Relationship Analysis between Subjective Evaluation and NIRS-Based Index on Video Content

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Abstract. Brain activities have been investigated, and various functions of brain have been revealed recently. In our experiment, decrease of oxy-Hb change at frontal cortex was observed while subjects were watching video contents. Also, the degrees of decreases were different among the subjective evaluations about impression against the video contents. Revealing the cause of the decrease has the possibility to evaluate video content objectively. In this paper we discuss the relationship between subjective evaluation and brain activity on video content.

Keywords: Frontal cortex, Near-infrared spectroscopy, Subjective evaluation, Video content.

1 Introduction

A traditional evaluation method for video contents has been based on customers' reviews, and the numbers of them. However, the method has some problems on reliability and, needs to embrace scientific approaches regarding to brain activity [1]. Thus, in this study, we focused on a brain activity, and analyzed the relationship between subjective evaluations of video contents and brain activity.

We observed brain activity at frontal cortex during watching video contents, as frontal cortex was related to higher-level cognitive function. We used Near-infrared spectroscopy (NIRS), as it was non-invasive and restraint-free, less noise than electroencephalography (EEG), and higher temporal resolution than functional magnetic resonance imaging (fMRI) [2].

Nine healthy right-handed subjects watched six videos (two excellent videos, two average videos and two poor videos). We used NIRS to measure oxygenated hemoglobin (oxy-Hb) change in frontal cortex. Consequently we found a decreased oxy-Hb change during watching video (TV Commercial). In addition, there are significant differences among excellent videos, average videos, and poor videos in oxy-Hb change.

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These results suggest that the decrease in oxy-Hb change is related to subjective evaluations of video content.

2 Subjective Evaluation of Video Contents for NIRS Experiment

2.1 Subjects

Thirty healthy Japanese adults (22 men and 8 women, aged 21 to 25) participated in first subjective evaluation. Subjects were divided into three groups. In second subjective evaluation after the first evaluation, other nine healthy adults (all were men, aged 21 to 24 and right-handed), who were differ from the thirty subjects, participated to confirm the result of the subjective evaluation.

2.2 Procedures

In the first subjective evaluation, each thirty subject watched sixteen videos, and answered a questionnaire to gather the evaluation about overall impression, background music, story, persona, company, and product by the 5-point rating scale: Very Poor (1), Poor (2), Average (3), Good (4), Excellent (5). In this paper, we used only the evaluation about overall impression in analysis. We used 30-second TV Commercials as video contents. The commercial were related to products, such as home electronics, foods, etc., and companies themselves. The orders of the sixteen videos were random for each group. Their ratings were averaged for each video, and sixteen videos were ranked by the average score.

Also, we picked up the top two videos as excellent, the worst two videos as poor and two videos which are near 3.00 point as average.

In the second subjective evaluation, each nine other subject watched the six videos (the excellent, average, and poor videos) and answered the same questionnaire to confirm the previous result of ranking.

2.3 Result

Table1 and Fig.1 showed the result of subjective evaluation of sixteen videos in thirty subjects, also Table2 showed six videos; two excellent videos, two average videos, and two poor videos.

Table3 and Fig.2 showed the result of subjective evaluation of the six videos in nine subjects.

Compared with Table2 and Table3, the ranking of the six videos was almost the same between thirty subjects and the other nine subjects. Thus, these videos were elected accurately as excellent, average, and poor among the adults who aged 21 to 25. These six videos were used in NIRS experiment.

Table 1. Sixteen videos (TV Commercials) list. The videos were sorted in descending order of the average score about overall impression by 5-point scale.

