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Interference of the End: Why Recency Bias in Memory Determines When a Food Is Consumed Again

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The results of three experiments reveal that memory for enjoyment of the end rather than the beginning of a gustatory experience determines how soon people desire to repeat that experience because memory for end moments, when one is most satiated, interferes with memory for initial moments.

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Wink, Wink, Nudge, Nudge: The Behavioral Science of Eating

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Paper #1: Paper #1: Interference of the End: Why Recency Bias in Memory Determines When a Food is Consumed Again

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Paper #2: Paper #2: Happier with Less? Increasing the Hedonic Appeal of Smaller Portions with Enhanced Hedonic Sensory Imagery

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Paper #3: Paper #3: Making Choices when Sequentially Encountering Healthy and Unhealthy Options: The Role of Sensory Mode of Evaluation

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Paper #4: Paper #4: Consumption Patterns and Weight Loss

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SESSION OVERVIEW

Despite the fact that over 50% of Americans report wanting to lose weight (Brown 2013), the obesity rate has remained stable for nearly a decade (Cohen 2014). Regulators have attempted to aid consumers in their battle against obesity by imposing legislation to encourage more healthful eating (e.g., ban on large size sugary soft-drinks). However, many of these policies have been met with strong consumer reactance, and the effectiveness of these restrictive approaches has been questioned. In light of the limited success of these more paternalistic approaches, behavioral science has been advocated as an alternative means of nudging consumers towards more healthful consumption, since many behavioral interventions are subtle and less likely to evoke consumer reactance or resistance (Just et al. 2008; Sunstein and Thaler 2003). In addition, behavioral interventions are often easy and inexpensive to implement and have strong practical implications (Just et al. 2008). The theme of the proposed special session relates to “the behavioral science of eating” and how subtle behavioral interventions can nudge consumers towards more healthful consumption.

In the first paper, Morewedge, Garbinsky, and Shiv focus on how remembering end moments of a consumption experience can increase the interval between food consumption episodes. They find that recency effects lead consumers to remember the end (vs. initial moments) of a consumption episode. Since sensory specific satiety is higher at the end of a consumption episode, remembering the end (vs. initial moments) of consumption leads to longer interconsumption intervals. In the second paper, Cornil and Chandon identify hedonic sensory imagery as a possible means of nudging consumers towards more healthful food choices. Their results show that imagining consumption of small portions of hedonic foods leads to increased expected enjoyment of eating and can lead children and adults to choose smaller portions. Biswas, Szocs, and Inman examine how the sequential order in which consumers are exposed to healthy and unhealthy food items and the sensory mode of evaluation influence choice. They find that when consumers visually evaluate a sequence of healthy (H) and unhealthy (U) foods, preference for the healthy

option is greater for the H-U (vs. U-H) sequence. However, the effects reverse when consumers get to sample (i.e., taste) the products. Finally, Haws, Liu and Redden examine associations between consumption patterns and weight loss in a clinical weight loss trial and find that dietary variety as well as specific types of foods/beverages are associated with weight loss.

Collectively, the four papers in this session aim to address the important research question of how behavioral science can be applied to food contexts to aid consumers in making more healthful choices. The proposed special session brings together leading scholars and addresses behavioral science of eating using diverse methods (e.g., field experiments, lab experiments, and a longitudinal clinical trial) and multiple populations (e.g., adults, children, and dieters enrolled in a trial). We expect this session to have a broad appeal.

Interference of the End: Why Recency Bias in Memory Determines When a Food is Consumed Again

EXTENDED ABSTRACT

Portion sizes in the United States have been steadily increasing since the 1980s (Young & Nestle, 2002), which has affected both food intake and enjoyment. Larger portions imply larger normative amounts of food to consume, which increases overall intake. People finish the portion they are given whether it is a small or large portion (Geier, Rozin, & Doros, 2006). Increased intake also leads to greater sensory-specific satiety. As each bite of food is less pleasant than the one before it, eating more of a food reduces the average enjoyment of that food during a particular consumption experience (Rolls et al., 1981). Sensory-specific satiety is a major factor regulating food intake decisions in the present moment (e.g., Maier, Vickers, & Inman, 2007; Rolls et al., 1981), but if and how memory of past satiety affects future consumption decisions is unclear.

