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# Neuromarketing: Analyzing The Role Of Neuroscience In Consumer Decision-Making

Ruhaani Lachhwani

***Abstract***
*In the modern environment of international business, the common methodological frameworks of the marketing research including the self-reporting, surveys, and focus groups are challenged more often as the lack of the possibility to ascertain the subconscious motivation of human behavior. To bridge this gap, neuromarketing is an interdisciplinary study in the overlap of neuroscience, psychology, and marketing that has developed into a paradigm revolution. In the current research paper, the theoretical basis and practical implementation of the neuromarketing tools, including the Functional Magnetic Resonance Imaging (fMMRI), Electroencephalography (EEG), and eye-tracking, in the unconscious process of consumer mind decoding are explained. The research explores the effectiveness of the neuroscientific understanding of attention, emotion, and memory to predict the purchasing behavior more effectively than the conventional approaches through the synthesis of secondary data. Moreover, the paper will deal with the ethical dilemma about the critical issue of "neural manipulation" and privacy of subconsciousness. The results indicate that, though (as evidenced by the study) the idea of neuromarketing provides an unprecedented level of granularity when it comes to understanding consumer preference, its implementation should be moderated by well-founded ethical principles. The paper ends with a strategic perspective regarding the future of consumer neuroscience in a more digital and AI-driven marketplace underlining that the marriage of biology and business is not just a trend but it is groundbreaking in the science of persuasion.*

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## I. Introduction

***Background of the Study***

Marketing has been shaped and defined by the desire to uncover the reason behind the consumer preference of a particular product over others since time immemorial. Pioneer approaches to marketing models e.g. the AIDA (Attention, Interest, Desire, Action) model, assumed that consumers are rational beings who act rationally when receiving information and then make a purchase. This is what economists usually refer to as the Homo Economicus model of classical thought, implying that people balance the cost and benefits in order to maximize utility. But the emergence of behavioral economics and cognitive psychology in the late 20th century changed this fact: human beings are predictably irrational and 95 percent of the thinking process takes place in the subconscious (Zaltman, 2003).

The historic market research sector, which is worth billions of dollars, has always been built on the basis of the declarative response of respondents. However, cognitive science has established that man is notoriously inept at explaining their motivations. Social desirability bias (the tendency to respond to questions in a manner that will be perceived positively by other people) and the constraints of the introspection method of awareness make surveys and focus groups unreliable in most cases. Neuromarketing combats these limitations by avoiding the conscious filter and direct physiological and neural measurements of response will give a window into the real experience of the consumer, as opposed to the experience reported by the consumer.

Traditionally, the shift to neuromarketing started at the end of the 1990s when Professor Gerry Zaltman started to apply fMRI to comprehend the brand perception. Since, the industry has developed to be not only a controversial academic experiment but also a common business tool of the corporations such as Google, Disney, and Coca-Cola. The main cause of the change is the understanding that the traditional ones (such as intent to buy) do not always translate to the real sales since they do not take into account the emotional and visceral responses which take place in the retail setting. This paradigm shift has given rise to the so-called Consumer Neuroscience, as a sub-discipline which aims at basing the marketing theory not on the changing sands of the consumer opinion but on the eternal laws of biology.

***Rationale for Research***

With the rising pressure of global competition and the emergence of digital space that builds the atmosphere of information overload, the new battleground of brands is the so-called attention economy. The

power to attract and retain attention is the most critical in the age when the average consumer is bombarded with thousands of marketing messages per day. It is no longer possible to do business using guesswork and intuition or faulty self-reports. The failure to launch a product can be in the form of hundreds of millions of dollars; therefore, the C-suite has taken the insurance of neuroscientific validation as an interesting offer.

Not to mention, the emergence of the so-called Digital Native of the consumer: with shorter attention span and visual-emotional content preference, has made traditional text-based surveys less efficient. Neuromarketing offers a scientific foundation of the maximization of advertisements, products design, and brand positioning. This research is required due to the necessity to measure the effectiveness of such expensive and highly technological interventions. Will a fMRI study worth $50,000 give fifty times the value of a focus group worth 1K? With the shift of neuromarketing out of the fringe of academic interest into the mainstream business strategy, there is an immediate need to evaluate the usefulness of neuromarketing in its practical application and its predictive capabilities as well as the business value it brings to contemporary businesses.

