Ethical Issues in Neuromarketing

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ABSTRACT

Purpose – The purpose of this paper is to examine neuromarketing in order to define ethical issues that raise criticism in this area and identify approaches how to address such issues.
Methodology approach – This research is conducted in the form of a critical literature review. Having examined the background of neuromarketing, its terminology and techniques, findings and implications for consumer research, an outline of the main ethical implications follows, after which the review ends in a discussion of counter measures. The finalization of the literature review will be done by concluding whether the research questions have been answered, if further investigation is needed and whether new questions have arisen.
Findings – The findings of the study indicate that neuromarketing offers substantial potential for consumer research; efficiently obtaining more accurate data and new insights on human behavior than has been previously possible. The regulations and standards in the area of neuromarketing are weak and fragile. It is that in this context that ethical issues have arisen. The two main concerns are the violation of consumer's autonomy and privacy. Autonomy claims should be re-considered and privacy concerns can be substantially reduced if clear global standards are implemented.
Practical implications – The research proposition holds a practical relevance as well as a theoretical introduction regarding the research topic. It sharpens the awareness of the implications in consumer protection and privacy rights. Thus, this research is relevant in providing a better understanding of the requirements for organizations, public and marketers when using neuroscientific methods. It also provides an overview of the ethical challenges they might face.
Originality/value –This paper adds value to the existing literature as it provides a distinct overview of neuromarketing, its ethical issues and discusses potential pre-emptive measures.

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Keywords

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1. INTRODUCTION

1.1 Preface

For decades, marketers have been trying to understand human behavior with traditional measuring tools such as focus groups and interviews to clarify what consumers truly want. Unfortunately, consumers are not always able to articulate their true feelings (Kenning & Plassmann, 2008; Thaler, 2000) which limit the usability of the traditional marketing tools.

The disclosure of the new science called neuroscience has revealed what was invisible to traditional market research (Ariely & Berns, 2010; Dimoka et al, 2012; Knutson & Cooper, 2005). It enables marketers to look into the consumer's unconscious mind, thoughts and feelings (Hubert & Kenning, 2008). Neuroscience studies human automatic and unconscious systems (Hubert & Kenning, 2008) by measuring the blood flow in the brain in contrast to their current action. The findings of neuroscience evoked interest in the landscape of marketing (Knutson & Cooper, 2005) at least for the following two reasons. First marketing hopes "it might be cheaper and faster than current marketing tools" and secondly is the expectation that "it could provide hidden information about products that would otherwise be unobtainable" (Ariely & Berns, 2010, p.13). With specific neuroscientific techniques such as the functional Magnetic Resonance Imaging (fMRI) and Electroencephalography (EEG) the impact of marketing stimuli on consumers can now be studied in a different way.

Although neuromarketing promises significant benefits, the technique to capture people's unconscious thoughts for a commercial purpose has raised several criticisms on consumer deception and privacy invasiveness (Hammou, Galib & Melloul, 2013; Wilson, Gaines & Hill, 2008). One can argue that neuromarketers are able to manipulate consumer behavior (Palmer & Hedberg, 2013) and consumer ability to make logical purchasing decisions. In addition to the above, consumer rights protection and the threat to autonomy are questioned (Egrie & Bietsch, 2014).

While ethical issues of neuromarketing have been addressed in previous research, the social aspects of autonomy and privacy have not been addressed to an appropriate degree. The research adds value to this aspect.

1.2 Research questions

The main objective of this study is to clarify the ethical issues of neuroscientific methods within marketing research. The following research problem has been formulated:

What are the main ethical issues of neuromarketing and what is the proper response to such issues in case of neuromarketing research?

A critical literature review is given in this study to answer the above questions and to examine the following research questions:

1. What is Neuromarketing?

2. What are the ethical issues of marketing in general and how are they categorized?

3. What are the ethical issues in the area of neuromarketing?

4. How do marketers, public and policy makers respond to the ethical issues?

5. How to address ethical issues in neuromarketing?

1.3 Paper overview

The research paper is structured in the following way: First, the paper presents an overview of neuromarketing, its history, terminology and techniques, and the benefits and limitations for consumer research. Second, the main ethical implications are described. Third, counter measures by marketers, public and policy makers are formulated. Fourth, the paper outlines whether the research questions are answered, if further investigation is needed and whether new questions are arisen.

1.4 Research methodology

This research is conducted by reviewing articles of different scholars, critically discussing them and comparing their opinions concerning all the aspects of the research questions. The related articles were collected by accessing different scientific search engines such as Scopus (the world's leading database of scientific articles), Google scholar (www.scholar.google.com) and Scirus (www.scirus.com). The scientific citation index was used in order to find high-impact articles from peer-reviewed and influential journals concerning the research in neuromarketing. For example, journals such as the 'Journal of Marketing Research' and the ´Journal of Consumer Research´ were reviewed which both are ranked with an A+ according to the VHB-Jourqual2 by Schrader and Hennig-Thurau (2009). The academic foundation of neuromarketing with its implication is often associated generally with marketing, but other sources are law, philosophy, psychology and sociology. This paper includes sources from several disciplines in order to reflect the development and diversity of neuromarketing.

2. LITERATURE REVIEW

2.1 History of Neuromarketing

There have been several economic predictions made throughout history where some have been proven wrong and some right. In 2000, Thaler made a prediction that "Homo Economicus will evolve into Homo Sapiens"(p.140). In the past, economic theories have relied on homo economicus, a concept which states that individuals are simply unemotional and rational beings. The concept of homo sapiens as human beings with feelings, emotions and subconscious mind was neglected due to its intricacy and lack of measurement (Thaler, 2000). However, Thaler predicted that economists will realize that findings of other sciences are equally useful, which in turn can be incorporated into economic theories. This can be used to sharpen the traditional economic picture of individuals. Meanwhile other researchers also stated that traditional "economic models do not provide a satisfying theory of how individuals differ"(Camerer, Loewenstein & Prelec, 2005, p.52) and hence relying solely on the Homo Economicus will not be beneficial in the future (Camerer et al., 2005; Slovic, 1995).

Despite the decades of segregation, Thaler´s (2000) prediction has been proven right. Economics are increasingly relying on behavior sciences to solve economic problems.

Another scientific study that reveals human behavior is called neuroscience. It is built on a conclusion drawn by Angelo Mosso, an Italian physiologist, in 1881. Angelo Mosso stated that a variation in the blood flow of the brain is associated with variation to mental action. The idea that the mind can be studied by measuring the blood flow in the brain was forgotten over the time until neuroscience emerged in the 1960s. The term neuroscience was first coined in 1962 and it "uses imaging of brain activity and other techniques to infer details about how the brain works"(Camerer et al., 2005, p.9). It is a (scientific) "study of the brain and nervous system"and "is beginning to allow direct measurement of thoughts and feelings"(Camerer et al., 2005, p.10). In fact, this science uncovers the "physiological elements and somatic variables"(Hubert & Kenning, 2008,

p.273) "that may prove relevant to economics"(Camere et al., 2005, p.15). Despite some initial skepticism, to neuroscience, neuroeconomics has emerged in the late 1990s.

