Neuromarketing & Ethics: How Far Should We Go with Predicting Consumer Behavior?

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ABSTRACT
In the past decade, neuromarketing research became increasingly more utilized by companies as a tool to understand the consumer's buying behavior. However, the science of neuromarketing has given rise to an ethical discussion with a variety of questions regarding the fact whether this innovation in marketing research is ethically responsible in terms of the possible violation of brain privacy and human dignity. Firstly, this paper will discuss relevant theories in regard to the ethical implications that go hand in hand with neuromarketing research, which will lead to a research model that will investigate the main influencers of the consumer's sentiment towards neuromarketing practices in general. Consecutively, this paper will include the results of a survey focused on the consumer's attitude towards technology, ethical ideology and perception of neuromarketing hazards, linked to the overall sentiment towards neuromarketing of the consumer. The survey has been constructed to test three hypothesis concerning the relationship between the dependent variable and independent variables mentioned above. The findings demonstrate that the proposed research model is partly explaining the consumer's perception towards neuromarketing, as only two of the three hypotheses could be accepted based on the statistical results in this paper.

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1. INTRODUCTION

Neuromarketing has become increasingly more popular throughout the last decade as a vital market research practice in the field of digital marketing. Neuromarketing itself can be defined as: *"the utilization of modern brain science that determines the impact of advertising and marketing on consumers"* (Bhatia, 2014). Some examples of practices where neuromarketing is commonly used are: advertising effectiveness, consumer decision making, branding, product design, and innovation (BusinessIQ, 2017).

Despite the fact that neuromarketing is widely perceived as a valuable tool to study consumer behavior, organizational behavior and psychology through the use of neuroimaging, neurophysiological and biochemical tools (Verhulst, De Keyser, Gustaffson, Shams & Van Vaerenbergh, 2019), there are also ethical issues that arise when utilizing neuromarketing tools to gather data about the consumer's conscious and subconscious behavior. One of the main ethical concerns in neuromarketing relates to the *brain privacy* that is breached when utilizing neuromarketing tools (Matthews, 2015). For instance, when taking a blood sample to assess the alcohol permillage of an intoxicated driver, a limited amount of data is screened that primarily concerns the alcohol level that is present in the blood sample. However, neural scans are not limited to the parameters of a specifically defined question that you want to have answered, as additional psychological variables may be revealed through an fMRI (functional magnetic resonance imaging) scan when primarily scanning for a physical disease. Such additional variables could be the identification of a subject's subconscious desires, level of reasoning or a lack of certain capabilities (Alpert, 2007). Another ethical implication would be the fear among consumers that neuromarketing may render their choices completely predictable by removing their sense of independent decision making. This would result in the possibility that these consumers may also fear that organizations that predict consumer behavior will see them as robots without freedom or dignity (Stanton, Sinnott-Armstrong & Huettel, 2016).

Ulman *et al.* (2014) elaborate further on this consumer's sense of human dignity and integrity in relation to the utilization of neuromarketing practices. They state that these two concepts can be seen as the basis for ethical principles such as autonomy, self-determination, privacy, reliability, confidentiality, protection of vulnerable groups and honest interpretations of research findings corresponding with manipulation risks by commercial actors. Neuromarketing is prone to breaching several of these principles, such as invading a person's brain privacy and interpreting this sensitive data for the company's good. Lungu (2017) states that by far most of these organizations that use neuromarketing tools try to "crack the neural code of consumer's decisions", in order to discover complex algorithms in the human brain that dictates the behavior of consumers. Once this code has been cracked, companies will endlessly exploit this by pushing the consumer's "buy button", which is seen as one of the primary fears consumers experience towards neuromarketing.

The consumer's attitude towards neuromarketing research has been studied by Bakardjieva & Kimmel (2016) through including two factors that might influence this attitude: (1) attitude towards technology and (2) ethical ideology. Despite the fact that these two variables provided adequate insights about the consumer's attitude towards neuromarketing, the primary model that is used in this paper extends upon the model by Bakardjieva & Kimmel (2016) by adding a third variable to explain the consumer's sentiment towards neuromarketing, which is: (3) the fear towards the ethical hazards related to neuromarketing. This third variable will provide more meaningful data about how consumers perceive the ethical issues regarding neuromarketing practices. It will also illustrate whether there is a difference in this perception between different neuromarketing tools, like fMRI, eye-tracking or biochemical tools for instance. This model will be presented and elaborated upon in section 2 of this paper.

As this study heavily focusses on the ethical implications that are linked to neuromarketing, there will be minimal focus on the technical aspects of the neuromarketing tools that are discussed in this paper. The aim of this research is to discover to what extent consumers feel (un)comfortable when companies apply different neuromarketing tools to predict and influence consumer behavior, by gathering data and insights about the three independent variables that explain the dependent variable in this research: the consumer's sentiment towards neuromarketing. The aforementioned factors led to the following research question of this study:

How do the ethical implications of neuromarketing impact the consumer's sentiment towards these neuromarketing practices that predict and/or influence consumer behavior?

This research question aims to reveal whether consumers perceive the ethical implications regarding privacy breaches by these neuromarketing tools as a major hazard, somewhat as a risk, or as a minor inconvenience that can be ignored due to the utilitarian benefits neuromarketing provides in terms of profits and innovation of technology. In order to explain a certain stance towards neuromarketing, it will also be analyzed to what extent this relates to a person's ethical ideology and attitude towards technology in general.