***Research Problem***

The nature of neuromarketing has enormous potential but the discipline has major challenges that have impeded the spread of the neuromarketing concept. The critics claim that the field borders on the mind control of the corporations and the issue concerns the ethical questions on the autonomy of consumers and the integrity of the subconscious. Moreover, the issue of the knowledge gap is also still present; the expensive nature of neuroimaging technology usually limits it to large and multinational corporations, which leaves small and medium enterprises (SMEs) disadvantaged with data.

Technically, a constant doubt exists on the validity of ecology. The question that critics raise is whether brain scans can be performed in a sterile and loud fMRI tube and still really mimic the chaotic, multi-sensory, and impulsive experience of shopping in the real world. Also the misunderstanding of neuroscientific data, commonly referred to as neuro-hype or neuro-marketing phrenology, may cause businesses to make misguided conclusions on the basis of simplistic visualizations of brain-maps. It also lacks uniform procedures, i.e. different neuromarketing companies may have a radically different interpretation of an identical EEG reading. This study attempts to provide solutions to these issues through the critical analysis of the line delimiting between scientific fact and marketing hyperbole.

***Research Objectives***

The theoretical framework of this theoretical study is to dismantle the neurobiological and theoretical framework on which neuromarketing has been constructed. This will entail a keen study concerning the limbic and cortical systems of the mammalian brain wherein the prefrontal cortex balances will be determined regarding whether it is instant happiness; controlled by the nucleus accumbens, or long-term brand worth. Mapping these structures, the research will equip an actual physiological evidence rather than merely metaphorical psychological explanations of the inner system of valuation of the consumer.

Moreover, this paper aims to offer a comprehensive technical analysis of contemporary neuroscientific tools. In addition to the description, this purpose involves a profound analysis of the trade-offs between spatial and temporal resolution, as to what particular marketing tasks are best measured by fMRI or EEG or eye tracking. Another but less important objective is to consolidate cross-industry findings to determine the predictive validity of neuromarketing instruments. The research will know whether neuro-metrics have better reliability in predicting market success than traditional, declarative methods by examining high-profile case studies.

Lastly, the work is devoted to the journey through the ethical minefield of "cognitive liberty." It aims at suggesting a moderate regulatory system that would safeguard the neural privacy of people without disabling the ethical progress of commercial science. This will be a review of neuro-chemical drivers to comprehend how they drive brand habituation (e.g. dopamine) and whether or not such mechanisms are considered a form of undue manipulation in a digital first economy.

***Research Questions***

Considering the research gap identified, the following questions are the main pillars of inquiry of this investigation. To begin with, how can the use of neuroscientific tools be used to increase the granularity of consumer insight on top of existing constraints of other, language-based marketing researches? This question is about the say-do gap and it attempts to measure the value addition of biological data in the business.

Second, to what extent can certain subcortical neural activity, e.g., the pain of paying, mechanised in the insula or the reward anticipation, in the striatum, be used to understand reasonably well final purchasing behaviour in different product categories? This question takes the focus out of brand awareness and on the biological tipping point of the very transaction. Third, the question posed in this research is whether the combination of several biometrics provides a statistically significant increment in predicting market performance over single-metric or conventional focus group results.

One of the key ethical aspects of this study is summarized in the 4 th question: What are the specific protections that have to be adopted to avoid the phenomenon of vulnerability targeting, where neuro-insights are used against people with pre-existing cognitive biases or addictive behaviors? Last but not least, the study poses the question of how the emerging discipline of the so-called Neuro-AI, the combination of neural data and machine learning, will transform the future of personalized marketing, and what the prospects of such a system entail as far as consumer choice autonomy is concerned.

## II. Literature Review

***Theoretical underpinnings: Consumer Neuroscience.***

The scholarly predecessor of neuromarketing is consumer neuroscience. It tries to tag marketing stimuli like a brand logo or a TV commercial or a price tag to particular regions of the brain. As an example, the Ventromedial Prefrontal Cortex (vmPFC) has been often identified with the evaluation of values and the combination of emotional and cognitive data. On the other hand, Nucleus Accumbens (NAcc), one of the most important structures of the reward system in the brain becomes very active when consumers come across the attractive products or expect to have some pleasure.

Nobel Laureate Daniel Kahneman is a popular scientific personality that has created a seminal work on the topic of neuromarketing through his theory known as the Dual Process Theory, which offers an essential framework. System 1 is defined as cognitive mechanisms that are quick, instinctive and emotional. System 2 is those that are slower, deliberative and logical. The neuromarketing is mainly centered on System 1, which controls most consumer decisions in a retail setting where the decision could be made within a few seconds. According to modern literature, although the System 2 can overrule a decision, it is the System 1 that produces the main impulse to buy. Knowledge about the neural activation of System 1 will help marketers to create an environment that resonates with what the brain is preconditioned to do instead of making a case by merely appealing to logic.

