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The Primacy of “What” Over “How Much”: How Type and Quantity Shape Healthiness Perceptions of Food Portions

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Six studies test our proposal that consumers treat food type as a primary dimension and food quantity as a secondary dimension in health impact, such that a change in type (vs. quantity) has a greater impact on perceived health impact, even when holding objective impact constant in terms of calories.

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This Looks, Feels, and Smells Healthy: Multi-Sensory Tools to Encourage Healthy Consumption

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Paper #1: The Primacy of “What” Over “How Much”: How Type and Quantity Shape Healthiness Perceptions of Food Portions

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Paper #2: Some Like it Hot: The Effect of Serving Temperature on Perceived Caloric Content and Intent to Purchase Complementary Food

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Paper #3: Unpacking Self-Control: When More Categories Lead to Lower Calorie Budgets

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Paper #4: The Smell of Healthy Choices: The Paradoxical Effects of Ambient Scent on Children’s and Adults’ Food Choices

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SESSION OVERVIEW

The theme of the proposed special session relates to altering perceptions of healthiness through various multi-sensory tools. The collection of papers identifies tools related to the visual, haptic, and olfactory senses that consumers can use to see, touch and smell their way to healthier consumption. In the first paper, Liu, Haws, Scherr, Redden, Bettman, and Fitzsimons focus on visual factors that influence healthiness. They examine the effects of varying the type of food (e.g., chocolates vs. cookies vs. almonds vs. crackers) and the quantity (e.g., ½ serving vs. 1 serving vs. 2 servings vs. 3 servings) on healthiness perceptions. They find that the type of food serves as the primary dimension that dominates healthiness judgments while the quantity of food serves as the secondary dimension that does not critically affect healthiness perceptions.

The second paper focuses on a haptic factor that can influence healthiness perceptions. Specifically, Baskentli, Block, and Morrin examine how the temperature at which a food is served might influence consumers’ calorie perceptions and complementary food choices. They identify a “serving temperature bias” whereby serving a food hot leads to higher calorie perceptions than serving the same food cold. This is because warm foods are perceived as “homelike” and enhance perceptions of hedonic pleasure.

The third paper by Jia, Krishna and Li examines another visual factor that influences healthiness perceptions. They investigate how setting calorie budgets by day (i.e., an “overall approach”) versus by meal (i.e., a categorical approach) influences the total number of calories budgeted and consumed. They find that the categorical approach to budgeting leads to lower total budgets and lower con-

sumption by offering the consumer more opportunities to exercise self-control.

Finally, Biswas and Szocs examine how an olfactory factor related to ambient scent of an indulgent (vs. non-indulgent) food influences consumers’ food choices. They find that children and adults choose healthier options when they have prolonged exposure to an indulgent (vs. non-indulgent) ambient food scent. They attribute their effects to cross-modal sensory compensation whereby olfactory inputs compensate for gustatory pleasure.

Collectively, the four papers in this session identify four novel multi-sensory factors that influence healthiness perceptions. The key question, raised by all the papers as a group, relates to what might be some critical sensory factors that can influence healthful consumption? The proposed special session brings together leading scholars and addresses healthful consumption using diverse methods (e.g., field experiments, lab experiments) and multiple populations (e.g., adults, children). We expect this session to have a broad appeal.

The Primacy of “What” Over “How Much”: How Type and Quantity Shape Healthiness Perceptions of Food Portions

EXTENDED ABSTRACT

Imagine a consumer with a healthy eating goal who is deciding whether to consume a particular portion of chocolate candies. Like most consumers with healthy eating goals, this consumer’s main health goal consists of losing or maintaining weight (International Food Information Council Foundation 2012), such that calories are typically considered the objective measure of health goal impact (Campbell and Warren 2015; Chandon and Wansink 2007; Cochran and Tesser 1996; Huang, Zhang, and Broniarczyk 2012). Given the importance of calories as an objective measure for most consumers’ health goals, there are two main aspects of the food consumed that ought to combine to jointly determine how a given food portion will affect the consumer’s health goals: the type of food and the quantity of the food. However, do a consumer’s judgments of the health impact of a food portion fully factor in both type and quantity, or are they driven more by one dimension than the other?

