New scanner data for brand marketers: How neuroscience can help better understand differences in brand preferences

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Abstract

A core goal for marketers is effective segmentation: partitioning a brand's or product's consumer base into distinct and meaningful groups with differing needs. Traditional segmentation data include factors like geographic location, demographics, and shopping history. Yet, research into the cognitive and affective processes underlying consumption decisions shows that these variables can improve the matching of consumers with products beyond traditional demographic and benefit approaches. We propose, using managing a brand as an example, that neuroscience provides a novel way to establish mappings between cognitive processes and traditional marketing data. An improved understanding of the neural mechanisms of decision making will enhance the ability of marketers to effectively market their products. Just as neuroscience can model potential influences on the decision process—including pricing, choice strategy, context, experience, and memory—it can also provide new insights into individual differences in consumption behavior and brand preferences. We outline such a research agenda for incorporating neuroscience data into future attempts to match consumers to brands.
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Introduction

How do companies determine which consumers are the "right" buyers for their products? And, how do they target those consumers through their marketing programs? Consumers' preferences for products or brands arise from the combination of many different factors. Some factors come from features of the product itself (e.g., price, durability), while others are attributes of consumers themselves (e.g., goals, attitudes, discretionary income). Marketing researchers—and the brands they support—acquire information about consumer preferences to identify how individuals will differ in their choices. In differentiated markets, companies are incentivized to identify sets of consumers ("market segments") who share characteristics and hence have similar preferences—,

ones that might differ from those of other consumers. Such an approach allows the brand managers to focus their marketing efforts (e.g., product development, communication and branding efforts) to particular segments, thus becoming more efficient in their allocation of resources.

Identifying the appropriate segmentation criteria presents challenges to marketing researchers and brand managers. Consider the example of New Coke, which was introduced in 1985 after the market share of Coca Cola had dropped significantly to stiff competition from the sweeter tasting Pepsi (Schindler, 1992). New Coke was introduced after comprehensive market research involving focus groups, field tests and surveys. Although the focus groups uncovered some negative responses to the change, those responses were attributed to peer pressure

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and the executives moved forward with the launch of the new formula. Yet, within three months, they were forced to reintroduce their original formulation as Classic Coke after public outrage emerged, particularly among the most loyal Coke drinkers. Termed as a major marketing research failure, the responses and tests had failed to capture the emotional intensity of the negative responses among a particular customer segment (i.e., the most loyal Coca Cola drinkers) that had felt alienated by the switch.

Traditional market segmentation groups potential consumers based on demographic variables: geography (e.g. country, population density, climate), demographics (e.g., age, sex, gender, socioeconomic status), purchasing history (e.g., store scanner data), and even responses to marketing activities (e.g., commercials or focus groups) (Keller, 2008). Current approaches to segmentation also often include measures of consumers' *attitudes*, based on variables like anticipated benefits, brand loyalty, usage frequency, and others (Churchill & Iacobucci, 2005; Greenberg & McDonald, 1989; Yankelovich & Meer, 2006). What largely remains absent, however, is reliable information about potential individual differences in the decision-making process itself, as could be obtained from measures of cognitive or emotional processes. While a *cognitive segmentation* approach could hold substantial promise, it faces a key obstacle: the difficulty of understanding the thought processes, both conscious and nonconscious, that consumers apply when making decisions.

Recent neuroscience research provides a potential new tool to address the challenge of understanding consumer decision making. Neuroscience has generated significant advances in identifying the neural mechanisms underlying decision-making processes, commonly grouped under the term *neuroeconomics* (Clithero, Tankersley, & Huettel, 2008; Sanfey, Loewenstein, McClure, & Cohen, 2006). In parallel, marketing research has indicated that consumer behavior can be predicted by determining the likely decision processes consumers will employ in a given context (Simonson, Carmon, Dhar, Drolet, & Nowlis, 2001; Weber & Johnson, 2009), such as how consumers will respond to various brands in a snack aisle as they walk through. These independent successes suggest that models that integrate cognitive processes, traditional marketing data, and various measures of benefit would improve market research and segmentation (Ariely & Berns, 2010; Kenning & Plassmann, 2008; Plassmann, Ramsøy, & Milosavljevic, in press). For instance, there exist functional magnetic resonance imaging (fMRI) studies that elucidate neural markers for preferences for food items, both experienced and in monetary value (Knutson, Rick, Wimmer, Prelec, & Loewenstein, 2007; O'Doherty, Buchanan, Seymour, & Dolan, 2006), as well as how those processes can potentially be affected by context (De Martino, Kumaran, Seymour, & Dolan, 2006; Hare, Camerer, & Rangel, 2009; Venkatraman, Huettel, Chuah, Payne, & Chee, 2011). An understanding of the neural mechanisms underlying consumer decisions could both increase understanding of the cognitive processes that lead to individual variability in consumer behavior, and would create new approaches for marketing researchers to segment their target markets.

