Original Article

Preliminary examination of scenery images for tourism promotion using a neuromarketing approach

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Abstract

As the outbreak of the novel coronavirus disease caused great damage on inbound tourism in Japan, developing an effective promotion way to revitalize the inbound tourism is an important issue. Since many inbound tourists to Japan have expected healing and relaxing for their travels, motivating prospective tourists who look for these comforts is a key to increase the number of inbound tourists for the future. In this study, the authors conducted an experiment to examine whether photos (still image) or videos (moving image) of scenery are more effective to stimulate tourist's interests to visit Japan with an approach utilizing neuromarketing. In the experiment we recorded the brain activity of subjects, which is monitored as the amount of cerebral blood flow change by using near-infrared spectroscopy (NIRS) and obtained their impression evaluation for each scenery image by using Semantic Differential (SD) method. The results of the experiment which showed the amount of cerebral blood flow change were similar for both still images and moving images. Moreover, the results of SD measurement were also similar for both still and moving images. Additionally, it illustrated that the mean values of SD adjectives related to healing were higher than other adjectives. These results suggest that the effectiveness of using photos or videos of scenery for promoting tourism on SNS or website does not have a big difference. In addition, the photos or videos which often give relaxing feelings can be effective to motivate prospective tourists who seek a relaxing time in Japan.

Keywords

tourism promotion, neuromarketing approach, NIRS, Semantic Differential method, inbound tourism

1. Introduction

The number of foreign tourists to Japan had been increasing toward 2020, when the Tokyo Olympic and Paralympic Games were planned to be held, as the Japanese government put great efforts on promoting Japan as tourism-oriented country [JTB Tourism Research & Consulting Co., n.d.]. However, the number was dramatically decreased by 99.9 % in 2020 due to the effects of COVID-19 pandemic according to the report of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) [Ministry of Land, Infrastructure, Transport and Tourism, 2020]. It is an urgent issue to recover this difficult situation and Japan needs new promotion ways to increase the number of foreign tourists.

According to the report on 2019 Consumption Trend Survey for Foreigners Visiting Japan, many foreign tourists to Japan answered "enjoying nature and scenery sightseeing" and "bathing in a hot spring" for the question concerning what they wanted to do during their trip to Japan before coming to Japan, and "bathing in a hot spring" and "experiencing four seasons" for the question concerning what they want to do for the next trip to Japan [Japan Tourism Agency, 2019]. From this result, it can be assumed that many foreign tourists expect some healing or relaxation for their trip to Japan. Since inbound tourism is under difficult circumstances, developing an effective promotion way to revitalize the inbound tourism using online, such as SNS or websites, should be considered.

Digital marketing has been receiving attention in tourism and Japan National Tourism Organization (JNTO), which is a governmental organization to promote inbound tourism, developed the guidelines for digital marketing to explain how to make photos or videos attractive on Instagram, Facebook, and websites based on their expertise [Japan National Tourism Organization, n.d.]. Photos or videos are used on SNS or websites in order to motivate prospective tourists. Using photos in digital marketing does not require much cost. On the other hand, using videos can provide much information at a time. Both have an advantage in tourism promotion. As many tourists use SNS or websites to collect information for their trip beforehand, examining which promotion way is more effective in digital marketing.

Additionally, neuromarketing has been attracting attention in recent years. Neuromarketing is a new marketing subcategory, which is based on techniques of neurosciences to see consumer behavior or psychology by examining brain activity. Neuromarketing is used in product design, branding, advertising in many business fields and applied in other fields such as engineering, communication, and education [Klinčeková, 2016;

Nilashi et al., 2020].

Our motivation to conduct this research is to examine the effectiveness of photos or videos as a means of inbound promotion using a neuromarketing approach. In this research, we used ten different images of scenery in Japan related to nature or scenery of sightseeing which can be regarded as healing images preparing them as a form of photo and video. As a subject, 12 Japanese students who are between 18 and 25 years old were asked to look at photos and videos and evaluate them with a questionnaire. For measuring their brain activity, near-infrared spectroscopy (NIRS) was used. For evaluating images, we used semantic differential method (SD method) with a questionnaire for 12 elements. Since this research is preliminary to see whether the experiment design is appropriate or not, only Japanese students were the subjects.

This paper consists of five sections. Section 2 discusses previous studies in neuromarketing in tourism, techniques of neuromarketing, and SD method in tourism. Section 3 explains the procedure of the experiment: experiment with NIRS and questionnaire with SD method. Section 4 illustrates the results of the experiment and discussion. Finally, Section 5 provides conclusion.

