The Mind Behind the Buy: Exploring the World of Neuromarketing

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Pepsi or Coke? Believe it or not, these are the kinds of questions a neuroscientist may ask themselves. An emerging field, which combines the worlds of business and neuroscience, is known as neuro-marketing or consumer neuroscience (1). Put simply, consumer neuroscience involves studying the brain to better understand, predict, or even manipulate consumer behavior and decision making (1).

The Birth of Neuromarketing

Traditional market research, utilized by most Big Ten companies and business schools, was formed on the belief that logic and knowledge principally shape consumer's decisions (2). This belief led to the standardization of collecting data and analyzing consumer interest, based on the information captured from surveys, interviews, or questionnaires (2). However, bias is inevitable with these subjective methods of data collection. While one may assume that consumer choices are dictated by rational thinking, intuition and instinct actually dominate decision making (2). In fact, 95% of decision making takes place in the subconscious mind, while the other 5% pertains to rational thinking or the conscious mind (2). These two cognitive processes can be reduced to two systems; System 1 is responsible for making the majority of quick and automatic decisions, whereas System 2 oversees more intentional and slower cognitive processes. Neuromarketing offers new research methods (which will be explained later on) to measure System 1 processes, compared to traditional research methods which act upon System 2.

The term "neuro-marketing" first appeared in 2002, in the publication titled "Looking into the brain: On the prospects of neuromarketing," by Professor Ale Smidts, from the Rotterdam School of Management of the Erasmus University (3). Smidts was the first person (on record) to coin this new, strange field of neuroscience (3). Back in the 1990s, the first neuro-marketing corporation was established by marketing professor Gerald Zaltman, and neuroscientist Gemma Calvert (3, 4). On a trip to Nepal in 1990, Zaltman provided local inhabitants with disposable cameras and asked them to capture moments of their daily life (3, 4). Once the photographs were developed, Zaltman asked the same citizens to analyze the pictures. Interestingly, the photographs showed what could not be said (3,4). For example, many citizens refused to capture the feet of other citizens, as it exposed their poor economic status (3,4). This experiment inspired and led to the development of the Zaltman metaphor elicitation technique (ZMET).

The ZMET technique utilizes visual and sensory images (or in this case photographs) in combination with interviews, to provide insight into the unconscious brain, including emotions, feelings and thoughts (5). Many large business corporations such as Coca Cola, General Motors and Nestle quickly caught wind of the ZMET technique, and sought collaborations with Zaltman, to learn more about the neural substrates underlying the choices of their consumers (4,5). By 1999, Zaltman had begun to use a common neurological brain scanning tool, known as functional magnetic resonance imaging (fMRI), to demonstrate the relationship between advertising stimuli and a consumer's brain activity (4,5). Zaltman's ground-breaking research inspired the use of other brain scanning techniques, to be used in a marketing or business setting.
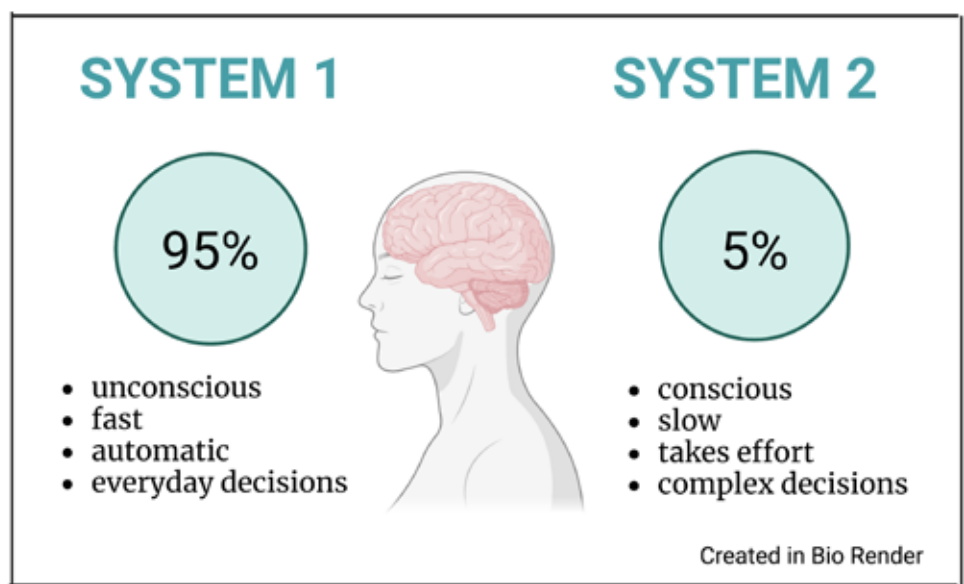
The "tools" behind Neuromarketing

Figure 1.Illustration depicting the two cognitive processes involved in decision making: System 1 and System 2.

