Identifying Symbols of the Consumer Marketplace From Human Brain Activity

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Rapid advances have been made in our understanding of the neural basis of value representation, but we still have great difficulty in accounting for the myriad of influence from subtle signals like brands. Here, we used functional neuroimaging to study how these intangible characteristics are represented in the brain.

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Transformative Consumer Neuroscience
Chair: Martin Reimann, University of Arizona, USA

Paper #1: Scamming Depression Era Elders: Neuroanatomical Basis for Poor Decision Making Among Older Adults
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Paper #2: Linking Individual Differences in Motivational and Executive Control Neurocognition to Real World Craving and Snacking Behavior: The Case of Restrained and Unrestrained Eaters
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Paper #3: Identifying Symbols of the Consumer Marketplace from Human Brain Activity
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Paper #4: Reward Substitution: Incentivizing Consumers to Choose Smaller Portion Sizes
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Deborah MacInnis, University of Southern California, USA
Antoine Bechara, University of Southern California, USA

SESSION OVERVIEW
The purpose of this session is to integrate investigations on consumer neuroscience and neuromarketing—that is, the study of brain function associated with consumers’ judgments and choices—(e.g., Plassmann, Yoon, Feinberg, & Shiv, 2011; Reimann, Schilke, Weber, Neuhaus, & Zaichkowsky, 2011; Smidts, 2002) with transformative consumer research—that is, research on how to increase consumers’ welfare and quality of life (Ozanme, 2013). This session will highlight contemporary research in this new domain of transformative consumer neuroscience—which we define as “utilizing neuroscience insights and methodologies to improve consumers’ judgments, choices, and overall well-being”—and stimulate discussion on future research. The four papers in this session make important contributions in areas such as aging and decision making (Koestner, Hedgcock, Halfmann, & Denburg), craving and snacking behavior (Lu & Dubé), encoding of intangible characteristics of rewards (Chen, Hsu, & Nelson), and incentivizing consumers to choose less food (Reimann, MacInnis, & Bechara). In Paper 1, Koestner, Hedgcock, Halfmann, and Denburg study the neurobiology behind consumer vulnerability, particularly the brain activation patterns of older adults viewing deceptive and non-deceptive advertisements. The authors found that decreased activation in a region of the prefrontal cortex is crucial to real-world decision making (Bechara et al., 2000). Sadly, these numbers do not take into account the devastating fraud that can have on the elderly and their families, often wiping out entire savings and years of work in a single action, not to mention the negative psychological effects.

The neurobiology behind elder fraud has received very little attention from researchers, but there is a sizeable literature in cognitive neuroscience that can be used to generate hypotheses. To illustrate, multiple studies have lent support to the idea of the “frontal aging hypothesis”, which states that the frontal lobe of the brain undergoes the greatest amount of age-related decline in the context of healthy aging (West, 1996). Also, lesion studies have demonstrated that the prefrontal cortex, and specifically the ventromedial prefrontal cortex, is crucial to real-world decision making (Bechara et al., 2000). Most directly, a recent study conducted by our research group demonstrated that patients with acquired ventromedial prefrontal cortex lesions displayed greater vulnerability to advertisements with misleading and deceptive content than both normal comparison and patients with brain damage outside the prefrontal sector (Asp, Manzel, Koestner, Denburg, & Tranel, 2012). Combined, these studies led us to hypothesize that older adults who were vulnerable to consumer fraud would have abnormal brain activation in ventromedial prefrontal cortex and insular cortex while viewing advertisements.

The older adult participants were recruited from a registry compiled in the Department of Neurology, University of Iowa College of Medicine. Thirty-two participants, age 62 to 88 years, participated; however, the data from one participant was excluded secondary to malfunction during the functional magnetic resonance imaging session, resulting in 31 final participants (52% female; M_age = 76.8, SD = 7.0 years). Participants were scanned using a Siemens 3T magnetic resonance imaging scanner with 12-channel head coil. Data analysis was completed using the Brain Voyager QX software package. Stimuli were created based on six advertisements deemed deceptive by the Federal Trade Commission (FTC, 1998). We created deceptive and non-deceptive versions of each advertisement. While in the scanner, participants were shown three deceptive and three non-deceptive advertisements. Outside of the scanner, each participant completed a questionnaire that assessed their comprehension of the unseen brands with accuracies significantly above chance. Finally, in Paper 4, Reimann, MacInnis, and Bechara establish that offering non-food rewards (lottery tickets, toys) bundled with smaller food portions as an alternative to full-portion meals can substantially decrease chosen portion sizes. The authors explain this effect by a “common reward currency” at the brain level. All four papers incorporate different neuroimaging and neuropsychological measurements to study imperative questions on consumers’ decision making and well-being.

