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EXPERIMENTAL STUDIES OF ADVERTISING MESSAGE EFFECTIVENESS IN VIRTUAL REALITY

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Abstract: *One of the most important elements of advertising campaigns is their message. Many factors can influence message effectiveness,* inter alia*, the content, the form, the carrier, or the location of the advertisement. Together, these aspects can determine how visible the advertising message is to the audience. At the campaign-planning stage, it is usually hard to tell how the advertisement should be presented and properly exposed so that the recipients perceive and remember it. We propose performing the pre-test of advertisements with the use of a virtual reality system that provides the environment close to the natural conditions and using cognitive neuroscience tools to record the objective measures of the audience's opinions. Our proposal shows the procedure for designing and conducting an experiment that allows for an assessment of the advertising message effectiveness based on its visibility. The article also presents the preliminary results of a pilot experiment that was designed to test both the virtual reality system and the proposed procedure.*

Keywords: *Virtual reality, cognitive neuroscience tools, advertising messages, effectiveness.*

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INTRODUCTION

One of the most important elements of advertising campaigns is their message. The effectiveness of the campaign greatly depends on the extent to which its content reaches the recipients. The proper reception of the presented messages hinges on their form and content, as well as the manner and place of exposition. The most carefully designed and implemented message will not fulfill its role if it is not noticed by the audience. Therefore, knowledge about the reception of the message is extremely valuable to making decisions, already at the campaign-planning stage, regarding its presentation in such a way that the recipients can notice and remember it (Daszkiewicz, 2011).

The procedure for dealing with such a situation usually involves creating several possible variants of the message and pre-testing which variant is the most effective. For this purpose, various methods are used - most often questionnaires (Shukla, 2008): the message is shown to a group of subjects and a survey is conducted to collect their opinions, or structured interviews (Lincényi & Bulanda, 2023). However, survey methods do not provide knowledge that is reliable enough to choose the content or the way of displaying the message, because people sometimes cannot (or do not want to) determine their true preferences when asked about them (Calvert & Brammer, 2012; Zaltman, 2003). In addition, surveys are usually not conducted in an environment close to the natural conditions in which recipients come into contact with advertising messages.

Such problems could be solved with the use of virtual reality (with which you can create the impression of being in a natural environment) in combination with cognitive neuroscience methods that allow you to collect psychophysiological data and determine objective metrics defining the subconscious reactions and opinions of the subjects about the presented messages.

These methods include tools and techniques to measure, map, and record nervous system activity. They allow the observation of nervous processes taking place in real time. They fall into three broad categories: neuroscience tools and techniques that record neural activity (electromagnetic and metabolic) inside the brain (e.g., electroencephalography, magnetoencephalography, functional magnetic resonance imaging, near-infrared spectroscopy) and outside the brain (e.g., eye tracking electrocardiography, skin-galvanic reaction measurement, electromyography) and neuroscientific methods that allow the manipulation of neuronal activity (such as transcranial magnetic stimulation) (Lim, 2018). Mentioned methods are widely described in the literature (cf. (Bercea 2012; Kable 2011; Morin 2011; Plassmann et al. 2007; Ramsøy 2015; Żurawicki 2010)).

A virtual reality system using cognitive neuroscience methods can be a very helpful tool to support marketing decisions. On the basis of the data collected from the system, indexes (psychometrics) can be determined, which will help make decisions about the choice of a specific form and method of displaying the advertising message in terms of its effectiveness. For the purposes of this article, it is assumed that the effectiveness of the message can be assessed on the basis of its visibility for the recipients (more on the effectiveness of advertising in: (Wells, 2009)). Visibility is defined as the degree to which something is perceived by the public/audience (Cambridge Dictionary). It can be measured indirectly, including metrics such as attention (Dillard et al., 2007), recognition (Pashna et al., 2019), recall (Guixeres et al., 2017) or memorization (Vecchiato et al., 2014).

Due to the technological complexity of the proposed system, carrying out pre-tests of advertising messages in terms of their visibility to recipients is a very complicated process. Therefore, it is advisable to develop a detailed research procedure in this regard. The purpose of this study is therefore to determine such a course of experimental procedure that would allow the assessment of the visibility of advertising messages in various types of campaigns, at the planning stage, using a virtual reality system in conjunction with neuroscience methods. We also present the concept of virtual reality system that could be used to prepare an appropriate experimental environment. The article presents also the results of the pilot experiment that was designed to test the elaborated procedure and VR system.

