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Neuromarketing's Socioeconomic Status and Racial Discrimination and Lack of Transparency

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Abstract

Neuromarketing, the scientific study of the nervous system applied to marketing, is evolving rapidly. Marketers recognize that brain and biometric studies lead to a deeper understanding of consumer preferences. This research provides a historically accurate timeline of significant discoveries, plus a review of present-day neuromarketing tools and corporate case studies. A systematic methodological review was conducted, and findings were synthesized using secondary peer-reviewed research, media reports, and academic studies by marketing associations. This study shows that this area of neuroscience has challenges due to a lack of transparency, minimal standardization, and little to no corroboration among scientists. Additionally, neuromarketing researchers may not address the effects of racism and socioeconomic status on the brain, which, if not considered, can render the sampling results incomplete. With multinational corporations driving the demand for neuromarketing, attaining reliable data from a diverse and robust cross-section of subjects should be prioritized.

Keywords: Marketing, Neuromarketing, Neuroscience, AI, Racism

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Introduction

The United States President, George Bush, declared the 1990s to be the time in history that the brain would have its moment (Goldstein, 1994). Studying the brain's purpose, or its connection to the rest of the body, known as neuroscience, dates back 2500 years. It was when the Greek "Alcmaeon of Croton (~460 BC), a great philosopher and pioneer of anatomical dissection, traced the nerves of the sense organs until their terminations in the brain and inferred that the brain was the seat of sensation and thought" (Goldstein, 1994; Fan & Markram, 2019).

Ancient anatomists to present-day scientists have shared their findings on the brain. Such discipline, known as neuroscience, is defined as a branch of the life sciences that deals with the anatomy, physiology, biochemistry, or molecular biology of nerves and nervous tissue, especially with their relation to behavior and learning" (Binder et al. 2009).

The science of studying the brain has continued to expand quickly because of easily accessible shared findings, which has fostered integration into other fields of work (Bočková, Hanák, & Michal, 2021). One such area of growth is the practice of neuromarketing.

Neuromarketing loosely refers to measuring physiological and neural signals to gain insight into customers' motivations, preferences, and decisions, which can help inform creative advertising, product development, pricing, and other marketing areas. The field employs brain imaging, scanning, or other brain measurement technologies to capture consumers' responses to marketing stimuli and to circumvent the challenges of relying on consumers' self-reports (Harrell, 2019; Brenninkmeijer, Schneider, & Woolgar, 2020). Neuromarketing studies how the brain and body react to marketing stimuli through various measurement technologies. It might very well be construed as a customer relationship tool (CRM) as it can also share insights on the consumer purchasing journey (Marcin, 2020).

Scientific excellence is essential for the improvement of neuromarketing research. As research evolves more internationally, establishing collaborations with other researchers and institutions across the globe, through various cultures and socioeconomic backgrounds, will be vital to advancing scientific knowledge within the domain. Understanding the similarities in standards applied to neuroscience experiments with multiracial subjects in neuromarketing research and where ethical issues, level of transparency, and protocol standardization might lie is crucial. Cultural differences and societal values also contribute to these similarities and differences between human subjects and stimuli during experiments. This study offers an overview of the available primary literature on the topic. It concentrates on the ethical challenges concerning human subjects participating in neuroimaging and neuromarketing investigations, consumer subjects experiencing the effects of investigation results, and researchers performing such experiments, sharing the concerns of many other researchers in the field (Bercea Olteanu, 2015; Kalaganis et al., 2021). It highlights areas of concern related to neuromarketing's socioeconomic status, racial discrimination, and the lack of transparency in experiments. It argues for fundamental changes in the current neuromarketing investigation practices.

