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Eating a food reduces the desire to eat more of that food. General-process theories of motivation posit that eating a food also increases the motivation to eat other foods—an effect known as cross-stimulus sensitization. The authors propose that eating a food selectively sensitizes consumers to its complements rather than to all foods. Eating a food activates a goal to consume foods that consumers perceive to be well paired with the consumed food. In five experiments, imagined and actual consumption of a food sensitized participants to complementary foods but not to unrelated or semantically associated foods. These findings suggest that cross-stimulus sensitization is more specific and predictable than previously assumed. The authors identify goal activation as the process through which cross-stimulus sensitization occurs and can be instilled.

Keywords: sensitization, habituation, motivation, goal priming, food consumption

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Selective Sensitization: Consuming a Food Activates a Goal to Consume Its Complements

Whether listening to a song, drinking a cocktail, or taking a vacation, consuming a good selectively influences the desirability of other goods. One route through which this occurs is satiation or habituation, whereby repeatedly consuming a preferred good decreases its desirability to the point that it becomes less desirable than its alternatives (e.g., Galak, Redden, and Kruger 2009; Kahn 1995; McAlister 1982; Van Trijp, Hoyer, and Inman 1996). One might generally prefer to read on a beach than ski in the mountains but prefer skiing after a long beach vacation. A second route is through cross-stimulus sensitization, whereby consuming a good increases the desirability of other goods (McSweeney and Swindell 1999; Morewedge 2016; Wadhwa, Shiv, and Nowlis 2008). Taking, or merely anticipating, a beach vacation might increase how much one desires to drink margaritas or listen to surf music. In this article, we examine the scope and process responsible for cross-stimulus sensitization.

As with satiation and habituation (e.g., Epstein et al. 2009; Morewedge, Huh, and Vosgerau 2010; Redden 2008; Rozin et al. 1998), we suggest that top-down psychological processes drive cross-stimulus sensitization. More specifically, we suggest that the consumption of complementary goods such as cookies and milk, cheese and crackers, or pizza and cola is associated in procedural memory (Wood and Neal 2007). Consequently, consuming one good activates a goal to consume its complements—goods that are interrelated or positively associated with its consumption. Complements are typically goods with super additive utility. Their simultaneous consumption produces greater pleasure than the consumption of the goods in isolation (Nagle and Holden 1997; Venkatesh and Mahajan 2009). Movies and popcorn are complements because they are more pleasurable to consume together than separately. We present evidence for our goal-activation theory of selective cross-stimulus sensitization in the domain of food consumption.

In five experiments testing our hypotheses with nine different pairs of food (i.e., six complementary pairs and three noncomplementary pairs), we find that consumption of a food activates a goal to consume its complements. Consequently, it

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increases the desirability of complementary foods but does not increase the desirability of unrelated or semantically associated foods. This effect is not attributable to the activation of a more general drive-state such as arousal or hunger (e.g., Ariely and Loewenstein 2006; Wadhwa, Shiv, and Nowlis 2008), or to vice–virtue balancing (e.g., Sela, Berger, and Liu 2009). Selective sensitization to complements is observed when participants merely imagine consuming a food and only in cultures in which those foods are perceived to be complements. We conclude by discussing implications of our findings for general-process theories of motivation and marketing strategy with regard to food marketing, product bundling, and behavioral targeting.

TWO ROUTES TO STIMULATE DEMAND

Repeatedly consuming a desirable food increases the motivation to consume other foods through at least two goal-directed pathways: by reducing the desire to consume that food, and by increasing the desire to consume other foods (Epstein et al. 2009; Groves and Thompson 1970; Kahn 1995; McSweeney and Swindell 1999). Satiation and habituation are the processes by which repeated or extended exposure to a stimulus decreases enjoyment of the stimulus and motivation to continue consuming it, respectively. Whether eating jelly beans, listening to a song, or socializing with other people, people enjoy and desire the first bite, chorus, or hour of interaction more than they do the tenth (Kahn 1995; McAlister 1982; McSweeney and Swindell 1999; Morewedge 2016). Top-down cognitive processes such as attention, memory, categorization, and mental imagery play a fundamental role in satiation and habituation (Huh, Vosgerau, and Morewedge 2016; Redden 2008; Rolls, Rowe, and Rolls 1982; Rozin et al. 1998; Wansink 2004). People do not actually need to eat a food to exhibit satiation or habituation to it. Repeatedly imagining that one is eating a food is sufficient to engender satiation and habituation to that food (Kappes and Morewedge 2016; Larson, Redden, and Elder 2014; Morewedge, Huh, and Vosgerau 2010).

When the desire to consume a food or other goods is decreased through satiation or habituation, consumers exhibit increased variety seeking with regard to the array of goods that they consume (e.g., Inman 2001; Kahn 1995; McAlister 1982; Van Trijp, Hoyer, and Inman 1996). These processes reduce the desirability of a consumed food, thereby making other, typically less desirable alternatives (e.g., substitutes) temporarily more desirable and shifting consumption to those alternative foods (Kahn 1995; Rolls et al. 1981). Within a meal, a consumer might eat successive bites of a cheeseburger until the French fries that accompany it are more desirable, and then eat those French fries until (s)he has habituated to the fries and the cheeseburger is again more desirable (Inman 2001; Rolls et al. 1981). Across meals, the same consumer might choose to eat (typically less preferred) sushi the following night because (s)he remembers eating the cheeseburger the night before too well to enjoy it more than the sushi (e.g., Galak, Redden, and Kruger 2009; Garbinsky, Morewedge, and Shiv 2014a, b; Inman 2001).

Sensitization, a second route, occurs when exposure to a stimulus increases enjoyment of and motivation to consume that stimulus (Groves and Thompson 1970; McSweeney and Swindell 1999; Morewedge 2016). A moviegoer may exhibit an increased desire for popcorn if its smell permeates the lobby of the cinema or if images of it above the concession stand are sufficiently salient (e.g., Cornell, Rodin, and Weingarten 1989; LeGoff and Spigelman 1987; Papies and Hamstra 2010). After the first bite of a desirable food, such a "whetting" or "appetizer" effect is often observed (Yeomans 1996). High-level cognitive processes play a central role in sensitization to appetitive stimuli such as food, alcohol, drugs, and sexual stimuli. If a thought of an appetitive stimulus is sufficiently strong to intrude on a consumer's consciousness and (s)he elaborates on that thought, a goal to acquire and consume it may be activated (Kavanagh, Andrade, and May 2005). Consumers who imagine the smell of chocolate chip cookies shown in an advertisement, for example, exhibit greater salivation after ad exposure than do consumers not instructed to imagine the smell of the cookies (Krishna, Morrin, and Sayin 2014).

Exposure to or consumption of a stimulus can also sensitize the consumer to other stimuli through a process called cross-stimulus sensitization. There is little current consensus, however, regarding the breadth of cross-stimulus sensitization and its underlying psychological causes (Epstein et al. 2009). Research in rodent and drug studies shows conflicting evidence of its breadth and have focused primarily on physical attributes of stimuli that may induce cross-stimulus sensitization, such as their intensity. Its potential psychological origins have been largely ignored (De Wit 1996; McSweeney and Swindell 1999). Some effects in the consumer literature may be attributable to cross-stimulus sensitization, such as a sip of juice increasing consumers' desire for all hedonic goods (Wadhwa, Shiv, and Nowlis 2008), masturbation to pornography increasing men's desire for other sexual activities (Ariely and Loewenstein 2006), and the sight of sexually laden stimuli increasing men and women's pecuniary reward seeking (Festjens, Bruyneel, and Dewitte 2013; Van den Bergh, Dewitte, and Warlop 2008). However, these effects seem to be due to the activation of more general biological or reward-seeking drives ("hot states") such as hunger, thirst, and sexual arousal rather than effects of the consumption of a specific good on the desire for other specific goods (Dagher 2009; Gal 2012; Siep et al. 2009; Van den Bergh, Dewitte, and Warlop 2008; Xu, Schwarz, and Wyer 2015).

We investigate whether there are specific effects of cross-stimulus sensitization in food consumption. More precisely, we test whether consuming a food sensitizes one to other foods—and, if so, to which foods and why. Understanding cross-stimulus sensitization may enable marketers to predict when the consumption of one good will increase desire or demand for another good and to learn how to create such a relationship if it does not yet exist. Elucidating its scope and underlying processes may thus help predict and develop successful marketing strategies for brand extensions, product bundles, cross-marketing, and behavioral targeting in industries such as in-store and online retailing, food, and entertainment, in addition to its societally important implications for consumer welfare such as obesity reduction.

CROSS-STIMULUS SENSITIZATION THROUGH GOAL ACTIVATION

We suggest that cross-stimulus sensitization is due to a process of goal activation that is more selective than general reward-seeking drives such as hunger, thirst, and sexual arousal that increase the incentive salience of *all* stimuli that might satisfy the drive (Ariely and Loewenstein 2006; Dagher 2009; Siep et al. 2009; Wadhwa, Shiv, and Nowlis 2008). More specifically, we suggest that consumption of a food activates a goal to consume its complements.

When a stimulus is associated with a goal, exposure to the stimulus activates associated behaviors. For example, if a context (e.g., a movie theater) is associated with a goal-related behavior (e.g., eating popcorn), cuing the context may activate the pursuit of the associated behavior (Wood and Neal 2007). Similarly, addicts exhibit cue-induced craving. Their desire for a substance such as alcohol or cocaine increases when they are exposed to cue contexts or objects associated with its consumption (e.g., a bar or mirror; Berridge and Robinson 2011; Sinha et al. 2000). Such automatic cuing is particularly likely to occur when the goal pursued is associated with reward or positive affect (Aarts and Dijksterhuis 2000; Wood and Neal 2007).

We hypothesize that, similar to cue-induced craving, consuming a food activates a goal to consume complementary foods. Much like a stimulus can activate a goal with which it is associated, we suggest that activating a goal to consume one good can activate a goal to consume another good, if their consumption is associated. Consequently, when a goal to consume one food is primed or engaged through its consumption, a goal to consume its complements is activated. Note that unlike cue-induced craving, in which any cue can activate a goal as long as the association between the cue and the goal is sufficiently strong, we suggest the association has to be of a particular kind. The two foods need to be complements. Because the consumption of complements produces greater pleasure than the consumption of the goods in isolation (Nagle and Holden 1997; Venkatesh and Mahajan 2009), consuming one will activate the goal to consume the complement to a greater degree than the goal to consume foods that are merely associated.

The challenge in defining food complementarity, however, is that biological, chemical, and cultural factors determine what consumers accept as food complements or appropriate food pairings. The biology of flavor perception and the chemistry of aroma compounds and their interactions are incredibly complex. Coffee contains approximately 700 different aroma compounds, for instance, but there are only a few aromas that are perceptible to the nose (Blank, Sen, and Grosch 1991). Culture, regional customs, and social norms also play a fundamental role. In the United States, cola is a complement for pizza, but ketchup is not. By contrast, in India both cola and ketchup are complements of pizza and are commonly eaten with it. This cultural variation reflects a general inability of consumers to know, a priori, which pairs of foods are complementary. It was only discovered recently that caviar and white chocolate are complementary (Blumenthal 2002). Combinations of salt and chocolate have proliferated as a consequence, and today there are many varieties of salty chocolate that did not exist a decade ago.

