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Consumer Behaviour Through Neuromarketing Approach

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Abstract: The advance of neuroscience allowed neuromarketing to use neuroimaging tools, whether for marketing purposes or to study people's daily behaviour. As the main contribution, this review shows how to effectively employ neuroscience tools to understand an individual's decision-making processes effectively. To this end, we will describe the period of neuromarketing development and its application in evaluating the perception towards marketing stimuli. After that, we will discuss the tools for measuring brain activity and non-brain activity, the pros and cons, what it measures, and when does it use each device. This paper will also discuss a series of publications related to the neuromarketing subject. Moreover, this paper will discuss the ethical issues raised by using these tools to assess human behaviour during purchase decisions. In conclusion, it will be discussed the challenges of this field and the possible future scenario.

Keywords: Neuromarketing, Neuromarketing tool, Ethical issues, Decision-making

INTRODUCTION

In the first decade of the 21st century, the prosperity in using neuroscience technology to better understand consumer's behaviour to various stimuli is undoubtedly interesting (Cherubino et al., 2019a). The term "neuromania" was coined by Tallis and Taylor (2011). It refers to the obsession with neuroimaging technology in several studies to explain the reactions of the consumer's mind. However, until the last ten years, these applications were still seen as theoretical studies, far from being applicable widely outside the laboratory. Admittedly, the neuroscientific methods became a powerful tool to investigate unconscious reactions in the consumer's brain, for example, how a consumer perceives, processes, and evaluates external stimuli in decision-making in daily activities (Gluth, Rieskamp, & Büchel, 2012). It is back to the technological progress and the development of innovative solutions applied to neuroimaging, such as less invasive, and wearable devices such as eye-tracking (Di Flumeri et al., 2019).

One of the biggest questions in today's market is what drives consumers to decide on one product instead of another or why consumers interact with a specific brand. So, there is a growing interest in understanding how brain responses reflect the decision-making process of consumers. Therefore, marketing has evolved from studying consumers' behaviour to exploring the consumer's brain responses toward marketing stimuli, known as "neuromarketing" (Stanton, Armstrong, & Huettel, 2017). Neuromarketing is defined as applying neuroscience technology in marketing research to analyze and understand consumer behaviour toward marketing stimuli. NM is also defined as the commercial field of consumer neuroscience on the one hand (Plassmann, Venkatraman, Huettel, & Yoon, 2015).

Neuromarketing studies explore different brain regions' activity toward marketing stimuli to find the relationship between an individual's behaviour and neurophysiological system. By using the knowledge of neuroanatomy and physiological functions of the brain, it is possible to figure out the neuronal activity underlying the individual's behaviour by using neuroimaging technology such as fMRI; thereby, scientists and researcher can compare the activation regions in the brain during a specific task to develop models which can describe the individual's decisions mechanisms, and also the incompatible between thoughts and actions of an individual (Jordão, Souza, Oliveira, & Giraldi, 2017).

This paper differs from other papers related to NM in terms this study describes the state-of-the-art of neuromarketing and provides a review of the main studies conducted in the area in the last two decades. This

article presents a better understanding of neuroimaging tools, how and why we use them, besides how we can appropriately employ them to study the consumer's behaviour in a real marketing context. Besides, this article discusses the ethical issues related to neuroimaging tools to assess consumer's behaviour during purchase processes. Finally, it concludes the work and potential future trends.

HISTORY OF NEUROMARKETING

Over the years, individuals tried to understand how they make decisions. But the contemporary neuroscientific studies have shown that most mental processing occurs unconsciously, including making decisions. These unconscious processes explain why individuals fail to predict their future choices (Vecchiato, Cherubino, Trettel, & Babiloni, 2013). Often, it can be noticed that individuals say something and do something else; thereby, their thoughts do not affect their actual choices (Boksem & Smidts, 2015). "Consumer neuroscience" is a new approach within consumer research that has rapidly developed; it is considered the academic use of neuroscience to better understand consumer behaviour's marketing effects (Ariely & Berns, 2010).