Neuroscience Discoveries Foster Neuromarketing Tools: Timeline

From ancient times to the present, the brain's processes continue to inspire and ignite scientific research. While anatomical dissections took place in ancient Greece, neuroscience started to gain traction in 1849 and continues present day, as noted in the below timeline:

- ⇒ **1849** - German Emil du Bois-Reymond studied human skin and found it electrically active (Widacki, 2015)
- ⇒ **1878** - Electrical signals were discovered in animals' brains by Richard Canton (Marcin, 2020)
- ⇒ **1879** - French ophthalmologist Louis Émile Javal found that eyes do not constantly move continuously through a straight line of copy when reading. This discovery is considered the start of eye tracking, where saccades, rapid eye movements between two fixations, were discovered by Javal (Kumar, 2016). Lamare, who worked in Javal's lab, was the first to discover and apply a mechanical device to record the eye jerks and stops (Płużyczka, 2018).
- ⇒ **1890** - French physician Charles Féré and Russian physiologist Ivan Tarchanof jointly discover the galvanic skin response test, which is still considered one of the best discriminators between people providing deceptive answers to test questions and non-deceptive subjects (Widacki, 2015).
- ⇒ **1898** - E. Huey (Płużyczka, 2018) developed the first eye tracker.
- ⇒ **1901** - Americans R. Dodge and T.S. Cline developed the first noninvasive and accurate eye tracker (Płużyczka, 2018).

⇒ **1924** - Hans Berger, inspired by Richard Canton in 1875, invented the electroencephalogram (EEG). As one of the first tools used in neuromarketing research, it has withstood the test of time, and today, it has still widely used and considered very reliable (Marcin, 2020).

⇒ **1931** - The Ophthalmograph and Metronoscope, which record the movement of eyes, were created by Earl, James, and Taylor and were first used for education but later adapted for neuromarketing research (Leggett, 2010).

⇒ **1938** - Photoplethysmography (PPG), a noninvasive optical technique used to track changes in blood vessels, was introduced by Hertzman (Elgendi, Fletcher, & Liang, 2019).

⇒ **1956** - At a Dartmouth College conference in New Hampshire, the term "Artificial intelligence," or AI, was created (Lewis, 2014).

⇒ **1958** - James Vicary created the concept of subliminal advertising, which later was proven not to exist despite a U.S. Congress bill to ban subliminal ads on TV (Thomas et al., 2017). It marked the beginning of stealth marketing, where products or services are marketed in subtle or hidden ways.

⇒ **1964** - Herbert Krugman started experimenting with pupilometers. Such a device measures spontaneous pupil dilation as an indicator of peoples' interest while looking at packages or print advertisements (Sutherland, 2007).

⇒ **1968** - Magnetoencephalography (MEG), a tool used for mapping brain activity, was discovered by David Cohen (Marcin, 2020).

⇒ **1969** - The behavior of monkeys was studied at Washington University by E.E. Fetz and his associates using technology that led to the creation of the brain-computer interface (BCI). Also, magnetic resonance imaging (MRI) was invented in 1969 by Raymond Vahan Damadian. Later, Stephen Hawking used technology to share his lectures (Marcin, 2020).

⇒ **1971** - Herbert Krugman was among the first marketing scholars to utilize electroencephalography (EEG) to examine advertising (Daugherty et al., 2018).

⇒ **1975** - Michael Ter-Pogossian, a nuclear physicist, and assistant professors in Ter-Pogossian's lab, Michael Phelps and Edward Hoffman, revolutionized the ability to study brain activity with the Positron Emission Topography (PET) (Pornow, Vaillancourt, & Okun, 2013).

⇒ **1976** - Ekman and Friesen established the Facial Action Coding System (FACS), a reliable facial electromyography (fEMG) process that measures facial expressions (Kulke, Feyerabend, & Schacht, 2020).

⇒ **1980** - Entrepreneurial businesses started offering neuroscience tests to corporations that supposedly measured accurate, subconscious emotional and cognitive responses (Ramsøy, 2019).

⇒ **1985** - Transcranial magnetic stimulation (TMS) is developed by Antony Barker's UK team (Marcin, 2020). TMS has been used in research to learn strategies to entice people to be more susceptible to messages encouraging them to engage (Harrell, 2019).