We suggest that a recency bias in memory leads satiety at the end of the food consumption experience to influence how long people wait until consuming that food again in the future. We argue that recency effects are especially likely to prevail in the gustatory domain because of memory interference. Interference is greater for more similar experiences, such that maximum interference occurs when experiences are identical (Oberauer & Kliegel, 2006). Eating, in many contexts, is a highly repetitive experience. A glass of juice, bowl of ice cream, or bag of potato chips contains many units of very similar stimuli that are consumed one sip or bite at a time until the entire portion has been eaten. We suggest that the repetitive nature of consumption should cause memory of the end of an experience to interfere with memory of the beginning, making the beginning less salient (Eysenck, 1977; Schank, 1982).

As memory for end moments of a consumption experience should interfere with memory for initial moments, we hypothesize that end enjoyment has a greater influence on the inter-consumption interval (ICI), defined as the number of days that pass until the consumption of a food is repeated. In this way, sensory-specific satiety influences future consumption as the more satiated a person is to a food, the lower their end enjoyment and thus the longer the interval until that food is consumed again. We report three experiments providing support for our hypothesis.

Experiment 1 examined whether recollection of initial or end enjoyment plays a greater role in determining the ICI. Controls ate a large or small portion of crackers and decided the next day when to

eat those crackers again. We used portion size to manipulate end enjoyment, as a larger portion should result in greater sensory-specific satiety at the end than a smaller portion. We also included two conditions in which participants were guided to recall a moment during their previous consumption experience before deciding when to eat the crackers again. In the end recall condition, participants recalled the end of their previous consumption experience. In the beginning recall condition, participants recalled the beginning of their previous consumption experience.

Recency effects played a larger role than did primacy effects in determining ICI. Participants in the control conditions who ate a larger portion desired a longer ICI than did participants who ate a smaller portion. Identifying the critical role of end satiety, end enjoyment of the consumption episode mediated the difference in ICI between the large and small portion conditions. Suggesting that better recollection of the end underlies this recency effect, participants in the end recall condition exhibited the same differences between conditions (and the mediating effect of end recall) as did controls. In contrast, participants in the beginning recall condition did not exhibit a difference in the desired ICI between the large and small portion conditions (so no mediation analysis could be performed).

Experiment 2 reversed the relationship between end enjoyment and amount eaten with a reset condition. *Controls* drank juice and then ate two crackers. Participants in the *reset condition* did the same, but also drank an additional sip of juice after a delay. The next day, all participants reported how soon (days until) they would like to consume the juice again. Our logic was that the crackers would partially reset adaption to the juice (Epstein et al., 1992), increasing end enjoyment for participants in the reset condition. We selected crackers to reset enjoyment because past research has shown that perceiving food as belonging to a different category is an important determinant of satiation (Redden, 2008). We found that end enjoyment rather than portion size determined ICI: Participants in the reset condition desired a shorter ICI than did controls despite having consumed more juice, and end rather than beginning enjoyment mediated this difference in ICI between conditions.

Experiment 3 directly tested whether end enjoyment is more influential because of memory interference. All participants drank 8oz of grape juice. After consuming each ounce, participants in the serial rating condition rated enjoyment on separate pages (one page per rating), whereas participants in the simultaneous rating condition rated enjoyment after each ounce on the same page (one page for all ratings). To rule out the potential influence of rating the food while consuming it (Larsen, Redden, & Elder, in press), we included a control condition that made no ratings during consumption. After consuming the juice, all participants retrospectively rated their initial enjoyment. The next day, all participants reported how soon (days until) they would like to consume the juice again.

As evidence that interference is responsible for the effect of end enjoyment on the ICI, the format of ratings in the simultaneous rating condition appeared to facilitate memory for initial enjoyment of the juice. Participants in the simultaneous rating condition better recalled their initial enjoyment of the juice than did participants in the serial condition. As we predicted, their better memory for initial enjoyment appeared to influence their desired delay: There was a shorter ICI for participants in the simultaneous condition than for participants in the serial and control conditions.

