GRANT journal
ISSN 1805-062X, 1805-0638 (online), ETTN 072-11-00002-09-4
Vol. 9, Issue 1
EUROPEAN GRANT PROJECTS | RESULTS | RESEARCH & DEVELOPMENT | SCIENCE

The effect of sensory marketing from the perspective of neuromarketing

Pavel Rosenlacher[1]
Jaromír Tichý[2]

[1] University of Finance and Administration; Estonská 500, 101 00 Praha 10, Czech Republic; pavel.rosenlacher@vsfs.cz
[2] University of Finance and Administration; Estonská 500, 101 00 Praha 10, Czech Republic; jaromir.tichy@vsfs.cz

Grant: 7429/2020/05
Name of the Grant: Processing of visual stimuli by the consumer from the point of view of the eye tracking method
Subject: AN - Psychologie

Abstract The aim of the survey was to find out by which sensory organ the most emotional reactions are evoked within the subjective evaluation of the product. The set goal was fulfilled by neuromarketing research with the help of several biomedical methods. This involved monitoring of brain activity using EEG, by which not only the emotional response was determined, but also the degree of attention that the respondent paid to the tested product. In addition to the EEG method, the respondents were monitored for skin surface temperature, cardiac activity – blood volume pulse (BVP) and galvanic skin resistance (GSR). The research also included a questionnaire survey, where respondents assessed using a numerical scale to what extent the tested product emotionally appealed to them. The neuromarketing data showed that the emotional reactions to the tested product were manifested by the visual and olfactory effects of the product. However, in the subsequent questionnaire evaluation after the end of data collection, the respondents perceived the tested product most emotionally through sight, smell and touch.

Key words Marketing, neuromarketing, sensory marketing, eye tracking, marketing communication

1. INTRODUCTION

In today's highly competitive marketing environment, it is very important for companies to be able to engage customers with their product and better understand their customers' needs. Based on this, there is an interest in combining cognitive neuroscience methods and consumer behaviour research (GOTO et al, 2019). It is possible to use neuromarketing as one of the relatively newer approaches. There is more talk about neuromarketing starting already in 2002 (MORIN, 2011), although some sources indicate the origin of the word neuromarketing in the 90s (GURGU, 2020). Basically, neuromarketing connects psychology, neuroscience and marketing (KHUSHABA, 2013). Neuromarketing „uses investigation of brain imaging and clinical psychology to discover what people think and feel when they look at prints, are exposed to messages from different brands, watch TV, shop, and browse internet, play video games or are trained in various activities“ (GURGU, 2020). Heart Rate (HR), electroencephalography (EEG), galvanic skin response (GSR) or Eye Tracking (NILASHI, 2020, Decision to Adopt Neuromarketing Techniques for Sustainable Product Marketing) are very often used as research methods in neuromarketing. Many of these methods therefore have their origins in medicine (ZURAWICKI, 2011). Thanks to these methods, neuromarketing research can be used to monitor brain activity in situations such as the purchasing decision-making process, the evaluation of variants or the selection of variants (CHRISTIANSEN, 2016). Firms and marketers thus obtain much more objective data compared to classical marketing research on consumer psychological reactions (FORD, 2019).

2. MATERIALS AND METHODS

In As part of the neuromarketing survey itself, the sensory effect of the selected product on the respondents and their overall evaluation of the product were tested using selected neuroscience methods.

The product that served as a stimulus in the neuromarketing survey itself was warm, freshly brewed fruit tea, a product that is not expected to be never drunk by respondents and may be preferred regardless of the respondent's gender. The choice of tea was subject to several criteria. The first of the criteria was the colour of the tea, which must have been attractive and rich at first glance. Therefore, green and citrus teas, which have a faint colour, were discarded. Fruit teas that contain brightly coloured fruits were chosen, such as strawberries and raspberries, because they often have a rich and distinctive red colour. Another criterion was the taste, which should not be bitter, because it would narrow the circle of respondents who would like the tea, and so another criterion was that the tea should not contain rose hips. This might seem like a problem, as most teas, especially cheaper ones, contain it. Once fruit tea was chosen, it also had to taste fruity, and preferably like the fruit it contained. One of the last criteria was the smell. It had to be nice, but not extra strong. After analysing and evaluating these criteria, Dilmah raspberry tea was chosen (Dilmah Gourmet Raspberry black raspberry tea, composition: Ceylon black tea, raspberry aroma (3.8%), hygienic packaging 2g, 3 - 5 Minutes, manufacturer: Dilmah Ceylon Tea Company PLC, Sri Lanka). (DILMAH, 2020)

Given that this was an experimental survey, the sample of respondents consisted of a total of 10 respondents, namely high school students, of which 2 were boys and 8 girls. Students were selected on the basis of purposeful selection, where the respondents were selected by the authors of the study themselves. The addressed students were students of high school focused on teaching marketing. The students of this school were chosen mainly because they are already aware of neuromarketing, so there was no risk associated with excessive stress in the experiment itself. The age range of respondents ranged from 16 to 17 years.