In this research, we examine the effects of varying food types (e.g., chocolates vs. cookies vs. almonds vs. crackers) and varying food quantities (e.g., ½ serving vs. 1 serving vs. 2 servings vs. 3 servings) on healthiness perceptions. In comparison, the existing food and health literature generally either: (1) separately examines type or quantity; or (2) does not distinguish between type and quantity, instead defining objective healthiness in terms of total calories. We instead introduce an explicit comparison between pursuing health via changing the type versus quantity of a food. Drawing from literature on processing categorical versus continuous attributes (Ha, Park, and Ahn 2009) and by drawing an analogy to research on how people make area judgments of geometric figures (Krider, Raghubir, and Krishna 2001), our main proposition is that for healthiness perceptions, food type is treated as a “primary dimension” (i.e., a highly salient dimension that dominates judgments), whereas food quantity is treated as a “secondary dimension” (i.e., a dimension that does not affect judgments much unless made salient, and, even then, affects judgments less than a primary dimension).

We demonstrate the secondary nature of quantity and the spontaneous tendency to underweight quantity across six studies. Studies 1-3 utilize a visual food diary paradigm with before-after photos of food portions to indicate a snack episode. Study 1 provides initial evidence for our primary-secondary account by showing that consumers' healthiness evaluations of these snack episodes reflect food type differences but are largely insensitive to food quantity differences, even though consumers are able to perceive the quantity differences. Studies 2a and 2b then test process-related predictions stemming from our primary-secondary account by examining two theoretically-motivated ways of increasing the salience of quantity at the time of making healthiness judgments. Study 2a increases the salience of quantity by prompting a joint evaluation mode among participants (González-Vallejo and Moran 2001; Hsee 1996). Study 2b increases the salience of quantity by drawing from expectancy-disconfirmation theory (Bettman 1979; Helgeson and Beatty 1987) to create a condition in which participants evaluate a portion size much larger than would be expected for consumption on one occasion. Studies 2a and 2b show that when the salience of quantity is increased, consumers adjust their healthiness perceptions to account for quantity but only to a small extent.

Study 3 further tests our primary-secondary account by adding emphasis to the actual consumption or eating of (nearly) the entire food portion, finding that consumers continue to treat quantity as secondary. In addition, while our main focus is on healthiness perceptions, Study 3 examines the additional outcome of caloric perceptions and shows that they track less than 1:1 with size perceptions, again suggesting an underweighting of quantity in caloric perceptions.

Study 4 then further tests our primary-secondary account of healthiness perceptions by examining healthiness perceptions when caloric information about food portions is explicitly provided. Study 4 shows that the secondary nature of quantity in healthiness assessments holds even when consumers are provided with caloric information. Study 4 also finds support for our primary-secondary account using direct process measures adapted from Krider et al. (2001).

Finally, Study 5 examines choice implications by examining how consumers instructed to make choices for a healthy lifestyle choose between portions of two calorically dense but differentially healthy foods (chocolates vs. almonds). We find that consumers choose the healthier food type (almonds) even when the size of the almond portion means that the caloric content of the almond portion far exceeds the caloric content of the chocolate candies portion. This finding suggests that the secondary nature of quantity is also reflected in consumers' food choices.

In closing, we provide substantial evidence that although both the types and quantities of foods eaten jointly contribute to weight and overall health, consumers treat type as a primary dimension and quantity as a secondary dimension. Accordingly, a food's type (vs. quantity) has greater impact on perceived health impact, across multiple study designs and stimuli, and even when controlling for caloric content or providing caloric information. Given that healthiness perceptions are an important input to food choice, the tendency towards neglecting or under-weighting quantity may have negative effects on those pursuing health goals, especially weight loss goals.

Our findings offer contributions to two main literatures. First, we contribute to the goals literature by showing that even when a change in type or quantity results in exactly the same caloric change, the changes are perceived by consumers to impact healthiness to different extents. This stands in contrast to the existing goals literature, which has to-date treated calories as an objective indicator of health impact given that weight loss is a common health goal. Further, our

research also contributes to the extensive food decision making literature, which has generally used two different choice paradigms (either choice among different food types or choice among different food quantities) to examine the healthiness of food choices. We show that the choice paradigm used affects consumers' perceptions of the healthiness differences between options, suggesting that conclusions from one choice paradigm may not always translate directly to contexts involving the other choice paradigm.