EXTENDED ABSTRACT
Deceiving the elderly is not a new problem, but it is one that has been growing in prevalence. To illustrate, financial abuse of elders aged 65 and older has risen from a low of 8% in 1950 to an astounding 20% in 2010 (Infogroup / ORC, 2010; Kemp, 2005). These recent statistics may even underestimate the extent of the problem, with only 1 in 25 cases being reported (Wasik, 2000). Financial losses due to elder fraud are considerable. Estimates have placed losses at $2.6 billion in 2008, rising to $2.9 billion in 2011 (MetLife, 2011). Sadly, these numbers do not take into account the devastation fraud can have on the elderly and their families, often wiping out entire savings and years of work in a single action, not to mention the negative psychological effects.

The neurobiology behind elder fraud has received very little attention from researchers, but there is a sizeable literature in cognitive neuroscience that can be used to generate hypotheses. To illustrate, multiple studies have lent support to the idea of the “frontal aging hypothesis”, which states that the frontal lobe of the brain undergoes the greatest amount of age-related decline in the context of healthy aging (West, 1996). Also, lesion studies have demonstrated that the prefrontal cortex, and specifically the ventromedial prefrontal cortex, is crucial to real-world decision making (Bechara et al., 2000). Most directly, a recent study conducted by our research group demonstrated that patients with acquired ventromedial prefrontal cortex lesions displayed greater vulnerability to advertisements with misleading and deceptive content than both normal comparison and patients with brain damage outside the prefrontal sector (Asp, Manzel, Koestner, Denburg, & Tranel, 2012). Combined, these studies led us to hypothesize that older adults who were vulnerable to consumer fraud would have abnormal brain activation in ventromedial prefrontal cortex and insular cortex while viewing advertisements.

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advertisement’s content as well as their purchase intentions for each of the advertised products. During an earlier testing session, all participants completed a battery of neurocognitive evaluations and the Iowa Gambling Task (IGT; Bechara, 2007), a laboratory measure of decision making under uncertainty.

From the questionnaire data, we utilized participants’ comprehension ratings of the three deceptive advertisements to create two groups based on their susceptibility to being deceived: “vulnerable” (n = 16) and “non-vulnerable” (n = 15). These two groups did not differ with regard to demographic variables (age, education, sex distribution) or cognitive variables (intellect, attention/working memory, language, visuospatial, anterograde memory, executive functioning) (all ps > .05). Vulnerable participants had less activation in the ventromedial prefrontal cortex when viewing both deceptive and non-deceptive advertisements than non-vulnerable participants (p < .05). We also observed that brain activation in the ventromedial prefrontal cortex was inversely correlated with personality trait Trustworthiness (a measure of “gullibility” from the NEO Five-Factor Inventory) (p < .05). Finally, brain activation in insular cortex correlated with Iowa Gambling Task performance such that laboratory decision making was positively associated with insular activation (p < .01). Interestingly, poorer laboratory decision making performance was predictive of greater activation for deceptive advertisements contrasted against non-deceptive advertisements (p < .05).

These findings provide some of the first evidence for differential neural patterns of brain activation to deceptive advertisements among older adults in relation to consumer vulnerability, personality traits, and decision making performance. Overall, older participants demonstrating greater susceptibility to deceptive advertising, higher gullibility, or lower financial decision making performance displayed less activation in brain regions crucial to decision making and emotional processing, suggesting that prefrontal brain regions, such as the ventromedial prefrontal cortex and insular cortex, may be integral to the protection of the older consumer from fraud.