⇒ **1990** - After the discovery of structural MRI, Ogawa (Marcin, 2020) developed functional magnetic resonance imaging (fMRI). Also, Richard Silberstein developed Steady State Topography (SST), a tool used in cognitive neuroscience and neuromarketing research for observing rapid changes and measuring human brain activity. SST also offers new insights based on neural processing speed instead of

the more common EEG amplitude indicators of brain activity (Bercea, 2012). In the same year, U.S. President George Bush formally designated 1990–2000 the decade of the brain. The number of articles on neuroscience increased due to the stepped-up use of EEG and other brain imaging techniques (Brenninkmeijer, Schneider, & Woolgar, 2020; Marcin, 2020). Martin Lindstrøm of Denmark is thought to be the driving force of neuromarketing (Marcin, 2020). Lindstrom partnered with researchers from Oxford University and launched the single most extensive neuromarketing study ever conducted—twenty-five times more significant than any such study up until that time. In a three-year effort, costing more than seven million dollars and using two of the most advanced, innovative neuro-imaging technologies available at that time—the fMRI and SST—scientists scanned the brains of over 2,000 people. These human subjects were from all over the world. They were exposed to various marketing and advertising signals, including clever product placements, sneaky subliminal messages, iconic brand logos, shocking health and safety warnings, and provocative product packages (Lindstrom, 2008).

⇒ **1993** - Functional near-infrared spectroscopy (fNIRS) was first used (Marcin, 2020).

⇒ **1994** - The diffusion MRI (dMRI) was developed by Peter Basser as a noninvasive method that did not require any external contrast agent, becoming a pillar of modern neuroimaging (LeBihan, 1994ab; Descoteaux et al., 2015; Mueller et al., 2015; Ramsøy, 2019).

⇒ **1999** - Gerry Zaltman of Harvard University was the first to use fMRI to test marketing concepts, leading to the development of the Zaltman Metaphor Elicitation Technique (ZMET) which helps understand how unconscious and conscious processes interact (Hanlon, 2007). ZMET, having been used in more than 20 countries, explores B2B and B2C environments and challenges and has helped pave the way for neuromarketing (Coulter & Zaltman, 1994; Zaltman, 1996). Retailers started using virtual reality (VR) and augmented reality (AR) as consumer research tools.

⇒ **2002** - The term *neuromarketing* was introduced by Ale Smidts (Smidts, 2002; Šola, 2013).

⇒ **2004** - Multiple neuroscience articles were inspired by the Triennial Invitational Choice Symposium and then published following workshops focused on one topic related to human choice behavior and individual decision-making, which gave neuroscience attention in the media (Chakravarti et al., 2005; Blanchard & Thompson, 2020; Marcin, 2020).

⇒ The well-known Coca-Cola vs. Pepsi case study occurred at Baylor College of Medicine using fMRI (Lehrer, 2006; Harrell, 2019).

⇒ **2005** - The term neuromarketing was added to The Collins Dictionary by Harper Collins (Marcin, 2020).

⇒ **2008-2010** - In 2008, Martin Lindstrøm published what is now a best-selling book, *Buyology*: *Truth and Lies About Why We Buy* (Lindstrøm, 2008), which has been considered an early defining publication for neuromarketing (Ramsøy, 2019). He devised the idea that every brain has a buy button, which we know today as untrue (Van Belleghem, 2012; Thomas et al., 2017).

⇒ In 2009, a new direction in experimental paradigm design was proposed (Makeig et al., 2009) to enable, for the first time, measurement, and analysis of human brain dynamics under natural conditions, including the subject's eye and motor behavior in 3-D environments (Ojeda et al., 2014).

⇒ **2012** - Neuromarketing Science and Business Association (NMSBA) was established. The core objective is to support marketers and consumer insights professionals (Brenninkmeijer et al., 2020).

⇒ **2015** - Numerous automatic software solutions for Facial Action Coding Systems (FACS) were developed (Kulke, Feyerabend, & Schacht, 2020).

⇒ **2017** - The Advertising Research Foundation publishes extensive research examining neuromarketing tools versus more traditional analysis methods (Harrell, 2019).

⇒ **2018- Present** - Corporate clients and agencies have become savvier about utilizing various neuro tools and the resulting insights. Combinations of devices are used to gather more accurate data results and to utilize smartphones and apps that can feed real-time data back to the lab, producing more realistic results (Mouammine & Azdimousa, 2019).