Happier with Less? Increasing the Hedonic Appeal of Smaller Portions with Enhanced Hedonic Sensory Imagery

EXTENDED ABSTRACT

Consumers generally expect that eating enjoyment increases with food quantity, especially if the food is palatable (Sorensen et al. 2003). In reality, eating a small portion is just as enjoyable as eating a large portion, and overall eating enjoyment can even decrease with larger portions (Rode et al. 2007; van Kleef et al. 2013). How can we make consumers realize that they will be happier with less food?

We know that the first bites of food are the most pleasant and that subsequent bites are decreasingly pleasant, a phenomenon called sensory-specific satiation, experienced by all individuals since infancy (Rolls et al. 1981). We also know that mentally simulating an experience makes people retrieve cognitive representations, emotions and bodily states related to that experience (Barsalou 2009). For instance, repeatedly imagining eating a food (at least 30 times) leads to a simulated state of satiety and decreases the desire to eat (Morewedge et al. 2010).

In the current research, we investigate how to lead consumers to choose smaller portions *without* satiating them or decreasing desire. We develop a new intervention, “enhanced hedonic sensory imagery”, which consists in vividly imagining the taste, smell and oro-haptic sensations of three tasty foods, prior to choosing a portion size. Mentally simulating a pleasurable sensory experience should help consumers retrieve more accurate representations of the relation between sensory pleasure and food quantity. Hence it should increase the hedonic appeal of smaller portions (higher pleasure anticipations from the first few bites), and simultaneously decrease the hedonic appeal of larger portions (better anticipation of sensory satiation), promoting the choice of smaller portions without affecting desire for the chosen portion. By considering hedonic sensory imagery as an ally of healthy eating, our hypothesis contrasts with past research, which identifies spontaneous sensory imagery as the trigger of food cravings, and suggests that blocking sensory cues or imagining negative consequences on health should help consumers control their food intake (Giuliani et al. 2013; Tiggemann and Kemps 2005).

In Study 1, 55 Americans were assigned to either an enhanced sensory imagery condition (imagine vividly the hedonic eating sensations of three desserts shown on pictures) or a control condition (rate office chairs). Then, all participants provided their maximum willingness to pay (WTP) for one small and one large slices of the same cake. The sensory imagery intervention had no main effect on WTP ($F < 1$), but significantly interacted with portion size ($F(1,53)=4.1, p < .05$): sensory imagery (vs. control) increased WTP for the small slice (resp. $M=\$3.0$; $M=\$2.3$) and directionally decreased WTP for the large slice ($M=\$3.8$; $M=\$4.0$).

In Study 2, we ruled out the alternative explanation that small portions are associated with higher-quality food by assigning 41 five-year old French children to a food sensory imagery condition (similar to study 1) or a non-food sensory imagery condition, in which they imagined non-food hedonic sensations such as feeling the sun on their skin. Subsequently, the children were asked to choose stickers of different sizes representing cakes and fruit juices and to choose portions of cake and juice for an afternoon snack. Across all four replications (cake sticker, juice sticker, real cake, real juice), food sensory imagery made children choose smaller portions (all p 's $< .03$).

Study 3 compared the effects of sensory and health imagery on both expected and experienced pleasure. We assigned 336 young French women (with heterogeneous dieting tendencies) to a food sensory imagery condition, a control condition, or a health imagery

condition in which they imagined how eating three desserts would impact their health and weight. Subsequently, one group rated the expected enjoyment of five portion sizes of brownies and chose one portion. Three other groups ate the smallest, the medium, or the largest portion and rated their actual enjoyment. We also examined moderating effects of dieting, expecting that sensory imagery would backfire in dieters, for whom hedonic thoughts about food lead to compensatory overeating (Stroebe et al. 2013). For normal eaters, both sensory imagery and health imagery led to choosing smaller portions compared to control (resp. $z=-2.19$, $p=.03$; $z=-2.45$, $p=.01$). However, health imagery decreased expected enjoyment of all portions compared to control ($z=-1.89$, $p=.06$), whereas sensory imagery increased expected enjoyment of smaller portions ($z=2.4$, $p=.02$) and decreased expected enjoyment of larger portions ($z=-2.05$, $p=.04$). Furthermore, a conditional logistic regression revealed that the choice of smaller portions was more determined by pleasure expectations in the sensory condition than in the health condition ($z=5.75$, $p<.001$). For dieters, sensory imagery backfired: it increased expected enjoyment of all portions ($z=3.5$, $p<.001$), leading to choice of larger portions ($z=2.03$, $p=.04$). Actual eating enjoyment was unaffected by the intervention and consistently decreased with size ($t=-4.8$, $p<.001$). Thus, sensory imagery led normal eaters to choose smaller portions which were, indeed, preferred before and after consumption.

