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Consumer Neuroscience: A Multi-disciplinary Approach to Marketing Leveraging Advances in Neuroscience, Psychology and Economics

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Table of Contents

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Abstract

For decades, neuroscience has greatly contributed to our foundational understanding of human behavior. More recently, the findings and methods of neuroscience have been applied to study the process of decision-making in order to offer advanced insights into the neural mechanisms that influence economic and consumer choices. In this thesis, I will address how customized marketing strategies can be enriched through the integration of consumer neuroscience, an integrative field anchored in the biological, cognitive and affective mechanisms of consumer behavior. By recognizing and utilizing these multidisciplinary interdependencies, marketers can enhance their advertising and promotional mix to elicit desired neural and affective consumer responses and measure these reactions in order to enhance purchasing decisions. The principal objective of this thesis is to present a comprehensive review of consumer neuroscience and to elucidate why it is an increasingly important area of study within the framework of human behavior. I will also describe how the insights gained from this emerging field can be leveraged to optimize marketing activities. Finally, I propose an experiment that illuminates key research questions, which may have considerable impact on the discipline of consumer neuroscience as well as the marketing industry.

Keywords: Consumer, Neuroscience, Marketing, Decision, Behavior

I: Background/Introduction to Consumer Neuroscience

Marketing is a key business function that encompasses the communications between a seller and consumer. The principal objective of all leading marketing practices is to evoke customer behavior that is aligned with the seller's interests, often intended to prompt a purchase transaction. In doing so, marketers seek to make a profit by fulfilling the needs and wants of a target audience through the cultivation of economic exchanges and commercial relationships. The American Marketing Association has defined marketing broadly as "the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large" ("American Marketing Association," 2013). In order to induce a desired consumer behavior, marketers must initially understand how their product or service may influence the thoughts, perceptions and activities of their targeted consumer audience.

When considering how to market a product, one may turn to experts to understand the best practices for selling a product to a consumer. Many experts have historically relied on the integration of four principal elements known as the 4 "P's" of marketing: price, placement, product and promotion (Magrath, 1986). However, these foundational tenants are too simplistic to capture the dynamics of the market place; that is, they focus on the product while more modern marketing practices also include the customer. To appreciate how to market a product in today's increasingly complex and dynamic marketplace, one must better understand the consumer to whom she is marketing and how that targeted consumer will interpret and subsequently act on those communications. In other words, companies should market their products based on their desired

consumers' and construct customer-centric strategies that aim to comprehend and predict how the target customer will consider and execute decisions.

I-A: Economic Decision Making Model

There are multiple ways in which researchers have characterized consumer decision-making, which can be described as the process of making purchase decisions based on cognitive and emotional influences (Schiffman, Hansen & Kanuk, 2008). Together, the fields of economics and psychology have contributed predictive models connecting economic and cognitive algorithms that explain decision making from different perspectives.

One well-known model is the "rational choice theory" proposed by Muth (1961). This seminal theory, shown in Figure 1, provides a framework within which we can understand social and economic behaviors and, specifically, how individuals consistently make choices between different alternatives (Levin & Milgrom, 2004). In this theory customers make their decisions based on utility maximization, which means they will always attempt to obtain the most value for the least amount of money (Levin & Milgrom, 2004). Utility maximization implies that customers generally make practical and sensible decisions that provide them with the greatest benefit and satisfaction. This satisfaction is subjective to the consumer and is in reference to their personal implicit or explicit judgments. Rational decision-making is defined as employing the theory of utility maximization (Levin & Milgrom, 2004). Thus, based on this theory, customers make rational decisions that are that are aligned with their end goals and within the limits imposed by given conditions (Simon, 1976).

In order to make these essentially "rational decisions," economic theory assumes that individuals must take stock of necessary information in an objective manner, consider possible alternatives and make choices that have the highest likelihood to maximize expected benefits while reducing any costs or disadvantages. Put another way, by implying that all decisions are rational, this theory argues that decision makers will undergo a conscious, careful and calculated process prior to categorizing potential courses of action in which they will develop criteria against which all given options and alternatives can be evaluated and carry out the decision that will maximize utility. Although this theory of choice provides a refreshingly straightforward representation of decision making, it also oversimplifies the factors involved in choice and dismisses other important contributing factors that describe and predict how we as complex, psychological, sociological and economic beings behave.

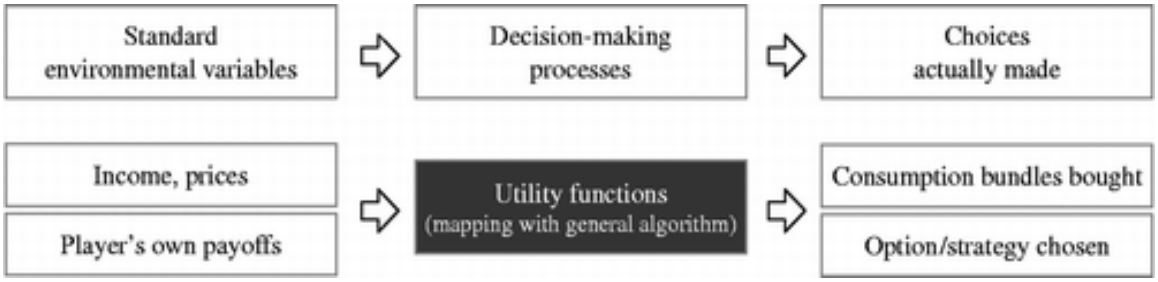


Figure 1: *Standard Economic Model of Decision Making* (Vromen, 2010)

I-B: Disproving Rational Choice Theory

The rational choice theory described above suffers from several shortcomings. In particular, it focuses on inputs and outputs, but does not properly explicate how we experience and undergo the intricate and highly subjective process of forming a

decision. In fact, the purely economic decision-making model disregards motivational influences on human behavior: the model does not include intermediate processes of *why* an individual might chose one option over another (Vromen, 2010).

In 1979, psychologists Daniel Kahneman and Amos Tversky challenged the assumption of human rationality in economic decision-making and revolutionized the way in which the sciences approach the process of choice and judgment by introducing a new model for decisions known as "prospect theory" (Kahneman & Tversky, 1979). These researchers demonstrated that there are many contradictions in human behavior that cause individuals to respond differently to the same choice asked in different contexts. For example, they found that participants would drive far distances to save $5 on a $15 calculator purchase but would not commute the same distance to save $5 on a $125 coat (Kahneman & Tversky, 1979). Similarly, when given a choice between getting $1000 with certainty or having a 50% chance of receiving $2500, most participants chose to get $1000. However, when participants were told that they could either certainly lose $1000 or have a 50% chance of no loss or a $2500 loss, participants chose to take the risk and opted for the latter alternative (Dubner, 2010). This discrepancy between participant's risk-aversion and risk-seeking behavior demonstrates that human behavior is not as consistent and regulated as economic theory proposes and provides evidence for the idea that humans might not be fully rational when making decisions.

According to Kahneman and Tversky's prospect theory (1979), individuals make decisions between probabilistic alternatives based on subjective evaluations of gains and losses, a process that relies heavily on heuristics, which are mental shortcuts that allow us to make efficient and abrupt decisions without taking in all relevant information. This

theory directly contradicts the rational economic decision making model because it contends that individuals do not make fully comprehensive and calculative analyses during the decision-making process but rather develop neural mechanisms and shortcuts to aid the process. Some of the most common heuristics that human beings apply when taking in new information is "loss aversion," the tendency to place a much stronger emphasis on avoiding any type of loss rather than accumulating gain, and "framing," which demonstrates how people react very differently when the same information is framed in a different manner, such as when either the positive or negative consequence of a situation are specifically mentioned.

Kahneman and Tversky also found that, even though individuals might feel as though they are making controlled, fully informed, conscious and rational decisions, scientific research demonstrates that humans make decisions that significantly deviate from maximum utility, described earlier as getting the greatest possible value for the least cost, due to the fact that our decisions are often subconsciously influenced by extraneous information (Kahneman & Tversky, 1979). This peripheral information can reflect an individual's subjective experiences and preferences, which are formulated based on prior experiences, unidentifiable emotions and subconscious neural practices, thereby making it impossible for economists to distill the underlying mechanisms within decision-making through observation alone (Kmenta, 2014).

Ariely (2008) furthered Kahneman and Tversky's work by fundamentally changing the way in which individuals think about how they make decisions through the introduction of the idea of "predictable irrationality." He demonstrated that humans are more likely to act irrationally than rationally when making certain decisions (Ariely,

2008). Ariely offers many different examples of "normal" irrational behavior to demonstrate that although some human behavior might be viewed as relatively rational, this behavior would be irrational as defined by economists because it is not based on rigid theory of utility maximization and other factors within the economic model. One such example was an experiment conducted on the MIT campus in order to show the allure of free products. In this experiment, Ariely sold Lindt truffle and Hershey Kiss chocolates to students and limited each student to only one chocolate per customer (Ariely, 2008). Ariely displayed a difference in quality by selling the truffles for $0.15 and the Kisses for $0.01 and found that students' preferences for chocolate purchases were relatively equal with 73% of students purchasing truffles and 27% purchasing Kisses. Subsequently, Ariely lowered the price of each chocolate by $0.01 such that the truffles now cost sold for $0.14 and the Kisses were free. With this very slight price change but the same price difference between products and the same expected benefit, now 69% of students chose the Kiss. Through this experiment Ariely demonstrated that the concept of a free product distorts the decision-making process and causes humans to act irrationally. As such, he argues that human beings often make irrational choices.

Ariely supports his arguments by challenging certain well-known foundational concepts in economics including principles of supply and demand. Economists argue that the price of a product in a market is determined by the intersection and an equal balance between the price of production (supply) and the price consumers are willing to pay (demand) (Ariely, 2008). However, Ariely argued that this price point can be swayed. Through a series of experiments based around a concept known as *anchoring*, Ariely proved that the price individuals are willing to pay can be easily manipulated, as

consumers are not as in tune with their personal preferences as economic theory implies. Anchoring is a marketing principle that asserts that when consumers encounter a new good or service whose characteristics are unfamiliar to them, the first price they see (no matter how arbitrary it may be) becomes an anchor, which has a strong lasting effect on the price they will be willing to pay for similar products from that time forward (The Anchoring Effect in Marketing, 2014). For example if a consumer first saw a cellphone priced at $500, the principle of anchoring would argue that this consumer's baseline for the price of a cellphone is now $500 and thus she believes that $500 is a fair price for any cellphone.

Ariely also underscores irregularities in our decision making through the "decoy effect." When we are presented with two distinct options, we find it difficult to make a decision between them. However, if a third alternative is introduced into the scenario that is similar to one option but clearly inferior, it completely alters the choices that we make (Ariely, 2008). Ariely offers the following example to demonstrate this effect: pretend you had to choose between a weekend in Rome with all expenses paid and a weekend in Paris with all expenses paid (Ariely, 2008). This decision would be difficult because the two options are, in some ways, very similar, since they are both weekends abroad, but in other ways, such as the details of the location, quite different. However, Ariely argues that if a decoy option was added, our choice would become easier and could be manipulated by the decoy alternative. In this scenario, the decoy could be a weekend in Rome with all expenses paid except for morning coffee. Ariely argues that the thought of Rome without coffee causes participants to gravitate to Rome with coffee because it appears as the better alternative (Ariely, 2008). As such, introducing this third option that

is slightly worse than one of the original options makes the original option (the trip to Rome) seem much better.

Given these examples of human behavior, Ariely argues that humans do not have as much rational control over their decisions as economists may suggest (Ariely, 2008). Rather, our decisions are a function of various external and subconscious stimuli that actually exceed our cognitive capacities but are simplified through heuristic properties. Since the decision-making process is much more complicated than economic theory proposes and involves many elements that cannot be quantifiably evaluated and measured based solely on economics, a more cognitive perspective must be incorporated into the model in order to form a more comprehensive understanding of decision-making. However, these cognitive processes arise from neural function, an area not typically considered by economists.

