Evaluation of advertisement placement using near-infrared spectroscopy

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Abstract. In the marketing field, sales from Internet advertisements have increased. In previous research using questionnaires, pictorial advertisements were evaluated more positively when positioned on the left side of the page, whereas the opposite pattern was observed for verbal advertisements. In addition, neuromarketing is receiving a lot of attention as a new method of marketing. In this study, we examined the effect of advertisement placement on brain activity using a near-infrared spectroscopy (NIRS) system. The experiment used 34 pictorial advertisements, 34 verbal advertisements, and 34 webpages, with the two advertisements placed on the right- and left-hand sides of the page. First, 7 subjects viewed 34 web pages. Then, they viewed 68 advertisements and evaluated them on a seven-point scale. Brain activity was measured with the NIRS when they viewed the advertisements. The NIRS results show that, verbal advertisements do not affect brain activity, and pictorial advertisements increase the concentration of oxy-Hb when the advertisement is positioned on the left. In addition, the concentration of oxy-Hb increased when subjects viewed highly rated advertisements compared to poorly rated ones. According to the above results, pictorial advertisements were evaluated more positively when positioned on the left side.

Keywords: NIRS, Neuromarketing, Internet advertisement, Advertisement placement

1. INTRODUCTION

In the marketing field, Internet advertising has produced results. Internet advertisements are advantageous because of their cheap utilization rates compared to other advertising media, and they can be easily and quickly posted. There are various studies on advertising. In previous research, experiment subjects evaluated pictorial advertisements positioned on the left-hand side of a web page more positively, whereas the opposite pattern was observed for verbal advertisements (Chris, 1988; Gangseog et al, 2007).

Lately, neuromarketing is receiving much attention as a new method of marketing. Neuromarketing is a field of

marketing research that studies consumers' unconscious decision-making.

Originally, from an economic perspective, decision-making and economic behavior has been analyzed on the premise that consumers are rational. However, behavioral economics research has demonstrated that consumers are not always rational (Amos et al., 1981; Timothy et al., 2000). Therefore, neuromarketing is considered to improve the quality of marketing by estimating consumers' unconscious decision-making patterns.

In this study, we examined the effect of pictorial and verbal advertisement placement on brain activity using a near-infrared spectroscopy (NIRS) system.

2. METHOD

2.1 Measurement of Brain Information

NIRS measurements were conducted with the OEG-16 (Spectratech Inc., Yokohama, Japan), with 16 channels and a 0.08 second sampling interval. The measurement area is the prefrontal region (Figure 1). The numbers in Figure 1 represent each channel.

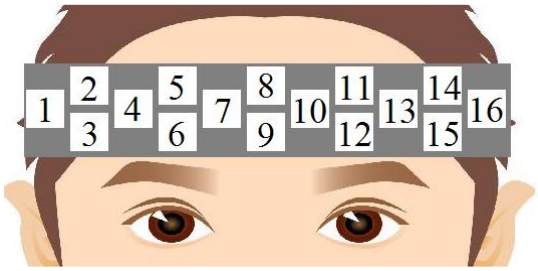


Figure 1: Measurement area.

Changes in oxygenated hemoglobin (oxy-Hb) concentrations and deoxygenated hemoglobin (deoxy-Hb) concentrations are measured by the NIRS. In this study, we use only changes in the oxy-Hb concentration for NIRS data analysis.

2.2 Outline of the experiment

Seven right-handed subjects (three females; four males) of 22 and 23 years participated in this study. All the subjects were students of the Faculty of Engineering at the University of Toyama.

2.3 Stimuli

In the study, 68 internet advertisements (34 pictorial advertisements and 34 verbal advertisements) were used. Examples of the stimuli are shown in Figure 2. Pictorial advertisement is consisted of picture mainly, and verbal advertisement is consisted of character mainly.

We chose these advertisement because evaluation of everyone is similar in pre-assessment that was conducted to 10 people.

Pictorial advertisement Verbal advertisement

Figure 2: Examples of stimuli.

2.4 Experimental task

In this study, subjects evaluated advertisements after viewing the web-pages where two advertisements were placed on the right- and left-hand sides of the page (Figure 3). The flow of the experiment task is shown below.

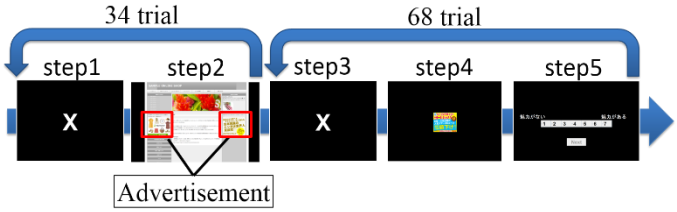


Figure 3: Experimental task.

step1. Rest period for stabilizing brain activity (5 s). "X" was displayed on the screen.

step2. The web page was displayed on the screen (15 s). After that, the subject returned to step 1. However, the process proceeded to step 3 after 34 web pages were presented.

step3. Rest period for stabilizing brain activity (10 s). "X" was displayed on the screen.

step4. An advertisement was displayed on the monitor (10 s).

step5. The subjects evaluated the attractiveness and unattractiveness of the each of the advertisements on a seven-point scale. After

that, the process returned to step 3. However, the task was finished after 64 advertisements were presented.

The purpose of this task is to make the subject evaluate advertisement placement unconsciously. Therefore, in steps 1 and 2, we did not tell subjects that this experiment relates to advertisements. We told subjects that this experiment relates to webpages and asked subjects to pay attention to the text in the middle of the webpage.

2.5 Measurement site

We analyzed the NIRS data of 2-15 channels and excluded channels 1 and 16 because many artifacts were found in those channels.