The following section will elaborate upon the different theories that are included in this research, as well as defining and conceptualizing the proposed research model in the context of neuromarketing and ethics. Section 3 will describe the methodology behind the empirical part of this study to answer the sub and main variables integrated in this paper. Furthermore, section 4 will present the results of the data analysis performed with SPSS 25, while these results will be thoroughly discussed in section 5. Section 6 will provide a general conclusion, followed by sharing the limitations of this research.

2. THEORETICAL FRAMEWORK

This section of the paper will discuss different theories and insights from past research regarding the ethical implications of neuromarketing, in order to investigate what already has been researched to be able to create new research insights related to this topic. The discussed theories from the relevant literature contributed to the research model that will be proposed in this section. Resulting from this research model, three hypotheses have been constructed, where each hypothesis tests whether the independent variable has a significant effect on the dependent variable.

2.1 Neuromarketing Practices

According to the paper by Verhulst *et al.* (2019), neuromarketing, or as it is stated here as the neuroscientific method, captures the changes in brain activity, peripheral system and the neurotransmitters and hormonal system. While this study does not focus on the technicalities of the different neuromarketing tools, a short overview will be given to provide some relevant context. Neuromarketing is a broad concept, and is subdivided into different practices that each measure a different part of the human body. There are three different distinctions to be made among neuromarketing tools, which can then be divided into the specific practices. These three categories

are: (1) neuroimaging tools, (2) neurophysiological tools and (3) biochemical tools (Verhulst *et al*., 2019).

2.1.1 Neuroimaging

Neuroimaging tools measure the changes in brain activity by either measuring an activity in a specific area of the brain (temporal) or by differentiating between the different segments of the brain (spatial). Examples of popular neuroimaging tools are electroencephalography (EEG) and functional magnetic resonance imaging (fMRI). EEG captures the voltage fluctuations on the surface of the brain in order to measure affective processes, which can be identified as temporal measurement. fMRI, however, captures the change in blood flow in the brain to measure these affective processes in the human brain through spatial resolution.

2.1.2 Neurophysiological

Neurophysiological tools do not directly measure the neural activities of the brain, but rather measure other physical parts of the body that are closely related to brain stimuli. Examples of widely used neurophysiological tools are eye-tracking, where the position and movement of the eyes is measured in addition to the pupil dilation, and cardiovascular tools, where the heart rate variability is measured to determine a person's impulses to desires or reasoning.

2.1.3 Biochemical

Biochemical tools capture the amount of neurotransmitters and hormones in the human body through blood draws and urine samples for instance. Measuring these biochemicals can be helpful to determine a person's behavior and processes, such as testosterone, cortisol and dopamine that each cause a different reaction within the human body (Verhulst *et al.*, 2019).

2.2 Fear Towards Neuromarketing

2.2.1 Perception or Reality

Stanton *et al.* (2016) argue that the main criticisms regarding neuromarketing refer to the risks related to harms and violations of human rights. Two different harms are identified that are potentially caused by neuromarketing: (1) immediate effects on individual customers and (2) long-term effects on society as a whole. The authors state that some of these ethical risks and the widespread consumer fear related to it is justified, but that there are also many fears that are unrealistic and therefore insignificant. They question, which is justifiable, whether all of the consumer's fear regarding neuromarketing and its ethical hazards are realistic, or just a perception of reality. There are two main fears among consumers: (1) the fear of predicting consumer behavior and (2) the fear of influencing consumer behavior. The first ethical issue regards the fear of consumers that large organizations using neuromarketing tools may render consumer's choices predictable. This implies that companies are able to predict a consumer's choice for products like food or goods. A critical viewpoint would be that consumers may fear that companies who predict consumer behavior will perceive their customers as robots without freedom and human dignity, whose minds can be read. This fear would be justified, as using neuromarketing just for the neuromarketer's end would likely turn out to be very immoral and dangerous as in the scenario described above. On the other hand, neuromarketing research on specific participants and conclusions are only drawn based on generalized samples of the entire population of consumers, which would insinuate that every consumer is different and brain privacy is not invaded through the use of neuromarketing (Stanton *et al.*, 2016).

2.2.2 Neuromarketing and Human Dignity

A key element that is prone to be negatively influenced by the ethical concerns that are related to emerging technologies like neuromarketing, is the concept of the human dignity. This concept is seen as the basis for ethical principles such as autonomy, self-determination, privacy, reliability, confidentiality, protection of vulnerable groups and honest interpretations of research findings corresponding with manipulation risks by commercial actors. The dignity of an individual is tied to the integrity of the subject's body and mind, which both depend on the subject's self-image as an independent person (Ulman *et al.*, 2014). In the context of neuromarketing as a disruptive technology, it should be questioned whether making use of neuromarketing technologies challenges this human dignity and infringes the ethical principles. On the one hand you can argue that neuromarketing practices were designed as marketing research methods to serve a commercial purpose, not a clinical one. However, Ulman *et al.* (2014) further explain that the application of neuromarketing tools should be provided with bioethical considerations, on top of the basic business ethics requirements, as the human dignity and integrity are both endangered by this technology. These seven bioethical principles are loosely interpreted and summarized in Table 1 (Schröder-Bäck *et al.*, 2014)

Bioethical principle	***Definition***
Non-maleficence	Do not harm the subject to reach a beneficial outcome.
Beneficence	Provide individual benefits for the subjects as an act of sympathy.
Welfare maximization	In contrast to individual benefits, provide macro-benefits for society's well-being.
Efficiency	Efficient use of resources to help more people with existing resources.
Autonomy	Emphasis on respect for the autonomy of the subject.
Justice	Demanding equal opportunities and a fair distribution of beneficial outcomes.
Proportionality	Balancing individual freedom against wider social goods in a proportionate way.

