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Review Article

Myths and Misunderstandings in Consumer Neuroscience

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ABSTRACT

The interdisciplinary field of consumer neuroscience utilizes techniques from psychology, neuroscience, economics, and marketing to gain a more comprehensive understanding of the consumer experience. Ethical, legal, and social consequences of integrating physiological and brain technology into market research have raised concerns, especially as this field continues to expand. Further, the expectations of the technology and research findings are often tainted by misrepresentation of false claims, neuromyths or inaccurate reporting. Herein, an explanation of consumer neuroscience is provided, as well as its limited power of persuasion. Concerns for autonomy, control, and privacy are addressed by reviewing common misconceptions of the influence consumer neuroscience has on decision making. Additionally, this paper clarifies the limitations of certain techniques implemented and discusses the importance of public knowledge to combat inaccurate interpretations of data results. By acknowledging the best applications for these tools, the value of consumer neuroscience in market research is revealed.

Keywords: Consumer neuroscience; Ethics; Privacy; Market research; Technology; Mind-reading; Neuroscience

INTRODUCTION

The Facebook-Cambridge Analytica scandal has become a household name, synonymous with invasion of privacy and violation of ethical practice [1,2]. The mix of quickly advancing technology, social behavior, and over-reaching marketing research is a cautionary tale of ethical infringements for executives and consumers alike. But the lesson is much deeper than just about fake news and social platform privacy. The hasty reconstructing of research ethics and business value chains around new technologies is introducing moral concerns across many industries.

The current business environment is a free-for-all race as seen in market research where suppliers compete to impress clients with new capabilities. What is at stake isn't just which research providers survive, but whether the last standing companies end up in a high-tech Wild West where anything goes. One of the fields most effected by advancing technology, with a mist of mythology and misinformation, has been in the relatively new field of consumer neuroscience (also referred to as neuro marketing, applied neuroscience, or behavioural science [3-5].

The field of consumer neuroscience is plagued with myths and misunderstandings that often lead to concerns about the ethics of conducting consumer research with neuroscientific methodologies. Consumer neuroscience providers, eager to sell services, perpetuate neuromyths. These neuromyths lead to fundamental misunderstandings of the science. Misunderstanding the science leads to misuse and fear.

In this article we will start with a review for basic understanding of consumer neuroscience and the delicate relationship between research providers and industry clients. We will discuss how misconceptions and neuro-hype have led to a misunderstanding about what consumer neuroscience can and cannot do, and how that impacts current ethical and privacy concerns. Additionally, this paper touches on how this type of research affects the consumers themselves and the ethics around consumer privacy and autonomy in a world of using neuro- and behavioural science to influence consumer behavior.

LITERATURE REVIEW

What is consumer neuroscience?

Consumer neuroscience stems from the idea that consumer researchers can use methodologies from neuroscience and psychology to test what is driving consumer decisions. Drivers of decision making, such as choosing which product to buy, can be anything from elements of an advertisement to the color of packaging or any of the attributes of a food product. The goal is to use these methodologies to assess the consumer experience beyond, or in place of, the traditional approach of explicitly asking the consumer. These implicit approaches (non-cognitive or non-conscious measures) are often touted as deeper dives into the

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consumer psyche.

Along a continuum of non-conscious to conscious thinking and decision making (Figure 1), researchers can tap into cognitive and non-cognitive processes to gain insights into the influences and drivers surrounding a consumer's decision-making process. The neuroscience toolbox has many great options for exploring the consumer experience from measuring skin temperature and heart rate to more advanced technologies such as EEG (electroencephalogram) and fMRI (functional magnetic resonance imaging [6,7]. However, it is important to recognize that non-conscious activity is not easy to measure. The human brain is far too complicated to be reduced to a simple algorithm read by one device to deliver a straightforward answer (which is not to say that physiological measures can't determine something about consumers' reactions and decision processes, but more so that it is not the same as mind reading). Neuro measurements provide nuanced and complicated results that are heavily influenced by research design.

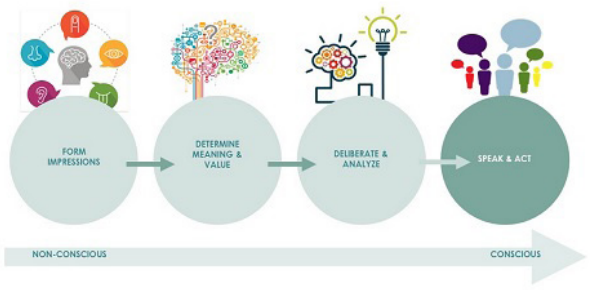

Figure 1: An image displaying the non-conscious to conscious decision continuum. Any experience starts with neural receptors sensing changes in the environment, which in turn forms impressions in the brain. The brain then interprets those signals into meaningful information which is then analysed and interpreted and finally used as guidance for behaviour. This process starts as a non-conscious experience and becomes more cognitive as the decision making becomes more conscious.