CM No.	Year	Company name	Average score
1	1980	FUJIFILM Corporation	4.39
2	1974	Panasonic Corporation	4.13
3	1976	Meiji Holdings Co., Ltd.	3.96
4	1982	Tokio Marine & Nichido Fire Insurance Co., Ltd.	3.91
5	1987	Sony Marketing (Japan) Inc.	3.91
6	1990	Sony Marketing (Japan) Inc.	3.83
7	1970	Panasonic Corporation	3.74
8	1976	Shiseido Company, Limited	3.61
9	1978	Ryukakusan Co., Ltd.	3.48
10	1978	LOTTE Co., Ltd.	3.43
11	1973	Sony Marketing (Japan) Inc.	3.09
12	1981	Lion Corporation	3.09
13	1977	Panasonic Corporation	3.04
14	1969	PILOT CORPORATION	2.96
15	1985	Shiseido Company, Limited	2.74
16	1980	Yamaha Motor Co., Ltd.	2.61

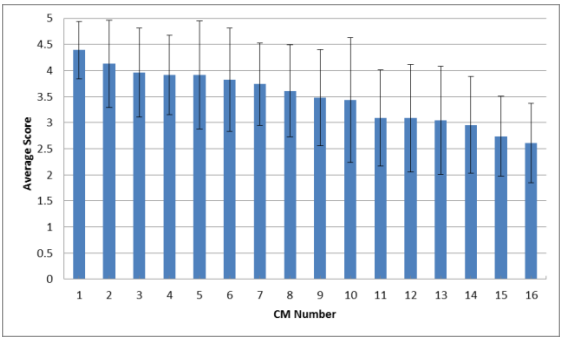

Fig. 1. Average score and standard deviation of sixteen videos. The standard deviations showed that there were differences among individuals.

Table 2. Videos; excellent, average and poor videos in the experiment in thirty subjects

CM No.	Year	Company name	average score	evaluation
1	1980	FUJIFILM Corporation	4.39	Excellent
2	1974	Panasonic Corporation	4.13	Excellent
13	1977	Panasonic Corporation	3.04	Average
14	1969	PILOT CORPORATION	2.96	Average
15	1985	Shiseido Company, Limited	2.74	Poor
16	1980	Yamaha Motor Co., Ltd.	2.61	Poor

Table 3. Videos; excellent, average, and poor videos in the experiment in other nine subjects. The ranking was almost the same as the result of previous ranking in thirty subjects. Only the rank of No.14 (PILOT CORPORATION, 1969) and the rank of No.15 (Shiseido Company, 1985) were reversed. We used these six videos for NIRS experiment.

CM No.	Year	Company name	Average score	Evaluation
1	1980	FUJIFILM Corporation	4.67	Excellent
2	1974	Panasonic Corporation	4.33	Excellent
13	1977	Panasonic Corporation	2.67	Average
15	1985	Shiseido Company, Limited	2.56	Average
14	1969	PILOT CORPORATION	2.22	Poor
16	1980	Yamaha Motor Co., Ltd.	2	Poor

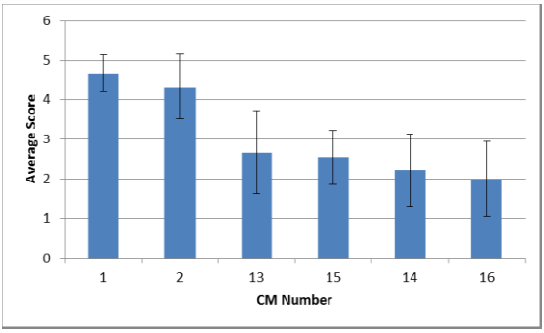

Fig. 2. Average score and standard deviation of six videos. There was an obvious difference between excellent(CM No.1 and 2) and poor videos(CM No.14 and 16).

3 NIRS Experiment during Watching Videos

3.1 Subjects

Nine healthy Japanese adults (the same 9 subjects in the previous subjective evaluation of confirmation) participated in this NIRS experiment.

3.2 Procedure

This NIRS experiment was conducted concurrently while the nine subjects were evaluating 6 videos. Each subject was seated in front of a table on which 17-inch display was placed. Changes in the concentration of oxy-Hb were measured at 22 channels with an ETG-4000(HITACHI Medical Corporation, Japan) during the watching of six videos in Table3. We measured frontal cortex area according to the international 10-20 system in electroencephalography (Fig.3, Fig.4) [3] [4]. Each subject watched and evaluated the overall impression of the six videos one by one using the 5-point rating. The 6 videos were presented on the display, and in random for each participant to avoid order effect. A block paradigm was used in a design of experiment for watching six times repetition of video [5]. A condition was 30-second period of video task (CM Task) with a 40-second period of rest. The rest consisted of 25-second rest time, 5-second evaluation time for overall impression by hands, and 10-second rest time (Fig.5). This condition was repeated 6 times for each participant.