Our goal is to provide a conceptual framework for bridging research in neuroscience and marketing, particularly in the realm of brand evaluation. Brands, their images and their logos are pervasive in the everyday environment. Recent estimates suggest the typical United States consumer is exposed to several thousand brands each day (Story, 2007). Firms spend millions of dollars to understand how specific brand exposures and associations will motivate different segments of their consumer base (Brasel & Gips, 2011; Hang & Auty, 2011). Yet, little is known about the processes underlying consumers' evaluation of brands. We first introduce some key findings from neuroscience research on decision mechanisms, with a focus on processes related to consumer choice. Next, we consider the perspective of a brand manager (e.g., a manager faced with a task analogous to the development of New Coke) and how she might employ measures of choice and process into her brand-evaluation method. Though we use brand evaluation as a prototypic example, we believe that the concepts introduced in this paper extend to many other realms of marketing research and consumer behavior. We conclude with a discussion for how marketing research might employ new types of "scanner" data, obtained from neuroscience.

Consumer neuroscience: what we know

In this section, we review three critical areas where neuroscience has made significant contributions to our understanding of behavioral phenomena relevant for consumer behavior and marketing. First, to evaluate a brand (or to buy a product), consumers must determine whether or not the product and the price are to their liking (*preference measures*). Second, consumer preferences are susceptible to context and hence it is important to understand how perturbations to cognitive and neural processes will affect choice (*context dependencies*). Third, like all things, preferences will vary across consumers (*individual differences*). We discuss each of these in greater detail below.

Preference measures

Although "market segmentation" can imply a desire to identify which individuals prefer which brands, identifying individual willingness-to-pay is also crucial. In different choice environments and with different pricing schemes, fMRI studies have identified brain regions such as orbitofrontal cortex (OFC) and ventromedial prefrontal cortex (VMPFC) that consistently encode various measures of individual subjective value, including willingness-to-pay (Chib, Rangel, Shimojo, & O'Doherty, 2009; Montague, King-Casas, & Cohen, 2006; Plassmann, O'Doherty, & Rangel, 2007) and relative value (FitzGerald, Seymour, & Dolan, 2009). If neuroscience is able to identify brain activity that corresponds to preference measures, this demonstrates an ability to identify precise computations taking place in the brain. In other words, the existence of value signals in the human brain argues for a cognitive process of subjective valuation, and that mechanism can be studied in the context of pricing or another costs associated with consumption. Similarly, fMRI studies have also looked at product purchases at given prices (Knutson et al., 2007) or the social influences on preferences

(Campbell-Meiklejohn, Bach, Roepstorff, Dolan, & Frith, 2010). These studies, in addition to others, demonstrate that cognitive neuroscience can identify both a homogeneous neural mechanism for different types of valuation and the heterogeneous output of that mechanism across individuals.

Neuroscience may even provide, in some circumstances, measures of hidden preferences and of implicit processes. For example, neuroscience data can reveal preferences for public goods in a manner that cannot be readily elicited from behavioral data (Krajbich, Camerer, Ledyard, & Rangel, 2009). Similarly, neuroscience can be used to demonstrate the role of implicit, automatic processes in guiding complex decisions. In one such study, distributed activation pattern across two brain regions (anterior insula and medial prefrontal cortex) during the initial presentation phase of a task (where subjects were merely rating the attractiveness of cars) reliably predicted subsequent choices, despite subjects being unaware that they had to make these consumer choices at the end. These findings support the argument that consumers make a lot of purchasing decisions automatically, in the absence of explicit deliberation and without attention to products (Tusche et al., 2010).

Context dependencies

The ability of emotions (Loewenstein & Lerner, 2003; Shiv, 2007), memory (Bettman, 1979), social comparisons (Forehand, Perkins, & Reed, 2011), and previous actions (Ariely & Norton, 2008) to affect consumer choices is well known. Similarly, the manner in which a decision problem is posed may affect choice behavior (Hertwig & Erev, 2009), including whether or not an individual is in the physical presence of potential options (Bushong, King, Camerer, & Rangel, 2010). All of these scenarios involve changes in decision context and modulations of choice behavior.

Neuroscience studies now exist that attempt to understand how choice processes are modulated by various contextual changes, whether external (e.g., framing of a problem) or internal (e.g., mood, memory). For example, changes in the price of wine modulate both subjective reports of flavor pleasantness and the corresponding neural activity (Plassmann, O'Doherty, Shiv, & Rangel, 2008). Similarly, the presentation of an equivalent risky choice problem has been shown to affect the neural processes recruited to resolve it (De Martino et al., 2006). Internal manipulations, such as sleep deprivation, have also been shown to affect the neural processing of risk (Venkatraman, Chuah, Huettel, & Chee, 2007). Another manipulation, self-regulation, has been shown to affect both physiological and neural responses to reward (Delgado, Gillis, & Phelps, 2008); neuroscience can quantify the ability of an individual to self-regulate. Finally, neural markers of decision processes can be shaped by choice-induced changes in the evaluation of outcomes (Sharot, De Martino, & Dolan, 2009), as well as by preference changes borne out of cognitive dissonance (Izuma et al., 2010).