With more accessible tools (cheaper headsets, greater popularity, etc.), what was once a very academic field has become more mainstream in consumer and market research, especially in the areas of advertising, marketing, product research and measuring consumer emotions. Finding the best tool for measuring emotions is a highly sought-after goal within consumer neuroscience since it presents an opportunity to better connect consumers with products, concepts, or packaging. However, this search has been plagued by difficulties. The complexity of studying and identifying emotion, as well as the need to choose the right tool for the right research question, stresses the need for interdisciplinary and thoughtful approaches. Developing a purposeful, emotional research design can aid in gaining a comprehensive understanding of the consumer experience [8].

Trust: on myths and misunderstandings

Traditional market research methodologies, such as interviews and surveys, are the backbone of a good business strategy. Getting the voice of the consumer is one of the key factors used in maintaining competitiveness. Therefore, being able to trust in research results from market research is paramount to healthy, functioning industry, and often, this is entrusted to research providers and partners. In the case of Facebook-Cambridge Analytica, this problem goes beyond the trust between consumer-company relations. Trust in research extends into the company-research provider relationship. Companies not only need to be cautious and protective of their consumers, but they also need to be cautious of the research providers feeding them data. From using consumer research to drive innovations to claims substantiation and development, the cost of losing trust goes straight to the bottom line.

In 2018, Der Spiegle magazine shook the world of market research with a damning article: "Manipulation in market research: How surveys are forged and customers are cheated." The article revealed internal documents leaked from various (popular and large) market research companies proving repeated and deliberate research fraud. The range of deceptive market research studies spanned from sham interviews to fake respondents, bringing into question even the most trusted forms of traditional market research.

For companies to obtain that consumer voice, they frequently rely on market and consumer research providers. And by relying on a third party to provide that product, trust is required. The B2B (business to business) relationship stands solidly on trust. On an already existing background of mistrust in surveys (i.e., that surveys do not tell the true voice of the consumer), the Der Spiegle article brought some confirmations to those arguing about the accuracy and quality of the data collected via market research. But the Der Spiegel investigation is the only one of many to put a spotlight on this growing threat. More and more market research samples contain fake respondents, fake credentials, and fake answers, making any decisions based on the study results perilous. Many industry insiders are concerned about these threats but don't currently have an effective way to address them.

The idea of using consumer neuroscience in addition to traditional market research is an appealing one, especially given the current climate of mistrust in the traditional measures, but also for a business desire of "faster, better, cheaper." This drive, however, opens the door to hyped mythologies about what neuroscience can provide for consumer research. Consumer neuroscience companies have taken to suggesting that not only traditional market research providers are distrustful, but also consumers cannot be trusted to tell the truth. Such that when answering a survey, consumers may just give the responses they think are wanted as opposed to how they truly feel. These companies (neuro marketers) suggest that by using methodologies from neuroscience and psychology, researchers can bypass the consumer voice and go straight to their unfiltered, "true," and unconscious thoughts.

"Face the evidence: customers don't know what they want! Traditional research methods won't help you find what triggers decisions in their brains because they are based on self-reports"-neuromarketing company website

"We create solutions to better understand consumers' true emotions, motives and drivers"-neuromarketing company website

This line of sales pitch is puffery at its best and dangerous at its worst. From a research provider perspective, the danger is that in applying these methodologies incorrectly, the well is poisoned, so to speak. and clients become disappointed and disillusioned by the

reality and their poor experiences.

Neuro-hype: What consumer neuroscience can and cannot do

Applied neuroscience is appealing but is most useful as a complement, rather than a substitute, to an existing methodology [9]. Technical inconveniences in using neuroscience to study consumer experiences (such as experimental noise, reliability of measures, etc.) do exist. Therefore, the application of neuroscience and psychological methods should be done thoughtfully with care to correctly use certain tools to best answer specific experimental conditions. This means recognizing the limitations of these, often over-hyped, tools.

