

An Overview of Neuromarketing Research in Developing Countries: Prospects and Challenges

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ABSTRACT

Neuromarketing has opened a new door in marketing research understanding behavioral economics with the help of Neuroscience. Over the past decade, Neuroscientists, Psychiatrists, Engineers, and Market-researchers have conducted several groundbreaking studies aiming to understand consumers' motivations, preferences, and decisions. However, these studies and practices are mainly based on developed countries. In this study, we outline the opportunities, real-life applications, future scenarios and shed light on the challenges faced by the researchers, marketers, and policymakers in developing countries including Bangladesh. Moreover, we have focused on the significant brain lobe involving neuromarketing research with the explanation of current technologies used in this area. We have concluded with some feasible recommendations to continue and sustain the growth of the neuromarketing field in developing countries. We expect that this study will give the directions on the inauguration of neuromarketing research in developing countries like Bangladesh that will help technologists, researchers, and marketers understand the advantages, challenges, and state-of-art of neuromarketing research.

CCS CONCEPTS

• **Applied computing** → *Electronic commerce*.

KEYWORDS

Neuromarketing, Neural recording, Consumer neuroscience, Pattern recognition, Machine learning, Brain-computer interface

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1 INTRODUCTION

Neuromarketing is a combined discipline of neuroscience and marketing, which uses physiological and neural signals to gain insight into consumers' purchase intention, motivation, and decisions. In the process of decision-making, emotions and thoughts play a key role. Among all the human decisions 95% are taken by the non-conscious brain [7]. In marketing, marketers need to know how their customers decide while purchasing any product. If they can understand their consumer's brains, it would help them to satisfy consumers' needs and demands. As decision-making depends mostly on the subconscious brain, it is not easy to understand. Moreover, discovering the effects of any advertising message, product acceptance rate, and customers' satisfaction level are very difficult tasks. The advances in neuroscience, qualitative advertising research in the last decades make it possible to understand those unspoken languages.

Neuromarketing has created a channel between marketing products and consumers' minds, which provides the companies with their desired sales uplifting their product demand. Without effective marketing, a product may fail to attract, engage, and sustain its targeted customers [3]. In this case, neuromarketing is helping to design, develop customers' desired products that are able to meet consumers' needs and demands. However, traditional marketing evaluation approaches such as self-reporting surveys, interviews, and focus group discussions are inaccurate and time-consuming that are sometimes skeptical. On the other hand, neuromarketing is a reliable and effective tool for marketing research.

Neuromarketing is focused on a psychological factor of marketing, which is the physical and emotional attraction in an advertisement that creates trust and recognition. This influences customers'

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preferences and purchase behavior. Neuromarketing enables advertising companies to identify several subsections of advertisements such as sound effects, images, and motto for developing effective advertising commercials. Various industries such as television, media, advertising, media, technology, online auction, food, automotive, social networking, etc. are using neuromarketing in their product enhancement and customer satisfaction.

It is evident that more than 100 companies are using neuromarketing commercially. The Neuromarketing Science and Business Association (NMSBA) is an international trade association for all people who are interested in the neuromarketing field. The organization supports both marketers and consumers globally for the meeting, buying, and learning about neuromarketing products, services, and their indispensable needs. According to NMSBA, the United States and the United Kingdom are the top countries having 10 companies each of neuromarketing. The vendors of the NMSBA are found across the world in 42 countries, where Central and South America and Europe have the highest concentration of companies. There are some other countries such as the Netherlands, Denmark, Italy, Germany, Spain, Turkey, Africa that also have a discernable number of neuromarketing companies.

This scenario indicates that most of the neuromarketing vendors and companies are in a thriving stage in most of the developed countries, while a few companies are found in developing countries. China, South Africa, and India are some of the developing countries where neuromarketing has already started its journey into the marketing industry, despite having many challenges. Though there are few research findings and practices of neuromarketing in developing countries, mentioned countries' bold steps make us confident in the inauguration of neuromarketing in developing countries including Bangladesh. In this case, we need to search out the promising benefits, main barriers, and guidelines of how can we cross them to sustain the economic growth of developing countries with the help of neuromarketing. Hence, the main objectives of this study are exploring the scopes, benefits, and capacities with present drawbacks, and approaching some suggestions for the direction of the initiative of neuromarketing research in developing countries including Bangladesh.