Some Like it Hot: The Effect of Serving Temperature on Perceived Caloric Content and Intent to Purchase Complementary Food

EXTENDED ABSTRACT

Which temperature, hot or cold, to choose for a meal or snack is a common – one might say ordinary-- food decision that consumers make throughout the day, at home as well as at a variety of food retailers. Despite the ubiquity of this decision, no research to date has examined the impact, if any, that consuming a food item served hot, rather than cold, has on consumer inferences regarding its caloric content. Biased caloric estimates have important implications for consumers, as research has shown downstream consequences on obesity (Chandon and Wansink 2007), subsequent and/or concurrent food choices, and overall food well-being (see Chandon and Wansink 2012, and Bublitz et al. 2013).

With this research, we uncover a phenomenon we refer to as the “*-serving temperature bias*,” as well as the theoretical underlying source of this bias. The serving temperature bias refers to the notion that people generally believe that a food or beverage served hot has more calories and is more fattening than the same item served cold. Specifically, we show that the serving temperature bias results from a series of sequential linkages. We show that warm foods and beverages are perceived to be prepared with love and that consuming them feels indulgent. We thus build consumer theory by showing that perceived love triggers feelings of indulgence, which is the direct antecedent of perceived caloric content. This research also extends the basis upon which the concept of “psychological warmth” is based. Whereas previous research has suggested this concept arises primarily from the physical holding and cuddling that provides infants with warmth, we suggest it is also based on the warmth emanating from the nourishment (foods and beverages) provided by caregivers early in life. Importantly, we show the existence of a downstream consequence of the serving temperature bias in the form of compensatory consumption.

We begin by providing phenomenon-based evidence of the downstream consequence of the food serving temperature bias in the form of complementary foods or beverages using collected sales receipts from a sandwich shop. Results of this field study revealed that customers who ordered a cold sandwich purchased significantly more complementary items (bag of chips, cookies, beverages) than those who ordered a hot sandwich ($M_{\text{cold}} = 0.79$ vs. $M_{\text{hot}} = 0.33$; $F(1, 121) = 9.48, p = .003$).

In study 2a, we gave participants a sandwich consumption scenario and asked them to imagine consuming the sandwich either hot or cold. Results revealed a significant main effect of serving temperature such that those who imagined consuming the hot sandwich estimated the caloric content to be higher than those who imagined consuming the cold sandwich ($M_{\text{hot}} = 4.71$ vs. $M_{\text{cold}} = 4.13$; $F(1, 103) = 11.11, p < .002$). We also showed the underlying reasons for the serving temperature bias. Results showed that the path from serving temperature (hot = 1, cold = -1) to prepared with love was significant ($B = 0.40, p = .0088$), as was the path from prepared with love to

indulgence ($B = 0.26, p = .0009$) and the path from indulgence to perceived caloric content ($B = 0.23, p = .0021$). In support of our theorizing, a bootstrap analysis of this causal chain yielded a confidence interval that did not contain zero (indirect effect = .0236, $SE = .0150, 95\% CI = .0051$ to $.0728$). Similar to the results observed in the field study, an ANOVA confirmed a significant main effect of serving temperature on complementary food choices such that participants in the cold condition were more likely to order a bag of chips with their sandwich than participants in the hot condition ($M_{hot} = 3.77$ vs. $M_{cold} = 4.62, F(1, 103) = 4.90, p = .029$). Studies 2b, 3 and 4 revealed similar results in actual food consumption settings (i.e., apple cider, chocolate chip cookie, and milk respectively). Through our lab studies we are also able to rule out several alternative explanations (such as effort, satiation, taste, mood, freshness, relevant sensory attributes, and perceived consumption quantity).

Then, in study 5, we show that it is not the initial temperature of the food that matters, but rather the temperature at which it is served that elicits the biased perceptions. To do this, participants were assigned to one of three conditions; hot, cold, or cold-then-hot. An ANOVA with caloric content as the dependent variable was significant ($F(2, 153) = 5.17, p = .007$). Planned contrasts revealed that, as predicted, those in the hot sandwich condition estimated the caloric content to be significantly higher than those in the cold sandwich condition ($M_{hot} = 4.26$ and $M_{cold} = 3.71, t(153) = 3.15, p = .002$) as shown in the previous studies. Importantly, and in support of our serving temperature bias, people in the cold-then-hot sandwich condition also estimated the caloric content of their sandwich to be higher than those in the cold sandwich condition ($M_{cold-then-hot} = 4.09$ vs. $M_{cold} = 3.71, t(153) = 2.16, p = .033$) and equally caloric to those in the hot sandwich condition ($M_{hot} = 4.26$ vs. $M_{cold-then-hot} = 4.09, t(153) = .94, p = .349$).