Given the complexities that arise from the interaction of biological, chemical, and cultural factors determining what foods are complementary, we adopt an operational definition of food complements as foods a consumer perceives to provide greater pleasure when consumed in conjunction than when consumed separately (Nagle and Holden 1997). Note that our definition hinges on the consumer's perception rather than on the foods' physical properties. On the aggregate level, our definition of food complements converges with the classic definition of complements in economics and marketing, defined as goods that exhibit cross-price elasticities of demand < 0. An increase in the price of one good causes a decrease in the demand of both goods (e.g., Deaton and Muellbauer 1980).

We hypothesize the complementarity relation between two foods to lead to an association of consumption goals, such that consumption of one food activates a goal to consume the other. Eating cookies should sensitize a consumer to milk because their complementarity relation associates the consumption of one with the goal of consuming the other.

H_1: Goal activation underlies cross-stimulus sensitization in food consumption.

Therefore,

H_{1a}: The consumption of a food should sensitize consumers to complementary foods.

Our attribution of cross-stimulus sensitization to goal activation assumes that it is due to top-down motivational processes rather than to physical attributes of the foods consumed (Aarts and Dijksterhuis 2000; Wood and Neal 2007). Eating a cookie sensitizes a consumer to milk, for example, because it primes a goal to drink milk, not because eating the cookie dries out her mouth and makes her thirsty. In other words, actual consumption of the target should not be necessary to sensitize a consumer to its complements. Our attribution of cross-stimulus sensitization to goal priming thus suggests both that (1) the consumption of a target food should activate a goal to consume its complements and (2) merely activating a goal to consume the target food should sensitize consumers to complementary foods.

H_{1b}: Merely activating the goal to consume a food should activate a goal to consume complementary foods.

Our hypothesis implies that cross-stimulus sensitization is selective. If cross-stimulus sensitization is due to goal activation rather than a general increase in reward seeking or perceptual fluency that results from semantic associations between a food and its complements (Labroo, Dhar, and Schwarz 2008; Morewedge and Kahneman 2010), cross-stimulus sensitization should be observed to a greater degree for complements of the food consumed than for similar foods that are not its complements or for foods that are merely semantically related to the food consumed.

H_2: Consumption of a food should selectively sensitize consumers to complementary foods, not to unrelated or only semantically associated foods.

This distinction should be starkest in the moderation of cross-stimulus sensitization across cultures. If two foods are complements in culture A but are not complements in culture B, then cross-stimulus sensitization should be observed in culture A but not in culture B. Note that this prediction assumes that cross-stimulus sensitization is not contingent on bottom-up sensory properties of the stimuli (e.g., how flavors commingle) or vice–virtue balancing and more general licensing effects (e.g., Sela, Berger, and Liu 2009).

H_3: Cross-stimulus sensitization between two foods should hinge on the perception of their complementarity.

OVERVIEW OF EXPERIMENTS

We tested our hypotheses in five experiments. We tested for evidence of cross-stimulus sensitization (H_{1a}) in Experiment 1 by examining whether the actual consumption of a food increases consumers' willingness to pay (WTP) for a complementary food. We tested the hypothesis that cross-stimulus sensitization is attributable to goal activation (H_{1b}) by testing whether the consumption of a target food increases the cognitive accessibility of a complementary food in Experiment 2a, and whether considering the consumption of a food increases WTP for a complementary food more after a delay than when WTP for the complementary food is assessed immediately in Experiment 2b. Experiments 3 and 4 examined whether cross-stimulus sensitization is specific to foods that are complements of the target (H_2) by testing whether actual (Experiment 3) and imagined (Experiment 4) consumption of a food sensitizes consumers to complementary foods but not to unrelated foods or close semantic associates. Finally, Experiment 5 tested whether perceived complementarity induces cross-stimulus sensitization (H_3) by examining sensitization effects between pairs of foods in cultures in which the pairs are and are not complements (i.e., India and the United States). We report all stimuli, procedures, measures, and participant exclusions in each of our experiments. When observations are excluded, we report the analyses with and without exclusions.

EXPERIMENT 1: CONSUMPTION-INDUCED CROSS-STIMULUS SENSITIZATION

In Experiment 1, we tested whether consumption of a food would induce cross-stimulus sensitization to a complementary food in an incentive-compatible design (H_{1a}). We predicted that participants who consumed a drink (i.e., Coca-Cola) would have higher WTP for a complementary food (i.e., a McDonald's hamburger) than would control participants who did not consume the drink.

Method

One hundred ten students at Hong Kong University of Science and Technology (61 women; M_{age} = 20.85 years, SD = 1.25) received HK$30 (approximately US$4) for participating in the experiment. We pretested several food pairings for complementarity in Hong Kong (Appendix A) and selected cola and hamburgers, ranked third in complementarity, as stimuli for the experiment.

All participants, seated in private cubicles with a computer, first indicated their current hunger on a five-point scale with endpoints "very hungry" (1) and "very full" (5). In a between-subjects design, participants randomly assigned to a complements condition then consumed 5 oz of Coca-Cola. Participants randomly assigned to a control condition did not consume any drink or food.

All participants were then given an experimental budget of HK$30 and indicated their maximum WTP for a real voucher for one McDonald's hamburger, sold for HK$20 at the nearest franchise. Following the incentive-compatible Becker–DeGroot–Marschak (1964) procedure, participants were told that they would receive the voucher only if their WTP was as much or more than an experimenter-set price that had been determined in advance and was enclosed in a sealed envelope on their desk. If their WTP was greater than or equal to this predetermined price, they would purchase the voucher for the predetermined price and also keep the remainder of their experimental budget. If their WTP was less than the predetermined price, they would not purchase the voucher and instead keep all of their experimental budget. Participants could enter any value from HK$0 to HK$20 as their maximum WTP. After participants indicated their maximum WTP for the voucher, they opened the envelope to discover the predetermined price (HK$19) and received either HK$11 and the voucher, or HK$30.

Results and Discussion

No responses were outliers, so the analysis includes the full sample. As we predicted in H_{1a}, participants who consumed Coca-Cola were willing to pay significantly more (+29.42%) for the hamburger voucher (M = HK$13.11, SD = 4.91) than were control participants (M = HK$10.13, SD = 5.75; $F(1, 108) = 8.57$, $p = .004$, $\eta_p^2 = .07$; Mann–Whitney U = 1,956.50, $p = .007$). Thus, we found evidence of cross-stimulus sensitization in an incentive-compatible price-elicitation task. Consumption of a target food increased the motivation to consume a complementary food, as indicated by a higher WTP for that food.

EXPERIMENTS 2A AND 2B: TESTING GOAL ACTIVATION

In Experiments 2a and 2b, we tested hypothesis H_{1b}, whether cross-stimulus sensitization to a complement is due to goal activation. In Experiment 2a, we tested our goal-activation hypothesis by examining whether actual consumption of a good would increase the cognitive accessibility of words related to the goal to consume a complement before, but not after, the complement was consumed. We contrasted our goal-activation hypothesis in Experiment 2b with an alternative memory-based process by testing whether sensitization to the complement increased (or decreased) if its consumption was delayed.

EXPERIMENT 2A: COMPLEMENT ACCESSIBILITY PRE- AND POSTCONSUMPTION

In Experiment 2a, we tested whether goal activation underlies cross-stimulus sensitization with a lexical decision task and novel pair of complementary goods (i.e., cereal and milk). Participants in a complement consumption condition ate a target food (i.e., cereal). Participants in the control condition did not eat any food. All participants then performed a lexical decision task measuring how quickly they recognized different strings of words before and after consuming the complement (i.e., milk). Goal activation enhances the accessibility of goal-related constructs until the goal is fulfilled (Koole et al. 1999; Liviatan and Jost 2014; Shah and Kruglanski 2002), and faster reaction times in lexical decision tasks indicate that a concept is more cognitively accessible (Neely 1991). Following this logic, we predicted that before consuming milk, participants who consumed cereal should exhibit increased accessibility for milk-related (vs. unrelated) words relative to those in the control condition. After consuming milk, however, there should be no difference between conditions in the accessibility of milk-related (vs. unrelated) words.

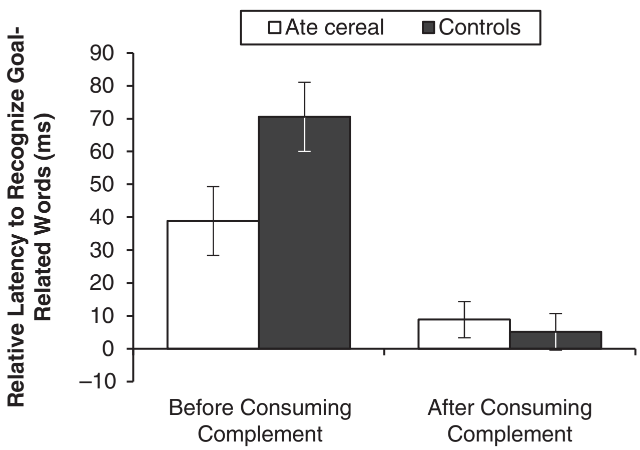
Method

Two hundred forty-nine undergraduate students at Hong Kong University of Science and Technology (116 men and 133 women; M_{age} = 20.22 years, SD = 1.13) completed the experiment for extra credit or HK$30 (approximately US$4). Students, seated in private cubicles with a computer, played a word game. On each trial, a string of capital letters was presented in the middle of the computer screen. Participants were instructed to press "1" if the string of letters was a word and "9" if it was not a word and to respond as quickly and accurately as possible. The string of letters remained on the screen until a response was made. Immediately after the response, a fixation cross (i.e., "+") was displayed for one second before the next letter string appeared. Participants first completed six practice trials with three words unrelated to milk (i.e., driver, listen, and tissue) and three nonwords (i.e., nehpo, inels, and hojfe).

After the practice trials, participants randomly assigned to the cereal consumption condition received a bowl containing four tablespoons of dry cereal and consumed the cereal in its entirety. Participants randomly assigned to the control condition did not consume any food or drink. Then all participants participated in the first block of the lexical decision task, in which they categorized five words associated with milk (i.e., cow, milk, dairy, cream, and drink), five words not associated with milk (i.e., pen, car, wall, nurse, and write), and ten nonwords (e.g., mrat, kenls, tvnee, lalwe, lhile) in a random order. After completing the first block of the lexical decision task, all participants received a cup containing 3 oz of milk and were asked to drink all of it. They then completed a second identical block of the lexical decision task. Finally, participants reported demographic information and any problems they experienced during the experiment.