VIRTUAL REALITY, ADVERTISING AND COGNITIVE NEUROSCIENCE – LITERATURE REVIEW

Virtual reality (VR) is understood as a computer-generated simulation of a situation involving a user who perceives it with one or more senses (mainly sight, hearing and touch) and interacts with it in a way that appears to be real (LaValle 2023; Parsons et al. 2017).
VR is a rapidly expanding topic, both in terms of technological advances and the domains of its applications – including experimental marketing research (Beck et al. 2019; Wei et al. 2019) or application in ecotourism (Folgado-Fernández et al., 2023). There is also a great interest in conducting such studies with simultaneous recording of the activity of the nervous system using various tools and methods of cognitive neuroscience (Russo et al., 2022), however, the question arises - does this research concern the use of a virtual reality system to pre-test various variants of the message at the stage of planning an advertising campaign?

For the purposes of this article, a literature review was made according to the procedure presented in Figure 1. The review focused mainly on academic literature relating to virtual reality, advertising and cognitive neuroscience. When selecting studies for the review the one of the largest multidisciplinary database was used – Scopus. The search was performed in February 2023.

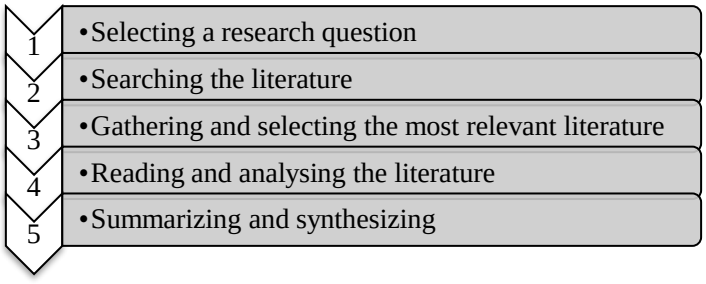
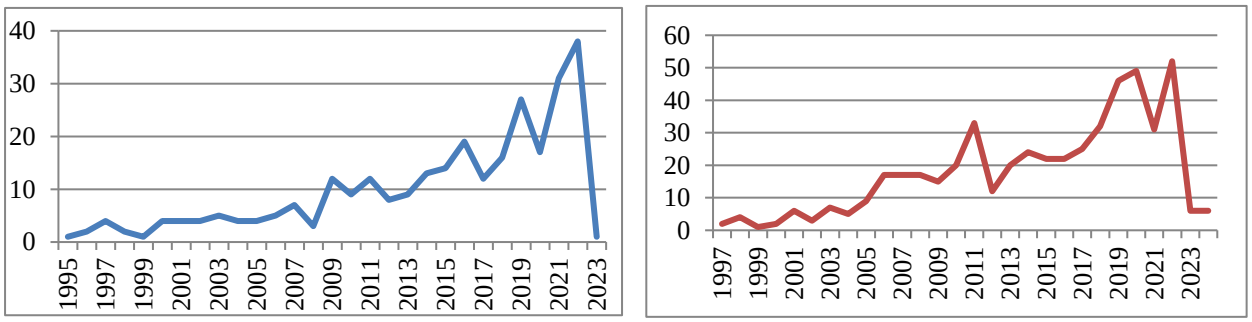


Figure 1. The literature review procedure

The search was performed with the use of basic combined keywords, relating to research question, as: ("virtual reality" OR VR), (advert* OR ads), (neuroscience OR psychometrics OR biometrics), (experiment*). Additionally, some general filters were applied to improve the search results for the aim of this study. These filters include: (1) search fields: keywords; (2) conference papers and articles; (3) papers written in English.

The search was conducted in two phases. The first uses the phrase: (("virtual reality" OR VR) AND (advert* OR ads)). 131 results were obtained. An analysis of the number of publications appearing from 1995 to 2023 confirms the growing - almost exponentially - interest in the use of VR in relation to advertising related research (Figure 2a). The obtained results were searched for the occurrence of the phrase (neuroscience OR psychometrics OR biometrics) - obtaining 16 publications, including 12 concerning experiments (experiment*).
In the second phase, the phrase: (("virtual reality" OR VR) AND (neuroscience OR psychometrics OR biometrics)) was used, obtaining 499 results. The number of publications appearing in the years 1997 - 2023 also confirms the growing trend in the interest in the use of VR in combination with neuroscience methods (Figure 2b). The obtained results were searched for the phrase (advert* OR ads) - obtaining 12 publications, including 9 concerning experiments (experiment*).



a b

Figure 2. The number of found publications in years

In total, 21 articles were received (12+9), of which 3 were repeated in both phases - thus 18 publications were then analyzed in the context of the research question. It turned out that (Hernández-Fernández et al., 2019) does not refer to VR, while (Russo et al., 2022) presents only theoretical considerations on the possibility of using VR and neurotechnics in marketing. As many as 7 publications found (Słupińska et al. 2021; Baumann and Sayette 2006; Mancini et al. 2021; Pozharliev et al. 2021; Ershow et al. 2011; Wang et al. 2019; Skeva et al. 2021) does not describe the use of VR in advertising, although one of them discusses experimental research in VR using cognitive neuroscience techniques (Słupińska et al. 2021).

