

Neuromarketing: Methodologies of Marketing Science

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Abstract— Studies of neuromarketing passed a decade, finding the insights and decision making process has not changed overnight. In our research, we have found that traditional marketing research has been failed, whereas neuromarketing as a contemporary issue going made an evolutionary history. Different methodologies are now being used to get the hidden unaware subconscious mind what is not possible by the conventional marketing research. We have shown the neural process how the human brain works in different techniques. In this paper, we described the application of several techniques and the pros and cons of different methodologies that are studied pre-dominantly. Literatures indicate that tools have the potential to provide valuable consumer insights and can develop marketing research. Ethical dilemma and privacy issues are always concerning with the application of the techniques but it's the beneficial for the marketing decision maker. The studies close by conclusionary reward and anticipate the needs for the evolution of this field.

Keywords— Neuromarketing, Marketing, Methodologies

I. Introduction

Neuroeconomics is a relatively new transdisciplinary field, which developed out of Neuroscience. This burgeoning discipline analyses our brain activity when we calculate risks and evaluate rewards, and utilizes brain-scanning technology to study how people make decisions, evaluate personal choices and even decide which products to buy. As a result of combining neuroscience (Reimann et.al.,2011) with marketing, neuromarketing arises as a relatively new research discipline, it has now become an obvious factor that will become a "key to success" of the marketing in future. Taking advantage of advances in technology, this emerging field goes beyond traditional tools of quantitative and qualitative research, focusing on consumer's brain reactions in front of marketing stimuli.

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By studying and understanding these subconscious and emotional areas of the brain, marketers and advertisers can make informed decisions on what people like, don't like, want, need, fear, are bored by, excited by and so on to alter products and messages most likely to appeal to consumers. Unlike traditional market research, neuromarketing removes subjectivity and the potential for a test subject be inarticulate, indecisive or untruthful in reporting. It bridges the traditional research with contemporary methodologies. Instead of opinion, neuromarketing measures by attention level, emotional engagement and memory storage. Consumer neuroscience as the study of the neural conditions and processes that underlie consumption, their psychological meaning, and their behavioral consequences (Lee et.al,2007) that were not possible to get by conventional research approaches. Technical instruments, mostly used in medicine and machines are used in neuromarketing studies. This paper analyzes each instrument's advantages and drawbacks from a neuromarketing study perspective. Neuromarketing measures responses of the consumer's brain to advertising messages using neuroimaging tools such as electroencephalography (EEG), magnetic resonance imaging (fMRI) or magnetoencephalography (MEG), so methodology has raised ethics issues concerning privacy. In neuromarketing latest advanced technologies are used for brain scanning to learn more about the mental processes behind customer purchasing decisions and help to match the products.

II. Background of the study

Neuromarketing is a more applied field concerned with the application of brain scanning technology to the traditional goals and questions of interest of the marketing industry. For each brain area, the signal during the task is compared to the signal at rest; those areas of the brain with stronger signals during the task are presumed to be processing the information. These studies offer us a glimpse into exactly what these new technologies are being adapted for and how they are being applied, which is more often than not, for the sole purpose of marketing products to consumers. Study of marketing is fully related with human psychology and science. The purpose of the current paper is to make a bridge in between traditional research and neuromarketing techniques, review the relatively new alternative techniques used in neuromarketing research.

III. Literature Review

Neuromarketing is the science of understanding consumer psychology. By practicing the use of different technologies to measure the activities of brain of consumer to discover how people are responding to products and different marketing stimuli. The goals of neuromarketing studies are to accrue relevant information about the inner workings of

the brain. Neuromarketing identifies a very significant fact, namely that, as a rule, decisions are taken by the customers from mental, emotional and instinctive level (Boricean, V., 2009).

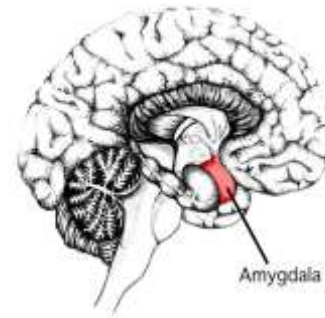
As a branch of cognitive science, neuromarketing relies on the ability to visualize how the brain captures the choices and makes decisions, and provides snapshot images of brain activity at crucial moments of retail choice. Moreover, it is the process of implying the use of imaging technology (positron emission tomography- PET, magneto encephalography- MEG, functional magnetic resonance imaging- FMRI, and electroencephalography -EEG, ET-Eye Tracking) in order to quantify emotions and record reactions of the human brain to different stimuli such as sound, smell, images, touch, taste and others. Scientific researchers in this field have sought to better understand the decision-making processes of individuals rather than the conventional research approach. In that way marketers claim that it can predict whether a product or a campaign will be successful through experiments using imaging technology on customers, recording their brain signals and activation. By using Mindmetric's of neuromarketing technology, we can easily understand consumer's reactions that help to get the desired consumer response (Email Wire, 2009). By using neuromarketing techniques, researchers are able to uncover the hidden from people that they do not know what to reveal and what exactly influences on their decision making, even the things that are unaware to them.