I-C: Neuroeconomics

New integrative fields have emerged to better understand and characterize the neural correlates behind human behavior and the processes underlying choice. These behavioral economic theories have begun to incorporate findings from neuroscience to discern the neurological and physiological elements as well as the somatic variables that influence human behavior. As such, neuroeconomics evolved from the integration of economics and neuroscience and proposed an interdisciplinary approach to examining the neural correlates of decision-making (Sanfey, Lowenstein, McClure & Cohen, 2006). The field of neuroeconomics directly monitors the biological responses to reward, punishment and other motivations by leveraging recent advances in neuroscientific metrics and

experimental techniques in order to identify the neural substrates that are associated with economic decision-making and processes underlying choice behaviors. The observations and data that are gathered by neuroeconomics researchers contribute to algorithms and models that can predict human behavior and characterize how individuals make decisions under an array of varying circumstances. By broadening the spectrum on which the fields of neuroscience and economics co-exist, we are presented with a progressive holistic understanding of how we determine the optimal, most efficient path between multiple alternatives. Although economists focus on explaining aggregate human behavior through averaged observational data, primarily obtained through behavioral experiments and economic games, neuroscience focuses on the cognitive and physiological influences of an individual's actions and behaviors. The field of neuroeconomics takes an interdisciplinary approach to decision making by examining neural correlates and mechanisms at an individual level in order to more accurately explain the intricacies and irregularities in human behavior. Current research within the field capitalizes on measuring neural feedback while subjects make monetary and other economic and purchase decisions, thereby specifically exposing the process of decision-making within the umbrella of human behavior. Some neuroeconomists specialize even further in studying specific groups of populations in order to understand their decision-making processes, such as consumers.

I-D: Consumer Neuroscience

Consumer neuroscience is a discipline within neuroeconomics that directly addresses marketing related decision-making and leverages insights arising from

neurological data (Fugate, 2007). Although consumer marketing research has been a progressive and prominent field for decades, without the addition of neuroscience researchers were previously not able to determine the underlying mechanisms and processes that control consumer behavior. They lacked the pivotal key to unlock mysteries as to the biological and physiological underpinnings that inform consumer choice, which can potentially be conditioned to map and ultimately influence consumer behavior. With the more recent introduction of consumer neuroscience, researchers are now able to directly illuminate patterns in brain activity with the objective of elucidating foundational neural explanations that regulate purchasing behaviors. With this knowledge, we are able to better understand how and why consumers make certain purchasing decisions so that we can predict purchasing behavior and create more effective advertisements that will drive such behaviors.

Consumer neuroscience aims to analyze consumer behavior through the application of neural processes and neuroscientific techniques in order to form a holistic understanding of the neural basis of brand relationships and purchasing power. The ultimate goal of this emerging research field is to enlighten psychological and scientific phenomena that play a significant role in purchasing decisions and to provide a comprehensive assessment of the effectiveness and influence of various marketing tactics such as advertising and product placement by focusing on how these tactics affect an individual's neurobiology. Consumer neuroscience allows for an all-inclusive investigation into the neural pathways and processes that catalyze purchasing behaviors through neuroimaging and event-related potentials (ERP) (Javorm Koller, Lee, Chamberlain & Ransmayr, 2009). We can use the techniques of consumer neuroscience

to identify and potentially modulate specific regions of the brain that are essential for select behaviors with regards to economic choice.

Consumer neuroscience, as a field, emerged in 2002 when companies such as SalesBrain and Brighthouse began offering marketing and consulting services that were based in neuroscience mechanisms and theories (Morin, 2013). In the first consumer neuroscience study, McClure and his colleagues used fMRI data to find the neural correlates of participants' preferences between Coke and Pepsi (Morin, 2013). They first administered double blind taste tests to determine participant's behavioral preferences for the different drinks and found that subjects were split equally in their preference for Coke and Pepsi when considering taste alone (McClure, Li, Tomlin, Cypert, Montague & Montague, 2004). FMRI results substantiated these behavioral results as indicated through the strong BOLD signals in the Ventromedial Prefrontal Cortex (VMPFC), a neural region closely associated with signaling basic appetitive aspects of reward, for both beverage products (McClure et al., 2004.) Subsequently, McClure and his colleagues tested the effects of brand loyalty and had the participants view Coca Cola commercials and then drink the samples again, this time informing them when they were consuming Coke. Once the participants viewed the advertisements and knew what they were drinking, three-fourths of them reported preferring Coke, compared to 50% during the blind taste test. Interestingly, this change in preference caused participant's neural activity to change as well and caused activation in the Dorsolateral Prefrontal Cortex (DLPFC), the hippocampus, and the midbrain (McClure et al., 2004).

The DLPFC and hippocampus have both been previously found to be involved in modifying behavior based on emotion and affect and the DLPFC is often activated

through tasks relating to cognitive control and information biasing behaviors based on affect (Davidson and Irwin, 1999). These results indicate that the VMPFC represents subjective participant preferences based on sensory information. However, these preferences can be easily modified through cultural stimuli and influences, as shown when the participants viewed Coca Cola commercials and subsequently drank Coke samples. McClure and his colleagues found that the brand information not only significantly influenced subjects expressed preferences, but also activated different neural regions associated with information bias (McClure et al., 2004). This study only grazed the surface of understanding brand loyalty, but it was the first experiment that offered neurological evidence to the power of marketing and brand loyalty endeavors by bringing to light the significant unconscious neural mechanisms that are at play during the decision making process and illustrating the power of using neuroscience techniques and experiments to help crack the neural code of our decisions (McClure et al., 2004).

Significant progress has been made subsequently in understanding the neural mechanisms behind human decision-making. All four elements of marketing- product, price, promotion and place- have been investigated using consumer neuroscience techniques and have contributed significantly to our understanding of how to best market a product or service. An increasing number of marketing papers, journals, schools, organizations and conferences employ neuroscientific data to explain the fundamental mechanisms behind decision-making and how that knowledge can be harnessed to create more effective marketing practices. Although consumer neuroscience has presented many opportunities for companies and marketers to reliably measure implicit reactions to

marketing stimuli, the field is still at an initial stage and requires substantial development from researchers and businesses alike (Morin, 2011).

I-E: Consumer Neuroscience vs. Neuromarketing

In the above section, the phrase consumer neuroscience is used to refer to the field that integrates marketing and modern neuroscience. However, in many literature reviews and scholarly articles, "consumer neuroscience" is used interchangeably with "neuromarketing." These two terms represent two distinct fields for understanding how neuroscience can be applied to consumer decision-making. Neuromarketing was actually the first term used to reference the integration of neuroscientific methods and economic decision-making models in 2002 (Ramsoy, 2014). The word "neuromarketing" was first coined by Ale Schmidt, who used it to define a specific area within marketing that studies the effect of marketing stimuli on consumer behavior as well as cognitive and affective responses (Ramsoy, 2014). Today, neuromarketing is often used in a commercial environment to describe how insights and tools from within neuroscience can be used to help organizations sell a brand, product or service. As a result of this more commercial use, many academic scholars dislike the term "neuromarketing" because they believe it has been exploited by companies under false pretenses and represents a field that uses erroneous neuroscientific principles and insights in order to drive profit in commercial applications. Consequently, many scholars have suggested using the alternative term "consumer neuroscience" to better distinguish less self-interested insights and the academic research of engaging neurological methods to investigate and illuminate consumer psychology and behavior (Plassmann, 2012). In fact, researchers

Oullier and Sauneron (2010) propose that the field of neuromarketing is particularly harmful to consumer neuroscience and the academic research it expounds. The behavioral insights that constitute consumer neuroscience delve more deeply into the ways in which consumers respond to stimuli and act on decisions, rather than using the information for commercial use, and thus ties directly back to the academic field of neuroeconomics in its aim to understand the causal brain mechanisms of our choices and how those mechanisms are carried out through decision making (Ramsoy, 2014).

II: Why Incorporate Neurological Data?

Prior to the emergence of Consumer Neuroscience, research in consumer marketing had all too often recognized human beings as a "black box" into which marketers were unable to fully gain direct biological and related behavioral insights. Prior classical models had to rely more primarily on retrospective theoretical constructs to predict and elucidate human behavior. As a result, marketers and researchers were dependent on indirect methods of obtaining data such as imprecise self-reported assessments in order to attempt to understand the underlying mechanisms of human decision-making and the purchasing process (Groeppel-Klein, 2005). These coarse methods of observation and data collection facilitate researchers to obtain correlational explanations as to why humans might think they make the decisions they do but are unable to inform researchers of the contributing factors of causal relationships and uncover why consumers make certain decisions under specific circumstances and not others. However, now combining these traditional marketing assessments with data from

consumer neuroscience can in fact illuminate new insights that may not otherwise have been revealed.

There are many reasons why neurological data provides more substantial and insightful penetration into the consumer decision-making process compared to self-reported and other more qualitative assessments. Perhaps the key motivations behind incorporating neurological data into consumer marketing methodologies is that the observation and understanding of brain activities can enlighten more unbiased and precisely quantitative perspectives into how we as humans undergo the process of choice.

Initial research within consumer neuroscience addressed conventional principles of marketing processes- product, placement, promotion and price- while conferring specific emphasis to promotion and placement. Consumer neuroscience researchers have since demonstrated the significant value of incorporating neural data into these purchasing decisions in addition to their typical self-report measures. For example, Knutson et al. (2007) demonstrated that by supplementing neural measures to self-reported measures, they were able to significantly improve their predictions of how participants would act following the presentation of specific advertisements (Knutson, Rick, Wimmer, Prelect & Lowenstein, 2007). Plassmann et al. (2008) also investigated how fMRI techniques could present a better understanding of how price changes affect customer's perception of products and found that higher priced products differentially activate the pleasure centers of the brain compared to the same products at lower price points (Plassmann, O'Doherty, Shiv & Rangel, 2007). These researchers tested whether price changes directly influence downstream product perceptions and found that such

changes in price can actually influence consumer's brain regions involved in interpreting taste, thus leading consumers to think higher priced food products taste better. Taken all together, cognitive neuroscience opens a door into how researchers can measure explicit and implicit reactions to marketing stimuli and thereby significantly optimize or maximize the effectiveness of advertising, marketing and promotion directed to consumers. The addition of neurological measurements allows researchers to uncover the subconscious processes that greatly affect consumer behavior and purchasing decisions.

The primary reason why many researchers are now turning to these more quantitatively reliable neurological measurements to enhance their marketing campaigns is not only due to the rejection of the rational decision making model but also the result of the more recent commonly accepted understanding that most of our mental processes operate unconsciously and at a much faster rate compared to the conscious human decision-making process. Traditional market research techniques are subject to systematic biases and sampling errors, which undermine the validity of their findings, because the data on which they rely is not only significantly influenced by the type of question being asked in a self-assessment or external context but is also prejudiced by the neural mechanisms that are occurring beneath a participant's level of consciousness and can dramatically sway an individual's decision absent awareness of how or why. Tools and advanced insights from neuroscience empower marketers and researchers to minimize the extent to which these more extraneous variables affect experimental results thereby contributing to a more sophisticated and reliable understanding of the unconscious drivers of our behaviors and how they contribute and correlate with our conscious decision-making.

II-A: Unconscious Processes

The main advantage of integrating neurological data with marketing research is the ability to gain access to the underlying unconscious and affective processes that significantly affect our consumer behaviors but are not consciously generated or understood.

Recent research has found that the human brain expends only 2% of its energy on conscious activity, with the rest dedicated to unconscious processing (Singer, 2010). These unconscious processes occur with little to no awareness or volitional control, thus preventing individuals from having any introspective awareness of their happenings (Bargh, Chen & Burrows, 1996). As a result, these unconscious occurrences significantly affect an individual's decision-making process without their knowledge, which demonstrates why using only self-reported measures to determine what a participant is thinking is insufficient.