The next 8 articles deal with VR as an advertising medium. Some of them present the results of experimental research - but conducted without the use of cognitive neuroscience methods (Griffin et al. 2023; Breves and Dodel 2021; Lo and Cheng 2020; De Gauquier et al. 2019). (Silberstein et al., 2020) presents theoretical considerations on researching VR as an advertising medium in conjunction with neuroscience methods, while (Grigorovici, 2001) considers the potential possibilities of VR as an advertising medium without connection with cognitive neuroscience. Very interesting from the point of view of our research question in this group of publications is the article (Leanza, 2017) presenting experimental study with the combined use of VR and registration of brain oscillations (delta, theta, alpha, beta) and skin conductance level, when subject observed four traditional TV commercials and four VR commercials. However, the purpose of the presented research was not to pre-test advertising

messages, but to compare VR with another advertising medium in terms of effectiveness. Equally interesting is the article (Borawska et al., 2020) presenting the proposal of an experiment that allows to study the effectiveness of virtual reality game in raising awareness of healthy eating – but also applies to VR as an advertising medium.

Only one of the 18 articles selected for review refers to experimental research using VR and neuroscience in the context of pre-testing messages (on the example of a social campaign promoting safe driving) (Borawska et al., 2018), however, the focus is on the assumptions that meet the VR system to make such experiments possible, and not on the experiment procedure itself. This gap is filled by this article, which focuses on detailing the experimental procedure that allows for pre-testing various variants of the advertising message in both social and commercial campaigns.

EMPIRICAL RESEARCH PROCEDURE

Architecture of the Virtual Reality System

The architecture of virtual reality system used for conducting experimental research is presented in Figure 3. During the experiment, the examined persons will be controlling the object representing them in the simulation. This object could be a three-dimensional human model, but it is not required. In the real world, we see elements of our body, but if it is not important, our consciousness ignores them (like the nose). For this reason, the subject in our simulation is represented by an invisible stereoscopic camera and a pair of hands. The movement of the examined person's head is transferred to the movements of the camera, thanks to which the examined person can look around the simulation world as in the real world. In hands, the subject holds controllers whose movement is tracked, which allows for the appropriate placement of hand models in the simulation. The controllers are equipped with buttons and touchpads that allow performing various actions, such as opening the door. All actions performed by the examined person as well as the location of the camera and controllers are recorded for later analysis by the module for recording location, spatial orientation, collisions, and states.

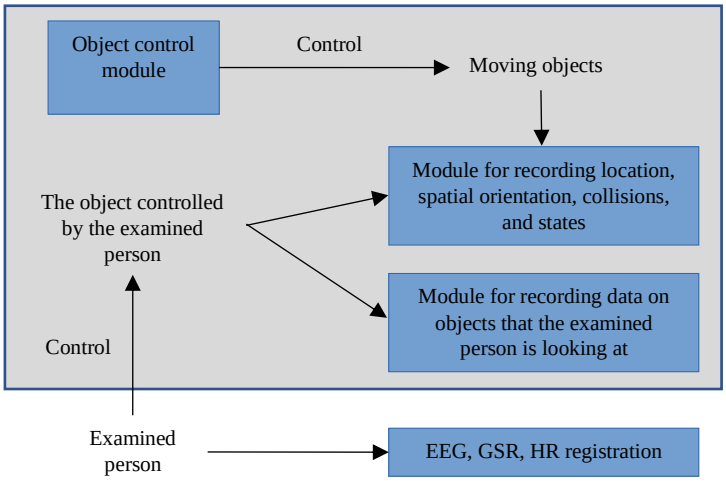


Figure 3. Architecture of VR system

In addition to the object representing the player, there are other objects in the simulation that can perform certain actions on their own. An example of such object could be a bus that moves around the city and has to halt at stops, taking care not to collide with other objects. The operation of these objects is managed by the object control module, which ensures their proper behavior by supervising their movement and reacting to unforeseen situations, such as the possibility of a collision with another object. The movements and actions of such objects are recorded by the module for recording location, spatial orientation, collisions, and states as well.

VR glasses are equipped with an eye-tracker, which allows you to check what the test person is looking at. The recording of data on such objects is handled by the module for recording data on objects that the examined person is observing. This module "fires" the beam in the direction the examined person is looking at and registers the name of the first object that the beam "hits". Such registration is made with the frequency of the eye-tracker, thanks to which, based on the number of noted object names, it is possible to calculate how long the examined person looked at a given object.

The tested person will have an EEG cap on and GSR and HR electrodes attached. EEG, GSR and HR data are synchronized with the simulation operation. This allows defining, for example, the emotions that are associated with performing certain activities in the simulation.

Course of the Experiment

The proposed course of the experiment was elaborated based on previous experience of the Authors concerning conducting the similar research and the literature review of publications relevant to the topic of the paper.