Neuro-marketing tools can be classified into three different categories: behavioral, physiological and neurophysiological. Behavioral tools, such as surveys, observations and interviews, provide important insight into the behavior or attitudes of consumers. Physiological tools, such as ECG, eye-tracking, galvanic skin response, facial expression recognition, measure involuntary bodily functions, such as blood pressure, heart rate, and sweat. Neurophysiological tools measure brain activity and are divided into two categories: to measure electrical activity (EEG) and to measure metabolic brain activity (fMRI and fNRIS).

Currently, fMRI is one of the most utilized neuroimaging tools, along with EEG, in consumer neuroscience experiments (6). fMRI measures brain activity, through the detection of blood flow and oxygen levels, corresponding to neural activity (6). Areas that are active in the brain will require more oxygen, and, therefore, result in more blood flow towards that area (6). Task-related fMRI involves measuring metabolic changes after conducting a motor or cognitive task in response to a stimulus. Resting-state fMRI involves measuring metabolic changes while the brain is at rest, or without any stimulus or task. Regarding consumer behavior, fMRI are useful in providing detailed, emotional responses to determine levels of engagement and measuring recall (1,6). Within marketing so far, fMRI have been used to set pricing and improve branding (1,6). Disadvantages of fMRI include that they are incredibly expensive, must be performed in a lab, and are considered an invasive method (1,6). On a more positive note, however, fMRIs are considered the gold standard for measuring specific emotions (1,6).

This is because they measure the brain activity in regions involved in emotional responses, including the amygdala and nucleus accumbens (1,6). Similar to fMRI, functional near infrared spectroscopy (fNRIS) measures metabolic brain activity. In contrast to fMRI, fNRIS's resolution is very low, making it difficult to image deep structures of the brain. The application of fNIRS in neuromarketing research is new. So far, fNIRS has been used to better understand consumer attention, arousal, emotions, sensory perception and valence. fNIRS is a noise-free neuroimaging tool, which reduces any bias created from auditory stimuli.

Other common neuro-imaging techniques include electroencephalogram (EEG), which involves attaching several electrodes on the scalp in order to measure electrical activity or signals (1). As a result, images of electrical activity in the brain are produced as different amplitudes or frequencies (1). For marketing purposes, EEGs are good at measuring different levels of engagement and recall. Additionally, EEGs can help improve ads and branding (1,6). But EEGs are not as precise as fMRIs, although they can measure changes over smaller increments of time (1,6), so they are often used in combination with other neuromarketing tools.