3.3 Data Analysis

Oxy-Hb changes of two excellent, two average, and two poor videos were averaged and the grand averaged waveforms were made. Also grand averaged waveforms were compared by t-test between excellent and average videos, poor and average videos, and excellent and poor videos.

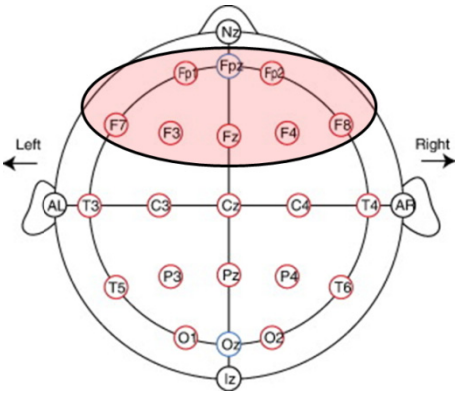

Fig. 3. Names and positions of international 10-20 system in this study [4]. We measured frontal cortex area which was marked.

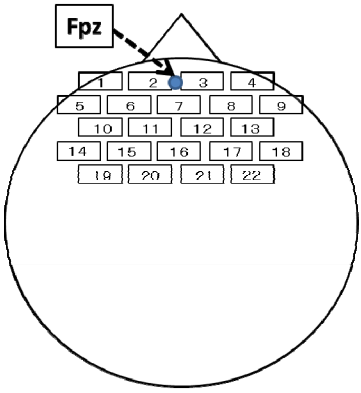

Fig. 4. The location of 22 channels. We located the middle of channel 2 and channel 3 at Fpz.

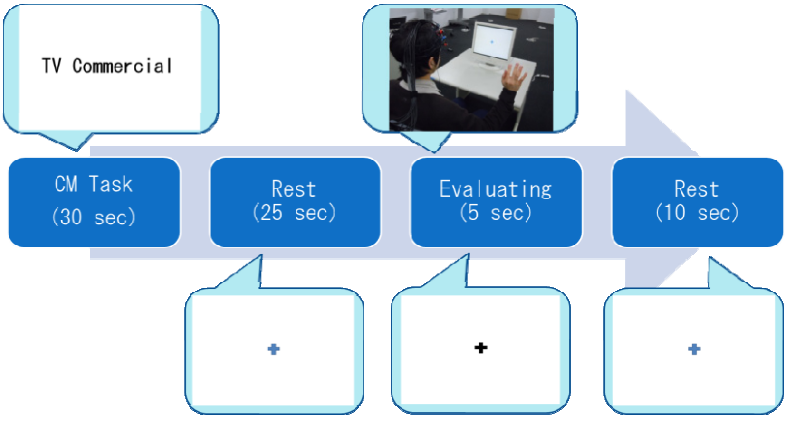

Fig. 5. Design of experiment. This cycle was repeated 6 times for a subject.

3.4 Results of NIRS Experiment

According to the Fig.6, a decrease of oxy-Hb change was observed in each video. Also, the degree of decrease was different from each other.

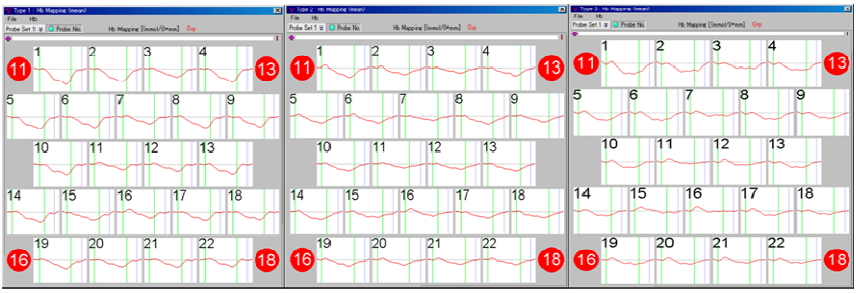

Fig. 6. Grand averaged waveforms (left; Excellent videos, middle; Average videos, right; Poor videos). The number of subjects is nine.