Proposed study can be realized according to the specified procedure that generally has two main stages – design and execution. In every stage certain steps should be performed to ensure the appropriate course of the research. The design of the experiment with its following steps is depicted in Figure 4. Where it is applicable next to the appropriate actions, corresponding methods and used tools are mentioned.

At the beginning of the procedure, the experimental design is prepared. At this stage all the factors considered to be relevant for the study are selected. The selection could include such elements as the format, the carrier and the location of advertising messages in the virtual environment. The next step is to choose variants of the messages which will be examined. Since they will be presented in three-dimensional environment at this stage also proper 3D scene will be prepared in order to ensure the right presentation of the stimuli. Then, the appropriate measurement methods (traditional or neuroscience) should be selected depending on the needs resulting from the nature of the tested product and the aspects that are of interest. In this phase also suitable metrics are chosen – depending on methods that are intended to be used. On the basis of the choices made at this stage, the number and characteristics of the tested people should also be determined and divided into appropriate subgroups in accordance with the considered variants of the tested materials. At the end of the preparatory stage, a detailed experiment scenario is developed, taking into account the method of presenting the materials to the test subjects. Depending on the nature of the

research, in this step you should also formulate tasks to be performed by users, which will be carried out by them during the experiment.

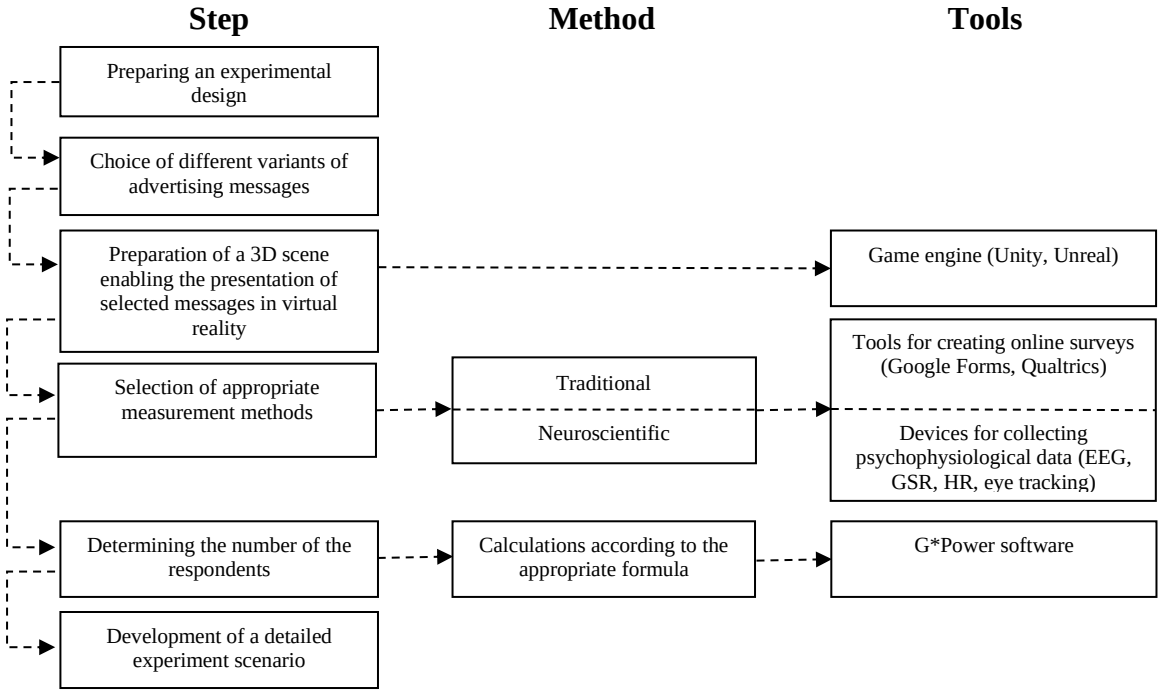


Figure 4. Design of the experiment

Once the study is designed, one can proceed to conduct the experiment (see Figure 5). It starts with the recruitment of participants. If it is needed for the purpose of the study, preliminary screening of the volunteers is conducted. It is done especially when the subjects need to fulfill certain conditions (e.g., have driving license or be familiar with VR technology). After the pool of the participants for the study is completed, each subject individually is invited to the research lab. In terms of time, it is advisable to choose the right hours to conduct the experiment. It is recognized that research should preferably take place between 9 and 11 am, due to the peak of cognitive abilities of participants (Babaç & Yüncü, 2022).

Before the exact experiment may begin, it is very important to perform proper preparation steps. First, the research laboratory room should have appropriately set and constantly monitored environmental parameters such as temperature and humidity. This is advisable in order to minimize their impact on the collected data (Liapis et al., 2021). Conducting the study should begin with familiarizing the subjects with the experimental environment and discussing the course of the study. After familiarizing themselves with the procedure, the examined person should give written consent to participate in the research project. If necessary, after giving consent, demographic and VR familiarity data is collected as well. The next step is the assembly and calibration of the VR googles and research equipment depending on the cognitive neuroscience methods selected for the study.