Challenges with Neuromarketing Tools

Past and present marketing research methods have included focus groups, surveys, social media listening, interviews, experiments, field trials, and observation, to name a few (BrandWatch, 2019). Using neuroscience lab techniques, scientists, academics, and marketers have found it possible that the answers given by participants in an experiment can be biased or skewed. These answers can also be consciously or unconsciously, due to the influence of stereotypes, cognitive biases, emotions, social and moral norms, or simply because they are incapable of expressing their feelings, thoughts, and what motivates the purchase decision (Teichert et al., 2019; Ross, 2020). The director of the Wharton Neuroscience Initiative, Michael Platt, argues that what comes out of our mouths is not always a perfect rendition of what is going on in our brains (Harrell, 2019; Tremblay et al., 2020). In other words, the risk of error in understanding consumer preferences is very high using traditional marketing research methods (Gurgu & Gurgu, 2020).

Neuromarketing measurement tools can be broken down into multiple categories, with the two most prevalent areas being brain activity and physiological activity, as seen below (Ariely & Berns, 2010; Hsu, 2017; Bočková, Hanák, & Michal, 2021):

Tools Registering Brain Activity

Electroencephalogram (EEG)

- Analyzes brain electrical activity
- Noninvasive electrodes are placed on the subject's head
- Relatively cheap
- Provides good time resolution of brain processes
- Widely used
- Portable

Functional Magnetic Resonance (fMRI)

- Tracks blood flow across the brain
- Noninvasive (person lies inside the machine)
- Can peer deep into the brain (Harrell, 2019)
- Answers three questions (Gurgu & Gurgu, 2020):
    - Did the activity trigger an emotional response
    - What remains in the memory of the activity
    - Did the activity capture attention
- Expensive

- Widely used
- Portable

Magnetoencephalography (MEG)

- "Analyzes and registers magnetic activity in the brain with a helmet that contains 100-300 sensors. It is a method that detects changes in magnetic fields induced by the brain's electrical activity" (Bitbrain).
- The lab setting required is unnatural, which may skew the results
- Resolution superior to EEG (Weng, 2018)
- Noninvasive
- Expensive
- Not portable

Positron-emission tomography (PET)

- Measures changes in metabolic processes like blood flow (Mayo Clinic)
- Provides accurate results (Bočková, Hanák, & Michal, 2021)
- Invasive (subjects receive an injection of radioactive substance)
- Expensive
- Not used often for neuromarketing

Steady State Topography (SST)

- Records brain electrical activity
- Can continuously track rapid changes over extended periods (Weng, 2018)
- Noninvasive (uses band or helmet)

Transcranial magnetic stimulation (TMS)

- It does not study but alters brain activity through the skull (induces or suppresses brain activity) (Bočková, Hanák, & Michal, 2021)
- Highly accurate (Benussi et al., 2021)
- Portable
- Noninvasive

fNIRS

- Functional near-infrared spectroscopy can investigate deeper brain structure (Rawnaque et al., 2020)
- Noninvasive
- Expensive
- Poor resolution
- Portable
- Wearable

Tools Registering Physiological Activity (outside the brain)

Electrocardiogram (ECG or EKG)

- Measures heart rate with the understanding that a slower heart rate is calm and an elevated heart rate is excited
- Real-time results measure emotion
- Low cost
- Noninvasive

Galvanic skin response (GSR or EDA)

- Most effective tool to distinguish between deceptive and non-deceptive answers (Widacki, 2015)
- Used for polygraph examinations
- Cannot offer conclusive evidence on the why of emotional activity (Weng, 2018)

Eye-tracking (ET)

- Measures where a person is looking
- A reliable indicator of emotional arousal (Marcin, 2020)
- Particularly useful for analyzing ads, websites, and at point of sale (Bočková, Hanák, & Michal, 2021)
- Widely used
- Affordable
- User-friendly

