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COMMENTARY

Ethical Issues in Neuromarketing: "I Consume, Therefore I am!"

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Abstract Neuromarketing is a recent interdisciplinary field which crosses traditional boundaries between neuroscience, neuroeconomics and marketing research. Since this nascent field is primarily concerned with improving marketing strategies and promoting sales, there has been an increasing public aversion and protest against it. These protests can be exemplified by the reactions observed lately in Baylor School of Medicine and Emory University in the United States. The most recent attempt to stop ongoing neuromarketing research in France is also remarkable. The pertaining ethical issues have been continuously attracting much attention, especially since the

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number of neuromarketing companies has exceeded 300 world-wide. This paper begins with a brief introduction to the field of neurotechnology by presenting its current capabilities and limitations. Then, it will focus on the ethical issues and debates most related with the recent applications of this technology. The French Parliament's revision of rules on bioethics in 2004 has an exemplary role in our discussion. The proposal by Murphy et al. (2008) has attracted attention to the necessity of ethical codes structuring this field. A code has recently been declared by the Neuromarketing Science and Business Association. In this paper, it is argued that these technologies should be sufficiently discussed in public spheres and its use on humans should be fully carried out according to the ethical principles and legal regulations designed in line with human rights and human dignity. There is an urgent need in the interdisciplinary scientific bodies like ethics committees monitoring the research regarding the scientific and ethical values of nonmaleficence, beneficence, autonomy, confidentiality, right to privacy and protection of vulnerable groups.

Keywords Neuromarketing · Neuroscience · Ethical issues · Human dignity · Public engagement

Introduction

Economics, psychology, neurobiology and neuroscience are converging into a unified discipline called neuroeconomics where economists and psychologists are providing conceptual tools for understanding and modeling behavior, while neurobiologists provide tools for the study of mechanism. The goal of this discipline is shown to be revealing the processes underlying the connection between perception and action by investigating the neurobiological mechanisms by which decisions are made (Glimcher and Rustichini 2004). Neuromarketing can be regarded within this scope as a practical field. Marketing research has experienced a groundbreaking turn with the increasing use of neurotechnologies and neuroimaging techniques especially in the last decade. Beyond the traditional marketing research methods that are based on verbal reports and introspection, neuromarketing has been more objectively developed for understanding what is happening inside the *black box*, namely the human brain (Camerer et al. 2005). The term "neuromarketing" has been suggested by Ale Smidts in 2002; and since then, this field has attracted much attention by academics and multi-national companies. The number of publications about neuromarketing has increased from 10 (2000) to 250 (2010), and it is currently estimated that there are more than 300 companies working in this field (Plassmann et al. 2012).

It is important to distinguish the two main research domains: the first one is academic and could be referred as "consumer neuroscience" as suggested by Hubert and Kenning; the second one is the direct application of the neuroimaging techniques for sector-specific aims (Hubert and Kenning 2008). Although these two research domains interact with each other, it is important to note that sector-specific research has been the central issue in several ethical debates within the societies which will be discussed in detail herein after. Another important issue related to the perception of neuromarketing is the

direct application of the neuroimaging or biometric techniques. The neuroimaging techniques could be explained as directly brain-based measurements like electroencephalography (EEG), magnetoencephalography (MEG), functional magnetic resonance imaging (*f*MRI) or positron emission tomography (PET) (Damasio 2009). On the other hand, biometric methods have focused on measuring the levels of bodily outputs as evidence for neural system activity, thus these could be accepted as indirect measurements for brain-related activations (Gazzaniga 2005). The Neuromarketing Science and Business Association (NMSBA) has declared that any type of research method other than neuroimaging and biometrics such as classifying articulations of the participants (i.e. their verbal responses for rating the products or asking for their brand preferences) could not be regarded within neuromarketing research methods but they could be used for explaining the outcomes from neuromarketing techniques. Nick Carr, a journalist from *the Guardian*, questioned the mind-reading capability of neuromarketing methods, specifically emphasizing the borders between acceptable influence and manipulation (Carr 2008). Carr stated that the businesses will be very advantageous since they will have more knowledge about what and how we think than we will. Thus, our perceptions could be controlled by them. *According to* Carr, this might shift the power balance within the marketplace from the buyer side to the seller side (Carr 2008). These public concerns are understandable in the light of the recent research findings by Gallup (Gallup 2011). This research has demonstrated that people tend to evaluate marketing and advertising practitioners with a very poor reputation, since these findings show that advertising practitioners have been ranked at the bottom of the honesty scale just above three groups including members of Congress, car salespeople, and lobbyists (Gallup 2011).