All of this evidence speaks broadly to the following: neuroscience data cannot facilitate prediction of all purchasing decisions by individuals, but it can facilitate an understanding of when and how preferences can change (e.g., deviate from the "norm"). An understanding of preference-forming mechanisms and how they are modulated by context leads to predictions of how changes in behavior might be encouraged or avoided. For example, if an individual's self-control processes for unhealthy snack foods can be modulated by contextual cues (Hare, Malmaud, & Rangel, 2011), improving the ability to identify individuals with weaker preferences (i.e., those more likely to susceptible to contextual changes in a decision environment) would be of tremendous value to marketing researchers.

Individual differences

Broadly speaking, the most compelling application of neuroscience in marketing is its ability to understand individual differences at multiple biological levels (Hariri, 2009). Neuroscience brings the ability to integrate many different explanations of behavior (Geschwind & Konopka, 2009), and multiple levels might be necessary for various consumer phenomena. Indeed, neuroscience works to understand when different individuals employ different choice strategies (Bhatt, Lohrenz, Camerer, & Montague, 2010; Venkatraman, Payne, Bettman, Luce, & Huettel, 2009). These efforts can build upon existing efforts in marketing to identify different strategies behind choices (Bettman, Luce, & Payne, 1998), providing a clear path for neuroscience to impart novel insights into how individuals utilize different decision-making strategies.

Beyond cognitive process differences, neuroscience is also increasingly interested in socioeconomic status and its effects on brain development and cognitive processes (Hackman, Farah, & Meaney, 2010). There is overlap in the trait and behavioral data that marketing research and cognitive neuroscience research employ; the key enhancement is the ability of neuroscience to test mechanistic explanations with high-dimensionality biological data (e.g., fMRI, hormones, genetics). The success of cognitive neuroscience in identifying individual differences in reward processing and decision making is strong evidence that marketing research can potentially enjoy similar interdisciplinary success.

Neuroscience has already demonstrated the ability to identify neural markers that correspond to individual traits. Consider again a cognitive process crucial to shopping restraint: self control. Like many cognitive processes, self control varies across different environments (Baumeister, 2002; Shiv & Fedorikhin, 1999). A recent fMRI study identified differences in the neural mechanisms behind self control for certain food items, and those differences affected the computation of subjective value measures pertaining to food items (Hare et al., 2009). Specifically, individual differences in self control arise from the variability in the ability to regulate (through activation in the dorsolateral prefrontal cortex) valuation signals (computed in VMPFC). Knowledge about these mechanisms therefore has tremendous implications for understanding clinical disorders like obesity and addiction, as well as for motivating public policies to promote health and savings. Similar experimental paradigms can be extended into the domain of brand research. In other words, despite the fact that heterogeneity exists in the behaviors of consumers, neuroscience can illuminate the lesser-known fact that biological traits that engender those differences likely exist at many points (e.g., genes, hormones, brain regions) in the neurobiological mechanisms pertaining to decision

making. Isolating and identifying different components of that mechanistic heterogeneity would facilitate broader predictions in marketing.

Stages in brand marketing: insights from neuroscience

We contend that the current set of neuroscience tools could improve the efficiency of marketing strategies. Neuroscience cannot replace, either now or in the future, traditional approaches to understanding consumer needs (Keller, 2008). Instead, neuroscience data can indicate implicit processes, improve out-of-sample predictions, improve the generalization of models of behavior, and provide a reliable and process-based approach for segmenting customers. We hereafter describe how research directions in neuroscience can be employed to pursue research agendas of interest for brand marketers. We outline six different stages for brand marketing, and discuss in greater detail what neuroscience can and cannot contribute to each stage.

Testing prototypic ideas and concepts

A common preliminary step for a company considering a new product is to collect information on how their target customers would respond to the proposed product; the goal is to evaluate the merits of investing in a full-fledged production process. At this stage, marketers typically collect responses from small focus groups and large online surveys, to assess qualities of the product and its presentation. In most cases, this stage is followed by a field test, where feedback is obtained from a section of the potential customers who get to evaluate a version of the proposed product. Consider again the example of New Coke (Schindler, 1992). Before the introduction of the new formula, marketing executives obtained responses using taste tests in focus groups and surveys. Taste tests comparing the New Coke mixture, Pepsi, and traditional Coca Cola revealed that a large majority of participants preferred the new formulation of Coke. Subsequently, participants were also asked if they would prefer the drink if were to be sold as the new Coca Cola. Such responses provide initial insights into the general responses of a market segment, which can then be used to improve subsequent versions of the product. This research, though, did not lead to an understanding of the deep, emotional and often nonconscious attraction that the majority of consumers had to the original Coke brand and formula. Neuroscience can tap into these emotional and nonconscious processes (McClure et al., 2004), which could dramatically improve concept testing, and lead to better predictions of true consumer preferences.