Thus, in six studies, we provide empirical evidence of the serving temperature bias, demonstrate the underlying reasons (while ruling out several alternative processes) and show the existence of an important downstream consequence of the serving temperature bias in the form of compensatory consumption.

Unpacking Self-Control: When More Categories Lead to Lower Calorie Budgets

EXTENDED ABSTRACT

Research on self-control has documented that people have trouble limiting their consumption across various domains such as eating and smoking (Heatherton and Baumeister 1991). One way to effectively address the problem of overconsumption is to set budgets (Herman and Polivy 2004). In this research, we study how different budgeting approaches result in different total consumption budget, and why they do so. Specifically, we examine two approaches that consumers may employ to set their daily consumption budgets. One approach sets an individual calorie budget for each consumption occasion (e.g., breakfast, lunch, dinner, and snacks; hereafter, called the “categorical approach”). Alternatively, consumers directly set an overall calorie budget (hereafter, called the “overall approach”).

Prior unpacking effects suggest that unpacking an overarching category into its components will increase numeric judgment (Rotenstreich and Tversky 1997; Tversky and Koehler 1994). However, we propose and demonstrate that unpacking, i.e., the categorical (vs. overall) approach, makes consumers set a lower budget – we call this the “Budget Contraction Effect” (BCE). We show that the BCE arises because the categorical (vs. overall) budgeting approach provides multiple opportunities for individuals to exert self-control.

Study 1a was conducted to test the BCE. Participants ($n=294$) were randomly assigned into one of the three conditions. In the *categorical* condition, participants were asked to set calorie budgets for four eating occasions (breakfast, lunch, dinner, and snacks). The budgets that participants set for the four occasions were automatically summed to derive their total daily budget. In the *overall-with-category-information* condition, participants were asked to set a daily calorie budget but were reminded to include their calorie intake for breakfast, lunch, dinner, and snacks. In the *overall-without-category-information* condition, participants were just asked to set their daily calorie intake budget without being reminded of the four eating occasions.

An ANOVA revealed a significant effect of budgeting approach on the calorie budget ($F(2, 291) = 3.06, p < .05$). A contrast analysis further indicated that participants set a lower budget under the categorical approach ($M = 1801.92$ calories) than either the overall-with-category-information approach ($M = 1981.39$ calories; $p = .03$) or the overall-without-category-information approach ($M = 1978.16$ calories; $p = .04$). There was no significant difference in budget between the two overall-approach conditions ($p = .97$). To test the robustness of the BCE, we used natural food groups (e.g., vegetables, grains) as the components in study 1b and replicated the findings of study 1a.

Next, we test the self-control process explanation. We argue that the BCE occurs because (many) consumers want to limit their consumption. Therefore, the strength of consumers’ self-control motivation should moderate the BCE.

In studies 2a and 2b, we test individuals’ internal motivation strength. In study 2a ($n=392$), as well as the later studies, we included only the overall-with-category-information condition to keep the component information constant between the overall and categorical conditions. The proxy for motivation strength was whether participants were dieters or non-dieters. We found that the BCE was observed for dieters ($M_{categorical} = 1756.29$ calories, $M_{overall} = 1950.52$ calories; $F(1, 388) = 5.85, p = .02$) but not for non-dieters ($M_{categorical} = 2082.89$ calories, $M_{overall} = 2195.36$ calories; $F(1, 388) = 1.92, p = .17$).

In study 2b ($n=122$), we manipulated participants’ motivation to control calorie consumption. In the *dieting-is-better* [*exercise-is-better*] condition, participants were told that to lose weight, “eating less” is better than “exercising more.” [“exercising more” is better than “eating less.”] We found a significant interaction between motivation and budgeting approach ($F(1, 118) = 7.10, p = .009$). The BCE was observed in the dieting-is-better condition ($M_{categorical} = 1664.26$ calories, $M_{overall} = 2420.00$ calories; $F(1, 118) = 16.72, p < .001$) but not in the exercise-is-better condition ($M_{categorical} = 2097.65$ calories, $M_{overall} = 2157.04$ calories; $F < 1$).