Table 1. Seven Bioethical Principles
(Schröder-Bäck *et al., 2014)*

Disregarding these bioethical principles while conducting neuromarketing research will threaten the subject's sense of human dignity and integrity, as the consumer refuses to be seen as a "mere consumer, or client" whose behavior and desires can be easily detected and predicted through brain imaging with e.g. fMRI or EEG. Therefore, the human dignity of a subject in neuromarketing research should be respected and protected regarding this person's autonomous decision-making process to share his/her subconscious desires and preferences (Ulman *et al.*, 2014).

2.2.3 Crack the Neural Code

Diving further into the human mind, it can be characterized as 'essentialistic', implying that every human being has the urge to compress information into essences, meanings, in order to understand certain contexts (Lungu, 2017). When this is applied to neuromarketing research, the concept of essentialism causes us trying to 'crack the neural code of our decisions' (Morin,

2011). We want to achieve this, because cracking this code allows us to discover complex algorithms that dictate human behavior. Lungu (2017) further argues that once researchers discover how the algorithmic machinery in our brain functions, companies will exploit this by endlessly pushing the consumer's 'buy button', which is something that consumers do and maybe even should fear. On the one hand it is not strange to doubt the far-reaching capabilities of neuromarketing described above regarding the prediction of consumer behavior. The main two counterarguments to this fear are:

1. The human brain is no algorithmic machinery with a code that can be cracked.
2. If this machinery does exist, it might only increase the chances of predicting consumer behavior, while these predictions might be inaccurate (Morin, 2011).

Supporters of these arguments claim that consumer profiling through neuromarketing is just to be seen as an approximation tool that requires human interpretation, with the end goal to increase the sales for companies. It can even be argued that these neuro-tools will eventually improve the consumer experience as these tools indicate more precisely what consumers want. Therefore, the argument can be made that neuromarketing is also for the consumer's good. The ethical dangers of neuromarketing will start to become significant when an individual's data will originate from multiple sources, when the mining of data will be done in a more and more automated manner, when the power of these neuro tools will increase, and when small data will collide with big data (Lungu, 2017).

2.3 Research Model

Having thoroughly considered the different theories regarding neuromarketing and its ethical implications, a research framework has been constructed containing three independent variables (IV) that explain the dependent variable (DV). Figure 1 depicts the conceptual model that has a central role in this research paper.

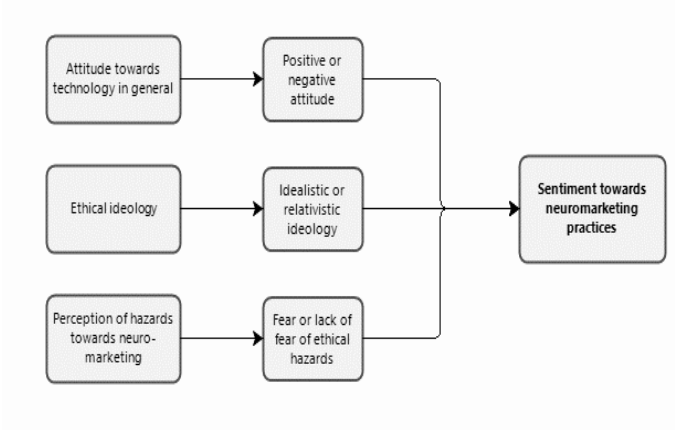

Figure 1. Conceptual Research Model that Explains the Consumer's Sentiment Towards Neuromarketing

The first independent variable, which is "the attitude towards technology in general" gives an indication whether a consumer feels comfortable with newly disruptive, intrusive technologies that are frequently used in modern society. This variable influences the probability a consumer will feel positively or negatively about neuromarketing methods. Also, this variable has been extracted from Bakardjieva & Kimmel (2016). The second independent variable, "the ethical ideology" has also been extracted from this research, and distinguishes consumers that are highly absolutistic and somewhat exceptional (idealistic), and consumers that value situationism and subjectivism (relativistic). This variable influences the ethical point of view a consumer has when assessing neuromarketing practices. "The perception of the potential ethical hazards towards neuromarketing practices", which is the third independent variable, regards the fact whether consumers do or do not experience the fear that their human dignity is in danger when companies predict and/or control their behavior through neuromarketing. This variable has been inspired from the research paper by Stanton *et al.* (2016). Further elaboration on the variables will be provided in the following section regarding the methodology.

2.4 Hypotheses

Based on the proposed research model provided in the previous subsection, three different hypotheses have been constructed in order to determine the relationship between the independent and dependent variables. These variables and their relationships will be tested in SPSS 25 in section 4 of this paper.

H_1*:* A person's attitude towards technology has a significant effect on this person's sentiment towards neuromarketing practices.

H_2*:* A person's ethical ideology has a significant effect on this person's sentiment towards neuromarketing practices.

H_3*:* A person's perception of hazards towards neuromarketing has a significant effect on this person's sentiment towards neuromarketing practices.