Role of neuroscience: improving behavioral predictions using brain data

Recent work has shown that measures of brain function can be used to improve predictions of simple decisions (Knutson et al., 2007), even when the neural data correspond to different tasks that do not pertain to preferences of interest (Lebreton, Jorge, Michel, Thirion, & Pessiglione, 2009; Levy, Lazzaro, Rutledge, & Glimcher, 2011). These efforts are related to the more broad goal of cognitive neuroscience to identify individual experiences using only neural patterns of activation (Haynes & Rees, 2006; Mur, Bandettini, & Kriegeskorte, 2009), a skill that allows delineation of different visual experiences (Kay, Naselaris, Prenger, & Gallant, 2008), cognitive tasks (Poldrack, Halchenko, & Hanson, 2009), or unconscious decisions (Soon, Brass, Heinze, & Haynes, 2008). Neuroscience also can provide insight into differences across individuals in the absence of observable differences in behavior (Fig. 1). Identifying differentiable processes—perhaps one consumer recalls several memories to make a choice and another simply chooses impulsively—would allow for clustering of consumers based upon the means of arriving at a choice, and lead to both different approaches to communicating and meeting their needs, as well as different predictions for additional choices that might be arrived at using the same cognitive processes.

The nature of current technology, however, limits the applicability of neuroscience data in some product segments. For example, consumer goods that are experienced through physical interaction before purchasing (e.g., sitting on furniture, trying on clothing) may not be easily tested using fMRI. Even in these cases, however, neuroscience data may still be useful for improving marketing campaigns (e.g., presenting visual representations of the items) and for segmenting potential consumers, as will be described in the following sections.

Developing the physical product

Once the brand manager has collected sufficient information about a new potential product, they can then make revisions to their original prototype and revise the design of the product. Feedback obtained from market research in stage 1 can also aid in modifying brand name and packaging strategies. The scale and scope of such processes is heavily product-dependent. Thus, the contributions of neuroscience to this stage may be limited, although procedures similar to those outlined in stage 1 can be iterated to improve the evaluation of modified prototypes.

Role of neuroscience: specifying brand traits that correspond to preference

While neuroscience may not be crucial for physical product development, the acquisition of relevant information may still be feasible. For example, neuroimaging work already exists that attempts to identify the components, both psychological and neural, that contribute to brand preferences of soft drinks (McClure et al., 2004); an extension of this work would be to predict if an individual's preferences between two goods is driven by sensitivity to the taste of relatively similar items, or rather sensitivity to different cultural relevance or importance (Yoon, Gutchess, Feinberg, & Polk, 2006). Similarly, applications that are useful at other stages, such as neural signatures for taste preferences (O'Doherty et al., 2006) and neural responses to prices (Knutson et al., 2007; Plassmann et al., 2008) can also be easily refined during product development.

Additionally, even if the final physical product is completed and approved, neuroscience may also be able to determine which attributes of the product are the most salient, or the most crucial in contributing to individual preferences. With food items, the healthfulness and tastiness of food items can have
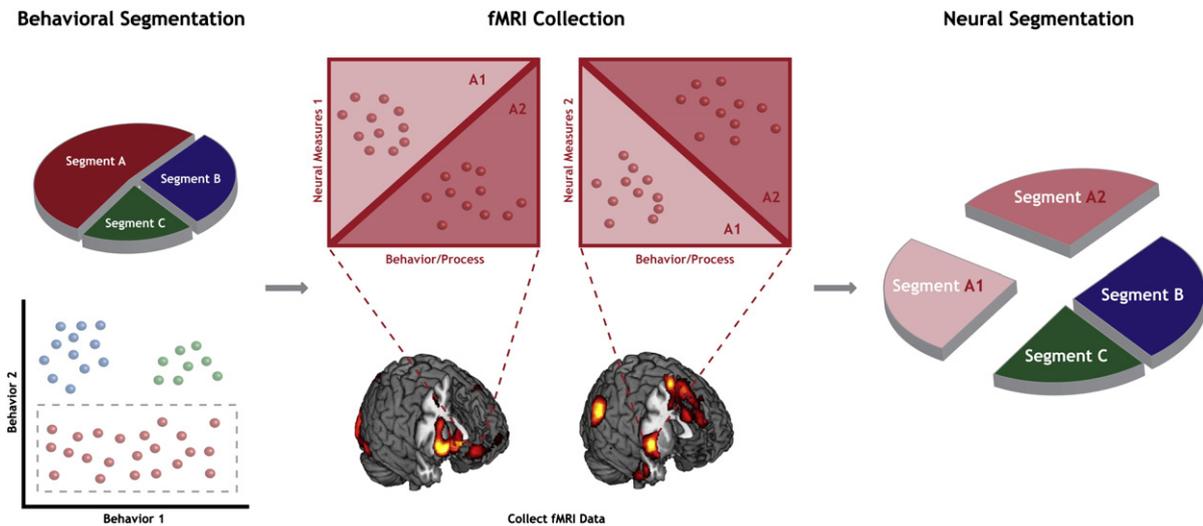
Fig. 1. A framework for neural market segmentation. In an attempt to differentiate consumers, marketers identify three segments (shown as A, B, C) using two behavioral traits. Segment A, however, does not show significant variability in Behavior 2 compared to Behavior 1, and is also a much larger segment than B or C. By designing an fMRI experiment on a sample of Segment A, marketers are able to identify neural differences within a group with homogeneous Behavior 2. By comparing different brain networks (Neural Measures 1 and 2) with the same measures of behavior and cognitive processes (Behavior/Process), researchers show that different cognitive processes lead to similar observable behavior. These additional neural and behavioral data allow the marketers to segment Group A into two further segments (A1 and A2), facilitating a marketing strategy that accounts for an additional layer of consumer heterogeneity.