II-B: Evidence for the Value of Unconscious Mechanisms

Mormann and colleagues (2012) tested whether exogenous stimuli, external stimuli and events that are not consciously perceived by the human brain, could influence or drive consumer choice (Mormann, Navalpakkam, Koch & Rangel, 2012). The researchers showed participants images of clothing products on a computer screen and altered the relative brightness and contrast of selected products to test whether this minor change in appearance would influence product choice. After being shown the images for 70 to 500 milliseconds, the participants would choose certain products to purchase

(Mormann et al., 2012). The researchers found that the subjective perceptual quality of the picture, or the visual saliency, considerably influenced the final purchase decision when participants were shown the image for brief exposure times and participant's initial preferences dominated their decisions when exposed to the pictures for a longer period of time (Mormann et al., 2012). Next, the researchers ran the same tests while the participants' cognitive load, defined as the total amount of mental effort being used in the working memory or the total amount of information the working memory is processing at that time, was higher (Mormann et al., 2012). In this circumstance, the researchers found that the higher the cognitive load, the stronger the visual saliency effect, which means that the participants with a higher cognitive load were more likely to make purchase decisions that were related to the visual quality and brightness of the images (Ramsoy, 2014). This experiment demonstrates the power of external stimuli that operate on a subconscious level and greatly influence our purchase decisions. During a self-report assessment, participants would not be able to determine why these certain products were more attractive than others yet through our understanding of neuroscience and investigation into the underlying neural mechanisms that inform our decisions, Mormann and colleagues were able to elaborate the prevailing reason why their participants made these specific purchase decisions.

II-C: Evidence for the Value of Unconscious Affective Processes

In addition to these unconscious processes, another area that cannot be directly measured through conventional marketing tactics alone is human emotion. Although the concept of emotion is deeply embedded in our everyday language and appreciations of

our overall existence, recent scientific developments have shown that some of our previously held beliefs regarding emotions and its relation to our consciousness are actually incorrect. Although many people believe that they can control their emotions, they do not recognize that not only is there no way to have total volitional control over our emotions, we are actually not consciously aware of many of the emotions we generate. In fact, researchers have found that once an emotion has been cognitively filtered and enters into our conscious awareness, it is no longer an emotion but instead a feeling. Damasio (1999) suggests that feelings emerge in an individual's brain when he becomes conscious of his unconscious emotional arousal to a possible danger or opportunity. However, since we cannot consciously identify or control our emotions, which are unconscious and separate from our feelings, there is no way to access them without turning to neurological measures. Recent research has demonstrated the importance of accessing these emotions by showing the significant influence that emotion plays in making our decisions.

Damasio was one of the first researchers to document how emotions notably affect the decision making process. Damasio studied participants with damage to their amygdala, the area of the brain where emotions are generated, and found that while their cognitive ability seemed to be intact, they were unable to feel any emotion (Bechara & Damasio, 2005). However, beyond this discovery, Damasio also found that these participants were also unable to make decisions. Although they could describe the benefits and disadvantages between different options and seemed to have full cognitive function, they found it very difficult to make even simple decisions, such as when to schedule an appointment or what to eat (Bechara & Damasio, 2005). As such, Damasio

demonstrated that in the absence of emotion, it is impossible to make choice decisions (Buchanan & O'Connell, 2006). In fact, he showed that even though we often think our decisions are made based on pure logic, all of our choices have considerable roots in stimuli tied to unconscious emotional connotations that influence and alter the end result.

II-D: The Value of Unconscious Affective Processes in Marketing Research

Since our emotions play a pivotal role the decision making process, and these emotions operate on a subconscious level, it is thus impossible for humans to fully understand how an advertisement or marketing campaign may influence their emotions without employing neurological measures. Self-report assessments can attempt to identify a participant's feelings but such feelings are filtered through various neural states before arriving at a conscious level. In fact, Schreiber and Kahneman (2000) demonstrated that, when recalling prior events, individuals are often very often wrong about their affective memories and can assign incorrect emotions to prior experiences.

Understanding how emotional catalysts affect our decisions is very important for marketing research and consumer neuroscience because many studies have shown that emotionally triggering advertisements and marketing campaigns are significantly more likely to attract potential consumers (Wood, 2012). As such, the most successful marketing tactics employ information that appeals to consumers on an emotional level. This phenomenon was demonstrated by Wood in 2012 who argued that utilizing emotionally charged content was more likely to persuade individuals to purchase proposed items. Wood (2012) showed that emotional pulls have more persuasive influence than purely quantitative data by having 150 participants view 18 different

historical television advertisements regarding food, drink or household products and subsequently rate the likelihood that they would purchase each mentioned object. Results indicated that participants were more likely to want to purchase the item that appealed to them on an emotional level, through an interactive story, rather than the items that were presented in conjunction with factual evidence and statistics relating to the product's success (Wood, 2012).

Similarly, the Institute of Practitioners in Advertising (IPA), the world's most influential professional body for practitioners in marketing and advertising, holds an IPA Effectiveness Award competition in which they measure and track the most successful submitted ad campaigns of the year (Dooley, 2009). Recently, the IPA combined 1400 advertising campaigns submitted over the last three decades and compared the campaigns which relied primarily on emotional appeal to those which used rational persuasion and information. They found that the campaigns with purely emotional content performed approximately twice as well (31% vs. 16%) versus those with only informational content (Dooley, 2009).

Much of consumer neuroscience also attempts to address how individuals create increasingly loyal relationships with brands and make brand associations that can extend loyalties. Interestingly, recent studies have demonstrated the significant relationship between emotionally triggering advertisements and increased brand loyalty. When loyal customers are presented with a particular brand they like, they experience the same cognitive processes much like as if they were being rewarded in a choice task experiment, which causes them to develop strong emotions towards a brand. These loyal customers also tend to activate the same neural regions associated with emotion, which

suggests that loyal customers develop a strong affective relationship to the brands they like and feel rewarded when viewing their advertisements, thus enhancing their motivation for repeat purchases (Plassmann et al., 2008). These findings provide refined insights into brand loyalty as they demonstrate that such behaviors have neural linkages to emotion and neural predispositions, which tend to unconsciously activate the human action reward system. Overall, these findings offer crucial insights, benchmarks and biomarkers into how marketers can attract and retain target consumers based on their neural tendencies, patterns of activation and predictive measures of biological activity.

Researchers are now able to apply these neuroscientific principles to traditional marketing models in order to expand our previous understanding of how individuals are influenced through marketing and advertising tactics. For example, consumer neuroscience has already contributed to the reevaluation of a popular traditional model in advertisement research known as the hemisphere theory. This theory proposes a very simplistic view of the brain in which emotions are processed solely in the right hemisphere and rational stimuli exclusively reside in the left hemisphere (Hubert, 2010). However, through the application of neuroscientific and advertising models working in tandem, we have learned that this overly simplistic theory of clear-cut discrepancies between each hemisphere is far too one-dimensional and, in fact, the human brain is comprised of much more complex neural networks and mechanisms that work concurrently to carry out its function. Consumer neuroscience informs this more comprehensive understanding of human decision-making and the intricate latticework of overlapping neural mechanisms that all together contribute to consumer choice. In order

to acquire this valuable information regarding human decision-making, specific consumer neuroscience tools must be utilized.

III: Tools Employed in Consumer Neuroscience

Like any emerging field, there are numerous experimental techniques that are deployed in order to characterize all of the interrelated factors associated with a consumer brand experience. However, there are three main categories of research techniques that are most commonly accepted in today's consumer neuroscience studies. These include psychometric, biometrics and neurometric or neural response techniques. Psychometrics mainly pertain to the implicit association testing techniques which aim measure implicit attitudes or subconscious influences of past experiences that serve to mediate positive or negative or feelings or thoughts towards social decisions and stimuli (Greenwald & Banaji, 1995).

Biometric techniques, on the other hand, are often quantified through facial coding, eye tracking, heart rate monitoring, skin conductance, voice analysis, motion detection and respiration analyses and thus focus primarily on the analysis of biological factors. These distinct techniques enable researchers to gather important data relating to an individual's reaction to different stimuli, such as an advertisement or product packaging. By utilizing these biometric techniques, researchers are able to gather objective and unbiased information that occur below an individual's level of consciousness. For example, Fiszman et al. (2013) observed the importance of packaging and labeling configurations in his experiment, which set out to determine how different presentations and arrangements of labels on a brand of jam affected consumer's

attention. They found that the size of the picture on the packaging label as well as the shape of the bottle influenced consumer's willingness to try the product. These researchers were able to determine the specific elements of this product experience that altered the customer's perceptions through eye tracking technologies, which allowed them to map the specific elements of the product that contributed to increased consumer attention. Eye movements have been found to be accurate behavioral measurements for processes such as visual attention and information acquisition because they are closely related to higher-order cognitive processes and offer insight into neural mechanisms.

In contrast, consumer neuroscience also uses neurometric techniques to primarily test the neural activity of participants through the use of electroencephalography (EEG), magnetoencephalography (MEG) and functional magnetic resonance imaging (FMRI). These three neurometric measurements aim to quantify the physiological responses to advertising by non-invasively mapping brain activity. In fact, the majority of consumer neuroscience data has revolved around these brain-mapping technologies. EEG technology offers researchers the ability to assess the electrical activity of the brain by measuring voltage levels that arise from ionic currents within the neurons of the brain (Greenwald & Banaji, 1995). By measuring the changes in electrical activity over time, researchers are able to identify abnormalities or significant changes in voltage levels that occur when consumers are introduced to various stimuli. On the other hand, MEG diagnostics are used to map brain activity through the assessment of magnetic fields, which are produced naturally in the brain by electrical currents. This technique provides researchers with information and metrics regarding localized brain activity and assists the determination of relationships between certain behaviors and their

corresponding neural regions. Lastly, in order for researchers to obtain a direct and clear understanding of the neural mechanisms behind consumer decisions, fMRI is often used to measure brain function. Through these measurements, researchers are able to obtain a BOLD response, also known as a Blood Oxygenation Level Dependent, in order to observe which areas of the brain are active at given times. This assay method equips researchers with the ability to ascertain which specialized brain areas are at work during different activities. Taken all together, these methodologies are contributing complementary data and insights into consumer behavior that can increasingly empower marketers to better understand and influence customer preferences and purchase decisions.

IV: Areas of Focus Within Consumer Neuroscience

Using these tools, consumer neuroscience researchers have worked to identify and describe the neural networks associated with consumer purchasing decisions. In particular, consumer neuroscience researchers have focused towards the neural systems involved in reward behavior, responses to pricing models, brand loyalty development, affective responses and processes and memory formation.

IV-A: Reward Systems

A wide array of human decision-making has been studied through a consumer neuroscience lens. However, there are two major brain systems that are considered to be the most fundamental of all human behavior, the reward system and the avoidance system. According to neurobiology research, the reward system is anchored in the meso-

limbic pathway, which encompasses the nucleus accumbens (NACC), the limbic system and the orbitofrontal cortex (OFC). The avoidance system, on the other hand, which deals with the anticipation of loss, pain or punishment and the role of avoidance, activates the insula (Javor et al., 2013). Neuroscience research has demonstrated the vital role of these brain systems in the basic reward behavior of animals. However, consumer neuroscience has expanded this knowledgebase of reward behavior to incorporate consumer decisions and purchasing acts in order to identify how these neural regions are influenced and activated by consumer stimuli and behaviors (Javor et al., 2013).