3. METHODOLOGY

3.1 Design

In order to investigate the consumer's sentiment towards neuromarketing practices, empirical research has been conducted in the form of an online survey via Google Forms. The survey in question will deliver quantitative data through the integration of a seven-point Likert scale in each of the survey items, ranging from "Strongly Disagree" (1) to "Strongly Agree" (7). Every single item has been coded so that a score of 1 signifies a negative attitude towards neuromarketing, while a score of 7 signifies a positive attitude towards neuromarketing. The survey data was collected from 43 respondents with a minimum age of 16 years old. There were no additional requirements for respondents to fill in the survey. The respondent's average age was 27 years old *(SD = 10)*, with 51,2% female respondents and 48,8% male respondents from 13 different countries. A more detailed overview of the descriptive statistics can be found in Table 2.

Variable	**N**	**Mean**	**SD**	**Min.**	**Max.**
Age	43	26.53	10.084	16	57
Attitude towards technology	43	3.8372	0.98768	1.33	6.00
Ethical ideology	43	3.8760	0.96506	1.67	6.00
Perception of neuromarketing hazards	43	3.3837	1.03954	1.38	5.38
Sentiment towards neuromarketing	43	4.0744	1.27244	1.00	6.20

Table 2. Descriptive Statistics Research Design

The survey items were categorized in four different segments, where each segment answered one of the four variables that are central in this study. Question 1, 2 and 3 gathered data to answer the sub variable "attitude towards technology in general". Question 4, 5 and 6 gathered data to answer the sub variable

"ethical ideology". Question 8, 9, 10, 11, 12, 13, 14 and 15 gathered data to answer the sub variable "perception of neuromarketing hazards". Question 16, 17, 18, 19 and 20 gathered data to answer the main variable "sentiment towards neuromarketing practices". Question 7 has no valuable significance in terms of answering a variable, as it was only a useful indication for the author's interpretation of the results. A complete overview of the survey items can be found in Table 9 in the appendix. In order to ensure that only truthful survey responses will be taken into account in this study, a mix between cold- and warm-start survey items has been applied. Respondents were given the option to leave their email address behind if they were interested in receiving the final results of this empirical research.

The aim of this empirical research is to draw meaningful conclusions about the consumer's sentiment towards neuromarketing based on the data this sample provides. Since the sample size of this study is less than 100, this research should be considered to be a pilot testing for future researchers in this field.

3.2 Operationalization

As aforementioned, this research includes three independent variables (IV), which are "attitude towards technology", "ethical ideology" and "perception of hazard towards neuromarketing". These three variables explain the dependent variable (DV) "sentiment towards neuromarketing practices". These four variables will be thoroughly operationalized in the following subsections. Table 3 gives a clear overview of the operationalized variables.

3.2.1 Attitude Towards Technology in General

The independent variable that relates to the consumer's attitude towards technology is defined as "the degree to which a person evaluates technology positively or negatively" (Bakardjieva & Kimmel, 2016). For instance, some people may fear that the cloud is not a safe place for the storage of their personal data, or that large third parties such as Google have access to sensitive data. Another key factor to determine a person's attitude towards technology is to assess whether they perceive technology as a source of opportunities, or rather as a source that creates threats. This variable was measured with three items, where each item provided a statement where the respondent could either agree or disagree with on a seven-point Likert scale. Respondents either had a favorable or unfavorable attitude towards technological innovations.

3.2.2 Ethical Ideology

The second independent variable regards the ethical standards a respondent possesses, which is divided in two different categories: an (1) idealistic ideology and a (2) relativistic ideology (Kleiser *et al.*, 2003). Respondents who were categorized as "idealists" demonstrated signs of absolutism and exceptionalism. This implied that they assumed that moral rules should always be followed universally in order to achieve the best results. However, other respondents that were categorized as "relativists" appeared to be more situational and subjective towards what is ethical, and what is not (Wiid *et al.*, 2014). This variable was measured with three items, where each item provided a statement where the respondent could either agree or disagree with on a seven-point Likert scale. Respondents were either idealistic or relativistic.

3.2.3 Perception of Neuromarketing Hazards

This independent variable concerns the extent to which a respondent experiences the fear that his/her human dignity is endangered when organizations use neuromarketing tools to gather consumer data. For instance, consumers could fear that their brain privacy is prone to be invaded through an fMRI scan that captures the consumer's blood flow in the brain. Respondents could either be categorized as "fearful" or "indifferent" towards the ethical implications of neuromarketing (Stanton *et al*., 2016) based on the results of the survey. Fearful respondents recognized that neuromarketing has serious ethical implications that should be minimized, as they experience a loss of human control. Indifferent respondents, however, perceived the hazards of neuromarketing as acceptable more or less, as neuromarketing tools are scientifically better and more sophisticated methods to research consumer behavior. The survey items that measure this variable investigate whether there is a difference between several neuromarketing tools. The neuromarketing tools that are distinguished in this section are: fMRI, eye-tracking, cardiovascular and biochemical tools. This variable was measured with eight items, where each item provided a statement where the respondent could either agree or disagree with on a seven-point Likert scale. Respondents were either categorized as "fearful" or "not fearful".