Figure 1

RELATIVE LATENCY TO RECOGNIZE GOAL-RELATED WORDS BEFORE AND AFTER CONSUMING A COMPLEMENT AS A FUNCTION OF THE TYPE OF FOOD THAT HAD BEEN PREVIOUSLY CONSUMED (EXPERIMENT 2A)



Notes: Participants who ate a food (i.e., cereal) were faster than control participants to recognize words related to a goal to consume the food's complement (i.e., milk) relative to neutral words before, but not after, both groups consumed the complement (Experiment 2a). Error bars indicate ±1 standard error of the mean [SEM].

Results

Exclusion and transformation of data. Following Bargh and Chartrand's (2000) recommendation for the analysis of response latencies, we excluded incorrect responses (2.33% of all responses) and responses with latencies deviating more than three standard deviations from the mean in each experimental condition (1.81% of all responses). For the first and second experimental block of the lexical decision task, we then computed an index of the relative accessibility of goal-related words versus unrelated words as the difference in response latencies (i.e., $RT_{related} - RT_{unrelated}$; Anderson, Benjamin, and Bartholow 1998). Lower values indicate that milk-related words were more accessible relative to unrelated words. In Appendix B, we report the analysis of the individual response latencies that constitute the relative accessibility score.

Goal activation. We examined whether consumption of cereal activated the goal to consume milk in a 2 (condition: cereal consumption, control) × 2 (relative accessibility: lexical decision block 1, lexical decision block 2) mixed analysis of variance (ANOVA) with repeated measures on the last factor. The analysis revealed a significant main effect of block ($F(1, 247) = 37.31$, $p < .001$, $\eta_p^2 = .131$), no main effect for goal priming ($F(1, 247) = 2.45$, $p = .12$, $\eta_p^2 = .010$), and the predicted interaction ($F(1, 247) = 5.14$, $p = .02$, $\eta_p^2 = .020$) (see Figure 1). Planned comparisons showed that before consuming milk (block 1), participants who consumed cereal were faster to recognize milk-related words (M = 38.89, SD = 107.49) than were those in the control condition (M = 70.53, SD = 125.61; $F(1, 247) = 4.57$, $p = .03$). After consuming milk (block 2), in contrast, participants who consumed cereal and participants in the control recognized milk-related words equally quickly (M = 8.90, SD = 60.97 vs. M = 5.13, SD = 62.42, respectively; $F < 1$; for means, see Table 1). Analyzing the data with robust errors clustered by participant yields almost-identical estimates.

Discussion

Relative to participants in the control condition, milk-related words were more accessible for participants who had consumed cereal before, but not after, both groups consumed milk. This increased accessibility preconsumption but not postconsumption suggests that consuming cereal activated a goal to consume milk that was then fulfilled (Koole et al. 1999; Liviatan and Jost 2014; Shah and Kruglanski 2002).

Although the results provide support for our hypothesis that consumption sensitizes people to complements, the results are potentially attributable to cognitive processes other than goal activation. Exposure to a food should stimulate thoughts of associated foods (Anderson 1983), which may be activated in memory even though they are not complements. For example, cheese and yogurt are not usually consumed together but are semantically associated through their membership in the category of dairy foods. By this interpretation, consuming a food may sensitize people to its complements by making them more cognitively accessible and thus perceptually fluent (e.g., Labroo, Dhar, and Schwarz 2008; Morewedge and Kahneman 2010). In Experiments 2b and 3, we performed two direct tests of whether this alternative process might underlie the cross-stimulus sensitization effect observed in Experiment 1. In Experiment 2b, we tested whether sensitization to complements increased or decreased after a delay between exposure to the target and the evaluation of the complement. In Experiment 3, we tested whether sensitization to complements would be greater than sensitization to foods that are closer semantic associates of the target food.

Table 1

WORD ACCESSIBILITY BY CONSUMPTION OF CEREAL AND MILK (EXPERIMENT 2A)

	Round 1 (Before Consuming Complement)					Round 2 (After Consuming Complement)				
	Milk-Related Words		Unrelated Words		Relative Accessibility of Milk-Related Words	Milk-Related Words		Unrelated Words		Relative Accessibility of Milk-Related Words
Condition	*M*	*SD*	*M*	*SD*	*M*	*M*	*SD*	*M*	*SD*	*M*
Cereal	668	134	629	112	39	558	83	549	82	9
Control	689	171	618	106	71	560	79	555	71	5

Notes: Participants who ate a food (i.e., cereal) were faster than control participants to recognize words associated with a complement (i.e., milk) before, but not after, both groups consumed the complement (Experiment 2a). There were no differences between conditions in the accessibility of unrelated words. Means represent reaction times in milliseconds.

EXPERIMENT 2B: GOAL ACTIVATION VERSUS SEMANTIC PRIMING

Experiment 2b directly compared the goal-activation and semantic priming accounts of cross-stimulus sensitization by examining how delaying exposure to the complement influences sensitization to it. Whereas semantic priming effects are strongest immediately and decrease with time (Bargh and Chartrand 2000), goal activation increases over time if the goal remains unfulfilled (Fitzsimons, Chartrand, and Fitzsimons 2008; Förster, Liberman, and Friedman 2007; Sela and Shiv 2009). Because we hypothesize that goal activation is the process responsible for cross-stimulus sensitization (H_1), we predicted that participants primed to consider the consumption of a target food (i.e., pizza) would be willing to pay more for a complement (i.e., cola) if WTP were measured after a five-minute delay than if it were measured immediately. Deliberating on the consumption of pizza should activate a goal to consume the pizza (Kavanagh, Andrade, and May 2005; Krishna, Morrin, and Sayin 2014; Larson, Redden, and Elder 2014; Stroebe et al. 2013), which should then activate a goal to consume its complements (e.g., cola) that increases in strength over time if that goal is unfulfilled. Note that we designed this experiment to induce cross-stimulus sensitization through priming consumption of the target food, not through its actual consumption (H_{1b}).

Method

Two hundred forty-four undergraduate students at Boston University (144 men, 97 women, and 3 who preferred not to specify gender; M_{age} = 19.80 years, SD = 3.33) completed the experiment for course credit. In a private cubicle, participants first saw a slice of pepperoni pizza on a computer screen and reported their current WTP for that slice of pizza with an analog slider marked at \$.50 increments, with endpoints \$0 and \$5. Participants in a no-delay condition then immediately saw a 12 oz glass of cola and reported their WTP for it on an identical scale. Participants in a delay condition first reported their WTP for the slice of pizza, then listed as many words as they could containing the letter e in the middle (e.g., apartment) for five minutes (a delay task used by Sela and Shiv [2009]). After the delay task, they reported their WTP for the 12 oz glass of cola.

All participants then reported how often they consumed pizza together with water, iced tea, and cola as well as how often they consumed cookies and orange juice on seven-point scales with endpoints at "never" (1) and "very often" (7). Participants then rated the extent to which the foods in each pair seemed related to each other on seven-point scales, how often they consumed cola with pizza out of the last ten times they ate pizza, and demographic information.

Results

Five participants were classified as outliers (i.e., they indicated a WTP more than 3 SD from their respective cell means). One participant did not provide WTP data. We did not include the responses from these six participants in subsequent parametric analyses.

Random assignment to experimental conditions was successful; participants had similar WTP amounts for pizza in both conditions ($M_{\text{no delay}}$ = \$1.61, SD = .94; M_{delay} = \$1.77, SD = 1.12; F(1, 236) = 1.34, p = .25). More importantly, participants were willing to pay more for Coca-Cola when WTP was measured after the delay (M_{delay} = \$1.30, SD = .82) than when it was measured immediately after participants reported their WTP for pizza ($M_{\text{no delay}}$ = \$1.03, SD = .75; F(1, 236) = 7.19, p = .008). The main effect of delay remained largely unchanged when WTP for pizza was included in the analysis as a covariate (F(1, 235) = 5.81, p = .017). The covariate itself had a strong positive effect on WTP for cola (F(1, 135) = 39.48, p < .001). With the five outliers included, a nonparametric test revealed the same main effect of delay (Mann–Whitney U = 2.89, p = .004).

Discussion

The results support the hypothesis that goal activation is the process underlying cross-stimulus sensitization (H_1). A semantic priming account of cross-stimulus sensitization would predict that the desirability of complements of a food would be greatest immediately following evaluation of the target than after a five-minute delay. By contrast, WTP was higher for participants who evaluated the complement after the five-minute delay than for participants who evaluated the complement immediately after evaluating the target. In addition, cross-stimulus sensitization was induced in Experiment 2b through evaluation of the target food rather than its actual consumption. Thus, only top-down psychological processes could have induced this sensitization effect. It could not have been induced by preingestive sensory factors such as taste, smell, or sensory balancing (Kosslyn, Ganis, and Thompson 2001).

EXPERIMENT 3: GOAL- VERSUS FLUENCY-BASED SELECTIVE SENSITIZATION

In Experiment 3, we extended our hypothesis testing in two ways. First, we further tested our goal-activation account (H_{1b}) against an alternative perceptual fluency account based on semantic priming. Second, we began testing our second hypothesis that cross-stimulus sensitization is selective in scope (H_2). This prediction sets our theory apart from more general reward-seeking theories in which activation of a general drive state such as hunger changes the incentive value of all drive-related stimuli (e.g., Dagher 2009; Siep et al. 2009; Wadhwa, Shiv, and Nowlis 2008).

Using novel pairs of stimuli, we examined whether consumers would exhibit greater sensitization to a food (i.e., grape jelly) after consuming a complement (i.e., peanut butter) or a food that is a closer semantic associate but not a complementary food (i.e., strawberry jelly). Crackers served as the delivery route for these food pairs. Participants first ate two crackers topped with nothing, peanut butter, or strawberry jelly. We then observed how many (out of ten) grape jelly–topped crackers they ate ad libitum. We included the control condition in which participants consumed plain crackers before eating grape jelly crackers in case participants would exhibit sensitization for both pairs, but more for one pair than the other.

Our goal-activation hypothesis (H_{1b}) predicts that participants would exhibit a selective cross-stimulus sensitization effect (H_2). That is, participants who first ate peanut butter–topped crackers would subsequently eat more grape jelly–topped crackers than would participants who first ate strawberry jelly–topped crackers or plain crackers. By contrast, if cross-stimulus sensitization is due to spreading activation in memory, the perceptual fluency of foods should be increased to the extent that they are associated with the food consumed. Thus, a fluency account would predict that participants who first ate strawberry jelly–topped crackers would subsequently eat more, or at least an equal amount of, grape jelly–topped crackers as would participants who first ate peanut butter crackers. In addition, participants who consumed strawberry jelly–topped crackers and those who consumed peanut butter crackers would subsequently consume more grape jelly–topped crackers than would participants who first ate plain crackers.

Stimuli Pretest

Fifty Amazon Mechanical Turk (MTurk) workers residing in the United States (19 women; M_{age} = 30.06 years, SD = 10.63) viewed ten food pairs: strawberry jelly and grape jelly, peanut butter and grape jelly, mangoes and cheese, cheese and yogurt, cheese and crackers, cheese and grapes, bread and broccoli, pizza and ketchup, pizza and rice, and pizza and cola. Participants rated the extent to which each pair seemed related (measuring semantic associations) and how often they consume each pair of foods together (measuring complementarity) on two seven-point scales with endpoints "not at all" (1) and "very related" (7), and "not at all" (1) and "very often" (7), respectively.

