

## EYE TRACKING STUDY REGARDING THE PERCEPTION OF AI-BASED SERVICE ROBOTS

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### Abstract

Neuromarketing is a relatively new topic and plays an important role nowadays in marketing and consumer research. Especially in the business environment, companies thrive to better understand the attitudes, the feelings and the involuntary reactions of their future customers. In such cases, it is very useful for them to take into consideration the use of the neuromarketing tools as research methods. This paper presents the results of an eye-tracking experiment which analyses the consumer's reactions towards home service robots and their appearance. A picture collage containing four types of service robots with more or less human-like characteristics was presented to the subjects. The results of the eye-tracking experiment show that the consumers are not yet prepared to accept robots with an increased level of anthropomorphic appearance. The key performance indicators show that the robot with the least human-like characteristics was the first one to be noticed, while the robot with the largest display has been studied for the longest time. Furthermore, most consumers have been curious about the various tasks done by each robot and have watched their descriptions for a relatively long period of time.

### Keywords

Neuromarketing, artificial intelligence, robots, eye-tracking, consumer behavior.

### JEL Classification

M10, M31

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### Introduction

Nowadays, the robots we used to see in movies are no longer just a scientifically fantastic image that cannot be reached, but a reality that is present in the consumer's everyday life. Moreover, home service robots have become even more popular, being frequently used by those willing to accept help on their everyday activities from a small machine empowered with artificial intelligence.

The scientific approach of this paper is to highlight some punctual aspects of a neuromarketing research using an eye-tracking tool in order to determine the reaction of the consumers towards service-robots. Although both artificial intelligence and neuromarketing are relatively new topics, they have important implications on the everyday life of consumers. First of all, it is important to determine the reactions of the consumers towards various types of service robots, as this will have a contribution to the esthetic development of the artificial intelligence machines, with the purpose of making them more user friendly and easier to be trusted. Secondly, the use of eye-tracking will help us determine the

unconscious reaction of the consumers towards the service robots, which brings along a great value to this experiment.

### **Literature review**

The scope of neuromarketing research and technology is to optimize marketing methods, to influence the purchasing decisions of potential customers and to create products which are suitable for them. According to Fugate (2007), emotions can influence the economic decisions, by having a role in attracting the people's attention and by motivating them to focus on a certain product (Fugate, 2007).

Neuromarketing provides two kinds of information to marketing studies: new insights about the consumers' unconscious behavior and the validation of the traditional consumer knowledge with neuroscience techniques (García-Madariaga, 2018). Neuromarketing is a combination of marketing and analysis methods of the brain. This area uses investigative devices such as: EEG equipment, MEG and fMRI, Eye-Tracking, facial recognition, which test how the brain responds to various stimuli. Using neuroimaging techniques, researchers can study brain activity "in vivo" in response to specific stimuli and correlate each stimulus to the triggered response. In more understandable language, these new marketing tools could be used to convert the advertising messages into a language that stimulate different parts of the brain, motivates buying decisions and guides consumers to prefer one product over another (Zurawicki, 2010).

Consumers respond in different ways to stimuli and neuromarketing can help producers to improve the quality of the brand, the product or the advertising. The point-of-sale behavior has been studied for decades with the aim of finding new ways to improve product development, advertising campaigns or product and brand positioning (Hernández-Fernández, 2018). By means of neuromarketing, marketing communication efficiency and effectiveness can be measured. These are: emotional engagement, memory retention, purchase intention, novelty, awareness and attention. Consumers make decisions based on their emotions (Vlăsceanu, 2014).

Neuromarketing is an interdisciplinary field at the border between neuroscience and economics and aims to build a new model for the decision-making process in an economic context. Neuroscientists (most of whom are neurologists or psychologists) have concerns about the physiology and functionality of the brain itself, while economists are more interested in interpreting these responses through economic concepts and the applicability of results. Many marketing specialists have guessed in the past that brain imaging has a neurological explanation. Those who work in marketing should assess the level of oxytocin confidence in products. This will help marketers to analyse whether the level of confidence should be achieved or not. Neuromarketing tools can add value to marketing, based on their cost-utility ratio and by their ability to give an insight in hidden consumer information that cannot be obtained by other marketing research methods (Meyerding, 2018). Neuromarketing techniques can be used for several business purpose, with social and economic impact.