In studies 3a and 3b, we test the role of the budgeting unit (e.g., calories vs. food points). We predict that the BCE will be stronger when the budgeting unit can activate self-control (e.g., calories) versus not (e.g., food points). In study 3a ($n=386$), half of the participants were asked to set consumption budgets using *calories* as the budgeting unit while the other half of the participants used *food points* as the budgeting unit. We found a significant interaction between budgeting unit and budgeting approach ($F(1, 382) = 4.82, p = .03$). The BCE was observed when the budgeting unit was calories ($M_{categorical} = 1873.98$ calories, $M_{overall} = 2049.00$ calories; $F(1, 382) = 9.01, p = .003$) but not for food points ($M_{categorical} = 27.54$ food-points, $M_{overall} = 25.16$ food-points; $F < 1$).

To further test the role of the budgeting unit, we conducted study 3b ($n=198$) with smokers. Half of the participants were asked to set budgets for “cigarette consumption”, while the other half of the participants were asked to set budgets for “nicotine consump-

tion” from cigarettes. We found a significant interaction between budgeting unit and budgeting approach ($F(1, 191) = 4.21, p = .04$). The BCE was not observed when the budgeting unit was cigarettes ($M_{\text{categorical}} = 12.54$ cigarettes, $M_{\text{overall}} = 11.43$ cigarettes; $F < 1$) but was observed when the budgeting unit was nicotine ($M_{\text{categorical}} = 91.22$ mg-of-nicotine, $M_{\text{overall}} = 122.57$ mg-of-nicotine; $F(1, 191) = 4.59, p = .03$).

In study 4 ($n=89$), we test the behavioral consequence of budgeting approaches. In day 1, participants were asked to set a calorie budget for their food consumption next day. In day 2, participants reported their actual consumption by taking pictures of the food that they ate all day. We found that participants set a lower budget under the categorical versus overall approach ($M_{\text{categorical}} = 1528.36$ calories, $M_{\text{overall}} = 2011.36$ calories; $F(1, 87) = 13.55, p < .001$), and consumed less under the categorical versus overall approach ($M_{\text{categorical}} = 1418.22$ calories, $M_{\text{overall}} = 1649.44$ calories; $F(1, 87) = 5.33, p = .02$). A mediation analysis further revealed that budget set fully mediated the effect of budgeting approach on real consumption.

Our research adds to the literature on unpacking and self-control and has implications for obesity and anti-smoking programs.

The Smell of Healthy Choices: The Paradoxical Effects of Ambient Scent on Children’s and Adults’ Food Choices

EXTENDED ABSTRACT

The obesity rate among children continues to be high (Ogden et al. 2014). Childhood obesity often leads to lifelong medical problems including diabetes, heart disease, and cancer (Weiss et al. 2013), along with social and psychological problems (Puhl and Latner 2007). While physical exercise and even genetic factors can potentially influence obesity, food choices and diet regimens play more influential roles (Livingston and Zylke 2012).

To tackle the high obesity rates among children, regulators/policymakers have implemented restrictive policies to encourage healthier eating, such as by banning sales of “junk food” (Lincoff 2014), sugary sodas (Park 2011), and chocolate milk (Firger 2014) in school cafeterias and vending machines. However, such restrictive policies have often been met with strong resistance and even led to unintended negative consequences, suggesting that subliminal factors might be more effective in influencing behavior (Biswas et al. 2017).

This research examines how one such subliminal factor, in the form of ambient scent, might help to encourage healthier food choices. We focus specifically on how ambient scents related to indulgent (e.g., pizza, cookie) versus non-indulgent foods (e.g., strawberry, apple) influence children’s food choices at school cafeterias. We build on work related to cross-modal sensory compensation which shows that the sensory cortical areas, and particularly the areas related to the olfactory and gustatory systems, are interconnected (De Araujo et al. 2003; Maier, Wachowiak, and Katz 2012) as well as work which shows that exposure to pleasurable stimuli activates reward centers of the brain (Aharon et al. 2001). We propose that when exposed to an ambient scent of an indulgent food item, due to cross-modal sensory influences the reward circuitry of the brain can be satisfied with the sensory olfactory inputs of something tasty and unhealthy, which in turn will reduce the desire for actual indulgent (i.e., unhealthy) foods. We test this hypothesis in five studies.