varying importance, depending upon the goals of the consumer (Hare et al., 2011). In more uncertain decision contexts, different pieces of information, or different potential outcomes, may be more salient or more important to a consumer (Venkatraman et al., 2009).

Communicating product information

Once a product is developed, a communication strategy is typically put in place to educate consumers on the both the existence and the benefits of the product. This communication strategy will be integrated across all the various ways in which the firm interacts with the consumer (e.g., from product packaging to in-store displays to social media, and traditional advertising campaigns). Many marketing researchers still follow historically popular approaches to measuring the effectiveness of these efforts. For example, a brand manager may employ a memory test to measure recall, assuming this measure is a good determinant of advertisement effectiveness. If memory recall does indeed always accurately correspond to increased preference and purchasing behavior, this would be a sufficient metric.

A recent body of research, however, has shown that subconscious exposure to advertisements and even brand logos can have dramatic influences on consumer behavior and consumer choice (Chartrand, 2005; Ferraro, Bettman, & Chartrand, 2009; Fitzsimons, Chartrand, & Fitzsimons, 2008). A common assumption is that a failure to recall a specific advertisement implies the advertisement has had no effect, but the impact of the advertisement may well be outside of awareness (Fishbach, Ratner, & Zhang, 2011). It might be the case that, during preliminary copy testing, an advertisement leads to a high level of recall, but may no behavioral impact on individuals who do not recall the advertisement. By contrast, a different advertisement for the same product, one that leads to less recall, may have dramatic effects on choice behavior, perhaps in part because it slipped past the consumer's conscious defense mechanism (Friestad & Wright, 1994). These different processes—often unconscious (Chartrand, 2005; Dijksterhuis, Smith, van Baaren, & Wigboldus, 2005) and not easily observable from the perspective of behavior—may be identifiable with neural data, as discussed below.

Role of neuroscience: constructing reliable indices for implicit processes and hidden preferences

Even in the best-designed behavioral experiment, individuals do not always reveal true underlying preferences. Often times, there could be experimenter demand effects: individuals in focus groups and surveys are more likely to say what they intuit the interviewer wants to hear. Alternatively, (hypothetical) consumers may be unwilling to express their true preferences or may even be unaware of or unable to articulate their true preferences. Perhaps more importantly for marketing research, individuals do not always reveal true underlying reasons for their underlying preferences. Indeed, the ratings and scales cannot necessarily capture the emotional responses associated with the decision or motivation of the actual purchase. In essence, consumers may have private reasons (either conscious or unconscious) for not consistently or completely revealing their underlying preferences.

Recent applications of fMRI, however, provide compelling evidence that neural data can be used to both predict and potentially induce behavior (Krajbich et al., 2009). Similarly, there is also neural evidence that the brain subliminally acquires information about value in a decision-making environment (Pessiglione et al., 2008). A question, then, is to what choice domains such effects can be extended. Other fMRI studies have revealed strong correlations between activation in different brain regions and incentive-compatible measures of willingness to pay for items

(Plassmann et al., 2007) as well as strong correspondence between similar brain regions and consumption of enjoyable goods (Aharon et al., 2001; O'Doherty et al., 2006). Importantly, additional studies have also demonstrated that individual sensitivity to context can also be uncovered with neural data, even if there are no observable behavioral differences (Sharot et al., 2009). Thus, models that incorporate this additional layer of information may be more robust (Reutskaja, Nagel, Camerer, & Rangel, 2011).