2 METHODS OF NEUROMARKETING

Understanding the relationship between brain function and human behavior and actions triggered by external sources (e.g. marketing advertisements) is critical for neuromarketing research. Understanding the functions of brain regions and other physiological parameters allows us to predict the hidden response, such as the consumer's intention. For delineating the process of capturing the consumers' behavior, this section will concentrate on the brain lobes involved in neuromarketing, various techniques for recording those neural activities, and the computational process of the most common research method for customer choice prediction.

2.1 Brain Region Involved in Neuromarketing

Marketers need to know consumers' purchasing behavior to satisfy their needs and demands. Researchers have done numerous experiments to identify the source of customers' attention and buyers' motivation. One research shows that we need to focus

on the deep structure of the brain to understand the consumers' motivation, whereas another study has suggested that we would focus on the frontal cortex (FC) to identify customers' attention [20]. [15, 22] proposed that the frontal cortex (FC) and prefrontal cortex (PFC) play an important role while administering the neuromarketing experiments. PCF plays an essential role in cognitive control functions influencing attention, emotional reactions, and cognitive flexibility. Similarly, [9] experimented on TV advertisements and found out that it is possible to classify like and dislike with collected signals from the FC. To acquire the information from the PFC, FC, and other lobes of the brain, we need to collect them as signals of the non-linear pattern called brainwaves [24]. The neural signature, which is divided into frequency bands known as rhythms, is linked to these brainwaves. The most common bands are $\delta(0.1 - 4Hz)$, $\theta(4 - 8Hz)$, $\alpha(8 - 12Hz)$, $\beta(12 - 30Hz)$, and $\gamma(30 - 90Hz)$. In neuromarketing studies, the theta band is involved with the like and dislike of the products[22]. Again, studies also show that alpha, beta, and gamma waves are also responsible for predicting consumer choice or buying decisions [14, 16, 19] Taken together, theta band is mostly used in neuromarketing studies as most studies focused on like and dislike among consumers. Recently, other bands are reported significant for the buying decision or willingness to buy a product.

2.2 Neural Recording Techniques for Neuromarketing

Over the last decades, researchers of neuromarketing are investigating on finding the best approach that can explain how people use their brains to comprehend, explain, and influence the world around them. Depending on the nervous system, all the research tools and techniques fall into two categories. The first technique measures responses from the central nervous system (CNS) and the other approach measures responses from the peripheral nervous system (PNS)[12].

The CNS consists of the brain and spinal cord that is primarily responsible for decision making. Using this type of brain measurements, neuromarketing captures the activity controlled by the CNS within the brain[4]. Neurological indicators such as electroencephalography (EEG), functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG), and transcranial magnetic stimulation (TMS) are included in this category that can be found in table 1. These types of technologies are complex however they are more accurate and detailed, which made it feasible to conduct neuromarketing research in both the academic and the commercial domain.

Among all the techniques, functional magnetic resonance imaging (fMRI) has been widely used in neuromarketing applications since it can identify the cerebral regions that are associated with the cognitive and emotional response. It measures the blood flow of the cerebral cortex by producing a sequence of images of the cerebral activity combining magnetic field and radio waves. The main disadvantages of fMRI are its high expense with poor temporal resolution. After being exposed to the stimuli, the cerebral blood flow changes. Due to the low temporal resolution to the order of seconds, fMRI can't record brain activities in milliseconds precision that made it unsuitable to examine brain state.