It is important to ensure that research objectives dictate the choice of the methodology rather than include a measure which may not provide useful information to answering the research question. The availability and normalization of a diverse portfolio of neuro-tools to use may adjust how research is ultimately approached. It is then even more important to make sure the right and most valid tool is used for the specific research situation. Further, the integration between measures, such as traditional explicit measurements with implicit or neuroscientific tools, will probably be more common in the future as the neuro-hype fades and researchers better understand the utility of combining tools. But certainly, and currently, consumer neuroscience results cannot stand on their own and require cognitive self-report to be performed alongside for real interpretation.

When consumer neuroscience research providers suggest that these tools can read minds and replace cognitive self-report, it brings into question the ethics of using such tools. Is it ethical to record physiological data that tells us what someone is thinking? Is it ethical to use that data to influence the consumer's behavior?

Before we can even answer these questions, however, it's important to note what the science can and cannot do. Can consumer neuroscience tools really even read the mind? Can we access full memories and knowledge via physiological measures? Can we tell what a consumer is thinking about an experience or product without them realizing it? Can physiological data lead to product designs that force people to do something beyond their own intention?

It is our position that these concerns are based on fundamental misunderstandings of what physiological data are really telling us.

Do you see what I see? When new technology is developed, the unfamiliar terminology or measurements may be intimidating. In order to decipher any technology's real purpose or value, it is crucial to dive into the complexities to ensure its validity and reliability. Oversimplifications of complex topics may create misunderstandings and misinformation. Catchy slogans, click bait titles and generic explanations are also contributing factors to the spread of misleading claims. By questioning how measures are made and information is inferred, the context of a claim or result is grounded in caveats, nuances, or limitations.

A frequent tool glamorized for its capability to provide neuro feedback is the electroencephalography (EEG). An EEG is a non-invasive method to record the electrical activity along the scalp for measuring brain states [10,11]. However, consumer-grade EEG products entered the market over ten years ago as a potential "thought control" tool, which adjusted more recently to claims of "brain enhancement" and "cognitive wellness" [12]. These marketing claims neglect the complexity of the brain by assuming any technological measurement would tap into the brain to override an explicit feeling or perceived experience. Yet, a uni-dimensional approach to breaking into an individual's perspective of the world is flawed. Specific mental states are complex and do not have a direct relationship to any type of neural activity [13]. Furthermore, to actually detect patterns in brain activity requires an immense amount of control over an environment, and even then, still includes uncertainty regarding what caused certain types of brain activity. Data artifact, such as electrical crosstalk from various muscle movements in the body, can cause interference with recordings. Additionally, an EEG does not have the strength to reach deep cortical activity due to its non-invasive nature. While retesting is an option for building confidence, the interpretation of the data relies on the researchers to draw conclusions and recognize the fundamental limitations in the tools utilized. Pseudoscience and disinformation often result from incorrect interpretations of factual data.

Even when data is properly collected, analysed and peer reviewed, opportunity for lofty claims still exists. Research about using a combination of decoding and image reconstruction techniques to investigate participant perceptions via an EEG recording [14]. The research followed the scientific method with results suggesting, under specific conditions, EEG data can reproduce mental impressions of facial images. Yet, the particular conditions should not be overlooked. The research was conducted in a lab with optimal control over the environment, the exposure, the setup and the manipulation. Additionally, the stimulus included 32 blocks over 2 sessions with a total of 260 trials. The investigation focused on young adult white male face stimuli, with each face being viewed twice in a session. The images were controlled for with luminance, accessories (such as jewellery or hair), Root Mean Square (RMS) contrast, positioning, size, and expression [14]. This allowed the classification algorithm methods employed in this research to decode the data more simply.

The level of control within the experiment heavily influenced the researchers' abilities to reconstruct the face images, something that is not feasible in real-world application. Yet, this research received a lot of buzz for its "mind reading" capabilities and for what it accomplished, while minimizing the conditions it was accomplished in. The truth is the research conducted did not read the participants' minds. Patterns of reactions were matched to a trained algorithm to help distinguish and categorize trends. The algorithm was programmed to follow a code and was capable of matching certain codes to reconstruct a repeated visual, hence debunking the notion of mind reading. This critique is not to undermine the impressive work of this research team, but to acknowledge the results for what they are. EEG decoding, regardless of the AI-powered EEG technology programmed into the analysis, is still very much in its infancy and limited in its reliability [13]. By digging into the details, the caveats and nuances of research are revealed and easily humble over exaggerated blogs circling the internet.