While it might come as a surprise, eye-tracking devices (ET) are also considered a neuro-marketing device, and are the most commonly used. These can detect exactly where subjects direct their gaze (1). ET is principally used in neuromarketing to study visual behavior (involving fixation, gaze, pupil dilatation), customers' visual attention mechanisms and consumers' engagement. In fact, eye-tracking can help determine what grabs a consumer's attention, what confuses them or what
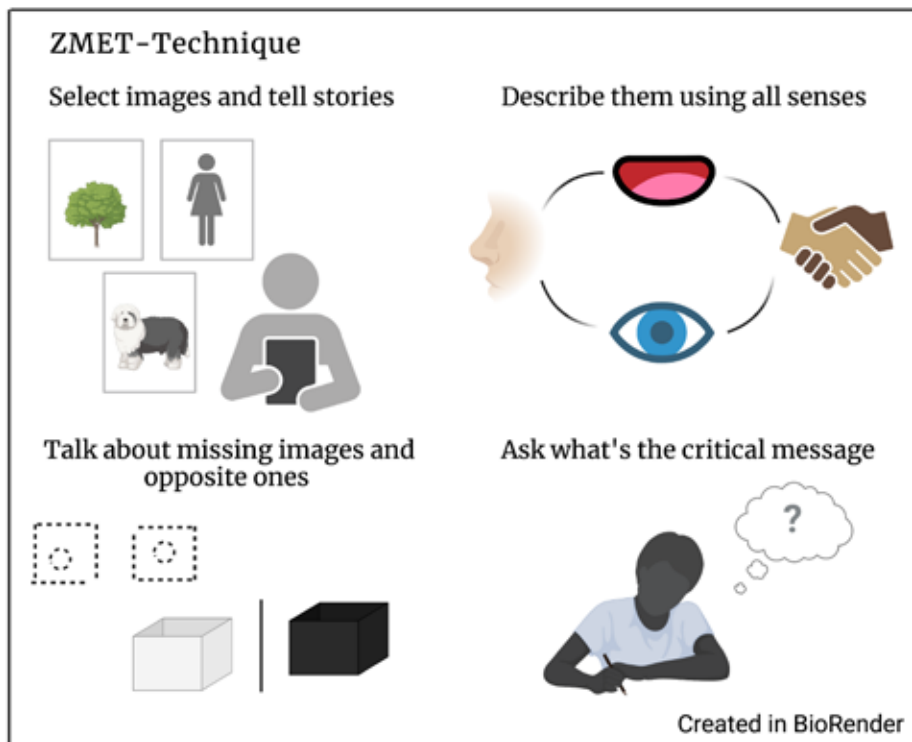

Figure 2.*The Zaltman metaphor elicitation technique (ZMET): visual and sensory images provide insight into the unconscious brain, including emotions, feelings, and thoughts, and is used to understand consumer behavior and decision making.*
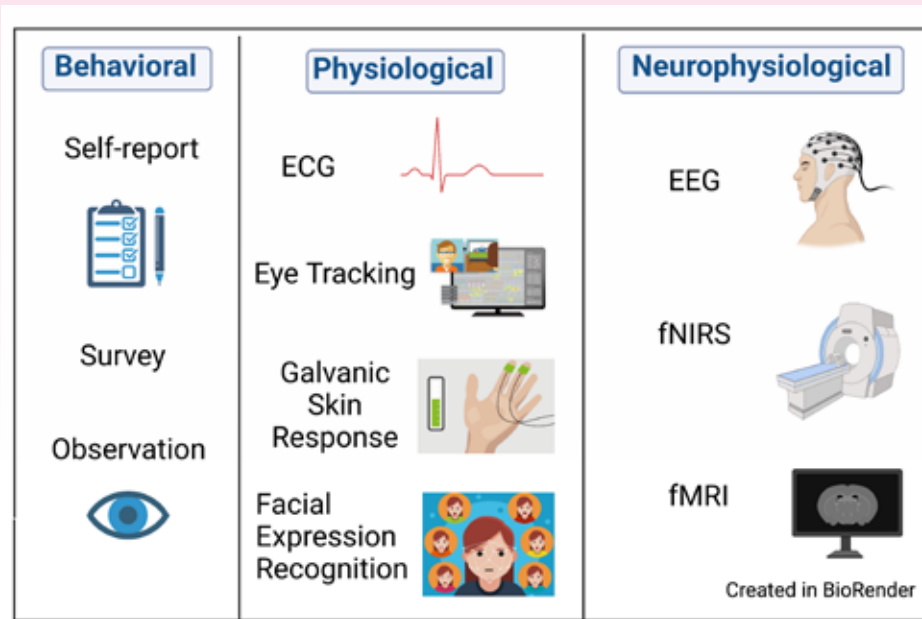
Figure 3.*Neuromarketing tools classified into three categories: behavioral, physiological, and neurophysiological. These tools are used to study and measure consumers' emotional and physiological responses to marketing stimuli.*

their speed of recognition is. ET has been used in marketing to improve website design, ads and packaging (1). The advantages of ET include that it is relatively inexpensive, easy to administer, and is best used in combination with biometrics (1,6). Unfortunately, ET does not have the ability to measure emotions (1,6). Currently, there are two types of ET devices available: wearable ones consisting of spectacles with an integrated camera and fixed ones which are controlled on a computer monitor.

