Neuromarketing: Inside the mind of the consumer

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Abstract
Managers today are under tremendous pressure to uncover factors driving customers’ attitudes and behavior that can serve a source of competitive advantage. Unfortunately, traditional methods of generating customer insights suffer from well-known limitations, and have remained largely unchanged since their introduction decades ago. As a result, there is growing interest in brain-based approaches that may enable managers to directly probe customers’ underlying thoughts, feelings, and intentions. The goal of this article is to provide practical guidance to managers on using these tools. In particular, we focus on two distinct use cases: validation of existing insights and generation of novel insights. Throughout, we stress that managers should see traditional and brain-based approaches as complements, rather than substitutes, in discovering insights.
Introduction

“All the time and money and skill poured into consumer research on the new Coke could not measure or reveal the deep and abiding emotional attachment to original Coca-Cola felt by so many people..., and you cannot measure it any more than you can measure love, pride, or patriotism.”

– Don Keough

Understanding how customers think, feel, and respond to a company’s offerings has always been a tricky business. Surveys and focus groups, the workhorses for generating customer insights in these areas, are fast, inexpensive, and offer tremendous value for marketers. For many companies, however, acting on them can sometimes feel like a matter of faith. The canon, so to speak, goes something like this: customers are assumed to be able and willing to tell marketers what they are looking for; in turn, marketers are assumed to be able to ask the right questions to customers, then code, analyze, and interpret the data correctly, all before generating actionable insights.

The shortcomings with the traditional customer insight generation process are well known. The precision of measures using introspection is often suboptimal for highly quantitative decisions such as those involving pricing and distribution. The validity of self-report measures can be severely compromised by a number of well-known shortcomings. Respondents have imperfect memory. The mere act of asking a question is known to change respondents’ behavior. Highly sensitive questions are subject to misinterpretation or outright deception. Perhaps most worryingly, there are few ways to distinguish between cases where respondents are being truthful versus when they are not, and when marketers ask the appropriate questions versus when they do not. Given these shortcomings, many managers may well conclude, as Don Keough did on his reflection on the failure of New Coke, that customer mindsets are simply too difficult to be able to measure with reasonable confidence.

In an increasingly customer-oriented era where business strategy depends upon customer insights to stay ahead of the competition, this lack of confidence can pose important challenges for companies. First, rapid advances in measuring marketing ROI has led to a situation where firms prioritize strategies, such as pricing and promotions, that are or at least appear to be measured with precision. Amazon and Google, for example, routinely conduct A/B testing and experiments on a daily basis to check managers’ intuitions and hypotheses before executing changes on a large scale. They remain, however, challenging in many areas of brand and product management dealing with questions, such as brand image and customer loyalty, that are strategically important but data poor. This had led to an ironic situation where, even as companies increasingly view marketing expenditures as sound long-term investments rather than short-term costs, actual expenditures more and more emphasize short-term effects at the expense of long-term health.

Second, the inability to trust customer insights gathered using traditional techniques can result in considerable skepticism and confusion within companies ranks, often leading to difficult conversations between managers within marketing and those outside. In a recent study from McKinsey & Co., one CFO was said to have held the sentiment that, “Marketing has a vague status. We’re going to give a certain amount of dollars to those guys. They’re going to make ads and do whatever it is they do. And let’s hope it generates demand”.

Given these challenges, there is growing interest in alternative techniques that can address the inherent limitations of traditional approaches. In particular, recent developments in brain-based approaches have opened the possibility for marketers to directly probe and measure customers’ underlying thoughts, feelings, and intentions. However, as often is the case with cutting edge technology, there has been a widespread tendency to overestimate both effectiveness and limitations. The goal of this article is to provide an overall framework and practical guidance on how managers can use brain-based methods to understand customers and
generate actionable insights. In particular, by viewing traditional and brain-based approaches as complements, rather than substitutes, marketers and firms can combine them in novel and innovative ways, in order to generate and validate customer insights that are foundational in strategy formulation.