Two food pairs exhibited the required dissociation of semantic association and complementarity: strawberry jelly and grape jelly, and peanut butter and grape jelly. A 2 (pairs: strawberry jelly and grape jelly, peanut butter and grape jelly) × 2 (rating: semantic association, complementarity) repeated-measures ANOVA yielded a significant interaction ($F(1, 49) = 82.34$, $p < .001$, $\eta_p^2 = .63$). Pairwise comparisons revealed that grape jelly was more strongly associated with strawberry jelly (M = 6.30, SD = .95) than with peanut butter (M = 5.58, SD = 1.47; $F(1, 49) = 11.97$, $p = .001$) but was less frequently consumed with strawberry jelly (M = 2.16, SD = 1.72) than with peanut butter (M = 4.94, SD = 1.89; $F(1, 49) = 82.12$, $p < .001$). Consequently, in Experiment 3, peanut butter served as a complement to, but not an associate of, grape jelly. Strawberry jelly served as an associate of, but not a complement to, grape jelly. Because strawberry jelly and grape jelly are substitutes, the inclusion of this pair also enabled us to test whether sensitization would occur for substitutes.

Method

Two hundred two students at Carnegie Mellon University (99 men, 102 women, and 1 who preferred not to specify gender; M_{age} = 20.62 years, SD = 4.12) participated in exchange for $2.

Participants first indicated how much they liked various kinds of food including grape jelly on a five-point scale with endpoints "dislike extremely" (1) and "like extremely" (5). All participants then ate two Ritz crackers. Participants randomly assigned to the control condition ate plain crackers (i.e., no condiment was added). Participants randomly assigned to the complements condition ate crackers topped with peanut butter. Participants randomly assigned to the associates condition ate crackers topped with strawberry jelly. After eating their two crackers, all participants indicated how pleasant or unpleasant it was to eat the crackers on a seven-point scale with endpoints "extremely unpleasant" (1) and "extremely pleasant" (7).

All participants were then offered ten grape jelly–topped Ritz crackers to eat ad libitum. The number they consumed was surreptitiously measured and served as our primary dependent measure. When they had finished eating, participants indicated how pleasant or unpleasant it was to eat the grape jelly–topped crackers on a seven-point scale with endpoints "extremely unpleasant" (1) and "extremely pleasant" (7).

Results

Participant exclusions. Seven participants were classified as outliers (i.e., they ate more than 3 SD from their respective cell means). Their responses were not included in subsequent ANOVAs.

Liking and pleasantness ratings of the stimuli. Random assignment to the conditions was successful. Participants reported liking grape jelly equally in all three conditions ($M_{controls}$ = 3.02, SD = 1.15; $M_{complements}$ = 2.97, SD = 1.03; $M_{associates}$ = 2.89, SD = .95; $F < 1$). Eating the first two crackers also appeared to be similarly pleasant in all three conditions ($M_{controls}$ = 4.84, SD = 1.37; $M_{complements}$ = 5.20, SD = 1.26; $M_{associates}$ = 4.92, SD = 1.44; $F(2, 192) = 1.24$, $p = .29$).

Cross-stimulus sensitization. We examined the number of grape jelly–topped crackers eaten across the three conditions with a one-way between-subjects ANOVA, which revealed a significant main effect of condition ($F(2, 192) = 4.15$, $p = .02$, $\eta_p^2 = .04$). In line with the findings of the previous experiments, planned comparisons revealed that participants in the complements condition ate 24.43% more grape jelly–topped crackers (M = 2.75, SD = 1.64) than did participants in the control condition (M = 2.21, SD = 1.53; F(1, 192) = 4.03, p = .05). More importantly, participants in the complements condition also consumed 38.88% more grape jelly–topped crackers than did participants in the associates condition (M = 1.98, SD = 1.47; F(1, 192) = 7.76, p = .006). The amount of the crackers with grape jelly consumed by participants in the control and associates conditions was not different (F < 1; see Figure 2).

With the seven outliers included, a nonparametric test used to account for nonnormality revealed the same main finding (Krukal–Wallis = 8.17, p = .02). Participants who had consumed a complement subsequently consumed more grape jelly–topped crackers than did control participants (p = .02) and participants who consumed a semantic associate (p = .01). The amount of grape jelly–topped crackers consumed in the control and the strawberry jelly cracker conditions was not different (p = .84).

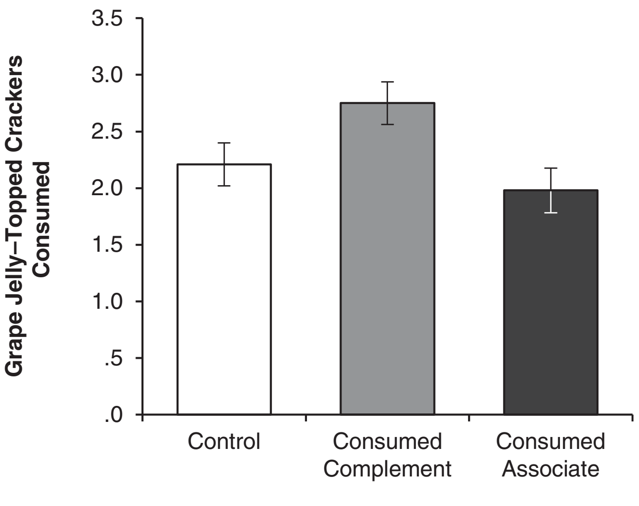
Discussion

Consumption of a food selectively sensitized participants to complementary foods. Participants who first ate peanut butter–topped crackers subsequently ate more grape jelly–topped crackers than did controls who first ate plain crackers. Sensitization, however, did not occur for a more closely semantically associated food. Participants who first ate strawberry jelly–topped crackers subsequently ate no more grape jelly–topped crackers than did participants in the control condition. Because peanut butter and grape jelly are complements but are less semantically related than grape jelly and strawberry jelly, these findings suggest that cross-stimulus sensitization is selective. Cross-stimulus sensitization occurs because consumption of a food activates a goal to consume complementary foods, not because it initiates a general drive state (e.g., Wadhwa, Shiv, and Nowlis 2008) or increases the processing fluency of semantic associates (e.g., Labroo, Dhar, and Schwarz 2008; Morewedge and Kahneman 2010).

Factors other than sensitization, however, could have caused the observed pattern in Experiment 3. Peanut butter is high in fat and salt. Participants may have tried to balance their consumption of crackers with peanut butter by subsequently consuming something sweeter (sensory balancing) or lower in fat (vice–virtue balancing; Sela, Berger, and Liu 2009). In Experiment 4, we examine these alternative explanations by using an imagined consumption paradigm. In Experiment 5, we test whether cross-stimulus sensitization is moderated by cultural differences regarding which foods are considered complementary.

Figure 2

NUMBER OF GRAPE JELLY–TOPPED CRACKERS EATEN AS A FUNCTION OF THE TYPE OF FOOD THAT HAD BEEN PREVIOUSLY CONSUMED (EXPERIMENT 3)



Notes: Participants in Experiment 3 ate more grape jelly–topped crackers if they first consumed crackers topped with a complement (peanut butter) than topped with an associate (strawberry jelly) or with no topping (control). Error bars represent ±1 SEM.

EXPERIMENT 4: COGNITIVELY INDUCED SELECTIVE SENSITIZATION

Experiment 4 tested whether cross-stimulus sensitization is specific to complements of the food consumed (H_2) using a paradigm in which sensitization effects could not be attributed to the physical properties of the foods. Participants first imagined eating either 3 or 30 crackers or M&M's. All participants then ate cheese cubes ad libitum. Because crackers and cheese are complements, we predicted that participants would eat more cheese if they had first imagined eating 30 crackers than 3 crackers. Because M&M's and cheese are not complements, we predicted that consumption of cheese would not be greater whether participants had imagined eating 3 or 30 M&M's. We chose the food pairs on the basis of the results of a pretest of U.S. participants (see Appendix C).

Method

One hundred nineteen students at Carnegie Mellon University (66 men and 53 women; M_{age} = 21.13 years, SD = 5.85) participated for partial course credit or $5. Participants in an experiment about "thought and perception" were seated at computers in private cubicles. First, they rated the extent to which they liked M&M's, cheese, and crackers on separate 100-point analog scales with endpoints "dislike extremely" (0) and "like extremely" (100). Next, they reported how often they used coin-operated laundry machines on a five-point scale with endpoints "never" (1) and "weekly" (5).

Participants were then randomly assigned to one of four conditions. To keep the number of imagined actions and mental effort exerted constant across experimental conditions, all participants imagined performing 33 repetitive actions. Participants in a small portion condition first saw a bowl containing 30 U.S. quarters and imagined inserting each quarter into a laundry machine one at a time. Next, they saw a picture of a bowl containing three units of a food (i.e., crackers or M&M's). In a guided imagery task, they were shown a picture of one cracker or one M&M every five seconds and imagined eating it; they did this three times. Participants in a large portion condition first imagined inserting three quarters into a laundry machine one at a time. They then saw a picture of a bowl filled with 30 units of a food (i.e., crackers or M&M's) and imagined eating each of the 30 units according to the same procedure.

After completing the imagery task, all participants were given a bowl containing 40 grams of cheddar cheese cubes and were told to sample the cheese to answer questions about its taste and texture. Participants ate ad libitum and notified the experimenter when they were done. The experimenter then removed the bowl and surreptitiously weighed it. Finally, participants reported demographic information, their current affective state on the Positive and Negative Affect Schedule (PANAS; Watson, Clark, and Tellegen 1988), when and what they last ate, if they performed the imagination task as instructed, and if they had previously participated in a similar experiment.

Results

Nine participants reported not performing the imagination task as instructed, two participants reported having previously participated in a similar experiment, and the responses of two participants were classified as outliers (i.e., they ate more than 3 SD from their respective cell means). We did not include these participants' responses in the subsequent ANOVA.

We examined the amount of cheese consumed by participants in a 2 (imagined consumption: crackers, M&M's) × 2 (repetitions: 3 units, 30 units) ANOVA. The analysis revealed a marginally significant main effect for imagined consumption ($F(1, 102) = 2.99$, $p = .09$, $\eta_p^2 = .03$) and a significant main effect for repetition ($F(1, 102) = 6.65$, $p = .01$, $\eta_p^2 = .06$). More important, these were qualified by the predicted interaction ($F(1, 102) = 7.13$, $p = .009$, $\eta_p^2 = .07$). Planned comparisons revealed that participants who had imagined eating 30 crackers ate significantly more (105.88%) cheddar cheese cubes (M = 17.50 g, SD = 12.99) than did participants who had imagined eating 3 crackers (M = 8.50 g, SD = 5.61; $F(1, 102) = 14.60$, $p < .001$), whereas participants who had imagined eating 30 M&M's ate an equivalent amount of cheddar cheese cubes (M = 9.96 g, SD = 6.37) as those who had imagined eating 3 M&M's (M = 10.11 g, SD = 7.85; $F < 1$) (see Figure 3).