**Linking Individual Differences in Motivational and Executive Control Neurocognition to Real World Craving and Snacking Behavior: The Case of Restrained and Unrestrained Eaters**

**EXTENDED ABSTRACT**

**Background**

Recent neuroscience research has generated detailed models of brain circuits involved in reward processing, decision-making, and self-control to understand motivated behaviors, including eating (Dagher, 2012). However, research thus far has typically considered neurocognition components, one at a time (Vainik, Dagher, Dubé, & Fellows, 2013), divorced from the complexity of brain and real-life environment (Hammond et al., 2012). Thus, it is important to bridge the current knowledge of brain from neuroscience lab to real-world eating, sparking the transformation in individual behaviors, marketing practices, and public health policy (Dubé et al., 2008). Lab measurements of individual neurocognition should be empirically linked with field observations of eating to explore: which neurocognitive components are engaged in real-life eating; and how individual differences in neurocognition are related to eating as responses to internal (e.g., hunger or craving) and external cues (food cues).

**Research Aims and Hypotheses**

At any given point of time, eating is jointly determined by neurocognition components that combine homeostatic (e.g., hunger), motivational (e.g., attentional bias to food cues and incentive salience in working memory) and executive control (e.g., inhibitory control and mental flexibility) processes (Dagher, 2012). Many but not all food consumptions result from yielding to craving, which has been attributed to a combination of inhibition over responses to rewarding cue, poor mental flexibility, and resulting incentive salience in working memory (Kavanagh, Andrade, & May, 2005). Individual differences in these motivational and executive control processes can be traced both at neurocognitive (Affective Shifting Task, AST; Murphy et al., 1999) and behavioral levels (restrained and unrestrained eating; Herman & Polivy, 1984).

Presuming individuals are constantly being exposed to high-caloric highly-rewarding food (HRF) cues, this study aims to examine the expectation that a person’s likelihood of having HRF snacks, after hunger being controlled, will be predicted by the presence of craving. At individual level, we further expect that both snacking and the predictive power of craving on snacking vary between restrained and unrestrained eaters under the operation of different motivational and executive control processes. Restrained eaters are self-trained to heavily rely on their inhibitory control to regulate eating (Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). As their goal is to resist the temptation of HRF, its related information persists and is elaborated in working memory resulting heightened craving (Polivy, Coleman, & Herman, 2005). Therefore, we expect restrained eaters with relatively better inhibitory control would be more vulnerable to HRF eating. Mental flexibility is the cognitive ability of intentionally directing attention to facilitate the switch between tasks with different cognitive rules (Cserjesi, Molnár, Luminet, & Lénaître, 2007), and is one of the critical neurocognition components to resist the temptation of rewarding cues (Mobbs, Iglesias, Golay, & Van der Linden, 2011). Unrestrained eaters do not particularly intend to regulate eating beyond homeostatic processes (LeBel, Lu, & Dubé, 2008); while HRF cues catch their attention, they may or may not want to shift attention away depending on their contextual goal (e.g. whether they are hungry). But if they do, we expect that a stronger mental flexibility would contribute to resist HRF eating.

**Method**

In laboratory, 109 non-obese adult women performed AST. Restrained and unrestrained eaters were identified by restraint-scale (Polivy, Herman, & Warsh, 1978). They subsequently participated in an experience-sampling study (Reis & Gable, 2000) reporting their hunger feeling, HRF craving and snacking 6times/day in a ten-day period.

In AST, English words were presented, one for each trial, on a computer screen. In half of trials, participants were asked to quickly respond to positive English words (rewarding cues) and ignore neutral words; in the other half of trials, the rule was reversed. The rule-switches were structurally arranged. For each participant, AST indicators were obtained to assess her neurocognition components: Attentional bias was reflected in one’s superior responsiveness to rewarding cue, poor mental flexibility, and resulting incentive salience beyond homeostatic processes (LeBel, Lu, & Dubé, 2008); while HRF cues catch their attention, they may or may not want to shift attention away depending on their contextual goal (e.g. whether they are hungry). But if they do, we expect that a stronger mental flexibility would contribute to resist HRF eating.

**Attention Set Switching (AST)**

In AST, English words were presented, one for each trial, on a computer screen. In half of trials, participants were asked to quickly respond to positive English words (rewarding cues) and ignore neutral words; in the other half of trials, the rule was reversed. The rule-switches were structurally arranged. For each participant, AST indicators were obtained to assess her neurocognition components: Attentional bias was reflected in one’s superior responsiveness to rewarding cue, poor mental flexibility, and resulting incentive salience beyond homeostatic processes (LeBel, Lu, & Dubé, 2008); while HRF cues catch their attention, they may or may not want to shift attention away depending on their contextual goal (e.g. whether they are hungry). But if they do, we expect that a stronger mental flexibility would contribute to resist HRF eating.

