

Decision-Making in (Bio)ethics: a Preliminary Study Using Mobile Eye Tracking

A Tomada de Decisão (Bio)ética: Estudo Preliminar Utilizando o Mobile Eye Tracking

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ABSTRACT

Decision-making is a key dimension in the training of health professionals, as mentioned in the current National Curriculum Guidelines for Medicine Undergraduate Course. Decision-making in the health context involves various aspects, including (bio)ethical elements. Hence, researches to investigate decision-making in (bio)ethics may elucidate steps not completely clarified yet, allowing a more effective building of skills in (bio)ethics, both in undergraduate and postgraduate courses. Therefore, the aim of the present study is to explore the possibilities of using mobile eye tracking while watching feature films, to investigate the role of visual attention in (bio)ethical decision-making.

RESUMO

A tomada de decisão é uma das dimensões essenciais da formação do profissional da saúde, como mencionado nas atuais Diretrizes Curriculares Nacionais do Curso de Graduação em Medicina. O processo decisório, no âmbito da saúde, envolve diferentes aspectos, incluindo os elementos (bio)éticos. Nesse sentido, pesquisas que investiguem a tomada de decisão em (bio)ética poderão elucidar passos ainda não completamente esclarecidos, permitindo uma mais efetiva construção das competências em (bio)ética, na graduação e na pós-graduação. Diante desta perspectiva, o objetivo do presente estudo é explorar possibilidades de uso do Mobile Eye Tracking para o estudo do papel da atenção visual – durante a exibição de filmes de cinema – no processo decisório em (bio)ética.

KEYWORDS

- Bioethics;
- Education;
- Decision-making;
- Medical Education.

PALAVRAS-CHAVE

- Bioética;
- Ensino;
- Tomada de Decisão;
- Educação Médica.

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INTRODUCTION

The process of training in medicine and in the other professions in the health field has undergone several attempts of change in recent years in the around the world¹, including Brazil. Efforts have been made by the government and by higher education institutions (HEI) to adjust the professional training of health care workers to the health needs and demands of the Brazilian population². Thus, the most frequent changes observed in the reality of HEI are related to (1) the integration of disciplinary curricula – decreasing the dissociation between the basic cycle and the clinic one³ –, (2) diversification of practice – shifting from the tertiary to the secondary level and above all, to the actions in primary health care (PHC)⁴ –, (3) integration into the Public Health Services in the beginning of the course, in order to decrease the dissociation theory-practice⁵ and, (4) the inclusion of disciplines, axes or modules about concepts related to (bio)ethics and humanities⁶. Certainly such adjustment proposals in education – like the integration of scenarios and fields of knowledge, as well as the proximity to the reality of daily work – brought the emergence of conflicts and situations of more complex resolution within the scope of health care⁷. Moreover, one must recognize that the profile of graduates and health workers –clearly – remains stable in the perpetuation of the *habitus* characteristic of this field⁸ – the biomedical paradigm, with its goods and its evils, incorporated into everyday life, pervading medical practice with a scientism removed from the (bio)ethical and social commitment. Such context makes perception, thinking and the solution to real (bio)ethical dilemmas little practiced and experienced by students, workers and professors – a constant if one analyzes undergraduate courses in medicine and the current medical practice⁷. In this sense, it is essential to disseminate the knowledge provided by clinical (bio)ethics⁹ – considering it brings in its core the importance and urgency of discussing ethical implications applied to the care of people by health workers, reflecting about the dilemmas these processes involve¹⁰ – since the decision-making will clearly have to be founded on sound theoretical tools to be able to reach the best decision on a given moment. Thus, the aim is to have the decision-making process always supported by (bio)ethical principles – associated in the best possible way with technical provisions – which doubtlessly will be an important point for better addressing the conflicts constantly faced by health professionals^{7,9,11}. In this context the decision-making process becomes important in the solution of (bio)ethical problems, and studying it points to new perspective in better training professionals and students. The process depends on several factors, such as, previous experiences, momentary circumstances, a subject's personality,

his/her reflexive process, the chances of debate the school offers, among so many others¹². The sensory organs, especially sight, play another important role in the decision-making process. It is known that a person's visual attention – related to a specific image – can totally influence his/her choices when it is time to act, and equally, that focusing the attention in different images may lead to different decisions. Certainly such variable composes the breeding ground for decision-making in the context of health care, however, until now little has been achieved in quantifying its importance due to subjectivity and difficulties in analysis^{13,14,15}.