Table 1: Neural Recording Techniques used in Neuromarketing. Temporal and Spatial Resolution are defined as - (Low) ++ (High) and Exploration is Indicated from 1 (Low) to 3 (High)

Nervous System	Recording Techniques	Type of Measurement	Temporal Resolution	Spatial Resolution	Portable	Expensive	Technology	Exploration
Central Nervous System (CNS)	EEG	Electrical potentials	++	-	Yes	No	Less complex	3
	fMRI	Hemodynamic response (BOLD)	-	++	No	Yes	More complex	3
	MEG	Magnetic fields	+	++	No	Yes	Simple	2
	TMS	Magnetic fields	++	+	No	Yes	Simple	1
Peripheral Nervous System (PNS)	ECG	Electrical potentials	+	-	Yes	No	Less complex	2
	GSR	Electrical potentials from sweat gland activity	-	+	Yes	Yes	Simple	2
	Eye tracking	Eye movement, position, and gaze time	++	+	Yes	Yes	Simple	3

Alongside fMRI, in terms of cost and demand for conducting research, EEG is another popular neuromarketing method. This technique aims to investigate the impact of the stimuli measuring the electrical activity in the cerebral cortex of the subjects. The use of EEG in neuromarketing is increasing due to its high temporal resolution with mobility advantages. There are various types of EEG devices in the marketplace. Emotive EPOC and Emotive EPOC+ are the most common of them. Another commonly used EEG device is NeuroSky, Mindwave. These devices have various sampling rates from 128 to 2000 Hz. This allows researchers to select the most appropriate EEG device for their research goals and objectives.

MEG is another approach that is used frequently in neuromarketing. Sven Braeutigam with his research team had used the MEG to investigate the temporal relationships of cerebral areas involved in consumers' decisions. It uses magnetic potentials from the scalp to record brain activity. In this technology, magnetic field-sensitive detectors are used that are placed on the subject's head. These fields are not affected by the blood or bony tissues, however, electric field-based EEG devices are influenced by these tissues. In the same manner, as MEG, TMS uses magnetic fields that are generated by the electromagnetic induction of an iron core. TMS stimulates the targeted part of the brain through which social and behavioral experiments are conducted. In a way, TMS and MEG are like mirror images of one another. The former induces currents in the brain via magnetic fields, while the latter detects magnetic fields generated by neural currents. Unlike EEG, MEG and TMS are both expensive; however, both of them are based on simple technology.

On the other hand, the PNS is made up of nerves and ganglia that are located outside of the brain and spinal cord. This method focuses on measuring the physiological reactions of the body to external stimuli experienced via the senses. In neuromarketing, electrocardiography (ECG), eye tracking (eye movement, blinking, gaze time), and galvanic skin response (GSR) are the most widely used techniques in this category.

Heart Rate (HR) is used as an important metric, which measures the rate of heartbeat to measure arousal and focus of the consumers who are stimulated by commercials. ECG is an independent measure that uses external skin electrodes to assess the electrical activity of the heart [20]. Increasing HR indicates arousal while slower HR in response to a commercial indicates the increased focus towards the stimuli.

Another physiological metric is galvanic skin response (GSR), which occurs when the skin functions as an electrical conductor as a result of increased sweat gland activity caused by stimulus exposure. The amplitude and the response latency of GSR provide a direct estimation of arousal while watching television commercials, though they cannot make any independent relation with emotional valency. Besides all types of physiological recording techniques, in neuromarketing research, eye tracking is the most widely used method for measuring customer response since it counts visualization time and gaze route across a screen. Moreover, the pupil dilation test assesses the audience's attention and arousal to marketing cues. The most popular eye-tracker, Tobii Pro X2-30 is used with fMRI-based neuromarketing experiments to explore consumers' attention [20].

2.3 EEG-based Computational Method

Among all the neuromarketing tools, EEG and eye tracker are the most used devices due to their key benefits: cost-effectiveness, availability, ease to use, and non-invasive procedure. Researchers have conducted a vast amount of experiments through EEG analysis for predicting consumers' choices [5, 14, 23]. This section explains the common design process of EEG-based prediction systems mentioning some classification models of neuromarketing that have successfully identified consumers' preferences.