A Brief History of Brain Sciences in Business

“Businessmen will eventually realize that customers are merely bundles of mental states and that the mind is a mechanism that we can affect with the same exactitude with which we control a machine in a factory.”

– Hugo Münsterberg (1913)

Despite its associations with modernity, the desire to look into minds of customers has a surprisingly long history. As far back as 1913, Hugo Munsterberg, the father of organizational psychology, was said to have declared that, “Businessmen will eventually realize that customers are merely bundles of mental states and that the mind is a mechanism that we can affect with the same exactitude with which we control a machine in a factory.”

It was not until nearly the end of the century, however, that biomedical imaging technology finally progressed to the point of allowing researchers to non-invasively measure and track neural activity at a spatiotemporal scale that reflect core features of cognitive and behavioral operations of the human brain (Exhibit 1). In a relatively short period of time, these techniques have revolutionized basic scientific understanding of a number of fundamental aspects of human cognition, in particular the set of neural circuits underlying perception, attention, and memory (Exhibit 2).

Indeed, today it would be unimaginable for a researcher working in these areas to be ignorant of the underlying neural mechanisms, which was largely unknown merely a generation ago. Moreover, these findings have had tremendous influence on a number of applied fields, for example the impact of memory research on eyewitness testimony, and the diagnosis and treatment of attention deficit disorder in psychiatry.

Perhaps surprisingly in hindsight, it was not particularly clear at the time that these advances had much to offer to marketing. Gerald Zaltman at Harvard Business School was one of the first to appreciate this potential, and indeed obtained the first patent on applying neuroscientific methods to marketing. However, it was only when a group of neuroscientists, psychologists, and economists began to unravel the neural basis of financial and consumer decision-making did marketing academics and practitioners take notice.

In particular, a few pioneering neuroscientists began to investigate the ways in which the brain responded to marketing stimuli, particularly those that are known to exert powerful effects on consumer behavior. An early examples of this is a now classic study patterned after the Pepsi Challenge in the lab of Read Montague. Together, this and subsequent studies provided some of the first convincing evidence that, far from a mishmash of random brain regions, marketing stimuli and actions produce systematic and interpretable effects on the brain. Most importantly, they captured the imagination of marketers and opened their eyes to a future where marketers can have direct access to customers’ internal mental states.

As of this writing, there is over a dozen companies that use brain-based approaches as part of their primary product offering (Exhibit 3). In addition to these companies, some of which are still in embryonic stages, brain-based approaches have attracted the interest of the mainstream marketing research industry, in particular the Nielsen Corporation, which acquired Neurofocus, one of the first neuromarketing companies, in 2011,
followed by Innerscope Research in 2015. While there is substantial diversity on the technological side, including among others EEG, fMRI, and eye-tracking, conceptually current offerings have in common that they focus on using brain states to infer hidden information that respondents are thought to be unwilling or unable to articulate to researchers armed with traditional self-report measures. These include using brain-based methods to capture, among others, consumers’ emotional responses to product design and advertisements, purchasing likelihood, and brand loyalty.

-- Exhibit 3 about here --

What Brain Sciences Can Do For Marketing

“I don’t ask why patients lie. I just assume they all do.”
– Gregory House M.D. (Fictional Character)

Despite its intuitive appeal, there has been skepticism from the beginning about our ability to directly extract hidden information from neural data that are of interest to marketers. The reason is two-fold. The first concerns the many functions a brain region may contribute to. In particular, much ink has been spilled on the difficulty of inferring mental states from brain activity, often referred to as the “reverse inference” problem. For example, that a particular TV ad activates parts of the emotion circuit does not necessarily provide strong support for the ad being highly “emotionally engaging”. Specifically, insofar as these circuits as abstractions of biological processes, many brain regions can be grouped to belong to many circuits. For example, the amygdala can be variously classified as being part of the emotion, attention, memory, and valuation circuits.