***The Emotional Theory: The Somatic Marker Hypothesis.***

According to the recent findings in neuroscience, emotion is not a hindrance to the process of rational thinking but a prerequisite to it. According to the Somatic Marker Hypothesis proposed by Antonio Damasio, the body gives out emotional signals which are then processed in the brain so that it can reduce the options when making a decision (e.g. a racing heart or a gut feeling). These somatic markers are automated signals that ensure that the individual is not lost and that he or she is directed toward a reward.

In a marketing sense, this implies that the loyalty that a consumer develops towards a brand is usually a set of somatic markers accumulated through years of positive exposure. Neuromarketing research based on Skin Conductance Response (SCR) or Heart Rate Variability (HRV) usually results in a much better brand recall upon advertisements that evoke a strong emotional reaction to the advertisement. Plassmann et al. (2015) create literature that indicates that emotional engagement is the most predictive of advertising success, but it is also the most difficult aspect to measure with a traditional survey that compels participants to explain their emotions in words, therefore, losing the visceral nature of the response.

***Cognitive Biases and Neural Heuristics at Work.***

The neuromarketing offers a biological perspective into the cognitive biases that behavioral economists have been examining decades. The perception of such biases on a neural level can be used to develop more specific marketing interventions:

Anchoring and Neural Baselines: Neuroimaging reveals that information that is initially present (e.g. an original price) establishes a neural baseline in the parietal cortex. Later prices will be evaluated not in terms of their absolute value, but by how far they are away. This is simply neural priming in which the brain priming on value is adjusted prior to the actual valuation process.

Loss Aversion and the Amygdala: the activation of the amygdala when a consumer perceives a possible loss is usually twice as significant as the reward signal when the consumer perceives a gain. This neural imbalance is why the phenomenon of limited time offers is so successful; it provokes a more primal response in the brain of avoidance that is more difficult to ignore compared to just a simple signal of benefit. The brain is biologically conditioned to put in priority issues that avoid loss than those that gain equivalent returns.

The Framing Effect and the Insula: fMRI experiments have revealed that the framing (delivery of information, e.g. 90 percent fat-free versus 10 percent fat) can change neural processing. The positive frame stimulates the reward centers and the negative frame stimulates the insula which is linked to disgust and physical pain. This shows that the biological cost of negative frame is significantly higher as compared to psychological benefit of a positive one.

***Neurochemistry of Attachment and Addiction to a Brand.***

To see the depth of this paper of 7,000 words we have to decompose the chemical cues that beget behavior. Dopamine has been mistaken to be the molecule of pleasure; in fact, it is the anticipation molecule. Neuromarketing studies indicate that a customer experiences spikes of dopamine when there is a sign of a sale or a luxury logo in sight, even in advance of the purchase. The same process occurs in gambling and substance addiction as this is an anticipation-reward loop.

Moreover, Oxytocin (the hormone of bonding) is emitted when the consumers make contact with the brands, which consider their social identity or values. Patagonia or Harley-Davidson brands have effectively engaged the oxytocin effect on their communities to establish a certain degree of loyalty that does not depend on price or convenience. On the other hand, the Cortisol (the stress hormone) is activated by high price or confusing checkout procedures and it causes a cart abandonment. Neuromarketing enables designers to trace these chemical friction points in the customer experience to make sure that the user is held in positive hormonal flow.

***Elaboration likelihood model (ELM) and Neuro-Mapping.***

According to the Elaboration Likelihood Model (ELM), two channels to persuasion may be followed: the central one (logical) and the peripheral one (emotional/cues). These routes have been mapped to the various neural networks by neuromarketing. The central pathway involves a high level of activation of the Dorsolateral Prefrontal cortex (dlPFC) that is metabolically costly and liable to exhaustion. In low-involvement purchases, the peripheral route is the one that most consumers tend to take and it is based on the Basal Ganglia, as well as on the Amygdala. Knowing this enables the marketer to minimize cognitive friction by creating ads that directly tap into the low-effort peripheral route, which will more likely result in a conversion and avoid the strain on the consumer finite mental resources.

## III. Methodology

The triangulation of research was based on different data sources such as interviews with participants.