According to Lee, Broderick, & Chamberlain (2007), the nervous system's study to knowledge the biological basis of human behaviour is called "cognitive neuroscience," and it is divided into two categories clinical and non-clinical research. It can be differentiated between them as follow: Clinical research is known as "neurology" it studies the human with a lesion in the brain (e.g., tumors and nervous system disorders) and how these lesions can influence their cognition, emotion, and behaviour compared with healthy human. At the same time, non-clinical research is studying the responses of healthy consumers toward stimuli. As mentioned previously, consumer neuroscience refers to neurophysiological tools (e.g., EEG, ET, etc.) to conduct specific marketing research. Neuromarketing is applying neuroimaging tools in marketing research to understand consumer's behaviour toward marketing stimuli (e.g., brands, advertisements, etc.) to drive business further (Hakim et al., 2018). Therefore, the Neuromarketing concept is exclusively related to brain activities to understand the consumer's unconscious mind. According to literature, Smidt's was the first one who coined 'neuromarketing' in 2002, who defined it as the study of the consumers' brain's mechanisms to understand the consumers' behaviour and to optimise the marketing strategies (Orzan, Zara, & Purcarea, 2012). It was the first announcement about NM field by the Bright House Company in the USA in 2002; besides, the creation of a department for using fMRI technology to conduct marketing research purposes (Fortunato, Giraldi, & de Oliveira, 2014). Although the term "neuromarketing" is a new approach, some establishments (e.g., Pepsi Co.) were used other techniques before, such as EEG, to solve marketing issues (Cherubino et al., 2019a).

Undoubtedly, NM has expanded in the realm of studying the brain regarding stimuli and how it affects behaviour and perception. NM steams from three pillars: neuroscience, psychology, and economics (Page, 2012). NM brought a more comprehensive range of concealed knowledge toward the unconscious mind, which oriented consumers in their purchasing decisions. Sebastian (2014) suggested that the traditional research is connecting to the consumers' real-world; thereby, it can measure the emotional and cognitive experiences based on conscious verbal expressions. That leads us to the real issue of those traditional methods is that it supposes the accuracy of consumers' insights toward products, services, or advertisements which completely depend on the consciousness of the consumers and neglected the unconsciousness which plays a vital role in decision-making, which in turn lead to the huge gap between real market and what companies think about the market (Basaly, 2020). Therefore, from the marketing perspective, neuromarketing is an interesting and revolutionary realm for marketing research. As a result of those mentioned above, neuromarketing has received considerable attention in the academic and industrial environment; thereby, increasing the number of neuromarketing companies recently (Alsharif, Salleh, & Baharun, 2020; Plassmann, Ramsøy, & Milosavljevic, 2012). Furthermore, it can notice the number of publications in the last decade has been increased in the prestigious marketing journals (Figure 1), besides the number of neuromarketing companies.