**Linking Individual AST Indicators with HRF Snacking**

To link individual AST indicators with HRF snacking reported in the experience-sampling study, data was analyzed by a generalized hierarchical linear model with two-level specification (see Appendix). At episode-level, HRF snacking (Yes/No) was explained by context variables (hunger and time) and HRF craving (Yes/No). At individual-level, the individual differences in HRF snacking likelihood and the predictive power of craving were further explained by...
AST indicators, restraint-group (Restrained/Unrestrained eaters), and their interactions.

### Major Findings

Consistent with our expectations, at episode-level, after controlling for hunger \((p < .001)\), HRF craving was positively associated with snacking \((p = .04)\). At individual level, both restrained and unrestrained eaters’ HRF snacking likelihood was positively related to their AST indicator of attentional bias to rewarding stimuli \((ps < .02)\).

Differences in both snacking likelihood and the predictive power of craving emerged in the neurocognitive processes that were expected to vary between restrained and unrestrained eaters. Specifically for unrestrained eaters, better mental flexibility was directly associated with lower HRF snacking likelihood \((p = .001)\). In terms of the predictive power of craving, stronger attentional bias was associated with higher likelihood that snacking had been triggered by craving \((p = .03)\), while better mental flexibility was associated with lower triggering power of craving \((p < .001)\). These results suggest that unrestrained eaters’ ability of directing attention helped them to attend to activities other than eating. As of restrained eaters, neither inhibitory control nor mental flexibility could directly account for HRF snacking likelihood. But the better restrained eaters were at inhibitory control, the more likely was it that snacking was triggered by craving. Neither difference in their attentional bias nor mental flexibility affected the triggering power of craving on eating.

The pattern of results suggests that it is possible to examine the pathways by which neurocognition components impact real-life motivated behavior. Results also highlight that mental flexibility is a natural contributor to healthier food choices for a large segment of population. Future research should not only bring these results back to neuro-imagery labs but also examine the possibility that restrained eaters could be trained to foster mental flexibility.

### Appendix

#### Episode Level Model

Snack (Y/N) = \(P_0 + P_1 \times (\text{Craving}) + P_2 \times (\text{Hunger}_{t-1}) + P_3 \times (\text{weekend}) + P_4 \times (T_j)\)

Where, Craving and Snack are dummy variables with HRF craving or snacking being denoted as 1, otherwise 0. Hunger \((t-1)\) is a continues variable (0-150), which is group centered. Weekend is a dummy variable indicating weekend and holidays as 1. \(T_j\) \((j=2-6)\) are dummy variables indicating the time of the day.

#### Individual Level Model

\[ P_0 = \beta_{00} \times \text{(Unrestrained)} + \beta_{01} \times \text{(Restrained)} + \beta_{02} \times \text{(Unrestrained * AST indicators)} + \beta_{03} \times \text{(Restrained * AST indicators)} + \beta_{04} \]

\[ P_1 = \beta_{10} \times \text{(Unrestrained)} + \beta_{11} \times \text{(Restrained)} + \beta_{12} \times \text{(Unrestrained * AST indicators)} + \beta_{13} \times \text{(Restrained * AST indicators)} \]

\[ P_2 = \beta_{20} \times \text{(Unrestrained)} + \beta_{21} \times \text{(Restrained)} \]

\[ P_3 = \beta_{30} \]

Where, \(P_0\) is the coefficient indicating an individual overall HRF snacking, that is, the probability to take HRF snack without craving being reported on the same episode. \(P_1\) is further explained by Restrained (a dummy variable: restrained eater as 1, otherwise 0), a set of AST indicators, and the interaction between Restrained and AST indicators.

\(P_2\) is the coefficient indicating how likely a participant followed her craving to take snack (the predictive power of HRF craving), which is further explained by Restrained, a set of AST indicators, and the interaction between Restrained and AST indicators.

### Identifying Symbols of the Consumer Marketplace from Human Brain Activity

#### EXTENDED ABSTRACT

Consumer neuroscience seeks to understand how consumer decisions are shaped by marketing actions. Recent research, guided by formal economic models, has made rapid progress in understanding the neural basis of value representation. These idealized models, however, rely on well-defined and stable preferences in a human population that is famously fickle, and prone to influence from subtle signals like brands, which may be unrelated to intrinsic value. An understanding of these influences is therefore critical for both our understanding of consumer decision-making, as well as potential real-world applications.