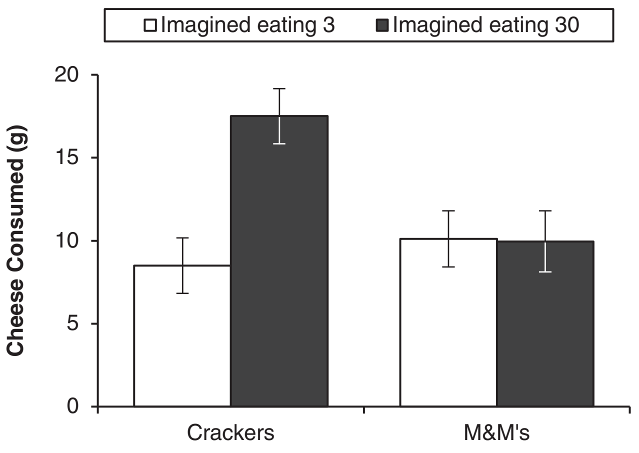
We obtained similar findings when we analyzed the data without excluding any participants (which resulted in significant skew) using nonparametric tests: Participants who had imagined eating 30 crackers ate more cheese than did participants who had imagined eating 3 crackers (Mann–Whitney U = 353, $p = .048$). Participants who had imagined eating 30 M&M's and 3 M&M's ate a similar amount of cheese (Mann–Whitney U = 331.5, $p = .32$). The manipulations did not influence the extent to which participants reported experiencing positive or negative affect on the PANAS (all $Fs < 1$).

Discussion

Replicating the results of the previous experiments, participants exhibited cross-stimulus sensitization to complements (H_1). Specifically, participants ate more cheese if they first imagined consuming a larger than a smaller portion of a complementary food, crackers. Providing support for H_2 (that cross-stimulus sensitization is specific with respect to complements of the food consumed), participants ate no more cheese if they first imagined consuming a larger or smaller portion of an unrelated hedonic food, M&M's. These results suggest that cross-stimulus sensitization is specific to complements and is not an instance of a more general activation of a drive state such as hunger (e.g., Wadhwa, Shiv, and Nowlis 2008). Furthermore, the cross-stimulus sensitization effect observed cannot be attributed to physical properties of the food consumed.

Figure 3

EFFECTS OF IMAGERY TASK ON AMOUNT OF CHEESE CONSUMED (EXPERIMENT 4)



Notes: Participants in Experiment 4 who imagined eating 30 units of a complementary food (crackers) subsequently ate more cheese than those who imagined eating only 3 units, whereas imagined consumption of an unrelated food (30 vs. 3 M&M's) had no effect on the amount of cheese subsequently consumed. Error bars indicate ±1 SEM.

EXPERIMENT 5: PHYSICAL VERSUS PERCEIVED COMPLEMENTARITY

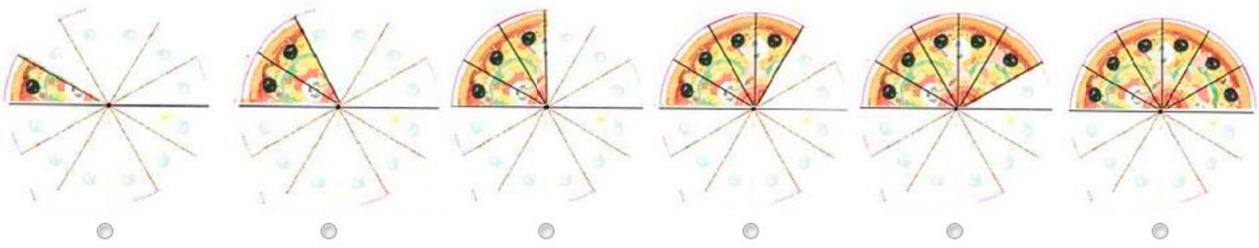
In Experiment 5, we tested whether perceived complementarity, rather than physical properties of foods or vice–virtue balancing, induces cross-stimulus sensitization (H_3). We examined whether cross-stimulus sensitization would be observed for a pair of foods perceived to be complements in both India and the United States (i.e., cola and pizza) and for a pair of foods that are perceived to be complements in India but not in the United States (i.e., ketchup and pizza). Our hypotheses predict that imagined consumption of cola or ketchup should both sensitize Indian participants to pizza. By contrast, only consumption of cola should sensitize American participants to pizza. Because the food pairs were identical and only differed with respect to their perceived complementarity across cultures, any differences in cross-stimulus sensitization would be due to cultural perceptions and not to the foods' physical attributes (e.g., sugar, fat, calories).

Method

Stimuli pretest. We conducted an online pretest with 82 residents of India (31 women; $M_{age} = 30.61$ years, SD = 10.77) and 77 residents of the United States (35 women; $M_{age} = 30.25$ years, SD = 10.37) recruited through MTurk. Participants saw seven different foods and indicated how many times they had consumed each of the seven foods during the last ten times they had eaten pizza on 11-point scales with endpoints "never" (0) and "ten times" (10). As we predicted, U.S. participants reported consuming pizza more frequently with cola (M = 3.58, SD = 3.25) than with ketchup (M = .26, SD = 1.02; $t(76) = 8.63$, $p < .001$). By contrast, Indian participants reported consuming pizza as frequently with cola (M = 4.07, SD = 3.44) as with ketchup (M = 4.26, SD = 3.56; $t < 1$).

Figure 4
MEASURE USED IN EXPERIMENT 5

Right now, how much pizza would you like to eat?



Notes: This image was the measure used to elicit the number of slices of pizza desired in Experiment 5.

Participants and procedure. Two hundred Indian participants (77 women; $M_{age} = 29.04$ years, $SD = 8.53$) and 200 U.S. participants (79 women; $M_{age} = 28.57$ years, $SD = 8.37$) were simultaneously recruited through MTurk and completed the experiment for \$.25. Participants randomly assigned to the cola condition were shown a 32 oz glass filled with 16 oz of cola and imagined drinking all 16 oz, one sip at a time. Participants randomly assigned to the ketchup condition were shown a single serving of ketchup and imagined eating the entire serving, a little bit at a time. Both imagery inductions were self-paced. All participants were then shown a pizza divided into 12 slices and indicated how many slices they wanted to eat right then on a six-point scale (see Figure 4). Finally, participants indicated whether they had performed the imagery induction as instructed (i.e., "yes" or "no") and whether they had previously participated in a similar experiment (i.e., "yes" or "no").

Results

No responses were outliers. Seven participants reported performing the imagery task incorrectly. Their responses were not included in the subsequent analyses.

A 2 (imagined consumption: cola, ketchup) × 2 (country: India, United States) between-subjects ANOVA revealed no main effect of imagined consumption ($F < 1$) and a significant main effect of country ($F(1, 389) = 42.32$, $p < .001$, $\eta_p^2 = .10$), which was qualified by a significant interaction ($F(1, 389) = 6.35$, $p = .01$, $\eta_p^2 = .02$). As we predicted (H_3), planned comparisons revealed that U.S. participants who had imagined drinking cola subsequently wanted to eat 21.2% more pizza ($M = 3.03$ slices, $SD = 1.57$) than did U.S. participants who had imagined eating ketchup ($M = 2.50$ slices, $SD = 1.51$; $F(1, 196) = 5.82$, $p = .02$). By contrast, Indian participants who had imagined drinking cola wanted to eat as much pizza ($M = 3.65$ slices, $SD = 1.63$) as did Indian participants who had imagined eating ketchup ($M = 3.91$ slices, $SD = 1.45$; $F(1, 193) = 1.34$, $p = .25$) (see Figure 5).

Without excluding any participants, we found the same results using a nonparametric test (Kruskal–Wallis = 44.93, $p < .001$). U.S. participants who had imagined drinking cola subsequently wanted to eat more pizza than did U.S. participants who had imagined eating ketchup (Kruskal–Wallis = 36.61, $p = .02$). Indian participants who had imagined drinking cola wanted to eat as much pizza as did Indian participants who had imagined eating ketchup (Kruskal–Wallis = 16.09, $p = .23$).

Discussion

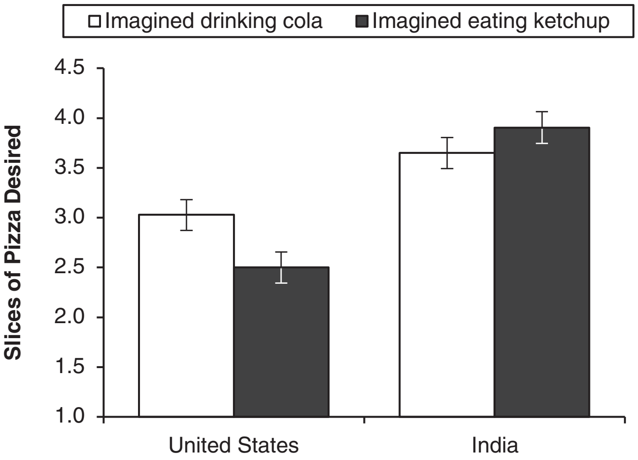
The results of Experiment 5 suggest that perceived complementarity, rather than physical attributes of goods or vice–virtue balancing (Sela, Berger, and Liu 2009), underlies the cross-stimulus sensitization effects observed in the previous experiments. U.S. and Indian participants imagined consuming the same stimuli (i.e., cola or ketchup) and subsequently reported their desire for the same target food (i.e., pizza). Indian participants, for whom both stimuli were complements of pizza, exhibited sensitization to pizza in both conditions. U.S. participants, for whom only cola was a complement of pizza, exhibited sensitization to pizza when they had imagined drinking cola. They did not exhibit sensitization to pizza when they had imagined eating ketchup.

One possible alternative interpretation of the results is that the oddness of asking U.S. participants to eat ketchup by itself may have induced negative feelings such as disgust that reduced their desire for pizza. To examine this possibility, we conducted an ancillary study (for a full description, see the Web Appendix). We tested sensitization effects among U.S. participants ($N = 522$) with a pair of unrelated foods, ketchup and pizza (as in Experiment 5), and a novel pair of complementary foods, ketchup and French fries. Participants imagined repeatedly eating ketchup or did not imagine eating anything (control condition) and then indicated their present desire to eat either pizza (an unrelated food) or French fries (a complementary food). Participants in the experiment who imagined eating ketchup desired pizza as much as did control participants ($F < 1$, n.s.) but desired French fries more than did control participants ($F(1, 516) = 10.67$, $p = .001$). The absence of a significant difference in desire for pizza between control participants and participants who imagined eating ketchup suggests that negative feelings such as disgust cannot explain the results of Experiment 5. Cross-stimulus sensitization is driven by the perceived complementarity of foods, not foods' physical properties, the initiation of a drive state (Wadhwa, Shiv, and Nowlis 2008), or vice–virtue balancing (Sela, Berger, and Liu 2009).