Understanding user experience

The study of actual post-purchase consumption is relatively limited in practice (but see Tse and Wilton (1988)). Once a product leaves the shelf, firms rely on diary style reports from consumers about the ways in which they use the product and why. While there is considerable room for improvement in this arena, neuroscientific approaches are currently constrained in many of these settings. For example, understanding the neural processes when consumers actually consume their breakfast cereal requires consideration of simultaneous experiences like watching television, listening to children fight, and pondering the day ahead at work. Such a set of experiences, as well as thought processes, would be difficult to capture with current neuroscience methodologies. The constraints here are similar to those of stage 2, but due to the fact that most experiences happen in everyday environments and not in the controlled setting of a store, are even more stringent. As a result, we do not see a compelling case for neuroscience at this time. However, to the extent that neuroscience data *before* an experience can be linked to predictions *of* experience, there may be room for neuroscientific contributions.

Role of neuroscience: differentiating different types of subjective experience

Psychology has facilitated different conceptualizations of utility in economics (Kahneman, Wakker, & Sarin, 1997), and, as we are outlining here, consumer research is also concerned with multiple phases of the consumer judgment and decision-making process. These different concepts of subjective value have led to growing efforts to identify similarities between brain regions associated with expectation and experience (Kahnt, Heinzle, Park, & Haynes, 2010), coupled with findings that implicate similar neural underpinnings for hypothetical scenarios to real consumer purchases (Kang, Rangel, Camus, & Camerer, 2011).

The user-experience phase is also an important phase for identifying relevant emotions in the consumer experience (Richins, 1997). As such, one possible avenue for neuroscientific contributions in this area will come from advances in understanding the neuroscience of emotion (Phelps, 2006). There are additional examples of pleasure (Rolls & Grabenhorst, 2008) and preference information being encoded in the brain when choices are not required (Lebreton et al., 2009; Levy et al., 2011). These studies and others reflect a broader goal of neuroscience to delineate the neural processes behind pleasure and other economic-oriented measures of well-being in the brain (Kringelbach &

Berridge, 2009). In this dimension, marketing and economics have much in common. Moving forward, then, marketers can strive to capture additional experiential information from neural data over traditional methods.

Segmenting consumers for effective marketing

No single approach can adequately complete each and all of the above stages in developing a product (e.g., considering how best to communicate the merits of the product, or forecasting how well it is likely to sell). Rather, consumers are likely to differ in meaningful ways, such as responsiveness to product packages, or marketing communications. As a result, a product manager may often want to classify consumers into different and unique market segments that they can then target with appropriate pricing and promotion strategies.

Any segmentation framework uses a combination of consumers' background characteristics and their market history for classifying them into meaningful segments. Traditionally, methods for analyzing market history have included the use of scanner data for history of purchasing profiles (Bucklin & Gupta, 1992), individual consumer's frequent card purchase information, and choice data obtained from a pre-selected heterogeneous group of individuals that form a focus group. Marketers then administer a series of surveys on these individuals (including questions about background characteristics) to identify a range of responses, which can subsequently be used to categorize them into different segments. However, these methods are often restricted to observed choice behavior and provide very limited insights into the psychology behind a customer's behavior.

Role of neuroscience: understanding individual variability

We argue that neuroscience data can play an important—and complementary—role in this market segmentation process through its ability to inform individual differences in decision making. Specifically, neuroscience data can help the segmentation process in three ways. First, neuroscience can help identify consumers that vary along a particular measure of interest. For example, the integration of neuroimaging and survey data can allow the researcher to elucidate regions in the brain that vary as a function of context or trait differences across individuals. Second, knowledge about the underlying neural mechanisms can help identify novel approaches to segmenting markets, which may be quite different from the segments identified from traditional methods. Using neural measures of implicit processes, the researcher might classify individuals into different segments. For instance, once neural characteristics such as framing sensitivity (De Martino et al., 2006), strategic reasoning (Bhatt et al., 2010), or moral sentiments (Chang, Smith, Dufwenberg, & Sanfey, 2011) have been identified, consumers can be grouped in those neural dimensions. Third, within a particular segment, neuroscience can help identify individuals who employ different cognitive routes to the same solution, essentially providing insight into sub-segments within traditional segments (Fig. 1).

In the context of brand evaluation, magnitude of activation in different brain regions together with behavioral data can then be

used to classify individuals into segments based on the three different routes (cognitive, evaluative and motivational) (Aaker, 1997; Bucklin & Gupta, 1992; Fitzsimons et al., 2008). Therefore, using neural data provides a more effective means of segmentation that combines consumers' background with the psychological processes associated with purchasing decisions. Collecting similar (or identical) choice data in both behavioral and neural experiments provides a stronger theoretical and empirical link between choices and the processes behind them, making it possible to integrate more contexts and scenarios into models of purchase and decision behavior (Benhabib & Bisin, 2008).

