

NEUROMARKETING APPROACH: AN OVERVIEW AND FUTURE RESEARCH DIRECTIONS

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ABSTRACT

Neuromarketing is the embryonic field of marketing science. Despite being controversial, it remains the most promising field to study genuine consumers' responses in front of the marketing stimuli such as sound, brand and so forth. Therefore, neuromarketing aims to study the relevant part in the human termed as 'brain' which is swayed by marketing stimuli. Undoubtedly, the researchers and academia can record and measured the brain activity through using the state-of-the-art neuroimaging techniques such as functional magnetic resonance imaging (fMRI), the electroencephalography (EEG), and other neuromarketing methods. Therefore, the academia and industry are relied on neuromarketing due to the widely acknowledged fact that the majority of our emotions and thinking takes place beyond the level of our awareness, thereby, the consumer purchase decisions are made in the subconscious mind which impact on their daily deliberations. This study reviews and discusses the most important techniques of neuromarketing (e.g., fMRI and EEG) to understand the consumer's brain responses. The findings of this study refer to that neuromarketing is pregnant with valuable information toward consumer decision-making.

Keywords: *Neuromarketing, Consumer Neuroscience, Neuromarketing Technique, fMRI, EEG*

1. INTRODUCTION

Recently, how many times noticed people saying something and doing something else! Of course, many, this is returned to that decision-making of the consumer's brain is complicated, it is not easy to understand it. If the businesses understand our preferences for these goods or services over others, they will not fail to satisfy our needs. Therefore, no one can deny that the majority of our emotions and thinking are made beyond our awareness, as consumers should understand their preferences and the influence of these unconscious processes on our daily deliberations [1]. These days, the academia and the managers of the marketing have an enormously sought to find out what is in the consumers' brain, what they are thinking of, and explore the concealed centres in the brain which lead the consumers to decision-making in order satisfy their needs and desires. This means, marketing has developed from studying consumer behaviour by traditional methods to study the relevant part of the human termed as 'brain', which has become known as neuromarketing [2-4].

Neuromarketing has become renowned through the Bright House company when it has released the first report of establishing a department for using fMRI to conduct neuromarketing researches. Even though the electroencephalography had renowned, fMRI is the most essential nowadays due to that the fMRI provides accurate maps of the brain [3, 5-7]. Traditional marketing methods are often providing not reliable and inaccurate information because it is related to consumer's unwillingness to reveal facts among other flaws [1]. However, neuromarketing overcomes these limitations in the traditional research methods through interrogate the consumer's brain, thereby, it is pregnant with valuable information to solve the marketing issues which the researchers and companies cannot ignore this upcoming field, as it provides more precise information than the conventional methods to consumer's preference [2, 3, 8, 9]. Thanks in advance for neuromarketing to give us the opportunity to decode some information and use it for understanding decision-making in the consumer's brain [1]. According to Sebastian and Sciences [9], Venkatraman, Dimoka [10], Boksem and Smidts [11], neuromarketing and traditional

marketing methods are complementary, the reason turns back to that neuromarketing does not use similar techniques as in traditional methods but it uses state-of-the-art medical technologies to explore what is going on in the consumer’s brain in the front of the marketing stimuli in order to enhance the marketing strategies and the accuracy of the predictions.

Neuromarketing has been derived from several main fields, such as neuroscience, psychology, and marketing [2, 3, 9]. That has encouraged researchers in both academia and businesses to develop various techniques to improve marketing strategies [3, 12]. Neuromarketing initiatives concentrate on understanding the neural complexity, which overlaps with marketing notions as consumers’ responses to marketing stimuli [1, 3]. Neuromarketing is defined as the application of neuroscience in marketing researches, which resorted to using state-of-the-art medical techniques to study the consumer's behaviour [13]. Whereas, neuromarketing is defined as consumer neuroscience [10, 14-17]. According to Nyoni, Bonga [1], neuromarketing is defined as using the neural methods to understand better the consumers’ thoughts with the potential of identifying the 'buy buttons' in the consumers’ brain in order to develop marketing and advertising and make them more effective and efficient. However, most of the studies have defined neuromarketing as a bridge between neuroscience and marketing [5, 8, 14, 18-22]. In addition, neuromarketing gets the differences based on the spatial and temporal resolution [2, 9]. Accordingly, neuromarketing involves a wide spectrum of themes, research cases and challenges. However, neuromarketing methods can be classified into three essential categories (Figure 1) [1-3, 9, 23-25].

- i. Measuring metabolic activity in the brain: This uses state-of-the-art medical technologies such as fMRI and PET to measure the consumers’ brain responses to marketing stimuli.
- ii. Measuring electrical activity in the brain: This method is using magnetoencephalography [26], electroencephalography (EEG), transcranial magnetic stimulation (TMS), and steady-state topography (SST) to measure the consumers’ brain responses in front of the marketing stimuli.
- iii. Measuring physiological responses: this method measures the physiological responses of the consumer toward

marketing stimuli such as eye-tracking, respiration, heart rate, facial muscle movement, blood pressure, perspiration and implicit association test (IAT).