For developing a prediction system, an EEG device must be set on the head of the consumer for recording the brain signal of that customer. Then the marketing advertisements (e.g. static images, videos) are presented in front of the subject. While watching the

stimuli, EEG raw signals are recorded for examining his/her decision that can be seen from the following Fig1. After the experiment, the participant fills out a survey form labeling those stimuli as liked or disliked items. In the next phase, the raw EEG signals are preprocessed for noise removal. Generally, eye artifacts, line noise, and movement artifacts are found in the EEG signals. For removing these types of noises, bandpass filter, notch filter, and Independent Component Analysis (ICA) are used. Then, feature extraction is done for achieving time domain, frequency domain, and time-frequency domain features. After that, feeding the informative features a model is trained to classify the customer's choice. For selecting the appropriate classification model, the labels given by the participants have been taken as ground truth.

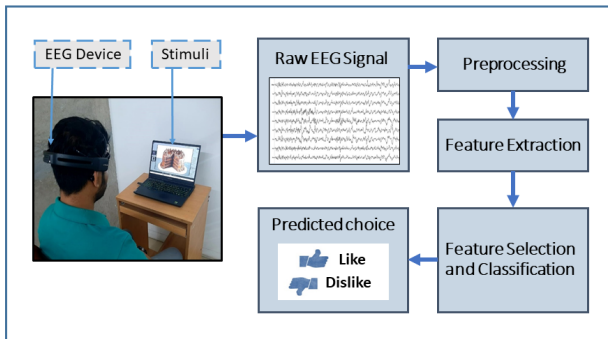


Figure 1: An EEG-based consumer choice prediction system is depicted. A customer is watching a stimulus while raw EEG signals have been recorded by EEG device. Then, The raw signals are preprocessed and feature extraction is done for extracting valuable information from the signals. After that, selecting informative features classification is done for predicting the consumer's likeliness toward the product.

In [25], the authors have presented a neuromarketing framework for determining customers' choice for some specific E-commerce products. They have used the Emotiv Epoc+ device for investigating subjects' brain activities. The customer has been asked to label the E-commerce products based on their likeliness. To classify the consumer's preference, they have used the Hidden Markov Model (HMM) based on a sequential classifier. Again, [11] used EEG signals and eye tracker devices for predicting the decision of 18 participants. Emotiv Epoc device has been utilized here for recording 14 channel EEG data. For extracting and analyzing eye-tracking data, Tobii x60 eye-tracker has been employed here. They have given the users 57 different choice sets for identifying the most relevant brain lobe involved with their task of making choice. They have examined that symmetrical frontal and occipital lobe have higher synchronization with the high values of theta, alpha, and beta waves. With the recent applications of deep learning in various fields [1, 13, 17], [2] have proposed an EEG recognition system for predicting pleasant and unpleasant preferences. Each participant rated 40 music videos based on their liking and familiarity. They have used a deep learning model for the classification and compared the performance of that with KNN and RF classifiers. The

deep learning model has outperformed with 94% accuracy using hinge cross-entropy.

3 FUTURE OF NEUROMARKETING IN DEVELOPING COUNTRIES

Neuromarketing is in an evolving phase in the marketing world. Most of the developed countries are being benefited economically from this revolution. However, the marketing sectors of developing countries are not very adaptive with this new strategy of market research compared to the developed countries. In this case, developing countries are facing many barriers such as knowledge gap, ignorance of the effectiveness of neuromarketing, irrational trust in traditional methodologies of marketing, lack of technological advancements, scarcity of combined research platforms for business professionals and academics, etc. Though it would not be possible to remove those barriers completely, we can try to face those challenges unitedly accepting the new adaptations that need to be changed. As neuromarketing is a relatively new concept in developing countries, we need to educate businessmen and marketers about the basic functions of neuromarketing with its effective use in specific domains through which they can achieve their goals with substantial revenues. In addition, we need to spread the knowledge of neuromarketing among the public to make new marketing approaches acceptable. In many cases, we tend to practice the behaviors with which we are most comfortable without knowing their benefits. This is the same case for traditional methods of marketing. In similar ways, Marketers rely on the old survey methods for years, though they are not a very reliable source of understanding consumers' choices. On the contrary, neuromarketing helps marketers to measure and visualize consumers' minds which is a much more trustworthy approach than the previous one. Another crisis is the lack of a combined research platform with technological developments. In this regard, the companies who are interested in applying neuromarketing can collaborate with the neuromarketing companies of developed or developing countries. Despite having some scarcity of technical developments, many developing countries have already used the neuromarketing tools, such as EEG, GSR, MEG, facial decoding, biometrics, etc. for market analysis, product design, and advertisements. This sign gives a positive direction for neuromarketing in developing countries. After all, we are very optimistic that all the developing countries will embrace this new technology which would have far-reaching consequences in their economic growth.