Although this is sometimes seen as a drawback, it in fact serves an important purpose, and underscores the interrelationship between these processes. For example, that the amygdala has functions critical for fear and alerting responses to novel or dangerous stimuli puts it at the core of the emotion circuit, but such functions are also critical for attending to, encoding and recall of, and weighting costs and benefits of such stimuli. That is, the complexity of the nervous system is such that, outside of basic sensory inputs, there is rarely a one-to-one correspondence between specific brain regions and mental states. This is in particular true for insights regarding abstract concepts such as “loyalty”, “love”, and “attachment” prized by marketers.

Second, unlike basic scientists, practitioners rarely have the luxury of controlling for the scores of confounding factors that academics take for granted. In fact, it is likely the case that the effectiveness of many marketing actions comes from the coordinated activation of multiple circuits. For example, highly successful ads are typically at once eye-catching, emotionally rich, and make for pleasurable viewing. In these cases, the urge to reduce the effectiveness of the ad to a single cause may well be both scientifically and commercially wrongheaded.

Trust, but verify: Asking the brain to validate customer insights

One reaction, common to those skeptical to brain-based approaches in the first place, is to declare that unless and until these limitations are overcome, marketers has little to learn by looking into the brain. Although seemingly reasonable, this view overlooks the many possible ways that technology can be used to address real-world problems.

To illustrate this, consider the role of DNA profiling in forensic science, in which variations in the genetic code are used to identify individuals. Like marketing researchers, forensic investigators deal with “messy” real world settings where there exists a mix of qualitative and quantitative data, and randomized control trials are challenging if not impossible to conduct. Both fields go through a set of stages involving problem identification (a death is reported, sales are down), evidence gathering (crime scene analysis, observational research), and actionable recommendations (arrest suspect X, increase promotion for segment Y). Finally, and
perhaps most importantly, there exist in both fields a number of biases that affect the judgment on part of the investigators, and variation in the ability and willingness on part of responders to tell the truth.

Rather than being used to generate a profile of the suspect, however, DNA profiling has been revolutionary in its ability to test whether the suspect is the source of the crime scene DNA. As opposed to marketing, the importance of validation is taken for granted from the very beginning, perhaps because people are better advocates of their own innocence than marketing programs. This is so despite the fact that even today it remains extremely challenging to extract even basic physical traits, such as height or weight, from human DNA. That is, the inability to reconstruct the suspect profiles from DNA evidence alone has not made the impact of genetic testing on forensics any less profound. In the same way, the fact that brain sciences cannot as yet pinpoint the precise cause of a customer’s behavior does not render it unusable for managers.

Recently, my colleagues and I conducted a study showing how marketers can apply the same principles to customer insights generated using traditional self-report methods. The central idea of the approach is that, rather than taking the participant’s response at face value, we can see whether what they say corresponds to what they are thinking. This approach is not new. In fact, it follows a long history of in psychology where researchers submit introspective insights to critical testing by matching them to their neural signatures. Specifically, the study used functional magnetic resonance imaging (fMRI) to test a classic conjecture in marketing that consumers anthropomorphize brands by attaching to brands a set of human-like characteristics, such as “down-to-earth”, “exciting”, or “rugged”. Like most other intangible attributes of brands and products, these associations, referred to as brand personality, exist purely in the mind of the customer. Traditionally, they are measured using a scale developed by Stanford GSB professor Jennifer Aaker, which has been highly influential in shaping how marketers think about how consumer relate to brands.

But do people actually think of a brand as “down-to-earth” when there are no market researchers around to ask? To see this, we asked whether participants’ brain activities were consistent with their self-reported thoughts (Figure 1). First, participants were scanned while they passively viewed four dozen or so of the most iconic global brands, including Apple, Disney, Ikea, BMW, and Nestle. Following scanning, they rated the extent to which they thought each brand was associated with human-like characteristics, such as “sincere”, “exciting”, “competent”, etc. Critically, participants had no idea what questions we would ask after the scan; nor were they presented with any explicit questions during the scan. This way, we can be confident their thoughts were not affected by our questions.