Do you know what I know? While the advancement in neuro technology provides a lot of excitement for what is in store in the future, technology can be easily misrepresented by those eager to expedite an already rapidly evolving field. Using neuro technology to explore an individual's perceived experience is a complicated endeavour to unravel. The logistical and ethical implications hinder scientific data's ability to truly glean what a person remembers or understands. Along with EEG, functional magnetic resonance

imaging (fMRI) is frequently associated with exploring memories through brain activity. Functional magnetic resonance imaging or functional MRI (fMRI) is a neuroimaging procedure which measures brain activity by detecting changes in blood flow. Measuring changes in magnetization between oxygen-rich and oxygen-poor blood is how information about brain activity is extracted from this tool [15]. Labs have made great strides in exploring human neuroscience research with the use of fMRI as a safe way to measure internal activity; however, scientists may overpromise the tool's ability to tap into an individual's subconscious [16].

Understanding how humans learn and recall experiences are some of the most fundamental questions within neuroscience and psychology. The complicated nature of these questions makes it even more suspicious to trust just one tool to provide answers. The reconstruction of a memory, even with extended training periods and machine learning algorithms, still does not break into what thoughts are being construed in an individual's mind. Explored creating and recalling memories by having participants watch an episode of a TV show and then describe the plot during an fMRI scan [17]. Although the research findings suggest similar patterns in brain activity, the fMRI output does not reconstruct the memory. This research uses information from the fMRI to understand the way the brain reacts to the request to recall information by seeing what regions are activated. However, the research does not explain why paths of activation occur. All fMRI research is correlational due to its nature of paralleling mental activity and behavior and, therefore, cannot establish causal connections [18]. Additionally, brain activity is highly distributed at any point; therefore, it is seldomly the case where a particular brain region is activated solely by one cognitive process [19]. Multiple structures work in tandem, cohesively, to complete thoughts. Studies exploring brain activity through the medium of an fMRI must remain ambiguous since the tool is only capable of measuring broad brain areas as opposed to retracing a single neuron. Underlying assumptions about the way the brain and conscious are interwoven make it impossible to extract detailed memories using tools currently available.

While the study cited above can be categorized as a form of memory acquisition, the use of fMRI within this context must consider the malleability of memories and perceptions. The literature about learning and recollection acknowledges the fallibility of memories due to modifications, suppressions, or enhancements [20]. Internal visual perceptions on personal experiences are neither right nor wrong due to the subjectivity of their nature. An individual's reality may differ from what occurred. Hence, the notion using neuroimaging tools, such as fMRI, to replace polygraph machines seems unrealistic from what little is understood about the relationship among memories, blood flow and neural activity. When considering the fMRI research which explored deception, it included groups of participants who assumingly complied with instructions provided since there was no benefit to do anything else. Yet, the opposite conditions would be true if this method were to be employed in a legal setting. Individual differences, as well as the possibility of manipulating a baseline response, could easily cause an fMRI lie-detector to be inconclusive [18]. Overall, the accuracy, specificity, and validity of neuro technology in real-world situations deserves intensive evaluations when considering any type of application, especially when involving the topics of memory reconstruction and lie detection.

Research on cognition within neuroscience, whether using fMRI or an EEG, does not have the capabilities of peering into an individual's thoughts. Like most neuro technology, information or scans from an fMRI is not to blame for the exaggerated findings researchers are reporting. Researchers, as well as those peer-reviewing, new studies, must be held accountable for ensuring limitations and improper use of certain tools are highlighted so readers have clarity on every method's purpose and value.

Do you feel what I feel? Given the complex nature of emotion, finding a comprehensive methodology to measure this phenomenon is challenging. Although the literature lacks a definition of emotion, multiple components of emotion such as physiological arousal, motivation, expressive motor behavior, action tendencies, and subjective feelings have widespread acceptance [21]. Yet, the information collected from these tools, especially when used as a singular measurement, is limited and can only emphasize specific components of the overall experience which result in an emotion. By learning more about these tools and what is measured, the emotional experience which can be determined is not detailed enough to violate an individual's privacy.

When studying emotion through measurements of different parameters of the human body, having a dimension of a traditional, quantitative questionnaire or conjoint analysis embedded in the research is important. No tool can replace a self-reported experience to evaluate subjective feelings. Autonomic measures for arousal (skin conductance), motivation (heart rate variability), emotional valence (fEMG), affective states such as stress (skin temperature) and eye tracking (visual attention) allow researchers to measure physiological and behavioural responses [22]. However, none of these tools can provide particular emotional profiles such as guilt or gratitude. These non-invasive tools simply measure bodily responses to an event, person, item, or situation, without detailing the explicit experience of the emotion.

