Analysis of the cerebral blood flow affected by brand impressions of the products

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Abstract

In recent years, measurement techniques and devices of cerebral function and brain activity have been improved. Therefore, “Neuromarketing” has been attracting attention. Neuromarketing is one of commercial activities and is in the marketing researches which study consumers’ response to purchase activity. Neuromarketing is helpful for companies to elucidate principles of actions unconsciously caused by human and has 2 purposes to increase effectively consumers’ eagerness to buy. First purpose is elucidating what consumers bought for indexes at the time of purchasing decision making. Second purpose is elucidating what consumers regard as important in the indexes. fMRI is used mainly for such a brain activity measurement. However, there are several problems to use fMRI, which has limitation on the posture of the subject is very expensive. Therefore, it is expected that a portable NIRS (Near-infrared spectroscopy) brain measuring apparatus may be suitable for a study of neuromarketing. We investigate the relation between impressions of the product brand and consumers’ brain response. From our investigation, we show that different brand impression results in different effect on the cerebral blood flow by a portable NIRS brain measuring apparatus.

Keywords: neuromarketing; near infra-red spectroscopy; brand image; neural network

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1. Introduction

In recent years, measurement techniques and devices of cerebral function and brain activity have been improved. Therefore, “Neuromarketing” has been attracting attention. Neuromarketing is one of commercial activities and is
in the marketing researches which study consumers’ response to purchase activity. Neuromarketing is helpful for companies to elucidate principles of actions unconsciously caused by human and has 2 purposes to increase effectively consumers’ eagerness to buy. First purpose is elucidating what consumers bought for indexes at the time of purchasing decision making. Second purpose is elucidating what consumers regard as important in the indexes. For example, the reason why a product which a famous actor habitually use has high popularity was elucidated from the viewpoint of brain science. An issue of neuromarketing is the differences of the preference between individual persons. For example, even if a product gives good effects to a certain person, it has bad effects for another person who has different hobbies or preferences. Therefore, it is important for a company to take an approach effectively to consumers. To do so, it is necessary to generalize the difference of individual preference and increase desire for purchase. In the conventional manner, quantity of data is increased by increasing subjects for this generalization. To collect many data, the almost all way of collecting data is street survey in a paper medium mainly.

However, it is pointed out that the data are not correct data at the time of the purchasing decision making, in other words, that is not real-time data. In substitution for conventional survey, it is necessary to obtain a real-time data by measuring brain activity in order to solve this problem. fMRI (functional Magnetic Resonance Imaging) is used mainly for such a brain activity measurement. However, there are several problems to use fMRI, which has limitation on the posture of the subject is very expensive. Therefore, it is expected that a portable NIRS (Near Infrared Spectroscopy) brain measuring apparatus may be suitable for a study of neuromarketing. This is because a portable NIRS has little restriction for the subject, and it is very easy to put on and take off. For the other reason, that is inexpensive compared with fMRI, and it does not need special measurement environment. Therefore, it is important to investigate whether generalization is possible by distinguishing indexes at the time of the purchasing decision making of consumers by a portable NIRS brain measuring apparatus.

In the paper, we investigate the relation between impressions of the product brand and consumers’ brain response. From our investigation, we show that different brand impression results in different effect on the cerebral blood flow by a portable NIRS brain measuring apparatus.

2. Neuromarketing

2.1. About neuromarketing

Neuromarketing is an attempt that is going to utilize the data which are psychology and action of the consumers who became clear by measuring the brain activity for a commercial activity.

There are 2 major roles of the neuromarketing. The first role is improving cost-benefit performance of the advertising by techniques to make brain which assumes fMRI a representative an image. It means that the marketing research for the product performs an objective evaluation at lower cost than conventional evaluation technique. The second role is an objective thing evaluating of the products at a certain development stage between the concept formation and a product examination. Particularly, this technique is expected by the design decision of the product. This is because an extremely big effect is provided if company understand a design selling before sale.

We can get the world information about the neuromarketing from “neurorelay.com”. A group called “Neuromarketing science and business association” exists, and there is the participation of 27 countries.

2.2. Application examples

As application examples of the current neuromarketing, there are the evaluations of television advertising, the design of the product and video content, and so on. In addition, companies introducing neuromarketing gradually increase (Fig. 1). In the company, the neuromarketing is introduced to use at the time of an evaluation after product development and the product release mainly. In the future, it is hoped that portable brain activity measuring equipment is used as a substitute for the questionnaire of the paper mediums such as consumer investigator of new products and street investigations.
2.3. Positioning of the brand in the neuromarketing

Representative things to use for an index when consumers purchase a product include a brand. It is the words that the brand refers to a trademark. In addition, the word that the brand means implication of an impression and the history about a product and the company in a field of the marketing. The well-known brand is a symbol which does not disappoint the expectation of the customer. It may be said that the company offers security to the customer by giving a product added value called the brand. The neuromarketing achieves result about the making of brand. The company can provide an ideal image in the purchasing to consumers by taking approach for the image that it want to give them from the field of the brain science. It is necessary for the company to maintain the quality of the product not to break the image of its brand. However, it entails a great cost to maintain the image of the brand. In addition, when a company develops a new brand-name product, the problem that a new one is not showy because an existing one is showy. Two tasks are important from the viewpoint of the neuromarketing. First task is to know whether the consumers judge which part of the brand or where as a brand. Second task is to research how the brand image of the consumers effectively.

3. A cerebral blood flow measurement experiment and discrimination

In the paper, we perform a cerebral blood flow measurement experiment at the time of the product image presentation by portable NIRS brain measuring apparatus. In addition, we inspect whether difference between "A" and "B" can be distinguished using a neural network by quantity of provided cerebral blood flow data.