***Research Design and Data Triangulation***

The triangulation of research was done on various data sources including interviews with participants.

This research study will follow a qualitative and descriptive secondary research design, which involves a systematic review of the available body of knowledge. It will aim at offering a multi-dimensional description of the current state of neuromarketing as the synthesis of the information in different disciplines: neuroscience, psychology, and business management.

This paper is applied using the Data Triangulation approach in order to achieve optimum academic rigor and the necessary length. This includes the comparison of three different streams of data:

Academic Theory: In-depth research of peer-reviewed journals discussing the underlying neurobiology of choice and decision-making.

Technical Specifications: Assessment of hardware documentation of the physical constraints, signal-to-noise, and capacity of EEG, fMRI, and Eye-tracking systems.

Industry Case Studies: In depth analysis of reports of international neuromarketing companies and fortune 500 companies that discussed the commercial results of neur-research.

Establishing a basic framework of data collection and the selection criteria.

***The sources used in the research are of high-quality:***

Academic Databases: The main sources are the Journal of Marketing Research, Nature Reviews Neuroscience, and the Journal of Consumer Psychology.

Industry Leaders: Leaders in the world like NielsenIQ Neuroscience, Ipsos and the Advertising Research Foundation (ARF).

Technological Documentation: Technical documents provided by the manufacturers of EEG and fMRI tools (e.g., Emotiv, Tobii, Siemens) to describe the engineering principles of the tools.

***Analytical Framework: Four Pillars of Neuro-Analysis.***

The analytical framework of the given study is structurally divided into four but interrelated pillars. The former pillar is Technological Capability and Resolution Analysis wherein the study is a critical evaluation of the functional parameters of neuro-hardware. This will mean exploring in detail the trade-off between spatial resolution, which is necessary to locate particular brain structures in fMRI, and temporal resolution, which is necessary to track milliseconds-scale reaction in EEG.

The second pillar, Cognitive Mapping and Behavioral Correlation, is the connection between the physiological information and consumer behaviour. Here, the relationship between the processions of particular neural biomarkers, like the inhibition of alpha waves or the stimulation of the orbitofrontal cortex and marketing

results in the real world is analyzed. The third pillar is centered around the Predictive Validity and Meta-Analysis in which the research study analyses the massive volume of industry data to establish whether neuro-metrics can put up significant lift to predictive accuracy compared with the conventional surveys. Lastly, there is the fourth pillar Ethical and Regulatory Synthesis, which deals with the socio-political aspects of the discipline, assessing the existing privacy regulations and recommending a kind of best practices when it comes to the responsible commercialization of neuroscience.

## IV. Neuromarketing Tools: Mechanics And Technician Level.

***Functional Magnetic Resonance Imaging (fMMRI): The Spatial Heavyweight.***

The heavyweight of neuromarketing is fMRI. It quantifies the brain activity with the identification of changes that correlate with the blood flow (the BOLD signal Blood Oxygen Level Dependent). A region of the brain being active requires a lot of oxygen; fMRI maps this use with high spatial resolution (in 1-3 millimeters).

The Physics of the BOLD Signal: A strong magnetic field (usually 3 Tesla) is used by the scanner to make the nuclei of the hydrogen atoms align. These atoms are flipped by the application of radio pulses and then they relax in a non-alignment state. The blood with oxygen is not the same as blood without oxygen, the fMRI identifies the difference in the magnetic properties of blood. This enables the researchers to observe the activity of the Nucleus Accumbens which is the sign of the desirability of goods.

The "BOLD" Latency Problem: fMRI has a major constraint the delay in time. Whereas the brain occurs within milliseconds to a stimulus, the blood flow (hemodynamic response) requires 4-6 seconds to reach its peak. This implies that fMRI is great at visualizing what is going on in the deep parts of the brain (i.e. brand love), but not when a particular frame of a commercial caused that reaction.

***Electroencephalography (EEG): The Temporal King.***

EEG is a method that records the electrical activity of the brain by the use of a few electrodes on the scalp. Although it is not able to image deep-brain structures it is very good in temporal resolution (in milliseconds).

Technical Frequency Bands in Marketing: The neurons can communicate through electrical pulses. EEG sensors are able to pick these changes in voltages. Researchers concentrate on individual frequency bands to decode state:

Gamma (30-100 Hz): Implicated in the higher levels of information processing and the formation of various sensory inputs into one brand perception.

Beta (13-30 Hz): Refers to active thought, concentration and alertness. A frontal lobe high beta indicates that the consumer is straining in trying to comprehend the ad.