There are several similar definitions related to neuroeconomics (Camerer et al., 2005; Hubert & Kenning, 2008; Lee, Broderick & Chamberlain, 2007, Rustichini, 2005) but all these definitions can be summarized into the latest definition given by Hubert and Kenning proposed in 2008. Hubert and Kenning (2008) state that "neuroeconomics employs methods originally used in brain research for investigating economic problems, and furthers the advance of integrating neuroscientific findings into the economic science"(p.272). As the ultimate aim of economics is to explain and predict human behavior concerning given choices, the reason for neuroscience to have an increased interest in economics is stimuli and forces (Hubert & Kenning, 2008; Rustichini, 2005). In order to make those predictions and explanations, economists make use of a set of data to analyze the given situation. Neuroscience "provides new data in addition to those we have available from theoretical, empirical and experimental research on human behavior. This is the set of psycho physiological data"(Rustichini, 2005, p.201). This clarifies why economics are increasingly interested in neuroscientific findings.

The new landscape of neuroscience is not similar to the older situation, where human psychology was thought to be rational and easy to categorize. Presently, several new insights are coming into realization effectively. It is in this context that one can understand why neuroscience has evoked some skepticism and intricacy. However, lately neuroscience has become so widely influential that several industries have started to become interested (Smith, Chorvat & McCabe, 2004). It has even been pushed into the mainstream of economics, even further to politics and marketing.

In fact, another area called neuromarketing has been developed from neuroeconomics (Hubert & Kenning, 2008; Murphy, Illes & Reiner, 2008; Wilson et al., 2008) as the consolidation of marketing and neuroscience. Emerging in the beginning of the 20th century, it seems to have followed a similar path such as development from economics to behavioral economics, skepticism and slow development in the beginning but then greatly in the last decades (Ariely & Berns, 2010; Hammou et al., 2013).

This interest was caused due to the acceptance of the following two facts. Firstly, it was discovered that human behavior "requires a fluid interaction between controlled and automatic processes and between cognitive and effective systems "(Camerer et al., 2005, p.11). It effectively revealed that consumers cannot solely be understood as rational beings, because the human behavior is controlled by automatic processes, emotions and unconscious causes (Bechara & Damasio 2005; Camerer et al., 2005; Ciprian-Marcel, Lăcrămioara, Ioana & Maria, 2009; Knutson, 2004; Thaler, 2000). Secondly, the use of modern brain science (neuroscience) has proven to measure those automatic and unconscious systems (Hubert & Kenning, 2008).

These findings enable marketer to gain insights into the thoughts and feelings of consumer, which was thought to be invisible in traditional marketing tools (Ariely & Berns, 2010; Dimoka et al., 2012). This has been a great contribution for markteres and researcher to understand consumer behavior in more depth. The leading global market research company Nielsen, for instance, has recently acquired the neuromarketing firm NeuroFocus (Prescott, 2014). According to Prescott (2014) NeuroFocus, through its neurological metrics, enables Nielsen to better understand customers' responses to marketing stimuli in order to develop more efficient and powerful advertising messages.

2.2 Definition of Neuromarketing

Several scholars (Lindstrom, 2012; Mosso, 1881) have been naming the term neuromarketing in literature, but no particular scholar could be named as the founder of neuromarketing, nor has adopted a general definition. However the word neuromarketing first appeared in a press release done by BrightHouse in 2002. BrightHouse was one of the first advertising companies using brain science methods for marketing research (Fisher, Chin & Klitzman, 2010). Several different definitions concerning neuromarketing can be found in recent times. According to Lindstrom (2012) neuromarketing is "an intriguing marriage of marketing and science"and thus the "window into the human mind" and the key to "the subconscious thoughts, feelings, and desires that drive the purchasing"(p.3). Hubert and Kenning (2008) define "the application of the findings from consumer neuroscience within the scope of managerial practice"(p.274) as neuromarketing. At this point, it is necessary to note that the "terms (neuromarketing and consumer neuroscience) are still used synonymously"(Hubert & Kenning, 2008, p.274) throughout literature. However Hubert and Kenning (2008) make a distinction between these terms. They state that while "´consumer neuroscience´ comprises the scientific proceeding"(Hubert & Kenning, 2008, p.274), neuromarketing is rather associated as a business field (Fisher et al., 2010). This has received several criticisms and has been engaged in an ongoing discussion whether neuromarketing can be seen as a science or a business field. Lee et al. (2007) highlights that neuromarketing should not be solely related to a commercial meaning. It should further encompass the wider scope of neuromarketing "such as inter and intra-organizational research". They defined neuromarketing as "the application of neuroscientific methods to analyze and understand human behavior in relation to markets and marketing exchanges"(Lee et al., 2007, p.200). This paper refers to the definition by Lee et al. (2007). It remains appropriately to discover various ethical issues of neuromarketing but still captures and conveys the principal idea.

2.3 Neuromarketing techniques

Neuromarketing uses diverse techniques of brain science to measure consumer's behavior. According to Postma (2013) these techniques fall into three main categories:

- External reflexes (based on body signals)
- Input-/output models (based on behavior signals)
- Internal reflexes (based on brain signals)

2.3.1 External reflexes

This technique measures consumer responses of the body on marketing stimuli. The most important measures include the following (Postma, 2013):

Empathic Design: The observation of consumers while they are using products and services in their own environment. Instead of asking consumers questions, empathic design is an objective observation based solely on behavior patterns (Leonard & Rayport, 1997).

Facial Coding: The measurement of facial movements. Individuals can show a wide variety of emotions (such as anger or joy) on the face. Facial expressions can be measured at two levels: observable changes in facial expressions, such as a smile, and unobservable micro-muscle movements.

Eye tracking: The measurement of eye movements and pupil dilation of consumers while viewing marketing stimuli. It investigates what consumers are really looking at.

The external reflexes are rather a supplement tool or an exclusive method of neuromarketing (Bergstrom et al., 2014).

2.3.2 Input-/output model

This approach measures the impact of marketing stimuli on people's reaction, done through online panel studies or various kinds of social media content analysis. The aim is to investigate which input variables (photos, price, words, features, etc. in commercials and on billboards), result in which kind of consumer output, such as brand attitude and purchase intention. The information data is then incorporated in an input-/output model (Postma, 2013). This is done in order to maximize advertising effectiveness and improve the (online) customer experience (Pispers & Dabrowski, 2013).

The input-/output model is used as both an independent tool and as a supplement to other neuromarketing techniques.