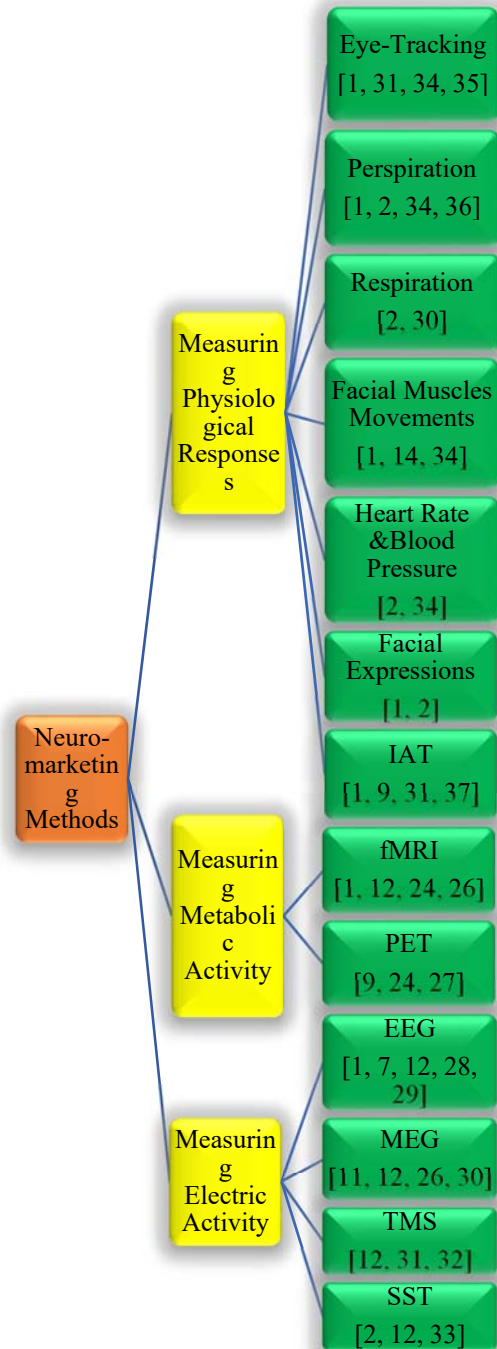


Figure 1: Neuromarketing Methods.

In recent times, neuromarketing survey papers have attracted wide attention [2, 24, 27]. The authors Nyoni, Bonga [1] have discussed the methods of neuromarketing to measure metabolic and electric activity in the brain, and physiological responses and reveals the importance of the neuromarketing, but the authors have not discussed the respiration rate, heart rate, and blood pressure methods. According to Sebastian and Sciences [9], shed light on the measuring methods metabolic and electric activity in the brain, and implicit association test (IAT), besides, eye-tracking but the authors have almost ignored the measuring of the other physiological responses such as perspiration, respiration, blood pressure, heart rate, facial expressions and facial muscles movement. Fortunato, Giraldi [3] briefly discussed EEG, fMRI, MEG, PET, eye-tracking, facial muscle movement (EMG), heart rate (ECG), perspiration (GSR), but the author missed for discussion SST, TMS, blood pressure, respiration, and IAT. Venkatraman, Dimoka [10] have presented an overview of fMRI, EEG, IAT, eye-tracking, heart rate, respiration, and perspiration (GSR), but the authors have ignored the discussion of the other neuromarketing methods such as MEG, PET, SST, TMS, blood pressure, and facial expressions. Plassmann, Venkatraman [6] have discussed a few of neuromarketing techniques but they missed the discussion of EEG, MEG, PET, SST, TMS, and all physiological methods to measure the consumer responses toward marketing stimuli. Smidts, Hsu [28] briefly discussed fMRI, EEG, eye-tracking, perspiration (GSR), facial expressions, sadly they have missed the discussion of the MEG, PET, TMS, SST, heart rate (ECG), blood pressure, respiration, and IAT. According to Heinonen [29], has concentrated on the fMRI method and the author has ignored all other methods to measure the consumer's brain responses in front of the marketing stimuli. Because the author has considered the fMRI as the most promising method to perform neuromarketing researches due to that its ability for localization in the brain. Harris, Ciorciari [7] have reviewed all methods using to measure the metabolic and electric activity methods in the brain, in addition to methods for measuring physiological responses except blood pressure.

Since then, these three genres of measuring the consumers' responses have been considered the main pillars of neuromarketing methods. In a hot research topic such as neuromarketing, many developments quickly come into the spotlight and need to be highlighted in order to provide clear insights for researchers to choose the best solutions that to save companies budget which uses in

ineffective advertisements campaigns [1]. Thus, this review paper is different from the other review papers related to neuromarketing, in that this study gives full consideration to discussing neuromarketing methods, as the study is concentrating on fMRI and EEG, which are considered the most main pillars of neuromarketing applications nowadays, and this study aims to provide an overview of current state-of-the-art neuromarketing practices, in addition to the pros and cons of the most popular techniques as fMRI and EEG. To this end, this study tries to incorporate as many directions into this article as possible. Restricted by size constraints, the hot research topics have been investigated deeply based on their respective sub-domains to achieve a precise, concrete and concise conclusion at the end of this article. The key contributions of this study are summarized as follows:

- Presents an overview of research topics on neuromarketing, including, neuromarketing methods, covering the recent industry development in the main areas of application, challenges, and key players;
- Address several important issues and features for neuromarketing that are considered the top priorities to reduce companies' budget which spends on the advertisement campaigns. Besides, investing that amount of budget in the research and development sector.
- It provides new references to other researchers who need insights into enabling neuromarketing methods.

The organization of this article is as thus; Section 2 presents an overview of the neuromarketing methods such as measuring metabolic, electric activity in the brain and physiological responses, and deeply discussed fMRI and EEG. Section 3 provides information about the future study of this promising field. Finally, Section 4 concludes the work.