The twin challenges in this work are the need to (1) capture, in controlled laboratory conditions, some tractable set of stimuli from consumer daily life, and (2) to characterize, using quantitative, theoretically-grounded measures, the underlying mental representations. Here we bring together research in consumer behavior and decision neuroscience to understand how these intangible characteristics are represented in the brain. Specifically, we investigated the neural basis of brand perception by building on the well-established semantic associations related to brands, widely known as “brand personality.” Brands are tractable and nearly inexhaustible. Frequently they are instantly recognizable, and emotionally and behaviorally evocative. Perhaps most importantly, brands have been nearly exhaustively studied. Research in consumer behavior in particular, has developed a rich framework for characterizing consumers’ perceptions and attitudes toward brands, how they are formed, and factors that influence them (American Marketing Association 2012).

Historically, neuroimaging studies systematically map brain regions to experimental manipulations of cognitive states and/or behavior. In consumer neuroscience, for example, there have been several studies that have investigated brain regions that respond differentially to branded vs. unbranded items, or when making inferences about brands vs. about people (Yoon, Gutchess, Feinberg, & Polk 2006; Schaefer & Rotte 2007). Our experiment, in contrast, asks the question, “What type of information about brands (or other aspects of the consumer experience) is contained in the brain regions that respond to brands?” We do so by studying the neural responses to brands by combining functional neuroimaging of brand perception with a quantitative model of an important aspect of brand perception—the brand’s personality.

A total of 18 participants underwent functional magnetic resonance imaging (fMRI) while being shown a set of 45 logos of well-known brands in a passive viewing task. Prior to the experiment, they were instructed to think about the characteristics and personalities of the brands. To access the latent perceptions of our participants, we used a measure of brand personality developed in Aaker (1997). Following the experiment, participants were asked to complete, for each brand, the 42 item brand personality scale, as well as familiarity and preference, for a total of 1,980 ratings per participant. The total time for completion of the experiment was approximately 3 hours, and they were paid $70 upon completion of the experiment.

This widely used and validated factor analytic system, which has been cited more than 2,000 times, posits that brand personality can be described as a set of five orthogonal personality dimensions: sincerity, excitement, competence, sophistication and ruggedness. With the dimensions of brand personality, we decompose each brand as the composition of these factors, using them as the measure of the mental contents of brands.
We first found that activity in the striatum is correlated with brand preference ratings. This is a region of the brain known to respond to primary and secondary rewards, and is consistent with the idea that our brains respond to preferences of abstract objects such as brands. Then, we found that activity in the temporal-parietal junction (TPJ) is correlated with the brand personality index. This brain region has been hypothesized to be a general brain region of thinking about people and intentions (Saxe, 2006). This provides the first evidence that a significant proportion of variance in brain responses to brands can be captured by the brand personality construct.

Next, we used multi-voxel pattern analysis to predict the cognitive states of the participant using their neural responses to the brands and their latent associations (Haxby & Gobbini 2011; Naselaris, Pregner, Kay, Oliver, & Gallant 2009). To train the model, we reconstruct the relationship between the personality dimensions and the brain activation. With those we were able to predict the brain activations associated with the brands outside the training set. Once trained, we evaluated our model by comparing the predicted fMRI images and the actual data. Our model successfully distinguished pairs of previously unseen brands with accuracies significantly higher than chance. Similarly, we are able to test whether we can reconstruct which brands participants are viewing by using the physical feature of the logos, such as shape, color, and text, as well as using the brand personality model. This can be interpreted as a more stringent test of whether neural representation of brands is sufficiently captured by the brand personality construct.

Understanding the neural basis of consumer psychology and behavior has important managerial, financial, and ethical implications. Here we investigate whether and how the brain represents a specific construct—brand personality—that has excellent psychometric properties and is widely studied in consumer behavior. Beyond branding, this research represents a novel attempt to overcome the conceptual and technical challenges in bridging the mind and the brain, and how our brains deal with the astonishing diversity of goods and services afforded by the modern economy.

