td><strong>TUESDAY</strong></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>WEDNESDAY</strong></td>
<td><strong>WEDNESDAY</strong></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td><strong>THURSDAY</strong></td>
<td><strong>THURSDAY</strong></td>
</tr>
<tr>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td><strong>FRIDAY</strong></td>
<td><strong>FRIDAY</strong></td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td><strong>SATURDAY</strong></td>
<td><strong>SATURDAY</strong></td>
</tr>
<tr>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td><strong>SUNDAY</strong></td>
<td><strong>SUNDAY</strong></td>
</tr>
<tr>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

Note: For half the sample, Doritos were used as the baseline food (i.e., the images of popcorn and Doritos were reversed).
REFERENCES

Accounting Principles Board (1973), Opinion No. 30: Reporting the Results of Operations-
Reporting the Effects of Disposal of a Segment of a Business, and Extraordinary,
Unusual and Infrequently Occurring Events and Transactions. *Stamford, Conn.*

Nutrient Content Claims in Advertising,” *Journal of Marketing*, 65 (October), 62-75.

*Psychological Inquiry*, 7 (1), 1-15.


Academic.


Systematic Review of the Literature,” *Journal of the American Dietetic Association*, 111
(January), 92-102.

1232-1254.


Table 1

Study 1: Within-Meal Frequency Analysis

<table>
<thead>
<tr>
<th></th>
<th>Model 1 (Breakfast)</th>
<th>Model 2 (Breakfast)</th>
<th>Model 3 (Lunch)</th>
<th>Model 4 (Lunch)</th>
<th>Model 5 (Dinner)</th>
<th>Model 6 (Dinner)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
<td>B (SE)</td>
</tr>
<tr>
<td>(Constant)</td>
<td>-0.040 (0.021)</td>
<td>-0.225* (0.109)</td>
<td>-0.049* (0.019)</td>
<td>-0.281** (0.089)</td>
<td>-0.070*** (0.020)</td>
<td>-0.343*** (0.097)</td>
</tr>
<tr>
<td>Meal Infrequency</td>
<td>0.309*** (0.003)</td>
<td>0.309*** (0.003)</td>
<td>0.100*** (0.003)</td>
<td>0.100*** (0.003)</td>
<td>0.074*** (0.003)</td>
<td>0.073*** (0.003)</td>
</tr>
<tr>
<td>Demographic controls?</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Overall R²</td>
<td>0.024</td>
<td>0.076</td>
<td>0.002</td>
<td>0.124</td>
<td>0.000</td>
<td>0.098</td>
</tr>
<tr>
<td>N</td>
<td>178,499</td>
<td>178,182</td>
<td>176,352</td>
<td>176,052</td>
<td>192,856</td>
<td>192,537</td>
</tr>
</tbody>
</table>

NOTES.— *p < .05. **p < .01. ***p < .001; The relationship between the infrequency of foods consumed in a meal and the number of calories consumed in the same meal. Models 1 and 2 examine breakfast; models 3 and 4 examine lunch; models 5 and 6 examine dinner. Demographic controls include age, gender, and BMI.
Table 2

Study 1: Across-Meal Frequency Analysis

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td><strong>SE</strong></td>
<td><strong>B</strong></td>
<td><strong>SE</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>(Constant)</td>
<td>-0.091***</td>
<td>0.018</td>
<td>-0.092***</td>
<td>0.018</td>
</tr>
<tr>
<td>Pre-dinner calories</td>
<td>-0.272***</td>
<td>0.002</td>
<td>-0.273***</td>
<td>0.002</td>
</tr>
<tr>
<td>Pre-dinner infrequency</td>
<td>0.011***</td>
<td>0.003</td>
<td>0.015***</td>
<td>0.003</td>
</tr>
<tr>
<td>Pre-dinner calories x pre-dinner infrequency</td>
<td>0.011***</td>
<td>0.002</td>
<td>0.010***</td>
<td>0.002</td>
</tr>
<tr>
<td>Dinner infrequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographic Controls?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Overall R²</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
<td>0.085</td>
</tr>
<tr>
<td>N</td>
<td>192,856</td>
<td>192,856</td>
<td>192,856</td>
<td>192,537</td>
</tr>
</tbody>
</table>

NOTES.— *p < .05. **p < .01. ***p < .001; The relationship between the frequency of foods consumed before dinner and the number of calories consumed during dinner on the same day. Demographic controls include age, gender, and BMI.
FIGURE 1: CONCEPTUAL MODEL

Beliefs of Smaller Weight Impact

Infrequent (vs. Frequent) Foods  Increased Portion Size; Decreased Compensation
FIGURE 2: PORTION SIZE DECISIONS (STUDY 6)

Note: Mean responses and standard errors, by condition. Portion size was reported on a scale from (1) Much smaller than usual to (7) Much larger than usual.
ABSTRACT

LAY THEORIES OF FOOD CONSUMPTION

WHY CONSUMERS NEGLECT INFREQUENT FOODS AND WHY IT MATTERS

THE CURRENT RESEARCH

STUDY 1: ARCHIVAL ANALYSIS OF INFREQUENT FOODS

Method

Data cleaning.

Computing infrequency.

Computing caloric content and additional data cleaning.

Results and Discussion

Summary statistics

Within-meal results.

Across-meal results.

Robustness checks

Discussion

STUDY 2: PORTION SIZE DECISIONS

Method

Participants

Design and Procedure.

Results and Discussion

Manipulation check and baseline consumption.

Portion size
Weight impact and mediation

Discussion.

STUDY 3: COMPENSATION DECISIONS

Method

Participants.

Design and Procedure.

Results and Discussion

Manipulation check.

Compensation.

Weight impact and mediation.

Discussion.

STUDY 4: IMPLICIT ASSOCIATIONS BETWEEN FREQUENCY AND WEIGHT IMPACT

Method

Participants.

IAT Procedure.

Results and Discussion

Manipulation check.

IAT D-Score.

Discussion.

STUDY 5: MODERATION BY BELIEFS

Method

Participants.
Design and Procedure.

Results and Discussion

Manipulation check.

Compensation.

Caloric estimation.

Beliefs

Discussion.

STUDY 6: DEBIASING WITH INFORMATIONAL INTERVENTION

Method

Participants

Design and Procedure.

Results and Discussion

Manipulation check.

Portion size.

Discussion.

GENERAL DISCUSSION

Theoretical Implications

Practical Implications

APPENDIX A

APPENDIX B

REFERENCES