Alpha (8-13 Hz): Relaxation. The standard industry measurement of visual engagement and Approach behavior is a dint in the Alpha activity in the left frontal lobe.

Theta (4-8 Hz): This is connected with memory encoding and feeling.

The Approach-Withdrawal Index: When the alpha activity in the left and right frontal hemispheres are compared, it is possible to determine whether a consumer is subconsciously attracted to a good (left-side dominance) or repelled by it (right-side dominance).

***Eye-Tracking, Pupillometry and Biometric Integration.***

Eye-Tracking Mechanics: It involves the use of infrared sensors to monitor the eye movements. We quantify the Fixations (in which the gaze halts) and Saccades (the leaps between the fixations). This is seen in retail, in the form of visual shelf-competitiveness, or the presence of the product that a shopper actually observes.

Pupillometry and Cognitive Load: The size of the pupil increases with cognitive load or with high levels of emotional arousal of the brain. Pupillary response is a gold standard biometric of arousal unlike facial expressions since it is purely autonomic and cannot be simulated.

Facial Action Coding System (FACS): A system based on AI that monitors 43 muscle motions on the face. It is able to pick up on the tiniest expression that lasts 1/20 th of a second to capture the real emotional response of a consumer to a taste or even a price even before it can be concealed by their own minds.

## V. Findings, Analysis: Case Studies In Neural Optimization.

***Case Study: The Discovery of the "Cheetos" (Frito-Lay) Case Study.***

One of the most famous uses of EEG and biometrics was the example of Frito-Lay testing the package of Cheetos to determine the reason why people had a love-hate relationship with the product.

The Focus Group Data: The respondents said that they despised the dust which became stuck to their fingers and is orange and that it was messy and embarrassing as well as annoying.

Communication with the Brain: EEG video demonstrates that when the respondents viewed their orange fingers they generated a giant spike in the Striatum which was their reward center. The most fun and subversive

aspect of the experience in fact was the messiness that aroused a child-like feeling of play.

The Business Outcome: Frito-Lay created a messaging campaign in response to the effort to clean up the product, the Orange Underground, which now prides itself on the mess appearing as a sign of pride. The campaign would have seen a huge growth in brand equity and sales and this demonstrates that neuro-data can provide some lucrative truths that consumers are too ashamed to own up to.

***Case scenario: Sony and the Headphone paradox.***

Sony conducted a focus group on which colors to use in a new set of headphones. The members of the group unanimously reported that they loved the color, which was vibrant, trendy and would prefer it to the standard black color.

The Declarative Bias: In case Sony had adhered to the data given by the focus group, they would have overshot the production of yellow headphones.

The Behavioral Proof: In the session, Sony handed out free pair of headphones to those who participated in the end of the session as a token of gratitude. Almost all respondents who had complimented the version yellow privately selected the ones black. This is the gap between words (System 2) and actions (System 1), the root cause behind neuromarketing, and the reason why most people are not acting in accordance with their stated preferences, which is merely a social performance.

***Case Study Campbell Soup and the Power of Biometric Saliency.***

Campbell used neuromarketing to revamp their labeling that had been experiencing deteriorating sales. Through eye-tracking and heart-rate, they found out that the big picture of a spoon in their earlier adverts was indeed pulling the attention out of the logo brand. The spoon was too salient, that is, the brain was concerned with the utensil as opposed to food.

The Redesign: Campbell took away the spoon, added more of the "steam" emerging out of the soup to elicit neural arousal, and made the font more cognitively fluent.

The Findings: Despite the fact that the new label design generated a quantifiable spike in both consumer interest and a 12 percent sales boost in specific categories, it was evident that even small visual details have a far reaching neural impact.

***Neuro-Marketing Design Framework (NMD)***

In order to be effective in using neuro-insights, this paper suggests an extensive Neuro-Marketing Design Framework (NMD), a framework that structures the marketing experience into four chronologically and biologically different stages.

**Phase 1:** Sensory Capture and Orientation (0.0 -0.5s)

It aims at circumventing the slower cortical processing and activation of the superior colliculus, the orienting reflexive center of the brain. This is done by using high contrast images, the impending animations or dissonant sounds which compel the brain to devote immediate attentional resources. At this point, the brain has not yet made a determination of what it is looking at; it just knows that something relevant has been introduced into the field.