3.2.4 Sentiment Towards Neuromarketing

The dependent variable that is central in this study relates to the consumer's sentiment towards the use of neuromarketing practices by companies. The consumer's attitude towards technology, ethical ideology and fear towards neuromarketing hazards are all three integrated into this variable, as this variable summarizes a respondent's final judgement regarding neuromarketing. A respondent that demonstrates a negative attitude towards technological innovations is very likely to evaluate neuromarketing as something negative, and vice versa (Bakardjieva & Kimmel, 2016). A respondent that possesses a relativistic ethical ideology has no universalistic moral codes, so this person would likely perceive the ethical implications of neuromarketing as insignificant compared to its benefits (Kleiser *et al.*, 2003). A respondent that experiences a high level of fear towards the ethical implications of neuromarketing will likely perceive neuromarketing practices as "evil" practices conducted by large organizations to gain maximum control of the consumer's buying behavior (Stanton *et al.*, 2016). This variable was measured with five items, where each item provided a statement where the respondent could either agree or disagree with on a seven-point Likert scale. Respondents either had a positive or negative attitude towards neuromarketing practices.

Variable	***Definition***	***Measurement***
Attitude towards technology (IV)	"The degree to which a person evaluates technology and technological innovations positively or negatively." (Bakardjieva & Kimmel, 2016)	Technology creates more opportunities than threats. Technology can be too intrusive.
Ethical ideology (IV)	"The extent to which a person possesses an idealistic or relativistic ethical ideology." (Kleiser *et al.*, 2003)	Moral codes are universalistic. What is 'right' or 'wrong' is dependent on the situation.

Perception of neuromarketing hazards (IV)	"The extent to which a person experiences fear when organizations use neuromarketing tools to gather consumer data." (Stanton *et al.*, 2016)	fMRI invades my personal data that I do not want to share. Eye-tracking is too sensitive to privacy risks.
Sentiment towards neuromarketing (DV)	The consumer's overall judgement regarding the use of neuromarketing tools.	The ethical implications weigh up against the benefits neuromarketing provides.

Table 3. Operationalization of the Variables

3.3 Reliability

For the internal consistency of this research to be tested, a reliability analysis will be conducted through SPSS 25 by computing the Cronbach's alpha. The reliability of this survey concerns whether the responses are consistent among the respondents that took part in this survey. It can be assumed that a higher sample size almost always leads to a better reliability. Since the sample size of this study is lower than 100, it is to be expected that the reliability of this study's responses is ought to be on the low end. The reliability will be computed per variable in the following section where the results are presented.

3.4 Validity

The validity of this empirical research concerns the degree to which the survey represent truthful answers that are meaningful to this research. A high level of validity insinuates that this study's findings truly represent the phenomenon that is investigated. In order to do this, the Pearson correlation coefficient (Pearson's r) will be computed via SPSS 25. Meanwhile, parameters such as the statistical significance and the beta coefficient of the regression model will also be computed. The validity will be computed per variable in the following section.

4. RESULTS

This study's analysis has been conducted via SPSS 25. Most of the relevant tables can be found in text, however specific tables regarding the survey items are integrated in the appendix of this research paper.

4.1 Cronbach's Alpha

In order to determine the internal consistency of the data gathered from the survey, Cronbach's alpha has been computed per variable. Several items have been recoded in SPSS before the reliability analysis could commence, as a combination of the cold- and warm-start method has been used in the survey. All the survey items have been recoded into warm-start items, where "Strongly Agree" always implies a positive attitude towards neuromarketing, and "Strongly Disagree" always implies a negative attitude towards neuromarketing. Furthermore, for a more detailed analysis, the specific tables can be found in the appendix.

4.1.1 Attitude Towards Technology in General

The Cronbach's alpha was computed for the sub variable "attitude towards technology in general". It was found that the Cronbach's alpha for this sub variable was 0.405, which implies that the inter-item reliability of this variable is inadequate, as the threshold value for Cronbach's alpha is commonly 0.600 or higher. However, if question 1 would have been deleted, the Cronbach's alpha would have significantly improved up until 0.703, which insinuates an adequate reliability.

4.1.2 Ethical Ideology

For the second sub variable "ethical ideology", the reliability was calculated and it was found that the Cronbach's alpha for this sub variable was 0.178, indicating that that the inter-item reliability of this variable is insufficient as well. However, if question 5 would have been deleted, the Cronbach's alpha would have been slightly improved up until 0.253, which still implies an insufficient reliability.

4.1.3 Perception of Neuromarketing Hazards

For the third sub variable "perception of neuromarketing hazards" the reliability analysis found that the Cronbach's alpha was 0.846, meaning that the inter-item reliability of this variable is in fact adequate, due to the high number of items. The reliability would not have been significantly improved if several items were deleted within this variable, however deleting question 9 would have resulted in a slightly higher alpha of 0.872.

4.1.4 Sentiment Towards Neuromarketing

Finally, the Cronbach's alpha was computed for the main variable "sentiment towards neuromarketing practices", which was computed as 0.882. This states that the inter-item reliability of this variable is good as well, similar to the preceding variable. Deleting any of the items would only have resulted in a lower Cronbach's alpha.

4.1.5 Conclusions for Cronbach's Alpha

It can be concluded from the reliability analysis that variable 1: "attitude towards technology in general" and variable 2: "ethical ideology" both demonstrated insufficient inter-item reliability. The inter-item reliability of variable 1 could have been significantly improved to an adequate level if question 1 was removed from the analysis. Variable 2, however, remained inadequately reliable due to the short item usage within this variable. Future research could test this with a larger item usage. Variable 3: "perception of neuromarketing hazards" and variable 4: "sentiment towards neuromarketing practices" both showed a high level of reliability, which is very likely the result of the relatively larger item usage within these variables.