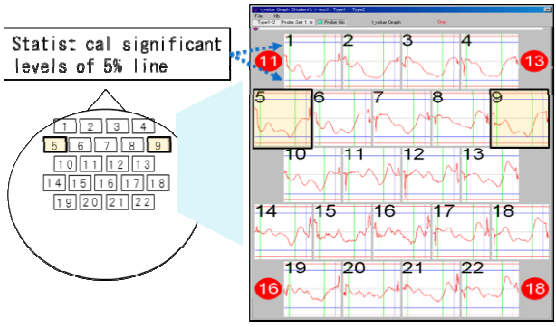

Fig. 7. t-value graphs of oxy-Hb comparison between excellent and average videos. Excellent videos were significantly smaller than average videos in the channels which were marked by a heavy line.

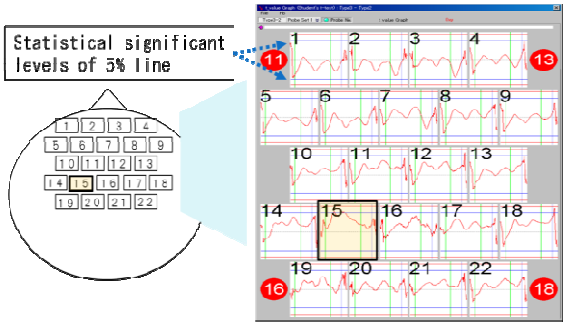

Fig. 8. t-value graphs of oxy-Hb comparison between poor and average videos. Poor videos were significantly larger than average videos in the channels which were marked by a heavy line.

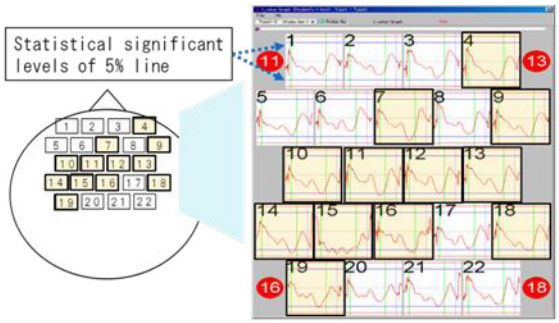

Fig. 9. t-value graphs of oxy-Hb comparison between excellent and poor videos. Excellent videos were significantly smaller than poor videos in the channels which were marked by a heavy line.

The result of the t-test for oxy-Hb changes showed some significant differences. Excellent videos were smaller than average videos in two channels (ch5 and ch9) (Fig.7). Poor videos were bigger than average videos in 1 channel (ch15) (Fig.8). Excellent videos were smaller than poor videos in 13 channels (ch4, 7, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, and 21) (Fig.9).

4 Conclusion and Discussion

We picked out excellent, average, and poor videos (TV commercials) properly about overall impression by using 5-point rating scale questionnaire. Also, we observed decrease of oxy-Hb changes in frontal cortex while subjects were watching the videos, and found that degrees of decreases were different among the evaluation of overall impressions. These results suggest that NIRS at frontal cortex can detect differences of subjective evaluations of video content. In addition, the results also suggest that we can measure the degree of the subjective evaluation by investigating change of oxy-Hb at the channels that showed significant differences.

Recently some researches have indicated the decrease of oxy-Hb change in various brain areas, and decrease of oxy-Hb change has been defined as brain deactivation [6] [7]. Also, some processes of deactivation at frontal cortex have been suggested. Two of them can be related to our decrease of oxy-Hb change. One is deactivation caused by engaging in goal-directed actions, such as detecting targets, because our task in which subjects are watching TV commercials can be as goal-directed action. Another is deactivation caused by conducting task that involve externally focused attention, because our TV commercials were so old that subjects could accept the TV commercials as external stimulation. In future research, we need to find out the cause of deactivation of our study along the two processes.

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