Data collection took place in two phases, where in the first phase the physiological responses of the respondents to the submitted stimulus (product) were monitored and in the second phase a short questioning related to the verbal evaluation of the stimulus took place. The first part of the survey was an experiment or a laboratory experiment, where several neuromarketing techniques were used for data collection. A Nexus-10 device and BioTrace+ software were used for data collection. Electroencephalography (EEG), skin galvanic resistance (GSR), skin surface temperature (TEMP), blood volume pulse (BVP) methods were used to collect neuromarketing data. As part of the EEG method monitoring brain activity, brain waves SMR, beta and gamma were monitored, while the placement of 4 measuring electrodes took place according to the international EEG methodology 10-20 at points Fp1, Fp2, Fp7 and Fp8 (SCHAFF, SHULTZ, 2009). The surface temperature of the skin was measured with an accuracy of a thousandth of a degree Celsius using a temperature sensor placed on the little finger of the non-dominant hand and the sensor was attached to the finger with a paper patch (JANSEN, BROEK, WESTERINK, 2010). The galvanic resistance of the skin was measured using two sensors attached with Velcro to the ring finger and the middle finger of the non-dominant hand (VECCHIATO, 2009). An overview of these methods, their placement on the respondent's body and the measuring sensors used is shown in Table 1 below.

Table 1: Overview of used methods

Method designation		Sensor (s)	Placement	Subject of measurement
GSR		2 sensors, Velcro	Ring finger and the middle finger of the non-dominant hand	Resistance of the skin
TEMP		Thermistor	Little finger of a non-dominant hand	Skin temperature
EEG	SMR	Electrodes (points: FP1, FP2, FP7 a FP8)	Left frontal lobe	Brain waves
	BETA			
	GAMMA			
	SMR		Right frontal lobe	
	BETA			
	GAMMA			
Blood volume pulse BVP		Clip-on mechanism	Forefinger of a non-dominant hand	Blood pulse

2.1 Data collection and measurement results

Data collection took place in the VŠFS Neuromarketing Laboratory in order to eliminate various undesirable phenomena and influences. We considered the disturbance of the respondent to a stimulating environment to be negative influences, at the same time it was possible to ensure the same conditions for all respondents in the laboratory, including, for example, lighting (ROSENLACHER, TICHÝ and SLAVÍKOVÁ, 2018). Students were invited to the laboratory individually so as not to come into contact with respondents who have just undergone data collection (TICHÝ, ROSENLACHER and MARŠÁLKOVÁ, 2017). The temperature of the tea served was also important, it should not be too high so that the respondent did not get burned during the tasting and it was pleasant to hold a mug in the hand. On the contrary, the tea should also not be cold, because it would not retain its taste and aroma. Therefore, a temperature between 54 ° C and 58 ° C was chosen, which w method designation as determined by pre-research with different tea temperatures. The whole laboratory experiment consisted of five phases, each one phase included exposure to one sense. At the beginning of the survey, instructions were given to each respondent and he was briefly acquainted with the course of data collection.

After connecting of all the necessary measuring sensors, a short time-lapse image of the sky was projected to the respondent using a projector, which was meant to calm him down and relieve his stress. At the same time, this was important mainly for later data processing, in which the data measured from the course of this rest mode were compared with the subsequent reactions to the sensory effects of the tested tea. The recording captured a cloudy sky and was 35 seconds long, and to determine the relatively rest state of the respondent, the last 3 seconds of the total footage were used for the calculation, when these 3 seconds were averaged for individual measured parameters (ROSENLACHER, TOMČÍK and BRŮNA, 2019).