In the last study, we showed that it is possible to enhance sensory imagery simply by using more vivid menu descriptions. 89 online Americans had to choose one size among six portions of cake. We provided vivid sensory information about the cake (sensory condition), information about fat and calories (health condition) or no information (control). Then, all participants chose one size among seven portions of whipped cream (no information in all conditions). Participants chose a smaller cake in both sensory and health conditions, compared to control (resp. $F(1,86)=4.7$, $p=.03$; $F(1,86)=3.7$; $p=.05$). The effect carried over to subsequent portion choice of cream in the sensory condition ($F(1,86)=3.7$; $p=.05$) but not in the health condition ($F<1$).

Overall, we show that enhanced hedonic sensory imagery increases the hedonic appeal of smaller (but not larger) portions, leading to moderation *without* hedonic cost. This suggests a way for food marketers to switch from a quantity business model to one focused on the quality of sensory experience. Thereby, marketers could decrease portions sizes and increase price per gram while keeping consumers satisfied. Marketers would also address the growing concerns about the contribution of increasing portion sizes to the obesity epidemic (Nestle 2003).

Making Choices when Sequentially Encountering Healthy and Unhealthy Options: The Role of Sensory Mode of Evaluation

EXTENDED ABSTRACT

Suppose while browsing through a retail store (such as Costco), a consumer first encounters a healthy item and then encounters an unhealthy item versus if she encountered the unhealthy item first and then the healthy item. Would the sequence in which she encounters the healthy and unhealthy items influence her choice? Moreover, some stores, many restaurants in food courts and even some school cafeterias give consumers the opportunity to sample food items before purchase. Would the effects of the sequence in which healthy and unhealthy items are encountered influence choice when the consumer only sees the items versus if she gets to sample (i.e., taste) them? This is the focus of our research.

Prior research examining how consumers make choices between healthy and unhealthy food options (e.g., Dhar and Wertenbroch 2012; Shiv and Fedorikhin 1999) has presented the food items simultaneously. While Chernev (2011) examined calorie estimation for sequentially encountered food items, no study has examined effects of order sequence of healthy and unhealthy items on product choices. Equally importantly, in these prior studies, participants only evaluated the products visually without actually sampling/tasting them. We argue (and our studies show) that the effects are influenced by the sensory mode of evaluation (i.e., visual vs. gustatory through actual sampling), whereby the preference pattern observed when consumers choose between visually evaluated sequence of healthy and unhealthy options *reverses* when consumers actually sample the options.

We propose that when evaluating a sequence of healthy and unhealthy options, the first stimulus tends to become the reference point for evaluation of the subsequent stimulus in the sequence (e.g., Biswas et al. 2010, 2014; Carlson et al. 2006). Thus, if the first product encountered in a sequence sets the reference point for the mode of decision making and if healthy foods are superior on cognitive dimensions while unhealthy foods are superior on affective dimensions (e.g., Shiv and Fedorikhin 1999), then for a healthy-then-unhealthy sequence (H-U), cognitive processing should dominate while for an unhealthy-then-healthy sequence (U-H), affective processing should dominate. This would imply that consumers would be more likely to trade off affective aspects of taste in favor of cognitive aspects of calorie content when options are presented in the H-U sequence. That is, we are predicting primacy effects, whereby preference for the healthy product (which is cognitively driven) will be higher for the sequence of H-U (compared to U-H). However, we also predict that actually sampling the food items will reverse this effect leading to recency effects. With taste sampling, recency effects should occur since traces from later experiences tend to erase the traces from sequentially earlier experiences (Biswas et al. 2014). We tested our hypotheses with the help of four experiments.