2. Previous studies

2.1 Neuromarketing in tourism

As neuromarketing is relatively new, there have not been many studies in the tourism field. There is a study especially for inbound tourism in Japan. JTB Tourism Research & Consulting Co. conducted a survey on intention of American tourists visiting Japan and neuromarketing experiment on preferable photos by measuring brain waves and eye movements and by analyzing subjective assessment [JTB Tourism Research & Consulting, 2019]. They found that the photos that American subjects liked in their questionnaire results were different from the ones in brain wave and eye movement results. With subjective assessment, which is a questionnaire, they liked unfamiliar scenery but with brain wave and eye movement measurement, they preferred the photos of a different culture.

For the studies outside of Japan, Bastiaansen et al. [2018] performed a neuromarketing experiment on emotional responses to destination marketing stimuli by using electroencephalography (EEG). They found that emotional responses to the destination stimuli, which are the photos of the destination, were stronger after seeing a movie that was related to the destination. They concluded that a popular movie can be used for effective destination marketing.

Additionally, Ramsoy et al. [2019] aimed to examine travel destination preference seeing the subconscious responses to destination stimuli using images and videos. They used eye-tracking and EEG for measurement in their experiment. This study concluded that there may be different mechanisms between subconscious emotional responses and conscious destination preference ratings and there may be a dual-system for decision making.

There are some studies dealing with neuromarketing or destination marketing related with tourism. However, there are not enough studies focusing on subconscious part in decision making prior to the real traveling. This study also deals with subconscious part comparing to conscious part.

2.2 Techniques of neuromarketing

Neuromarketing approach uses techniques of eye tracking, electroencephalography (EEG), magneto encephalography (MEG), functional magnetic resonance imaging (fMRI), near-infrared spectroscopy (NIRS), and so on [Klinčeková, 2016]. In this study we used NIRS to measure brain activities in the experiment. NIRS is a non-invasive device that uses near-infrared light to measure the brain activity, which can be seen as hemoglobin concentration rate.

There are three reasons that we decided to use NIRS. First, it can measure the deep part of the brain such as 3 cm from the scalp [Fukuda, 2011]. Therefore, the data recorded by NIRS does not contain much noise from peripheral devices. EEG is used in many related studies mentioned above and it can be more affordable than NIRS in terms of cost. However, EEG can measure brain waves from the brain scalp and it can be easily affected by the peripheral devices which emit electromagnetic waves. The data detected by EEG might contain much noise that interferes in analyzing the data. Second, NIRS is robust over movement. It can be used for a driving experiment and it does not add much stress on subjects even for long hours [Liu et al., 2016]. Third, NIRS is used for the studies related to brain activation with ICT screens. For example, Anuardi and Yamazaki [2019] reported the effective colors of background and letters and stated that the frontal area of the brain where NIRS can measure is related to memory information processing. Therefore, NIRS was used in this study to investigate activities of the brain when the subjects see photos (still image) and videos (moving image).

2.3 SD method in tourism

The experiment was conducted with relaxing sceneries in the form of photos and videos to see how the subjects evaluate them by a questionnaire. We used Semantic Differential method (SD method) to make the questionnaire. The SD method was developed by Osgood et al. [1957] and it is one of the rating scales to measure connotative meaning of concepts or attitudes and so on. Therefore, it is widely used in many different fields of study [Inoue and Kobayashi, 1985]. It uses a set of two polar adjectives such as “soft-hard” or “interesting-boring” as a factor. In addition, several scales are between them to be evaluated, such as extremely agree, moderately, or slightly. The results from SD questionnaires are analyzed statistically to calculate the mean score of the bipolar adjectives. By applying this calculation to all the adjectives, SD profile for the concept or attitude is formed and it shows how the concept or attitude can be evaluated.

The scales and adjectives are designed based on the purpose of the study. In this study, we used twelve modified adjectives used in the previous study in tourism [Sasaki, 2007] in order to evaluate the sceneries. In the tourism research field, SD method has been used widely [Kawase et al., 2015; Oida et al., 2018].

The previous studies utilizing NIRS and SD method in the tourism field uncovered the effectiveness of photos or videos as a promotion tool by comparing the subjects' conscious and subconscious parts. Therefore, in this study, we conducted an experiment to analyze the brain activity, which is subconscious, toward the relaxing sceneries in two forms by using NIRS and carried out image evaluation, which is conscious, toward the same sceneries by using an SD questionnaire.