4 NEUROMARKETING COMPANIES IN DEVELOPING COUNTRIES

Neuromarketing tools are contributing to various sectors of markets, such as product design and packaging, food retailing, media planning, advertising, software making, online auctions, neuro-consultancy, market research, and human behavior understanding, etc. Although there are many areas where developed countries are using neuromarketing, it can be found that a limited number of neuromarketing companies of developing countries have started their journey mainly focusing on advertising, and market research. Some noticeable neuromarketing companies of developing countries with their used technology for specific purposes are given

Table 2: Neuromarketing Companies of Developing Countries

Country	Company	Industry	Technology	Purposes
China	Brain Intelligence	Neuro-cosultancy	EEG, fMRI, biometrics, eye-tracking	Evaluation of emotional feedback and cognitive engagement on marketing stimuli
China	Derval Research	Research farm	Biometrics	Decoding human preferences and behavior
China	Nine Foresight	Market Research	EEG,GSR, eye-tracking, facial decoding	Understanding customer behavior and their requirements
India	Neurons Inc India	Advertising	EEG, eye-tracking, Survey	Retail and packaging, website and e-commerce, product experiences, R&D and innovation
Seoul, Korea	Think User	User experiences consultancy	EEG, GSR, eye-tracking, psychophysical experiments	Design sound, measurement of emotions, and UX concept development with optimization
Brazil	Forebrain	Neuromarketing Research and ad-hoc consultancy	EEG, eye-tracking, facial EMG	Product development, branding, and communication
Chile	Tobi Pro Latam S.p.A.	Research consultancy	Eye-tracking	To gain insight into human brain
South Africa	Neural Sense	Market research	Eye- tracking, biometrics	Advertising testing

in table 2. There are three Chinese companies, namely Brain Intelligence, Derval Research, and Nine Foresight are using EEG, fMRI, GSR, biometrics, and facial coding for decoding consumers' emotional and cognitive engagement on marketing advertisements, and their requirements for desirable products. Derval Research is a research farm, whereas Neurons Inc India is based on advertising. Neurons Inc India is a branch of Neurons Inc company which originated in Denmark. This collaboration also indicates that developing countries have a bright prospect in the neuromarketing sector. Think User, a company in Seoul Korea, develops user-experience (UX) concepts models, measuring the emotions of consumers using the technologies, namely EEG, GSR, eye tracker. Moreover, they also design ambient sound using some psychophysical experiments. Though most of the described companies are focusing mainly on EEG, GSR, and facial decoding for neuromarketing, Tobi Pro Latam S. p. A. (Chile) is using eye trackers only for gaining insight into the human brain. In addition, Fore Brain (Brazil) and Neural Sense (South Africa) are also using neuromarketing technologies for developing products and advertisements. These countries have already taken the first step in neuromarketing which will inspire the rest of the developing countries.

5 PROSPECTS AND BENEFITS

5.1 Contribution to Consumer Research

Consumer research involves the identification of inclination, motivation, and purchase behavior of the targeted customers, which is a major part of market research. It helps all the organization to understand the consumers' psychology, their choices, their needs and to create detailed purchasing behavior profiles, which can boost their business. Consumer neuroscience focuses mainly on the process of consumers' decision-making, reward system with motivation, emotions, attention, and memory. A key question of consumer research is how consumers make decisions during the time of purchasing