In spite of the great contribution eye-tracking systems and neuromarketing have for the marketing research, there are still ethical issues regarding the intrusion in the personal life of consumers. The discussion is, if it is ethical to "read minds", even if it is done for good purpose. Neuro-ethics aims to solve the problems regarding the manipulation of the human brain. The ethical development of Neuromarketing includes the protection of subjects, the responsibility of business and the accurate presentation and information for the public in this area. In academic and medical research centers, subjects that wish to volunteer for brain imaging research are protected by the Institutional Review Board Guidelines. In private companies it is possible that these topics do not exist. A neuromarketing-neuroscience initiative is to develop a code for the protection of people.

The Eye Tracking is a neuromarketing instrument that has many applications, being able to deliver value to the researchers, by studying the impression some products make on consumers. Moreover, the device can be used to provide data about human-computer interactions, in order to rate to which extent computers are able to satisfy human needs. This field of study is commonly used in the gaming industry, as it brings advantages to designers and developers who need to assess and measure the visual attention or reactions during games. The eye tracking analysis helps by finding ways in which the overall gaming experience can be improved (Farnsworth, 2017). Other application fields of this instrument include advertising, package design, purchasing behavior analysis, website testing and so on.

The Eye Tracking is a tool which can measure the point of gaze and register the movement of the eyes. The collected data is used to generate key performance indicators. The dilatation and movement of the pupils are being registered and classified according to specific areas of interest. The instrument not only registers every unconscious move of the pupils and every fixation, but it is also able to measure the exact times a certain point was fixed, including the number of the revisits. The true value of an eye tracking analysis lies into the fact that the reflexes which are being measured are unconscious, showing uncontrolled reactions to various stimuli which are being carefully selected (Rosca, 2017). The aim to of this instrument is to determine which stimuli are able to activate the attention of the subjects and which are unconsciously being ignored or overlooked.

**Research methodology**

The analysis of the results has been made based on the Key Performance Indicators generated by the Eye Tracking device. This eye tracking experiment aims to analyze the unconscious responses to four different artificial intelligence forms. For this, a photo collage has been created, featuring four types of robots. The role of this collage is to determine the willingness and tendency of people to favor or reject the anthropomorphic side of robots by having to judge them solely by their appearance. The collage was displayed for 10 seconds. Out of the 19 participants, 17 were female and 2 were male and the age range was between 23 and 33 years old.

The collage used in this research describes four types of home assistants. The description of the eight selected areas of interest can be found in Table 1. When selecting the AOI zones, the areas with text were separated from the corresponding robot.

**Table no. 1 Areas of Interest**

| Variable | Description of variable  |
|----------|--------------------------|
| AOI 001  | Home Service Robot       |
| AOI 002  | Hotel Service Robot      |
| AOI 003  | Restaurant Service Robot |
| AOI 004  | Greeting Service Robot   |
| AOI 005  | Home Service Text        |
| AOI 006  | Hotel Service Text       |
| AOI 007  | Restaurant Service Text  |
| AOI 008  | Greeting Service Text    |

*Source: Own Determination of Variables*

The first one is a home service robot with average height, looking only remotely as a human through details like little and fix hands and a head which shows an image of a happy face and a tablet through which it can be programmed. The second is a hotel service robot with no anthropomorphic details which can be also programmed from an incorporated tablet. The

third one is a restaurant service robot with a higher level of human-like characteristics: from the appropriate height to a human-like body including functional hands which can carry products and a head with a desktop which simulates certain face expressions. The fourth and last one is a greeting service robot equipped with the same anthropomorphic details like the one before, only that he has also a big LCD screen which makes him suitable for presentations.

### Results and discussion

The main key performance indicators with the results of the eye tracking experiment are presented in table no.2. The first KPI is the Sequence which shows the order in which the areas of interest were gazed, in which number 1 was the first to be looked at and number 8 the last. This parameter is usually correlated to the next one, the Entry Time, which shows the exact millisecond in which an element was first observed by subjects. On average, the respondents first looked at the AOI002 first, with an entry time of 793.2 milliseconds. This means that the majority of subjects first observed the hotel service robot. The next AOI to be noticed was the home service robot, the AOI001, in the 1350.1 millisecond. After that, the subjects analyzed on average the text under the Home Service robot (AOI005) in the 1356.7 milliseconds, then the text under the Hotel Service robot (AOI006) in the 1435.0 milliseconds. This means that at the moment when the picture appeared, the majority of the respondents had the tendency to analyze the first two robots, which are surprisingly the ones with very low anthropomorphized designs.

