Consumer Reactions to Sustainable Consumption Content – An Eye-Tracking Experiment

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Abstract: *Within the framework of the project "Sustainable Urban Consumption – Regional Differences" a website and Facebook profile have been created to disseminate the results. However, these platforms alone do not guarantee the effective reach of its web audience. The main purpose of this paper is to present the results of an eye-tracking experiment to assess the potential of the tested website to effectively disseminate information regarding sustainable consumption. The survey is based on data on the movement of the gaze, but in addition, are used data on heart rate and galvanic skin reaction of the respondents. Using eye-tracking techniques and tactile reactions analysis the authors formulate conclusions about web usability and the elements engaging the attention of the target web audience.*

1. INTRODUCTION

The problems of Sustainable Consumption in the context of UN Sustainable Development Goals, in particular, Goal 12 "Sustainable Production and Consumption", require action from all stakeholders. It is necessary to develop policies and programs by governments and local authorities, but they would not be realized if they failed to involve in their implementation a large part of the participants in society. Their success is possible only after the realization of the part of all individuals and organizations that it is their actions that ensure the environmental, social, and economic sustainability of living on the planet and in particular of the specific settlements where they live or function.

Within the project „Sustainable Urban Consumption – Regional Differences", funded by the Bulgarian National Science Fund (BNSF Contract Nr. KP-06-H35/7), a website and a Facebook profile have been created. They aim to disseminate project information in the context of Sustainable Consumption in several specific areas: housing; food; mobility in urban environments and product exemptions. The starting position of the project team is that the larger dissemination of information provides conditions for people to think about the problems related to excessive consumption; ways in which the waste is recovered; efficient consumption of water and electricity; and the way they move around in cities.

Considering the importance of disseminating this type of information to change people's behavior, a key point is to pay attention to the means that would ensure the effectiveness of communication channels. In this regard, it is necessary to take measures in the direction of the communication behavior of the subjects of management. How the target audience is communicated

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depends on whether the achievement of the communication goals is ensured. If the vocabulary of communication patterns is used, the message will be understood in cases where it is coded correctly. This would ensure its visibility within the target audience.

Speaking of content marketing management, a key point is knowing the mechanisms of perception, in particular visual ones, such as: which signals (words, color, image) are perceived; which elements of content engage the attention of the audience; are their positions that focus attention to the greatest extent, regardless of the content; how quickly content users get their bearings.

This paper aims to assess the usability of the developed project site by analyzing the visual and Tactile Reactions of a young audience. To achieve this goal, an experiment was conducted using a gaze-tracking technique and a research-grade biometric signal tracker for capturing heart rate and galvanic skin response with students.

2. LITERATURE REVIEW

The evaluation of audience response is a concept that was introduced in the mid-19th century, and Hermann von Helmholtz can be cited as the founder of such tests (Holden et al., 2020). In 1849, he conducted his studies using electrical stimulation to study nerve conduction speed. In the following years, approximately 150 years of such assessments were extended widely to medical research related to neurological disorders or insults (Holden et al., 2020), such as TBI/mTBI, PTSD, pharmaceuticals, aging, Parkinson's, dementia, schizophrenia, ADHD, sleep deprivation, caffeine, alcohol, autism spectrum disorders, and diabetes. According to the developed timeline for the development of tests to assess audience reactions by Holden et al. (2019) they began with the measurement of "Visual Reaction Time" and "Auditory Reaction Time" (reporting Human Performance in the 150-200 MSEC Range), and after the middle of the 20th century began the reporting of "Tactile Reaction Time", as already by 2000 the reporting of reactions extends from 150 to 400 msec. The advent of computer technology in more and more areas of public life has led to the expansion of opportunities for testing reactions. Developed technologies help to get such assessments of respondents out of laboratory conditions and conduct tests in an environment close to nature.

Technological innovation in the field makes it possible to use Eye-tracking technologies to test the reactions of the observed audience to changes in variables in the viewing experience (Dahmen, 2016). "Using an eye-tracking device, a researcher can analyze the respondent's eye movements and know exactly which area the respondent is focusing his or her visual attention on at any given moment" (Mičík & Kunešová, 2021). Ehmke and Wilson (2007) define Eye-tracking as a "technique whereby eye movement is recorded whilst the user is looking at a stimulus". The basic concepts that we need to be familiar with when using and are:
- Fixation – a moment when the eye rests on a certain part of the screen;
- Saccade – the moment of moving the gaze between two separate fixations;
- Gaze plot – show the moments of fixations and saccades for each of the respondents;
- Heat map – marks the time for which each screen area has been viewed.