Finally, the last tool which has become popularized within consumer neuroscience is biometrics. Biometrics can be used to measure skin conductance, heart rate and respiration (1,6). Regarding consumer behavior, biometrics measures levels of engagement, and can help determine whether a consumer's response is negative or positive toward a product (1,6). Biometrics have been used to improve ad content (1,6). Benefits of biometrics include that they

are best used in combination with other methods, such as eye tracking (1,6). Similarly, facial coding can be used to identify facial expressions. Facial expressions are important metrics of subjects' emotions and are usually divided into two main categories: observable and unobservable. Facial expression recognition software (fERS) can be used to measure positive or negative reactions to marketing stimuli (videos, ads). Within marketing, facial coding has been used to improve ad content (1,6). Facial coding is adept at conveying a consumer's general emotional response (1,6). Another asset of facial coding includes that it is relatively inexpensive (1,6). Ultimately, neuro-marketing provides access to the emotional and physiological sides of the human brain, which are otherwise impossible to capture using surveys, questionnaires or other traditional methods. Clearly, neuro-marketing is making a good case for itself. In fact, most of today's Big Ten companies including Apple and

Google are making the switch (1). Galvanic Skin Response, or GSR, is also an important tool for measuring changes in subject's arousal and valence based on activation levels of the autonomic nervous system. GSR equipment is uncomplicated and simple to move from place to place, making it ideal for all kinds of environments.

The beauty of neuromarketing tools is its profound ability to reveal how cognitive processes (such as perception, memory and attention) can improve marketing techniques by identifying brain regions involved in consumer behaviors. 45% of all neuromarketing studies investigate the impact of advertising on consumer behavior (preferences, satisfaction), emotions (positive, negative), and cognitive processes (attention, memory, engagement). Neuromarketing considers how consumer's experience, process and analyze advertisements. There are three different fields which can benefit from the application of neuromarketing into advertising: advertising effectiveness, target audience and salient features. An essential aspect of building a strong brand is creating an emotional experience for a consumer. Neuromarketing tools can be utilized to study emotional processes while a consumer chooses, experiences and remembers brand's name or logos. Price is often studied by neuromarketers as an effective measure that impacts a consumer's experience or behavior. There are three important factors in pricing strategy: price fairness, premium pricing, and promotion. Product design or development can also be improved with the help of neuromarketing. By understanding a consumer's preference for a product's internal and external characteristics, marketers can then improve product quality. Product experience refers to the interac-

tions between a consumer and a product, often seen in stores, in tourism and in destination marketing.

Putting Neuro-marketing into Practice

This brings us back to my original question: Pepsi or Coke? A research group back in 2004, studied this exact dilemma, which took the world by storm (7). Despite Pepsi and Coke having almost identical chemical formulas, they are considered a polarizing topic to most individuals. This study sparked the question: how do cultural messages affect our opinions enough to change behavioral preferences about something as mundane as a soda? Well here's how they tested it: researchers served participants Coke and Pepsi with two different conditions (7). The first condition involved an anonymous delivery of Coke and Pepsi, while the second condition involved revealing the brands during delivery (7). After participants indulged in Coke and Pepsi, they went through fMRI scans and brain responses were recorded (7). The hippocampus is a brain structure located deep in the temporal lobe and an important part of the limbic system, a cortical region which regulates emotions, memory, and learning (8). On the other hand, the dorsolateral prefrontal cortex (dlPFC) is a brain region within the frontal lobe and is associated with general executive control functions (e.g., decision making) including working memory (8). For participants who underwent the anonymous delivery, where brand names weren't revealed, sensory information strongly influenced drink preferences, as can be seen by activity in the ventromedial prefrontal cortex (7). For the other condition, brand names or labels guided preferences involving dlPFC and hippocampus (7). These findings imply that there are two interacting brain systems in the prefrontal cortex, one for taste and one for recalling cultural influence; the interaction of these two determine an individual's preferences (7). This study paved the way for all future neuro-marketing research, especially using brain-scanning techniques.