At the end of the 35-second recording, inducing a state of rest, the respondent was blindfolded. This is so that it is possible to act individually on selected senses and so that the tested stimulus is not affected by sight and, for example, smell at the same time. In the first of the 5 phases, the respondent should smell the tea. According to the instructions given to him, the respondent should once take a deep sniff at the cup of tea that the interviewer put to his nose, but the respondent was not allowed to touch the cup. In the second phase, the respondent's taste was influenced, when he tasted the tea with the help of a straw, in order to avoid spilling the respondent because he was blindfolded. In the third phase, the hearing was affected, when a short sound recording was started with pouring tea into a mug, which lasted 9 seconds. The fourth phase was the tactile phase. The respondent took the mug in his hand, and his task was to evaluate its temperature within 3 seconds, whether it was adequate, too warm, or vice versa. This was followed by the last phase of the experiment, the visual phase, in which the respondent's eyes were untied and he had a few seconds for his eyesight to get used to the light again. Then a glass mug of tea was placed on the table and the respondent was instructed to inspect its colour. Throughout all 5 phases, the respondent's physiological reactions were monitored, see Table 1. After evaluation, the tea was taken from the room and all measuring sensors were removed from the respondent. An overview of the individual phases of sensory action is shown in Table 2. Each of the phases lasted a limited period of time to ensure comparable conditions, while the respondent was not informed of the specific duration of the phase, only after the expiry of the time interviewer informed that the evaluation of the stimulus was to end.

Table 2: Overview of data collection phases

Phase	Sense	Activity	Duration	Conditions	Evaluation item
1.	Smell	Sniffing the tea	2 seconds	Blindfolded eyes	The smell of tea
2.	Taste	Tasting the tea	4 seconds	Blindfolded eyes	The taste of tea
3.	Hearing	Listening to the recording (simulation of pouring tea)	9 seconds	Blindfolded eyes	Sound effect of the recording
4.	Touch	Holding a mug with tea in the hand	3 seconds	Blindfolded eyes	Tea temperature
5.	Sight	View of a glass mug with tea	3 seconds	Untied eyes	Tea colour

In addition to measuring the physiological reactions of the part, the survey also included the second part, namely personal questioning, which partly took place during the testing of tea, and partly after its completion. The survey was divided into two parts, in order to make it easier for the respondent to express precisely and correctly his emotional effects of the tested tea through the sense organs. Both parts were written down by the interviewer on a pre-prepared record sheet. In the first part, which took place at the same time as the laboratory experiment, evaluation scales were used. The questions were always related to the just completed sensory phase of the experiment, and the questions were asked using a scale from 1 to 10, by which the emotional engagement of the stimulus was evaluated for each of the five phases of sensory action. A value of 10 meant the most intense emotional effect. This range was chosen so that the respondent could not mark the straight centre of the scale and thus choose a neutral position and attitude to the current phase of the experiment. Thus, the respondent evaluated the olfactory, then the taste, auditory, tactile and visual pleasantness of the tested tea, always immediately after the sensory action (see Table 2).

2.2 Data collection and survey results

In the second part of the survey, which took place only after the end of the collection of neuromarketing data, the so-called sequence scales were used, in which the cards were presented on the table. One human sense was written on each card and the cards were arranged according to the individual phases of the laboratory experiment - smell, taste, hearing, touch, sight. The respondent's task was to sort the individual human senses in descending order, according to their intensity, and how the individual sensory stimuli affected him more on the contrary less. The sequence scale in the form of printed cards was chosen for a simple reason, for the sake of clarity. Namely, when the respondent sees the cards with the individual senses, he is more likely to remember what he felt or saw when using each of the senses, than if we only ask him verbally. When evaluating the data, a value from 1 to 5 was assigned to each sense (5 = most emotionally impressive), according to the order determined by the individual respondents. For example, if a respondent identified olfactory as the sense that impressed him the most, he was assigned the number 5, for a better comparison with the first part of the survey, where the dominant result had the highest result. These columns were then evaluated for both parts of the survey using the mode, median and average functions. The results from both phases of the survey are shown in Table 3.

Table 3: Survey results

Senses	Rating scale - first part			Sequence scale - after the measurement		
	Average	Mode	Median	Average	Mode	Median
Smell	7,7	7	8	3,8	4	4
Taste	6,8	7	7	4	3	4
Hearing	5,8	5	5,5	2,1	1	1
Touch	7,4	10	8	2,1	2	2
Sight	7,8	7	8	2,6	2	2,5

From the table above, it is possible to read, by comparing the individual functions, which sense was emotionally most impressive when evaluating the individual scales. The table shows data from both, the first part of the survey (10-point scale), which took place during neuromarketing data collection, and it contains data from the final survey (5-point scale). The data shown in Table 3 show that taste and smell were identified as the most emotionally impressive senses in the subsequent questioning without the presence of the tested product. However, from the survey carried out during the operation of the product, sight, smell and touch were identified as the most impressive sense. The difference in order and evaluation may be affected by the effect of rationality in the second, subsequent phase of the questionnaire, which no longer took place immediately after the effect of the product. It is thus clear that the evaluation of the product is influenced by rationality and the resulting evaluation may differ from the immediate reactions.