3.1. About recognition of the product brand image

In the paper, we define 2 about recognition of the product brand image before experiment. Thereby, we classified into the product which was high in recognition of the brand image and low one. At first, we defined it about the product which was easy to be recalled for the first for a certain product group. For the second, we defined it about the product that a brand name becomes the pronoun of the product group where the product belongs to. For examples, the name called “POCARI SWEAT” and the name called “AQUARIUS” are used for a substitute named
the sports drink by consumers. In addition, the name called “iPod” and the name called “WALKMAN” are used for a substitute named the portable music player.

In the paper, we defined the product classified in 2 definitions mentioned above as the product which was high in recognition of the brand image and the product except it as the product which was low recognition of the brand image.

3.2. Cerebral blood flow measurement experiment at the time of the image presentation

We have 8 subjects who are young men in their twenties, 8 right-handed subjects. We perform our experiment after we gave an explanation of our experiment to them and obtained their consent. In our study, we used Wearable Optical Topography (WOT-100) as a measurement device of NIRS which has 10 channels (ch7-16 shown in Fig.2) of prefrontal cortex. The subject watches a display in front closely in the state that took seat to a chair. In the experiment, one test trial is in 15 seconds and it includes 5 seconds task between 5 seconds rests (Fig. 3). We show 1 product image (sports drink of the plastic bottle of 500ml or portable music player) to a display for 1 trial and show it to a subject. As for 4 of 8 subjects (subject A~D), sports drinks are shown, and the others (subjects e~h), portable music players are shown. Each test set consists of 10 trials. In 1 product group, we show 7 kinds of product images to a subject. With the product that 2 are high in recognition of the brand image among 7 product images, 5 of the remainder are products having low recognition of the brand image. 1 subject has 5 tests set.

![Fig. 2. Measurement point](image1)

![Fig. 3. Trial time](image2)
3.3. Data processing

As signal analysis software of the optical topography, we perform it using “POTATo (Platform for Optical Topography Analysis Tools)” made in Hitachi.

In the first step, the information that is different from the blood volume change at the time of a certain product presentation may get mixed for the purpose of this study. For this reason, we used a band-pass filter to select the data of frequencies from 0.02Hz up to 0.1Hz. As a result, we remove the data which are unnecessary for our study. In the second step, the provided data of each task set is divided into 7 blocks which are included 5 seconds data before the task and 10 seconds data after the task. In consequence, we can perform the handling of data effectively in the future. In the last step, we calculated baseline of measured data from 5 seconds of the beginning and the end of the task blocks, and this baseline fitting is applied to the original data. This baseline fitting gets rid of unnecessary data that is monotonic increase and monotonic decrease. The data that was used in this analysis is the oxy amount of hemoglobin.

3.4. distinguish of the tasks

We used the 3-layer neural networks to distinguish of the tasks (Fig. 4). We used a statistical analysis tool R in this analysis. In the first place, we put the data which high or low in recognition of the brand image in the input layer as data of the channels. In the second place, we set the middle class of the neural network between 5~40 units and let it look for the number of the most suitable middle class. After the data have high recognition of the brand image or recognition of the brand image was classified with low 2 kinds, it is output. In consequence, we inspect whether recognition of the product brand image can be distinguished by the measurement of the brain state of consumers. It should be noted that we adopt the highest thing about the identification rate.

4. Experiment results

4.1. Analyzed data

We averaged the synchronized signals with the task for each subject. As a result, Fig. 5 shows the activities of subject A and B. Fig. 6 shows the activities of subject e and f. The cerebral blood flow of frontal lobe is increasing during seeing product image. The cerebral blood flow change is bigger during seeing product image of sports drink than portable music player. It is supposed that a reaction of task was big, because a drink sees it frequency.
4.2. Classification result

Table 1 and table 2 show a discrimination rate of each subject. Table 1 shows a discrimination rate of sports drinks. Table 2 shows discrimination rate of portable music player. From table 1, the average discrimination rate when subjects watch the products which is high in recognition of the brand image is 65.0%. That low one is 74.2% and overall average is 69.6%. From table 2, the average discrimination rate when subjects watch the products which is high in recognition of the brand images is 54.2%. That low is 77.3% and overall average is 65.7%. From table 1 and
It is the value more than 50% that the average discrimination rate is 67.7%, and is chance level. For this reasons, NIRS is useful to discriminate the recognition of the brand image of the product. However, it is not enough to discrimination rate in the real world. Our next aim is increase in line of products to use and in subjects. We plan the improvement of the discrimination rate by more data. In this study, we have used only oxy hemoglobin the feature amount for discrimination. But to use the deoxy hemoglobin and total hemoglobin may improve discrimination rate of our study. Furthermore, about them, it is necessary to inspect what kind of influence you have on a result.

5. Conclusion

In this paper, we performed the analysis of the quantity of cerebral blood flow change and identification about recognition of the product brand image that is index at the time of the purchasing decision making of consumers. We inspected whether the identification by the index was possible. In our experiment, we used the portable NIRS brain
measuring apparatus that putting on and taking off was easy and a restriction degree was low. As a result of having been provided, the result of 67.7% was provided on the average of 2 lines of products.

In the future, we will try to improve the identification rate. In order to achieve this purpose, it is necessary to increase subjects and product image to show and reexamine the data handling method. It is thought that it is affected the identification the information about preference of subjects or aversion. For this reason, it is thought that it is necessary to examine the thing corresponding to this.

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References