Consumer neuroscience researchers have explored the neurobiological basis of reward behavior relating to purchasing decisions. In order to understand the short-term processing of advertisements, researchers Kenning et al. (2008) and Plassmann et al. (2007) investigated the neural correlates of attractive advertisements and how they influenced the human reward system (Kenning & Plassmann, 2008) (Plassmann, Ambler, Braeutigam & Kenning, 2007). In both experiments, brain activity was measured through fMRI scanners while the participants viewed and rated a series of advertisements on a scale of varying levels of attractiveness. The researchers found that advertisements that were perceived as attractive activated brain areas previously found to be associated with the perception of rewards, primarily the OFC and NACC (Hubert & Kenning, 2008). These observations demonstrate that attractive advertisements neurologically serve as rewarding stimuli and activate the same neural mechanisms to produce the same neurological outcomes.

Similarly, in another experiment by Aharon et al. (2001), the researchers showed that advertisements featuring a typically beautiful face contributed to the activation of the

same reward-related brain regions (Aharon, Etcoff, Ariely, Chabris, O'Connor & O'Connor, 2001). These experiments reveal the significant role that the reward system plays in our brand perception and purchasing behaviors by providing evidence showing that attractive stimuli in advertisements can activate the same neural substrates involved in basic pleasure-seeking behaviors. With this knowledge, marketers can create advertisements and marketing campaigns that specifically target these neurological systems in order to form a stronger connection to their target audience. As is well known to sophisticated advertisers, one of the most important aspects of marketing is portraying a product in a way that appeals to the preferences of the customer. As such, in leveraging this research, marketers are able to better present their products in a manner that will be best received by those same consumers they are trying to attract.

This concept was also shown in an experiment by Erk et al. (2002), who provided key insights into how the brain processes differentially designed goods (Erk, Spitzer, Wunderlich, Galley & Walter, 2002). By investigating fMRI results while participants viewed different brands of cars (sports cars, limousines and small cars), these researchers found that the cars that were associated with wealth and social dominance were more likely to activate reward-related brain areas, such as the OFC, the bilateral prefrontal cortex and the right ventral striatum, in which the nucleus accumbens is located (Erk et al., 2002). Additionally, there was a strong positive correlation between the perceived level of attractiveness of each car and the activation in these regions such that the more attractive the participant perceived a car to be, the stronger the level of activation in these reward-related areas. As a result, on average, the cars that generated the most neural

activation were the sports cars, followed by limousines and then small cars (Erk et al., 2002).

Based on these findings, researchers can correlate an advertisement's perceived attractiveness to predictive purchasing behaviors. Additionally, using these findings, researchers can determine the specific effects that advertisements have on their target audiences and discover what types of ads their consumers find most attractive, which will in turn reveal its effectiveness. A study by Knutson et al. (2007) supported these findings by showing that activation in the nucleus accumbens correlated with participant product preferences and predicted subsequent purchasing behavior patterns (Knutson, Rick, Wimmer, Prelec & Loewenstein, 2007). On the other hand, when shown the prices of certain products, some participants in this study had activation in the insula, which also predicted purchasing behavior because those who had strong insula activation were less likely to purchase the products they were shown. This demonstrates the concept of anticipation of losses as the participants who did not value the products with their associated price were more likely to activate the neural regions associated with loss rather than the regions associated with reward. All of these studies further demonstrate the power that neuroscientific findings and consumer neuroscience research can have on marketing and how they have together contributed to increasingly refined strategies that attract and retain valuable customers.

In addition to their effect on marketing practices, some consumer neuroscience experiments have demonstrated the power of neurological activity data on the prediction of actual sales. One experiment in particular found that measuring brain activity could directly predict the purchasing decisions of consumers. In 2007, Knutson et al. ran an

experiment in which participants viewed photos of Godiva chocolates, a smoothie maker and a Sex and the City DVD while in an fMRI (Knutson et al., 2007). Afterwards, the subjects viewed the items again and were given the price information of each product to see if they wanted to make a purchase. The researchers found that the participants who experienced neural activation in the brain areas associated with anticipating gain, specifically the nucleus accumbens, were 60% more likely to purchase the products compared to other participants (Knutson et al., 2007). This rate was higher than the subjects' self-reported preferences for the various items and better predicted the subjects' final purchasing decision. These representative data underscore the significant insights into purchasing behavior that neural activity can afford researchers. This concept was evidenced again in 2011 when neuroscientists Berns and Moore were able to predict the commercial success of new songs by asking adolescents to listen to clips of 120 recordings from unknown artists while in fMRI scanners (Berns & Moore, 2011). Results showed that the songs that significantly activated the nucleus accumbens were more likely to sell more than 20,000 copies and weak responses in this same area were correlative with songs more likely to sell fewer than 20,000 copies (Berns & Moore, 2011). Interestingly, when the same participants were asked to comment on their preferences for the different songs, their own self-reports of the songs they thought were best did not predict future sales (Berns & Moore, 2011).

IV-B: Consumer Responses to Pricing Models

Another important aspect of consumer research that has benefited from neuroscience is the concept of price policy. Dynamic pricing is a vital component of

marketing and refers to a strategy often used by businesses that are unsure of how a change in price will affect consumer behavior and sales. As such, these marketers set flexible prices for their products and services based on market demands and change their prices often to experiment with how their consumers will react in order to identify the maximum amount that their target consumers are willing to pay. Through market research, advertisers have found that a similar price can be perceived by a buyer in two principal ways, depending on the product, such that a high price can either deter customers from buying a product because it is perceived as excessive or it can be an indicator of higher quality and can therefore contribute to the value of a product and thereby increase the probability that the consumer will be willing to buy the product (Hubert & Kenning, 2008). However, consumer neuroscience allows researchers to delve deeper into the intricacies of pricing dynamics to more extensively understand how changes in price can affect consumer purchasing patterns. In a study by Plassmann et al. (2008), participants' brain activity was monitored through fMRI while they consumed different brands of wine and were presented with explicit price information. Results indicated that, regardless of the brand, participants found the more expensive wine to be more appealing and, in addition, the more appealing wine led to specific neural activation in the medial prefrontal cortex and in the rostral anterior cingulate cortex. According to this research, Plassmann et al. concluded that the perception of a product is not only dependent on intrinsic properties such as taste but is also significantly impacted by other adjustable external factors within a marketing model, such as a set price. Additionally, the researchers concluded that they could predict a participant's willingness to pay for a product based on their neural patterns of activation in these brain regions. These insights

allow researchers to better understand and predict patterns of consumer behavior and speculate how different products can be advertised, priced and promoted to lead to more effective campaigns and, in the end, result in overall higher sales.

IV-C: Brand Loyalty Formation

In addition to price policy, brand loyalty is one of the most important components of the marketing process. As such, many marketers have long sought to understand this concept and, specifically, the way in which consumers form loyal and lasting relationships with specific brands. Consumer neuroscience has contributed seminal and concrete explanations into the neural processes of brand loyalty to inform understandings of how consumers develop and sustain lasting relationships with different brands. For example, one consumer neuroscience study identified the neural correlates of retail brand loyalty by having participants choose between identical garments offered by different retail brands (Plassmann et al., 2008). After collecting prior research regarding the purchasing behaviors of participants, the researchers were able to identify subjects' favorite retail brands and sort participants into two groups according to their previous average buying behaviors with Group 1 spending a minimum of $250 on five or more shopping days per month at a specific retailer ("loyal customers") and Group 2 spending a maximum of $50 on only one shopping day per month at a specific retailer ("disloyal customers"). FMRI analyses showed that loyal customers activated different neural regions compared to disloyal customers, with significant activation arising in the ventromedial prefrontal cortex, another area involved in rewarding actions and behaviors and also involved in emotional decision-making. In contrast, this activation was not

found in the more disloyal participants. Conclusively, the researchers argue that emotional reinforcers in marketing can lead to long-term customer loyalty and retention. This is vital information for marketers because it allows them to better understand how to form enduring relationships with their clients through emotionally stimulating promotional messages, which often are the most profitable ones.

IV-D: Affective Processes

Consumer Neuroscience also delves deeply into the neural underpinnings and properties that influence consumer choice. One such catalytic component is found in human emotion and affective processes, which is well appreciated as critical to the practice of advertising as emotion and has been found to play a consequential role in ad memorization (Ambler, Ioannides & Rose, 2000). Through seminal findings in consumer neuroscience, we have discovered that different advertisements can correlate with signature neural activity in brain processes and regions such as the medial prefrontal cortex, posterior cingulate, nucleus accumbens and higher-order visual cortices. Specifically, consumer neuroscience research was able to first demonstrate the significant role of the ventromedial prefrontal cortex in bilateral emotional processes (Deppe, Schwindt, Kugel, Plassmann, Kenning, 2005). Through these consumer neuroscience experiments, researchers are able to pinpoint and "fingerprint" the localized neural regions that contribute to consumer behavior so that we can form a more comprehensive understanding of how different neural processes relate and interact to influence decision-making.

Additionally, consumer neuroscience has contributed meaningful advancements to the investigation of the discrepancies between cognitive and affective ads and found that both types of ads activate different neural networks with cognitive ads resulting in activation in the posterior parietal cortex and superior prefrontal cortices while affective ads activate areas within the amygdala, the orbitofrontal cortices and the brainstem (Ambler et al., 2000). These practices enable companies to present their advertisements in the most effective manner so as to augment and enhance the influence of their product branding and consumer directed messaging. In addition, marketers can use this information to better understand the effects that their advertisements have on their consumers and identify why some ads may be more effective in inducing purchasing behaviors compared to others.

IV-E: Memory Formation

Consumer neuroscience has also contributed to our considerably more advanced understandings in how consumers process, store and leverage the information they receive through advertisements. For example, these studies have demonstrated that advertisements that last longer than 1.5 seconds are more likely to be remembered by participants one week later compared to those advertisements that are shown for less than 1.5 seconds (Rossiter, Silberstein, Harris & Nield, 2004). These studies have also demonstrated that the advertisements that produce localized brain activity in the left frontal hemisphere are also more likely to be memorable in subsequent weeks. This threshold of time that an advertisement should be presented as well as the localized activity that memorable advertisements induce is crucial for marketers and advertisers to

better test and understand how the images and information they present is processed by consumers (Rossiter et al., 2004). Additionally, consumer neuroscience has also revealed that there are basic building block stages within a commercial or advertisement campaign known as "branding moments" that are far more influential than others in terms of establishing desired and sustained advertising effects. Consumer neuroscience researchers have been able to identify many of these moments through EEG and alpha, beta, and theta wave technology in order to facilitate how advertisers present their most valuable information within the most significant stages (Ambler et al., 2000). With these insights, marketers can create more effective campaigns and promotions that will not only produce immediate positive responses, but will also result in long-term benefits as well.

V: Critiques and Concerns

As a newly established field, consumer neuroscience has faced many critiques relating to its experimental methods, intentions and findings. One of the principle critiques of the field's scientific methods considers the question of whether or not consumer neuroscience research can directly inform our understanding of consumer behavior and predict future behaviors or if it rather simply characterizes prior behaviors. Behavioral researchers and economists argue over the ability of neural data to provide predictive insights into human behavior (Plassmann, Venkatraman, Huettel & Yoon, 2015). Most neuroscience studies, particularly those that utilize fMRI techniques, seek to identify *correlational* relationships between brain activity in a specific region and a demonstrated behavior or experience (Plassmann et al., 2015). An example of this

correlational relationship can be found in an experiment in which the ventromedial prefrontal cortex and the dorsolateral prefrontal cortex were found to become active when experimental participants reported their willingness to pay for a specific product (Plassmann et al., 2007). From this information, the researchers of this experiment argued that there is an *association* between these two brain regions and an individuals' calculation relating to their willingness to pay for a product (Plassmann et al., 2007). However, to claim a direct *causal* relationship, implying that brain activation *causes* a specific behavior, researchers must suppress activation in a specific neural region and directly measure the effects of that suppression on related behaviors. For example, in 2009 a set of researchers used transcranial magnetic stimulation to suppress activity in the dorsolateral prefrontal cortex, which in turn resulted in participants lowering their willingness to pay and changing their decision-making tactics, thus demonstrating the causal relationship between this brain region and the exhibited behavior (Camus, Halelamien, Plassmann, Shimojo, Doherty, Camerer & Rangel, 2009). Many economists and even neuroscientists argue that consumer neuroscientists claim their experiments attempt to demonstrate causal relationships when, in fact, they only provide associative inferences.