A review of the scientific publications shows that eye-tracking is used in some areas of marketing research, which are presented by authors in Table 1.

Table 1. Eye-tracking in marketing research

	Authors	Problem
2018	Bartels et al. (2018)	Information at the point of purchase optimizing.
2019	Țichindelean et al. (2019)	Usability testing.
2019	Höhne (2019)	A/D (Agree/Disagree) questions testing.
2020	Xie et al. (2020)	• Enhance online advertising effectiveness; • Improve the online purchasing process.
2021	Van Der Lans et al. (2021)	Online advertising – visual context.
2021	Mičík and Kunešová (2021)	Website optimizing: • Usability • Credibility; • Accuracy; • Appearance.
2021	Orzeł (2021)	Product package testing.
2021	Gómez-Carmona et al. (2021)	Testing the effect of packaging and label format on Google Ads in e-commerce sites.
2022	Muñoz-Leiva et al. (2022)	• At the point of sale – improve the product position and presentation; increase visual prominence; • Online store design or Web Usability; • Helping to attract traffic to websites or landing pages; • Achieving striking packaging design; • Analysis of advertising effectiveness in offline or online contexts; • Education in the marketing area.
2022	Chocarro et al. (2022)	E-Commerce Site Design Improvement - Product Area Visual Content Testing.
2023	Casado-Aranda et al. (2023)	Evaluating communication effectiveness online.
2023	Xie et al. (2023)	Analyzing eye-tracking data in the context of: • Print advertising; • Social interaction; • Face-to-face interaction; • Video viewing; • PC and mobile advertising.
2023	Martinovici et al. (2023)	Decision making - accumulation and prediction of brand choice.

Source: Own research

A number of the authors point to Eye-tracking as a Technique for identifying usability problems. In this connection Ehmke and Wilson (2007) present a relatively comprehensive summary of the metrics used for these purposes, grouping them into four groups, namely:

- Fixation-related – Time to first fixation on target; Fixation spatial density; Fixation duration, Fixation length; Fixations on target divided by the total number of fixations; Number of fixations overall; Repeat fixations (post-target fixation); Fixations per area of interest; Percentage of participants fixating on the area of interest; Fixations per area of interest adjusted for text length; Saccade/fixation ratio;
- Saccade-related – Number of saccades; Saccades revealing marked directional shifts; Saccade amplitude; Regressive saccades (backtracks/regressions); Saccade duration;
- Scanpath-related – Longer scanpath duration; Scanpath direction; Longer scanpath length; Small spatial density of scanpath; Scanpath regularity; Transition matrix (back and forth between areas); Transition probability between AOIs[3];
- Gaze-related – Gaze (dwell); Gaze orientation; Gaze duration on AOI; Number of gaze per AOI; Spatial coverage calculated with convex hull area.

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[3] AOI – Area of Interest

In recent years, Eye-tracking has been defined as an element of the overall UI or UX design process (Iegorova & Ilchenko, 2022). In addition to identifying usability problems, the authors' attention is also focused on site ergonomics. In the context of web applications, Chmal et al. (2022, p. 330) define ergonomics as "interfaces that are structured according to the user's characteristics". Interfaces should be close to what users expect and they should not need to be further trained to be able to work with them. In the context of this, the authors also derive the key metrics to be monitored, namely: 1. Time to first fixation in AOI; 2. Duration of first AOI fixation; 3. Total duration of AOI visits and 4. Number of AOI visits.

One such research aimed at creating an interface for a Web site close to its Web Audience is also considered by Rozova et al. (2022). They also look at a combined usability test approach on a website. In addition to the qualitative study based on fixations, gaze plots, and head maps, an additional qualitative study is added in the form of an in-depth interview after completing an Eye-tracking experiment. This second survey aims to enable respondents to argue their behavior during the first survey.

Regardless of the approach applied and the metrics that are included in it, it is necessary to take into account the reactions of individuals to different stimuli there is a certain error due to the time it takes for the body to react. Kim et al. (2020) indicate that in the Tactile Test, the response time is 16 ms, while in the Visual Test is 81 ms.

3. METHODOLOGY

For the purpose of this paper In the period April – May 2023, an experiment was conducted with 33 students aged between 20 and 22 years (9 males and 24 females). The experiment was conducted in controlled settings. The respondents browsed a tested website and worked on 6 different tasks, and in the end – free surfing. All participants have worked without time limitations. The individual's tasks are:

Task 1: Getting to know the home page;

Task 2: To find something about the creators of the site;

Task 3: Open publications on the site;

Task 4: Search by keyword;

Task 5: View the blog part of the site;

Task 6: Find contacts to contact the creators of the site;

Free surfing: Free viewing of the page to open things that impressed them while performing other tasks.