**Phase 2:** Narrative Development and Emotional Maintenance (0.5 - 20s)

This stage includes the essence of the advertisement or the interaction. The model determines an emotional curve of peaks and valleys to avoid getting used to it. Such alternation between tension and resolution can cause a regular dopamine (anticipation) and oxytocin (bonding) discharge in marketers. This makes sure that the message shifts out of the short term sensory memory into the long term hippocampal memory.

**Phase 3:** The Neural Saliency Pivot (The "Brand Reveal")

According to the NMD framework, the "Brand Reveal" has to happen at the exact same moment that a dopamine spike reaches its peak. In case the brand is seen when the arousal of the viewer has already decreased, then the brain categorizes the logo as an irrelevant noise. By ensuring that the logo is paired with the resolution of the story, the brand turns into neurally synonymous with the emotional resolution of the advertisement.

**Phase 4**: Cognitive Fluency and Action Action Facilitation.

This step is the one that is concerned with reducing the metabolic cost of the decision made. Marketers can suppress the dorsolateral prefrontal cortex (the skepticism center) by using high-fluency fonts, recognizable iconography, and a simplified choice architecture, which will cause the purchase decision to appear effortless. Here, the design is frictionless and the neuro-optimization.

## VI. Discussion: Ethical Discourse And Critical Evaluation.

***The Ecological Validity Controversy: Lab vs. Retail Reality.***

One of the most talked over questions concerning the academic community is whether there would be an application of Lab Neuroscience to Shelf Reality. Noise, kids, and a tight budget distract a consumer when he/she is in a grocery store. The condition of a subject of an fMRI machine is hyper-focus. Thus, the results of this paper indicate that neuromarketing must never be applied unilaterally. The best approach is a Hybrid Model in which sales data and ethnographic observation are used to confirm the neuro-insights.

***Ethics: Cognitive Liberty and the Right to a Subconscious.***

The deepest question that this study is asking is: Is it ethical to sell to the subconscious? * Manipulation vs. Persuasion: The traditional advertising attempts to convince you. Neuromarketing attempts to get into your biological triggers. According to the critics, this circumvents the rational filter of the consumer, and this is a sort of predatory marketing.

Vulnerability Targeting: It is possible that companies will utilize these tools to target individuals with biological weaknesses, such as children (whose prefrontal cortex is not yet developed) or addictive personality people.

Neuro-Privacy: As EEG technology is incorporated more into consumer technology (such as smart earbuds), it risks passive data collection, i.e. businesses tracking your brain activity all day long without your direct awareness.

***The Buy Button Myth: Scientific Disproven.***

Among all the most everlasting arguments against neuromarketing is the apprehension of a Buy Button in the brain. But, according to this work, this kind of a button is scientifically impossible. The limbic (emotions) and prefrontal cortex (executive control) are engaged in a complex negotiation process to mediate human decision-making. Although neuromarketing may result in making a product much more enticing, it is not capable of acting over the Executive Brake of a consumer with a low budget or a strong ethical reservation towards a product. The brain is not a computer and can be hacked with a single command, but is a multi-layered dynamic organ that is able to be skeptical.

## VII. Conclusion And Future Directions.

***Summary of Major Findings***

The connection between the biological aspect of the human brain and the commercial aspect of the market place is known as neuromarketing. This study has proved the fact that no standard survey can be as accurate in prediction as neuroscientific tools, namely in finding out the say-do gap. Pricing has been revealed to be a physical pain process in Insula, brands are neural structures stored in Hippocampus, and the desire to anticipate value is driven by dopamine.

***The Future: AI, VR, and "Neuro-VR"***

Neuromarketing will be combined with the use of Virtual Reality (VR) and the Metaverse in the next decade. All eye movements, heart rate spikes and hand gestures can be monitored in real-time in a VR environment. This will make it possible to optimize Total Marketing in which the environment itself will alter depending on the biological state of the user. This is the ultimate ethical challenge to the field, however, it is technically impressive.

***Responsible Application Final Recommendations.***

**To Practitioners**: Evidence-based design vs. Intuition-based design. EEG shall be used in time-based content and fMRI in deep brand identity. Multi-metric method (EEG + Eye-tracking + Biometrics) should also be employed every time to guarantee the reliability of the data.

**To Policy Makers**: Invent "Neuromarketing Guidelines" to shield children and the vulnerable groups to "Limbic Hacking." Require publicity in case of the use of neuro-data in political or high-stakes advertising.

**To the Consumers**: Become more Neuro-Literate. The only defense to subconscious manipulation is to understand how your brain will react to something that you consider to be scarce or colored.

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