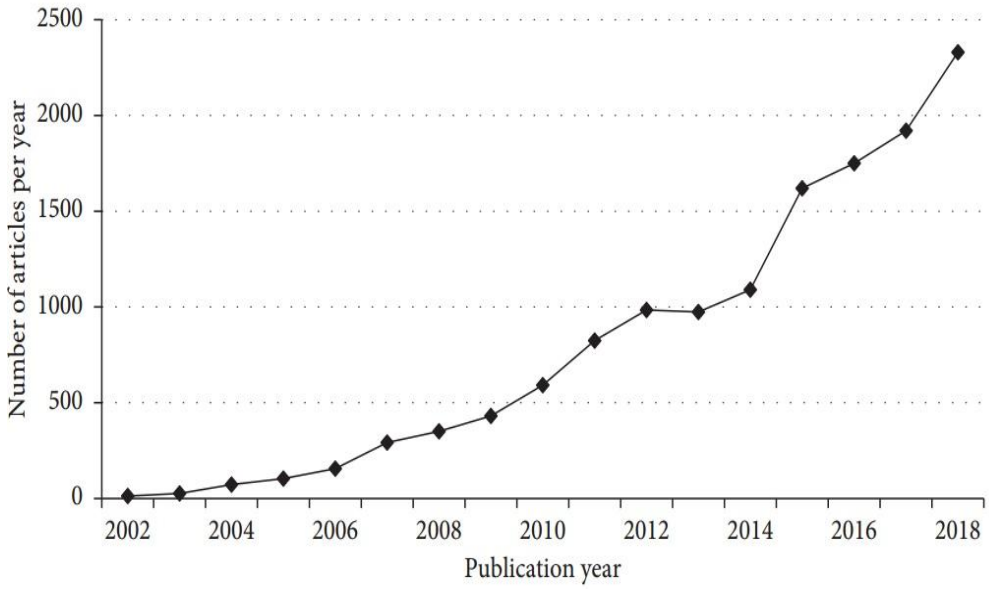

Fig.1: The Annual Number of Neuromarketing Publications from 2002 to 2018 (Source: http://www.scholar.google.com).

THE BENEFITS OF NEUROMARKETING TECHNOLOGY IN MARKETING RESEARCH

Neuromarketing techniques are commonly used in the advertising realm. Wherein NM is a tool used to know how different marketing stimuli, such as exposure to certain advertisements, impact buying decisions (Venkatraman et al., 2015). For example, identify the negative elements in advertising that cause an individual's aversion to the products and determine visual and audio features and selection of appropriate media (Fugate, 2007). Plus, NM can also identify the real unfulfillment consumers' needs; in such a way, it helps develop more useful and pleasant products, advertisements, and satiable the actual consumers' needs and desires; thereby, neuromarketing's contributions often help develop branding strategies and position a brand in the market (Fortunato, Giraldi, & Oliveira, 2014).

Furthermore, neuromarketing also can adjust its pricing strategy and developing brand and product. Therefore, like Fisher, Chin, & Klitzman (2010) mentioned, neuromarketing has enormous ability to determine the real marketing issue such as compulsive buying disorder (CBD). It can also create more successful social initiatives, such as encouraging seat belts in cars (Orzan et al., 2012) and antismoking campaigns (Cartocci et al., 2018). Indeed, neuromarketing measured and examined the intensity of emotional attachments toward a brand and the effect of stimuli to be implemented on the point of sale to promote purchases (Kühn, Strelow, & Gallinat, 2016). Consumers and markets have different characteristics depending on the period. For example, lifestyle nowadays is different from the past and it will be different in the future. Currently, the competitive environment has increased among companies as a result of technological progress. Therefore, new challenges, opportunities, and limitations have emerged, which considerably changed the marketing management. Each company seeks to discover new methods to know what is in the consumer's mind to meet their needs and beat competitors.

Consumer's behaviour defines by the American Marketing Association as the dynamic interactions between individuals and the environment in terms of the effect, awareness, behaviour and affected by the environmental factors (e.g., products, brands, .., etc.) by conducting their exchange aspects (Cherubino et al., 2019a).

Notably, by using neuroimaging tools, companies can better understand the consumer's behaviour as the mechanisms of making-decision and what processes are affected making-decision in the brain. But not as some researchers and journalists claimed that it could potentially determine the "buy button" in the consumer's brain and manipulate their brains and induce them to buy undesired products or services. Neuromarketing and traditional research can answer the research questions.

Kahneman has conducted some research about decision-making to determine how consumers make decisions. It has concluded that people are not rational decision-makers, but instead, he used the term "rationality limited". It has invented a brilliant model (system 1 and system 2) of making-decision mechanisms in the brain (Table 1). Traditional marketing studies embraced system 1, while neuromarketing relied on system 1 (Kahneman & Egan, 2011).

Table 1: The Model of the Making-Decision in the Human Brain.

System 1	System 2
Fast	Slow
High Capacity	Low Capacity
Unconscious	Conscious
Implicit	Explicit
Low Effort	High Effort
Automatic	Controlled

Source: Adopted by Kahneman (2011).