2.3.3 Internal reflexes

Internal reflexes analyze consumer's brain responses on marketing stimuli. It can be divided into two main categories: blood flow measures and electrical measures. The blood flow measures infer brain activity from blood flow changes; the main tool being the functional Magnetic Resonance Imaging (fMRI). The measurements directly captured are the electrical and magnetic signals produced by the brain. The other approaches are: Electroencephalography (EEG) and Magnetoencephalography (MEG) (Ariely and Berns, 2010).

According to Häusel (2013) the main internal reflex tools used in neuromarketing are the following:

- Electroencephalography (EEG): This procedure is carried out by attaching electrodes to subjects' heads and measuring fluctuations in electrical activity below the scalp which is caused by neural activity. It is thus a noninvasive technology and measures the intensity of consumers' intuitive and non rational responses on marketing stimuli, such as excitement or frustration.
- Magnetoenzephalografie (MEG) is another electrical technique that is similar to EEG. However this technique uses very sensitive devices such as SQUIDs (Superconducting Quantum Interference Device) and examines the electrical fields generated under the scalp and above the brain. Compared to EEG, MEW delivers superior signal quality and high time resolution (the minimum amount of time needed to produce a scan).
- Functional Magnetic Resonance Imaging (fMRI): This technique investigates consumers' brain activity by measuring blood flow. When a region in the brain is active, oxygen-rich blood flow is increasing in this area. Here fMRI relies on a research study by the honored chemist Linus Pauling. He discovered that oxygen-rich blood radiate a smaller magnetic field than oxygen-poor blood. Thus magnetic waves give an insight into the active areas of the brain. To perform this study, the test subject lies in tube like machine which tackles magnetic waves. The output of this measurement is a brain scan image, with the active areas flashed up. For example if the brain part ´hippocampus´ is shown to be light up on the scan, it means that the memory area is active, and the test subject is saving or recalling from its memory. The content of information that are saved or recalled however cannot be declared. Thus, marketers can detect which areas in the brain are active while the consumer is exposed to the marketing stimuli and consequently knows what kind of pleasure and emotion consumers feel.

While comparing electrical and blood flow measurements techniques, the main difference is EEG and MEG tell you when brain areas are active and fMRI tells where or which bran area is active. Moreover, electrical techniques measure brain activity at the speed of cognition, in milliseconds, fMRI however record with duration of two to 8 seconds. Electrical measures however cannot localize activity inside the brain with the same precision as fMRI (Morin, 2011). This is because the techniques measurements are based solely on the surface of the scalp. Another difference is that while measuring electrical signals of the brain, the body produces electric signals as well. Muscle movements produce a significant higher signal than brain activity, which means that the smallest movement, such as eye movement, of the test subject can disrupt the research.

In general, the internal reflexes measures have however become the most favored method (Hammou et al., 2013; Morin, 2011), as they tend to be more accurate and credible as other neuromarketing techniques (Bergstrom et al., 2014, Morin, 2011).

2.4 What does neuromarketing techniques measure?

To understand the criticism and issues arising among neuromarketing techniques, it is essential to state the outcomes of the techniques.

In empathic design, researchers measure "nonverbal cues of their (people) and responses through body language", (Leonard & Rayport, 1997, p.111). The customer data that emerge are mostly qualitative as "most data are gathered from visual, auditory, and sensory cues, thus empathic design teams frequently use photography and videography as tools" (Leonard & Rayport, 1997, p.110). The consumer responses that are measured are emotional arousal, choices, preferences and unarticulated needs. Compared to empathic design, facial coding techniques study unconscious emotions as well. Thus, it is primarily used to probe experienced emotions (Grandjean, Cornélis & Lobet-Maris, 2008) consciously and unconsciously. Eye tracking, however, provides several additional insights to emotions. It gives insights into consumers' attention, interest and attraction (Raschke, Blascheck & Burch, 2014). It further records preferences among alternative choices and the final product choice (Khushaba, Wise, Kodagoda, Louviere, Kahn & Townsend, 2013; Shi et al., 2013). The gathered data is quantitative such as frequency rates of eye gaze and pupil sizes and is often visualized in a graphic (Appendix 1a and Appendix 1b). The input-/output model measures similar consumer responses through data published on the Internet. The ideal source of information used within this model is the ´big data´ of the Internet. It includes data obtained by connection to the internet such as the IP address, contact information (such as name and address) and financial information (such as credit card number and security code) obtained from financing and payment transaction and data published by customer on "the social media space: blogs, podcasts, forums, and online communities" (Constantinides, Romero & Boria, 2009, p. 17). Monitoring consumer online can be thus a rich source of personal data and also represents useful customer responses in attention, interest, preferences and final product choice. The output data is textual, visual or aural content.

The EEG studies human behavior in more complex way due to its brain study. The output is a waveform image with several peaks. The mental states and emotions of consumers are difficult to integrate and interpret with the EEG. It has however

been the most efficient technique to probe unconscious motivation on marketing stimuli (Morin, 2011). The main findings produced by EEG are its ability to identify memory activation, motivation, changes in behavior, preferences and product choices (Khushaba et al., 2013). MEG is able to measure the behavior responses in real time and is thus more exactly. It is however not a good technique to measure the sub cortical areas (Morin, 2011).

FMRI is the most complex technique used in neuromarketing but delivers the most precise imaging and insights. Marketers make use of fMRI by analyzing "the activation of different brain regions, in-depth analysis of consumers to predict the behavior of the underlying neural activity, as well as what factors affects the predictions made" (Gang, Lin, Qi & Yan, 2012, p.288). It is the only technique to measure the value creation in the human brain, and thus reveal sub cortical areas of the brain (Kenning & Plassmann, 2008; Thaler, 2000). The most controversy finding is the possibility to predict behavior by fMRI, thus a researcher records behavior pattern before the test subject is aware of itself. The test subject behaves, as predicted, in an eight second delay (Gang et al., 2012). The output data is mostly displayed visually in a brain scan with the activated brain highlighted (Kenning, Plassmann & Ahlert, 2007).

To conclude, there are several data sets and consumer responses emerged from neuromarketing techniques. These outcomes include personal issues (motivation), emotions (valence and arousal), antecedent of human behavior (motivation, interest, attention, and preferences), automatic processes and cognitive process (value behavior, memorization, behavior predictions, and sensitivity) (Dimoka et al., 2012). As outlined in the previous section, each technique concentrates on a different finite area. Thus, an overview is formulated (Appendix 2).

3. STRENGTH AND WEAKNESSES OF NEUROMARKETING

Though each technique captures a different respond signal that is directly relevant for neuromarketing, they have still generated few controversies as well. In the following, the major advantages and disadvantages of neuromarketing techniques are explained and the limitations and risks are briefly mentioned.