and the process of accessing their favorite product when there are lots of alternatives in the marketplace. Moreover, how much the costs, designs, and benefits of those products influence them to decide. Neuromarketing research shows that the prefrontal cortex (PFC) of the human brain has a direct relationship with the process of decision-making. Researchers can measure the activity of these regions to get more useful information about the neural foundation of consumer choices. Another important area of consumer research is the reward system with motivation. Generally, humans respond to attractive and appealing reward items such as chocolates, cakes, beverages, and other types of food items, gorgeous dresses, gadgets, and drugs subjectively. In other words, a favorite brand can act as a satisfying stimulus within the consumer's brain that triggers the psychological motivation to buy the product or influence consumers' overall purchase behavior. Moreover, human behavior depends on two motivation systems according to neuroscience. Specifically, EEG studies showed that the right FC is associated with the behavior which indicates withdrawals and the left FC is involved with the motivation of approaching behaviors. Consequently, a significant topic of interest in consumer research is the investigation of the left-right asymmetry of consumers' cerebrum to interpret their responses, while influenced by a stimulus. Advertising logos and different product designs can stimulate humans quite differently, so the brain mechanisms associated with attention and visual processing could be another important research topic in this area. The aforementioned PFC plays a central role in directing and focusing attention, whereas the amygdala is responsible for the modulation of the memory system.

5.2 Contribution to Neurology

Neurologists and consumer neuroscientists have acquired enough depth knowledge on organizational behavior, the psychology of the reward system, frontal-cortex of the human brain, and their correlation with decision making. Moreover, the studies of neuroeconomics

can provide neuroscientists with new insights into different neurological diseases, like pathological gambling, and compulsive buying. They could also participate in many debates related to the ethics of neuromarketing. Doctors frequently find several common behavioral anomalies in many impulsive-compulsive disorders, where the reverse system is directly related to those anomalies. This relation could be a topic of research in both general and consumer neuroscience. Pathological gambling is recognized by one's mental state when he cannot keep himself away from gambling despite losing severely. It is a cycle that continues without any break. Pathological gamblers think to get back his lost money, that false hope disrupts his work, job, family life, and social life. [10]. There might be a definite relation between these consequences and the reward system pathways. When mesolimbic reward pathways are less active, the aforementioned mental disorder can be found. Many researchers' findings suggested that psychiatrists should get to know new insights from neuroeconomics. It has been argued that behavioral neuroscientists could use the paradigm involving gambling, and purchasing behavior of consumer neuroscience to examine the patients suffering from different neurological disorders. In psychiatry, compulsive buying is another type of mental disorder that is frequently debated. It is categorized as a tendency to buy something repetitively with a lack of impulsive control over buying, which is also related to the reward system. It has been reported that a higher degree of likewise behavior has been found in Parkinson's patients, frontotemporal dementia patients, and depressed patients. Compulsive and non-compulsive buyers show a significant difference in their level of reward and pain system activation. Behavioral neurologists could further investigate the responsiveness of the advertising brands of patients suffering from compulsive buying disorder.

5.3 Revolution in Marketing Industry

Neuromarketing can transform the marketing industries in a dramatic way, understanding customers' minds through the analysis of their cognitive and emotional responses while stimulated by external stimuli. Mainly, companies' failure depends on the difference between what their customers expect from what they provide. If the companies get to know about the consumer's demand before designing and providing their products, it would help them to fulfill customers' demand and boost their business. In this case, neuromarketing can bridge the gap by providing a complete and accurate analysis of consumer demand with the help of neuroscience. For a long time, traditional marketing methodologies, such as focus groups and interviews, have been used to observe consumer behaviors that are quite ambiguous and subjective. Currently, neuromarketing is taking place in this traditional technique's place, which is more effective and accurate in the measurement of consumer purchasing behavior. It can save both the time and money of each company, which also can reduce the risk of failure of the product. As neuromarketing measures the attention, emotional engagement, and memory from the subconscious brain, it has competitive advantages over all the conventional approaches in the marketplace. Neuromarketing can enhance product development by which consumers can set their well-suited product that will help the companies to increase the total sale of the product. In this

way, Industries can be benefited from neuromarketing research and applications. Moreover, it can help the process of packaging, advertisement, pricing, and negotiation that could increase consumer loyalty and brand image. Overall, neuromarketing can guide marketing industries, organizations, and companies to advertise, design, and make successful prototypes of demanded products in the marketplace.