Neuromarketing is the promising and evolutionary field to develop a marketing strategy at present and in the future. Nowadays, the most prestigious brands (e.g., Google, Campbell's, Estée Lauder, and Fox News) are conducted their experiments in specialised laboratories by neuromarketing agencies (e.g., Millward Brown, iMotion, Emsense, and Nielsen) (Plassmann et al., 2015). Lindstrom (2010) has discussed the benefits of neuromarketing tools for consumers and companies themselves. They suggested that the products and advertising campaigns designed based on neuromarketing tools will benefit consumers by facilitating their making-decision and not manipulating them. As for establishments, they can guarantee to save a large of the budget, which is spent on ineffective and inefficient advertising campaigns.

NEUROMARKETING TOOLS IN MARKETING RESEARCH

It has become possible to get the data in the form of neural signals and images from the individual's brain because of the advanced neuroimaging technology; thereby, they have become significant for early diagnosis, not only for marketing research (Di Flumeri et al., 2016). Figure 2 depicted the NM tools, which used in marketing research. The first official study on NM was conducted in 2003 and published in 2004 by McClure et al. (2004). This study led to several concerns in the society and academic environment, such as the potential power of these tools to tweak the individual's perception toward products, brands, or even advertisements, at the unconscious level. Journal Nature Neuroscience published an article about ethical issues in neuromarketing studies, which doubts neuro marketers' morality, entitled "Brain Scam". Neither critical articles nor the efforts deployed by consumer protection organizations (CPO) succeeded in reducing neuromarketing popularity and flourish. The development and progress in the technology reflected positively on neuroscientific tools.

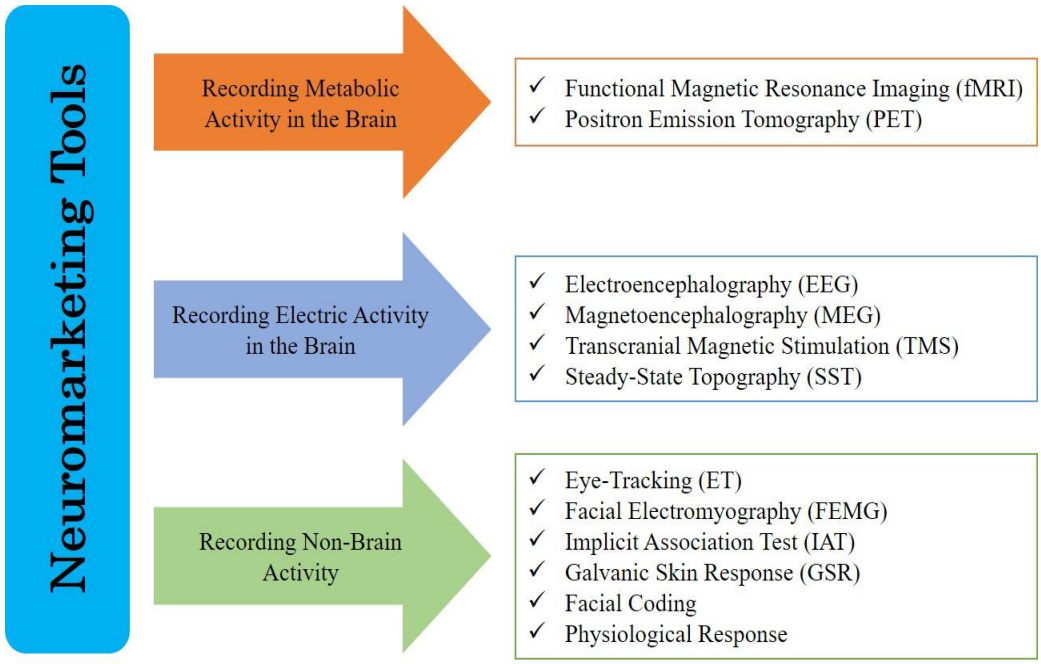

Fig.2:Classification of Neuromarketing Tools.