A brief review of literature on neuromarketing shows that the issue is presently studied and practiced with many dimensions to find out the inner information of market. Several comprehensive studies have been conducted to depict the issue more vivid. The purpose of the current study is to identify and introduce the new alternative techniques of marketing research by applying neuroimaging or bio-signal analysis that helps conventional research to get more information about customer's decision making approach and insights of a customer.

IV. The Neuro-anatomy of Brain

Finding out the brand preferences and customers product choice were the cornerstone target for neuromarketing researchers. It's the combination of consumer behavior and criteria for signaling process. Human brain is the center house of human functioning which combines with thousands of anatomic components.

A central component of the human motivational systems is the amygdala which is an umbrella term for a functionally and anatomically heterogeneous collection of nuclei that reside in the superomedial (situated above and at/or toward the midline) aspect of the anterior temporal lobes. The dense reciprocal interconnections that convey information to and from a wide variety of neural areas ensure that the amygdala is well situated to play an important role in the computations that underpin the perception of reward within market exchanges.



Amygdala, responses on all types of rewarding stimuli : watching and enjoying a favorite program, drug administration, smell, view of a smoker how they pick of cigarettes of his favorite brand, hearing and listening a music, receiving money, aesthetic judgments , evaluation of a sports car , or physical and sexual stimuli. The basolateral amygdala responds to more than just reward perception, but to the stimuli that predict the occurrence of a reward as well.

Some studies indicate that the amygdala is active in correlation with the intensity of a stimulus (Caldu and Dreher, 2007). Amygdala elicits an autonomous response through vagus nerve which accompanies the motivation to reward . The various nuclei constitutes the amygdala are defined according to the particular functional criteria, but it is generally agreed that there are two main clusters, older and smaller , corticomедial group and the basolateral group (Aggleton et.al. 2000). Visual input with an affective component, an advertisement, is projected from the occipital cortex to the ventral basolateral nuclei of the amygdala which in turn projects to the dorsal corticomедial group.

Paul McLean, a neurologist, suggested a model of the human brain composed of three imbricate (Cořirlea D.,2011) structures each specialized for certain functions:

1. *The R complex (reptilian) or the primitive brain* – known as the 'basal brain', 'archipallium', 'root brain' the R-complex consists of structures of the brain stem such as the medulla, pons, cerebellum, mesencephalon, the oldest basal nuclei - the globus pallidus, olfactory bulbs and basal ganglia, the reticular activating system and the midbrain controls the body and decides very quickly the strategy that must be used (act, withdraw or wait) in order to ensure the satisfaction of the basic needs (physiological, sexual, security and defense of territory, etc.).It it has several activities to find out the human expression (David Icke,2000), these are:
 - personal day-to-day rituals and superstitious acts
 - obeisance to precedent, as in legal, religious, cultural, and other matters
 - responding to partial representations (*coloration, "strangeness," etc.*), whether alive or inanimate
2. *The limbic system or the emotional brain* – Limbic system refers to the emotional circuits of the brain. It associated with emotions, feelings, attention, general attitude, wonted memory, immunity and hormonal balance, relationships with others; its decisions refer to

the pleasure or annoyance that we associate with that particular situation.

3. *Neo-cortex or rational brain* – analyses and solves problems, uses language and logic, builds rational memories (like the information learned for an exam) and drives creative thinking; its decisions regard compliance to rules and previous experiences, to beliefs and personal values, to self-image.

Basically, each of these three parts plays some particular role: the neo-cortex (rational brain) works for *thinking*, the limbic system (emotional brain) *feels*, and the reptilian brain *makes decisions of any situation*.