Arguing for causal relationships when no such direct association is confirmed can be disruptive to our understanding of the brain and can lead to an inaccurate understanding of neural mechanisms. However, most consumer neuroscience research does not actually claim any direct causal relationships between brain activity and behavior. Instead, researchers in this field argue for association-based inferences that still provide vital importance and implications for marketing theories. Additionally, such

findings would be difficult and in many cases impossible to obtain from behavioral data alone. For example, Karmarkar et al. (2015) recently examined the effects of price primacy on purchase behavior by conducting an experiment in which the price of a product was presented to participants either before or after the product itself was shown (Karmarkar, Shiv & Knutson, 2015). Through fMRI measurements, the researchers found increased activation in the medial prefrontal cortex, a key region for decision-making mediation, when the product was shown before the price information but not when the price was shown first. These findings show that early exposure to price, or "price primacy," effects the decision making process, as observed in the altered patterns of neural activity immediately before participants made their purchase decisions. Specifically, the researchers found that when participants viewed the products first, they primarily made their decisions based on the products' attractiveness or desirability but when they viewed the prices first, they made their decisions dependent on the products' monetary worth (Karmarkar et al. 2015). The researchers go on to argue that their findings demonstrate the power that price primacy can have in influencing purchasing acts and, specifically, can increase the purchasing of bargain-priced products when their worth is noticeably recognized (Karmarkar et al. 2015). This example demonstrates the value of consumer neuroscience research as a complement to other scientific, behavioral and marketing research that gives clear insight into the way in which human purchasing behavior can be measured and better understood through neural measurements. However, as with any experimental research, consumer neuroscience must rely on conclusions from other scientific fields regarding the processes and constructs that underlie their findings. Since consumer neuroscience is still in its infancy, it must still support its interpretations

with conclusions from other fields in order to verify and authenticate its findings. This multi-methodological approach allows consumer neuroscience to leverage more validated findings from economics, psychology, neuroscience and other fields to better understand and explain consumer decision making and provide associative claims, rather than causal ones, to describe the relationship between brain activities and behaviors.

Just as causal claims present a potential error in the interpretation of consumer neuroscience findings, so too does reverse inference which involves the extent to which psychological processes can be inferred from neural data (Plassmann et al., 2015). Although most of the early research in this field applies a forward inference approach to its experimentation, often demonstrated through the manipulation of a psychological process to find the associated region of activation, reverse inferences have become more common in consumer neuroscience studies that attempt to prove an individual's behavior or mental processes based on their patterns of neural activation (Poldrack, 2006). Reverse inferences can be problematic to our understanding of the brain and its relation to our behaviors because we still do not have a detailed map of the brain and all its various functions and associations. Additionally, we know that a single neural region can have various functions and can be involved in multiple processes and behaviors. As such, reverse inferences can be inaccurate or fail to provide a comprehensive representation of the brain's relation to human behavior. For example, in a New York Times Op-Ed study, a marketing writer had participants use their iPhones while in fMRI machines and concluded that people are truly "in love" with their iPhones because viewing their iPhones led to activity in the amygdala, a brain area linked to, among many other emotions, the feeling of love (Lindstrom, 2011). However, this claim cannot be

substantiated because the amygdala is involved in various other processes as well. In a meta-analyses of thousands of neuroimaging studies, Yarkoni et al. (2011) provide the statistical validity of reverse inference claims and explains that while some findings based on the concept of reverse inference can in fact be statistically significant and correspond to strong relationships between human behavior and brain activity, such as the relation between reward processing and activation in the striatum, other claims can be weak and misguiding (Yarkoni, Poldrack, Nichols, an Essen & Wager, 2011). These erroneous conclusions based in reverse inference findings can lead to substantial misunderstandings regarding the relationship between neural activation and its effects on consumer decision making.

Although reverse inferences can be potentially problematic for consumer neuroscience, their significance and value to the field in general can be mitigated through further research. These consumer neuroscience studies that are more exploratory in nature and rely on these reverse inferences to propose certain behaviors need to be followed with further studies that rely on statistical measures to ascertain the degree to which the region of interest is reliably and selectively activated by the psychological process observed (Poldrack, 2006). If consumer neuroscientists are able to provide further statistical evidence from a multitude of studies that support their findings, their inferences should be considered valuable and useful for the field at large.

Another common critique of consumer neuroscience pertains not to the methodological tactics of the field but rather the implications of its findings. Many people argue that consumer neuroscience practices and experiments are unethical, as researchers have been said to attempt to “read the minds of consumers” and delve into their

subliminal and private thoughts in order to maximize profit and marketing efforts (Javor et al., 2013). Various arguments have surfaced relating to whether consumer neuroscience and neuromarketing research should be regarded as a violation of individual consumer rights, such as the right to privacy. These individuals claim that consumer neuroscience aims to influence human behavior by identifying unconscious mental processes and uncovering the subliminal relationships between brain and behavior in order to manipulate mental processes for the sole purpose of maximizing the profits of large corporations (Satel & Lilienfeld, 2013). For example, researchers Ariely and Berns warn consumers about the potential of businesses being able to read the minds of consumers through consumer neuroscience techniques in order to maximize profit (Ariely & Berns, 2010). Similarly, in a 2007 New York Times article, using brain scans to understand behavior was referred to as "super mind reading" and was said to threaten the privacy and mental freedom of humans (Satel et al., 2013). However, neurological brain scans are used in many other fields as well, including neuroscience and psychology, and have led to numerous beneficial and vital contributions relating to our understanding of the intricacies of human behavior and mental processes. Consequently, consumer neuroscience must overcome perceptions of ethical problems and hurdles as other neuroscientific fields have done. However, unlike neuroscience and psychological studies, consumer neuroscience and other marketing experiments are not currently regulated or monitored by an institutional review board (IRB) (Satel et al., 2013). As a result, there is not currently an industry standard or monitoring body that prevents unethical experimentation and practices and ensures that participants in consumer neuroscience studies are treated justly and appropriately. Consequently, various

consumer protection groups and nonprofit organizations have tried to create regulations for neuromarketing research. In 2003, a nonprofit organization called Commercial Alert unsuccessfully appealed to the Department of Health and Human Services regarding consumer neuroscience research that was being conducted at Emory University under the accusation that this research could potentially be sold to corporations in order to persuade consumers to engage in unhealthy, destructive and addiction behaviors (Satel et al., 2013). Later, in 2011, a group of consumer protection groups filed a formal complaint with the Federal Trade Commission against the Frito-Lay Company for ostensibly using neuromarketing to influence the purchasing behaviors of teenagers and promote unhealthy eating habits (Satel et al., 2013).

Although the intentions and assertions of neuromarketing and consumer neuroscience may seem unethical to some, as it can be viewed as a way to positively influence the purchasing behaviors of consumers for the sole benefit of maximizing profit for a company, it certainly did not first introduce the idea of using advertisements to influence purchasing behaviors. In fact, soon after the advent of advertising, there has been various subliminal messages and other subtle attempts to influence and even manipulate purchasing behavior. Such influences are ubiquitous and can be found in the ambient music being played in a store, the colors of the walls and furniture at a restaurant, the sly endorsements of certain products by celebrities and elsewhere. Consequently, there is a proliferation of influencers that aim to manipulate purchase behavior in our daily environments, some of which are created by advertisers and some of which are element of the natural environment. In 2013, researcher James Vicary demonstrated the powerful influence of subliminal messaging through his “invisible

commercial" in which he flashed the messages "Hungry? Eat Popcorn" and "Drink Coca-Cola" for an indiscernible 1/ 3,000th of a second during movie showings. After six weeks of this subliminal exposure, the sales of popcorn and Coca-Cola at that movie theater increased by 18% and 58% respectively (Satel et al., 2013). This experiment demonstrates the power of unconscious marketing techniques that have been implemented for decades and have significantly influenced human behavior long before neuromarketing and consumer neuroscience research became accessible. Legally speaking, there is currently no federal law that prevents such subliminal messages from occurring in advertisements. However, just because these practices and subliminal influences have not been regulated in the past, does not mean that scientific research that aims to similarly affect human behavior should not abide to regulations similar to those shouldered by other more established scientific fields.

In order to provide regulation and monitor the validity of neuromarketing findings, the Advertising Research Foundation initiated a long-term project to develop a set of guidelines for the field of neuromarketing in 2010 (Satel et al., 2013). Specifically, the foundation concluded that, given the complexity and integration of the field, it was difficult to assess the legitimacy of the claims that commercial companies were making regarding their ability to enhance marketing efforts through neuromarketing applications (Satel et al., 2013). After reviewing the claims made by various neuromarketing companies, the project reviewers found that many companies were exaggerating the promises of neuromarketing and of our general understanding of the relationship between brain activation and human behavior (Satel et al., 2013). Given these exaggerated claims, the review board asserted that research protocols needed to be established in order to

bring more clarity to the capabilities of the field (Satel et al., 2013). Still, there is a significant lack of transparency surrounding the neuromarketing industry and the specific ways in which consumer neuroscience can be applied to commercial marketing and the corporate world.

Additionally, most neuromarketing firms do not publish their findings in order to protect both their clients and their proprietary research, which has resulted in a lack of detailed standard procedures and documentation regarding the research protocols and practices that neuromarketers employ (Satel et al., 2013). In 2013, Columbia University researchers demonstrated this lack of transparency in neuromarketing by reviewing the websites of 16 neuromarketing organizations and found that very few of them actually described their methodology for improving marketing effectiveness through consumer neuroscience research and, furthermore, almost half of these organizations did not use EEG or MRI technology, which is the primary measurement tool used in consumer neuroscience research (Satel et al., 2013). This lack of transparency further contributes to the prevalence of exaggerated claims and false promises in the neuromarketing industry, which in turn leads consumer neuroscience to develop a poor repute. However, unlike neuromarketing, consumer neuroscience aims to better understand consumer decision making not for the sole purpose of maximizing profit, but rather instead to form a holistic understanding of the neural basis of consumer behavior.

VI: Experiment: Investigating the Persuasive Effect of Text and Video Advertisements

VI-A: Background Literature

Few researchers have investigated how consumer persuasion is affected by different kinds of advertisements, such as print, static, video, TV and digital ads, to see if the presentation form or type of channel through which the ad is portrayed affects how consumers respond to the ad. However, some research has examined the types of messages that are most persuasive and the areas of the brain that are activated in the face of persuasive content. For example, there has been a significant amount of substantiation in support of using emotionally charged content in advertisements to persuade individuals as demonstrated in an experiment performed by Wood (2012), which showed that emotional pulls have more persuasive influence than more quantitative data.

Although some researchers have delved into the specific aspects of persuasive advertisements, not many experiments have been conducted exploring the most effective channels (the means through which information is portrayed to a consumer) to present such content. As technology tools and applications expand rapidly, more advertisers are relying on digital marketing campaigns to sell their products and services. In fact, many companies believe that, since digital media has become more prevalent in all aspects of our society, print advertisements have been, and should continue to be, pushed to the sidelines. However, little research has been conducted around the actual effectiveness of these different advertising channels and, in fact, much of the research that is available points to print ads as being more persuasive for consumers.

In 2009, the first neurophysiological experiment aimed at studying the differences between physical and digital marketing content was conducted in order to better understand how consumers process different types of media (Brown, 2009). These researchers found that print advertisements with text-based messages had a stronger neural impression, due to increased cognitive and affective processing, compared to their digital counterparts (Brown, 2009). Although this study was influential in beginning an important discussion around the differences in the neural mechanisms utilized when viewing different advertisement channels, the researchers failed to relate the identified neurophysiological differences to any actual measures of marketing success or purchase behavior. Consequently, this study failed to comprehensively address whether these abstract and underlying neural differences had a significant effect on marketing practices and also failed to identify why print ads were more successful and persuasive.