2. NEUROMARKETING METHODS

2.1 Metabolic Methods to Measure the Activity in the Brain

As aforementioned, this section will review the neuromarketing methods and concentrate on the most popular methods in this research area as fMRI and EEG due to that both methods are given more precise information to the consumer's brain responses toward marketing stimuli which are impossible in conventional marketing methods. Considering the aspects mentioned, the change is not

always our choice but it is an inescapable fact, and we need to adapt to it to keep pace with it. fMRI and EEG are the most favourite methods for scientists and researchers to measure the consumer's brain responses to products and services. Additionally, there are other methods such as measuring metabolic activity in the brain, measuring electric activity in the brain and measuring physiological responses such as eye-tracking toward marketing stimuli [9, 12, 23, 24, 30], in this study fMRI and EEG methods will be deeply discussed in the following subsections and highlight pros and cons for both methods.

2.1.1 Positron Emission Tomography (PET)

This method reliant on the blood flow in vessels as fMRI, by uses the isotopes of the radioactive chemical which injects into the blood vessels, thereby, if the activity increased in the particular region of the brain, it would increase emission of the radioactive in the blood vessels as a result of the marketing stimuli which conducive to emerge the activity of the particular regions on the monitor more than others [9, 27]. In addition, the researchers can get only one picture in each active minute of the brain which is considered a relatively weak method because needs a long time to measure the radioactive. The drawbacks of these methods are uncomfortable for participants because of radioactive isotopes, too costly, and have poor spatial and temporal resolution [3, 24].

2.1.2 Functional Magnetic Resonance Imaging (fMRI)

fMRI has become the most popular method in Neuromarketing and the most favourite for scientists and researchers [3, 24, 29]. This technique uses a powerful magnetic field and radio waves to measure blood flow in the consumer's brain [29], in order to record a high-resolution image of the active regions of the brain in time when the participants are exposed to marketing stimuli such as sound, brand, and so on [31]. The explanation of how the fMRI works, as follows:

In the beginning, the consumers should lie down into the fMRI tube which uses a powerful magnet surrounded the consumer's head to generate a strong magnetic field in order to measure the active regions in the participants' brain [32]. Then, the consumers have to stay on fMRI tube without any movement or speaking throughout the experiment duration but the responses are only by simple movement of fingers in order to get accurate data of the active regions in the

brain, this instrument is capable to access and record the blind areas and identify the active areas in the brain accurately [2, 3, 29, 33]. It is worth mentioning that fMRI measures blood flow in active regions by relying upon iron atoms in our blood, thereby, the scientists and researcher will present several marketing stimuli (i.e., brand, image, sound .etc.) to the consumer by display screen in front of the consumer, which lead to dilate in the blood vessels in the active regions to receive much more oxygenated blood and glucose, which active regions need it, thereby, the active regions generate stronger magnetic field than inactive regions due to the active regions have an oxygenated blood and glucose more than inactive regions in the brain. As a result of that, fMRI is recording the signals of the active regions and display it on the monitor as dark regions termed blood oxygen level-dependent (BOLD) [8, 9, 12, 27, 29, 34].

fMRI needs approximately 6 to 10 seconds to begin recording the active regions in the brain due to that the blood flow needs nearly 6 seconds to reach the active regions, which makes it has a poor temporal resolution and high spatial resolution [3, 33, 35]. fMRI uses 3D technology to analyze the brain's signals [9, 34], which helps the researchers and scientists to measure responses such as emotions, brand recall, brand preference and so forth [27]. The dominance of fMRI in this field makes several marketing managers and marketing researches considered the researches which based on neuromarketing is neuroscience [12, 36].

Table 1: Advantages and Disadvantages of fMRI

Advantages
<ul style="list-style-type: none"> • Ability to capture the most accurate picture of the brain responses toward marketing stimuli compared with other methods [1, 2]. • Permits interpretation of psychological processes in the consumer's brain [1, 37]. • Excellent spatial resolution accuracy [1, 3, 12, 24, 34], as it records the changes of the brain activity within a spatial resolution of 1-10 mm of deep structures in the brain [1, 2, 17, 24]. • Ability to detect changes in the chemical components or changes in the flow of fluids in the consumer's brain [1, 38], due to that it follows the metabolic activity in the brain [1, 39]. • Uses 3D technology to analyse the brain signals and display them on the monitor [9, 34].

- High ability to record the subtle regions in the brain during consumer choices and consumption experience accurately [1].
- Reliable and valid measurement for affective and cognitive responses [1, 38].
- Available statistical software packages [29].
- Available statistical software packages that allow both preprocessing and statistical analyses [1].

Disadvantages

- Poor temporal resolution accuracy [1-3, 24, 34].
- Highly sensitive to any movement, for example, if the subject moves his head a little bit, it will produce an inaccurate and unclear picture of the active brain regions, and also ban the subject's from speaking or movement inside it [1, 2, 34].
- Noisy machine, although it used the isolation headphone continuously [2].
- The participants cannot stay for a long time inside the fMRI tube, thereby, it is essential to enhance the method to shorten the research time [29].
- It costs the researchers an average of \$1000 per hour and often from 20 to 30 consumers are being scanned. additionally, those consumers are typically staying in the device from 30 to 60 minutes [1, 2, 40].
- High complexity in data analysis, thereby, need to experts and professional staff who know how to analyse and read the brain pictures [1, 2, 17, 41].
- Need approximately six minutes to begin to measure the dynamic changes in the brain regions [2, 17, 33, 41].
- Ethical barriers have raised, for example, an invasion of privacy [1, 38].