Source: Own illustration

The neuroscientific tools have become versatile; besides, these tools have improved in temporal and spatial accuracy; these tools' size has become smaller with more wearable, ergonomic devices. Nowadays, it is easier to investigate brain functioning, such as how individuals perceive, evaluate, react, and make decisions during daily interactions inside and outside laboratory/real environments (Cherubino et al., 2019a; Gluth et al., 2012).

Tools for Recording Brain Activities

Many consider fMRI the best technological innovation ever developed to conduct clinical and experimental research on the brain. No wonder there has been such tremendous enthusiasm for neuroimaging technology since its emergence in the mid-1980s. FMRI depends on blood flow in the vessel to measure the individual's brain (Morin, 2011). Therefore, fMRI is considered the most powerful technique for academicians and scientists today because it has excellent spatial accuracy (Plassmann et al., 2015), allows for recording the consumer's brain activity within 1-10 mm of deep structures in the brain. fMRI also uses 3D technology to analyse the brain's signals and display on the monitor, which helps the researchers and scientists measure responses, such as emotions, brand recall, brand preference, advertising effectiveness, and so forth (Zurawicki, 2010). FMRI is used to know how different marketing stimuli, such as exposure to certain advertisements, impact buying decisions (Boksem & Smidts, 2015). Besides, it can combine fMRI with PET to improve the result. That to find out what occurs at each moment by PET, and it can know the place of change by fMRI. PET also measures the metabolic activities in the individual's brain. Still, it is not used widely in marketing research because it uses the isotopes of the radioactive chemical material injects into the individual's blood vessel. However, these tools are enormous and require massive places; thereby, it is impossible to use them in realistic circumstances, and last but not least, costly (Cherubino et al., 2019a).

EEG is considered the most common and used technology between researchers and academia before releasing the fMRI technique due to its least expensive tool (Telpaz, Webb, & Levy, 2015). It uses electrodes placed on the consumer's scalp to measure the active neurons directly. EEG and MEG cannot measure distal brain activity because both tools have poor spatial accuracy; they have excellent temporal accuracy because they can record the individual's brain activity in milliseconds (Aditya & Sarno, 2018). Last but not least, EEG is not as expensive and noisy as the fMRI tool (Du Plessis, 2011), but MEG is expensive and required a specific environment such as low temperature. Both of them are somewhat limited to record the brain's cortical activity; thereby, they are not useful tools for recording the regions underneath the cortical (Morin, 2011).

The researchers use TMS to study the stimulation in a specific brain region by low and high frequencies on the participant's scalp; thereby, they can be noticed by neuronal activation (Lee, Brandes, Chamberlain, & Senior, 2017). Therefore, it can combine TMS with fMRI or EEG to improve the findings. Wherein TMS uses to study the causality of specific regions in the brain for a given mental task, EEG and fMRI study only the correlations between acquired data and stimuli. Generally, if the task requires high spatial accuracy, we can use fMRI. But if the task requires high temporal accuracy, for example, the processing of television advertisements moment by moment, EEG or MEG is appropriate (Solnais, Andreu-Perez, Sánchez-Fernández, & Andréu-Abela, 2013).

SST was pioneered in the nineties between Silberstein and colleagues, thereby, this method has used by several studies in advertising researches, wherein it has used to determine the swift changes of consumer' reactions to marketing stimuli such as aversion, approach, arousal, and attention by Silberstein's company, named Neuro-Insight. Also, this tool is used to measure the cortical regions in the brain (Silberstein & Nield, 2008).

Considering each tool's advantages and disadvantages, we can conclude that the traditional marketing and neuromarketing methods are complementary; thereby, the combination of traditional marketing with neuromarketing methods can provide better results, and new valuable consumer insights will be a revolutionary method for marketing research itself. Therefore, choosing the appropriate method for study rely on the questions and purposes of research.

