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Introduction to the *Journal of Marketing Research* Special Issue on Neuroscience and Marketing

This special issue showcases research that demonstrates the usefulness of neuroscientific approaches to a range of marketing-related questions. The past decade has yielded extraordinary advances in understanding of how brain processes produce human behavior. These advances have fueled a steady growth in the application of neuroscientific methods to generate both theoretical and practical insights into consumer behavior and marketing. They have been especially fruitful in illuminating consumers' decision processes across multiple marketing-related domains, particularly those underlying valuation and choice (for recent reviews, see Smidts et al. 2014; Yoon et al. 2012). Because these developments have been published primarily in neuroscience journals, marketing scholars and practitioners may not be fully aware of the range of problems and questions that neuroscientific methods can address. This special issue aims to bring *Journal of Marketing Research* readers up to date on what neuroscience has done, and can do, to inform marketing.

The special issue attracted a large number of high-quality submissions from researchers within marketing proper, as well as related disciplines, including the neurosciences, economics, psychology, communications, and management information systems. The ten articles included in this issue cover a diverse set of topics and methods. With the exception of the first article, which presents an overarching perspective on consumer neuroscience (Plassmann et al. 2015), this issue comprises original empirical research making use of neuroscientific tools. Specifically, the authors contribute to marketing theory, research, and practice by (1) generating insights about implicit processes and mechanisms (Cascio et al. 2015; Cerf et al. 2015; Chen, Nelson, and Hsu 2015; Karmarkar, Shiv, and Knutson 2015; Pozharliev et al. 2015), (2) uncovering individual heterogeneity that has consequences for preferences and choice (Plassmann and Weber 2015), and (3) offering the potential to substantially improve predictions of choice at both the individual- and

aggregate-market levels (Boksem and Smidts 2015; Telpaz, Webb, and Levy 2015; Venkatraman et al. 2015).

These articles use a wide variety of methods. This variety is important to note, because although functional magnetic resonance imaging (fMRI) is the most "glamorous" method (it "looks great on camera"), it is also the most expensive in marginal cost and has slow temporal resolution (which is poorly suited to studying rapid subsecond "fast and slow" processes). As a result, the most convincing conclusions will emerge when a combination of methods are used, typically across studies (cf. Venkatraman et al. 2015), so that the strengths of one method can offset the weaknesses of other methods.

In this issue, one article uses human single-neuron recording (Cerf et al. 2015), three employ electroencephalography (EEG; Boksem and Smidts 2015; Pozharliev et al. 2015; Telpaz, Web, and Levy 2015), and four use neuroimaging (Cascio et al. 2015; Chen, Nelson, and Hsu 2015; Karmarkar, Shiv, and Knutson 2015; Plassmann and Weber 2015). Venkatraman et al.'s (2015) study compares six commonly used methods to assess advertising effectiveness: traditional self-reports, implicit association test, eye tracking, biometrics, EEG, and fMRI.

Next, we present brief summaries of the articles in the special issue. After discussing Plassmann et al.'s (2015) overview article, we organize the remaining articles largely by the types of insights they generate for marketing theory, research, and practice: understanding processes and mechanisms, uncovering individual differences, and predicting individual- and market-level outcomes.

OVERVIEW

Plassmann et al. (2015) consider ways in which consumer neuroscience research can more directly influence marketing theory and practice. To be useful to academic scholars and practitioners in marketing, neuroscientfic methods should provide insights that are unavailable using traditional behavioral data. First, Plassmann et al. discuss how neuroscience can be applied to identify process mechanisms that ultimately lead to validation, refinement, and extension of theories of consumer behavior and marketing. Second, they note that neuroscience techniques are especially useful

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as a means to measure implicit processes that are typically difficult to access using other research methods. Third, they suggest ways that neuroscience can be useful in identifying dissociations between psychological processes, thereby revealing information that could not be obtained otherwise. Fourth, they consider ways in which neuroscientific methods can be used to observe heterogeneity in preferences and choice at the neural level. Finally, and of particular importance to marketing practice, the authors suggest that neuroscience offers the potential to substantially improve predictions of choice at both the individual- and aggregate-market levels. They further acknowledge several current challenges for consumer neuroscience and offer suggestions for addressing them.