The French Parliament has revised its 2004 rules on bioethics. The result, passed in 2011, is a section of the law that simply states: "Brain-imaging methods can be used only for medical or scientific research purposes or in the context of court expertise" (Oullier 2012). The revised law effectively bans the commercial use of neuroimaging in France, although neuromarketing companies have only to cross the border to continue their business (Code Civil 2011). Thus, in France, pursuing any commercial research and any act of commercialization by using brain imaging techniques is banned. However, it is still possible to carry out neuromarketing research by means of biometric techniques such as eye-tracking and galvanic skin response etc. This revision caused serious debates among neuroscientists and politicians about the exact position of neuroimaging technologies, and it was also stressed that the use of neuroimaging techniques in courts still takes place, despite the fact that there have been several cases of failure in this technology concerning reliability. Misinterpretation and over-interpretation are the possible common failures for the practical use of these neurotechnologies especially for disciplines like neuromarketing that are still at their infancy level (Madriga 2010; Ergen and Ulman 2012).

The present paper provides a general overview for the ethical considerations directly related to neuromarketing. Our initial approach is that neuromarketing poses several significant ethical problems which should be analyzed by giving credit to the relevance and importance of each issue. This paper outlines the ethical concerns including the consent of the subjects and privacy of personal information.

Our aim is to discuss the ethical and scientific debates both in the short and long-term, inspired by the last regulatory change in the Civil Code in France (Code Civil 2011).

Scientific Validity, Transparency and Reliability

One of the scientific and ethical concerns has been related to the validity of neuromarketing research (Rees and Rose 2004). There have been helpful but limited number of studies concerning the empirical foundations of the current status of neuromarketing as a broad research program. Different domains of cognitive activity such as consciousness (Chartrand et al. 2008; Pessiglione et al. 2008), attention (Bargh 2002), memory (Tom et al. 2007; Chessa and Murre 2007; Morrin and Ratneshwar 2003), decision-making (Plassmann et al. 2008; Chib et al. 2009), preference (Stoll et al. 2008), emotions (Groeppel-Klein 2005; Dolcos et al. 2004), sensory domains (Krishna and Morrin 2008; Morewedge et al. 2010; De Araujo et al. 2003), cultural impacts (McClure et al. 2004; Vecchiato et al. 2011) and predicting choices (Knutson et al. 2007; Levy et al. 2011; Tusche et al. 2010) have been explored and investigated. We need further scientific research, beyond these introductory academic studies in order to establish a stronger basis for the validation of the scientific background of neuromarketing.

The scientific competency of the researchers factors significantly in the scientific reliability of any research as well as the scientific quality of the equipment used (WMA, Declaration of Helsinki World Medical Association 2013). This factor is increasingly important for any emerging technology which claims to investigate the human brain, for instance by using EEG records. Hence, the oversimplified parameters such as “excitement”, “engagement” and “frustration” derived from the prepackaged software programs are highly disputable, and it is not clear whether they can capture the cognitive preferences of the human mind. Despite the fact that some prepackaged software programs are utilized in the field, the collected EEG data should be analyzed via custom-made methods solely by scientifically proficient researchers and practitioners.

As Illes pointed out, the interpretation of neuroscientific findings poses a significant problem because it requires a high level of knowledge integration and meaningful interpretation (Illes 2002). It is claimed that neuromarketing advisory companies might overestimate the findings and misguide the companies. Moreover, it is possible that the research units of multi-national companies might tend to overestimate the results in order to stand as valid and credible.

The risk of manipulation by commercials or mind-control is directly related to the discussion by Murphy about the invasion of the inner sanctum of private thought (Murphy et al. 2008). Murphy underlines that the “critical level of effectiveness” would be the most significant point in distinguishing acceptable from unacceptable facilities in neuromarketing (Murphy et al. 2008). However, it is not easy to provide such a distinction on the neural level due to several limitations including numerous

parameters from spatiotemporal resolution of brain imaging to individual and cultural differences.

Ethical Concerns

Regarding the ethical issues and debates related to neuromarketing, the concept of human dignity should be the ground for ethical principles such as autonomy, self-determination, privacy, confidentiality, protection of vulnerable groups, reliability and honest interpretation of research findings in line with the risk of manipulation by commercial actors. We propose that the role of bioethical discourse, together with the supervising and monitoring functions of ethics committees are relevant in this respect.