Attempts at classifying emotions via facial coding have been made by various psychologists. Based on the emotional theories [23,24,25], facial coding developed as a system to taxonomize human facial movements into emotional categories. Facial active coding system (FACS) extracts geometrical features of faces from captured video recordings and then produces temporal profiles of each facial movement including categorization of the calculated facial emotions and intensities. Facial coding is criticized due to design flaws in its foundational research, which included a selection of universal "basic emotions." Some of the criticisms of Ekman's work are based on experimental and naturalistic studies by several other emotion psychologists that have not found evidence to support Ekman's categorization or universality of facial expressions [26-30]. While surprise can be positive or negative depending on the situation, the basic emotion theory skews towards negative emotions (fear, anger, sad, contempt, disgust) given that only one positive emotion (happiness) is part of the emotional profile. Other concerns surrounding facial coding include neutral baselines misread or participants mimicking the exposure. Oversight can lead to inaccurate data, and thus muddy the outcome of the findings.

Another exploration in categorizing emotions through technology is with the use of neuroimaging. The theoretical model of discrete basic emotions suggests a single neural system is thought to be dedicated to the processes of each discrete emotion, such as happiness, sadness, anger, and fear [31,32,33]. To identify distinct neural pathways dedicated to each individual emotion, fMRI is utilized to explores brain activity of specific emotional and emotion-neutral exposures. The results are inconsistent with little agreement on categorizing basic emotions [31]. Ultimately,

the use of facial expressions and emotional profiling clearly has questionable validity and reliability, making it an unlikely threat to infringe on the privacy of internal emotions.

Don't make me think! Although marketers use tools from psychology and neuroscience to obtain information beyond surveys or focus groups, the results cannot coerce a consumer to do anything. The notion of a "buy-button" in the brain grossly oversimplifies the complexity of humans. Any ability to predict or influence a consumer is not distinctive to applied consumer neuroscience since the same opportunities for impact exist within other facets of marketing and behavioural studies. Use the example of tracking purchase behavior of females to find trends in a 27-30-day window to promote certain products based on a consumer's menstrual cycle [34]. These nudging strategies found in behavioural economics do not require neuroscience techniques to enhance purchase intention and are arguably taking more advantage of the lack of consumer awareness. After all, it is impossible to discretely wire a consumer up without his or her knowledge. Furthermore, to conduct any ethical research on human participants involves full transparency via a signed consent form which explicitly states what the research entails. Such standards should be upheld in order to assure the researchers and the participants both have a mutual understanding and expectation of the research experience.

Partaking in consumer neuroscience research is not jeopardizing autonomy. While the physiological factors measured are outside the realm of control, the consumer choice ultimately remains free. Any physiological or neuroscientific recordings cannot expose any internal dialogues or opinions, and the technology is not designed as a deterministic predictor of behavior. Consider the multitude of circumstances possible in any given decision. Now integrate every single individual's personal associations and experiences which shape perceptions of situations. Even with all that information, a forecast on an individual's decision is still only probabilistic. The decision-making process cannot be localized to a single neural pathway or region of the brain-the process includes both conscious and subconscious activities working together to gather the information necessary to make the perceived advantageous choice. Furthermore, the buying decision includes a temporal component of long- and short-term considerations which include forced trade-offs [35]. Consumers and marketers alike benefit when a purchase decision results in satisfaction. The company may increase profits when utilizing consumer neuroscience, but the findings allow for more effective advertising or more considerate products to meet consumer needs. This approach gives companies the tools to create better products, packaging, and communications to fit the lifestyles of consumers. However, for consumers to fully appreciate the value consumer neuroscience provides, the public must be educated on what this field entails rather than misconceptions of manipulation.

DISCUSSION AND CONCLUSION

Consumer neuroscience, as a field, will only continue to grow. More and more brands, products, and communications will use consumer neuroscience to optimize the consumer experience. Technology will continue to advance, and measures will become more accurate. End clients need to better understand these tools in order to be sure they are using valid approaches, but also to protect their own consumers. While it does not seem that real "mind reading" will be possible in the immediate future, concerns around these technologies will remain.

If research providers want to boost credibility with clients, communication is key. Today, people want, and often need, to understand what is in their products (be it a consumer product or a research product). And arguably, end research clients should want to know more about the practices and methodologies which research providers are using to develop their insights. Implementing change is the way to regain trust among consumers and clients at both the product and store level. And that's not a fad or trend, it's a harsh reality.

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