3.1 Major advantages of neuromarketing techniques

Neuromarketing techniques show a variety of benefits. The greatest advantage has been the new insights obtained from neuromarketing techniques. Neuromarketing techniques obtain more accurate data and new kind of insights than traditional tools (Ariely & Berns, 2010; Dimoka et al., 2012; Knutson & Cooper, 2005; Lewis & Phil, 2004). They measure unconscious processes that "people are unable, uncomfortable, or unwilling to truthfully self-report" (Dimoka et al., 2012, p.2). Moreover, while traditional tools may be affected by respond bias, neuromarketing techniques, in particular internal measurers, can measure behavior without respond bias. And lastly neuromarketing techniques allow real-time measurement that allows temporal precision in measurements (Dimoka et al., 2012). Neuromarketing techniques can thus mostly provide data that "is complementary, supplementary, or even contradictory to self reporting, observation, and secondary data because they are less subjective and are not restricted to conscious awareness and revealed preferences" (Dimoka et al., 2012, p.3).

Other advantages of neuromarketing techniques are the technical and practical requirements of the external measures and input-/output models. High-resolution webcams become standards on nearly all computers, laptops and mobile devices. These webcams can be used to measure facial coding and eye tracking at any given time across the world. Webcam-based measurements have become compelling advantages for neuromarketers. The costs are low and the turnaround times are fast. The perhaps biggest benefit is that research studies can now be conducted anywhere in the world at any point in time. Research studies are no longer lab-based and enables neuromarketers to reach a wider scope of audience that would be impossible with traditional or the internal measurers (Bergstrom, Duda, Hawkins & McGill, 2014). The portable and low priced equipment enable neuromarketing techniques also to become widely available and affordable (Shi et al., 2013, p.1022). Furthermore, new technology enables marketers also a more convenient way to analyze data. Software systems for facial coding, for instance, are available that automatically identify and classify facial expressions.

3.2 Major disadvantages of neuromarketing techniques

Neuromarketing techniques also have notable disadvantages. The disadvantages are their complexity, cost, interpreting and measurement issues. Most disadvantages are equal across all techniques but differ in their extent (Table 2).

A primary weakness of neuromarketing techniques is cost. Whereas the cots for the external reflex measures and the input-/output model are manageable, the internal reflex measures are very expensive, not just in its acquisition but also in its operation. For instance a fMRI scanner costs up to 1, 5 million Euros and running a fMRI machine with 15 to 20 test subjects costs 30.000 Euro (Lewis & Phil, 2004; Häusel, 2013). The reason is among others that it requires highly trained professionals for conducting and analyzing the findings. "Due to the high costs, the number of participating subjects is usually very low" (Gang et al., 2012, p.288). This is another disadvantage of neuromarketing techniques in particular concerning internal reflex measurers. It usually cannot study large samples.

Another important issue is the possibility of respond bias. This is mainly a disadvantage for the external measures and the input-/output model. Within these techniques, test subjects may become overly aware of the fact that they are being observed

Table 2 Comparison of neuromarketing techniques on cost, accessibility, complicity, and sensitivity

Neuromarketing technique		Cost	Accessibility	Complexity	Sensitivity
External reflexes	*Empathic design*	Moderate	Difficult	Varies	Low
	Facial coding	Low	Easy	Moderate	Low
	Eye tracking	Low	Easy	Low	Low
The input-/output model		Low	Easy	Low	Low
Internal reflexes	*EEG*	Moderate	Difficult	High	Moderate
	MEG	High	Difficult	High	Moderate
	fMRI	Highest	Difficult	Very high	High

which, in turn, may impact the way they behave and respond (Leonard & Rayport, 1997). Moreover face expressions are controlled partially under voluntary control; people can also experience emotion without showing a face expression or movement. Thus, accuracy and precision are limited (Grandjean et al., 2008). Another limitation is that consumers express opinions on the internet that they believe are socially acceptable. And if it is an opinion they think others do not share, they are less likely to reveal it. The abundance of "false" information has much in common with the limitations that arise with conventional marketing approaches (interviews, focus groups & surveys) and need to be treated with caution. Due to respond bias, the external measures and the input-/output model make a good substitute method to internal reflexes as they avoid largely respond bias.

All neuromarketing techniques require a high level of technical expertise to conduct a research study (Hammou et al., 2013; Schiessl, Duda, Thölke & Fischer, 2003). The fMRI is the most advanced technology and the research study is similar to a medical procedure, it requires highly trained staff, such as medical doctors and high skilled researcher. The analysis of eye tracking data is less difficult (Khushaba et al., 2013). As specialists benefit from general standardized metrics, a thorough understanding of data quality and application of statistical analysis is still required. Moreover, observation and data analyze is immense time consuming (Schiessl et al., 2003). Researcher and observers are restricted to the test subject's environment or a medical labor, and cannot conduct the study at any particular place. Another technical limitation is that measurement tools are very sensitive. For instance fMRI scanners are very sensitive to any movement, hence the test subject needs to lie very still in the machine otherwise the resulting image is blurred and the study needs to be repeated.

Another limitation is the interpretation of brain images (Gang et al., 2012). The output data of EEG and MEG shows memory and motivation brain activity and the output of fMRI are often visualized in a brain scan with the activated brain region highlighted (Kenning et al., 2007). There is a tendency to follow from such a result that the highlighted brain region equals one particular mental function. The production of emotions, thoughts and feelings are however complex functions in various brain regions (Häusel, 2013). Furthermore brain regions are active due to various reasons (Gang et al., 2012). This often leads to wrong conclusions and over-interpretations such as ´all emotional activity is situated in brain region A´ or ´brain region A is active when mental state b occurs´. Even if the fMRI reveal the activities of the cerebrum; the deep-rooted activities in the limbic system, that regulates behavior and emotions, cannot be gripped. The reason why the test subject feels pleasure or pain or what they actually think stays unknown. Consumer's brain remains thus a hidden "black box" within this technique (Morin, 2011). Also, within external measurers, the interpretation of study results involves difficulties. For example, pupil dilation does not respond differentially to emotional changes and is thus not a valid measurement tool. Furthermore, any changes in brightness changes pupil dilation (Bergstrom et al., 2014).

Each techniques has its own strengths and weaknesses, there is however no single technique best suited for all research studies, thus there is an increase interest in combine existing techniques in order to combine the strengths in each (Häusel, 2013). The external reflexes and the input-/output model are often used as a supplement method of internal techniques of neuromarketing (Bergstrom et al., 2014).

3.3 Ethical considerations

Neuromarketing has also ethical implications. Ethic is defined as reflection on norms and values that guide our behavior in terms of good and bad or responsible and irresponsible (Crane & Matten, 2007). It is "about some form of rationalization of morality" (Crane & Matten, 2007, p. 1806).