Dignity and Integrity, Beneficence and Nonmaleficence

The concept of human dignity is a key element underlying the ethical concerns regarding the implementation of emerging technologies. The notion of dignity has gradually received a more central place in ethical debate and has entered international conventions in the bioethics field. This inclination can be easily traced in universal instruments regarding bioethics and human rights. The Universal Declaration of Human Rights (1948) ensures the principle of dignity as the core instrument of human rights. (Preamble, Article 1); and stipulates the protection of privacy and personal information (Article 12) (Universal Declaration of Human Rights 1948). The Council of Europe Convention on Human Rights and Biomedicine (Oviedo Convention) provides the primacy of the human being by certifying that the interests and welfare of the human being shall prevail over the sole interest of society or science in Article 2 (Oviedo Convention Oviedo 1997). The underlying bioethical core value of human dignity has a pivotal importance as a link between human rights with bioethical values regarding the analysis of bioethical concerns in applications making use of neurotechnologies, such as neuromarketing. The dignity of the individual is, as elaborated by Nordenfeldt, tied to the integrity of the subject's body and mind, and also dependent on the subject's self-image as an integrated and autonomous person (Nordenfeldt 2009). Thus, the dignity of a person is referred to as integrity of moral stature and dignity of identity based on a set of rights on part of the human being. Paying respect to dignity means respecting the rights of the subject (Nordenfeldt 2009). As a matter of fact, the notion of human dignity is assessed as a cornerstone of bioethical norms to provide a solution with challenges raised by biomedical advances (Andorno 2012). The Oviedo Convention represents a milestone in the efforts of the European institutions to guarantee the protection of human rights in the biomedical field. It only aims to set up some basic principles to prevent practices that would most seriously infringe on human rights and human dignity (Andorno 2005). Therefore, respect to human dignity should be a fundamental guiding principle in scientific research gleaning into the human body and mind. This fact may seem to be correlated with the ethical

debate on emerging medical technologies such as neuroimaging techniques and their implementation on human persona in broad sense. Considering that human dignity presents an indispensable component of an autonomous human identity, it is claimed that while handling the uncertainties of predicting the effects of any technology, possible risks of harms and benefits to the concerned parties, should be taken into consideration. Thus, making use of neuroimaging technologies for neuromarketing research should be, first of all, questioned in view of its potential challenge to human dignity and integrity and its potential infringement of bioethical principles and values, namely, autonomy, confidentiality and privacy as the intrinsic values of the human individual. Although neuromarketing can be defined as a kind of marketing research carried out for commercial purposes rather than clinical research, this sort of application which is benefiting neuro devices should be provided with bioethical considerations, on top of business ethics requirements, as the human integrity and identity are in question. Human dignity should always take precedence enhanced with the ethical principles of self-determination, respect for private life, confidentiality and privacy over marketing forces. The human persona is not a "mere consumer, or client" whose preferences can haphazardly be detected through brain imaging and brain mapping techniques without taking due care. Human decision-making is a multifarious process peculiar to a subtle and sophisticated entity through rational and emotional procedures. Therefore the dignity and integrity of the human being should be protected by respecting the autonomous deliberation of the human individual on his/her preferences. Furthermore, it is extremely important to take additional precautions in caring for the vulnerable groups to protect them against the harmful effects of overconsumption and commercialization that may be pursued by neuromarketing research.

Autonomy and Informed Consent

Autonomy and Informed Consent are among the indispensable obligations that any researcher should ensure with the participants by giving them information about the thorough disclosure of benefits and risks. Murphy and her colleagues have noticed that the search of the responses of the human brain to the marketing stimuli in order to obtain objective data about the inner workings of the brain might be a potential threat to the autonomy of the participants from whom certain information is waived in obtaining consent prior to the research (Murphy et al. 2008). Therefore, informed consent must include full disclosure of benefits and risks. While most technologies used by neuromarketing may be considered at minimal risk, human participants should be advised and reminded of their right to withdraw at any time, without penalty, from any stage of the study for any reason, including minor discomfort (Beauchamp 1997).