During the monitoring of physiological functions, 1 152 216 statistically processable data were collected, and this information was processed using the SPSS Statistica program. Initially, before all data processing, all data was exported from BioTrace + software to SPSS Statistica. It was chosen because of the huge number of features it offers, which made the data processing process easier and saved a lot of time. In the case of EEG data processing, the values of brain waves SMR and beta representing the level of attention of the respondent and brain wave gamma presenting emotional manifestations were merged (ROSENLACHER, TICHÝ and TOMČÍK, 2016). In general, however, during data processing, the value of the respondent's rest state was first determined by monitoring up to the last 3 seconds of the time-lapse image of the sky, where the greatest calming was expected since the image was started. These quiescent values were compared separately for each respondent with their measured data from the course of tea testing. Thanks to this, it was possible to determine by what percentage the physiological reactions of the respondents changed during the sensory action of tea compared to their resting state. The table below shows the average values for all respondents.

Table 4: Questioning results

Senses	GSR	TEMP	EEG		BVP	Data average
			attention	emotion		
Smell	117 %	90 %	55 %	44 %	109 %	83%
Taste	114 %	89 %	43 %	38 %	100 %	77%
Hearing	109 %	89 %	54 %	45 %	95 %	79%
Touch	113 %	89 %	50 %	41 %	99 %	78%
Sight	119 %	89 %	83 %	77 %	98 %	93%

From the data given in Table 4 it is evident that the highest difference compared to the resting values shows the sight (93% average for all measured parameters) and then the sense of smell. This may be due to the fact that sight is generally one of the most important sensory organs, through which one receives most of the information from the environment. Smell is considered to be one of the sensory organs that has great potential to arouse emotions (LANGMEIER, 2009). Furthermore, the data also show that the monitoring of skin surface temperature does not show significant changes, even though it was measured with an accuracy of a thousandth of a degree Celsius and its contribution in this neuromarketing survey can be discussed. The data measured by means of a neuromarketing survey thus follow the data obtained from the immediate questioning of the respondents immediately after the sensory action, in which sight and smell were considered to be very important senses. The difference in evaluation in the second phase of the survey could therefore be influenced by rationality.

3. CONCLUSION

The survey found/confirmed that the dominant sense is sight, through this sense it is possible to obtain 80 to 90 % of information from the external environment. Another less dominant sense is smell, given that it is the most sensitive sensory organ, and also that stimuli that are received through olfactory receptors travel directly into the emotional experience of a person. The other senses do not have a clear order.

The experiment looked at the extent to which sensory information about a product is received in the subconscious. The survey shows that a person is aware of some brain processes and some are not. For example, in the case of sight and smell, one consciously receives information. This results from the fact that both in questioning and in the experiment, these two senses were more dominant than the others. For the other senses, the result is not so clear-cut. I think that the order of the individual senses is also influenced by the kind of stimulus that activates the individual senses. The survey also shows that the order of the senses is influenced by the time that elapses since the activation of the individual senses and the questioning. The longer the time, the more the order of the individual senses differs according to the respondent's decision from the brain reaction and physiological reactions.

Customers usually decide to buy impulsively, based on emotions and at the place of purchase, it can be said unequivocally that people are partially aware of their brain processes, but for the most part these processes take place subconsciously. Only the sight and smell take place consciously, but only if one acts impulsively, irrationally, and on the basis of emotions, that is, if one does not think about one's purchase for a long time.

Although the sight has been long considered the dominant sense, the results obtained from the experiment have yielded surprising results. Sight is generally considered to be a very important human sense, but it was a surprise that it is also the dominant sense in taste marketing. In this area, it would rather be assumed that the dominant sense will be taste and possibly smell. Initially, it was not assumed that taste in this case would act on the respondents as the least dominant sense, although to some extent this may also be influenced by the subjective preferences of the respondents.