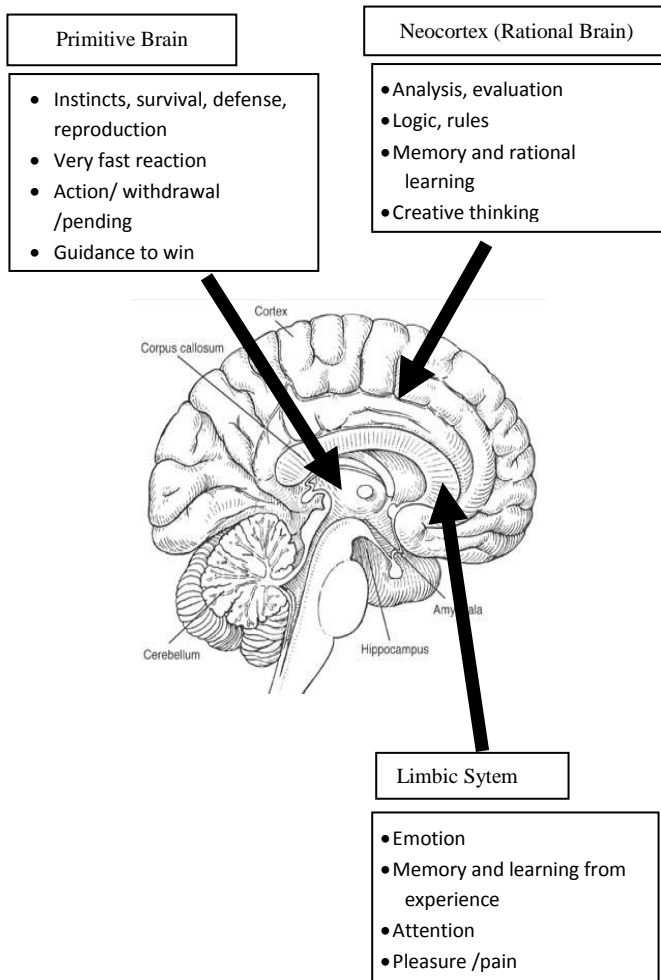


Figure 2: Model of human brain suggested by Paul McLean (Dragolea L. and Cotirlea D., 2011)

v. Neuromarketing Techniques

A young discipline the theoretical, empirical and practical scope of neuromarketing is still being developed. In order to test the effect of marketing stimuli on the consumer's brain neuromarketing techniques are widely used and help the traditional marketing research. Advances in brain imaging techniques are also used in neuromarketing research. Methodologies are described below:

A. *(Functional) Magnetic Resonance Imaging:*

Functional Magnetic Resonance Imaging (fMRI) has become popular from the last decade; it combines magnetic field and radio waves, producing a signal that allows viewing brain structures in detail. Prospect lies on a bed, the subject head surrounded by a large magnet which causes the atom particles (protons) inside the subject's head to align with the magnetic field. When a certain brain area is active, corresponding blood vessels dilate and more blood rushes in, reducing the amount of oxygen-free hemoglobin and producing a change in the magnetic field in the active area (Williams, 2010). A computer screen allows viewing this change, displaying colored areas overlapping the grey-scale image of the brain and refreshing the image every 2 to 5 seconds. This signal that is changed is called *BOLD signal* - Blood Oxygen Level Dependent signal.

fMRI helps us to measure: memory encoding, sensory perception, valence of emotions, craving, brand recall, brand preference, trust, brand loyalty, understanding of advertising, it guidelines on experimental design (task specification, design specification, planned comparisons), data acquisition (image properties), data pre-processing (general, inter-subject registration, smoothing), human subjects (details on subject sample, ethics approval, behavioral performance), statistical modeling (general issues, intra-subject fMRI modeling info, group modeling info), statistical inference and images or table. fMRI usually uses for testing new product performance, new campaign performance, preparing new advertising, lucrative packaging design, product pricing, market needs, positioning and repositioning the brands.

B. *Electroencephalography (EEG)*

EEG uses for identifying, recording and measuring brain waves produced by cortex, reflecting the positive or negative emotions. It records brainwaves through imaging mental states, such as relaxation (alpha waves), sleep (delta waves), wakefulness (beta waves), calmness (theta waves). Through the advanced technology of EEG by using a portable device which helps to record brain activity in any many circumstances. It measures emotional valence, cognition, memory encoding, recognition, attention, engagement / boredom, excitement, records surface activity of brain wave, decision making mechanism, allow to measure interest of any product. EEG usually used for identifying the key point of advertising or video material, testing and developing advertisements, testing new campaigns, product moment of correlation, in-store experience, testing websites design and usability, testing taglines etc.