All tasks end with a decision of the respondents, and they notify the moderator to move further.

The experiment was conducted according to the four stages proposed by Rozova et al. (2022): **Stage 1:** Acquaintance and instructions; **Stage 2:** Calibration; **Stage 3:** Realization of the experiment scenario, and **Stage 4:** Post testing.

The experiment was carried out by GP3 HD Eye Tracker 150Hz and a research-grade biometric signal tracker. All data are recorded with Gazepoint Analysis UX Edition software. In addition to eye movement data, heart rate, and galvanic skin response data are also registered. Some data are summarized and imported into JASP for statistical data processing.

4. RESULTS

The mean time taken by the participants in the experiment to complete the main 6 tasks was 388 sec. (368 sec. for males, and 395 sec. for females). The minimum mean time is 175 sec. (male) and the maximum is 1068 sec. (female). Men worked between 176 and 580 sec. and women worked between 185 and 1068 sec. Respondents went through the six main tasks of the experiment with a mean of 632 fixations (mean 720 fixations for males and 598 for females). The minimum number of fixations is 352 (female), and the maximum is 1400 (male). Manes complete 6 tasks with fixations between 401 and 1400, and females – fixations between 352 and 1175.

In JASP we conduct the Shapiro-Wilk Test of Normality[4] of these two variables. The null hypothesis (H_0) in both is rejected (tasks time p-value < 0,001; number of fixations p-value < 0,001), which means the data in the observed variables are not normally distributed. This requires a non-parametric test to be used when testing for a difference between the average on a given basis. Based on the Mann-Whitney U tests, we can conclude that there are no significant differences in the mean values (tasks time/gender p-value = 0,984; number of fixations/gender p-value = 0,176) of the time to work on the tasks and the number of fixations in a gender section.

Task 1: Getting to know the home page

Approximately 97% of the participants in the experiment declared that they had familiarized themselves with the home page after actually looking at the entire page. The mean time to complete the task is 109 seconds (min. 36,7 sec., max. 235,4 sec.). When performing the task, a mean of 244 fixations are reported (min. 102, max. 573). The T-Test performed shows that there is no difference between the mean work time between men and women (Shapiro-Wilk p-value = 0,066; T-Test p-value = 0,111), and as a result of the Mann-Whitney U test, it is found that there is a difference between the mean number of fixations women (Shapiro-Wilk p-value = 0,003; Mann-Whitney U test p-value = 0,044). Women go through this task with a mean of 123 fixations less than men.

One of the key things that is monitored within Task 1 is whether the information that is intended to be presented attracts enough attention. Figure 1 shows that the part of the home page with the icons of the main four categories that are presented on the website has a relatively good level of fixations in the respective Fixation Map.

With the help of a Heat Map, we can easily visually show what attention is paid to individual categories (Figure 2.). At this stage, it can be said that three of the four categories used attract the attention of the participants in the experiment: 1. Transport; 2. City life and 3. Recycling.

The next main point and whether respondents devote sufficient attention to the definitions of the categories themselves. Here, thanks to the visual examination, a relatively good balance of

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[4]   Shapiro-Wilk Test of Normality has been conducted for the purpose of determining the correct Independent Sample Test, but will not be described in the main text in order to optimize its volume.

engagement of the gaze about the leading image and the corresponding text box is concerned. Due attention is also paid to the part of the home page presenting the last 3 blog posts on the website.

To decide to get acquainted with the home page, approximately 18% of respondents have opened two additional pages on the website, 24% have opened one additional page, and the remaining approximately 58% have not clicked on an additional page. Most often click on the posts from the Blog part in the categories "Nutrition", "Recycling", and "Transport".
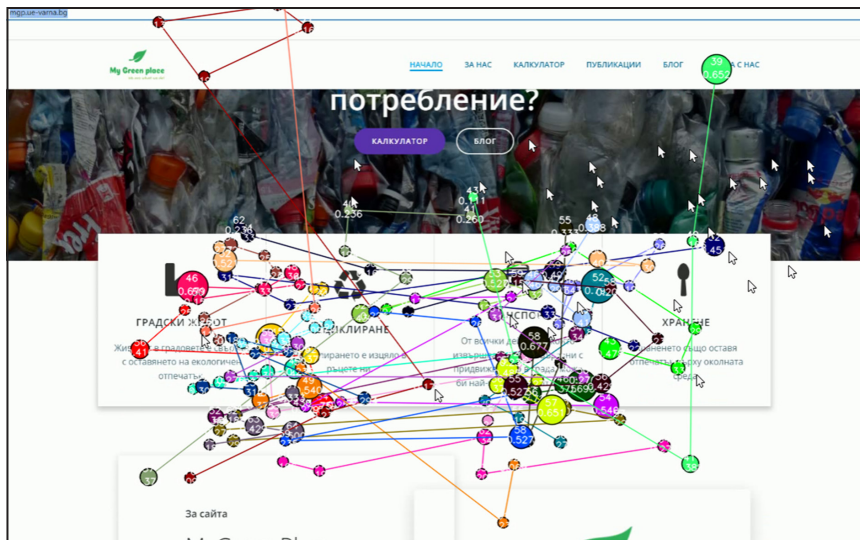