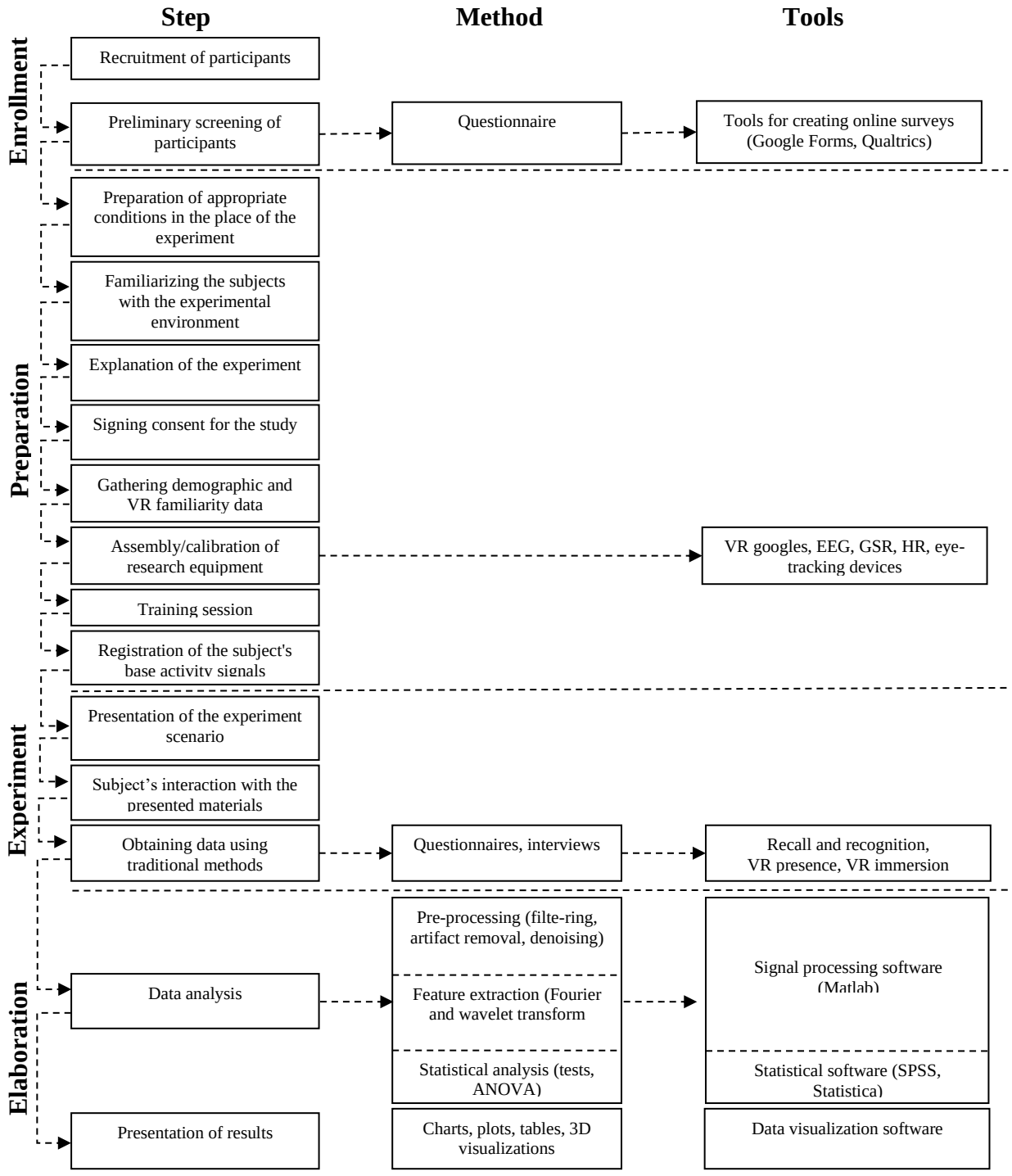


Figure 5. Execution of the experiment

At this stage, a training session is carried out to familiarize the subjects with navigation in the virtual environment and the requirements of the task (Riecke et al., 2002). Moreover, this step allows to exclude people who are not comfortable in the virtual environment

(dizziness, headaches, fatigue and negative emotional activity such as anxiety and stress) (Kweon et al., 2018). After the start of the experiment, the measuring equipment records the base course of psychophysiological signals of the experiment participant at rest. In the further part of the study, the stimuli are presented, and the user performs tasks according to the scenario of the experiment. During the interaction with the presented materials, psychophysiological data is collected. The recorded signals can be supplemented with data from traditionally used research methods –interviews and questionnaires. Concerning the presented stimuli, it gives the opportunity to gather data about recognition and recall of given materials. Moreover, it allows to assess the immersion and presence of the subjects in the virtual reality using such tools as The Igroup Presence Questionnaire (IPQ) (Igroup, 2016). This stage ends the practical part of the study, followed by the analysis of the collected data, taking into account both subjective and objective measures. The procedure ends with the interpretation and presentation of the results.