C. *Magnetoencephalography (MEG)*

MEG measures the magnetic fields generated by the brain's electrical activity, allowing the potential to measure activity throughout the brain by synchronizing neurons EEG, can indicate the depth of the location in the brain with high spatial and temporal resolution, population neural activity. Magnetic field helps us to measure perception, attention,

attitude and memory basically measurement of extremely weak magnetic fields. Neuro-scientist usually uses MEG when testing a new product, test advertising, identify sensory measurement.

D. Positron emission tomography (PET)

Nuclear medical imaging technique for quantitative measurement of physiologic parameters (Ziegler, 2005) which can change the whole impact and role of Nuclear Medicine. A battery of detectors surrounds the subject's head and traces radiation pulse and identify the object. PET is a nuclear medicine technique which requires the combination of a number of factors before any PET procedure can become an important clinical tool. The factors we consider critical are:

- The necessary radioisotope has to be available on a daily basis
- The combination of a radiopharmaceutical and a patient population for which the PET scan provides significant diagnostic information which is not readily available with other techniques.

PET measures valence of emotions, sensory perception, energy discrimination, and improvements in attenuation correction. It also helps in advertising development and maintaining sequence, testing new campaigns feasibility, product moment of correlation.

E. Transcranial magnetic stimulation (TMS)

TMS is a neurophysiologic technique that allows for non-invasive stimulation of the human brain. TMS uses magnetic induction to modulate the activity of certain brain areas. It uses an iron core, often in the shape of a toroid wrapped in electrical wire, to create a magnetic field strong enough to induce electrical currents in underlying neurons when placed on the head and follows the neural activity. TMS increasingly used for measuring the changes in behavior, getting attention cognition, recognition, attention, and engagement / boredom. TMS has been used to study the causal role of specific brain regions by temporarily taking them 'offline'. It also helps in advertising development, testing new campaigns feasibility, product moment relationship and correlation.

F. Eye Tracking

Eye Tracking (ET) is a traditional area of marketing. Recently people have shown their interest on ET issue. It is a tool for the analysis of visual attention and from the subject. It deals with the psychological significance, and the behavioral consequences. It measures the movement of one's eye relation to his head, pupil dilation, the number of blinks, fixation and saccades, the sequence of eyes shift from one location to another, measure the observation of controlled stimuli at fixed points in videos, photos, and user's interaction in many different marketing issues. ET helps in purchasing decision making.

G. Measuring Physiological Responses

Measurement of psycho physiological indicators is the oldest and simplest technique. Subject's emotional effects, helps to understand the behavior and purchasing decision. Monitoring the heart beat, blood pressure, skin conductivity, stress hormone from saliva, facial muscles contractions researchers can infer the emotional state for each moment and emotional attachment during purchasing. By using this technique it's easy to get the natural behavior of a customer.

H. Implicit association test (IAT)

Implicit association methods have a long history which infers unstated processes and responses, measuring the individual behavior and experience. The approach measures consumers' reaction times or accuracy on tasks that are systematically biased by their reactions to brands or ads and also measures the buyer's attitude. Implicit associations are linked to unconscious automatic attitudes. It's thought that brands have implicitly engaged in specific positive associations (e.g., quality, value, youth, strength, speed, etc.). Such implicit associations may be critical for the consumer's decision to buy.

I. Skin conductance (SC)

Psychophysiological tools (e.g., eye tracking, skin conductance) have recently received heated attention in the social sciences due to their ability to capture information from human body. SC is based on the analysis of subtle changes in galvanic skin responses (GSR) when the autonomic nervous system (ANS) is activated. It measures the emotional states by touching the skin with different measurement techniques. It arouses the responses on different circumstances which can helps to predict buyer behavior.

J. Ethical Issues With Neuromarketing

From the last decade neuromarketing is on the question of maintaining ethics. Human brain is still confusing to get the actual emotion and it's not possible to draw a conclusion. It changes over time. Investigation on understanding human decisions, emotions, action, reasoning and moral issues are going on, but people are getting interest in marketing to use neuromarketing techniques for decision making, so marketers should bring stability and standardization in research. Data manipulation is possible in neuromarketing. Matter of privacy and secrecy is also the question on neuromarketing issue. Sometimes applicable techniques are disregarded by people. So, healthy life for individuals can be ensured by the proper use of these techniques.

VI. Conclusion

Marketers are now using neuromarketing techniques to make the decision regarding marketing issues. Each of the techniques has specific strengths and weaknesses. Have the implication on different issues on different ways. Combination of each technique may provide accurate decision. It will cut more cost to implement all the techniques together. These methods are widely accepted

neural science studies. Marketing researchers can easily get the market condition by using these techniques. Valuable consumer insights come out from neuromarketing.

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