Next, using a set of data mining algorithms, we related participants’ patterns of brain activity to subsequent survey responses. That is, we assessed whether thoughts of “exciting” and “competent” crossed the mind of participants when they thought about Google, which scored high on these traits, and whether thoughts of “sincere” but not “sophisticated” occurred to participants for Campbell’s Soup, which scored high on the former and low on the latter.

Good news for marketers using the brand personality framework, the study found that it has a good deal to offer in terms of uncovering how participants think about different brands. Specifically, we were able to use the neural data to confirm that, indeed when participants thought of Campbell’s Soup, traits like “sincerity” or “down to earth” were present in their brain activity, consistent with participant self-reports. In contrast, this would not have been possible if participants systematically thought about features that are unrelated to brand personality traits. We can see this by comparing the performance of the brand personality scale with other scales that had similar statistical properties but did not contain information about brands personality. The brand personality scale performed significantly better.

Validation and hypothesis testing are the hallmarks of evidence-base management. In medicine, all diagnostic tools must undergo a rigorous process to ensure that they conform to the latest scientific knowledge. That is,
these tools must capture some underlying characteristic—e.g., cell type, protein level—which the medical community believes to be an important marker of health status. Without the ability to submit our hypotheses and tools to critical inspection, poor and sloppy practices go unchecked. Physicians take such procedures for granted. Marketers should accept no less.

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**Figure 1:** (A) Schematic of analytical approach used to validate self-report measure of brand personality. (i) For each iteration, two brands were held out of the training set (e.g., Disney and Gucci), and model calibration was done using the remaining 42 brands in the training set. (ii) Neural signatures of brand association were estimated using brands’ personality features derived from participants’ self-reported ratings. (iii) Coefficients for the five personality features are depicted in single-axial slice, with color representing image intensity. (iv) Cross-validation is completed by using trained neural signatures to predict observed neural responses to holdout brands. The predicted image for the holdout brand is calculated as a linear combination of the personality features of the holdout brands, weighted by the estimated coefficients associated with each feature. (B) Correspondence between neural and self-reported brand personality. For each brand pair, the correlation between predicted and observed brain images as evaluated from holdout sample (y-axis) against similarity in brands’ psychological properties as measured using correlation of self-reported trait ratings (x-axis). Adapted from Chen et al. (2015)

**Generate or refine: Asking the brain to produce novel insights**

In addition to validating insights from traditional methods, brain-based methods can be used to generate novel insights by providing new or improved measures for marketers. One particularly salient category concerns items that respondents are poorly equipped to provide the level of accuracy and precision that marketers desire. Consider the example of “engagement”, roughly defined as the ability of marketing content to capture the interest of customers. Prior research has explored a variety of techniques, including repetition, endorsements by popular figures, testimonials, among others, to measure engagement.

However, in addition to being widely criticized for being inefficient and expensive, these measures suffer from an additional weakness in terms of their temporal precision. For example, in a TV commercial, marketers may wish to identify which are the moments of maximum engagement and which are lulls, or how different sections of the commercial play off of one another. These require a level of temporal resolution that would be extremely difficult to achieve with self-report.

In this light, the fact that brain activity can be tracked without the need to ask subjects provides a means to address these difficulties. First, it allows measurement of the entire consumption experience. In contrast, traditional self-report methods offer incomplete coverage and has unclear temporal resolution. Second, the fact
that subjects are not interrupted during the consumption experience provides an additional degree of confidence that measurements are invariant to the subjectively perceived experience.