Sources

1. DILMAH, 2020. *Raspberry flavoured tea 160 teabags*. [on-line] © 2020 Dilmah Ceylon Tea Company PLC. [2020-06-03]. Available from: https://shop.dilmahtea.com/flavoured-tea-raspberry-flavoured-tea-160-teabags.
2. FORD, B. John, 2019. What Do We Know About Neuromarketing? *Journal of Advertising Research*. Vol. 59 no. 3 257-258. ISSN 0021-8499. DOI: 10.2501/JAR-2019-031. Published 1 September 2019.
3. GOTO, N., LIM, X.L., SHEE, D., HATANO, A., KHONG, K.W., BURATTO, L.G., WATABE, M., and SCHAEFER, A., 2019. Can Brain Waves Really Tell If a Product Will Be Purchased? Inferring Consumer Preferences From Single-Item Brain Potentials. *Front. Integr. Neurosci*. 2019 Jun 28. DOI: 10.3389/fnint.2019.00019.
4. GURGU, Elena, Ioana-Andreea GURGU, Rocsana B. Manea TONIS, 2020. Neuromarketing for a better understanding of consumer needs and emotions. *Independent Journal of Management & Production*; Sao Paulo Sv. 11, Čís. 1, (Jan/Feb 2020): 208-235. ISSN: 2236-269X. DOI: 10.14807/ijmp.v11i1.993.
5. CHRISTIANSEN, Bryan, 2016. *Neuroeconomics and the Decision-Making Process*. Hershey, Pennsylvania: IGI Global. ISBN 14-666-9990-6.
6. JANSSEN, J. H., BROEK, van den, E. L. & WESTERINK, J. H. D. M., 2010, *Method and system for selecting items using physiological parameters*, Patent No. WO2010113103.
7. KHUSHABA, Rami. N.; WISE, C.; KODAGODA, S.; LOUVIERE, J.; KAHN, B. E.; TOWNSEND, C, 2013. *Consumer Neuroscience: Assessing The Brain Response To Marketing Stimuli Using Electroencephalogram (EEG) And Eye Tracking*. Expert Systems With Applications v. 40, p. 3803–3812, Elsevier.
8. LANGMEIER, Miloš, 2009. *Základy lékařské fyziologie*. Praha: Grada. ISBN 9788024725260.
9. MORIN, Christophe, 2011. Neuromarketing: The New Science of Consumer Behavior. *In: Society*, s. 131-135. ISSN 0147-2011. DOI: 10.1007/s12115-010-9408-1. Available from: http://link.springer.com/10.1007/s12115-010-9408-1.
10. NILASHI, M.; YADEGARIDEHKORDI, E.; SAMAD, S.; MARDANI, A.; AHANI, A.; ALJOJO, N.; RAZALI, N.S.; TAJUDDIN, T, 2020. *Decision to Adopt Neuromarketing Techniques for Sustainable Product Marketing: A Fuzzy Decision-Making Approach*. 12, 305. February 2020. DOI: 10.3390/sym12020305.
11. ROSENLACHER, Pavel, Jaromír TICHÝ a Michal TOMČÍK, 2016. EEG studies of the effect of noise on the process of conscious learning. *Acta Oeconomica Universitatis Selye*, Komárno: the Faculty of Economics of J. Selye University, roč. 5, č. 2, s. 182-193. ISSN 1338-6581.
12. ROSENLACHER, Pavel, Michal TOMČÍK a Matěj BRŮNA, 2018. EEG study of the effect of virtual reality. *AD ALTA: Journal of Interdisciplinary Research*, Hradec Králové: Magnanimitas, roč. 8, č. 2, s. 216-218. ISSN 1804-7890. doi:10.33543/0802216218.
13. SCHAFF, K., SCHULTZ, T., 2009. *EEG-Based Emotion Recognition Using Support Vector Machines*. 1. Fachtagung Biophysiologische Interfaces, Berlin, Germany, 12.06, 2009.
14. TICHÝ, Jaromír, Pavel ROSENLACHER a Barbora SLAVÍKOVÁ, 2018. Creating of effective product photography from perspective of neuromarketing. *Economics Management Innovation*, Olomouc: Moravská vysoká škola Olomouc, roč. 10, 2/2018, s. 16-26. ISSN 1804-1299.
15. TICHÝ, Jaromír, Pavel ROSENLACHER a Lenka MARŠÁLKOVÁ, 2017. Neuromarketing Approach to Efficient Food Styling. *AD ALTA: Journal of Interdisciplinary Research*, Hradec Králové: Magnanimitas, roč. 7, č. 1, s. 180-183. ISSN 1804-7890.
16. VECCHIATO, G., 2009. The study of brain activity during the observation of commercial advertsing by using high resolution EEG techniques. *IEEE Engineering in Medicine and Biology Society*. September 2009: 57-60. DOI: 10.1109/IEMBS.2009.5335045.
17. ZURAWICKI, Leon, 2011. *Neuromarketing: exploring the brain of the consumer*. London: Springer. p. 51. DOI: 10.1007/978-3-540-77829-5.