Study 1A was a field experiment conducted at a cafeteria style restaurant at a major theme park; the restaurant layout allowed sequential encountering of food items when standing in the cafeteria line. For the H-U condition, the healthy dessert option (fruit) was displayed at the very beginning of the food line before the unhealthy option (cheesecake), while for the U-H sequence, this was reversed. Consistent with our hypothesis, the share of the healthy item was greater on the day when the items were displayed in the H-U (vs. U-H) sequence (65.45% vs. 40.48%; $\chi^2 = 5.99$, $p < .05$).

Study 1B was a single-factor between subjects experiment with three manipulated conditions (H-U sequence vs. U-H sequence vs. control condition of simultaneous presentation). Fruit salad (chocolate cake) was used as the healthy (unhealthy) option. A higher proportion of participants preferred the healthy food item in the H-U (vs. U-H) sequence (73.21% vs. 55.17%; $\chi^2 = 4.03$, $p < .05$) as well as versus the simultaneous presentation condition (51.79%; $\chi^2 = 5.49$, $p < .05$). Preferences were similar for U-H and simultaneous presentation ($\chi^2 = .13$, $p = .72$).

In Study 2, the results of a 2 (food sequence: H-U vs. U-H) X 2 (induced processing mode: cognitive vs. affective) between subjects experiment showed an interaction effect on choice (Wald $\chi^2 = 5.89$, $p < .05$). Consistent with our theorizing, when cognitive processing mode was induced, there was greater preference for the healthy item in the H-U (vs. U-H) sequence (53.13% vs. 22.73%; $\chi^2 = 4.99$, $p < .05$) with the effects getting attenuated under affective processing (37.50% vs. 46.15%; $\chi^2 = .38$, $p = .54$).

Study 3 examined the moderating role of sensory mode of evaluation. Study 3 was a 2 (food sequence: H-U vs. U-H) X 2 (sensory mode of evaluation: visual only vs. taste sampling) between subjects design experiment. The results of a logistic regression showed a significant interaction effect (Wald $\chi^2 = 5.89, p < .05$). When participants visually evaluated the food items, there was greater preference for the healthy item in the H-U (vs. U-H) sequence (52% vs. 29%; $\chi^2 = 3.40, p < .05$). In contrast, when participants actually sampled the food items, the pattern of results reversed, whereby there was marginally greater preference for the healthy item in the U-H (vs. H-U) sequence (48% vs. 29%; $\chi^2 = 2.63, p < .10$).

Collectively, the results of our experiments suggest that the sequence in which consumers are exposed to healthy and unhealthy food items and the sensory mode of evaluation influences their choice between the two options. When options are visually evaluated, we find primacy effects, whereby there is greater preference for the healthy option in the H-U sequence (vs. U-H sequence or simultaneous presentation). However, when the options are taste sampled, recency effects lead to greater preference for the healthy option in the U-H (vs. H-U) sequence. Overall, our findings provide insights into preference formation when sequentially encountering healthy and unhealthy items and the role of sensory mode of evaluation. In terms of conceptual and practical implications, choices for healthy versus unhealthy items are significantly influenced by the sequential order in which they are encountered and the sensory mode of evaluating them (through visual only versus actual taste sampling).

Consumption Patterns and Weight-Loss

EXTENDED ABSTRACT

According to a recent Gallup poll, around 30% of Americans are currently trying to lose weight (Saad 2011). Of those trying to lose weight, the majority reported various dietary changes as being the most effective strategies for losing weight (Saad 2011). Yet relatively little is understood about which consumption patterns relate to greater actual weight-loss. The present study aims to fill this gap by examining the associations between different consumption patterns and weight-loss.

This study includes data from 230 participants in a clinical weight-loss trial that lasted, on average, 94 days for each participant. Some participants were assigned to consume a high-fat diet, and other participants were assigned to consume a low-fat diet. All participants were weighed at the beginning and the end of the weight-loss trial. The majority of participants completed multiple dietary recalls ($M = 6.7$), in which they provided detailed records of all of the foods and beverages that they consumed in the previous 24 hours. These records were then coded using the NCC Food and Nutrient Database.