Facial Expression Analysis

- Facial Action Coding System (FACS)
    - "Fully standardized classification system of facial expressions based on anatomic features. It is used by expert human coders who carefully examine face videos and describe all facial expressions as combinations" (McKay, 2018)
    - Nonintrusive
    - Labor intensive
    - It does not produce real-time results
    - Expensive
- Facial electromyography (fEMG)
    - Sensors placed on the face coupled with automated observations via camera and software
    - Measures very subtle facial muscle movements
    - User-friendly
    - Noninvasive
    - Widely used
    - Inexpensive

Photoplethysmography (PPG) (Allen, 2007)

- Makes measurements at the skin surface that provides valuable information about the cardiovascular system (blood pressure and heart rate, to name a few)
- Noninvasive
- Simple to use
- Portable
- Inexpensive

Using neuromarketing tools, there are three categories of impacts of perception on consumers. The first is the valence of the emotional response. The second represents the degree of involvement (arousal) or the intensity of the feelings experienced. The third describes the degree of the participation of cognitive processes, including focusing attention on information, or how they pass into memory" (Bočková, Hanák, & Michal, 2021).

In 2017, academic research from the Advertising Research Foundation was published. Researchers at Temple University and NYU tested traditional marketing studies against various neuro methods, including eye tracking, heart rate, skin conductance, EEG, and fMRI. Subsequent analysis showed that fMRI provided the most significant improvement in predictive power over traditional methods but that other methods helped improve ad creativity and effectiveness (Harrell, 2019).

In addition to brain and biometric testing, the neuromarketing field is finding ways to bring together one or more technologies to build a more expansive consumer profile. Artificial Intelligence is considered one tool that aids in expanding insights while sifting

through reams of data that help to make neuromarketing testing more efficient regarding budget, time, and accurate results (Mouammine & Azdimousa, 2019).

Neuromarketing Case Studies

It might be assumed that there would be a plethora of shared research and case studies that would help to establish best practices for marketers, scientists, and academics alike, but the opposite is happening. With the influx of large corporations bringing neuromarketing labs in-house in recent years and independent agencies signing confidentiality agreements, neuromarketing results, for the most part, cannot be scientifically validated. Hence, these results remain a secret, raising the barrier to gaining insights into procedures, tools used, and outcomes (Brenninkmeijer, Schneider, & Woolgar, 2020).

Companies like Coca-Cola, Frito-Lay, GlaxoClineSmith, and IKEA, have all been noted as actively engaging in neuromarketing research. However, it is only possible to point to a few public case studies that inform the public (Gurgu & Gurgu, 2020). One example is the infamous Coca-Cola vs. Pepsi case study, the wine pricing test, Frito-Lay, GlaxoKlineSmith, and IKEA, as noted below:

Coca-Cola vs. Pepsi (2004)

Research Tool: Functional magnetic resonance imaging (fMRI).

Outcome: unidentified drinks showed no brain activity, and branded drinks showed increased activity.

Takeaway: brand knowledge alters a beverage's perception (Harrell, 2019).

Wine Pricing Test (2008)

Research Tool: Functional magnetic resonance imaging (fMRI).

Outcome: when consumers see a price, it may alter their perception of value.

Takeaway: two separate mental calculations took place from those tested: when pricing came first, the internal question asked by the test subject was, "is the product worth the price" but when the product came first, the internal question asked was, "do I like this product" (Harrell, 2019).

Frito-Lay (2009)

Research Tool: Electroencephalogram (EEG)

Outcome: Brain activity showed that women loved a Cheetos ad showing a prank pulled in a laundromat which a traditional focus group panned. “Frito-Lay Chief Marketing Officer Ann Mukherjee says brain-imaging tests can be more accurate than focus groups” (Bhatia, 2014).

Takeaway: Frito-Lay aired the ad with much success

GlaxoSmithKline

Research Tool: Galvanic Skin Response (GSR), eye tracking, fEMG (facial coding) along with self-reports (iMotions).

Outcome: previous product or brand engagement did not directly impact recall (Future Proof Insights, 2021).

Takeaway: #1, for recall to happen, marketing strategies should focus on driving an emotional response; #2, repeat business has to be earned repeatedly (Future Proof Insights, 2021).