Tools for Recording Non-Brain Activities

Heart rate and galvanic skin response

Emotion is one of the most important goals for scientists and researchers in marketing studies. Precisely, it is measured emotion through heartbeat by electrocardiogram (ECG) and perspiration by GSR. By both devices, it can monitor autonomic activity and assess the individual's internal emotional state. Blood pressure and heart rate are interrelated to each other, and they are considered the activity side of the blood vessels in humans. The researchers can activate blood pressure and heart rate through psychological inputs, including, activate pleasure, memory, emotional arousal, and so on. According to Fortunato, Giraldi, & Oliveira (2014), scientists found that the pressure device is susceptible to size and place on the subject's arm.

For this reason, blood pressure scales rarely emerged in marketing researches (Alsharif, Salleh, Baharun, & Safaei, 2020). The GSR is considered a convenient technique to measure the emotional arousal dimensions, sweat glands, and changes in skin conductance (Boucsein, 2012). According to Dawson, Schell, & Filion (2007), it is defined as a tentative rise in the skin's electrical conductivity, which leads to increase activity in the sweat glands. As the glands are dense on the palms and the feet' soles, they are measured by GSR, and it is a suitable method for studying consumer decision-making. Therefore, it is possible to use EEG tool with ECG and GSR to pinpoint the cognitive and emotional responses.

Eye-tracking

ET is one of the modern neurophysiological tools used in several studies, such as marketing, behavioural

psychology, and cognitive psychology (Chae & Lee, 2013). ET is actual used to record eye movements, fixation, and pupil dilation. It allows to measure the individual's brain's various processes toward stimuli; thereby, it gives valuable information about consumers' behaviour toward marketing stimuli such as brand and advertising (Fortunato, Giraldi, & Oliveira, 2014). Accordingly, it a useful tool for experimental psychology and neurological research because of the relationship between visual attention and eye movements (Hoffman, 1998). According to Chavaglia, Filipe, & Ramalheiro (2011), ET recording where and what individuals are looking at, fixation time, pupil dilation, the degree of focus, and also eye movements to get information about a specific area of interest (Alsharif, Salleh, Baharun, et al., 2020). Approximately the range of eye fixations lasting between 200 and 350 milliseconds during reading text and watching video scenes, respectively, while 200 milliseconds is approximately deemed the duration of saccadic eye movements (Rayner, 2009). The findings set of fixations and saccades are named the scan route and analyze visual perception, cognitive purpose, interest, and relationship (Zurawicki, 2010). Also, pupil dilation with a longer blinking period tells us better information about processing (Fortunato, Giraldi, & Oliveira, 2014).

In the era of technological progress, the ET has many uses relevant to human-computer interactions, where it can use in laboratory and real environments (King, Bol, Cummins, & John, 2019). For instance, in marketing research, the ET has typically used to assess the individual's reactions toward several stimuli (e.g., the usability of website, packaging, products designs, attention, the individual's responses to the ads, or the position of the product on the store shelves, and the cognitive and emotional influences on the brain regions) (Rossi et al., 2017). Knowing processes that direct consumers to pick specific elements in a picture has several uses in the business realm (Zhao & Koch, 2013). Thus, the neuro marketers and researchers can benefit from the information given appropriately by using it professionally to attract the consumer's attention and integrate them into visual activities (Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013). It can also use the ET with EEG to gather valuable insights about the consumer's emotional and cognitive responses toward marketing stimuli.

Facial expression

An Individual's face is deemed one of the wealthiest communication channels for emotional expression (Paul Ekman, 2003), and it plays a vital role in nonverbal communication among individuals (Salichs et al., 2006). For instance, faces can rapidly obtain information about gender, identity, age, ethnicity, physical health, emotional state, personality traits, and so forth (Jack & Schyns, 2015). Therefore, facial expressions are significant for communication among people, wherein they give people a chance to discover others' emotions in social life (P Ekman, 2003). In other words, a smile means we experience happiness; a frown means we experience sadness or anger; thereby, the facial expressions reflect the emotional status of consumers (Genco, Pohlmann, & Steidl, 2013). Consequently, the analysis of facial expressions is fundamental in marketing research, wherein facial electromyography uncovers valuable information about the consumer's perceptions to advertise (Cherubino et al., 2019b). Due to that, marks happening on the individuals' faces refer to intensity level and meaning of emotion such as changes in eyes pupil, eyebrow, minor and major zygomaticus, and so forth (Paul Ekman, 2003). Besides, they provide feedback about what others talk about (Cherubino et al., 2019b). For example, the eyebrows' movements provide a continuous commentary; the mouth movements provide pleasure and displeasure (Mutlu, Yamaoka, Kanda, Ishiguro, & Hagita, 2009). Facial EMG measures and evaluates facial muscles' physiological properties, such as voluntary and involuntary reactions (Ohme, Matukin, & Pacula-Lesniak, 2011).