### Reward Substitution: Incentivizing Consumers to Choose Smaller Portion Sizes

**EXTENDED ABSTRACT**

In many societies, food has become abundant and calorie-rich. A pandemic of obesity has ensued, with high costs to governments, businesses, and consumers. The medical sciences’ remedy to this issue seems deceptively simple: Consumers should eat less (Lamberg, 2006). However, this advice is easier to give than to follow or enforce in societies that value having freedom and a variety of available options. One stream of research shows that—without altering satiation—smaller portion sizes can drastically decrease the overall quantity of food consumed (e.g., Geier, Rozin, & Doros, 2006; Rolls, Roe, & Meengs, 2006; Rozin, Kabnick, Pete, Fischerl, & Shields, 2003). This notion of decreasing food intake by altering portion sizes has been investigated in several different yet related variants such as smaller assortment sizes (Kahn & Wansink, 2004; Redden & Hoch, 2009; Rolls et al., 1981), smaller package sizes (Scott, Nowlis, Mandel, & Morales, 2008; Wansink, 1996; Wansink & Kim, 2005; Wansink & Park, 2001), taller and more slender food containers (Wansink & Van Ittersum, 2003), and smaller bowls and plates (Van Ittersum & Wansink, 2012; Wansink & Cheney, 2005; Wansink, Van Ittersum, & Painter, 2006).

However, extant research has largely missed addressing the issue of how consumers can be incentivized to choose such smaller portions—a highly relevant question in a world of “family-sized” cereal cartons (Wansink & Van Ittersum, 2007), all-you-can-eat buffets (Wansink & Payne, 2008), and restaurants where tempting “super-sized” meals are offered ubiquitously (e.g., Hill & Peters, 1998; Nestle, 2003; Nielsen & Popkin, 2003). Moreover, from a business perspective, recent marketing research has shown that some profit-maximizing firms have dropped smaller portion sizes from their portfolios and menus because of decreased demand (Sharpe, Staelin, & Huber, 2008) and that introducing smaller food packages to the marketplace may only be profitable for firms under specific circumstances (Jain, 2012). This raises the question whether firms should actively offer such smaller packages and risk losing profitability.

In order to answer these important questions and fill this unforeseen gap in the extant literature on food choice and consumption, the present research introduces a novel food offering that promotes eating less, possibly without hurting food manufacturers’ and restaurants’ profitability. This food offering entails half-sized meals paired with non-food rewards such as a lottery ticket or a small toy (at the same price than a full-sized meal). Four studies establish and validate a novel food choice effect, which we termed “reward substitution.” For the purpose of this research, we define reward substitution as the exchange of parts of a (food) reward with another (non-food) reward. As such, we follow the established definition of rewards being positive reinforcers, which are sometimes also referred to as incentive stimuli (Schultz, 2000).

In Study 1 of the present research, initial evidence for the reward substitution effect is provided in a children population. Study 2 replicated the effect among an adult sample and further shows that the effect does not wear-off over time, even as consumers became familiar with the product. Because self-reported satiety/hunger did not moderate the reward substitution effect in Studies 1 and 2, we manipulated consumers’ satiety levels in Study 3 and found moderation of the reward substitution effect by manipulated satiety. In Study 4, we investigated the underlying neurophysiological process associated with choosing the half-sized meal with the non-food reward compared to choosing regular full-sized meals without such non-food rewards. Recent neuroimaging research has independently shown brain activation in the same brain system—the striatum—for non-food rewards such as food (Berriege, 1996), money (Knutson, Adams, Fong, & Hommer, 2001), beautiful faces (Aharon et al., 2001), and aesthetic packages (Reimann, Zaichkowsky, Neuhaus, Bender, & Weber, 2010). Our research builds on the idea of a common neural currency (Montague & Berns, 2002; Schultz, Dayan, & Montague, 1997; Wise, 1978) to see whether the combination of a small food portion and a non-food reward would attract activation in the striatum as does a large food portion alone.

Taken together, the findings from these four studies present a comprehensive examination of the reward substitution effect that contributes to the extant literature on consumer food choice by showing that attempts of promoting the choice of smaller food portions (1) can be behaviorally effective, (2) is moderated and even intensified by manipulated but not self-reported satiety, and thus, may be particularly effective in food-abundant societies in which consumers are generally satiated, and (3) attracts the same neurophysiological process, if non-food rewards are offered as partial substitutes for food.

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