Currently there are modern systems to track the gaze – called *Eye Tracking* – which consist of a setup that allows the users to have their point of gaze identified through detection of eye movements. The system enables finding in which elements of a given image the user focused his/her gaze – and for how long – enabling the analysis of visual attention. Thus it becomes possible to control and statistically analyze vision as a component of decision-making^{14,15,16}. The technique has already been used in studies involving the emotional aspects of decision-making. Nikolaev and collaborators thereby revised the most recent research findings about the use of *EyeTracking*¹⁷. Based on experiments with primates (humans and no humans) the correlation between emotions, point of fixation and saccadic movements^{18,19}, which occur involuntarily in the oculomotor system, has been established. Such movements help to interpret scenes or background images captured by the eyes. Their function is related to the links between all ocular fixations, covering the gaps between visual fragments in order to allow the brain to build a complete stable image²⁰.

Apropos of the debate on decision-making in clinical (bio)ethics, several authors discuss the relationship between variables involved in critical situations, such as prioritizing care and destination of resources to severely ill patients, or (bio)ethically judging what is beneficial or not to a patient, like in the wish for assisted suicide^{21,22}. There does not seem to be an easy answer to such questions, since they create great discomfort in health professionals concerning the need to decide about the extent and limits of care. Moreover, to ask ourselves about the various contexts in which difficult decisions happen implies to explore several variables, like theoretical and practical knowledge, emotions evoked, care setting, among many others⁹.

Based on these considerations, the objective of the present study is to investigate the possibility of using *Mobile Eye Tracking* to analyze the correlation between visual attention and motivated (bio)ethic decision-making while watching a feature film.

METHODS

The research was conducted – in March, 2014 – by a team of three physicians and Professors from Medical School in a Brazilian public university, all postgraduates (one MSc, two PhDs), practicing in general surgery, infectious diseases and public health. The participants were taken to a screening room and after comfortably seated each one received an eye tracking device, the *Mobile Eye Tracking- XG* (*Applied Sciences Laboratories*, Bedford, MA, USA). The mobile eye tracking is a mobile device that measures the subject's point of gaze through a system of cameras mounted on a pair of lightweight glasses²³. The device detects the image of the pupil and cornea, determined by the reflection of a source of infrared light on the surface of the cornea, exhibited in a video image of the eye²³. The equipment performs periodic measurements (each 40 milliseconds), providing the values of the exact point of gaze in each measurement.

After participants put on the glasses, calibration of the eye tracking system was adjusted. In this process an image was projected on the screen showing nine different numbers, each one in a different area of the screen. The subjects were asked to look at a given number so that the computer linked to the device could adjust the calibration between the position of the eye and the point on the screen where the gaze was focused. This process was carried out with the three research participants.

The eye tracking system having been installed and calibrated the research subjects were invited to watch the movie *Behind the Sun*²⁴. The film – launched in 2001 and directed by Walter Salles – tells the story of a man who lives in the northeast region of Brazil and undergoes major dilemmas after his older brother is murdered. The movie was shown on the same screen used to calibrate the devices. As the movie started all eye movements and the pupil diameter of the participants were monitored and stored in the system computer. It was thereby possible to know exactly which part of each scene each participant gazed every fraction of 40 milliseconds of the screening.

The screening was interrupted twice in moments of relevance for the decision-making process – (1) when the patriarch of a family observes an image of significance for the decision of sending the son to kill the man responsible for his brother's murder; and (2) when the leading actor finds himself in a dilemma: to escape from the family situation or go back home and accept his destiny – moments when an important decision was to be made. The participants were then asked which would be their decision in the same context. A sheet of paper and a pen were offered and each one had five minutes to write

TABLE 1.
Participants' search and visual attention patterns during experiment

Variables	Evaluated			
	P1	P2	P3	P
<i>First decision-making</i>				
Total of fixations	25,00	16,00	33,00	0,640
Duration of fixations	627,20	1430,00	713,94	0,317
Saccadic movements	4,00	8,00	4,00	0,143
<i>Second decision-making</i>				
Total of fixations	–	12,00	16,00	0,607
Duration of fixations	–	3650,00	2642,50	0,673
Saccadic movements	–	0,00	0,00	–

Source: research data

te an answer. Thus, each participant answered two questions, one after each interruption. After the end of the experiment data obtained were (1) computer data (eye tracking and pupil dilation) and (2) the manuscripts with the answers to the two questions proposed after interrupting the screening.

Descriptive analysis (mean) was performed to check the absolute values of the variables related to the visual search strategies data. Shapiro Wilk test was used for data distribution and One Way ANOVA for statistical inferences. Significance level adopted was $p < 0,005$. The software used for all tests was SPSS 18.0

The research was approved by the Ethics Committee on Research with Human Beings from the university – Universidade Federal de Viçosa (CAAE n° 25353714.8.0000.5153) – Participants received the Informed Consent Form to sign.

RESULTS

The search pattern and visual attention of the three participants were investigated through the analysis of three measures of visual search: (i) number of points of fixation in each decision, (ii) mean duration of fixation (in milliseconds) and (iii) saccadic movements. During the experiment a reading error in the system affected one of the participants, probably due to unintentional intervention of said participant on the device, this led to the impossibility of using data collected from then on. Results for the three above mentioned variables are shown in table 1.