2.2 Electric Methods to Measure the Activity in the Brain

2.2.1 Electroencephalography (EEG)

The electroencephalography technique is considered as the most commercially popular technique between academia, researchers and marketing managers due to its being much cheaper than fMRI and does not need a complex environment as MEG to conduct experiments with consumers [12, 42, 43]. Furthermore, Furthermore, electroencephalography is noninvasive technique

measure changes in electrical activity [7, 44], but rather the secondary potentials arising from it [3]. Although electroencephalography has an excellent temporal resolution [3, 24, 29], it lacks the ability to record the distal brain activity, which leading to infer that this technique has a poor spatial resolution [3, 12, 24, 45]. However, this method uses electrodes placed on the scalp of the consumer to measure the active neurons directly [46], which have the ability to record the cortex electrical signals [7], reflecting the positive or negative emotions [47]. Therefore, if it increases the number of the electrodes, it will have the ability to measure the extremely low frequencies of the active signals [2], in addition, this technology is not very expensive compared with fMRI technique and not noisy as well [33, 48, 49].

As well this equipment can measure the electrical frequency termed Hertz (Hz), terms the brain produces approximately 10Hz, terms the frequencies vary as a response of the mental cases which vary over time across different parts of the brain among participants as a drawback [2]. Thus, the researchers can recognize the frequencies which know as Delta, Theta, Alfa, Beta, and Gamma [34]. Delta (δ) is less than 4 Hz which appears in sleeping, Theta (Θ) is between 4-8 Hz which associated with the inner processes, then Alfa (α) is between 8-12 Hz appear with relaxation status [1, 2, 27], whilst Beta (β) is between 13-30 Hz associated with caution and wakefulness, and finally, Gamma (γ) is more than 30 Hz associated with learning, emotions and processing information [2, 42].

Table 2: Advantages and Disadvantages of EEG

Advantages
<ul style="list-style-type: none"> • It has no ability to record the distal regions in the brain during consumer choices and consumption experience accurately [1]. • A valid measure of emotional styles and the detection of psychopathologies [1, 3, 38, 50]. • Data Analysis straightforward [41]. • Relatively simpler in using if it compared with functional magnetic resonance imaging [1, 51]. • Relatively much cheaper and less invasive than fMRI and does not need a complex environment as MEG [41-43]. • It is easy to get it and quiet relatively if it compared with other technologies such as MEG relatively [2]. • Statistical software packages available [17]. • High temporal resolution, thereby, make researchers able to detect changes in brain activity accurately. Terms this technique can

measure the change in the brain at small intervals up to 10,000 times per second [2, 3, 8], connect to rapidly changing stimuli [1, 14].

- Ability to measure differences in the frequencies of electrical activity in the brain [1, 38].
- Allows comparisons between left and right hemispheres [17], measuring left hemisphere dominance related to positive emotional responses or negative emotional responses associated with withdrawal-related tendencies [14].
- Statistical software packages available [1, 17].

Disadvantages

- Ethical barriers have raised, for example, like an invasion of privacy
 - Electroencephalography cannot exceed the neo-cortex structure, thereby, it can only record superficial electrical signals of the active regions in the brain, which make it has low spatial resolution [1, 3].
 - The electric conductivity and the period-time differ among participants, thereby, it is often difficult to regain the precise location for each recorded signal [1, 34, 41].
 - Ability to identifies only if the emotion is positive or negative [1, 51].
 - It needs at least 36 participants to receive usable data, thereby, it costs the companies an average of \$25000 with almost 36 participants [1, 52].
 - Findings are not only influenced by artefacts but also by conventional settings as noted by [1], Wang and Minor [38].
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2.2.2 Magnetoencephalography

Magnetoencephalography (MEG) uses the magnet to measure the active regions in the consumer's brain [46], and this technique reliant on the active neurons in order to generate the magnetic field, in addition to, electric field. The working mechanism of this equipment is generating very small magnetic fields compared with functional magnetic resonance imaging machine [2]. Another interesting point is, this technique is more efficient than electroencephalography [29], but its drawbacks are more expensive and complex than fMRI [12], poor spatial resolution [11, 24, 27], and needs very specific equipment and environment such as very

low temperature almost zero throughout experiment time, and thereby, the researcher depends on the liquid nitrogen to achieve temperatures. As a result of that this technique is not beneficial in the neuromarketing field (Genco et al., 2013; Pirouz, 2004). Furthermore, this technique had not actually measured brain activity, but instead of that, it is measured the secondary potentials arising from it. However, this technique has superior temporal resolution [12, 29].

2.2.3 Transcranial Magnetic Stimulation (TMS)

It relies on high or low frequencies of electromagnetic impulses on the participants' scalp and the researcher can stimulate a particular cortical region by this equipment or deactivate it and the researcher can observe the effects by neuronal activation [12, 48, 53]. Doing this can help researchers to provide positive evidence of the necessity of a given area for a given task, thereby, this allows researchers and scientists to go beyond the simple observation of brain activity in association with a given task, in order leading to infer the causal necessity of a given area of brain activity for the completion of the task [12]. This technique is only used to measure the cortex regions because this instrument cannot exceed the neocortex, instead of deep brain structures as fMRI which makes this technique is not appropriate to the specific neuromarketing researches [12, 34].