Building models to predict consumer behavior

Marketers, like economists, are interested in predicting human choice behavior. Economists are increasingly interested in the processes behind observed behavior (Caplin & Dean, 2008; Gabaix, Laibson, Moloche, & Weinberg, 2006) and marketers have a long-standing desire to understand the process behind choices (Weber & Johnson, 2009). If some individuals are likely to employ heuristic processing when happy, whereas others more likely when angry, a model that accounts for this state-dependence will have broader generality than another model that does not account for the emotional state. In other words, an understanding of the mechanistic process and potential susceptibility (only identifiable at a neural or genetic level) will lead to the pruning of different behavioral models (Rustichini, 2009) by identifying more biologically plausible explanations (Clithero et al., 2008) for heterogeneity in consumer behavior.

Recall the relevance of self control to many consumer purchases (Baumeister, 2002). As the understanding of the neural mechanisms behind self control (Hare et al., 2009) and emotion regulation (Ochsner et al., 2004; Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008) improves, we will better understand how different modulations of decision-making processes of the brain result in behavioral changes. Emotion, in certain instances, can actually help optimize choice behavior (Seymour & Dolan, 2008). Effectively, an understanding of how mechanisms generalize across the brain (Rushworth, Mars, & Summerfield, 2009), implies more generalizable behavioral models for consumer choice.

Role of neuroscience: generating out-of-sample applications

Beyond improved predictive power within a specific decision context is the ability to identify broadly representative data and to make predictions under novel circumstances; this ability is of primary importance to marketers. Traditional methods, such as focus groups and surveys, do not easily extend to novel situations, particularly if the choice environment differs significantly (e.g., time, location). However, a biological model that is based on a joint understanding of behavior and underlying neural mechanisms—which presumably will not vary from one decision environment to the next - might prove more robust to new situations (Bernheim, 2009; Clithero et al., 2008).

Consider the following example of the effect of incidental emotions on consumer preferences. Individuals who are angry or happy are both likely to use heuristic strategies to solve complex economic problems (e.g., what kind of car to purchase). However, the motivation underlying the use of heuristic processing is different in these two groups. While angry individuals are often impulsive and hence have difficulties in concentrating cognitively (Leith & Baumeister, 1996), happy individuals are less motivated for systematic thought (Schwarz, Bless, & Bohner, 1991). In contexts with available heuristics (e.g., focusing on certain attributes of a car to make a purchase decision), both groups will be consistent in their observable choice preferences, but they will have employed different cognitive and affective processes that lead to those choices.

If neuroscience can detect distinct emotional states and their corresponding distinct decision-making processes (Venkatraman et al., 2009)—information not necessarily available from any behavioral experiment—it may well have very different out-of-sample predictions for an individual. Such information could be paired with knowledge of how individuals differentially respond to priming cues (Wheeler & Berger, 2007), meaning different individuals would require different priming strategies to elicit the same emotional state and hence the same decision-making process.

We emphasize that although our primary focus here is on fMRI, other neuroscience approaches can also play a significant role in marketing. For example, a recent eye-tracking study investigated the effects of biases in visual saliency using experimental designs from visual neuroscience. The authors showed that at rapid decision speeds, visual saliency influenced choices more than preferences. The degree of this saliency bias increased with cognitive load and was greater in individuals who did not have a strong preference between options (Milosavljevic, Navalpakkam, Koch, & Rangel, in press). Similarly, other methods like electroencephalography, trans-cranial magnetic stimulation, facial electromyography, skin conductance, and pupil dilation have also been used for studying visual attention, arousal, and emotional engagement in marketing (see Plassmann, Yoon, Feinberg, and Shiv (2011) and Kable (2011) for summaries and applications of these various approaches).

New goals for neuromarketing

Any attempt to integrate neuroscience data into marketing research will meet with resistance. For the brand managers of the world, the ultimate goal is the profitability of a brand, thus making the use of neural data a question of cost efficiency. To some critics, neuroscience does not inform models of behavior; it merely provides a pseudo-scientific veneer for unwarranted claims (Gul & Pesendorfer, 2008; Harrison, 2008). We sympathize with such critics on at least one count: commercial instantiations of neuroscience within marketing, nearly all targeted at optimizing advertising materials (i.e., "neuromarketing"), are unlikely to replace traditional methods for understanding consumer behavior. Yet, we disagree with critics who claim that neuroscience is irrelevant for models of behavior, even in principle (Clithero et al., 2008). We predict that a more nuanced approach—one that includes methods for neuroscience to shape the direction of brand marketing and market segmentation—will soon replace the current approaches to neuromarketing. The understanding of decision-making processes already established for choices over

simple goods, like snack foods, will translate into more complex applications for other brands of interest for marketers and consumers.