At first blush, using the brain to track something as abstract as engagement seems like a daunting task. Recent work from neuroscience, however, has discovered a class of brain-based measures with the potential to serve as a marker of engagement. The intuition of these measures is that, as engaging content triggers similar behavioral and psychological responses across individuals, this will be reflected in similar neural responses across people. Most importantly, these measures have been found to be highly predictive of subjective measures of engagement and memorability for a variety of stimuli. Thus, like validation studies, this class of measures obviates the need to pinpoint a precise “engagement” module of the brain, and instead focus on complementing and building upon existing measures.

![Figure 2: Using neural synchrony to track engagement.](image)

Figure 2: Using neural synchrony to track engagement. (A) Neurosynchrony is measured using CBC, defined as the pair-wise correlation between brain responses of all participants over the course of an experience, such as movie viewing. (B) Higher CBC captures moments where brain responses of participants change in similar fashion, and are distributed over multiple brain regions. Adapted from Hasson et al. (2004). (C) CBC can be used to capture moment-to-moment changes in engagement and segment differences, such as a Coca-Cola ad in the example. Adapted from Barnett & Cerf (2015).

Referred to as cross-brain-correlation (CBC), these measures exploit the high temporal resolution of neural data to measure neural synchrony within groups of individuals. This refers to the similarity, typically measured in pair-wise correlation, between multiple brains at a particular moment in time (Figure 2A). While brains might have lower activity in certain regions and higher in others at a given moment, this collective
pattern could in fact be indicative of the effect of external content if it is influencing multiple brains in the same fashion (Figure 2B).

Building on these measures, Barnett & Cerf (2015) was able to use EEG to probe engagement during movie viewing experience in an AMC theater. Unlike fMRI, the cost and portability of EEG measures provide a means to investigate experiential engagement in the field. Specifically, the researchers asked the extent to which CBC predicted self-reported engagement and memorability of different ads and movie trailers, and the specific events and timeframes that drove engagement (Figure 2C). Of the 13 movie trailers assessed, they found that the CBC was highly correlated with trailer recall ($r = .66$), as well as the specific time windows in which content was maximally engaging.

Although still in experimental stages, such measures can have a number of important managerial applications, ranging from segmentation and targeting decisions when combined with clustering algorithms, to budgeting and expenditure decisions, for example by quantifying the engagement value of one celebrity versus another. Barnett and Cerf, for example, found subjects who prefer action films showed heightened CBC during scenes involving weapons compared to those who prefer drama or comedy genres.

Beyond engagement, a cursory look around the marketing landscape reveals a number of such widely used but hard to quantify concepts, including “top-of-mind”, “consideration”, and “awareness”, which can all benefit from increased precision in their measurement. Even in the area of sales forecasting, the traditional stronghold of marketing analytics, there is evidence of the utility of brain-based approaches. In a recent study involving the Advertising Research Foundation (ARF), teams of independent academic researchers compared the effectiveness of various methods of forecasting, including both traditional and brain-based approaches. Their results indicated that even though traditional measures provided good predictors of commercial effectiveness, fMRI measures were nevertheless able to improve the predictive accuracy significantly.

What Is the Place of Brain-Based Approaches in Marketing?

“Economists have the least influence on policy where they know the most and are most agreed; [and] the most influence on policy where they know the least and disagree most vehemently.”

– Alan Blinder

The application of neuroscientific methods to marketing has a history that is brief in existence but long on controversy. In a particularly high-profile incident, the New York Times published an op-ed titled “You Love Your iPhone, Literally”, by the brand consultant Martin Lindstrom, which prompted a group of 44 neuroscientists to co-sign a response letter condemning the article.

Whatever the scientific merits of the claims, and indeed the data have never appeared in a peer-reviewed format, at the heart of the study lies a set of questions of great interest to marketers, consumer researchers, and the lay public alike. Namely, what are the set of thoughts and feelings that occur when people think or interact with the products that they own or are considering purchasing?