UNDERSTANDING PROCESSES AND MECHANISMS

Researchers in marketing typically collect explicit behavioral measures when providing process-based accounts of consumer behavior. Many processes, however, occur at the implicit or unconscious level so that consumers are unable to articulate the reasons for their behavior, which makes such processes challenging to measure appropriately. Of course, some behavioral measures of implicit processes (e.g., reaction times) do exist and can be useful, but they are at best proxies for the processes of interest and can fail to deliver deep or even accurate insights. Neuroscientific methods allow for more proximal examination of implicit or unconscious processes by enabling researchers to identify the neural processes underlying consumers' responses with suitably granular spatial and temporal resolutions.

In the age of online commerce and recommendation systems, in which marketing-relevant information can be instantly and widely shared, the effects of social influence on consumers are probably more pervasive than ever. However, consumers' susceptibility to social influence is often difficult to observe directly, and consumers may not be aware of it. Neuroscientific methods can be valuable for examining such implicit processes. For example, Cascio et al. (2015) use fMRI to investigate how adolescents' responses to peer opinions influence their own recommendations to others, a phenomenon in which self-reports may yield biased accounts of how influence works. They report evidence suggesting that both neural mechanisms previously implicated in susceptibility to social influence and greater consideration of the others' mental states contribute to other-directed recommendations.

Pozharliev et al. (2015) investigate a different aspect of social influence: whether brain responses during passive viewing of luxury- versus nonluxury-branded products are different when participants are alone versus together. By leveraging the temporal resolution afforded by EEG, they uncover differences in amplitudes of the event-related potential (ERP) across specific components (P2, P3) when consumers are alone versus together. They discover that the late positive potential (LPP) amplitudes are greater for luxury- than for non-luxury-branded products, but only in the together condition, suggesting that the presence of another person magnifies the emotional effect of brand type. Taken together, the ERP results are informative about increased attention allocation and motivational significance of brands—specifically, luxury brands—in the presence of another person.

Prices are obviously important in consumer decisions. However, whether the price is seen before or after the product seems to change the way the product information is processed. Using fMRI, Karmarkar, Shiv, and Knutson (2015) provide neural evidence of how consumer valuation processes differ depending on when the consumer sees the price. Understanding changes in the brain's valuation processes provides novel insights about how the order in which pricing is presented can influence willingness to pay for different types of products. This finding is especially relevant to marketers (and consumers) in online shopping contexts, in which companies can control, to some extent, the order of the price and product information.

An exciting new opportunity in consumer neuroscience combines machine learning techniques with fMRI data (sometimes called neural decoding). The decoding approach chooses, from the whole brain, sets of regions or individual voxels that encode abstract intangible characteristics or psychological constructs while carefully guarding against overfitting. The article by Chen, Nelson, and Hsu (2015) moves the field beyond questions that rely on spatial localization of brain data. It represents an advance in testing previously unaddressable research questions—notably, whether researchers can predict consumers' thought processes on the basis of some spatially distributed pattern of fMRI activity on a small group of participants. The authors report evidence that brand personality traits exist a priori in the minds of consumers; as a result, the brands a consumer is thinking about can be reliably predicted from patterns of neural activations.

Beyond fMRI and EEG methods, human single-neuron recording also has high spatial resolution as well as high temporal resolution, allowing for finer-grained measures of neural processes. In this method, ultra-thin electrodes are temporarily implanted to record firing rates in specific populations of neurons. The method is limited for consumer neuroscience because it is only used on people with severe brain disorders (e.g., epilepsy, Parkinson's disease) in just a handful of research hospitals around the world. However, it is useful for marketing scholars to be aware of, and evidence from nonhuman primates has been important for catalyzing many areas of decision neuroscience (e.g., the discovery of reward prediction error neurons in dopaminergic regions). The article by Cerf et al. (2015) illustrates how human single-neuron research can capture, at the neuronal levels of specificity, activity in consumers' brains associated with up-regulation (e.g., increase) of emotions in response to fear appeals.

UNCOVERING INDIVIDUAL DIFFERENCES

Neuroscience offers new ways to measure heterogeneity in consumer behavior by measuring differences in individual sensitivity across regions or structural differences in the brain. Uncovering individual differences at the neural level may generate ideas for how marketers can detect segments of consumers in markets. Plassmann and Weber (2015) use a novel automated structural neuroimaging approach, combined with behavioral experiments, to elucidate how individual differences in gray matter volume in brain areas associated with personality traits moderate the extent to which consumers respond to marketing-based expectancy effects (e.g., price).