In 2015, the Canada Post Corporation conducted an exploratory investigation of the value of their various marketing channels. Specifically, they examined the extent to which ads generated through different channels resulted in differing levels of consumer persuasion, as measured through activation patterns in neural regions associated with persuasion as well as actionable results from consumers, specifically in terms of sales ("Canada Post," 2015). Based on neural activation findings and sales research, the experimenters found that direct, or print advertisements, were 20% more persuasive than digital media advertisements and also concluded that direct mail advertisements were more easily processed both visually and cognitively compared to media campaigns ("Canada Post," 2015). Lastly, they found that ads generated through direct mail were significantly more likely to drive customer behavior and actionable sales compared to

digital media ads (“Canada Post,” 2015). Although this study was able to show that print advertisements might be more persuasive than digital advertisements, their research methods and results were not regulated by any review board and the researchers did not fully investigate the specific aspects of print campaigns that differentiate them from digital campaigns and make them more successful in inducing purchasing behaviors.

Another area within persuasion research that has been controversial are the regions of interest (ROIs) specifically associated with persuasive behavior. Since the act of persuasion is complicated and incorporates external factors, it has been thought that the neural underpinnings related to persuasion are unidentifiable. However, more recent research has indicated that this previous perception is invalid. Using fMRI techniques, researchers have been able to determine the neurocognitive processes associated with persuasion and, as such, they have been able to assess the activation in these regions during persuasive manipulations. Falk et al. (2010) conducted three fMRI studies that elucidated the neurological networks associated with feeling persuaded across different cultures and forms of media (Falk, Berkman, Mann, Harrison & Lieberman, 2010). In their study, Falk et al. explored the different networks associated with persuasion by having American and Korean participants read and hear arguments related to a number of different objects and activities during fMRI scanning sessions and subsequently rate their perceived persuasiveness for each argument through self report. In examining the neural response to the persuasive and unpersuasive arguments, the researchers found that the medial prefrontal cortex (MPFC) was significantly more active during the presentation of arguments that were later rated as more persuasive through self-report measures. Additionally, the bilateral posterior superior temporal sulcus (pSTS) and

bilateral temporo-parietal region (TP) showed higher levels of activation while participants viewed persuasive arguments compared to other neural regions (figure 2). Other studies have supported these findings by showing that activation in these specific neural regions can measure and predict persuasion levels through self repot and subsequent purchasing behaviors.

In addition to looking specifically at the MPFC, Falk et al. (2010) investigated activation in the precuneus, another region commonly associated with persuasive arguments and experiments. Coactivation in these regions has been found to predict future behavior changes and play a significant role in attitude adjustment (Lieberman, 2007) (McGuire et al. 1969). Additionally, activity in these regions has been used to predict spontaneous motor behavior several seconds before conscious motor intentions are formed, indicating that these regions might be involved in the formation of behavioral intentions that are not yet accessible to conscious awareness (Soon et al., 2008).

Falk et al. (2010) also tested the persuasiveness of different stimulus modalities by measuring BOLD response signals as participants viewed video-based or text-based commercials/advertisements (Falk et al., 2010). The researchers found that the text-based advertisements were significantly more effective in activating the ROIs associated with persuasive content- the MPFC, precuneus, bilateral PSTS and bilateral TP- compared to the video-based commercials. They also found that the MPFC was activated more significantly for “cognitive processing” text-based material while precuneus activation was observed in response to digital advertisements. Thus, these researchers concluded that each region previously identified as being activated in the face of persuasive content

might respond differently to persuasive content presented through different media channels (Falk et al., 2010).

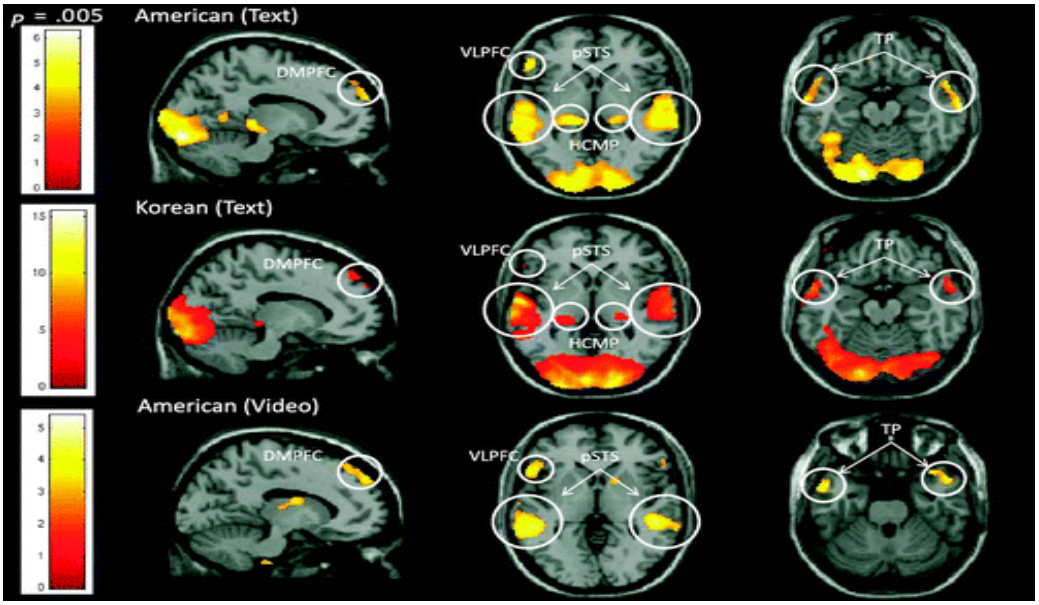


Figure 2 *This figure shows American and Korean neural responses for text and video advertisements from Falk et al. (2010). Increased levels of activation in the regions associated with persuasive content, the DMPFC, bilateral pSTS and bilateral TP, are observed for text advertisements compared to video advertisements. (Falk et al., 2010)*

From these findings, it seems that print advertisements might be more persuasive than digital advertisements because these ads present content through static, text-based messages while digital ads often show content through videos, which Falk et al. (2010) found to be less persuasive and less likely to result in activation in the persuasion-related neural regions. Additionally, another consumer neuroscience study found that physical media and text-based advertisements, as opposed to video-based digital ads, were more likely to stimulate emotional responses from consumers as observed through

electrodermal responses, which measures electrical activity in the sweat glands to observe an individual's level of arousal (“Enhancing the Value of Mail: The Human Response,” 2015).

Despite these research findings, more companies and services are opting for digital video advertisements to sell their products to consumers. In 2014, the digital video ad market grew 56% from 2013 and companies spent a total of $5.9 billion on generating these advertisements (Blattberg, 2014). Additionally, video ads shown through mobile devices grew 532% from 2012-2014, demonstrating the significant upward trend that this form of advertisement is on (Blattberg, 2014). However, as shown above, recent research reveals that such digital video ads are not as effective in driving consumer purchasing compared to their print ad counterparts. Although prior research has demonstrated the power of print advertisements, researchers have failed to uncover the specific aspects of print campaigns that make them more persuasive than digital campaigns.

As such, in this experiment, I intend to investigate one specific component of print based advertisements that make them unique and could possibly give insight into why they are more persuasive than digital ad campaigns. Specifically, I will look at the differences between text and video advertisements to see if one way of presenting content is more effective and persuasive than the other.

VI-B: Proposed Experiment Introduction

In today’s hyper-digitized world, marketers have the power to interact with consumers in more ways than ever. However, not every form of content presentation has the same effect on consumer purchasing behavior. Previous literature has shown that

print advertisements (physical hard copy ad campaigns) are more persuasive than digital advertisements (Falk et al., 2010), but it has not addressed why this discrepancy between ad types occurs. In other words, prior research has not addressed the specific components of print advertisements that make them more persuasive than digital advertisements.

The proposed experiment investigates why print advertisements, compared to digital advertisements, may be more persuasive and effective in inducing purchasing behaviors by specifically looking at the ways in which each type of ad commonly presents information; either through static messaging, for print ads, or video messaging, for digital ads. I will investigate the differences in neurological activation between text-based advertisements and video-based advertisements and observe which type of ad results in higher levels of consumer purchase behavior. This will offer important insight into why print ads might be more persuasive than digital, based primarily on the fact that print ads present content through text-based, rather than video-based messaging. The purpose of this experiment is to reveal the neural regions differentially engaged by persuasive vs. unpersuasive content as well as the regions activated by text and video advertisements. Based on the prior literature above, I hypothesize that static text-based advertisements will more strongly activate the neural regions associated with persuasion and induce participant purchasing behavior compared to video-based advertisements. These results should provide insight into the characteristics that make print advertisements more persuasive than digital advertisements. These findings may also provide evidence for more effective marketing tactics to persuade customers to purchase products.

VI-C: Hypotheses

Although I am running a whole-brain scan fMRI analysis for this experiment, I will look specifically at neural activation in a priori regions of interest that I hypothesize will offer key insights into why certain advertisements are more persuasive than others. I will look specifically at the MPFC and the precuneus, shown in figure 3 below, as these are the regions most commonly associated with behavior change and persuasion but I will also pay attention to the bilateral pSTS and the bilateral TP in order to determine the effectiveness of each type of advertisement. Additionally, I intend to look at which neural regions activate differentially for text and video conditions, specifically I hypothesize that the MPFC will activate more strongly for text advertisements while the precuneus will show stronger activation for the video advertisements, as this was found in prior studies (Falk et al., 2010). Based on prior literature, I know that stronger activation in these regions is associated with stronger levels of persuasive content (Falk, 2010).

For the behavioral results, I hypothesize that participants will be more likely to indicate they will purchase a product if they viewed that product through a text-based advertisement rather than a video-based advertisement. This will demonstrate that the neurological data aligns with the behavioral results, which indicates that text-based ads not only activate the neurological regions associated with persuasion but also lead to more persuasive consumer behaviors and purchasing decisions.

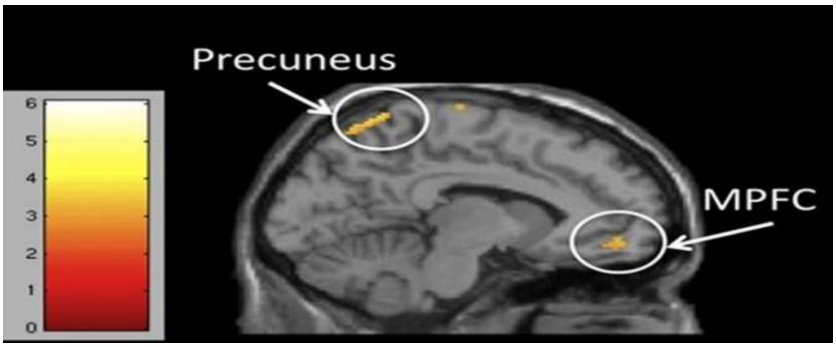


Figure 3 *This figure shows the neural location of the MPFC and the precuneus, two main regions commonly associated with persuasive behavior changes.*

VI-D: Materials and Methods

Participants

Approximately twenty participants (10 female) will be recruited for this study through mass emails and posted fliers explaining that all participants will receive financial compensation for their participation. All participants will be right-handed, European American, born and raised in the United States and will be native English speakers so that they have no difficulty understanding the advertisements, which will presented in English. Participants should also meet standard MRI safety criteria, which ensures that participants are (1) not claustrophobic; (2) have no metal in their bodies (other than tooth fillings) and (3) are not pregnant/breast-feeding. Additionally, participants should have no history of reading disorders or learning disabilities and should not be taking any psychoactive medication. Data should also be collected in accordance with an Institutional Review Board.