As stated previously, one of the principal advantages of neuro-marketing is the ability to combine several neuro-marketing techniques, in order to collect as much data as possible (1,6). On the contrary, one of the principal drawbacks of brain imaging techniques includes they are not able to be utilized outside of a laboratory setting (1,6). A study in 2012, accomplishes both, as participants go shopping at a real grocery store while wearing eye-tracking devices and EEG brain responses are being recorded in real time (9). Eye tracking devices were used to locate which objects or products participants were locating or engaging with (9). Meanwhile, EEG amplifiers were used to conduct EEG readings throughout the experiment (9). Results found that the selection of items such as alcohol, candy, frozen dessert, chips and crackers created the largest brain responses, with the least amount of time spent to select an item (9). The selection of items such as fruits and vegetables resulted in lowest brain responses, with the most amount of time required to select these items (9). There was a large emotional response or attribute to certain food items (9). Ultimately, items considered to be rewards or a necessity produced the largest positive responses (9). Items considered to be unnecessary or unattractive showed an opposite pattern (9). This study clearly demonstrates the novelty of neuro-marketing to be used in a non-laboratory setting, in addition to combining both EEG and eye-tracking devices.
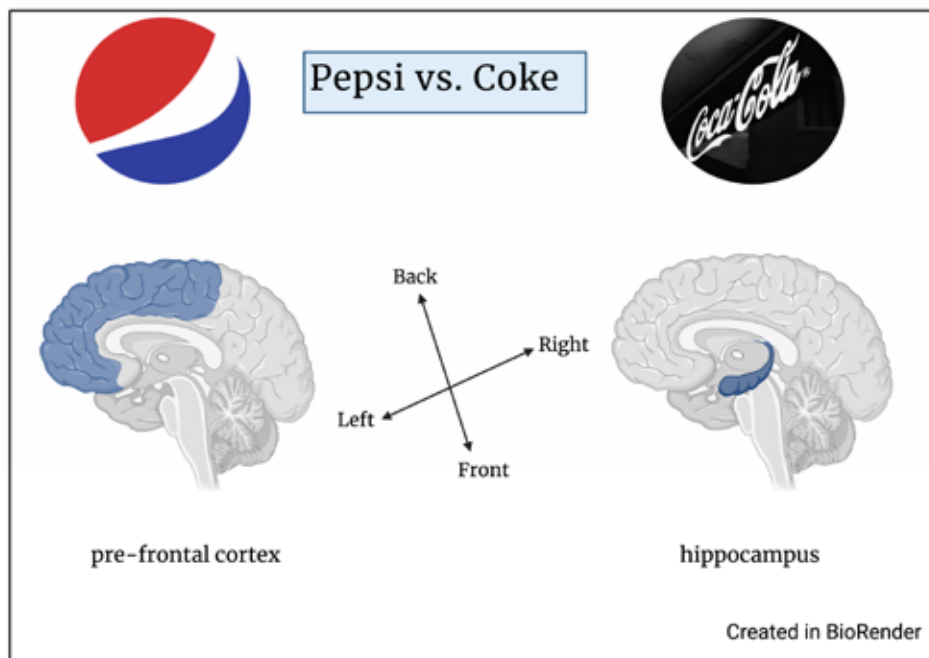
Not only did the Pepsi vs.

Figure 4. Participants who consumed Coke and Pepsi in an anonymous condition showed strong activation in the ventromedial prefrontal cortex, while those who were aware of the brand names showed activation in the dorsolateral prefrontal cortex and hippocampus.

Coke study spark major buzz, leading to neuromarketing becoming more widely accepted within the food industry; it gave rise to the first two consulting firms offering research and consulting services using neuro-marketing techniques: Brighthouse and SalesBrain (10). These consulting firms validated the existence of neuro-marketing as a real practice for the first time. Unfortunately, with certification comes controversy and criticism. Neuro-marketing quickly became a polarized subject. Some people felt strongly about only using neuro-marketing strategies within marketing, as the sole objective measure for consumer behavior, with its rapidity and cost as added benefits, while others were highly skeptical of the legitimacy of this research tool (11). To put a number to the name, there were around 800,000 searches for neuro-marketing in 2008, which quickly bumped up to a million and a half in 2021 (11). Ultimately, all this hype led to the founding of the Neuromarketing Business and Science Association (NMB-SA), whose mission is to promote neuro-marketing internationally and establish guidelines and a regulatory committee for the field (11). This committee will become useful later on in the article, as the ethical controversies surrounding neuro-marketing will be further addressed.