3. ANALYSIS

The data used in the analysis totals approximately 10 seconds (the sampling interval 0.08 seconds; there are 125 data points) of viewing time of the advertisements, collected at step 4 of the task. We pre-processed the data of the oxy-Hb concentration changes in each channel. The flow of signal processing is shown below.

1. All of the data were converted to a frequency domain using Fast Fourier Transform (FFT). In addition, we established a cut-off of less than 0.01Hz and more than 0.7Hz using the Band Pass Filter (BPF) to remove noise from the data.
2. The data of step 4 (10s) was selected from data. One data point before beginning step 4 were saved and used to calculate a baseline.
3. Data was shifted the direction of the vertical axis (oxy-Hb concentration) as data of one data point before beginning step4 is zero (base).

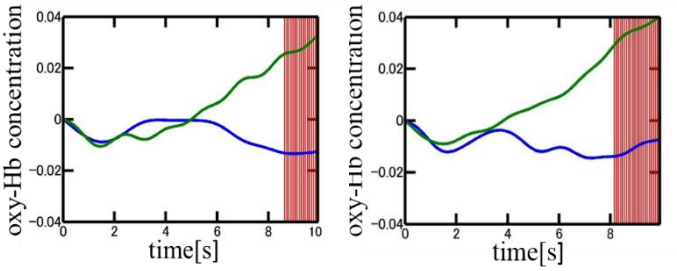
4. RESULT

One subject was excluded because he showed significantly different results compared to the others.

4.1 Difference in brain activity by the evaluation

Change in the oxy-Hb concentration of the six subjects in step 4 were divided into low rating and high-rating and averaged for each channel. In other words, the result is the arithmetic mean of the brain activity of the six subjects. We defined points one and two as a low rating and points six and seven as high rating on the seven-point scale questionnaire.

Figures 4 depict our results. The vertical axis represents the change in the oxy-Hb concentration, the horizontal axis represents time (seconds), and the solid line is the change of the mean of the subjects' brain activity over time (the blue line represents subjects that gave a low rating; the green line is those that gave a high rating).



ch5 ch14

Figure 4: Example of difference in brain activity by evaluation.

We examined significant differences between low and high ratings using a t-test. The red, vertical bar depicts the result of our t-test at a significance level of 5%. A significant difference was observed in channels 5, 6, 8, 9, 11, 12, 14.

4.2 Difference in brain activity by the placement

Change in the oxy-Hb concentration of six the subjects in step 4 was divided into pictorial advertising and verbal advertising. These changes were further divided into advertisements placed on the right and those on the left of the web page. After that, data of the six subjects were averaged for each channel. The average ratings for pictorial and verbal advertisements was 2.99 (SD=1.54) and 4.3 (SD=1.54), respectively.

Figures 5 depict results for pictorial advertisements. Vertical axis shows change in oxy-Hb concentration, horizontal axis shows time (second), and the solid line is time change of the addition average wave (The blue line represents the mean brain activity of subjects that viewed placed advertisements on left; green line is for those placed on the right placed on right).

We found significant differences between the two cases using a t-test. We conducted a result of t-test at a significance level of 5%. Significant differences were observed in channels 4, 5, 7, 8.

No significant difference was observed in verbal advertisements.

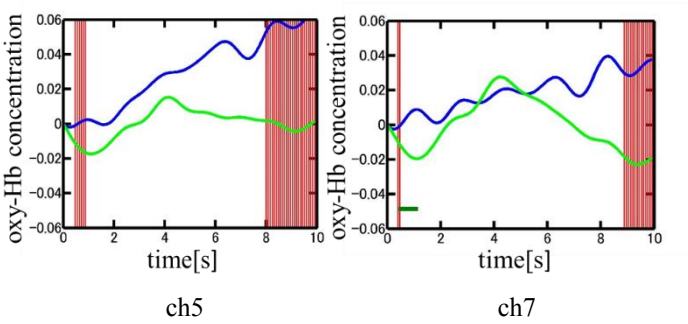


Figure 5: Example of difference in brain activity by placement.

5. DISCUSSION

From Figure 4, the oxy-Hb concentration was higher in the case of a high rating, and the oxy-Hb concentration was lower in the case of a low rating. In addition, from Figure 5, the oxy-Hb concentration was higher in the case of advertisements placed on the left compared those placed on the right. From these results, it is clear that pictorial advertisements receive a high rating when placed on left.

With pictorial advertisements, the reason significant differences were observed in the right hemisphere is likely because pictures are processed in the right hemisphere of the brain and characters are processed in the left. Furthermore, the reason no significant difference was observed in verbal advertisements is likely because the difference in brain activity was difficult to observe. The results of the questionnaire had been biased to low ratings compared to pictorial advertisements.

In future work, there is a possibility that significant difference is observed in verbal advertisement by selecting the advertisement which evaluation is not biased. In addition, it can be said one of the improvements to devising the division of data and method of analyzing data.

6. CONCLUSION

In this study, we examined the effect of pictorial and verbal advertisements placement on brain activity using NIRS system. For this purpose, carried out a questionnaire rating and measured brain activity after viewing web page in experimental task.

As a result, oxy-Hb concentration was higher in case of high rating, and oxy-Hb concentration was lower in case of low rating. And, oxy-Hb concentration was higher in case of placed on left compared to case of placed on right. From these results, it is considered that pictorial advertisement is evaluated high when placed on left. No significant difference was observed in verbal advertisement. The reason for this, it is considered that the difference in brain activity was difficult to appear because the results of the questionnaire had been biased to low ratings compared to pictorial advertisement.

In future work, significant differences may be observed in verbal advertisements by selecting advertisements for which evaluation will not be biased. Improvements could also be made in devising both the division of data and method of analyzing data.

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