Materials

Qualification Survey: Participants will be selected based on a survey administered to all potential participants prior to the experiment. This survey will ensure that all chosen participants enter the experiment with the same intention and desire to buy the presented products. Subjects will be shown a series of approximately 20 common supermarket products and will be asked to rate the likelihood that they would purchase each product on a scale of 1-10. To qualify for the study, participants will rate at least six products in the 5-7 range, indicating that they could be persuaded to purchase those items. In other words, these ratings indicate that participants will not be against purchasing these products but might need to be persuaded by advertisements in order to do so.

Advertisements: Advertisements will be created for six of the products rated most frequently in the 5-7 range on the qualification survey. Black and white 10-second text and video advertisements will be created for each of the six products. For each product, the same information will be shown for the text and video ad. Each participant will view all six products, three in text format and three in video format but the presentation of each product, which will be in text or video format, will be randomized for each participant. Each advertisement will be presented for 10 seconds and after each advertisement participants will press a button to indicate if they would either purchase or not purchase the identified product.

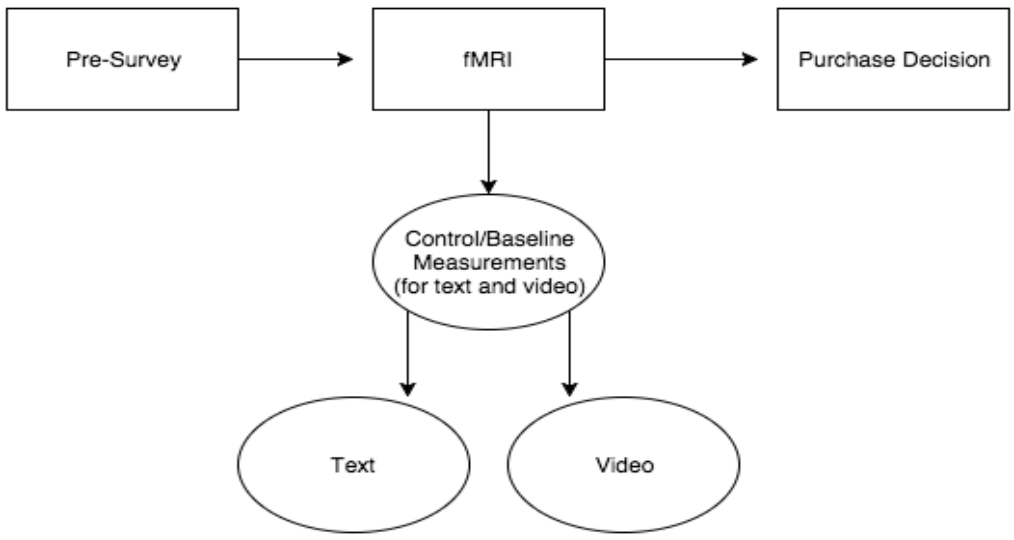
Persuasion Assessment: Following the presentation of all six advertisements, participants will complete a self-report questionnaire regarding their reactions to the products presented. This report will also ask participants to rate how much they think

each ad persuaded them to purchase the presented product, measured through a 10-point Likert scale. The questionnaire will include a manipulation check that will distinguish the participants who fully viewed and paid attention to the information presented from those who did not.

In order to test the internal consistency of each question on the persuasion assessment, a Cronbach's Alpha reliability analysis test will be run on each question to indicate that all questions are closely related and have relatively high internal consistency.

Procedure

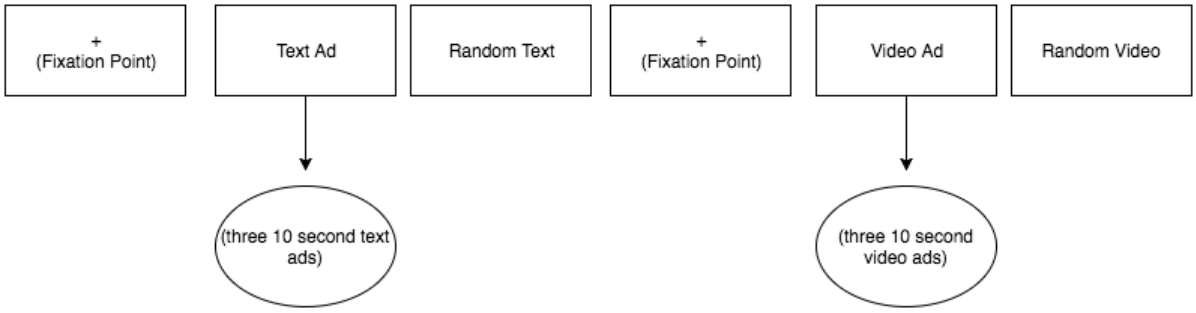
Figure 4



As outlined in figure 4 above, participants selected based on their answers on the pre-survey will complete a demographic questionnaire and sign informed consent forms. Next, participants will take part in the fMRI part of the study in which they will view the six advertisements in the MRI scanner. The text of the slides will also be read aloud through earphones to control for participant reading speed and to control for the sound

presented in the video advertisements. Before presentation of the ads, participants will be instructed to read the advertisements silently, consider each ad carefully, and will be told that they will be asked a series of questions about the ads following their presentation. The primary task will consist of a six block design with the following conditions:

Figure 5



As shown visually in figure 5 above, each condition/block will be presented for 30 seconds and will be split up into three 10-second trials. As such, each participant will view the fixation point condition for 30 seconds in order to establish baseline neural activity and will then view three trials within the text advertisement block, each 10-seconds long. This block will be followed by the random text condition in which they will view three 10-second random text trials. This same process will repeat for the same amount of time for the video conditions in the following order: fixation condition, video advertisements, and random video content. The random text and random video slides will show pre-prepared presentations of unrelated text or video in order to identify neural activation in regions associated with viewing text vs. Viewing moving video sequences but not associated with persuasion. The three advertisements within each condition will be randomly generated for participants so as to control for order effects. Each block will be separated by 10-second rest periods.

After viewing each of the six total advertisements, participants will be asked to indicate if they would purchase each product by clicking one of two buttons on a handheld controller. Pre-identified yes and no buttons will be established for participants. Following scanning, participants will indicate their attitudes towards each product in the persuasion assessment.

VI-E: Data Acquisition and Analysis

fMRI Imaging Data Acquisition Parameters

Imaging data will be acquired following a procedure similar to that described in Falk (2010). For example, images will be acquired using a Siemens Allegra 3 Tesla head-only MRI scanner. Head motion will be minimized using foam padding and surgical tape; goggles will also be fixed in place using surgical tape connecting to the head coil and scanner bed.

A set of high-resolution structural T2-weighted echo-planar images will be acquired coplanar with the functional scans [spin-echo; repetition time (TR) 5000 ms; echo time (TE) 33 ms; matrix size 128 128; 36 axial slides; field of view (FOV) 20 cm; 3 mm thick; voxel size 1.6 1.6 3.0 mm). One functional run will be recorded (echo-planar T2-weighted gradient-echo, TR 2000 ms, TE 25 ms, flip angle 90°, matrix size 64 64, 36 axial slices, FOV 20 cm, 3 mm thick; voxel size 3.1 3.1 3.0 mm) (e.g., Falk et al., 2010).

fMRI Data Analysis

The fMRI data will be analyzed using an fMRI analysis package such as Statistical Parametric Mapping (SPM8). Images will be realigned to correct for motion,

normalized into standard stereotactic space, and smoothed with an 8 mm Gaussian kernel full-width half-maximum. The task will be modeled for participants at the single subject level, comparing activity while watching advertisements to activity at rest. A random effects model will be constructed, averaging over these single subject results at the group level.

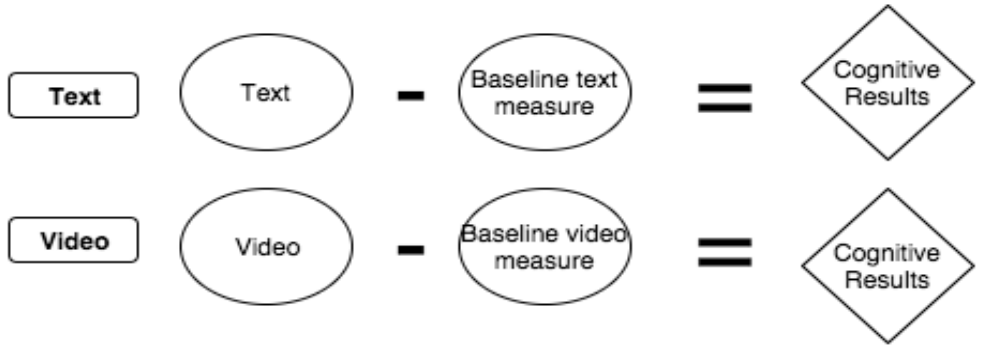
Contrast Analyses

Four types of contrast analyses will be conducted (two of which are shown in figure 6 and 7 below).

First, in order to identify neural activation solely from ad conditions and separate out the activation observed during fixation periods, neural activation from the fixation condition will be subtracted from the text ad condition and neural activation from the fixation period will also be subtracted from the video ad condition. This will result in the text and video conditions that will then be used to contrast with the text and video random conditions.

Figure 6

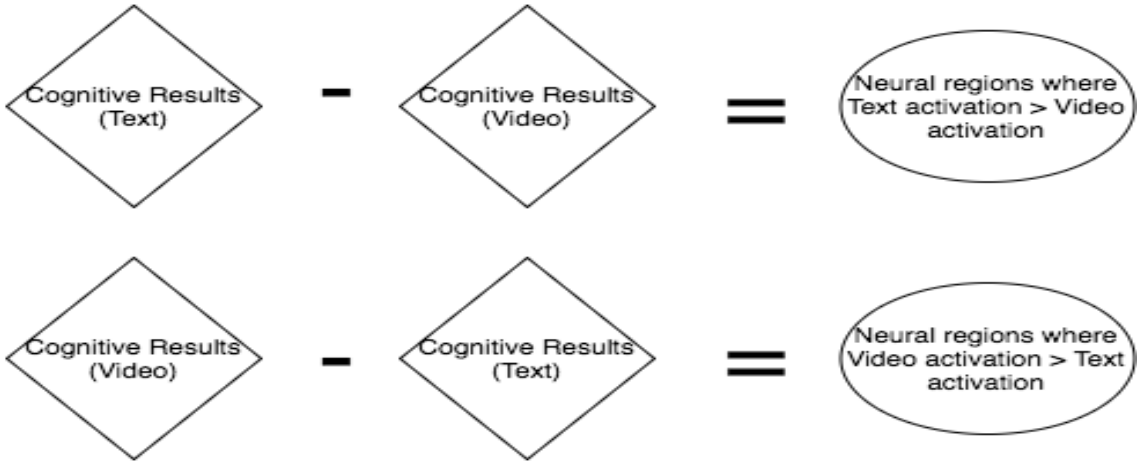
Contrast Type 2:



As shown in figure 6 above, the baseline text measure (when participants viewed the random text slide) will be subtracted from the neural activation identified during the text ad presentation (obtained from the previous contrast analysis). The same analysis will be performed for the video advertisements as well. These contrast analyses will determine which areas in the brain are activated from only the content of the advertisements presented and not due to the neural activity that occurs while viewing the specifics of text or video stimuli.

Figure 7

Contrast Type 3/4:



The data will then be analyzed to compare text and video activation together. In order to do this, I will take the cognitive results received from the text measures and subtract the cognitive results received from the video measures, which will show the neural regions where text activation is stronger than video activation. I will also use this method to subtract in the opposite direction to find the neural regions that were more strongly activated by video advertisements rather than text advertisements. This

subtraction method is shown in figure 7. This information will show the specific regions within the whole brain that are more active for each condition.