Variable	**Cronbach's alpha (α)**	**Nr. of items**	**Nr. of items deleted**
Attitude towards technology	0.405	3	1
Ethical ideology	0.178	3	0
Perception of neuromarketing hazards	0.846	8	1
Sentiment towards neuromarketing	0.882	5	0

Table 4. Cronbach's Alpha for the Four Variables

4.2 Correlation and Regression

In order to conduct the regression and correlation analyses for the dependent and independent variables, the independent variables will be tested upon the dependent variable. In this case, the attitude towards technology (IV), the ethical ideology (IV), and the fear towards neuromarketing (IV) will each be tested upon the consumer's sentiment towards neuromarketing (DV). Furthermore, the intercept of the regression analysis will be used to explain the effect of the independent variables on the

dependent variable. For the analysis of the correlation, the Pearson Correlation Coefficient (R) will be used.

4.2.1 Attitude Towards Technology in General

The hypotheses to test the relationship between a person's attitude towards technology and this person's sentiment towards neuromarketing are stated as following:

H_0: There is no significant relationship between a person's attitude towards technology and this person's sentiment towards neuromarketing.

H_1: A person's attitude towards technology has a significant effect on this person's sentiment towards neuromarketing practices.

As presented in Table 5, the statistical significance value (p-value) of the attitude towards technology on the sentiment towards neuromarketing is equal to 0.001, which implies that the null hypothesis can be rejected, since this research assumes $\alpha = 0.05$. This insinuates that the attitude towards technology has a significant effect on the consumer's sentiment towards neuromarketing.

Computing the correlation between the two variables using Pearson's Correlation Coefficient resulted in R = 0.478, which states that there is a moderate positive relationship between the two variables since there is a correlation of 47.8%. The squared correlation coefficient $R^2 = 0.229$ implies that 22.9% of the linear regression model explains the variability of the measured response data. The standard error of the estimate of 0.177 indicates an accuracy of 82.3% in terms of the predictions made with the regression line. Concluding this subsection, the slope of the regression line is B = 0.616, meaning that for every one unit increase in the independent variable, the dependent variable increases with 0.616, which causes the slope of the regression model to be relatively steep.

It can be concluded that a subject's attitude towards technological innovations significantly explains his/her sentiment towards neuromarketing as a marketing research practice. Bakardjieva & Kimmel (2016) found similar results with the conclusion that the attitude towards technology accounts for a substantial proportion of variation in neuromarketing scores.

Construct	B	Std. Error	Sig.	R	R^2
Attitude Towards Technology	0.616	0.177	0.001*	0.478	0.229

*Significant at $p < 0.05$ (2-tailed)

Table 5. Results of Regression and Correlation Analysis of Attitude Towards Technology with Sentiment Towards Neuromarketing

4.2.2 Ethical Ideology

The hypotheses to test the relationship between a person's ethical ideology and his/her sentiment towards neuromarketing are stated as following:

H_0: There is no significant relationship between a person's ethical ideology and this person's sentiment towards neuromarketing.

H_2: A person's ethical ideology has a significant effect on this person's sentiment towards neuromarketing practices.

Table 6 indicates that the statistical significance value of the ethical ideology on the consumer's sentiment towards neuromarketing is 0.581, which indicates that there is not enough evidence to reject the null hypothesis, since the p-value is higher than the significance level of 0.05. This incredibly high p-value implies that there is a 58.1% probability that there is no relationship between the two variables, which is unfortunate to conclude for this research. This may be due to the relatively low sample size, the low number of measurement items of the independent variable, or the quality of the existing items. Therefore, within this study it can be stated that a subject's ethical ideology has no significant effect on this person's sentiment towards neuromarketing.

The correlation coefficient of the two variables has been computed as R = 0.087, meaning that there is a positive relationship between ethical ideology and sentiment towards neuromarketing, but this relationship is very weak, since these variables only correlate for 8.7%. Therefore, it is no surprise that the squared correlation is very close to zero, as $R^2 = 0.007$. This insinuates that only 0.7% of the measured data fit the linear regression model that has been computed for these variables, which is extremely low. The standard error of the estimate of 0.205 implies that 79.5% of the absolute predictions made with the regression model are in fact accurate. Finally, the beta coefficient has been calculated as B = 0.114, indicating that every change of one unit in the independent variable causes an increase of 0.114 in the dependent variable. This causes the slope of the regression model to be not very steep, but rather gentle.

This research fails to prove that there is a statistically significant relationship between a person's ethical ideology and this person's sentiment towards neuromarketing, which may be due to the limited amount of survey items that measure this variable, as mentioned earlier. Bakardjieva & Kimmel (2016) were able to prove that there is a significant positive relationship between ethical ideology and perception towards neuromarketing due to their higher sample size and difference in items.

Construct	B	Std. Error	Sig.	R	R^2
Ethical Ideology	0.114	0.205	0.581*	0.087	0.007

*Significant at $p < 0.05$ (2-tailed)

Table 6. Results of Regression and Correlation Analysis of Ethical Ideology with Sentiment Towards Neuromarketing

4.2.3 Perception of Neuromarketing Hazards

The final hypotheses that will be tested to demonstrate the relationship between a person's perception towards neuromarketing hazards and this person's sentiment towards neuromarketing are stated as following:

H_0: There is no significant relationship between a person's perception towards neuromarketing hazards and this person's sentiment towards neuromarketing.

H_3: A person's perception of hazards towards neuromarketing has a significant effect on this person's sentiment towards neuromarketing practices.