Figure 1. Fixation map of the presented categories icons
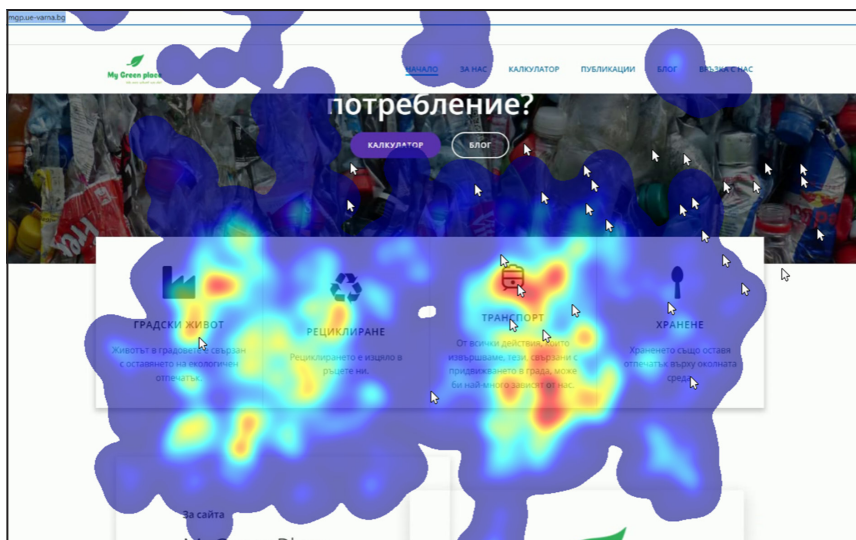**Source:** Own research

Figure 2. Heat map of the presented categories icons
Source: Own research

Task 2: To find something about the creators of the site

To decide that they had completed the task, respondents took a mean of 60.19 sec. (min. 17.06 sec., max. 167,97 sec.). Mean fixations are 89 (min. 40, max 197). Approximately 18% of the participants in the conducted Eye-tracking experiment did not open the required page with the

names of the scientific project team within the task. All of them remain on the main page and do not click on the correct one. A chi-square test was conducted for the presence of a statistically significant relationship between the variable sex and whether they were able to meet the condition correctly, but none has been established (p-value = 0,167).

A one-third of respondents click the first time on the correct page, and this is enough for them to complete the task. Approximately 30% open one additional page, 24% - two, 9% - three, and 3% - four. In 12% of cases, the additional pages opened are external, which is a problem because it can lead to leaving the page.

Task 3: Open publications on the site

There are two types of publications on the website: scientific and blog articles. The purpose of this task is to determine to what extent the target Web Audience distinguishes between the two. The opening of the part with the scientific publications of the project is considered a successful final. Approximately one-quarter of the participants in this Eye-tracking experiment did not complete this task.

To decide that they had completed the task the respondents took a mean of 50 sec. (min. 6.5 sec., max. 304.45 sec). The mean fixations are approximately 55 (min. 12, max. 313). Approximately 24% open only one page, 30% click on one additional page, 39% open two, and the remaining approximately 6% open three and six pages. A Heat Map review of this task clearly shows that the majority of respondents at the very beginning are heading to the right place to reach the scientific publications. This and relatively quickly within the first 4-6 seconds of starting the task. It should be borne in mind, however, that 42% open the part with scientific publications and blog articles at the same time, which shows the need to take additional measures to identify both types of information.

Task 4: Search by keyword

None of the participants in the Eye-tracking experiment used the intended functionality to search by keyword. The main place where respondents search is a Home page on the website (72.27%). 18% direct to search directly on the Blog page.