It is substantially important to explain the research and provide information on such technical issues in a clear and explicit way such that it can be understood by anyone. While taking informed consent, the participants should be informed in detail about the aim and scope of research together with the possibility of the incidental findings of brain research in a way that anybody can understand. As well

as the essential outcomes resulting from the research, the participants should also be informed of any further incidental findings that concern them throughout the research in which they voluntarily take part. As a matter of fact, voluntariness is an indispensable part of any research on any participant. Therefore researchers should be cautious of undue influence of such incentives, which may cross over into indirect coercion. It should be taken into consideration that some applications may be hidden from the participants in order to glean an authentic response to the inputs of the experiments. The key point to guide the researcher here should be to respect the participant's right to self-determination and autonomy.

In respect of incidental findings Gutman's exemplification of a brain imaging case is quite relevant. While examining functional magnetic resonance images collected during a memory study, researchers found an arteriovenous malformation, an abnormal connection between arteries and veins in her brain. The patient had the mass surgically removed, and recovered. Such discoveries—when physicians or researchers are looking for one thing and find something else—are known as incidental findings. Those secondary findings raise related issues: They are not the primary target of testing, but (unlike incidental findings) they are actively sought. Improved technologies are making incidental and secondary findings increasingly common. All practitioners—whether they are clinicians, researchers, and companies— should anticipate findings and describe (wherever feasible) what incidental findings are likely to arise from the tests and procedures before they are conducted. Practitioners should inform individuals about their plan for disclosing and managing incidental and secondary findings, specifying what findings will and will not be returned. It is recommended that clinicians engage in shared decision-making with patients before testing about the scope of findings that will be sought and communicated and about any further steps to be taken (Gutman 2013).

Privacy and Confidentiality

The participants should be assured that the information and results concerning them will be kept confidential in a database and the results should only be shared on scientific grounds and anonymously to secure the privacy of the individual research subject (Slowther and Kleinman 2009). Research findings should not be given/sold to any other party (like firms, insurance companies etc.). Illes argues that functional neuroimaging technology will have the risk of discrimination, stigmatization, and coercion that include a risk for penetration into privacy. In other words, the biologization of personal thought would enable the quantification of complex thought processes with getting screened on brain maps with various technological devices (Illes 2002).

Baylor College experiments and Commercial Alert's protests against this, as explained by an Editorial in Lancet Neurology 2004 issue, provide an example for this argument (The Lancet Neurology 2004). A neuroscientist at the Baylor College of Medicine claims to have used fMRI to show that consumers who prefer Pepsi during blind tastings have a five times stronger response in the ventral putamen than those people who preferred Coca-Cola. However, when the test was repeated

unblind, nearly all the participants said they preferred Coca-Cola. Interestingly, when the participants tasted Coca-Cola, both the ventral putamen and the medial prefrontal cortex—an area linked to our sense of self—lit up. It seems that the Coca-Cola brand is so attractive that it over-rides what our taste buds are telling us. On the basis of this new research, some marketing companies have decided to specialize in selling brain imaging technology to large corporate clients. The USA spent approximately US$6·8 billion on MRI equipment in 2002 on focus groups, opinion polls, and other marketing tools. This fact induced Commercial Alert, a non-profit organization that aims "to keep the commercial culture within its proper sphere", to send a strong letter to the president of Emory University on Dec 1, 2003, requesting the university's researchers stop their neuromarketing experiments. Commercial Alert followed up with a letter to the US Federal Office for Human Research Protections asking it to investigate whether the experiments violated federal guidelines for research on human beings. The Editorial in Lancet rightly criticizes whether it is proper for a university or medical center to provide "neuromarketing" services to corporate clients, and whether fMRI could be used in a way that would unacceptably infringe personal privacy. Despite the fact that brain imaging technologies promise great benefit to human health and welfare, it seems that they are going to be implemented for pure commercial use that may infringe ethical principles and personal rights, the privacy and confidentiality of people if not monitored and regulated.

Vulnerable Groups

Protection of vulnerable groups is crucial to set boundaries for the research on various—especially unprotected- groups such as children and patients with psychiatric disorders, as well as prisoners (Luna and Macklin 2012). These groups might be much more susceptible and could easily be deceived or negatively affected by the use of this technology. Farah emphasized the importance of protecting various groups, addicts and psychologically vulnerable parties (with major disorders) (Farah 2005), and others have pointed to the particular vulnerability of the incarcerated even when representatives or advocates for the vulnerable population serve on the Institutional Review Boards (Mobley et al. 2008). Vulnerable groups should be treated with special care. Thus their participation in the neuromarketing research experiments should be investigated. For instance, brain imaging techniques can be beneficial in learning how the children read, write, learn and how these techniques can be implemented to improve learning or any other cognitive talents on scientific grounds. Yet the commercial use of these techniques on children or on any vulnerable group can neither be defended nor justified on ethical grounds. Furthermore, their status of health and their interests should be under protection by the law.