The critics of neuromarketing claim that the techniques are invasive and that the intent is clearly manipulative. The concern that consumers are manipulated in their purchasing decisions when applying neuromarketing findings is also expressed (Lee et al., 2007; Palmer & Hedberg, 2013). Another area of concern is that neuromarketers are able to find the buy button and activate it even without consumers' willingness (Lewis & Phil, 2004). In addition to whether and when neuromarketing studies are able to influence and control consumers, there are number of other concerns that are proposed by scholars such as incidental findings, lack or regulation and vulnerable populations:

Incidental findings

In fact, incidental findings can arise in neuromarketing study's (Ariely & Berns, 2010; Wolf et al., 2012), around 3-12% in brain measurers and up to 30% in body measurers (Hegenscheid et al., 2013). Making an abnormal observation of participants can have a profound effect on a subject's wellbeing health and future plans. It might be a life-threatening abnormality such as evidence of current or past trauma or anatomic evidence of dementia (Wolf et al., 2012).

Lack of regulation

Further critics are made by Gang et al. (2012) who question the protection of human subjects and criticize the lack of regulation. This concern is mainly based on the fact the current regulations and guidelines of research studies with human subjects exist for governmental sponsored studies but do not encompasses commercial research studies (Murphy et al., 2008). There are no a legal requirements or industry standards that apply to marketing neuromarketing studies in order to protect test subjects (Ariely & Berns, 2010; Jordan & Gray, 2013). Moreover, when a research reveals incidental findings there is neither a "standard for how to handle these situations" (Ariely & Berns, 2010, p. 10) nor does a systematic reporting of incidental findings exists. In case an abnormality is found, ethical questions, such as to who should the information communicate and by whom, has arisen. Furthermore possibilities of over diagnosis and overtreatment can occur as neuromarketers are often no specialists in this area and do not know how to interpret or read incidental findings (Hegenscheid et al., 2013).

Vulnerable populations

Neuromarketing techniques can target general vulnerable consumers. Vulnerable consumers include individuals with mental health problems, people with money problems and children and young adults. It can pose a great threat and harm if this consumer group participate in neuromarketing studies because they are less able to protect their interests and are easier to influence (Palmer & Hedberg, 2013).

All these posed concerns by ethicists and the public raise important concerns of test subjects autonomy and privacy (Lee et al., 2007; Murphy et al., 2008; Wilson et al., 2008).

3.3.1 Autonomy

The duty to respect individuals' autonomy is a primary principle in various ethical dilemmas. Autonomy is defined by Gillon (1985) as "the capacity to think, decide and act on the

basis of such thought and decision freely and independently and without […] let or hindrance" (p.1806). It is a subarea of freedom and Aristotle's describe it as the ability to make rational decisions (Gillon, 1985).

The main concern of neuromarketing is that marketers are able to manipulate consumer's decisions and behavior (Egrie & Bietsch, 2014). Wilson et al. (2008) state that neuroscience techniques "trigger emotions that encourage purchase rather than provide consumers with accurate information on which to make beneficial decisions" (p.402). By adopting this view, neuroscientific findings hold the potential to harm consumer's ability to follow their own preferences and exercising free will around purchasing decisions (Fisher et al., 2010). Consumers are forced into preferences and decisions without full understanding, awareness and consent. Hence, consumers are harmed in making informed decision within autonomy (Wilson et al., 2008).

3.3.2 Privacy

Privacy is defined as "the freedom of individuals to choose for themselves the time and the circumstances under which and the extent to which their beliefs, behavior and opinions are to be shared or withheld from others" (Siegel, 1979, p.251). Neuromarketing makes use of private information and data which evokes the ethical concern of privacy invasiveness (Hammou et al., 2013). The main concerns are however the handling and assessment of consumer information and informed consent. According to Wilson et al. (2008) neuromarketing provides two ethical dilemmas in terms of informed consent in a research study. The first dilemma is whether consumers participating in a research study without true consent. The second ethical dilemma is whether consumers are aware of and consent to scrutiny of data. The growth of digital platforms has provided users with more options to generate and share content.(Constantinides et al., 2009) Due to the development of technology such as the increasing amount of smart phones, that enabled users to make content at any point in time, there has been an increase in the amount of personal data available on the internet. It also allows third aprties to share and access information (Pispers & Dabrowski, 2013). The main problem is the danger of security of this private data (Judd & Johnston, 2012). There is an ethical concern that some of the information could be transferred beyond a person's control, to third parties such as advertisers and government all of whom have an interest in people's private data (Turow, Hoofnagle, Mulligan, Good & Grossklags, 2006). Similar concerns arise with the data obtained from the other neuromarketing techniques such as the brain scans obtained from fMRI. "The use of data obtained from brain imaging poses ethical dilemmas for marketers, as some marketers seek to limit out understanding of their true intentions and some activity lack transparency. Potential moral issues emerging from neuroscience applications include awareness, consent and understanding of individuals consumers to what may be viewed as invasion of their privacy rights" (Gang et al., 2012, p.287). It introduced questions such as who controls and owns brain scans, who has access to the data and what measures will be taken to ensure that the information is used and interpreted confidentially (Wilson et al., 2008).

The ethical challenges and considerations posed by neuromarketing are largely the same for any traditional marketing research study (Egrie & Bietsch, 2014). Concerns addressing privacy, autonomy, protection of test subjects, validity and reliability of the findings have been problems faced in research studies by marketers for a long time (Smith & Murphy, 2012). For instance the importance to provide a good random sample of the population and ensure that study participants are fully informed about the research consequences and implications (Slovic, 1995; Wilson et al., 2008) has been established already with the introducing of marketing tools such as interviews and focus groups. The main difference between neuromarketing and marketing is however that the issues of privacy and autonomy are broadened significantly due to the development of the Internet and the inclusion of neuroscience techniques in recent years (Wilson et al., 2008).

3.4 Code of conducts

The ethical issues described in this paper have triggered numerous regulations and guidelines by both by the neuromarketing research industry and the government.

The protection of human subjects in research studies is well address and mandated by law in many nations (Murphy et al., 2008). In the United States, the protection of human subjects of biomedical and behavioral research is regulated in the Belmont Report or under the so called ´common rule´ (Jordan & Gray, 2013). The protection of human test subjects in the European Union (EU) is declared in a legal system named Charter of Fundamental Rights. Curiously though, none of those regulations proposed by government bodies apply in research studies that are not sponsored by government such as marketing and neuromarketing studies (Grandjean et al., 2008; Murphy et al., 2008).

In addition, professional organizations create guidelines which are based on published literature and expert opinions. Murphy et al. (2008) proposed for a ´code of ethic´ to be adopted by neuromarketers. It covered areas such as privacy, transparency, and full information transparency. Furthermore they pose guidelines to handle vulnerable niche population and incidental findings. Neuromarketers and research organizations may agree to these guidelines to show their ethical values and to ensure a safe research, the literature based guidelines are however not legally enforceable. Another way to show ethical attention is to develop, write and publish own ethical principles on the company's website.