**Table no. 2 Key Performance Indicators**

| Variable | Sequence | Entry time (ms) | Average fixation (ms) | First Fixation (ms) | Dwell time (ms) | Dwell time (%) | Hit ratio (%) | Revisitors   |
|----------|----------|-----------------|-----------------------|---------------------|-----------------|----------------|---------------|--------------|
| AOI 001  | 2        | 1350.1          | 239.2                 | 201.6               | 1284.9          | 12.9%          | 100%          | 19/20        |
| AOI 002  | 1        | <b>793.2</b>    | 233.9                 | 233.3               | <b>1413.2</b>   | <b>14.1%</b>   | 100%          | <b>20/20</b> |
| AOI 003  | 5        | 2536.6          | 212.0                 | 200.0               | 994.9           | 10.0%          | 100%          | 17/20        |
| AOI 004  | 9        | 4174.8          | <b>259.1</b>          | <b>266.6</b>        | 1024.9          | 10.3%          | 100%          | <b>11/20</b> |
| AOI 005  | 3        | 1356.7          | 385.2                 | 391.6               | 878.2           | 8.8%           | 100%          | 14/20        |
| AOI 006  | 4        | 1435.0          | 330.9                 | 313.3               | 929.9           | 9.3%           | 100%          | 16/20        |
| AOI 007  | 7        | 3219.8          | 360.2                 | 350.0               | 693.3           | 6.9%           | <b>95%</b>    | 9/19         |
| AOI 008  | 8        | 4109.7          | 404.1                 | 438.3               | 671.6           | 6.7%           | <b>90%</b>    | 4/18         |

*Source: Own Research*

The next parameter is the average fixation which shows the average time of the fixations of a particular AOI and may be presented in milliseconds or percentages, related to the total number of fixations. The analysis of the results of this parameter show that the AOI008 has been fixed for the largest uninterrupted time, for 404.1 milliseconds, while the AOI003 had the smallest value, 212.0 milliseconds. That means that the „Greeting Service” text under the last robot has attracted the attention of the subjects for larger periods of time, in which they studied it in detail. On the second place is the AOI005, the text under the „Home Service” robot, with an average fixation of 385.2 milliseconds. Out of the four robots, the AOI004, the Greeting Service Robot was studied for the longest uninterrupted time, for 259.1 milliseconds. On the second place was the AOI001, the home service robot, with an average fixation of 239.2 milliseconds, then the Hotel Service Robot (AOI002) with 233.9 milliseconds and on the last place, the AOI003, the Restaurant Service Robot, with an average fixation 212.0 milliseconds. Although the highly anthropomorphized greeting

service robot was observed later than the other ones, he has attracted the attention of the subjects for the highest uninterrupted time period.

The First Fixation indicator shows the time it took for a specific element to be firstly analyzed. Out of the four robots, the subjects analyzed the AOI004 (Greeting Service Robot) for an average of 266.6 milliseconds, which is the highest value compared to the other areas of interest. This means, that the moment the subjects observed the Greeting Service Robot for the first time, they spent the most time analyzing it, before moving their point of gaze to another element, which demonstrates the curiosity towards anthropomorphized designs. The hotel service robot, AOI002, comes on the second place, with a first fixation of 233.3 milliseconds on average. The analysis of the texts written under each robot took longer, which is why the values are higher for AOI005 to AOI008. The text to be analyzed the longest was AOI008 (for 404.1 milliseconds), then AOI005 (for 391.6 milliseconds), then AOI007 (for 350.0 milliseconds) and AOI006 (for 313.3 milliseconds).

The Dwell Time Indicator shows how much time a particular point was analyzed in total, being the sum of all the individual fixations on a certain point. This indicator is being expressed both in milliseconds and in percentages. The analysis of this parameter shows that the AOI002 (the Hotel Service Robot) was analyzed the most, for exactly 1413.2 milliseconds out of the 10 seconds time, corresponding to 14.1% of the total time. On the second place, 1284.9 milliseconds were allocated to AOI001, the Home Service Robot, meaning 12.9% of the total time. The Greeting Service robot finds itself on the third place, with 10.3%, 1024.9 milliseconds and the Restaurant Service robot was analyzed for the least time, for only 994.9 milliseconds (10.0%). These results should be interpreted taking into account the fact that the fixations were interrupted when the subjects have looked at other elements and then recalculated when their eyes have returned to the analyzed area of interest. The results of this parameter show that the AOI001 and AOI002 attracted the most attention of the subjects in total. Even if the moments in which they were analyzed were interrupted, the eyes of the respondents returned on these areas of interest with the unconscious will to gather more data or look for more details. This indicator shows, that the two robots with little to no anthropomorphic designs were the ones which focused the most attention of the subjects, while the ones with highly anthropomorphized forms were not watched with the same interest.