Unfortunately, in our rush to debunk unscientific claims, we academic researchers have offered practitioners largely a list of what neuroscience cannot do for marketers. As can often be the case, we are more than capable of offering a list of “worst practices” to be avoided, but at the same time leave practitioners twisting in the wind when it comes to “best practices” that one should engage in. The truth is that in any field, the wants and needs of practitioners far outstrip the ability of scientists to satisfy them. This is as true in marketing as it is in climate change, cancer treatment, or macroeconomics. The economist Alan Blinder, after having served on the Council of Economic Advisers, put it that, “Economists have the least influence on policy where they know...
the most and are most agreed; [and] the most influence on policy where they know the least and disagree most vehemently.”

In an analogous way, the prevailing attitude toward brain-based approaches in marketing in academic marketing can be summarized as one where, “neuroscience either tells me what I already know, or it tells me something new that I don’t care about.” This criticism, reasonable sounding as it is, is not so much misguided as incomplete. It implicitly pits traditional self-report and brain-based approaches in opposition to each other, and overlooks the considerable complementarities that they have. Here then, is a belated list of what brain-based approaches can do for marketing (Exhibit 4).

More broadly, by curbing the impulse to silo each approach within its own domain of application, an approach focused on maximizing the total value of existing tools has the potential to substantially extend the strategic impact of marketing research as a whole. Consider the classic thought experiment in branding, where managers are asked what would happen to a company like Disney if all its physical assets around the world were to disappear overnight, versus if all of its customers were to wake up without any memory of the company or its associations.

Widely used to illustrate the importance of “intangible” assets in branding, there is typically little follow-up discussion of how a manager might practically measure these intangible assets, which are of course taken for granted in the case of physical assets. For example, what is the magnitude of the total loss? Which intangible assets are easier or more difficult to rebuild? Are there any hidden opportunities in having a blank slate in terms? In these cases, what managers need is not so much thought experience that demonstrate the existence of value, but actual tools that can be used to guide and formulate strategic actions. Given the scope and importance of these long-standing concerns, even a small step forward would constitute a productive and substantial advance.
Exhibit 1: Methods of measuring brain responses. There exist a large number of methods of monitoring brain activity across a variety of spatiotemporal resolution. The figure below depicts some of the most widely used methods and the approximate range of their precision. Unfortunately, the most precise methods, which are capable of measuring firing of individual neurons or even the finer cellular and molecular changes within neurons, are almost entirely restricted to nonhuman animal research owing to their invasive nature.

For studying healthy humans, the three most widely groups of record methods are (i) magnetoencephalography (MEG) and electroencephalography (EEG), (ii) functional magnetic resonance imaging (fMRI), positron emission tomography (PET). A common feature of these methods is that they measure brain activity indirectly. MEG and EEG capture electromagnetic effects of neuronal activity across large areas of the brain that propagate through the scalp, and have excellent temporal resolution in the milliseconds but poor spatial resolution (cms). In contrast, fMRI captures oxygenation effects of neuronal activation on blood flow, and has superior spatial resolution (on the order of mm) but poor temporal resolution in the seconds. Finally, PET, which uses radioisotopes to label molecules in the brain, has poor temporal and spatial resolution but can detect specific neurotransmitters of interest.

In neuromarketing, EEG is by far the most popular method for commercial use, largely because it is the least expensive method. In contrast, fMRI, which is widely used and more popular in scientific and clinical use, is still rarely used in marketing and other business-related applications. Finally, because of the high cost and need to inject radioisotopes, there has been little interest in PET for commercial use in neuromarketing.

Spatiotemporal characteristics of techniques measuring neural activity in logarithmic scale. Boxes in solid line represent noninvasive methods used to monitor human brain activity. Those in dashed lines represent invasive methods typically restricted to monitoring brain activity in nonhuman animals.
Exhibit 2: Functional neuroanatomy of cognitive and behavioral processes. This exhibit describes the some basic neural circuits that are of relevance for consumer cognition and behavior. Each circuit consists of a collection of brain regions, whose coordinated activities are thought to give rise to some set of cognitive and behavioral processes. Although these circuits are abstractions of complex biological processes that have no simple start or end points, they have been invaluable to researchers because they capture and organize scientific knowledge in a parsimonious and tractable manner. Some circuits, such as those involved in language, are omitted for brevity.