Researchers have shown that a culture of consumerism and materialism has a dramatic negative impact on children's physical and psychological health. It is argued that the pattern of using emotions to influence consumerism has expanded to include research on how to exploit children's emotions to increase consumption.

Corporate clients are encouraged to use psychological findings on children's underlying needs, cognitive abilities, changing attitudes, and relationships with parents to sell their products. Childhood obesity has skyrocketed in the last 10 years; kids are smoking, drinking alcohol, and taking illegal drugs at alarming rates, and they are suffering from emotional and mental health problems at a higher rate than in the past. By giving reference to the American Psychological Association (APA)'s Ethics Code, Kramer alerts the public in developing informed judgments by teaching parents, educators, youth development professionals, and the general public about the potential damage caused by consumerism (Kramer 2006).

Research on a vulnerable group can be ethically justified if only the research responds to any health need or any benefit from the knowledge, practices or interventions that may result from that research in order to protect this group from harm and from exploitation. The Declaration of Helsinki serves as a guide especially for research on vulnerable groups, and although this code is specific to physicians and biomedical researchers, its universal ethical rules should be valid for neurotechnological applications, especially for neuromarketing (WMA Declaration of Helsinki).

Public Engagement, Public Sphere

Engaging the public in the debate and the discussion on new emerging technologies is an inseparable phase of a pluralistic society on its way to be founded on human rights and ethical values. Ethical values and principles are not abstract, insubstantial concepts; on the contrary, they are values refined and conceptualized out of the actual practice of life. Thus it is the scientist's ethical duty to take up the theoretical issues with their practical responses in life and to solve the theoretical dilemmas consolidated with daily life practices. Researchers, academics and specialists are expected to inform and share knowledge with the lay public about the dimensions of neurotechnologies, neuroimaging techniques and the application of neuromarketing as discussed in this article. In this way the public is the natural stake holder of an interactive process on the information, perception, understanding, and acting together concerning the neuroscientific advances, neurotechnologies including neuromarketing. Racine has rightly criticized the unilaterality of this process by drawing attention to the need for an effective public engagement on the topic (Racine 2010). The lack of knowledge and public information about neuromarketing, as noticed by Arlauskaitė and Sferle, may cause neuromarketing to be labeled as unethical, intrusive and abusive by menacing privacy, autonomy, the niche populations (Arlauskaitė and Sferle 2013). Otherwise the lack of information on part of the neuromarketing techniques may cause misunderstanding and misconceptions. The public engagement may also help to understand, first of all, if there is any need in neuromarketing research regarding human welfare, health and social need. This issue is also relevant to any country as the international firms and companies work beyond national borders and they announce their activities through internet pages (Internet Pages of worldwide neuromarketing companies 2014) which are open to access worldwide. The idea of the public sphere and the discursive ethics of Habermas may be relevant in this context.

In Habermasian terms, the public sphere combines materials and methods from sociology, economics, law, and political science, social and cultural history. The public sphere is between the civil society and the state, in which critical public discussion of matters of general interest is institutionally guaranteed (Habermas 1991). The ideas of the enlightenment—liberty, solidarity and equality—are implicit in the concept of the public sphere, and they provide standards for criticism. The public sphere is a space where subjects participate as equals in rational discussion in the pursuit of happiness and the common good. This rationale can be helpful to shed light on deciding about neuromarketing applications.