Industry associations have also begun recently to create general principles for neuromarketing research to which members must sign up to. The Neuromarketing Science and Business Association (NMSBA) introduced the first neuromarketing code of ethics in November 2012. It covers areas such as privacy, consent and transparency. Moreover, the validity and efficacy of neuromarketing is often criticized. As data from the brain is often seen as factually true it is rather overestimated. It is needed to question the quality of the research and the way research draws conclusions. Organizations, such as ESOMMAR (www.esomar.org), are dealing with such issues and provide information about validity and efficacy of neuromarketing studies. Additionally, the use of medical devices such as the fMRI and the EEG in food and drug advertising is regulated by the FDA. The FDA proposes guidelines and rules to guarantee that the devises are used adequately. Researcher, medical practitioners and academics conducting research studies with internal measurers on test subjects are supposed to follow those guidelines.

The compliance with such guidelines and conducts is however voluntary and the enforcement by the government and industry varies from country to country. Some countries have been failing to address and handle ethical issues in neuromarketing and others have been more aggressive by labeling laws to protect consumers. For instance using brain-imaging tools for commercial purposes in France has, in fact, been banned by law since 2004 (Oullier, 2012). Some of the reasons why regulations differ across countries is that neuromarketing is still

in its infancy and has generated high levels of uncertainty among countries. Another reason is the fundamental differences between countries in risk perception, opinions, ethical values, understanding and evidence.

4. DISCUSSION

There are advocates and critics examining the field of neuromarketing (Egrie & Bietsch, 2014). The first and basic claim by advocates (Ariely & Berns, 2010; Dimoka et al., 2012; Kenning & Linzmajer, 2011; Lewis & Phil, 2004) is that neuromarketing has an advantage over traditional methods (Ariely & Berns, 2010; Dimoka et al., 2012; Lewis & Phil, 2004). Traditional marketing techniques measure conscious recalls and if properly framed and validated, it is a sufficient measurement tool. Neuromarketing techniques can enhance traditional methods as they reveal more accurate data and new insights on human behavior than has been previously possible. Furthermore, neuroscience methods measure in real-time with less respond bias than traditional tools (Murphy et al., 2008).

Neuromarketing shows great promises in consumer research and has shown also potential to allow companies to perform better in new product development and advertising (Leonard & Rayport, 1997). Neuromarketing techniques enable researcher and marketers to make specific observations regarding preferences and product choices (Khushaba et al., 2013; Shi et al., 2013). For instance in the input-/output model monitoring and "listening to the customer is especially important in order to identify market experiences, new market needs, and hear early warnings about product problems indicating the need to improve, modify or drop products" (Constantinides et al., 2009, p.17). The findings can thus help marketers to test advertisement for effectiveness and withdraw market stimuli that show limited results (Hammou et al., 2013; Wilson et al., 2008). It can be beneficial not just for commercial advertising, but also for public service advertising. Public service announcement aims to educate and inform people rather to sell a product. Most public service announcements empower audience to change behavior such as promotions for medical checkups or smoking reduction. This is also demonstrated by the research done by Lindstrom (2012). He conducted "the largest, most revolutionary neuromarketing experiment in history"(Lindstrom, 2012, p.11) to demonstrate how marketing messages work on humans. Unfortunately, it reveals that cancer warnings and pictures on cigarette packages do not have an effect on smoking reduction. Neuromarketing can in this case make a useful contribution to figure out what kind of advertisement would be more effective to create the outcome that was intended to. It benefits marketers by saving money as they withdraw ineffective advertisement.

Despite the contribution of neuromarketing for companies, it has a great potential to increase customers experience. As mentioned above, ineffective marketing stimuli can be withdrawn and ultimately result in less marketing exposure on consumers. Neuromarketing might contribute also to an increase in customers marketing experience. Using neuromarketing can also enhance online user experiences. All external measurers have been used to test website usability (Shi et al., 2013). The findings that emerge are of importance for web-designer, online retailer and online advertiser (Pispers & Dabrowski, 2013). Eye tracking applied to website viewing, for example, has reveled customers' preferences in web page´s organization, advertising and design. Web-designers can for example adopt desirable display formats to build an effective web page and enhance users' online experience (Shi et al., 2013). Neuromarketing brings also several new insights for consumers. They are better informed about their own decision making process (Kenning & Linzmajer, 2011; Oullier, 2012) and neuromarketing can make customers wiser. This stresses the fact that the contribution of neuromarketing might be is beneficial for both companies and customers (Wilson et al., 2008). Wilson et al. (2008) talk about a win-win situation. Despite the contribution of neuromarketing to consumer and companies, it has received noteworthy criticism (Egrie & Bietsch, 2014). Critics of neuromarketing (Gang et al., 2012; Hammou et al., 2013; Judd & Johnston, 2012; Murphy et al., 2008) labeling neuromarketing techniques as manipulative and invasive due to the fact that unconsciousness processes of humans are measured which test subjects might not be aware of it. In particular there is the fear that research subjects lose autonomy and privacy rights (Hammou et al., 2013).

4.1.1 Autonomy

It is argued that marketers are able to read consumers mind and influence their decision making and purchase choice. The question in this debate is "whether the new tools of neuromarketing will provide sufficient insight into the human neural function to allow manipulation of the brain such that consumers cannot detect the subterfuge […] and that such manipulations result in the desired behavior in at least some exposed persons" (Murphy et al., 2008, p.279).

The concern that neuromarketing is able to read consumers minds, overestimates the findings and impact of the brain scientific technology (Oullier, 2012). The technology used to read body, behavior and brain responses is not the same as reading thoughts (Fisher et al., 2010; Kenning & Linzmajer, 2011). According to Kenning and Linzmajer (2010 "the technology provides only a limited opportunity to observe the brain activity not an ability to influence the brain" (p.121). Neuromarketing techniques are able to read certain physical states and brain activities that are associated with certain mental activity but it should be noted that the mental states such as joy and anger are not thoughts. As Murphy et al. (2008) explains that reading consumers mind "is not possible with current technology" (p.279). Furthermore, brain measurers are able to identify when consumers are paying attention and which brain area is active. It can tell that consumer's attention has turned to something but not what kind of attention is given. This may be the reason to reconsider the concerns about reading consumer's minds (Kenning & Linzmajer, 2011). What can be however measured are emotional responses of the test subject and it might be possible to identify emotions that the test subjects are not aware of themselves. This is based on the fact that "bodies express human identifies better than mind, a kind of standstill about the subject appears. The subject loses autonomy and self-determination" (Grandjean et al., 2008, p.603).