Study 1a, a field experiment conducted at a middle school cafeteria, examined the effects of artificially diffusing pizza (vs. apple vs. no) scent in the ambience of the cafeteria on schoolchildren’s food choices. The children were exposed to apple, pizza, or no scent as they waited to enter the lunch line. Sales data were obtained from the school administration. The results show that a higher percentage

of healthy items were purchased when the cafeteria had a pizza versus apple ambient scent (78.57% vs. 63.04%; $\chi^2 = 168.33, p < .001$) or versus the control condition of “no scent” (78.57% vs. 62.14%; $\chi^2 = 185.42, p < .001$). There was no difference when the ambient scent was apple versus “no scent” (63.04% vs. 62.14%; $\chi^2 = .47, p = .49$). Study 1b, another field experiment, replicated the effects of Study 1a using a different set of indulgent versus non-indulgent ambient scents (pizza vs. strawberry).

We hypothesized that an unhealthy food related scent would enhance feelings related to a “rewarding pleasant experience” in the reward circuitry of the brain, which in turn will reduce the desire for unhealthy foods. In study 2, we directly tested this proposed mediating effect. In addition, study 2 also examined the moderating effect of hunger. Since hunger tends to enhance the acuity of the olfactory system (Critchley and Rolls 1996), olfactory sensitivity is greater under higher hunger states (Stafford and Welbeck 2011). Hence, we propose that the cross-modal influence of food-related olfactory cues on satisfying gustatory desires related to the brain’s reward circuits would be stronger under high hunger and weaker under low hunger. Study 2 was a field experiment conducted at a middle school cafeteria. Ambient scent was manipulated as in studies 1a and 1b. Study 2 involved participants filling out a short survey. As hypothesized, exposure to cookie (vs. apple) ambient scent led to higher choices of healthier options (53.66% vs. 29.73%; $\chi^2 = 4.56, p < .05$). Mediation analysis using Preacher and Hayes’s (2008) bootstrapped samples (5,000) showed a direct effect of ambient scent on food choices ($CI_{95\%}: .2513, 2.3260$) as well as indirect effects with the effects being mediated by feelings of rewarding pleasant experience ($CI_{95\%}: -.7824, -.0013$). Also, there was a significant effect of ambient scent on food choices (at $p < .05$) for hunger values at 4.51 and above with the effects getting weaker, and attenuated, with hunger levels below this threshold point.

Study 3 examined the moderating effect of duration of exposure to the ambient scent. If as conceptualized, prolonged exposure to the indulgent ambient scent satisfies gustatory cravings, then the effects should hold when an individual is exposed to the ambient scent for a prolonged period as the children were in the field studies. In contrast, brief duration of exposure to the scents should whet the appetite (Wadhwa, Shiv, and Nowlis 2008), leading to priming effects. Study 3 was a 2 (ambient scent: cookie vs. strawberry) X 2 (duration of exposure: prolonged vs. brief) between-subjects experiment. The results of a logistic regression show an interaction effect (Wald $\chi^2 = 8.47, p < .01$). Long duration of exposure to the cookie (vs. strawberry) ambient scent led to greater degree of choice for the healthy option (78.0% vs. 59.74%; $\chi^2 = 4.57, p < .05$). The pattern of results reversed in the case of short duration of exposure to the ambient scents, whereby exposure to cookie (vs. strawberry) ambient scent led to lower degree of choice for the healthy option (55.17% vs. 72.22%; $\chi^2 = 4.08, p < .05$).

Finally, study 4 examines the moderating effect of scent identification capability. UPSIT kits were administered to determine scent identification capabilities. The results of a floodlight analysis demonstrate that the effects of ambient scent on food choices hold for individuals with moderate to high levels of scent identification capability but the effects attenuate for individuals with low scent identification capability.

Overall, across five experimental studies with both children and adults and using a mix of field and lab experiments, we show that prolonged exposure to indulgent food related ambient scents paradoxically enhances preference for healthy food options. These findings have implications for consumer wellbeing and managerial practices.

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