Bioethical Discourse, Ethics Codes, Ethics Committees

Habermasian theory of morality, the bioethics discourse can provide a feasible medium for a multilateral dialogue in a pluralistic society imbued with the values of respecting the dignity and integrity of the human being. The bioethical discourse has a social and pragmatic function of bringing people together for a meaningful engagement of argumentation (Finlayson 2005). Therefore the notion of the public sphere or the engagement of the public may be a common ground to understand and make a decision on the convergence of neurotechnologies—such as neuromarketing—into daily life. The ethical framework to guide the research and to set the standards of neuromarketing befits the duties of the researchers. Although the ethical codes would have a positive impact on companies and laboratories in the field of neuromarketing, it is important to have these ethical discussions with the contribution of the society, namely with the concerned stakeholders. In other words, it is significant to provide the active contribution of a wide range of members of society that would enable the multi-directional communication as opposed to unilateral information processing in the real public sphere. The public opinion, the ideas of the NGOs and information presented from the professional, academic organizations or specialty associations are all components inherent in the constructive learning and discussion on new emerging technologies including neuromarketing. Moreover, the role of supervising and monitoring bodies such as ethics committees is particularly relevant in the context of the emerging technologies. By assessing the benefits and potential risks to participants and volunteers, the ethics committees, owing to their multi-professional, pluralistic structure, express the need for conformity to accepted ethical standards and practices and thereby the viability of any research (Guide for Ethics Committees 2010). Ethics committees base their recommendations on ethical principles and rational deliberation, rather than on mere custom, political power or self-interest (Lo 2007). While analyzing the projects, the rational, objective and independent decision-making methods of the ethics committees can set an example for reviewing the research projects of private industry such as neuromarketing on human participants before they are conducted (Shamoo and Resnik 2009). The functions of impartiality and neutrality of the ethics committees, or multidisciplinary and democratic bodies functioning similarly to ethics committees may serve as a model for monitoring and supervising the neuromarketing researches (Izgi and Ulman

2013). Consulting ethics committees will provide benefit for decision-making procedure to assess the neuromarketing application at hand as regards a monitoring scientific body to be enhanced with both scientists and the laymen in the society.

Legal Framework

It seems essential to incorporate public engagement, ethical deliberation and a legal framework to deal with the neuromarketing research and applications. France has stepped forth by putting the applications of this technology in a legal framework by specifying the use of neuroimaging technologies only for human health and welfare. Considering the increasing interventions by information technology and life sciences into the human body and brain, a report prepared for the Committee on Bioethics of the Council of Europe points out the need in a new form of governance of the techno-scientific drivers and market forces. It suggests an inclusive process of societal learning, involving professional, public, political, and ethical deliberation; and draws attention to the functions of intergovernmental committees and public (bio)ethics bodies, like the Committee on Bioethics of the Council of Europe and the European Group on Ethics to take decisions and monitor commercial applications (Est 2014).

There seems at least three main routes for the future prospects: (1) place a total ban or a partial restriction on neurotechnology for commercial use (as the Parliament of France has done), (2) allow total freedom of use due to the lack of any regulatory standard (which is the current situation in many countries), (3) develop a regulatory framework (which would provide guidelines for ethical attitude and behavior in research practice). Whatever the choice, the neuromarketing applications should be controlled scientifically, ethically and legally against any misuse or harm to human beings by giving prominence to human dignity and health as a leading value. Yet, the adherence of bioethics principles into the issue should not be the "ethical" justification of the commercial use or commercialization of new technologies.

Conclusion

Neuromarketing has emerged as an applied field which may transform traditional marketing research by means of various neuroimaging tools. Since many details about this emergent application are unclear, the use of neuroimaging technologies in the marketing field has not been scientifically and ethically convincing yet, in the light of human health and welfare. Ethical concerns are raised by several governmental and non-governmental bodies, experts, scholars and by various groups in society. It is argued in this paper that public policies based on human rights laws and the bioethical value of human dignity and integrity should become a part of research in this newly emerging field. Evaluation and monitoring by bioethics committees and review boards are strongly advised, especially for the ethical review and decision-making as part of any proposed research. Above all, a

multi-faceted process of dialogue can steer all parties and social actors together including the public and the academic circles, policy makers, specialists and experts in order to develop a rational and meaningful debate as the basis for effective policy on neuromarketing. It has been proposed in this paper that bioethics discourse and ethical decision making can provide the medium for acknowledging the human participant, not as a mere consumer or client, but as an agentic human being with dignity to be protected from intrusion to autonomy, from violations of confidentiality and privacy, from misuse of niche groups by respecting nonmaleficence and beneficence. It should be remembered that cost-effectiveness is not to be the sole motivation of doing research on the brain activity of the living. The rational and beneficial use of the technologies should be based on scientifically and ethically contemplated public policies. The ultimate goal of scientific research is the welfare and health of all living beings on earth. On top of that it is the ethical duty of the professionals to take action at the societal scale to inform and educate the public, and to shape public policy concerning the use of neurotechnologies.

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