Another concern related to autonomy is that marketers may be able to influence consumer in making logical decisions (Wilson et al., 2008). Neuroscientific findings however discovered that humans making decisions based on consciousness and unconsciousness channels. Furthermore it has been revealed that the unconscious mind primarily controls human behavior (Lindstrom, 2012) and that rational and logical decisions are the exception in human behavior (Ciprian-Marcel et al., 2009). This inescapable fact creates few interesting challenges to define decision making autonomy. Consumers are acting according to unconscious influences and are not conscious about this influence. Given this fact, it can be argued that humans are fundamentally not free in making decision as the brain avoids conscious decisions when they can (Dehaene, Changeux, Naccache, Sackur & Sergent, 2006). An answer however can be that human beings exercise autonomy in decision making by

learning from their consequences of choices and actions. Consumers decide if they like a product or not in the end and do not buy it again if they are dissatisfied. This might be the way how consumers exercise autonomy in this area.

In addition the idea that consumers can be influenced without awareness and by merely being exposed to a marketing stimuli makes most people feel vulnerable and defenseless. This issue has been discussed by various researchers who are arguing that neuromarketing controls, influences and trigger consumer behavior. Research has, in fact, revealed that neuromarketing trigger consumer behavior. For example being exposed to a marketing stimuli increases the probability that consumer will buy that product by 5 percent. However research has revealed that people are not helpless in making purchasing decisions by being exposed to marketing stimuli. For example tobacco advertisement does not encourage smoking initiation. If someone does not smoke, the rugged looking Marlboro cowboy will not change his opinion and encourage him to start smoking (Lindstrom, 2012). The study of Henriksen, Schleicher, Feighery and Fortmann (2010) however reveled that it does encourage adolescents to start smoking. This shows that vulnerable groups need to be protected more extensively (Palmer & Hedberg, 2013). Furthermore, several studies show that neuroscientific insights used in advertising cannot evoke customer manipulation. Customer may even provide unconscious defenses that make it more difficult for marketers to persuade consumers (Häusel, 2013). For example if you use a particular brand since you were a child, the probability to buy that product is 95 percent even without being exposed to marketing stimuli. Furthermore the purchasing decision is also influenced by surrounding conditions. If the product is not available in the store or you do not have the money with you, there is always the 5 percent chance you choose an alternative. Thus consumers are not helpless when it comes to making purchasing decision but are influenced by marketing stimuli.

It is however essential to point out that the concern that neuromarketing controls consumers is rather unrealistic. Control is quite different from influence. Influence allows an alternative way, whereas control means that there is no chance of an alternative way and that the consumer has to do what the marketer wants. The competition available today makes it always possible to choose for an alternative way. Furthermore there is a study conducted by Ariely and Berns (2010) demonstrate that there is no evidence that neuromarketing findings are able to manipulate consumers.

> "Although some have argued for the existence of a "buy button" in the brain, current evidence suggests that [...] responses to marketing efforts and consumer choices depend on an array of neurobiological processes, and that no single brain region is responsible for a consumer choice" (Ariely & Berns, 2010, p.286).

This has also been expressed by Karremans, Stroebe and Claus (2006). They tried to assess whether subliminal priming effect of brand names and slogans of Lipton ice tea affects people choice for the brand and increase its sales. They secretly and subliminally were flashing messages with the brand name Lipton ice tea in a movie theatre. The results have revealed that people do perceive messages unconsciousness but that the effects are small and cannot produce the outcome that consumers are programmed to buy that product. The concluding remarks are that "priming of a brand name for a drink will only affect choice behavior of people who are thirsty (i.e., have a goal to drink) and not of people who are not thirsty" (Karremans et al., 2006, p.792). In fact research has revealed that there are two limitations before a prime can trigger behavior: First, people do not pursue something they do not already feel positive about. And second, people are resistance to if they do not perceive a gap between the goal and the current state. The existence of these conditions reinforces the idea that neuromarketing cannot control consumers but it indeed can trigger behavior (Häusel, 2013).

4.1.2 Privacy

It is argued that neuromarketing makes use of private information and data which evokes also ethical concern of privacy invasiveness. The degree of privacy invasiveness however varies among neuromarketing techniques.

External measurers

With informed consent of research participants and proper implementation, the risk for external measures can be minimal. The external measurers however become invasive if they are used in public without customer's awareness. For instance smart cameras have become available which enable face coding in public without consumer´s awareness (Real & Berry, 2010).

The Input/-output model

Although there are many positive benefits associated with the input-/output model, internet based research raises further questions of privacy invasiveness. When an internet connection is setup or whenever an individual is booking a flight or hotel, purchasing a product or joining a social networking website, private data is obtained (Wilson et al., 2008). The internet host part of the personal data and allows other to access it. "Boundaries can become blurred as multiple environments – personal, social, and professional – can intersect on the social network site" (Judd & Johnston, 2012, p.8). The vast amount of personal data is thus increasingly shared and even sold among companies and individuals. "It might not be in an individual´s best interest to have certain personal information available to others" (Farah, 2005, p.35).

From the perspective of the user and customer, increased attention must be paid to terms and condition of web pages and publishing content on the internet. Entering a social network page for the first time, users must complete a registration form and comply with the terms and conditions of the provider before they are allowed to publish any content. Since they have agreed the terms, they may not be able to blame providers or marketers, as it could be assumed that they are aware of the fact that the owner of all published content is solely the hosting company. The company might makes use of user profiles in ways that expand opportunities for them, by sharing and selling data among companies or other involved marketers. In 2012, the data protection regulations in the European Union (EU) Charter of Fundamental Rights have been renewed in order to tackle the new challenges of technology and social media platforms. Under this new legal framework, companies or individuals who gather and transfer personal information must protect this data from misuse and obey certain rights in the way they use the data. These legal requirements are an excellent beginning though; even if privacy invasiveness is a remaining issue in social platforms. Facebook, for instance, has billion users worldwide and other social network pages have also a global audience. "Social network sites offer an underestimated sense of audience, as users cannot be aware of all of those who will view shared information" (Judd & Johnston, 2012, p.8). Data is transferred and accessed worldwide which reduced the value of country or nation specific regulations significantly. A worldwide regulation is vital.

Additionally, users may not be expecting to be research subjects while posting and sharing content online. Consumers are publishing private information about themselves on social

networking websites, believing that they stay private. In reality, however, this is not the case (Judd & Johnston, 2012). Particularly if the webpage advertise a privacy policy, users believe that they have certain privacy rights (Turow et al., 2006). Consumers might be confused about privacy notices of the provider and how third parties can assess their data. Users claim that privacy notices are too long and difficult to understand (Wilson et al., 2008).

Internal measurers

Privacy invasiveness also refers to the handling of the brain images obtained from internal measurers (Gang et al., 2012). "Concerns exist about how individuals' privacy will be maintained, who ultimately owns brain scans, whether scans can be sold to other persons or institutions, and what happens to extraneous information, such as health problems, revealed by the scans"(Wilson et al., 2008, p. 399). When it comes to abnormality in research findings, there are no guidelines of how to handle the issues. The duties and responsibilities of neuromarketers in a case of incidental findings are thus not adequately addressed to protect test subjects (Wolf et al., 2012).