After the Coke versus Pepsi study was published, companies realized they could use neuro-marketing to learn more about their consumer's demographic, including race, sexuality and socioeconomic status. A study in 2005, involved both female and male participants during a simulated shopping session (12). Researchers were curious to see if there were any gender differences in consumer choice as they went shopping (12). Additionally, they wanted to see how likely participants would pick products they had purchased before or if they would be willing to take a risk and buy a new product (12). This particular study utilizes magnetoencephalography (MEG) as a brain imaging technique, by recording small magnetic fields produced by electrical currents, occurring naturally in the brain (12). Ultimately, researchers determined that there are distinct neuronal pathways for predictable (fast) choices and unpredictable (slow) choices (12). Additionally, they attributed different neuronal stages to cortical activations, including working memory, memory recall, semantic analysis, integration, binding, vocalization and judgment (12). Ultimately, gender differences were spotted around the time interval 400 ms after decisional onset, as women were found with a stronger activation in the left parietal occipital lobe, while males had stronger activation in the right temporal lobe (12). The parietal occipital lobe has important functions in vision perception, as well as spatial navigation and reasoning (8). On the other hand, the temporal lobe plays an important role with processing auditory information (8). Moreover, both men and women employed different strategies, as women made decisions based on the knowledge of the product to buy, while men honed in on their spatial memory (12). Based on this study, it is clear that when used right, there is a diverse range of applications neuro-marketing can be used for.

Besides gender differences, researchers were curious to distinguish if cultural differences have any significant impact when individuals engage with marketing material. In fact, a study by Handy TC. et al. 2019 tested just this, by observing if there are any cultural differences when watching the same kind of advertising related to carbonated beverages (12). Two different cultures were studied including Italy (Western)

and China (Eastern) (12). EEG tests were conducted on both cultures, as participants watched the TV commercial advertising a carbonated beverage (12). Attention spans of both groups were measured, it was hypothesized that these differences would be determined by the plot of the advertisement (12). Ultimately, it was found that the reveal of the brand of carbonated beverages during the advertisement held the attention spans for both groups (12). During the advertisement, there is a moment when an actor is playing guitar by himself, as well as scenes of collective groups of people (12). Cultural differences between both groups were reflected in different attention spans during the plot of the advertisement (12). The Chinese audience followed along more intently to collective scenes of people, while the Italian audience resonated more with the solo scene of the singer (12). Ideas of interdependence were found to be highly valued in Eastern cultures such as China, Japan, and Korea. On the contrary, ideas of independence were highly valued in Western cultures such as North America and Europe (12). Ultimately, there is so much more to be learned about neuro-forecasting that can tell us about the intersections between socioeconomic status, race, and sexuality with marketing.

The ethical regulation of neuro-marketing proves to be one of the biggest challenges facing this practice today. It is understandable for people to feel uncomfortable about the idea of companies knowing their innermost private thoughts, feelings and emotions. However, the concept of the intrusion of privacy is sadly not new to us. We live in a society consumed with social media and the internet, constantly collecting information or even listening to our conversations every

day, without our consent. Similarly, many individuals' concerns about neuro-marketing include they are unable to choose or consent to which information will be shared or not (13). However, the range of information which can be extracted today from neuro-marketing is still limited (13). That's not to say it won't change in the near future, with the evolution of technology and as researchers become more comfortable and knowledgeable in the field. Ultimately, the biggest fear existing around neuro-marketing can be boiled down to free will (13). Researchers are worried about the evolution of neuro-marketing becoming so advanced, corporations will be able to control or even change the minds of their consumers (13). This possibility is especially concerning for neurological or socioeconomically disadvantaged populations, as they are the most vulnerable (13). There is no knowing what kind of impact full mind control or manipulation using neuro-marketing may have on the economic state or overall health and well being of a country, especially if this practice expands internationally. Some researchers are asking for an ethical board, in order to regulate and prevent the use of mind control or manipulation for malicious reasons.

Mind Control or Neuro-forecasting?

While absolute mind control and manipulation hasn't been achieved yet, there is neuro-forecasting, which was proposed by two researchers, Knutson and Genevsky in 2018 (13). Neuro-forecasting refers to the ability to anticipate or predict future consumer purchasing decisions, using brain imaging (13). This concept has broader applications besides predicting product choices, as the success of songs, movies and other types of media are well within the realm of reach (13). It is no secret we are in the age of digitization neuro-forecasting may be able to influence and measure consumer behavior and brand loyalty from a digital platform, not just in real life (13). Neuro-forecasting is able to measure verbal and non-verbal responses to new products, prices and advertising promotions (13). It is true that the trend of online shopping has become more popular nowadays, instead of going into a store and picking up a product. If there is a clear link established between neuro-forecasting and

the digital world, this could have significant benefits for industries online or repercussions for industries unable to be translatable online.