<table>
<thead>
<tr>
<th>Neural Circuits</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Memory Circuit</strong></td>
<td>Enables retention and retrieval of facts and events, including one’s autobiographical history and knowledge of the world (declarative memory) and execution of integrated procedures such as riding a bike (procedural memory). Formation of declarative memory traces depends on integrity of the hippocampus, and extensive damage may result in anterograde amnesia—the inability to form and retain new memories. Upon consolidation, long-term memory is thought to be widely distributed across the cerebral cortex.</td>
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<tr>
<td><strong>Attention Circuit</strong></td>
<td>Enables the ability to selectively concentrating on a discrete aspect of stimuli, while ignoring other perceivable stimuli. In some cases, selection is driven by stimuli from the environment, such as a startling noise. This referred to as bottom-up attention, and engages regions of the insula, ACC, and DLPFC. In other cases, selection is driven by consumer’s internal goals, such as while scanning a restaurant menu. This is referred to as top-down attention, and engages a set of regions including the DLPFC, IFG, MT, IPS, PCC and PRC.</td>
</tr>
<tr>
<td><strong>Emotion Circuit</strong></td>
<td>Enables subjective feelings of emotional states such as fear, anger, joy, and sadness. Scientific understanding of emotion remains fragmented and surprisingly contentious. For basic emotions such as fear and anger that are thought to be shared with other mammals, they are known to depend on regions involving the thalamus, hypothalamus, amygdala. More complex emotions such as shame and guilt remain little understood.</td>
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<tr>
<td><strong>Valuation Circuit</strong></td>
<td>Enables ability to make cost-benefit analysis. Depends critically on the neurotransmitter molecule dopamine, which is released from the ventral tegmental area (VTA) and transmitted to the broader reward circuit including amygdala, striatum, and parts of the prefrontal cortex, especially orbitofrontal cortex.</td>
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### Exhibit 4: List of neuromarketing companies and their product offerings.