It is also essential to mention with this measure that consumers might have agreed on participating in a research but do not fully understand the potential risks and outcomes. They might did not know that the research may be reveals a life-threatening abnormality such as a trauma (Wolf et al., 2012).

In general, outweighing the criticism emerged in neuromarketing. It is clear that there are no clear guidelines or standards in practice at this point. This is either the case because of uncertainties of neuromarketing, or because no consensus on the appropriate counteraction exits. Furthermore, ethical claims about autonomy invasiveness in neuromarketing should be reconsidered. Critics tend to overestimate the impact that neuromarketing techniques will have on human behavior, as it is not possible to read individuals though precisely and to control consumer behavior. Privacy concerns however remain if test subjects are unaware of their participation or unaware of the research consequences. The best way to overcome this is that social network providers and researcher provide fully and easily understandable background about the handling and ownership of private information and the possible outcomes. Users must be made aware of potential risks by posting personal information or by participating in a research study. This is in particular the case for young adults as they are more likely to post private information (Judd & Johnston, 2012).

It is however clear that defining regulation that pleases everyone is very difficult. (Moore, 2008; Turow et al., 2006) This is at least for the following reason that fundamental differences, in risk perception, opinions, ethical values, understanding and evidence, exist between countries. It is true that autonomy and privacy perceptions differ between countries and generations (Moore, 2008). Social media has particularly changed privacy norms of adolescents (Turow et al., 2006). And it is equally true that individuals have different perception and understandings so that privacy notices will not and cannot be understood by everyone. Despite this difficulty, regulations and standards are of crucial importance to protect human research participants.

5. CONCLUSIONS AND RECOMMENDATIONS

Neuromarketing studies consumers´ behavior, brain and emotional responses on marketing stimuli. It obtains more accurate data and new insights on human behavior than has been previously possible. Neuromarketing techniques measure unconscious processes in real-time with less respond bias than traditional tools. Neuromarketing shows great promises in consumer research but its consequences on consumer protection are not considered adequately. There are no clear guidelines and standards in place at this point and the internet has increased the challenge to protect human subjects.

This paper has sought to ascertain the ethical issues in neuromarketing to identify approaches to address such issues. Some of the ethical issues include the handling of private information and consumer´s full awareness, permission and understanding of the research. The two main proposed concerns are autonomy and privacy invasiveness of consumer. The paper argues that the ethical concerns of autonomy should be re-considered and the potential privacy threats can be substantially reduce if clear global standards are implemented.

Neuromarketing research studies would benefit from more standardization in several areas:

1) Procedures of acquiring full awareness and understanding of the research through explicit explanations of research risks, -benefits, -goals.
2) Procedures of acquiring informed consent of test participants.
3) Procedures of handling private information particularly for incidental findings.
4) Procedures to protect vulnerable populations from neuromarketing studies.
5) Procedure to document data collection, analysis, and interpretation procedures.

This paper concludes that these global standards are an excellent start to enable industry growth and acceptance. To the extent neuromarketers show a willingness to comply with these standards, neuromarketing can be conducted more efficiently and with more confidence by both consumers and companies worldwide.

6. LIMITATIONS OF THE STUDY

The limitation of this literature review is the complete reliance on previously published research and the availability of these studies. Another limitation is that the paper must be within the scope of 10 pages. Furthermore, literature about neuromarketing is limited due to the recentness of this topic which further limits the generalization of the findings. Achieving a full understanding of the new area of neuromarketing and its ethical issues is thus limited. Furthermore this paper has a limitation in empirical evidence; the validity of the proposed assumptions is thus questioned.

7. RECOMMENDATIONS FOR FUTURE RESEARCH

Further studies should aim to empirically test the assumptions presented in this paper. Empirical research may lead to a examination of the findings in more depth and it might close the evidence limitation. Further research may also seek to test the ethical assumptions in various countries. As such it should then provide neuromarketers with more insights that are essential across borders and it may increase the validity and generalizability of this research. An additional recommendation for future research is to investigate the causal relationship between specific brain regions and human actions in more depth.

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10. APPENDIX

Appendix 1: Eye tracking data

Appendix 1a: Eye tracking output data

Timestamp	Number	FixationIndex	GazePointX	GazePointY	Event	StimuliName	AoiNames
267	16	4	674	374		barchart.png	Content
284	17	4	678	379		barchart.png	Content
301	18	4	681	376		barchart.png	Content
317	19	4	679	359		barchart.png	Content
334	20	4	675	375		barchart.png	Content
351	21	4	676	365		barchart.png	Content
367	22	0	0	0		barchart.png	Content
384	23	5	677	380	KeyPressed	barchart.png	Content

Table 1a. Eye tracking data output. Adapted from "Visual Analysis of Eye Tracking Data," by M. Raschke, T. Blascheck & M. Burch, 2014,*Handbook of Human Centric Visualization*, p.392

Appendix 1b: Visualization of eye tracking data

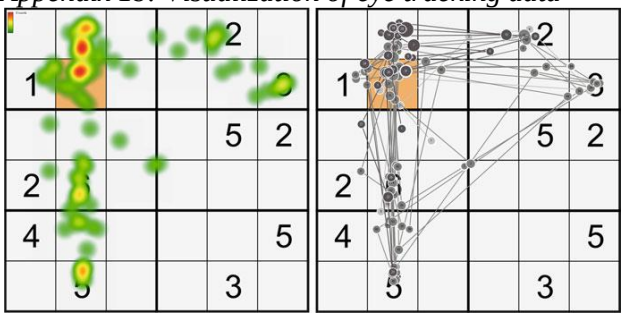

Figure 1. Visualization of eye tracking data: heat maps (left) and scan paths (right). Adapted from "Visual Analysis of Eye Tracking Data," by M. Raschke, T. Blascheck & M. Burch, 2014,Handbook of Human Centric Visualization, p. 392.

Appendix 2: Table 2

Table 2 Measuring consumer insights using neuromarketing techniques

		External reflexes			**The input-/output model**	**Internal reflexes**		
		Empathic design	*Facial coding*	*Eye tracking*		*EEG*	*MEG*	*fMRI*
Consumer insights	*What is recorded?*	Body language	Body language (facial movement)	Body language (eye movement & pupil dilation)	IP address, contact information, financial information & customer voice on social media space (comments, tweets)	Electrical activities in brain (voltage fluctuation at surface of brain)	Electrical activities in brain (magnetic streams induced by voltage fluctuations)	Metabolic activities in brain (blood flow)
	What is measured?	Behavior, emotional arousal, unarticulated needs, preference, product choice, usability	Behavior, emotional arousal and valence, preferences, usability	Emotional arousal, attention, interest, preference, product choice, usability	Attention, (emotional arousal and valence), interest, preferences, product choice	Memorization, motivation, change in behavior, preferences, product choice	Memorization, motivation	Behavior, behavioral predictions, experienced value, attention, emotional arousal and valence, sensory stimuli, preferences, product choice