6 CHALLENGES

6.1 Infrastructure

For the successful research and implementation of neuromarketing, the establishment of infrastructure is one of the prerequisites of all the conditions. Neuromarketing is an emerging field at present time. But all the progress and research involved with neuromarketing have been placed in the developed countries. Most of the developing countries like Bangladesh have no sufficient infrastructure for neuromarketing research. Some crucial factors including research fundings, equipment costs, establishment, and logistic costs, etc. are hindering the creation of the basement for neuromarketing research in developing countries. Another obstacle is the accessibility of research resources. It can be said that neuromarketing has an enormous market so, it will definitely attract significant attention from investors and industrialists. As a result, different industrialists will be willing to fund neuromarketing research in developing countries like Bangladesh. Moreover, if we can make a bridge of researchers, research organizations, firms, and marketers between developed and developing countries, this initiative could open a new door for neuromarketing research, establishment, and development in developing countries.

6.2 Collaboration between Technologists and Marketers

One of the major challenges in neuromarketing is ensuring the collaboration between researchers and marketers. Multidisciplinary is the basic feature of neuromarketing on which its sustainability depends. The results of this study need a group of very different backgrounds, where specific requirements may vary according to the research proposal and the use of equipment. Despite having these challenges, medical professionals, engineers, and marketers can engage in interdisciplinary collaboration in developing countries. If we have to start neuromarketing research with its application in developing countries like Bangladesh, different universities, research firms, and marketers need to establish a platform from which they can collaborate and contribute their portion of expertise. In this way, neuroscientists, psychiatrists, and marketers can come together to form a team and carry out their duties properly in the initiation of neuromarketing research with its proper advancements.

6.3 Ensuring Research Ethics

Neuromarketing has been introduced to connect the gap between marketing and neuroscience to understand the human brain. [18] illustrated that the interpretation of neuroscientific findings is misguided and overestimated by the neuromarketing advisory board to the outside world. The main disadvantage of this study is the

lack of information credibility. [8] have interrogated the authenticity of the neuromarketing companies as all of their real, or actual experiments happen behind the curtain. Moreover, a framework of ethical mapping has been proposed to analyze the specificities of neuroscience. It suggested that the concept of neuromarketing is established on three decisive factors. They are the industrial sector, organizational type, and purpose. Senior [6] recommended that marketers and neuromarketing research farms need to prove their reliability and the validation of their statistical data. Another ethical issue is the misuse of vulnerable and immature groups such as children, old citizens, and teenagers. In addition, the violence and ignorance of public privacy are very crucial issues that are directly related to neuromarketing practices. Most of the clinical experiments are done for commercial purposes [21]. So, this is the combined responsibility of society, research farms and companies to govern the ethical issues. However, these research ethics and policies are not applied and ensured in most developing countries. Therefore, necessary initiatives and steps should be taken to ensure experimental righteousness.

7 CONCLUSIONS

In this study, we examine the perspective of opportunities and challenges of neuromarketing research in developing countries. We have focused on the significant lobes of the human brain associated with neuromarketing research, the common approaches such as fMRI, EEG, ECG, GSR, eye tracking, etc., and the EEG-based consumer prediction system, which is the most popular method of neuromarketing. The prediction system through EEG analysis is a potential approach for neuromarketing in developing countries. If we can successfully implement this system, developing nations would make a huge profit out of this approach. On the contrary, neuromarketing has some disadvantages. Though it has more advantages than drawbacks, we try to shed light on those limitations indicating the positive scopes elaborately. We also give some suggestions to reduce those aspects and how we can start the journey of neuromarketing in developing countries. We think that investors, researchers, marketers, and policymakers will benefit from these ideas and scopes. They will get to know the potential benefits and obstacles of neuromarketing research, which will help to take necessary steps to bridge the gap between the current and future applications of neuromarketing.

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