IKEA

Research Tool: high-res EEG headsets and eye trackers.

Outcome: researchers learned about consumer reactions to green business strategies, which allowed IKEA to venture into other areas of their business, including solar home offerings, renewable plastics, and healthy food in their restaurants.

Takeaway: neuromarketing has the potential to reveal more insights than traditional market research methods, including feedback not initially asked for (Belascu, 2020).

Large Consumer Package Goods Company

Research Tool: SST and *Implicit Association Testing (IAT), a computer-based measure.

Outcome: agency that oversaw testing was able to guide the "large CPG company" towards determining the best brand imagery that made a neural impact; they found different trends in types of imagery (group shots vs. single product images).

Takeaway: "Large CPG company" felt more confident that their goals had been met in understanding the neural impact of varied product and brand imagery (Neuro-Insight).

*Note: Evidence from a 1998 Greenwald, McGhee, and Schwartz proposal that said the Implicit Association Test (IAT) measures individual differences in implicit social cognition was reviewed in 2019 and shows that there is insufficient evidence for this claim (Schimmack, The Implicit Association Test: A Method in Search of a Construct, 2019). A more recent study in 2021 showed no evidence that IATs measure implicit constructs (e.g., implicit self-esteem, implicit racial bias). "IAT proponents consistently ignore or misrepresent facts that challenge the validity of IATs as measures of individual differences in implicit cognitions. IATs are widely used without psychometric evidence of construct or predictive validity" (Schimmack, Invalid Claims About the Validity of Implicit Association Tests by Prisoners of the Implicit Social-Cognition Paradigm, 2021).

Challenges Facing Neuromarketing

Today's main challenge includes a lack of transparency (Wilson et al., 2008; Hensel et al., 2017; Trettel et al., 2017; Weng, 2018). Additionally, understanding and accounting for the impact of socioeconomic status and racism on the brain and biometric activity are also worrisome (Farah, 2017; Nemorin & Gandy, 2017; Rollins, 2021; Goncalves et al., 2022).

Lack of Transparency

Through the fast expansion of neuromarketing services, some agencies, starting around 2010, began to find a widening, fast-paced path toward attaining corporate clients (Ramsøy, 2019). The following issues have erupted since then:

- Without oversight, agencies and companies have built in-house labs and hired scientists to improve brain testing to predict brand, product, or service successes. Due to the lack of transparency, it is hard to say if the staff and scientists have the proper experience to run the tests and analyze the data (Wilson et al., 2008; Trettel et al., 2017; Brenninkmeijer et al., 2020). Also going unchecked is assurance that the test subjects are in line with the research objectives, which includes utilizing diverse sampling groups (e.g., gender, age, race) to provide legitimate results that could also lead to new learnings (Farah, 2017).
- Issues with relaying neuromarketing results can occur as data moves from the lab to the marketer and then to management or the client. Translating the lab data results into easy-to-digest, sharable content that leadership teams understand is challenging.

Questions to ask: Does the new language fully represent the original data? Has a story been attached to the data that makes false promises (Ramsøy, 2019)?

- Due to sponsorship relationships between lab testing and other science-based research, neuromarketing processes, outcomes, and discoveries remain concealed from the public. A corporate entity most likely pays for neuromarketing testing, and it is common for the company to demand that its results be confidential to remain competitive. When agencies funding experiments (e.g., grants, universities, government) do not have any vested interest in the outcomes, they do not keep their research processes and results private. The lack of transparency in neuromarketing experimentation is counter to scientific research tenets, which engage in discoveries through collaboration, as shown in the timeline of the discipline earlier in this paper. Such a situation presents a considerable challenge (Thomas, Pop, Iorga, & Ducu, 2017).