With domestic box revenues reaching around $5.99 billion in 2022, it is clear that the movie industry is a booming industry (14). Advertising serves as an essential component to not only ensure the success of a movie but also maximize revenues. With the help of neuro-forecasting, marketers can be better informed before making any decisions regarding money allocation, releasing trailers or even gauging public interest. A study in 2015, utilized both stated movie preferences and neural measures from EEG, to predict several different kinds of movie's success (14). 32 participants underwent EEG recordings, while watching 18 movie trailers, in a random fashion. (14). After viewing a movie trailer, participants rated the movies and suggested how much they would pay to watch it (14). After EEG recordings were conducted, participants were provided with the DVDs of the 18 movies they had just watched and organized movies in the order of most to least likely to watch (14). This particular study found that box-office revenue sales of a movie could be forecasted, due to increased activity at beta gamma frequencies at fronto-central sites (14). Ultimately, results showed that EEG data contains unique information, not accessible with traditional research methods (or in this case self-reports) (14). Based on this study, there is an additive value to using EEGs in neuro-forecasting; box-office revenue predictions improved significantly, with both EEG data and subjective data (14).

In a similar vein, another novel use of neuro-forecasting includes predicting the success of songs, especially before their release dates. A study in 2021, attempted to answer this question by looking at neural synchrony within the context of music (15). Neural synchrony has shown promise in determining a movie's popularity, in addition to being utilized as a predictor for public appreciation (15). Thirty one participants in the following study underwent EEG readings, in order to capture moment to moment neural similarity, while listening to music (15). Other neuro-marketing techniques were utilized to estimate likeability ratings, including Frontal Alpha Asymmetry and engagement (15). Frontal Asymmetry is a typical indicator of asymmetric brain activity in the frontal cortex, specifically between the left hemisphere and right hemisphere (15). Frontal asymmetry is widely relevant in models ranging from emotional processing to psychopathology and is considered a marker of affective states and traits (15). Participants were selected between the ages of 19 and 65 (15). Fragments of two songs were used as stimuli, including an R&B album called "It Was Good Until It Wasn't" by Kehlani and a pop album called "How I'm Feeling Now" by Charli XCX (15). The following albums were chosen because of their close release dates and being that they are different music genres (15). At the beginning of the experiment, participants were asked to rank the following music genres from 1 (preferred genre) to 6 (least preferred genre): rock, pop, alternative, Hip Hop/rap, jazz/blues, and R&B (15). Next, participants were asked to listen to and rate fragments of songs, while their brain activity was measured by an EEG device (15). On an individual level, other brain measures were shown to relate to individual subjective likeability ratings, including Frontal Alpha Asymmetry and engagement when combined with the

factors artist and single release (15). Ultimately, these results show the predictive value of brain activity measures outperforms stated preferences (15). Within the music industry, there is a marketing budget and the highest scoring songs are often released as promotional singles, therefore, using novel techniques such as neural synchrony may be key to ensure success of future music.

The Future is Personal

Neuromarketing has always been and will continue to be an influential and significant part of our lives. Whether it's affecting how we perceive movies or songs, deciding what type of ice cream we want to buy, or even what news we read, there is no escape. The use of neuro-marketing quickly expanded past the food industry, leading other important industries to take note and reap the benefits. While the gates have surely been opened, it is still unclear whether it is for good or for worse. Therefore, it is imperative that we as consumers understand the origin, tools and applications of consumer neuroscience, so that we can avoid these marketing traps and navigate the marketing world with control. Neuro-marketing is truly like a double edged sword. If used for good, different brands can create positive close relationships with consumers by better understanding their emotions, desires and needs. On the other hand, neuro-marketing can be used to promote harmful habits such as increasing sales of unhealthy food or facilitating false political propaganda. Not to mention, there is a very real possibility of complete mind control or manipulation using neuro-marketing. I guess you

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