GENERAL DISCUSSION

We find substantial evidence for selective cross-stimulus sensitization resulting from psychological processes in the domain of food. Consuming a food (or instantiating the goal to

Figure 5
EFFECTS OF IMAGERY TASK BY COUNTRY ON DESIRE FOR PIZZA (EXPERIMENT 5)



Notes: U.S. participants in Experiment 5 exhibited an increased desire for pizza after they had imagined eating a cultural complement (cola) but not a culturally unrelated food (ketchup). By contrast, Indian participants exhibited a similar desire for pizza after they had imagined eating either cultural complement (cola and ketchup). Error bars represent ±1 SEM.

consume a food) primes a goal to consume its complements, as evidenced by an increase in the extent to which people consumed, desired, and were willing to pay for complementary foods. The greater increase in desirability of complements with delay suggests that cross-stimulus sensitization is due to goal activation rather than to more general memory processes such as semantic priming. In our experiments, cross-stimulus sensitization generalized across six pairs of food and was not attributable to the two previously identified sources of sensitization: changes in drive states and physiological attributes of the consumed food. Consumption of a food did not induce sensitization to unrelated foods and semantic associates. Imagined consumption induced a cross-stimulus sensitization effect similar to actual consumption, but only in cultures in which the foods were perceived to be complements.

Theoretical Contributions

We believe the results make at least three substantive theoretical contributions. First, we identify the cross-stimulus sensitization as due to the consumption of a target food activating a goal to consume a complementary food. Eating a food increased the cognitive accessibility of concepts related to the consumption of its complement (Experiment 2a). The cultural moderation of cross-stimulus sensitization in Experiment 5 suggests that the effect cannot to be attributed to physical attributes of the target and complement (Inman 2001), an increase in perceptual fluency of the complement (Labroo, Dhar, and Schwarz 2008; Morewedge and Kahneman 2010), or vice–virtue balancing (Sela, Berger, and Liu 2009). Moreover, sensitization to the complement of a food increased with time (Experiment 2b), suggesting that the sensitization was not due to a semantic priming effect (which would decay with time) but rather to activation or priming of a goal to consume the complement (Fitzsimons, Chartrand, and Fitzsimons 2008; Förster, Liberman, and Friedman 2007; Sela and Shiv 2009). Indeed, eating a complement of a food induced a stronger sensitization effect than did eating a food that was a closer semantic associate to the target (Experiment 3).

Second, and more generally, the findings identify top-down processes as playing an important role in sensitization. Both top-down cognitive/motivational processes and bottom-up sensory processes are believed to play important roles in food intake (McSweeney and Swindell 1999), but their specific roles and independence has yet to be delineated. Top-down cognitive processes such as memory, imagery, attention, and categorization clearly play a role in habituation and sensory-specific satiety, the reduction in desire for and pleasure induced by a stimulus that is repeatedly consumed (e.g., Epstein et al. 2009; Garbinsky, Morewedge, and Shiv 2014a, b; Huh, Vosgerau, and Morewedge 2016; Kappes and Morewedge 2016; Morewedge, Huh, and Vosgerau 2010; Redden 2008; Rozin et al. 1998; Wansink 2004). Our findings suggest that similar motivational processes are involved in cross-stimulus sensitization as are involved in habituation and sensory-specific satiety. Specifically, similar goal-oriented processes as those through which imagining the repeated consumption of a food reduces the desire for that food (Morewedge, Huh, and Vosgerau 2010) appear to increase the motivation to consume complements of the food whose consumption is imagined.

Our results distinguish cross-stimulus sensitization from more general effects of activating "hot" drive states such as hunger and sexual arousal (e.g., Ariely and Loewenstein 2006; Dagher 2009; Gal 2012; Siep et al. 2009; Van den Bergh, Dewitte, and Warlop 2008; Xu, Schwarz, and Wyer 2015), to which cross-stimulus sensitization was previously attributed (McSweeney and Swindell 1999). Sensitization to complements can be understood in line with the coactivation of goals forming an association between those goals, which leads one to prime the other when it is activated (Aarts and Dijksterhuis 2000; Wood and Neal 2007). This effect is distinct from the consumption of a food triggering a drive state such as hunger, which would increase the incentive value of all palatable foods (e.g., Wadhwa, Shiv, and Nowlis 2008).

Third, cross-stimulus sensitization may underlie some of the behavior presently classified as variety seeking. People exhibit variety seeking, in part, to maximize the utility of consumption (Kahn 1995; McAlister 1982; Van Trijp, Hoyer, and Inman 1996). Consuming a variety of stimuli helps combat the effects of habituation that occur with the repeated consumption of a single good. Consuming fries with a cheeseburger, for example, may enable one to better enjoy the burger by slowing habituation and satiety and may even aid dishabituation (Garbinsky, Morewedge, and Shiv 2014b; McSweeney and Swindell 1999). The results of the present research suggest that consumers may also exhibit variety seeking because the consumption of a good increases demand for different, but complementary, goods. Rather than eating fries to maximize the utility of eating the cheeseburger, eating fries may itself make the cheeseburger more appealing than if no fries were present. In this sense, our results show that consumption of a good not only leads to a decrease in subsequent consumption of that good due to habituation but can also lead to an increase in the subsequent consumption of other complementary goods. Unfortunately, this also implies that cross-stimulus sensitization may pose another threat to consumers' ability to exert self-control.

Strategic Implications

Our results yield practical insights for marketing strategy in assortment design, behavioral targeting, advertising, and product bundling. First, identifying goal activation as the process underlying cross-stimulus sensitization has different implications for assortment design and behavioral targeting. Regarding assortment design, the findings suggest how categorical representations (e.g., Barsalou 1985; Huh, Vosgerau, and Morewedge 2016) can be used to stimulate consumer demand. Assuming that people have a goal to consume a particular product, such as a sandwich, embedding products in assortments arranged around goal-derived categories such as "things to eat for lunch" (e.g., positioning each sandwich alongside a side, dessert, and beverage) may stimulate consumer demand more than designing assortments around taxonomic categories formed on the basis of shared attributes (e.g., dividing menus by categories such as entrées, sides, desserts, and beverages).

Goal-derived assortments are already used in fast food by firms such as McDonald's, which offers entrées embedded in the context of an "Extra Value Meal," and by high-end restaurants that offer multicourse tasting menus (e.g., an *omakase*). Our research suggests why assortments may stimulate demand for complementary goods beyond simply reducing search costs or increasing their perceptual fluency. This insight is not limited to food marketing. Many product categories can be grouped by goals, such as clothes (e.g., for camping or a business trip), electronics (e.g., components of a media center), housewares (e.g., bedroom furniture), and vacations (e.g., a flight to the Caribbean, car rental, snorkeling trip). Recent research has shown that such goal-derived or complement-based assortments are particularly attractive for hedonic products. For utilitarian products, consumers prefer substitute-based assortments (Diehl, Van Herpen, and Lamberton 2015).

The identification of cross-stimulus sensitization as due to goal activation provides several strategic insights for behavioral targeting. A direct implication is to narrow postpurchase targeted advertising to complements of a purchased good rather than all related goods, particularly when the consumption of a purchased good satisfies a goal (e.g., booking a vacation). Perhaps more important, the results suggest that the effectiveness of targeted advertising for complements of a good may be greater after a delay than immediately after desire for the good has been expressed. If a consumer adds a swimsuit to his or her shopping cart, a beach towel may be more appealing if suggested or advertised after a delay (e.g., at the point of checkout or with subsequent e-mail retargeting) rather than immediately after the swimsuit is added.

Our findings suggest new marketing strategies through which advertising and product bundling can stimulate demand. Demand can be stimulated by creating new complementary pairs through associations formed through exposure to novel pairs in advertisements, product placement in entertainment, and novel product bundles (e.g., salt and chocolate). Companies may actively advertise new product consumption bundles and offerings such as Lunchables, sponsor creative chefs such as Heston Blumenthal, or ask their customers to suggest new combinations of foods (e.g., www.foodpairing.com) and new recipes.

When creating new product bundles, it may make sense to initially offer products as a pure bundle rather than a mixed bundle so they are perceived as complements if their bundling produces super additive utility. Demand for each product may then be stimulated in the future if they are offered as a mixed bundle. Taco Bell and Doritos have used pure bundling in their cobranding strategy (i.e., Doritos Locos Tacos). If consumers subsequently perceive tacos and Doritos as complements with super additive utility, it is possible that the consumption of one product could induce cross-stimulus sensitization to and demand for the other product. In addition, the results suggest that beyond basic congruency effects, brand extensions that are typically consumed with existing offerings are likely to be more successful than extensions that are not consumed in conjunction with existing offerings. Both the extension and existing complementary product offering are likely to stimulate demand for each other.

Finally, the research suggests different advertising effects for advertised brands and their complements. As a result of sensitization followed by satiation and habituation, the typical relationship between repeated advertising exposures and consumer responses to the advertised brand is an inverted U-curve. Early presentations of advertising increase purchase intention for the advertised brand (wear-in), but over subsequent exposures of advertising, responsiveness eventually decreases (wear-out; Pechmann and Stewart 1988). Our findings suggest that even if there is a wear-out effect for an advertised brand or product, there still can be a wear-in effect for its complements. Repeatedly advertising milk should decrease purchase intentions for milk, for instance, but should increase purchase intentions for complements such as cookies or cereal. In this vein, advertising complements of a product for which wear-out has begun may slow wear-out or again sensitize participants to the product. We note, however, that consumption of a target food was imagined repeatedly back-to-back in Experiment 4, whereas exposures to advertisement are infrequent and intermittent. Further research should test whether sensitization effects can be achieved with intermittent advertising exposures.

Conclusion

Consuming a good reduces demand for it and increases demand for a variety of substitutes. We found that consumption of a food can also produce cross-stimulus sensitization (i.e., increase demand for foods perceived to be its complements) and show that goal activation engendered this cross-stimulus sensitization effect. We found cross-stimulus sensitization to generalize across a variety of food pairs, inductions, and elicitation measures. By identifying this new pathway by which to stimulate consumer demand, our findings yield exciting new theoretical insights about motivation and actionable marketing strategies.

APPENDIX A: COMPLEMENTARITY PRETEST IN HONG KONG

To identify pairs of complementary and noncomplementary foods (unrelated food pairs) in Hong Kong, we conducted a pretest with Hong Kong participants. A total of 134 undergraduate students (44 men and 90 women; M_{age} = 20.16 years, SD = 1.16) in Hong Kong indicated how frequently they consumed 11 pairs of food together on seven-point scales with endpoints "not at all" (1) and "extremely often" (7). The pairs

Table A1
COMPLEMENTARITY RATINGS OF FOOD PAIRS FOR HONG KONG STUDENTS (N = 134)

	How Often Do You Consume These Foods Together?	
Food Pair	*M*	*SD*
Curry and rice	5.39_{a}	1.56
Cereal and milk	$5.14_{a,b}$	1.84
Hamburgers and cola	$4.81_{a,b}$	1.76
Pizza and cola	4.54_{b}	1.72
Cookies and milk	3.46_{c}	1.90
Pizza and ketchup	$3.16_{c,d}$	1.94
Chips and beer	$3.06_{c,d}$	2.02
Cheese and wine	$2.54_{d,e}$	1.81
Ice cream and yogurt	$2.16_{e,f}$	1.39
Peanut butter and jelly	$2.04_{e,f}$	1.69
Cheese and grapes	1.75_{f}	1.39

Notes: Responses were given on a seven-point scale (1 = "never," and 7 = "extremely often"). Post hoc pairwise comparisons (Bonferroni tests) with different subscripts are significant at $p < .01$.

were curry and rice, cereal and milk, hamburgers and cola, pizza and cola, cookies and milk, pizza and ketchup, chips and beer, cheese and wine, ice cream and yogurt, peanut butter and jelly, and cheese and grapes (see Table A1).