2.2.4 Steady-State Topography (SST)

According to Genco, Pohlmann [2], Lee, Brandes [12], Silberstein and Nield [54], Rossiter, Silberstein [55], steady-state tomography technique was pioneered between Silberstein and colleagues in nineties, thereby, this method has used by several studies in advertising researches. Where Silberstein has established a private neuromarketing company named Neuro-Insight, based on this Neuro-Insight company, it able to use this technique to determine the instant changes in the number of consumers' responses toward marketing stimuli, including, the chances of long-term activation of memory, attraction, get closer or aversion, in addition, the arousal of emotion or attention. According to Genco, Pohlmann [2], one of the drawbacks of this technique is the cap which uses to conduct the experiment largely uncomfortable. On the opposite side of the spectrum, this technique has high resistance of eye and body interventions as well as ability to reach the excellent findings when the consumer exposed to mental stimuli in test to

measure the brain's signal which is considered as an advantage to capture the signals resulting from responses of the incentive familiar against the responses of incentive which has novelty and unfamiliar advantage.

2.3 Physiological Methods to Measure Responses

2.3.1 Eye-Tracking

Eye-tracking is a fraction of the conventional marketing field [27]. According to Nyoni, Bonga [1], Fortunato, Giraldo [3], Du Plessis [48], there are several nuances in the eye-tracking to measure the customer responses toward marketing stimuli which encompass explore the movements of eyes, fixation, pupil dilation and the degree of focus. In the same context, pupil dilation with longer blinking period tells us the better processing information. Although the scientists can analyse the distribution time, vision time, pupil dilation, and the influence of catchphrase on the consumers' attention [34, 56], it is not reliable [38], not working good with improper lighting circumstances, consumers with glasses, lenses and long eyelashes [2]. Fees can range from \$5000 for basic readings up to \$65000 for more in-depth research [1, 57].

2.3.2 Perspiration Rate

Galvanic Skin Response (GSR) is a technique to measure the dimensions of the emotional arousal, activity of sweat glands, changes in skin conductance, and event associated with sympathetic activity [1, 58, 59]. According to Nyoni, Bonga [1], Dawson, Schell [60], it is defined as a tentative rise in the electrical conductivity of the skin which lead to increase activity in the sweat glands, terms the skin resistance varies with the state of sweat glands in the skin and, due to that the sweating is controlled by the central nervous system, thereby, researchers are able to get an indication of psychological and physiological arousal.

However, the amount of those glands is the most in the palmar surface of the hands which is measured by GSR and it is a good method for studying consumer decision-making [61]. Previously, the studies have shown that the presented stimulus to the individuals associated with dire consequences, Galvanic Skin Response predicts to happen in expectation of that outcome [2, 62]. Although this method has advantages such as less invasive methods, relatively simple for scientists to obtain data, reliable findings which provide an opportunity for scientists to predict attention and memory [63], the drawbacks of this method are

insensitive to trends or symmetry in response to emotional arousal, thereby, does not measure a specific preference [2, 59, 64], the temperature and humidity can affect the measurements which can lead to inaccurate results, in addition, it is not expensive [1].

2.3.3 Respiration Rate

According to Kumar [46], it is the number of breaths usually taken during one minute, and it is recording the deep extent and speed of the subject's breathing by using the part of the heart rate device placed on the chest. In fact, they found interesting findings, as follows:

- i. Deep and fast breathing is associated with emotional arousal, either positive or negative. While the reverse refers to the happiness or depression.
- ii. Deep and slow breathing is an indicator of the relaxation state. But superficial and fast breathing is associated with anxiety, concentration, and tension.

The breathing is considered the scale of emotions, but it cannot differentiate between positive and negative emotional equivalence [2].

2.3.4 Facial Muscles Movements

Electromyography (EMG) is still not widely used in neuromarketing researches, and this method is recording the invisible of the facial muscle movements [1, 14], which occur as a result of the conscious and unconscious emotional responses to the marketing stimuli [1, 65, 66], through electrodes placed on the mouth muscles (e.g., zygomaticus minor and major) and corrugator supercillii muscle in the forehead [1]. It is considered as a general indicator of the emotional state whether positive or negative [1, 67]. Although the emotional expression interrelated with the inner emotional state, some people exposed to inner emotional state appeared no expression on their faces. Therefore, the scientists and researchers are using very small sensors placed on the target areas in the consumer's face, then connected it with a monitor to record the signals. Nevertheless, there are advantages to this method such as high spatial resolution, growing credibility to analysis various affective reactions. On the opposite side of the spectrum, the drawbacks of these methods are that the electrodes fixed on the face of the consumer may inhibit some facial movements [2, 3].

2.3.5 Hearts Rate and Blood Pressure

Blood pressure and heart rate are interrelated to each other and they are considered the activity side of the blood vessels in humans, and the researchers can activate blood pressure and heart rate through the psychological inputs, including, activate pleasure, memory, emotional arousal and so on. The scientists found that the pressure device is very sensitive to size and place on the subject's arm. For this reason, blood pressure scales rarely emerged in the marketing researches [2, 3]. Accordingly, the period time between each impulse and another is defined as the rate of heart impulse and the rate perhaps decrease or increase based on stimuli. For instance, there is a reflect relationship between heart rate and attention in the short-term, but in the long-term, the heart rate increased when the consumer's exposed to emotional stimuli. Heart rate is considered as a good scale of emotional equivalence, and in several studies have found that the slowing down the rate of heart on short-term associated with positive and negative emotions, but the positive stimuli urge on increase of heart rate in long-term, while, the reverse is true [2, 3].