PREDICTING INDIVIDUAL- AND MARKET-LEVEL OUTCOMES

The potential benefits of neuroscience research to marketing are arguably the most evident in efforts to leverage the predictive power afforded by incorporating neural data in models of marketing-relevant behavior. Recent advances in neuroimaging methods and analyses have enabled researchers in consumer neuroscience the opportunity to generate consumer insights and to inform real-world marketing decisions with practical and economically significant consequences. In particular, the notion that neural data collected on a relatively small sample of participants can predict choices in real-world contexts holds tremendous promise for marketers.

In this special issue, two articles use EEG to make predictions about product choices. The first, by Telpaz, Webb, and Levy (2015), applies EEG to a small group of participants and shows that changes in amplitude of the N200 component and in theta band power during passive viewing of consumer products reliably predict future choices of consumer products. This is the first EEG study to predict product choices without eliciting any responses whatsoever from consumers. It has clear implications for marketing insofar as EEG is much more cost effective, widely accessible, and portable than fMRI.

Boksem and Smidts (2015) also use EEG and analyze amplitudes of beta and gamma oscillations of a relatively small group of consumers as they view movie trailers. The authors then use these neural measures to predict stated individual-level preferences as well as movie sales at the population level. They find a significant increase in predictive power of the neural measures, beyond self-reported preference measures, to predict people's willingness to pay and market-level sales outcomes. Thus, brains can help predict box office sales.

Finally, the article by Venkatraman et al. (2015) directly compares the efficacy of six behavioral and neurophysiological methods in assessing consumers' responses to 30-second television ads. The methods they compare span a wide range: traditional self-reports, an implicit association test, eye tracking, biometrics, EEG, and fMRI. They further compare the six measures in terms of how well they predict aggregate market-level advertising elasticities. They find that fMRI explains the most variance in advertising elasticities beyond the baseline traditional measures. Analyses of the 30-second advertising time intervals may have placed biometric and EEG measures at a disadvantage because those methods are better than fMRI for rapid subsecond resolutions. The authors note that biometric and EEG measures may be more effective for understanding millisecond-by-millisecond or scene-by-scene resolution of ads.

CONCLUSION

Adding neuroscientific methods to the researcher's tool kit will inevitably lead to richer insights about consumer behavior and marketing in general. Drawing on neuroscience is expected to yield several tangible benefits—for example, opportunities and guidelines to facilitate theoretical development; new empirical tests of standard theoretical claims; explanations for observed heterogeneity within and across consumer groups; and novel mechanisms for considering the physiological context and the role of numerous biological factors, including hormones and genes, on consumer preferences and decisions.

Going forward, we expect neuroscience research in marketing to continue to generate important insights that link specific brain processes and mechanisms to both unobservable intermediate concepts (e.g., traits, beliefs, goals) and observable behavior (e.g., choices, search). Advances in neuroscience and computational techniques have enabled the use of a diverse set of methodological approaches. Notably, fMRI and EEG can measure neural activity associated with specific mental processes without having to ask consumers what they are processing or which mental systems are engaged. Of course, each method (including other physiological methods, e.g., eye tracking, biometrics) has unique advantages and disadvantages in terms of what can be measured and the inferences to be drawn. (These relative strengths and weaknesses have been detailed elsewhere; see, e.g., Kable 2011.)

The articles in this special issue speak to the variety of neuroscientific approaches and methods that can be used to answer marketing-related questions. In particular, they both demonstrate and explicate how researchers can benefit from applying a mix of neuroscientific and behavioral perspectives to develop and test richer models and to generate insights that are ultimately valuable for not only academic scholars but consumers and practitioners as well.

We would like to thank all the authors who responded to our call for papers in this special issue. We are especially grateful to the authors of the articles in this special issue and to the many anonymous reviewers who provided suggestions. We also appreciate that the authors put in extra effort to make technical details and interpretation accessible to *Journal of Marketing Research* readers. We are excited about the new research paradigms that are now possible, and we hope that readers will share our enthusiasm.

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