APPENDIX B: ANALYSIS OF RESPONSE LATENCIES IN EXPERIMENT 2A

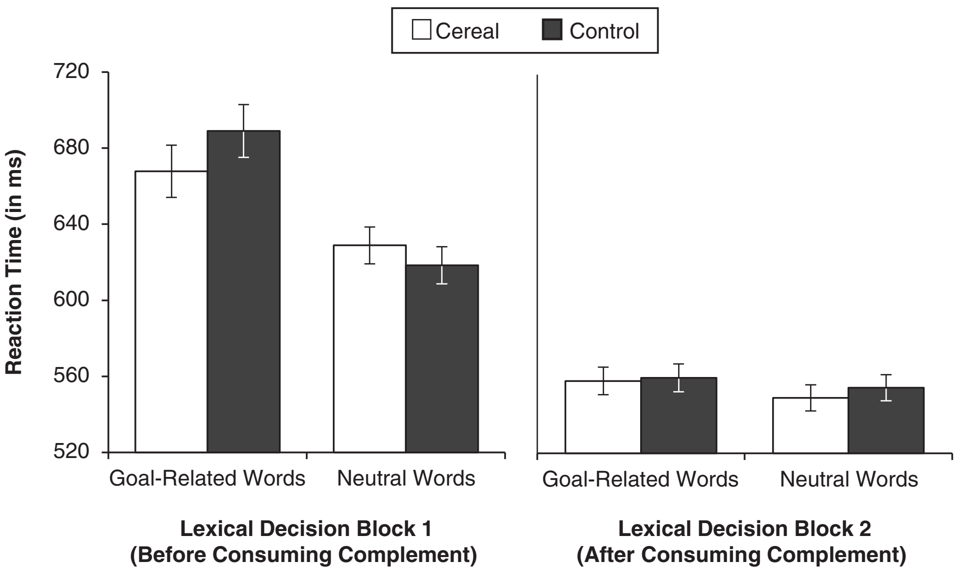
We used an index of relative accessibility of goal-related words versus unrelated words (i.e., $RT_{related} - RT_{unrelated}$), rather than individual response latencies for goal-related words and unrelated words, because the relative accessibility index (a difference score) reduces error variance stemming from individual differences in motor and general processing speed (Fazio 1990). Analyzing relative accessibility rather than the constituent response latencies is common practice in experimental psychology (e.g., Anderson, Benjamin, and Bartholow 1998; Denzler, Hafner, and Förster 2011; Bartholow et al. 2005). Furthermore, using a relative accessibility index rather than the constituent response latencies as dependent variables increases statistical power.

In a 2 (condition: cereal consumption, control) × 2 (block: block 1, block 2) × 2 (type of words: milk-related words, milk-unrelated words) mixed ANOVA with repeated measures on the last two factors, the predicted three-way interaction was significant ($F(1, 247) = 5.14$, $p = .02$). The pattern is consistent with our hypothesis. Reaction times differ only for the goal-related words in block 1, but not for neutral words in block 1 or goal-related and neutral words in block 2 (see Figure B1). The contrast for goal-related words in block 1, however, is not significant ($F(1, 247) = 1.18$, $p = .28$).

APPENDIX C: COMPLEMENTARITY PRETESTS IN THE UNITED STATES

We conducted two pretests to identify pairs of complementary and noncomplementary foods (unrelated food pairs and food pairs that are only semantically associated) for our U.S. participants. In the first pretest, 30 residents of the United States (13 women; M_{age} = 33.53 years, SD = 12.58) indicated how well 14 pairs of food paired together on seven-point scales with endpoints "not at all" (1) and "they go together very well" (7). The pairs were hamburgers and cola, cereal and milk, cheese and crackers, cheese and grapes, cheese and mangoes, cheese and M&M's, cheese and yogurt, French fries and ketchup, milk and cookies, peanut butter and butter, pizza and ketchup, pizza and rice, peanut butter and grape jelly, and strawberry jelly and grape jelly. In the second pretest, 30

Figure B1
MEAN REACTION TIME (IN MS) TO MILK-RELATED AND UNRELATED WORDS AS A FUNCTION OF CEREAL CONSUMPTION.



Notes: Error bars represent ±1 SEM.

Table C1

COMPLEMENTARITY OF FOOD PAIRS (IN THE UNITED STATES)

	Pretest 1 (N = 30)		Pretest 2 (N = 30)	
	How well do these foods go together?[a]		How often do you consume these foods together?[b]	
Food Pair	M	SD	M	SD
French fries and ketchup	6.53_{a}	1.04	5.47_{a}	1.83
Cereal and milk	6.50_{a}	1.01	5.43_{a}	2.00
Pizza and cola	$6.30_{a,b}$	1.09	4.10_{a}	2.16
Cheese and crackers	$6.27_{a,b}$	1.11	5.13_{a}	1.80
Burger and cola	$6.20_{a,b}$	1.27	4.07_{a}	2.21
Milk and cookies	$6.07_{a,b}$	1.31	4.33_{a}	1.77
Peanut butter and grape jelly	5.80_{b}	1.63	4.20_{a}	2.12
Strawberry jelly and grape jelly	3.80_{c}	1.67	1.47_{b}	1.76
Cheese and yogurt	$3.03_{c,d}$	1.61	1.90_{b}	1.63
Peanut butter and butter	2.67_{d}	1.79	1.40_{b}	1.16
Cheese and mangoes	2.50_{d}	1.46	1.13_{b}	.57
Pizza and ketchup	2.23_{d}	1.46	1.47_{b}	1.36
Pizza and rice	1.90_{d}	1.16	1.23_{b}	.94
Cheese and M&M's	1.80_{d}	1.13	1.27_{b}	.91

[a]Measured on a seven-point scale anchored at "extremely well" (7) and "not at all" (1).

[b]Measured on a seven-point scale anchored at "extremely often" (7) and "never" (1).

Notes: Post hoc pairwise comparisons (Bonferroni tests) with different subscripts are significant at $p < .01$.

different U.S. residents (22 women; $M_{age} = 37.73$ years, SD = 15.45) indicated how often they consume each of the 14 pairs together on seven-point scales with endpoints "never" (1) and "extremely often" (7). The presentation order of pairs of foods in both pretests was random.

The rank ordering of pairs was the same for both complementarity measures (Table C1), based on pairwise comparisons (post hoc corrected for multiple comparisons). Using the relative greater frequency of pairings according to these rank orders (Aarts and Dijksterhuis 2000), we identified the following pairs as complementary foods: hamburgers and cola, peanut butter and grape jelly, cookies and milk, cheese and crackers, cereal and milk, cola and pizza, and French fries and ketchup. Using the same criteria, we identified pairs of noncomplementary foods: strawberry jelly and grape jelly, cheese and M&M's, and pizza and ketchup.

REFERENCES

Aarts, Henk and Ap Dijksterhuis (2000), "Habits as Knowledge Structures: Automaticity in Goal-Directed Behavior," *Journal of Personality and Social Psychology*, 78 (1), 53–63.

Anderson, Craig A., Arlin J. Benjamin Jr., and Bruce D. Bartholow (1998), "Does the Gun Pull the Trigger? Automatic Priming Effects of Weapon Pictures and Weapon Names," *Psychological Science*, 9 (4), 308–14.

Anderson, John R. (1983), "A Spreading Activation Theory of Memory," *Journal of Verbal Learning and Verbal Behavior*, 22 (3), 261–95.

Ariely, Dan and George Loewenstein (2006), "The Heat of the Moment: The Effect of Sexual Arousal on Sexual Decision Making," *Journal of Behavioral Decision Making*, 19 (2), 87–98.

Bargh, John A. and Tanya L. Chartrand (2000), "The Mind in the Middle: A Practical Guide to Priming and Automaticity Research," in *Handbook of Research Methods in Social and Personality Psychology*, 2nd ed., Harry T. Reis and Charles M. Judd, eds. New York: Cambridge University Press, 311–44.

Barsalou, Lawrence W. (1985), "Ideals, Central Tendency, and Frequency of Instantiation as Determinants of Graded Structure in Categories," *Journal of Experimental Psychology. Learning, Memory, and Cognition*, 11 (4), 629–54.

Bartholow, Bruce D., Craig A. Anderson, Nicholas L. Carnagey, and Arlin J. Benjamin Jr. (2005), "Interactive Effects of Life Experience and Situational Cues on Aggression: The Weapons Priming Effect in Hunters and Nonhunters," *Journal of Experimental Social Psychology*, 41 (4), 48–60.

Becker, Gordon M., Morris H. Degroot, and Jacob Marschak (1964), "Measuring Utility by a Single Response Sequential Method," *Behavioral Science*, 9 (3), 226–32.

Berridge, Kent C. and Terry E. Robinson (2011), "Drug Addiction as Incentive Sensitization," in *Addiction and Responsibility*, J. Poland and G. Graham, eds. Cambridge, MA: MIT Press, 21–54.

Blank, I., A. Sen, and W. Grosch (1991), "Aroma Impact Compounds of Arabica and Robusta Coffee. Qualitative and Quantitative Investigations," in proceedings of *Quatorzieme Colloque Scientifique International Sur Le Cafe*, San Francisco, (July 14–19), 117–29.

Blumenthal, Heston (2002), "Weird but Wonderful," *The Guardian*, (May 4), [available at http://www.theguardian.com/lifeandstyle/2002/may/04/foodanddrink.shopping].

Cornell, Carol E., Judith Rodin, and Harvey Weingarten (1989), "Stimulus-Induced Eating When Satiated," *Physiology & Behavior*, 45 (4), 695–704.

Dagher, Alain (2009), "The Neurobiology of Appetite: Hunger as Addiction," *International Journal of Obesity*, 33 (Supplement 2), S30–33.

Deaton, Angus and John Muellbauer (1980), *Economics and Consumer Behavior*. New York: Cambridge University Press.

Denzler, Markus, Michael Hafner, and Jens Förster (2011), "He Just Wants to Play: How Goals Determine the Influence of Violent Computer Games on Aggression," *Personality and Social Psychology Bulletin*, 37 (12), 1644–54.

De Wit, Harriet (1996), "Priming Effects with Drugs and Other Reinforcers," *Experimental and Clinical Psychopharmacology*, 4 (1), 5–10.

Diehl, Kristin, Erica van Herpen, and Cait Lamberton (2015), "Organizing Products with Complements Versus Substitutes: Effects on Store Preferences as a Function of Effort and Assortment Perceptions," *Journal of Retailing*, 91 (1), 1–18.