PILOT EXPERIMENT TESTING THE VR SYSTEM AND PROCEDURE

Stimuli

Based on the described architecture we have created a virtual environment for the purpose of testing the visibility of advertisements. The main element of this environment was a model of a city in which participants should move following the certain path. Along the path, in three different places advertisiments concerning the energy saving were placed (see Figure 6). For the pilot experiment chosen places were: citylight next to the pedestrian crossing, billboard on the wall of one of the buildings and bus shelter. Apart of na object representing the examined person in the simulated environment we have put some other moving objects – cars and bus. They were used to enforce looking around while moving.
The advertisements used in the study come from the Polish social campaign of the Ministry of Climate and Environment – ”We save energy”[1]. They are still images and concern ways of saving electricity at home.

Figure 6. Screenshots of the virtual environment in the pilot experiment

[1] https://www.gov.pl/web/edukacja-ekologiczna/oszczedzamy-energie

Participants

The pilot experiment was conducted with 16 participants that are students of the University of Szczecin (including 11 males and 5 females). The sample size is comparable to other pilot studies described in the literature concerning eyetracking and virtual reality (Hummel et al., 2021; Kosmyna et al., 2021; Schröter & Mergenthaler, 2019; Vass et al., 2018). The subjects were between 18 and 24 years old. Most of them had previous experiences with virtual reality (75 %) but only 13 % use it on regular basis (once a week).

Procedure

The study was conducted at the Virtual Reality Laboratory at the Institute of Management at the University of Szczecin according to the procedure proposal presented in the article. The experiment took 15 minutes per one participant including the preparation and mounting the necessary equipment (VR goggles and eyetracker). After the training stage, the stimuli were presented. The scenario covered short walk through the streets of a virtual city along the route marked by arrows. The destination was a bus stop where the respondents were to wait for the bus. When the bus arrived at the stop, the experiment ended. In total, the time spent in the virtual environment did not exceed 5 minutes per participant. During the whole interaction with virtual environment, eyetracking data were collected. After completing the required tasks in VR, all participants filled questionnaire concerning their demographics, energy saving behaviors and immersion in virtual reality.

Data collection and processing

To perform the experiment the headset HTC VR VIVE Pro Eye was used. The resolution of the screen (Dual OLED 3.5" diagonal) of the device is 1440 x 1600 pixels per eye (2880 x 1600 pixels combined). The headset is equipped with an eyetracker (sampling rate 90 Hz). Analyses of the collected oculographic data was performed using Matlab software.

Measures

In the study we have gathered questionnaire and eye tracking data. Questionnaires included three main parts, apart of the demographic information. The first part was concerned with recall and assessment of given advertising materials. Next, there was a set of questions about the energy saving behaviors of participants and the frequency of performing these bahaviors. Each behavior was assessed on the Likert scale (1 – 5, where 1 was never and 5 always). The behaviors presented in this part to the participants are listed in the Table 2 in the results section.

The last part of the questionnaire allowed to assess the immersion and presence of the subjects in the virtual reality using The Igroup Presence Questionnaire (IPQ) (Igroup, 2016). This tool enables to measure the virtual reality experience of the participants along the four different dimensions – spatial presence, involvement, experienced realism and sense of "being there".

The eyeracking data were analysed in the context of areas of interest (AOI). In the virtual environment all three locations of advertising content was marked as AOI. Data recorded by eye tracker during the interactions of the participant with the virtual environment, after appropriate preprocessing give us the measure of gaze duration which is the total time spent looking at a particular area of interest.

Results

The spontaneuous recall of the presented advertising materials assessed by the questionnaire has shown that not all participant have paid attention to the advertising stimuli as they were focused on moving around in the virtual reality environment. Only one person in the study group has recalled the location of three advertising messages in VR environment. Two persons were able to point out two locations (bus stop and citylight) and nine remembered only a single spot (4 participants have noticed the advertisement on the bus stop, the same number paid attention to the billboard on the building wall and only one person in this group mentioned citylight). The rest of the group (4 persons) didn't pay any attention to advertising stimuli and didn't notice them in any location. Out of the 12 participants who have noticed advertisements, 7 of them remembered the topic of the campaign (58%).

The rest of the questions in the first part of the questionnaire was concerned with the subjective assessment of the presented advertisements and their locations. The detailed questions and the summary of obtained answers are presented in the Table 1.

Table 1. Subjective Assessment of Advertising Stimuli and their Locations in VR Environment.