Table 7 provides us with a statistical significance value that is equal to 0.000, which is an indicator that there is sufficient evidence to reject the null hypothesis, due to $p < 0.05$, stating that the alpha level has not been exceeded by the p-value. Rejecting the null hypothesis allows us to state that the consumer's perception of neuromarketing hazards does have a significant effect on the consumer's sentiment towards neuromarketing practices.

Furthermore, the correlation analysis of the two variables in SPSS gives us that the correlation coefficient has been computed

as R = 0.580, which indicates that there is a moderate positive relationship between a person's perception of the dangers that are associated with neuromarketing, and this person's overall sentiment towards neuromarketing practices, as the two variables have a correlation percentage of 58.0%. Squaring this correlation coefficient provides us with $R^2 = 0.337$, which can be interpreted as the percentage of the measured data in this research that fits the linear regression model that has been computed through SPSS for these two variables. This percentage is 33.7%, and indicates that the effect size of the model is relatively low to moderate. Additionally, Table 7 grants us a standard error of the estimate of 0.156, implying that 84.4% of the predictions made by the regression line are accurate. To finalize this subsection, the beta coefficient of the regression model is B = 0.710, insinuating that for every one unit increase in the independent variable, the dependent variable increases with 0.710. This means that the consumer's sentiment towards neuromarketing practices is very sensitive to the consumer's perception of the dangers that are linked to neuromarketing in the first place.

As might have been expected, the conclusion can be made that there is in fact a statistically significant relationship between how a consumer perceives the ethical dangers of neuromarketing practices, and the consumer's sentiment towards these neuromarketing practices in general. Individuals who tend to prioritize the ethicalities over the economic and societal benefits related to neuromarketing are also very likely to evaluate neuromarketing practices as negative.

Construct	B	Std. Error	Sig.	R	R^2
Perception of Neuro-marketing Hazards	0.710	0.156	0.000*	0.580	0.337

*Significant at $p < 0.05$ (2-tailed)

Table 7. Results of Regression and Correlation Analysis of Perception of Neuromarketing Hazards with Sentiment Towards Neuromarketing

As stated in the introduction of this paper, it is also interesting to investigate whether there is a difference in the perception of the different neuromarketing methods: fMRI, eye-tracking, cardiovascular and biochemical tools. There were no major differences to be recognized, as the means of the participants scores were between 3 (somewhat negative towards neuromarketing hazards) and 4 (neutral towards neuromarketing hazards), on a 7-point Likert scale where 1 signifies a negative attitude towards neuromarketing, and 7 implies a positive position. However, biochemical tools seem to be the most negatively evaluated by the participants with a mean score of 3.000, while eye-tracking has the relatively most positive score of 3.5116. fMRI and cardiovascular tools are in the middle with mean scores that are respectively 3.1163 and 3.2791. Table 8 will provide an overview of these differences in the perception between the four neuromarketing tools.

Neuro-tool	**Mean**	**Std. Deviation**
fMRI	3.1163	1.54626
Eye-tracking	3.5116	1.42046
Cardiovascular	3.2791	1.51698
Biochemical	3.0000	1.55839

Table 8. Descriptive Statistics of Differences in Perception Towards Different Neuro-tools

5. DISCUSSION

The aim of this research was to create a theoretical framework that would explain the consumer's sentiment towards the ethical implications of neuromarketing practices, for this framework to be applied in the empirical part of this study. After conducting statistical tests in SPSS with the collected survey data, a number of things became clear regarding the reliability, validity and significance of the proposed research model in Figure 1.

As stated in the results section, the inter-reliability of the first two variables, 'attitude towards technology' and 'ethical ideology', were both very low. This low inter-reliability is likely the result of these two variables being measured with only three items per variable, while the other two variables, 'perception of neuromarketing hazards' and 'sentiment towards neuromarketing' were measured with eight and five items respectively. This also explains why these two variables had a good inter-reliability. Despite concluding that not every variable is sufficiently reliable, the data will still be used for making conclusions in the remaining part of this paper.

The data analysis demonstrated that two of the three proposed hypotheses that are central in this study were statistically significant and could be accepted, while one hypothesis had to be rejected due to insufficient evidence supporting the relationship between an individual's ethical ideology and this person's sentiment towards neuromarketing. There was in fact a positive relationship to be recognized by computing Pearson's R, but the relationship turned out to be very weak and statistically insignificant. On the one hand it can be argued based on the empirical results that a person's ethical viewpoint is not a deciding factor when this person evaluates whether neuromarketing is a responsible tool to be used in society by companies. It may be that a person's ethical standards differ per subject in society, and that another independent variable would have been more effective to explain the sentiment towards neuromarketing. On the other hand, similar research has been conducted by Bakardjieva & Kimmel (2016), and they were able to prove that there is some kind of positive relationship between ethical ideology and perception towards neuromarketing, which would mean that future research can build upon this paper to further prove the significance of the relationship between these two variables. However, for this research the conclusion has to be made that the ethical ideology does not significantly influence the sentiment towards neuromarketing.

As aforementioned, the other two hypotheses regarding the variables 'attitude towards technology' and 'perception of neuromarketing hazards' were both supported by sufficient statistical evidence to be accepted. The moderate to strong positive relationship between a person's attitude towards technological innovations and his/her view upon neuromarketing was partly to be expected, since a person who is very open towards new technologies that influence our daily lives, and thinks that technology creates more 'good' than 'bad,' is logically also expected to be more open towards neuromarketing as a new and disruptive method of conducting market research. An individual who believes the opposite, however, undoubtedly will evaluate neuromarketing (which is in fact a technology) with its privacy implications in a more negative way. The acceptance of this hypothesis confirmed the general assumptions made in the beginning about the relationship between technological attitudes and neuromarketing sentiment. Thus, it can be concluded that attitude towards technology does significantly influence the dependent variable in this study.