2.3.6 Facial Expressions

In this method, the scientists and researchers use a video camera to identify and measure the unconscious responses on the consumer's face as a result of the emotional state, in terms measure six core emotions such as dislike, anger, envy, sadness, fear, and surprise, thereby, it is considered as an indicator of the emotional in general [1, 2]. For instance, happiness state is associated with a real smile, but the discontent smile is linked with frustration, this denotes the facial expressions analysis is limited [2]. Although they are subjective in deciding when an action has happened or when it meets the minimum requirements for coding, facial expressions are random, they give real-time data [1].

2.3.7 Implicit Association Test (IAT)

According to Sebastian and Sciences [9], Du Plessis [48], implicit association test (IAT) had proven very fruitful to neuromarketing such as cognitive psychology and looking for the most sensitive of the social aspects. By this method, the consumer's response time at the moment when they hear the name of a brand can be measured [1]. It is worth noting that our brain has the tendency to maintain information in an interconnected structure, thereby, the positive association will be raised by a

positive emotion. Reference to Genco, Pohlmann [2], Sebastian and Sciences [9], Renvoisé and Morin [68], this method is considered as one of the complex methods but give an opportunity to record more precisely the cognitive and emotional responses of the consumer toward marketing stimuli is growing up significantly. Although this method is not guaranteeing only the success but also knowing the decision-making processes, the purchase decision is often swayed by the primitive brain, while the reptilian brain is being responsible for making a decision. Therefore, companies and organisations can make their campaigns and products more efficient [1].

3. FUTURE DIRECTIONS

By neuromarketing they can study the responses of the consumer brain toward marketing stimuli, thereby, establishing positive ads and save half of the company budget which uses in the advertisement campaigns to investing it in the research and development sector in the company [3]. Therefore, neuromarketing researches experienced significant growth lately. Thus, the studies should be concentrated on a positive side of neuromarketing to understand what exactly consumers' needs and consumer aberrations [29]. Undoubtedly, all these genres of experiments have to be controlled by government oversees and consumer protection organisations (CPO) to protect consumers from companies which only looking for profits in unethical ways. Otherwise, we cannot ignore this upcoming field to improve our understanding of decision-making and ban this field for arbitrary assumptions by a few either researchers or practitioners. Neuromarketing companies are encouraged to hold professionalism and also take note of some ethical issues associated with neuromarketing [1]. because this field identifies unfulfilled needs by traditional methods, and solve the marketing issues towards marketing stimuli and paucity customers [59, 69]. According to Kotler [70], the problems that face the business nowadays are not a paucity in products, but a paucity in customers. Thereby, the studies urge the readers and researchers to look beyond the hype and anachronistic assumptions and look towards the positive side of this upcoming field. Hence, scientists and researcher have to use neuromarketing for the sake of improving people's lives, not for their own goals.

4. CONCLUSION

Neuromarketing cannot be taken as a replacement of traditional marketing techniques, because both methods complement each other, but it should be an instrument to understand the consumer's brain as a novel way to analyze the consumer's brain responses towards the marketing stimuli. Therefore, neuromarketing will give more opportunities for researchers and scientists to understand the basics of the decision-making mechanism. It will be the foundation to understand the way in which consumers respond to various marketing stimuli. Using neuromarketing methods uplift researchers' knowledge to a superior level of consumer's behaviour. This paper has contributed to the clear vision toward neuromarketing by critically examining metabolic and electric activity techniques, and physiological responses adopted in neuromarketing.

No one can deny that the majority of researches and companies that using these methods as fMRI, do not distribute the authentic findings, in addition, the results of experiments have manipulated by companies and marketing managers to appropriate their goals. The limitations of this technique are too expensive and need experts, term one participant costs approximately 1000\$ and at least 30 minutes to map the brain activity in front of marketing stimuli. In fact, these methods are extremely important for disabled people who cannot express their needs, also important to reduce the advertisement budget and invest it in the innovation department, and last but not least, appropriate the real need of consumers.

The emergence of neuromarketing should not be taken as a magical stick to target the consumers, but it should be an instrument to help us to dive into the consumers' brains and know what exactly the consumers are thinking of when they faced of product or brand. In this context, there are challenges for marketers to cope with ethics issues of manipulating consumers' data in negative ways. However, this paper is focusing on using this instrument in an honest way by scientists and researchers to better understand consumers, their needs and motivations to provide solutions to daily problems. According to Harris, Ciorciari [7], neuromarketing is still in its embryonic stage, but it gains more credibility and adoption with each study focusing on consumer preference despite its controversial origins.

REFERENCE:

- [1] Nyoni, T., W.G.J.D.R.J.J.o.E. Bonga, and Finance, *Neuromarketing Methodologies: More Brain Scans or Brain Scams?* 2017. **2**(3): p. 30-38.
- [2] Genco, S.J., A.P. Pohlmann, and P. Steidl, *Neuromarketing for dummies*. 2013: John Wiley & Sons.
- [3] Fortunato, V.C.R., J.d.M.E. Giraldi, and J.H.C.d. Oliveira, *A review of studies on neuromarketing: Practical results, techniques, contributions and limitations*. Journal of Management Research, 2014. **6**(2): p. 201.
- [4] Page, G.J.I.J.o.M.R., *Scientific Realism: What 'Neuromarketing' can and can't Tell us about Consumers*. 2012. **54**(2): p. 287-290.
- [5] Fisher, C.E., L. Chin, and R. Klitzman, *Defining Neuromarketing: Practices and Professional Challenges*. Harvard Review of Psychiatry, 2010. **18**(4): p. 230-237.
- [6] Plassmann, H., et al., *Consumer neuroscience: applications, challenges, and possible solutions*. 2015. **52**(4): p. 427-435.
- [7] Harris, J.M., J. Ciorciari, and J.J.J.o.C.B. Gountas, *Consumer neuroscience for marketing researchers*. 2018. **17**(3): p. 239-252.
- [8] Morin, C., *Neuromarketing: the new science of consumer behavior*. Society, 2011. **48**(2): p. 131-135.
- [9] Sebastian, V.J.P.-S. and B. Sciences, *Neuromarketing and evaluation of cognitive and emotional responses of consumers to marketing stimuli*. 2014. **127**: p. 753-757.
- [10] Venkatraman, V., et al., *Predicting advertising success beyond traditional measures: New insights from neurophysiological methods and market response modeling*. 2015. **52**(4): p. 436-452.
- [11] Boksem, M.A. and A.J.J.o.M.R. Smidts, *Brain responses to movie trailers predict individual preferences for movies and their population-wide commercial success*. 2015. **52**(4): p. 482-492.
- [12] Lee, N., et al., *This is your brain on neuromarketing: reflections on a decade of research*. 2017. **33**(11-12): p. 878-892.
- [13] Solomon, M.R., *O Comportamento do Consumidor-: Comprando, Possuindo e Sendo*. 2016: Bookman Editora.
- [14] Ohme, R. and M.J.I.p. Matukin, *A small frog that makes a big difference: Brain wave testing of TV advertisements*. 2012. **3**(3): p. 28-33.

- [15] Babiloni, F., *Consumer neuroscience: a new area of study for biomedical engineers*. IEEE pulse, 2012. **3**(3): p. 21-23.
- [16] Javor, A., et al., *Neuromarketing and consumer neuroscience: contributions to neurology*. 2013. **13**(1): p. 13.
- [17] Plassmann, H., T.Z. Ramsøy, and M. Milosavljevic, *Branding the brain: A critical review and outlook*. Journal of Consumer Psychology, 2012. **22**(1): p. 18-36.
- [18] Butler, M.J.J.J.o.C.B.A.I.R.R., *Neuromarketing and the perception of knowledge*. 2008. **7**(4-5): p. 415-419.
- [19] Vecchiato, G., et al., *Understanding the impact of TV commercials*. 2012. **3**(3): p. 42.
- [20] Lee, N., A.J. Broderick, and L. Chamberlain, *What is 'neuromarketing'? A discussion and agenda for future research*. International journal of psychophysiology, 2007. **63**(2): p. 199-204.
- [21] Hubert, M. and P.J.J.o.C.B.A.I.R.R. Kenning, *A current overview of consumer neuroscience*. 2008. **7**(4-5): p. 272-292.
- [22] Garcia, J.R. and G.J.J.o.C.B.A.I.R.R. Saad, *Evolutionary neuromarketing: Darwinizing the neuroimaging paradigm for consumer behavior*. 2008. **7**(4-5): p. 397-414.
- [23] Damasio, A., *Neuroscience and the emergence of neuroeconomics*, in *Neuroeconomics*. 2009, Elsevier. p. 207-213.
- [24] Hsu, M., *Neuromarketing: inside the mind of the consumer*. California Management Review, 2017. **59**(4): p. 5-22.
- [25] Reimann, M., et al., *How we relate to brands: Psychological and neurophysiological insights into consumer-brand relationships*. 2012. **22**(1): p. 128-142.
- [26] Hsu, M., et al., *Neural systems responding to degrees of uncertainty in human decision-making*. 2005. **310**(5754): p. 1680-1683.
- [27] Gani, M.O., S. Reza, and M.R.I. Rabi. *Neuromarketing: methodologies of marketing science*. in *Proceedings of The 3rd International Conference On Advances in Economics, Management and Social Study*. 2015.
- [28] Smidts, A., et al., *Advancing consumer neuroscience*. 2014. **25**(3): p. 257-267.
- [29] Heinonen, J.J.C.P., *Conjoint fMRI method for shortening analysis time*. 2018. **5**(1): p. 1446254.
- [30] Stanton, S.J., W. Sinnott-Armstrong, and S.A.J.J.o.B.E. Huettel, *Neuromarketing: Ethical implications of its use and potential misuse*. 2017. **144**(4): p. 799-811.
- [31] Huettel, S., A. Song, and G.J.S. McCarthy, MA: Sinauer Associated, *Functional Magnetic Resonance Imaging (Vol. 3rd)*. 2014.
- [32] Williams, J.J.P.p.I., *Neuromarketing: When science and marketing collide*. 2010.
- [33] Pradeep, A.K., *The buying brain: Secrets for selling to the subconscious mind*. 2010: John Wiley & Sons.
- [34] Zurawicki, L., *Neuromarketing: Exploring the brain of the consumer*. 2010: Springer Science & Business Media.
- [35] Ariely, D. and G.S. Berns, *Neuromarketing: the hope and hype of neuroimaging in business*. Nature reviews neuroscience, 2010. **11**(4): p. 284.
- [36] Lindebaum, D.J.h.r., *Critical essay: Building new management theories on sound data? The case of neuroscience*. 2016. **69**(3): p. 537-550.
- [37] Reimann, M., et al., *Functional magnetic resonance imaging in consumer research: A review and application*. 2011. **28**(6): p. 608-637.
- [38] Wang, Y.J. and M.S. Minor, *Validity, reliability, and applicability of psychophysiological techniques in marketing research*. Psychology & Marketing, 2008. **25**(2): p. 197-232.
- [39] Perrachione, T.K. and J.R. Perrachione, *Brains and brands: Developing mutually informative research in neuroscience and marketing*. Journal of Consumer Behaviour: An International Research Review, 2008. **7**(4-5): p. 303-318.
- [40] Nobel, C.J.D.n.h.w.f.c.s.h.n.m.-t.-i.-p.-c.-c., *Neuromarketing: Tapping Into the 'Pleasure Center' of Consumers*, *Forbes*. 2013.
- [41] Kenning, P., H. Plassmann, and D.J.Q.M.R.A.I.J. Ahlert, *Applications of functional magnetic resonance imaging for market research*. 2007. **10**(2): p. 135-152.
- [42] Cruz, C.M.L., et al., *Neuromarketing and the advances in the consumer behaviour studies: a systematic review of the literature*. 2016. **17**(3): p. 330-351.
- [43] Telpaz, A., R. Webb, and D.J.J.J.o.M.R. Levy, *Using EEG to predict consumers' future choices*. 2015. **52**(4): p. 511-529.
- [44] Ciorciari, J.J.P., Biophysics, and B. Engineering, *Bioelectrical signals: The electroencephalogram*. 2012: p. 539.
- [45] De Martino, B., et al., *Frames, biases, and rational decision-making in the human brain*. Science, 2006. **313**(5787): p. 684-687.