Epstein, Leonard H., Jennifer L. Temple, James N. Roemmich, and Mark E. Bouton (2009), "Habituation as a Determinant of Human Food Intake," *Psychological Review*, 116 (2), 384–407.

Fazio, Russell H. (1990), "A Practical Guide to the Use of Response Latency in Social Psychological Research," in *Research Methods in Personality and Social Psychology*, Vol. 11: Review of Personality and Social Psychology, C. Hendrick and M.S. Clark, eds. Newbury Park, CA: Sage Publications, 74–97.

Festjens, Anouk, Sabrina Bruyneel, and Siegfried Dewitte (2013), "What a Feeling! Touching Sexually Laden Stimuli Makes Women Seek Rewards," *Journal of Consumer Psychology*, 24 (3), 387–93.

Fitzsimons, Gráinne M., Tanya L. Chartrand, and Gavan J. Fitzsimons (2008), "Automatic Effects of Brand Exposure on Motivated Behavior: How Apple Makes You Think Different," *Journal of Consumer Research*, 351 (1), 21–35.

Förster, Jens, Nira Liberman, and Ronald S. Friedman (2007), "Seven Principles of Goal Activation: A Systematic Approach to Distinguishing Goal Priming from Priming of Non-Goal Constructs," *Personality and Social Psychology Review*, 11 (3), 211–35.

Gal, David (2012), “A Mouth-Watering Prospect: Salivation to Material Reward,” *Journal of Consumer Research*, 38 (6), 1022–29.

Galak, Jeff, Joseph Redden, and Justin Kruger (2009), “Variety Amnesia: Recalling Past Variety Can Accelerate Recovery From Satiation,” *Journal of Consumer Research*, 36 (4), 575–84.

Garbinsky, Emily N., Carey K. Morewedge, and Baba Shiv (2014a), “Does Liking or Wanting Determine Repeat Consumption Delay?” *Appetite*, 72 (1), 59–65.

———, ———, and ——— (2014b), “Interference of the End: Why Recency Bias in Memory Determines When a Food is Consumed Again,” *Psychological Science*, 25 (7), 1466–74.

Groves, Philip M. and Richard F. Thompson (1970), “Habituation: A Dual-Process Theory,” *Psychological Review*, 77 (5), 419–50.

Huh, Young E., Joachim Vosgerau, and Carey K. Morewedge (2016), “More Similar but Less Satisfying: Comparing Preferences for and the Efficacy of Within- and Cross-Category Substitutes for Food,” *Psychological Science*, 27 (6), 894–903.

Inman, J. Jeffrey (2001), “The Role of Sensory-Specific Satiety in Attribute-Level Variety Seeking,” *Journal of Consumer Research*, 28 (1), 105–20.

Kahn, Barbara E. (1995), “Consumer Variety-Seeking Among Goods and Services: An Integrative Review,” *Journal of Retailing and Consumer Services*, 2 (3), 139–48.

Kappes, Heather B. and Carey K. Morewedge (2016), “Mental Simulation as Substitute for Experience,” *Social and Personality Psychology Compass*, 10 (7), 405–20.

Kavanagh David J., Jackie Andrade, and Jon May (2005), “Imaginary Relish and Exquisite Torture: The Elaborated Intrusion Theory of Desire,” *Psychological Review*, 112 (2), 446–67.

Koole, Sander L., Karianne Smeets, Ad van Knippenberg, and Ap Dijksterhuis (1999), “The Cessation of Rumination Through Self-Affirmation,” *Journal of Personality and Social Psychology*, 77 (1), 111–25.

Kosslyn, Stephen M., Giorgio Ganis, and William L. Thompson (2001), “Neural Foundations of Imagery,” *Nature Reviews Neuroscience*, 2, 635–42.

Krishna, Aradhna, Maureen Morrin, and Eda Sayin (2014), “Smellizing Cookies and Salivating: A Focus on Olfactory Imagery,” *Journal of Consumer Research*, 41 (1), 18–34.

Labroo, Aparna A., Ravi Dhar, and Norbert Schwarz (2008), “Of Frog Wines and Frowning Watches: Semantic Priming, Perceptual Fluency, and Brand Evaluation,” *Journal of Consumer Research*, 34 (6), 819–31.

Larson, Jeffrey S., Joseph P. Redden, and Ryan S. Elder (2014), “Satiation from Sensory Simulation: Evaluating Foods Decreases Enjoyment of Similar Foods,” *Journal of Consumer Psychology*, 24 (2), 188–94.

LeGoff, Daniel B. and M.N. Spigelman (1987), “Salivary Response to Olfactory Food Stimuli as a Function of Dietary Restraint and Body Weight,” *Appetite*, 8 (1), 29–35.

Liviatan, Ido and John T. Jost (2014), “A Social-Cognitive Analysis of System Justification Goal Striving,” *Social Cognition*, 32 (2), 95–129.

McAlister, Leigh (1982), “A Dynamic Attribute Satiation Model of Variety Seeking Behavior,” *Journal of Consumer Research*, 9 (2), 141–50.

McSweeney, Frances K. and Samantha Swindell (1999), “General-Process Theories of Motivation Revisited: The Role of Habituation,” *Psychological Bulletin*, 125 (4), 437–57.

Morewedge, Carey K. (2016), “Utility: Anticipated, Experienced, and Remembered,” in *Blackwell Handbook of Judgment and Decision Making*, 2nd ed., G. Keren and G. Wu, eds. Malden, MA: Blackwell Press, 295–330.

———, Young Eun Huh, and Joachim Vosgerau (2010), “Thought for Food: Imagined Consumption Reduces Actual Consumption,” *Science*, 330 (6010), 1530–33.

——— and Daniel Kahneman (2010), “Associative Processes in Intuitive Judgment,” *Trends in Cognitive Sciences*, 14 (10), 435–40.

Nagle, Thomas T. and Reed K. Holden (1997), *The Strategy and Tactics of Pricing*. Englewood Cliffs, NJ: Prentice Hall.

Neely, James H. (1991), “Semantic Priming Effects in Visual Word Recognition: A Selective Review of Current Findings and Theories,” in *Basic Processes in Reading: Visual Word Recognition*, D. Besner and G. Humphreys, eds. Hillsdale, NJ: Laurence Erlbaum Associates, 264–336.

Papies, Esther K. and Petra Hamstra (2010), “Goal Priming and Eating Behavior: Enhancing Self-Regulation by Environmental Cues,” *Health Psychology*, 29 (4), 384–88.

Pechmann, Cornelia and David W. Stewart (1988), “Advertising Repetition: A Critical Review of Wearin and Wearout,” in *Current Issues and Research in Advertising*, Vol. 11, Claude Martin and James Leigh, eds. Ann Arbor: University of Michigan School of Business, 285–330.

Redden, Joseph P. (2008), “Reducing Satiation: The Role of Categorization Level,” *Journal of Consumer Research*, 34 (5), 624–34.

Rolls, Barbara J., Edmund T. Rolls, Edward A. Rowe, and Kevin Sweeney (1981), “Sensory Specific Satiety in Man,” *Physiology & Behavior*, 27, 137–42.

———, Edward A. Rowe, and Edmund T. Rolls (1982), “How Sensory Properties of Foods Affect Human Feeding Behavior,” *Physiology & Behavior*, 29 (3), 409–17.

Rozin, Paul, Sara Dow, Morris Moscovitch, and Suparna Rajaram (1998), “What Causes Humans to Begin and End a Meal? A Role for Memory for What Has Been Eaten, as Evidenced by a Study of Multiple Meal Eating in Amnesic Patients,” *Psychological Science*, 9 (5), 392–96.

Sela, Aner, Jonah Berger, and Wendy Liu (2009), “Variety, Vice, and Virtue: How Assortment Size Influences Option Choice,” *Journal of Consumer Research*, 35 (6), 941–51.

——— and Baba Shiv (2009), “Unraveling Priming: When Does the Same Prime Activate a Goal Versus a Trait?” *Journal of Consumer Research*, 36 (3), 418–33.

Shah, James Y. and Ari W. Kruglanski (2002), “Priming Against Your Will: How Accessible Alternatives Affect Goal Pursuit,” *Journal of Experimental Psychology*, 38 (4), 368–83.

Siep, Nicolette, Anne Roefs, Alard Roebroeck, Remco Havermans, Milene L. Bonte, and Anita Jansen (2009), “Hunger Is the Best Spice: An fMRI Study of the Effects of Attention, Hunger and Calorie Content on Food Reward Processing in the Amygdala and Orbitofrontal Cortex,” *Behavioural Brain Research*, 198 (1), 149–58.

Sinha, Rajita, Tiffany Fuse, L-R. Aubin, and S. Stephanie O’Malley (2000), “Psychological Stress, Drug-Related Cues and Cocaine Craving,” *Psychopharmacology*, 152 (2), 140–48.

Stroebe, Wolfgang, Guido M. van Koningsbruggen, Esther K. Papies, and Henk Aarts (2013), “Why Most Dieters Fail but Some Succeed: A Goal Conflict Model of Eating Behavior,” *Psychological Review*, 120 (1), 110–38.

Van den Bergh, Bram, Siegfried Dewitte, and Luk Warlop (2008), “Bikinis Instigate Generalized Impatience in Intertemporal Choice,” *Journal of Consumer Research*, 35 (1), 85–97.

Van Trijp, Hans C.M., Wayne D. Hoyer, and Jeffrey J. Inman (1996), “Why Switch? Product Category–Level Explanations for

True Variety-Seeking Behavior," *Journal of Marketing Research*, 33 (August), 281–92.

Venkatesh, R. and V. Mahajan (2009), "The Design and Pricing of Bundles: A Review of Normative Guidelines and Practical Approaches," in *Handbook of Pricing Research in Marketing*, V.R. Rao, ed. Northampton, MA: Edward Elgar, 232–57.

Wadhwa, Monica, Baba Shiv, and Stephen M. Nowlis (2008), "A Bite to Whet the Reward Appetite: The Influence of Sampling on Reward-Seeking Behaviors," *Journal of Marketing Research*, 45 (August), 403–13.

Wansink, Brian (2004), "Environmental Factors That Increase the Food Intake and Consumption Volume of Unknowing Consumers," *Annual Review of Nutrition*, 24, 455–79.

Watson, David, Lee Anna Clark, and Auke Tellegen (1988), "Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales," *Journal of Personality and Social Psychology*, 54 (6), 1063–70.

Wood, Wendy and David T. Neal (2007), "A New Look at Habits and the Habit-Goal Interface," *Psychological Review*, 114 (4), 843–63.

Xu, Alison Jing, Norbert Schwarz, and Robert S. Wyer (2015), "Hunger Promotes Acquisition of Nonfood Objects," *Proceedings of the National Academy of Sciences of the United States of America*, 112 (9), 2688–92.

Yeomans, Martin R. (1996), "Palatability and the Micro-Structure of Feeding in Humans: The Appetizer Effect," *Appetite*, 27 (2), 119–33.