According to Somervuori and Ravaja (2013), the zygomaticus major's movement can indicate purchase decisions. According to McDuff, El Kaliouby, Cohn, & Picard (2014), an experiment has conducted to predict the online purchase decision by recording the facial muscle movements, and the percentage of accuracy was 78%. Lewinski (2015) asserted the importance of analysing facial expressions to evaluate marketing messages and videos'. Liaudanskaitė et al. (2018), an experiment has conducted to measure the intensity of the consumer's emotions toward static advertising. It measures the dimensions of emotion (e.g., valence and arousal) (Hadinejad, Moyle, Scott, & Kralj, 2019). According to M. D. Bercea (2012), facial EMG is usually used to measure social communication, emotional valence, emotional expressions, testing video materials, testing consumer reactions to advertising, and testing brand recall(Alsharif, Salleh, Baharun, et al., 2020).

Reaction time

Reaction time can be measured by the IAT technique. According to Sebastian (2014), IAT had proven very fruitful to neuromarketing, such as cognitive psychology and looking for the most sensitive of the social aspects (Alsharif, Salleh, Baharun, et al., 2020). By this method, it can be measured brand awareness (e.g., recall and recognition of a brand), brand perception, emotional valence (e.g., positivity or negativity), logo, and measure the reaction time of the participants toward stimuli such as advertising, brand, and so on; thereby, it is possible to compare among two brands or advertisings, to overcome the lack in traditional marketing methods such as but not limited to survey (Maison & Gregg, 2017). This method is indirect methods to measure the unconscious

consumer's reactions/attitudes to brands or advertisements. Accordingly, it has found evidence that renowned brands have implicitly engaged in positive associations such as quality and value; thereby, it crucial for purchase decisions (Gani, Reza, & Rabi, 2015). IAT was founded in 1998 by Greenwald, McGhee, & Schwartz (1998) to measure the individual differences in implicit cognitions such as self-concept, self-esteem, and racial attitudes. Currently, It is used to measure the reaction time and strength associations of the consumers to brands and categories. According to Zurawicki (2010), it is extremely important for marketing research to measure the consumer's reaction time between stimuli display and its response. A shorter latency refers to the vigour association of this brand or advertising in the consumer's mind. As M. Bercea (2013) stated, despite being the difference between responses toward stimuli is a few milliseconds, this is highly important to evaluate the consumer's preference.

ETHICAL ISSUES

The significant concern for the term "Neuromarketing" has only quickly increased throughout the last decade, which led to the discussion of a series of ethical issues in society and scientific committees, media, and press (Ulman, Cakar, & Yildiz, 2015). For example, when the publicity and media have reported about the potential dangers of NM regarding finding a "buy button" in the individuals' mind by advertisers and marketers (Stanton et al., 2017), to analyse their private thoughts and emotions to impact on their purchasing decisions, and manipulation of the consumers' minds (Berliñska & Kaszycka, 2016). NM is used to create better products or ads to entice consumers but not manipulate the consumers' minds (Stanton et al., 2017). For example, companies can know their consumers' preferences and behaviours by NM and, thus, can provide more beneficial and profitable services and products. According to Ariely and Berns (2010), NM's application by companies concentrating on profit rather than consumers' wellbeing through harmful ads for products (e.g., tobacco, alcohol..., etc.). This may be true to some extent, the reason to indicate NM for violating ethical boundaries and breaking the consumers' trust.