Task 5: View the blog part of the site

Before requesting termination of the task, respondents spent a mean of 112.93 sec. on the website (min. 28.47 sec., max. 710.66 sec.). An average of 153 fixations are recorded (min. 72, max. 674). Unfortunately, approximately 60% open only one of the four tested posts. All four blog articles were opened by only 6% of respondents.

Figure 3 shows that the most attention on the blog page is paid to the title of the tested article from the category "Transport". This is actually the only title that stands out from the others, as it makes an association with a relatively famous song. However, this is not enough to make the participants open and read the material. Two-thirds of respondents opened the blog article, related to the category "Nutrition". Approximately 33% open up the material associated with air pollution. Equally are the clicks in terms of "Recycling" and only 9% - "Transport". In 3% of participants, no publication aroused interest[5].

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[5]   Percentages Exceed 100 Because Study Participants Opened Multiple Articles on Blog page.
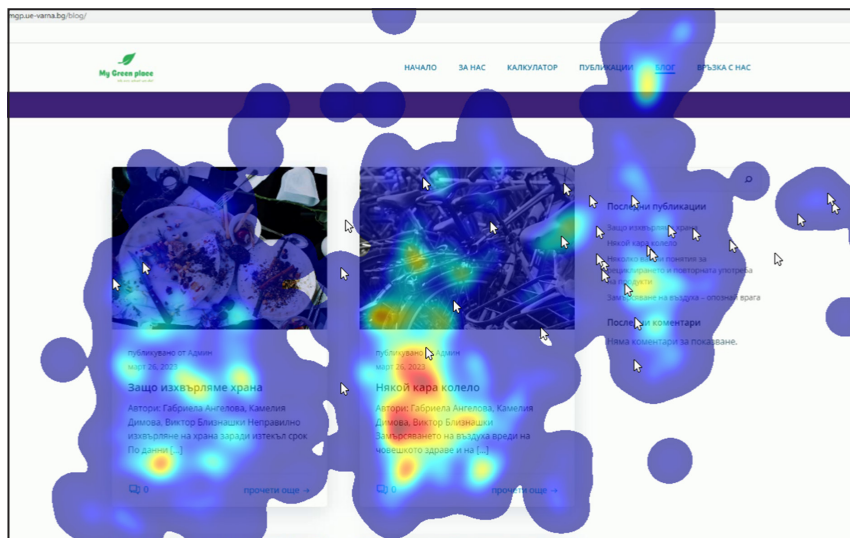
Figure 3. Heat map of the Blog page
Source: Own research

Task 6: Find contacts to contact the creators of the site

Approximately 94% click in the right place in no more than 12 seconds. The remaining 6% do not reach the contact form.

Free surfing: Free viewing of the page to open things that impressed them while performing other tasks

The calculator for assessing one's own level of Sustainable Consumption is the most visited part of the website at this stage in an Eye-tracking experiment. Approximately 55% of respondents open it. The Heat map for this part of the study shows that the additional graphic layout (a button in a different color in a central place) makes the necessary impression and stimulates the opening of this link. There are many cases when the task ends on the Home page.

Within the entire Eye-tracking experiment, there is registered a single emotional response (a registered increase in skin reaction) and it is linked to a blog article in the "Nutrition" category. Emotion is registered in a woman.

5. FUTURE RESEARCH DIRECTIONS

In this paper, attention is paid mainly to the number of fixations and the time that the relatively tested site manages to keep the attention of its users. An important aspect, however, is what is the time that the individual elements of the site manage to engage within the interaction. There is enough data that after further processing can serve these purposes and, accordingly, reach conclusions, in the context of the AOI.

6. CONCLUSION

Based on the conducted research, some of the elements that make an impression on potential users of the website can be displayed. As a result of the Eye-tracking experiment, it can be said that the created site manages to attract some attention from the Web Audience. The homepage manages the attention

on the categories of information. A relatively good balance between visual elements and text boxes has been achieved. It can certainly be said that in a significant proportion of respondents there is confusion between publications (scientific) and blog articles. This makes it necessary to consider a way to make them clearer. Young people do not use the built-in search option on the site. They browse, read, and even open multiple pages to find a keyword. In this regard, it is necessary to find a place all that is considered key yet on the Home page. Most respondents pay attention to an element that is designed to evaluate their behavior (the Sustainable Consumption calculator), and the corresponding Heat map clearly shows that the given emphasis on the access point manages to attract attention.

The results can be used as a starting point to assess the usability of websites through the analysis of visual and Tactile Reactions, as well as to improve content about Sustainable Consumption in households.

Acknowledgment

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