Reliability of Results: Socioeconomic Status and Race

No human brain exists out of context; human experiences affect how the brain and body react. Because of this, neuromarketing researchers should consider how socioeconomic status (SES), diversity equity and inclusion (DEI), and racism affect the brain and biometric activity. fMRI has proven that SES has an impact and found differences in how brain systems are deployed for executive function that has not been observed in behavioral studies (Farah, 2017). Figure 1 showcases three scenarios on how SES can affect brain structure:

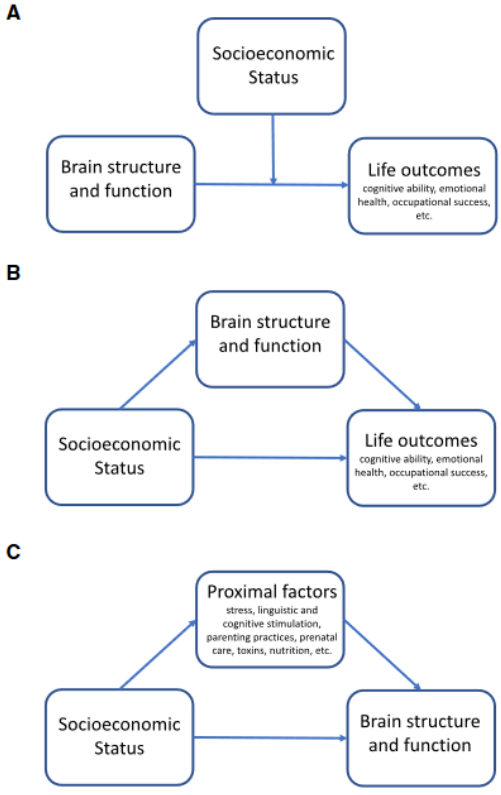

Figure 1. Possible Relations among the Causes and Consequences of SES and Its Neural Correlates
(A) Moderation of brain-behavior relations by SES.
(B) Mediation of behavioral consequences of SES by the brain.
(C) Mediation of SES-brain relations by proximal factors associated with SES.

Figure 1. Possible connections between SES and the brain connection. SOURCE: Adapted from Farah, 2017.

A recent experiment using dMRI showed that the effects of SES indicators on cerebellum cortex microstructure and integrity are weaker in Black than in White families. The finding is in line with the Marginalization-related Diminished Returns (MDRs), defined as weaker effects of SES indicators for Blacks and other racial and minority groups than Whites (Assari & Boyce, 2020). Another study found that in response to being socially excluded by Whites, Black participants appeared to be more distressed, showing more significant social pain-related neural activity and reduced emotion-regulatory neural activity (Masten, Telzer, & Eisenberger, 2011).

Neuroscientists and neuromarketing researchers, aware that brain activity can be uniquely based on phenomenology, should be required to focus on a more diverse human test sampling. Such a strategy could achieve more legitimate results, a topic rarely mentioned or investigated through neuromarketing research but is a challenge nonetheless. "Researchers risk reproducing scientific racism by omitting racial experiences that do not fit or are too tricky to understand in neurobiological calculations" (Rollins, 2021). That reality, coupled with the fact that the average neuromarketing research participant comes from a white middle-class background, skews insights compiled for global organizations appealing to multicultural communities. It may produce incomplete results due to a lack of diversity in the sampling because the subjects come from societies that are western, educated, industrialized, prosperous, and democratic. The behaviors of such human subjects cannot be generalized to the large segments of humanity living under different circumstances (Farah, 2017).

In addition to the lack of representation in lab experimentation sampling, biometric analysis, and secondary tools should also be reviewed for their efficacy in testing diverse subjects. AI is often used as a secondary neuromarketing tool. An example of such a tool is Artificial Intelligence (AI). In this case, it can be defined as the creation of intelligent systems composed of analytical processes whose goal is to propose solutions and algorithms that enhance our daily lives and learn from human behavior through data collection" (Mouammine & Azdimousa, 2019). Researchers are using AI to gather and interpret data from other neuro tool sources as it allows for a more in-depth and reliable understanding of consumer behavior (Mouammine & Azdimousa, 2019). The challenge using AI, as argued by Timnit Gebru, a former Google employee and founder of Black in A.I., is the concern about group thinking, insularity, and arrogance in the A.I. community (Metz, 2021; Bedoya, 2022). In short, AI tools have not yet learned how to recognize the differences between black faces because the images used to train it mainly had been of white faces. As a widely known constraint when using AI, the conflict is that neuromarketing researchers may not be accounting for this disparity (UN News Global Perspective Human stories, 2020).