Participants' answers for each proposed question are presented in table 2.

DISCUSSION

Decision-making is influenced by several variables, some precede the fact in question – the memory of experiencing similar situations, personal convictions, (bio)ethic concepts adopted –

TABLE 2.
**Answers of research participants concerning
 decision-making during the screening**

Moment 1 – Question 1: After seeing the spot on the shirt, a sign that the debt must be collected with the execution of a member of the rival family, would you opt for murder?	
Participant	Answer
P1	No; someone needs to interrupt the murder cycle between the families, moral is in interrupting this vicious cycle.
P2	No.
P3	No. I would not kill a member of another family.
Moment 2 – Question 2: Given the opportunity to abandon the family context, the hardship on the farm, few joys and the cycle of executions would you go back home?	
Participant	Answer
P1	I would not go back; for autonomy and freedom.
P2	I would not go back.
P3	I would not go back.

Source: research data

while others are directly related to the time of the event – feelings like rage, pity, sadness, and reactions to audio-visual stimuli, concerning which one can emphasize (1) the role of visual search and (2) the influence of visual stimuli in decision-making.

In this context, the use of new technologies, like the mobile eye tracking devices, may contribute to investigate decision-making process in the (bio)ethical field. Such research method is currently a focus of interest for researchers in various fields of knowledge, like behavior, advertise, sports, security²⁵. The increased technical improvement in recent years – with more modern devices – has allowed obtaining a greater amount of information as well as more detailed and reliable data, as presented by Mele and collaborators²⁶. Its usage in health sciences however is still not routine. In any case, it is worth mentioning a study which used – simultaneously – the *Mobile Eye Tracking* and electroencephalogram (EEG) during free observation of scenes; focus activities were observed along with theta and beta waves, adjustment of focus and saccadic movements were correlated with activated cortical areas^{18,19}. *Mobile Eye Tracking* has also been used to investigate psychiatric and developmental disorders. Mercadante et al²⁷ assessed the search and visual focus pattern in autistic patients compared to a group control of healthy subjects, concluding autistic subjects present search and focus patterns of images that in certain aspects configure peculiar social situations. Orsati et

al¹⁹ came to the same conclusion, despite the small size of the sample. Data obtained point to the necessity of new studies with a higher number of participants^{19,27}.

Concerning decision-making, Postma et al published a research that demonstrates the use of *Mobile Eye* in the analysis of vision in decision-making processes. The authors analyzed the behavior of women athletes of ball games faced with the matter of focusing attention for a larger or smaller time in a ball thrown in their direction, to decide if it could be reached or not. The investigation tried to determine if the initial moments would be essential or if it would be necessary to observe the ball either continuously or for a longer time to conclude if it was reachable or not. Despite the study being inconclusive, one envisages the possibility of achieving tangible results with better structured investigations and a higher number of participants being analysed²⁸.

Based on these preliminary investigations the present study may be considered a groundbreaking one, once one acknowledges that the use of the *Mobile Eye Tracking* for the investigation of matters concerning (bio)ethics is still incipient. Indeed, we aimed to assess the use of eye tracking systems for the investigation of the decision-making process over ethical questions. For this, film excerpts were used – once feature films constitute one of the main pedagogic tools for the debate and teaching of clinical (bio)ethics^{12,29,30}. It must be emphasized that the decision-making process in both moments screening was interrupted though not immediately correlated to contemporary (bio)ethical debate, bears an unequivocal ethical character, in terms of the decision to kill or let live. Indeed, the proposed method was able to identify each research participant's pattern of visual search and compare it to the decision-making stimulated during the proposed questions. In this context it was possible to observe that all research subjects showed very similar search patterns of visual elements in the movie, both in attention time aimed at each element of the scene and in the quantity of visual focus change during screening, these the two main parameters analyzed. As for the answers to the proposed questions – decision-making – the pattern was also the same among the three participants, which somewhat points to the possibility of correlation between visual search and decision-making.

Certainly, in this preliminary study several limitations prevented from finding sound scientific evidence. Among the main ones, the reduced number of research participants (n=3) can be highlighted; but one must consider, regarding this point, that the objective was to define – preliminarily – a methodology to investigate visual attention in the decision-making process in (bio)ethics.

FINAL CONSIDERATIONS

Future prospects with studies using the Mobile Eye Tracking are indeed likely to clarify the role of vision in decision-making about (bio)ethical matters. Therefore, this study had the merit of preliminarily presenting the method and the prospect that there is much to be explored in this field of knowledge. Thus the intention is to investigate henceforward the technical improvements in the use of the device, as well as to structure research designs that allow to determine with both significant statistical data and the use of artificial intelligence methods^{31,32} the connection between visual search and the decision-making process, above all in matters related to clinical (bio)ethics.

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