- [46] Kumar, S., *Neuromarketing: The new science of advertising*. Universal Journal of Management, 2015. **3**(12): p. 524-531.
- [47] De Martino, B., et al., *Frames, biases, and rational decision-making in the human brain*. 2006. **313**(5787): p. 684-687.
- [48] Du Plessis, E., *The branded mind: What neuroscience really tells us about the puzzle of the brain and the brand*. 2011: Kogan Page Publishers.
- [49] Calvert, G.A. and T. Thesen, *Multisensory integration: methodological approaches and emerging principles in the human brain*. Journal of Physiology-Paris, 2004. **98**(1-3): p. 191-205.
- [50] Allen, J.J. and J.P. Kline, *Frontal EEG asymmetry, emotion, and psychopathology: the first, and the next 25 years*. 2004.
- [51] O'Connell, B., S. Walden, and A. Pohlmann. *Marketing and Neuroscience What Drives Customer Decisions*. in *American Marketing Association*. 2011.
- [52] Smith, D.J.M.B., *Neuromarketing and Mindlab*. 2011.
- [53] Stewart, L. and V. Walsh, *Transcranial magnetic stimulation in human cognition*. 2006: MIT Press.
- [54] Silberstein, R.B. and G.E.J.I.J.o.A. Nield, *Brain activity correlates of consumer brand choice shift associated with television advertising*. 2008. **27**(3): p. 359-380.
- [55] Rossiter, J.R., et al., *Brain-imaging detection of visual scene encoding in long-term memory for TV commercials*. 2001. **41**(2): p. 13-21.
- [56] Duchowski, A.T., *Eye tracking methodology. Theory and practice*, 2007. **328**: p. 614.
- [57] Arrington, *Prices of eye tracking solutions*. 2016.
- [58] Boucsein, W., *Electrodermal activity*. 2012: Springer Science & Business Media.
- [59] Fortunato, V.C.R., J.d.M.E. Giraldo, and J.H.C. de Oliveira, *A review of studies on neuromarketing: Practical results, techniques, contributions and limitations*. Journal of Management Research, 2014. **6**(2): p. 201.
- [60] Dawson, M.E., A.M. Schell, and C.G. Courtney, *The skin conductance response, anticipation, and decision-making*. Journal of Neuroscience, Psychology, and Economics, 2011. **4**(2): p. 111.
- [61] Dawson, M.E., A.M. Schell, and D.L. Fillion, *The electrodermal system*. Handbook of psychophysiology, 2007. **2**: p. 200-223.
- [62] Bechara, A., et al., *Deciding advantageously before knowing the advantageous strategy*. Science, 1997. **275**(5304): p. 1293-1295.
- [63] Hilderbrand, M.L., *Neuromarketing: An essential tool in the future of advertising and brand development*. 2016.
- [64] Banks, S.J., et al., *Bilateral skin conductance responses to emotional faces*. 2012. **37**(3): p. 145-152.
- [65] Cacioppo, J.T., et al., *Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions*. 1986. **50**(2): p. 260.
- [66] Dimberg, U., M. Thunberg, and K.J.P.s. Elmehed, *Unconscious facial reactions to emotional facial expressions*. 2000. **11**(1): p. 86-89.
- [67] Bolles, P.D., A. Lang, and R.F.J.C.R. Potter, *The effects of message valence and listener arousal on attention, memory, and facial muscular responses to radio advertisements*. 2001. **28**(5): p. 627-651.
- [68] Renvoisé, P. and C. Morin, *Neuromarketing: Understanding the buy buttons in your customer's brain*. 2007: HarperCollins Leadership.
- [69] Eser, Z., F.B. Isin, and M.J.J.o.M.M. Tolon, *Perceptions of marketing academics, neurologists, and marketing professionals about neuromarketing*. 2011. **27**(7-8): p. 854-868.
- [70] Kotler, P., *Marketing insights from A to Z: 80 concepts every manager needs to know*. 2011: John Wiley & Sons.