Conclusions and Recommendations

As marketers understand the value of brain and biometric research, neuromarketing will continue to grow globally at a fast pace where the goal of attaining deeper consumer understanding drives the industry. While on the precipice of considerable innovation that could forever positively change how companies compete and grow, some challenges range from a lack of transparency, minimal standardization, and little to no research collaboration.

Additionally, with brain activity being synchronous with an individual's own lived experiences, socioeconomic status and racism need to be considered and measured with technologies that accurately account for the same, which includes the neuromarketing secondary tool AI. Knowing that an almost entirely white American male workforce is building various AI structures with data from personal experiences and knowledge, one can assume, and many accounts prove, that AI is far from infallible or fair. Furthermore, such bias is not considered when compiling and presenting neuromarketing data and insights.

As indicated in this paper, international collaborations involving ethical neuroscience and neuromarketing investigation models are essential if the endeavors to understand the consumer's brain selection and decision-making process are to be successful. Implementing such international collaborative connections might enable further data sharing and transparency to improve scientific excellence, reliability, trustworthiness, reproducibility, and outcomes. Most significantly, while communicating ideas, concepts, and data, researchers must also be willing to share ethical best practices that improve the transparency of the investigation process and the standards of welfare and care of consumers during neuromarketing experiments. Ultimately, the consumer markets to which research results impact.

While there are prominent differences in data protection standards, such as the European General Data Protection Regulation (GDPR) and the United States considerable lack of such protections, other standards must be harmonized to be effective. It would include ethical standards of neuromarketing experimentation and practice based on cultural values, race, ethnicity, and diversity. Neuromarketing researchers should acknowledge such differences and their potential effect on scientific collaborations and practice. If societal differences impede scientific progress and innovation, addressing the resulting issues is a step toward overcoming any problem. Nevertheless, how can we overcome this predicament so that collaborations can be implemented and maintained and efforts towards scientific progress mutually benefit all parties involved? Much research still needs to be conducted in this area. Overall, adopting a transparent approach that highlights and addresses these issues effectively is a basis for working towards improved ethical and transparent neuromarketing standards for research.

Research Limitations and Future Directions

The number of studies in the neuromarketing discipline continues to grow, which should contribute to the standardization and transparency of research. This research has many limitations as there are many other aspects to be investigated. Some other areas not covered in this study include understanding consumer emotions, reasoning, self-consciousness, moral free will, and decision-making process.

Another limitation of this study concerns ethical issues, which act as a barrier to the development of neuromarketing. More research needs to be developed in this area, although, to a certain extent, these are regulatory mechanisms for the progress of the field. Such limitations of this study encourage further research as it raises the potential benefit of neuroethics in neuromarketing and the reason societies and organizations in neuroscience use it. Of course, ethics must also be delineated between its limitations and risks.

Much more research needs to be conducted in this area. It would promote more dependable neuromarketing experiments, competitive data gathering, and insights for big data and thick data analysis, which could improve the support for finding pathways that foster economic and sustainable growth and drive innovation and inclusion globally. As neuromarketing

challenges are effectively addressed, adopters of neuromarketing today, multinational corporations, may be able to lean on more reliable tools.

We hope, by the end of the decade, if not sooner, it will be possible for neuromarketing researchers worldwide to work together and find commonalities that enable each country's standards of the individual and consumers' welfare and regulations to be workable and to consider the cultural differences. Much more research and collaboration need to exist in this area.

Neuromarketing could serve society and the environment, promoting a healthy life for individuals and society. Clear rules must be communicated to increase credibility and allow field development. Scientists and researchers should offset what needs to be achieved and the rules to be obeyed to conduct an ethical neuromarketing investigation. Neuroethics should reinforce consumers' education in making decisions based on their free will following accurate information provided. Neuroimaging technology can be used in a more favorable marketing research area. For instance, to assist consumers in finding what they need and guide them in living healthful lives instead of just giving them what they want. Responsibilities should be taken into consideration regarding subjects participating in studies, consumers, and researchers.

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