Overall, we found that the average participant lost 11.2 pounds during the weight-loss trial. Surprisingly, the average weight-loss did not differ across participants in the low-fat and high-fat diets ($M_{lowfat} = 11.5$ vs. $M_{highfat} = 11.0, p = .66$), yet there was considerable variation in weight-loss across participants in both diet groups ($SD_{lowfat} = 8.6$ vs. $SD_{highfat} = 8.9$ pounds). Thus, the focus of our research is to test for associations between different consumption patterns and weight-loss, and to examine whether such associations differ depending upon diet type (low-fat versus high-fat). Below, we report some initial analyses examining (a) the association between variety in foods consumed and weight-loss; and (b) the association between types of foods consumed and weight-loss; and (c) whether these associations differ by diet type. Beyond these initial findings, we will also have conducted a range of additional analyses on this extremely rich data set well before October 2014.

We first examined the association between dietary variety and weight-loss. Although there are multiple potential ways to calculate dietary variety, we chose to focus initially on across-day dietary variety (calculated as the number of unique NCC food groups consumed divided by the number of foods consumed). We found that across-day dietary variety was negatively correlated with weight-loss, but only for participants who were assigned to consume a high-fat diet ($r = -.43, p < .0001$). We replicated this result using the Herfindahl index as our measure of variety ($r = .16, p < .07$). These findings indicate that greater dietary variety is associated with less weight-loss, particularly for those on a high-fat diet (which is what many weight-challenged people consume). This finding is consistent with research showing that variety can increase intake (Rolls, van Duijvenvoorde, & Rolls 1984), thereby potentially deterring weight-loss.

We then examined the associations between consumption of different types of food (water, meat, grains, fruits, vegetables) and weight-loss. For participants on a high-fat diet, simple bivariate correlations showed that water consumption was positively associated with weight-loss ($r = .43, p < .001$), meat consumption and grain consumption were negatively associated with weight-loss (meat: $r = -.38, p < .001$; grains: $r = -.31, p < .001$), and fruit and vegetable consumption were not associated with weight-loss (fruit: $r = -.10, p = .22$; vegetables: $r = .13, p = .12$). When these different types of products were entered simultaneously in a linear regression predicting weight-loss, water consumption remained positively associated with weight-loss ($\beta = .28, t = 2.97, p < .01$), meat remained negatively associated with weight-loss ($\beta = -.26, t = -2.99, p < .01$), and fruit consumption remained unassociated with weight-loss ($\beta = -.06, t = .82, p = .41$). Grain consumption was no longer associated with weight-loss ($\beta = -.03, t = -.33, p = .75$), and vegetable consumption became positively associated with weight-loss ($\beta = .19, t = 2.49, p < .02$). In contrast, for participants on a low-fat diet, simple bivariate correlations showed that consumption of the different products was not associated with weight-loss (water: $r = .01, p = .90$; meat: $r = -.03, p = .76$; grains: $r = .07, p = .51$; fruit: $r = .04, p = .70$; and vegetables: $r = .11, p = .31$). In addition, when these different types of food were entered simultaneously in a linear regression predicting weight-loss, consumption of the different products remained unassociated with weight-loss.

Future analyses will examine other ways of calculating dietary variety and how they relate to weight-loss. In addition, future analyses will examine whether dietary variety and different types of food may interact in their effect on weight-loss. Finally, this data set also contains data on participants' physical activity, and future analyses will examine whether physical activity is related to weight-loss, and whether physical activity and diet may interact in their impact on weight-loss.

This research offers an opportunity to examine the associations between different consumption patterns and actual weight-loss. Two key strengths of this research are that we have detailed data on what people consumed over multiple days and that we have substantial actual weight-loss (11.2 pounds on average). We anticipate that this research will help generate future research on consumption patterns that facilitate weight-loss and will be of broad interest both to consumer behavior researchers who study self-control, variety, and food, and to practitioners interested in the design of weight-loss interventions.

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