The Hit Ratio shows the number of subjects who have gazed at least once at an area of interest and the Revisits include the number of respondents who have watched an area of interest, then got distracted by another AOI and then came back to the first AOI. Interesting is that not all people looked at all AOIs. For example, only 95% of the subjects read the „Restaurant Service” text and only 90% read the „Greeting Service” text. The number of revisits is also interesting. AOI002 (the Hotel Service robot) is the only element who was observed and revisited by all 20 subjects. The AOI001 was also observed by all subjects, but only 19 out of 20 chose to come back and take another look at it, while for AOI003 (Restaurant Service Robot) only 17 people came to revisit. On the last place is AOI004, which was analysed by all subjects, but only revisited by 11 of them. This is a very low value for this indicator and shows the lack of interest for this specific element, as only half of people felt like they want or need to look at this robot more than once. These results are surprising, as usually the robots with anthropomorphic appearance are able to attract more interest, curiosity or even intrigue and therefore are usually being analysed more than the robots with basic designs. However, in this case, the first two robots have captured most of the attention of the subjects.

## **Conclusions**

The present study explores the way in which different forms of artificial intelligence are perceived by consumers. A contribution to the topic regarding the tendency for

anthropomorphic systems is brought by this work, as from the analysis of the collage results that consumers have more interest in a normal robot with basic designs compared to the robots with highly human-like appearance, which can prove greater independence (Pelau & Ene, 2018). According to the results of this study, robots with human-like designs are not yet preferred by society.

Smart devices have become a big part of the everyday life. Therefore, the analysis of the impact of artificial intelligence forms on the consumer's unconscious perceptions is more relevant than ever, as people use applications daily for most activities they perform. As technology has completely transformed the business environment and the ways that companies operate, it is crucial to analyse if the automations and the general use of robots brings a relevant added value to the business.

This study offers an overview on the way in which technological advances are received with open arms or restraint by society. Since the subjects are between 23 and 32 years old, the results may be categorized as optimistic, as young people have generally a higher acceptance to technology. Even so, the results show that the robots which look more independent are currently considered less popular than the basic ones.

## References

- Farnsworth, B., 2017. *Eye Tracking: The Complete Pocket Guide*. [online] Available at: <<https://imotions.com/eye-tracking/>> [Accessed 12 November 2018].
- Fugate, D.L., 2007. Neuromarketing: a layman's look at neuroscience and its potential application to marketing practice. *Journal of Consumer Marketing*, 24(7), pp.385-394.
- García-Madariaga, J., Blasco López, M-F., Burgos, I.M., Virto, N.R., 2018. Do isolated packaging variables influence consumers' attention and preferences? *Physiology & Behavior*, 200, pp.96-103.
- Hernández-Fernández, D.A, Mora, A., Vizcaíno Hernández, M.I., 2018. When a new technological product launching fails: A multi-method approach of facial recognition and E-WOM sentiment analysis. *Physiology & Behavior*, 200, pp.130-138.
- Meyerding, S.G.H., Mehlhose, C.M., 2018. Can neuromarketing add value to the traditional marketing research? An exemplary experiment with functional near-infrared spectroscopy (fNIRS). *Journal of Business Research* (in press). <https://doi.org/10.1016/j.jbusres.2018.10.052>.
- Pelau, C., Ene, I., 2018. Consumers' perception on human-like artificial intelligence devices. *Proceedings of the 4th BASIQ International Conference on New Trends in Sustainable Business and Consumption (BASIQ)*, pp.197-203.
- Pop, N.Al., Iorga, A.M., Pelau, C., 2013. Using Neuro-Marketing Studies to explore Emotional Intelligence. *Proceedings of the 14th European Conference on Knowledge Management*, Kaunas, Lithuania, 1-8 September 2013.
- Rosca, M.I., 2017. *Metode de cercetări de marketing utilizate în publicitate*. București: Editura ASE.
- Vlăsceanu, S., 2014. Neuromarketing and evaluation of cognitive and emotional responses of consumers to marketing stimuli. *Procedia - Social and Behavioral Sciences*, 127, pp.753- 757.
- Zurawicki, L., 2010. *Neuromarketing: Exploring the Brain of the Consumer*, Springer.