For the last hypothesis that regarded the relationship between perceived neuromarketing dangers and sentiment towards

neuromarketing it can be said that there is enough statistical evidence to support the relationship between the two variables. Again, this moderate to strong positive association between the variables confirmed the existing presumptions made about the influence of perception towards neuro-dangers and the overall evaluation of neuromarketing. Consumers who are convinced that neuromarketing tools such as fMRI and EEG carry too many ethical risks related to an individual's brain privacy are also inclined to have a negative attitude towards neuromarketing practices used by companies. This assumption was proven by the statistical tests on the empirical data in this paper, which leads to the conclusion that perception towards neuromarketing hazards does significantly influence neuromarketing sentiment among the consumer.

6. CONCLUSION

This research was conducted to answer the following research question that was proposed in the introduction:

How do the ethical implications of neuromarketing impact the consumer's sentiment towards these neuromarketing practices that predict and/or influence consumer behavior?

The ethical implications in this research question were translated to the three hypotheses that were tested in this research. In testing these hypotheses, it became clear that the proposed research model did not fully explain the consumer's sentiment towards neuromarketing, however other relevant literature regarding neuro-ethics demonstrated that the ethical principles within a person do largely influence this person's assessment of neuromarketing, and to what extent it is ethical. Furthermore, this study proved that fear of intrusive technology results in a high probability that this fear is translated into a negative attitude towards neuromarketing as a technology in particular. Finally, a consumer that recognizes that there are multiple privacy risks related to neuromarketing that endanger the human dignity of a subject, is most likely to perceive neuromarketing as a bad practice. As a conclusion from the research findings in this study, the ethical implications of neuromarketing significantly impact the consumer's sentiment towards this practice when a consumer has a negative attitude towards technology and perceives the risks towards neuromarketing as threatening to his/her brain privacy and dignity, while the ethical ideology does not have the same effect on this sentiment as an independent variable alone.

7. RESEARCH LIMITATIONS

There are always research limitations present in a study, which may have limited the generalizability of this paper. Firstly, the sample size was lower than expected, since it was lower than 100. After the survey was published for two days, responses stagnated quicker than expected, which may be the result of not targeting the right audience when advertising the survey, or the items being too complexly formulated. A larger sample size would have increased the reliability and validity of the proposed research model, and might have led to different research findings and conclusions. A future study could build on this paper by having a larger sample size in order to prove that ethical ideology significantly influences neuromarketing sentiment. Furthermore, another limitation would be the reliance of this research's scale on Bakardjieva & Kimmel (2016), Stanton *et al.* (2016) and Kleiser *et al.* (2003) since three of the four variables are extracted from their studies. Even though relying on other researcher's scales usually provides a sound reliability, more robust and explorative research findings could have been discovered with more diverse items.

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10. APPENDIX

Variable	*Definition*	*Survey Items*
Attitude towards technology in general	"The degree to which a person evaluates technology and technological innovations positively or negatively." (Bakardjieva & Kimmel, 2016)	1. I fully trust that my online personal data is safely hidden from third parties. 2. I often feel that technology can be too intrusive. 3. Technology creates more opportunities than threats.
Ethical ideology	"The extent to which a person possesses an idealistic or relativistic ethical ideology." (Keiser *et al.*, 2003)	4. Ethical courses of action are always more important than profitable courses of action. 5. Being morally 'right' or 'wrong' is entirely dependent on the circumstances of the situation. 6. Ethical standards are universalistic and therefore are the same for everyone.
Perception of neuromarketing hazards	"The extent to which a person experiences fear when organizations use neuromarketing tools to gather consumer data." (Stanton *et al.*, 2016)	7. In basic terms, I know what neuromarketing research is.* 8. I feel that neuromarketing gives companies too much power over me as a consumer. 9. I make independent choices and neuromarketing tools cannot predict nor influence these decisions I make. 10. Neuromarketing is a manipulative way to sell products and services to consumers. 11. I am concerned about the side effects (e.g. privacy breaches) of medical devices in neuromarketing research. 12. fMRI scans (neuromarketing scans that capture the blood flow in the brain to reveal the subconscious processes of consumer behavior) might reveal subconscious data about me that I prefer to keep private. 13. Eye-tracking research (measuring the position and movement of the eyes through VR glasses) is too sensitive to risks regarding government surveillance, sharing of subconscious data and intentions of bad actors. 14. Cardiovascular neuromarketing tools (measuring heart rate variability) are too intrusive, as they share cognitive and affective processes, such as reasoning and (sexual) desires. 15. Biochemical tools (blood draws, urine samples) used by companies to measure the amount of hormones in humans are unethical methods to research consumer behavior.
Sentiment towards neuromarketing practices	The consumer's overall judgement regarding the use of neuromarketing tools.	16. The benefits neuromarketing provides for companies weigh up against the ethical implications that come along with it. 17. Neuromarketing is a new and scientifically better way to research consumer behavior. 18. Neuromarketing is a necessary and unavoidable innovation from traditional market research. 19. Neuromarketing is ethical. 20. I would be open to participate in neuromarketing research in the future.

*****Question 7 was excluded in the data analysis.

Table 9. Survey Items