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Offering</th>
<th>Neuroscience</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brain Intelligence</strong></td>
<td>Quantify emotions, moods, and perceptions in response to all forms of stimuli: media ads, products/packaging</td>
<td>Eye tracking; EEG; Galvanic skin response; EMG; Implicit Association Test</td>
</tr>
<tr>
<td><strong>Buyology</strong></td>
<td>Provide quantitative evidence of emotions, moods, and perceptions in response to all forms of stimuli: media ads, products/packaging, shopper/user experience.</td>
<td>Go/No-Go Association Task, Implicit Association Test, EMG, fMRI, EEG, eye tracking</td>
</tr>
<tr>
<td><strong>FKF Applied Research</strong></td>
<td>Analyzes emotions in real-time through reaction to stimuli to help marketers understand customer attitude</td>
<td>fMRI</td>
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<tr>
<td><strong>Forebrain</strong></td>
<td>Analyzes implicit responses consumers have to marketing stimuli and how companies should use this for effective communication</td>
<td>EEG; eye-tracking</td>
</tr>
<tr>
<td><strong>Innerscope Research</strong>^2</td>
<td>Analyzing conscious and non-conscious responses to media and packaging</td>
<td>Facial coding, eye tracking, biometrics, EEG, fMRI, voice analysis</td>
</tr>
<tr>
<td><strong>Institute of Sensory Analysis</strong></td>
<td>Determine emotions triggered by advertising; optimize user interface and physical consumer experience</td>
<td>Eye tracking, EEG, EMG, fMRI, GSR</td>
</tr>
<tr>
<td><strong>Keystone Network</strong></td>
<td>Analyzes different aspects of consumer experience to understand unconscious behavior</td>
<td>Eye tracking/observation cameras, EEG, GSR</td>
</tr>
<tr>
<td><strong>Merchant Mechanics</strong></td>
<td>Explain what customers think, feel, say and do and the scientific underpinnings behind the differences in these actions</td>
<td>Eye tracking, EEG, EMG, fMRI, biometrics</td>
</tr>
<tr>
<td><strong>Mindlab International</strong></td>
<td>Examine non-conscious attitudes to find what underlies consumer motivations and decision-making; how consumers connect with marketing and intended messages</td>
<td>Implicit Association Test, EEG, eye-tracking, biometrics, EMG, GSR</td>
</tr>
<tr>
<td><strong>MSW Research (MSW/Lab)</strong></td>
<td>Provides research and consulting based on neuro and other types of research specifically to create effective advertising messages and more long-lasting profitable brands</td>
<td>Facial Coding, eye-tracking, GSR, EEG</td>
</tr>
<tr>
<td><strong>Neurensics</strong></td>
<td>Generate insights into consumer motivation by measuring brain activity from all sensory marketing stimuli</td>
<td>fMRI, eye movements</td>
</tr>
<tr>
<td><strong>Neuro-Insight</strong></td>
<td>Specialize in how the brain responds to communications through branding and the media</td>
<td>EEG/SST</td>
</tr>
<tr>
<td><strong>NeuroFocus</strong>^3</td>
<td>Measure real-time subconscious and conscious responses to understand response to marketing</td>
<td>EEG; eye-tracking</td>
</tr>
<tr>
<td><strong>Neurosense</strong></td>
<td>Provide online consumer tests that allow for analysis of non-conscious thought processes as well as consulting based on these tests</td>
<td>Implicit Reaction Speed Tests; fMRI</td>
</tr>
<tr>
<td><strong>NeuroSpire</strong></td>
<td>Examines the neural basis of attention, memory, emotion, and decision</td>
<td>EEG; Eye-tracking</td>
</tr>
<tr>
<td><strong>Nielsen Neuro</strong></td>
<td>Capture non-conscious aspects of consumer decision-making with neuroscience tools.</td>
<td>EEG; Biometrics; Facial coding; Implicit association testing; Eye tracking; fMRI</td>
</tr>
<tr>
<td><strong>One To One Insight</strong></td>
<td>Uses EEG to gain insights into how consumer respond to media at no prior engagement</td>
<td>EEG</td>
</tr>
<tr>
<td><strong>SalesBrain</strong></td>
<td>Focuses on using neuromarketing research to improves sales process</td>
<td>EEG, eye-tracking, facial imaging, biometrics</td>
</tr>
<tr>
<td><strong>Sands Research</strong></td>
<td>Generates neurological data in a marketing environment to measure emotional engagement</td>
<td>EEG, Eye-tracking, biometrics</td>
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^1 Source: neurosciencemarketing.com  
^2 Acquired by Nielsen in 2011.  
^3 Acquired by Nielsen in 2015.
Exhibit 4: Framework for using brain-based approaches in marketing. Use brain-based methods to address high-level strategic questions, such as brand positioning, where uncertainty is often greatest and mistakes are most costly. Like other successful technology, brain-based approaches enable marketers to ask questions that were not previous feasible.

First, like A/B testing, brain-based approaches in marketing allow marketers to take a scientific and hypothesis-driven approach to strategy formulation. Under this view, insights that are previously taken for granted as basis for actionable recommendation may now be critically tested as any other piece of raw material. Second, together with traditional techniques, they provide increased flexibility and allow marketers to ask how to maximize the joint value of the family of techniques available.

- Use brain-based approaches to complement traditional approaches, not to supplant them or silo each in its own application domain.
- Subject customer insights from focus groups, surveys, or ethnography to critical testing using brain-based methods.
- Use brain-based measures to improve precision and temporal resolution of traditional measures.
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