I will perform an additional contrast analysis that only includes the neural activity for the trials in which participants indicated that they would purchase the presented product. By focusing on participants who were successfully persuaded by the advertisements they viewed, I will be able to separate out the persuasion effect from the actual purchasing decision. For this analysis, I will use the same subtraction method shown above in figure 7 and subtract cognitive video results from cognitive text results in order to find the neural regions where text activation is stronger than video activation and visa versa for stronger video activation regions for participants who were successfully persuaded by the ads.

VI-F: ROI & Whole Brain Analysis

In order to construct the a priori regions of interest Talairach coordinates for the MPFC and precuneus, I will use information from Soon et al. (2008). In their experiment, MPFC coordinates were averaged and a 10 mm cube was constructed centered on the midline at the y and z coordinates (0 60 9). To construct the precuneus ROI, the same procedure was followed, centering the 10 mm cube on the midline at the y and z precuneus coordinate reported by Soon et al. (2008) (0 57 39).

To explore neural regions that are associated with behavior change, but that I did not choose in my a priori ROI analysis, I will regress behavior change scores onto neural activity (during the presentation of the advertisements, compared with rest) at the group

level. This analysis should be performed both before and after controlling for self-reported attitudes and intentions (Falk et al., 2010).

VI-G: Expected Results

Behavioral Results

I expect that participants will be more likely to click the purchase button when they are viewing a product presented through a text-based ad rather than a video-based ad. This will show that text-based ads are more persuasive than video-based advertisements regardless of which product is shown. Additionally, I believe that greater observed BOLD responses in the regions associated with persuasion, the MPFC, precuneus, bilateral pSTS and bilateral TP, will predict behavior above and beyond persuasion assessment scores. This will indicate that neural activity directly predicts real life behavior and purchasing acts more so than an individual's personal opinion of their reaction to a product. This will be observed through a regression analysis comparing the level of activation in the persuasion regions to the self-reported questionnaire scores for each participant. I believe that the neural activation will be a more accurate predictor of purchasing behavior, the likelihood of a participant actually purchasing the product, compared to the amount of persuasion each participant will indicate on the persuasion assessment.

A Priori ROI Analysis

In accordance with prior literature and research, I believe that the text-based advertisements will result in higher levels of persuasion for participants compared to the video-based advertisements. Specifically, I expect that, when I contrast the cognitive

results from text ads with the cognitive results from the video ads, I will find that text activation is significantly stronger in the MPFC than all other regions, demonstrating that text ads activate the region of the brain most commonly associated with persuasion. I also expect that I will find increased activation in the pSTS and bilateral TP regions during this analysis as well, as these regions are also associated with persuasion.

I also expect that when subtracting the text cognitive results from the video cognitive results in order to find where video activation is stronger than text activation, I will observe that the precuneus is more strongly activated than all other regions, as this was observed in prior experiments that measured video advertisements. However, I do not believe that the activation in the precuneus will be as strong as the activation in the MPFC, observed in the opposite contrast analysis, because I do not believe that video ads will elicit the same amount of persuasion or neural activation as the text ads.

Finally, in the fourth and final contrast analysis, which looks only at participants who chose to purchase a product, I believe that I will find the same activation differences as in the third contrast analysis but that the MPFC, pSTS, bilateral TP and precuneus will be more strongly activated in each analysis than in the previous contrasts. Since this condition includes only participants who were successfully persuaded by the advertisements they viewed, I expect to see the strongest levels of activation in the identified persuasion regions and the strongest differentiations between activation in the areas activated by text ads and those activated by video ads. These neural results will correlate with the behavioral results and demonstrate that stronger levels of activation in the specific neural regions associated with persuasion can predict real-life purchasing behaviors.

VI-H: Discussion

The success of any marketing campaign can be directly measured through the way in which it translates to real-world market outcomes. However, much of consumer neuroscience literature revolves around hypothetical research and theoretical inquiries. As such, I chose to conduct an experiment that integrates academic and abstract findings from within consumer neuroscience with concrete and real-world applications to marketing practices. In order to do this, I sought to use neurophysiological tools along with self-report measures in order to test the effectiveness of text and video advertisements in terms of their persuasive appeal and to show the value of neurophysiological data. Specifically, I wanted to shed light on the differences between print and digital advertisements by focusing on why print ads might be more effective, paying attention to how each ad type is likely to present information to consumers. My hope is that this information can be leveraged to better understand the affective and cognitive processes that arise in the face of different advertising techniques. These findings should eventually be integrated into further research that will shed light on how marketers can leverage other human neural networks in order to create more effective advertisements.

The main findings of this study will reveal that, despite many popular opinions as well as a global industry tend that favors digital video advertisements, text-based ads are more persuasive in causing consumers to make purchase decisions. Additionally, these results will indicate that activity in the predetermined neural regions associated with persuasion can clearly predict the effectiveness of an advertisement in terms of real-world consumer decision-making whereas self-reports cannot as accurately predict behavior.

From this research and the research conducted by many others in this field, it is clear that self-reported data can be influential in inferring about behavioral information at the processed-response level but fails to provide a complete assessment of a given construct, as most of human reactions and impulses arise from a subconscious level and can only be measured neurologically.

These proposed findings suggest a powerful role for non-digital advertisements in such a hyper-digitized world. While advertising industry trends show that more and more digital advertisements are incorporating video-based messages, this experiment shows support for the superior persuasive appeal of text-based messages, which could potentially be one key reason why print advertisements are empirically shown to be more persuasive than digital advertisements. By tapping into the inherent and primarily subconscious neurological mechanisms and processes that trigger action through persuasion, text-based advertisements seem to be more effective in persuading consumers to make purchase decisions. As such, in order to capitalize on advertising efforts, marketers should be sure to not renounce all printed and other text-based advertising efforts but instead find ways to successfully implement such efforts in a technologically advancing society.

Last, the proposed experiment suggests that there is a substantial differentiation between the information available through self-reported measures and that obtained through neurological data. Results gathered through neurological measurements allow us to predict the behavioral efficacy of a persuasive message above and beyond what participants' own self-report measures could predict. This indicates a major step forward

in our understanding of psychological and neurological responses, which can be used to forecast actual behavior that may contradict self-reported attitudes.

VI-I: Limitations/Future Research

Although this study argues that print ads might be more persuasive than digital ads due to the fact that they portray content through text rather than video messaging, there are various other components of print advertisements that could also correlate to their increased persuasiveness besides the format of content employed. In fact, one of the key features of print advertisements that set them apart from digital ads is their physicality. Prior research has demonstrated the significant value of integrating an individual's sense of touch with marketing strategies, showing that such sensory stimulation is directly correlated with a consumer's motivation to act ("Canada Post," 2015). These theories argue that the more an individual physically touches an item, the more likely he or she will be motivated or persuaded to purchase that item. In fact, the Canada post exploratory investigation, described earlier, went so far as to propose the integration of other sensory modalities on the marketing process in addition to touch ("Canada Post," 2015). These researchers were the first to integrate additional senses into a marketing model experiment and sought to understand how the accumulation of different senses activate and engage the brain. They found that, for the most part, the more sensory inputs exposed to a participant during the marketing phase of the consumer purchasing process, the more likely the consumer will purchase the product, until the consumer becomes overwhelmed with inputs and the experience turns from positive to negative ("Canada Post," 2015). In all, it is clear that sensory engagement, especially in

the tactile form, works to further engage the consumer in a given ad campaign and is more successful in driving action compared to purely visual advertisements. In light of this research, it is clear that further research should be conducted to measure the different aspects of print campaigns, beyond their text-based format, that lead them to be more persuasive than digital advertisement campaigns.

Additionally, it is also important to consider what type of advertisement would be best in different situations, as text-based or printed advertisements may not always be the most effective way to get a message across. Whereas print advertisements might be more impactful on a local level, digital video-based advertisements are able to cast a wider geographic net aimed at a specific kind of demographic or customer. Additionally, it is often easier for companies to track and analyze their ad effectiveness through digital channels with measures such as CTR (click-through-rate) and others that are aimed at quantifying consumer interest and engagement with advertisement campaigns. As such, it is important for marketers to consider different types of advertisements for different appeals and consider other specialized aspects of print campaigns that might lead to their increased persuasiveness so that marketers can harness that persuasive appeal for future advertising efforts.

VII: Thesis Conclusion

As members of an intellectually and technologically advanced society, we are often influenced by consumer oriented technologies and subtle advertising messages intended to alter consumers' decisions through customized messages tailored to their purchasing habits. However, prior to the advent of consumer neuroscience, little was

understood about how these micro strategies may ultimately appeal to targeted consumers or how effective these strategies can be in influencing purchasing behaviors. Consumer neuroscience has allowed marketers to more effectively deliver messages to receptive customers as well as measure impact in reliably predictive ways.

Consumer neuroscience empowers researchers to directly observe the underlying and fundamental neural processes and biological pathways associated with marketing stimuli and messages in order to form a more comprehensive understanding of how those messages are perceived and processed on a cognitive and affective level. Leveraging novel consumer neuroscience techniques, researchers enable marketers to better characterize and even predict consumers' both conscious and unconscious responses, attentional patterns and neurological activations in order to illuminate insights into target markets and reveal the triggers that prompt customers to react positively to marketing campaigns and advertisements. Moreover, consumer product companies can delve into more sustainable relationships with targeted customers by appealing directly to them on more biologically signature levels not otherwise accessible through conventional methodologies like focus groups and self-report questionnaires.

In this thesis, I reviewed why consumer neuroscience is a natural progression to our increasingly sophisticated understanding of economic and behavioral decision-making as well as why the addition of neurological data to marketing research is not only advantageous but essential in order to form a signature understanding of how individuals make purchasing decisions in response to various promotional stimuli. In addition, I identified and described the neural networks associated with consumer purchasing and addressed prevailing concerns of the field, demonstrating that most of these critiques

relate to the ability for consumer product companies to gain preferential access to consumers' private thoughts and thereby maximize profits by harnessing the subliminal relationships between brain and behavior. However, less cynical interpretations underscore that the insights and data acquired through consumer neuroscience can elucidate vital insights into human behaviors and judgments and allow for more integrative, comprehensive and informative understandings of the neural networks and mechanisms underlying consumer decision-making.

These unconscious and affective influences to the economic decision making processes that are elucidated by consumer neuroscience are important for advancing our understandings of how humans undergo the process of choice. Since the unconscious mind typically processes 11 million bits of information per second compared to the approximately 40 bits of information that is then translated to our conscious awareness, it is abundantly clear that unconscious neural mechanisms significantly affect how we make purchase decisions and must be more fully appreciated in order for us to best comprehend the decision-making process (Ramsoy, 2014). As such, we must rely on physiological signals and measurements to obtain more accurate and unbiased information regarding consumer behavior. Consumer neuroscience enables researchers and marketers to access, analyze and interpret that physiological and neurological data in order to fully understand how consumers respond to marketing stimuli on a neurological level, instead of relying solely on an individual's conscious and thereby biased and insufficient interpretation of their own experiences. The opportunity to leverage the mechanisms behind decision-making through neurobiological methods provides rich diagnostics regarding the neural systems involved in reward behavior, responses to

pricing models, brand loyalty development, emotional responses and memory formation. With more granular knowledge of the neural mechanisms that anchor consumer decision-making, we can obtain an authentic, unbiased and comprehensive understanding of purchasing behavior that extends beyond surface-level insights. Therefore, purchasing and forecasting models can incorporate unconscious and affective processes that significantly affect decisions and marketers can create advertisements that more effectively influence behavior.

Last, I proposed an experiment that integrates the academic and theoretical underpinnings of consumer neuroscience with applicable marketing practices to demonstrate how consumer neuroscience can directly influence advertising strategies and enhance overall marketing effectiveness. Using experiments such as this, we can leverage the insights from consumer neuroscience to constructively inform advertising and promotional strategies with the promise of aligning buyers authentically with product brands and ensuring more enduring and gratifying relationships between companies and customers.

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