Question	% of the whole group (16)		% of the group that noticed ads (12)	
	Yes	No	Yes	No
Do you think the social campaign content was appropriate for the selected ad location?	69	31	92	8
Were the ads clear and readable enough in virtual reality?	44	56	58	42
Do you think the social campaign was convincing and effective in conveying its energy saving message?	56	44	75	25
Did you like the advertisements of the social campaign about energy saving in the selected location?	62.5	37.5	83	17

The participants assessed the perceived effectiveness of the campaign, answering the question: *Rate the extent to which the ads you see would encourage you to save energy*. The Likert scale used for this evaluation was from 1 to 5, where the highest note indicated that campaign certainly will have impact on energy saving behavior of the participant. Taking into account the results of the subjects that actually noticed the advertisements and remembered the topic of the campaign the perceived effectiveness was assessed on average as 2.67 (SD = 1.07).

The next part of the questionnaire was intended to measure proenvironmental behaviors concerning energy saving. Participants were asked to determine their frequency of performing some of the most important actions aiming in energy conservation. The mean values and standard deviations based on their answers are presented in the Table 2. The three most common behaviors among the examined group include: switching off the lights in rooms that are not used, using natural light instead of artificial one when possible and limiting air conditioning and heating. The least frequent is using programmable thermostat (probably due to the investment that it requires), changing filters in cooling and heating systems and ironing in lower temperatures.

Table 2. Energy Saving Behaviors analysis.

Behavior	Mean	Standard deviation
I turn off the lights in rooms when not in use.	4.56	0.63
I unplug unused electronic devices from sockets.	2.50	0.63
I use a programmable thermostat to control the temperature in my home.	1.81	1.28
I change filters in heating and cooling systems according to the manufacturer's recommendations.	2.38	0.89
I save water when washing dishes and showering.	3.75	0.86
I try to use natural light during the day instead of artificial lighting.	4.19	0.91
I limit the use of air conditioning and heaters when they are not necessary.	4.00	0.73
I try to iron or dry clothes at lower temperatures to save energy.	2.44	0.89
I avoid leaving devices in standby mode.	3.13	1.09
I carefully insulate windows and doors to reduce heat or cooling loss.	3.25	1.44

To check the validity of virtual environment as a setting for pre-testing the advertising content, the last part of the questionnaire used IPQ scale (Igroup, 2016). The results obtained for the examined group are shown in Figure 7. The maximum possible value in each dimension could be 6. The virtual environment used in the experiment did not achieve that high results in any of the considered aspects. Best evaluation was achieved in the Spatial Presence dimension (M = 3.8, SD = 0.69) which is the sense of being physically present in the virtual environment. The subjective experience of realism was the weakest point of the presented VR environment (M = 1.89, SD = 0.87). The experience in VR was also assessed in the terms of physical well-being during the experiment. We have asked on question concerning the side-effects of virtual reality (dizziness, nausea). Three persons (all females) confirmed that they had such symptoms.

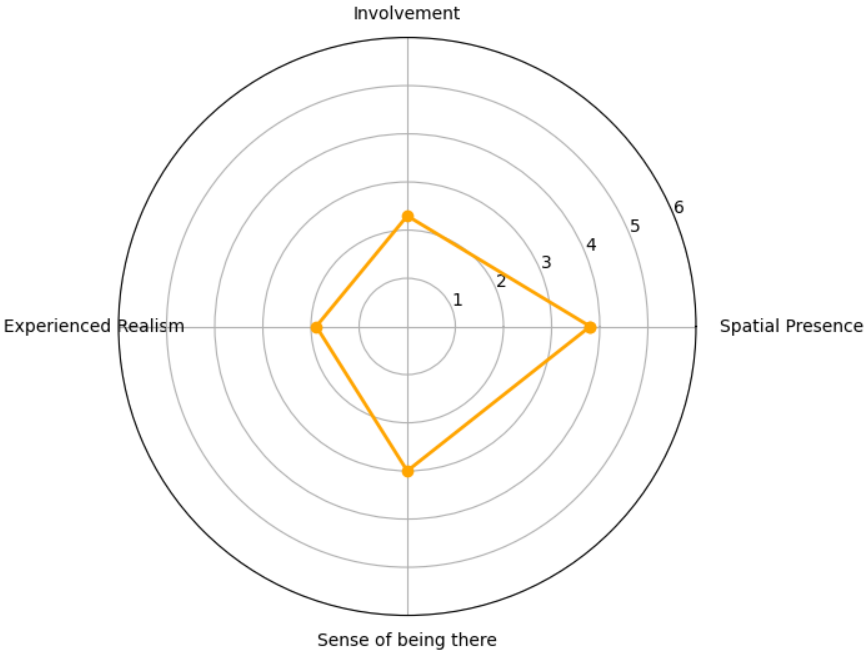


Figure 7. Radar chart showing the assessment of virtual environment experience along the four dimension

The eyetracking data registered during the experiment allowed to calculate how long each participant have looked at each advertising. The results are presented in the Table 3. Participants of our study did not pay any particular attention to any of the presented advertising stimuli. The most watched stimuli was presented on the billboard placed on the wall of one of the buildings, probably due to the size of the advertising and tha fact that it was visible from the distance. The second best location was bus shelter, since the participants were forced by the experiment scenario to remain near the bus stop for a longer period of time (waiting for the bus). Very little attention was given to the citylight placed near to the pedestrian crossing – the length of the total gaze on average was 0.13 (±0.22).