Current neuromarketing trends are not sustainable

One popular perception is that neuroimaging data can identify a "buy-button" region in the brain; neuromarketing, then, should simply strive to find products and services that activate this region for consumers (Pradeep, 2010; Renvoisé & Morin, 2007). Essentially, neuroscience could provide a means of obtaining covert knowledge about the underlying personal preferences of an individual. This often raises practical and ethical concerns of how firms might manipulate activation in such a "buy-button" region, leading in turn to manipulation of consumer purchases in supermarkets and other preference domains, such as voting (Ariely & Berns, 2010; Murphy, Illes, & Reiner, 2008).

As others have mentioned (Ariely & Berns, 2010; Hubert & Kenning, 2008), however, cognitive neuroscience is unlikely to ever identify such a brain region. Rather, a more fruitful and unique task will be to isolate the various cognitive processes—and their associated neural mechanisms (Poldrack, 2010)—involved in decisions. By delineating these processes, cognitive neuroscience can potentially predict differences in thought processes being deployed by consumers that might not necessarily be observable with behavior. In a sense, this could lead to the delineation of a "buy-process"—an understanding of how multiple processes intertwine in purchasing decisions—which might be of tremendous use to marketers. Cognitive neuroscience is not built on simple measures of activation or deactivation in the brain; it is a network science (Bullmore & Sporns, 2009) working to understand functional neural networks, their associated contributions to cognitive function, and the resulting varieties of behavior. Mounting evidence that cognitive and affective mechanisms in the brain are overlapping also motivates researchers to understand the full network of regions involved in decision making (Pessoa, 2008). Only neuromarketing techniques that take advantage of the strengths of cognitive neuroscience will have a lasting impact on the marketing community.

Neural segmentation as an effective neuroscience application

Cognitive neuroscience aims to explain variance on many different scientific levels. Clearly, it provides the social sciences with the means to understand the neural mechanisms behind traditionally-observable behavior variables. There exist many elaborate examples, including memory performance in older adults. While memory declines in most older adults, some older adults perform similarly to younger participants. Neuroimaging data reveal that the later group utilizes more resources leading to improved performance; that is, their brains engage new computational processes as a means of "functional compensation" (Cabeza, Anderson, Locantore, & McIntosh, 2002). Thus, while there may not be a behavioral dissociation between groups, there is a neural one. Such mechanistic insights from neuroscience can then be used to map behavioral

predictions to other domains, including episodic memory and temporal discounting (Peters & Buchel, 2010), as well as how those generalizations vary across individuals. Here, individuals with significant heterogeneity in mechanisms that generalize across a broad array of behaviors would be more effective for applications of neural market segmentation.

Targeting specific groups of consumers also plays at a common criticism of neural data: its expense. As marketers use methods like (traditional) scanner data to integrate information across several customers over a long time period to device marketing strategies, a common misconception is that there is a need to use the newer scanner data (neural activations) of every single potential customer as they make shopping decisions to make meaningful inferences. We agree this would be impractical. Instead, as outlined in the previous section, we advocate the use of neuroscience to obtain data from a small heterogeneous group of individuals, the findings from which can then be generalized to the general population (Table 1). This selective use of neuroscience is both more practical and more likely to succeed.

Conclusions and future directions

While many discussions involving marketing and neuroscience attempt to justify a general use of neural data for marketers, we prefer to provide market segmentation as a prime example of how neuroscience can aid marketing and consumer research. As a parallel, consider personalized medicine (Hamburg & Collins, 2010). A central goal of medicine is to provide proper treatment and care; matching patients to certain drugs is an immensely complicated process, and momentum is growing to individualize elaborate medical treatments. However, some drugs (e.g., Tylenol) may work more consistently than others (e.g., antidepressants). Similarly, traditional methods used by marketing researchers reveal that some approaches work more consistently than others in shaping consumer choices. Neuroscience approaches will not replace the data and methods in current marketing practice, but can provide complementary information about choice processes and types of consumers. Doing so, we argue, may lead to better approaches for market segmentation and more effective marketing practices.

Table 1

Stages of brand marketing. There are three core areas where neuroscience of decision making has made significant contributions to brand marketing: Preference measures (PM), Context sensitivities (CS), and Individual differences (ID). These three foundational sets of knowledge can be applied to traditional methods (column 1) to provide novel complementary insights (column 2).

Traditional method	Neuroscience complement	Concept
Concept testing	Improving behavioral predictions	PM
Product development	Identifying product traits	CS
Information communication	Indices of implicit processes	CS, ID
User experience	Measures of subjective experience	PM, CS
Market segmentation	Employing individual variability	ID
Model building	Making out-of-sample predictions	PM, CS, ID

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