In addition, many scientists and researchers have pointed out NM might threaten individuals' privacy if this technology can deal with consumer behaviour effectively and accurately (Murphy, Illes, & Reiner, 2008). But others have argued that these worries are probably premature because state-of-the-art imaging technology does not allow for precise predictions of consumers' decisions (Brammer, 2004). Thus, NM danger concerns have led several governments (e.g., France) to take some concrete procedures against rogue use of NM tools (Nemorin & Gandy, 2017). Therefore, the ethical issues are considered the most sensitive factors that should be considered when neuro-scientists, neuro-marketers, and companies conduct their academic and commercial NM research (Pop, Dabija, & Iorga, 2014). Thus, companies have to abide by rules and ethics issues (Arlauskaitė, Sferle, & Arlauskaite, 2013). Plus, companies should abide by the laws and the government's declarations regarding consumers, children, and patients (Ulman et al., 2015).

In this regard, firstly, companies and organization have to focus on the orientation of the NM toward the right way by increasing the wellbeing society and produce profitable products to satisfy the actual consumers' needs and desires; meanwhile, it should not fall into promoting harmful products such as but not limited to, tobacco, which the press and media can be exploited it to fuelling speculations and trigger aggressive attack to NM. Secondly, companies and organizations should not look at these arbitrary assumptions and continue to strive for success and stay productive. Eventually, it is hoped that all companies follow the government rules and instructions to secure the consumers' safety and privacy foremost.

CONCLUSION AND FUTURE DIRECTIONS

As a result of advances in neuroimaging technology in the last decade, it has become possible to record consumers' bio and neuro-signals with wearable, reliable, and comfortable devices. That encouraged scientists and researchers in the academic and industrial realm to conduct experiments for marketing purposes and applications in daily life (Di Flumeri et al., 2016). In other words, it has become possible to record real-time consumer reactions, whether mental or emotional states, in a real environment without relying on the consumer's report. With respect to methods that assess the emotional and mental state of the consumer, such as behavioural (i.e., performance and reaction times) and subjective measures (i.e., survey), neurophysiological signals show numerous additional pros (Zander & Kothe, 2011). Consequently, NM studies overcome the biases from interviewers or intrusive from participants by using neuroimaging tools to study the participant's actual mental and emotional reactions (Emic, Cabro, & Emic, 2019). This research paper shed light on numerous neuromarketing applications published in the last 20 years, and the number of publications will likely increase in the future. Furthermore, there are still challenges faced in this field, and we must address them.

From an academic perspective, according to Plassmann et al. (2015), there are three major challenges, as follow: Firstly, consumer neuroscience research often face the criticisms that they provide correlational evidence but not causal evidence; thereby, they provide valuable information about understanding the consumers' brain, not consumers' behaviour. Accordingly, marketing researchers encourage to see neuromarketing as an additional tool to improve/develop behavioural measures and interpretation. Secondly, because of the small sample size,

the experiments of neuroscience lack generalizability and reliability of the findings; for example, the sample size of experiments almost 20-30 volunteers in each circumstance, to present converging evidence toward the specific case. The last challenge is interpreting findings; it is assumed that the brain region is united based on the previous study. In other words, it has been noticed that when a certain cognitive process happens, a particular region in the brain is active but might there is another cognitive process that is not examined directly but associated with that cognitive process (i.e., a reverse inference) (Cherubino et al., 2019a).

Accordingly, researchers advise integrating neuroscience into traditional marketing research techniques, as NM alone is not always the answer to the research questions. Considering the research questions and objectives, it is better to choose the appropriate NM technique, it is another intriguing point that companies and organisations have to focus on the orientation of the NM toward the right way by increasing the well-being of society and producing fruitful products to satisfy the actual consumers' needs and desires. It is hoped that all companies follow the government rules and instructions to secure the consumers' safety and privacy foremost. Finally, the coming years will see greater collaboration between various fields (e.g., economics, neuroscience, marketing, and sociology) to describe accurate decision-making processes in real contexts.

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CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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