Table 3. Gaze duration depending on the location of advertisement

Advertisement location	Gaze duration (seconds)	
	Mean	Standard deviation
Citylight next to the pedestrian crossing	0.13	0.22
Billboard on the building's wall	0.82	1.09
Bus shelter	0.74	0.73

Discussion

The largest number of participant has noticed the advertising on the bus stop (7 out of 16 but only 5 of them rembered the topic of the campaign). This may be caused by the fact that their

task was to wait for the bus in the bus shelter, so they have the opportunity and time to look at the ad which was placed there. The smallest number of subjects in the group paid attention to the citylight that was placed near to the pedestrian crossing. It may be due to the fact that they needed to look around when crossing the street in order not to be hit by a car. One of the persons that did not noticed any advertising had also pointed out in the free comment section of the questionnaire that the training session before the experiment was not sufficient in order to familiarize with the virtual environment and all attention was directed to navigation in the city and not to other elements of the environment. It is a strong indicator to lengthen the training session in performing similar experiments in the future.

Subjective assessment of the advertising stimuli and their locations in the virtual environment has shown that most of the participants had positive attitude towards the advertisement. The main problem was the clarity and readability of the campaign's message in the virtual environment. This could be the result of not sufficient resolution of the equipment (VR goggles screen). Taking this limitation into account we may state that for the time being the pre-tests of the advertisements in virtual reality should involve messages that do not contain much details and a lot of writings (especially small captions).

Issues with the clarity and readability could have affected the poor assessment of the perceived effectiveness of the campaign's message expressed by the participants. To confirm this conclusion, however, there should be an additional evaluation session of the advertising stimuli presented outside of the virtual environment. This could clarify if the advertisements are considered to be ineffective due to their content and the message conveyed or due to their imperfect virtual representation.

The survey concerning the energy saving behavior of the participants indicated that they are not fully aware of all the possible actions that can be taken in order to conserve the energy and they haven't implement them in their everyday life. The presented campaign was not able to convince them to change behaviors, as its perceived effectiveness was low. The main aspect of the research was, however, not to assess the effectiveness of the campaigns message itself, but evaluate the impact of the advertisement location on their visibility. Further experiments may include additional aspects of social advertising – in the context of energy saving it would be interesting, to check the environmental attitudes of the participants first, and then compare results in subjective and objective measures among the proenvironmental and nonenvironmental individuals.

The pilot experiment revealed that the virtual environment should be improved in order to increase its realism. Such improvements could enhance the quality of participants experience and increase the usefulness of virtual reality system as a tool of pre-testing the advertisements.

Concerning the problem of choosing best locations for placing advertising content, eye tracking data confirmed the results obtained with the help of questionnaires. The most remembered locations were building's wall (billboard) and the bus shelter and among all three advertising stimuli these two gained the most visual attention during the virtual tour. These results suggest that it is advisible to invest in large advertisements or put them in places were people are forced to spend more time outdoor. The location near to the pedestrian crossing did not meet expectations, since people were to busy looking whether it is safe to cross the street. Further research should take this result into account. It could be advisable to test if the presence of traffic lights on the pedestrian crossing could improve the visibility of

the advertising, as they provide a reason for people to stop and take the responsibility off pedestrians to ensure they can cross the street safely.

CONCLUSION

The aim of the article was to propose the research procedure for designing and conducting experiments with the use of virtual reality system and cognitive neuroscience techniques to assess the effectiveness of advertising message in terms of its visibility. The focus was on presenting the advised course of a study and the features of a system that allows to create experimental environment using virtual reality. The proposal presented in the article was tested by performing a pilot experiment. It has shown that it can be a very interesting and promising approach to test the effectiveness of advertising messages before they are aired to the public. However, there are some limitations of this proposal that need to be considered. During the experiments conducted in the virtual reality we may encounter the issue of simulator sickness (Kweon et al., 2018) experienced by some participants. It may exclude them from participation in the study. Additionally, there is a challenge in creating the virtual environment itself to provide high levels of presence and immersion that correspond to reality. Despite of these concerns we believe that the proposed approach can bring substantial benefits for the advertising message effectiveness assessment. The next steps of our research assume performing more experiments with the greater pool of participants in order to introduce the refinement of the procedure and the VR system to suit better the purposes of pre-testing advertising messages of commercial and social campaigns aired in Poland

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