3. Experiment methodology

As mentioned in Section 1, many foreign tourists visiting Japan seek some healing or relaxation in their trip. Therefore, we selected photos or videos related to nature or scenery of sightseeing in Japan to examine which form (photo or video) is more effective as a means of inbound promotion. The goal of this study is to investigate effective inbound promotion tools on SNS or website. However, this experiment was conducted preliminary with Japanese subjects to see if the design of the experiment, selections of images for photos or videos, and environment of experiment are appropriate or not. Participants were 12 Japanese students who were between 18 and 25 years old. There were 11 male students and 1 female student.

The photo and video images were related to nature and scenery sightseeing as shown in Figure 1. We chose several images depicting the seas because 39 prefectures are facing the sea out of 47 prefectures in Japan. The seas and oceans are one of Japan's primary natural resources and tourist attraction sites. They were prepared only for this experiment considering the number of factors in one image. If there are many factors in one image, it is difficult to assume what factor has an affect on the brain. The purpose of this experiment is to see whether photo or video is more effective as a tool for tourism promotion on SNS or website. Therefore, we carefully made the still image and moving image with fewer factors. First, a short video of an image was taken without moving the video camera itself. Then, a still image was cut off from the video to make a photo for the experiment. Thus, the difference between the photo and the video used in the experiment is that it is a still image or moving image of the same scenery.

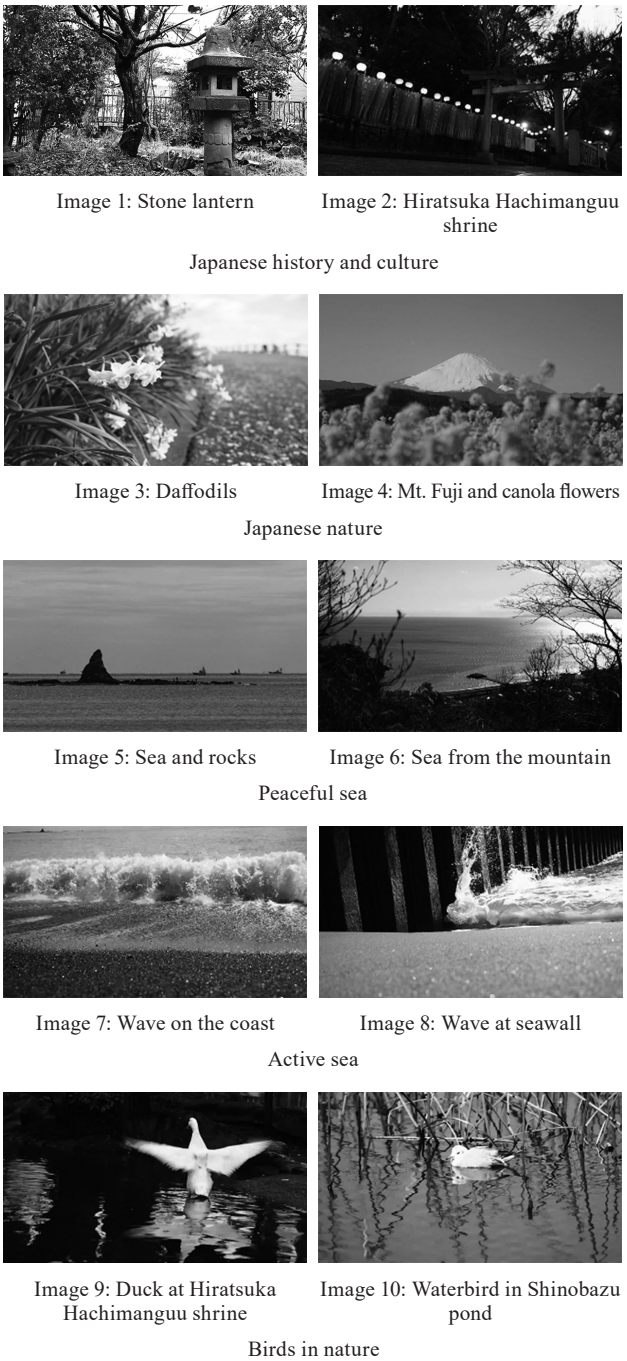

Image 1: Stone lantern | Image 2: Hiratsuka Hachimanguu shrine

Japanese history and culture

Image 3: Daffodils | Image 4: Mt. Fuji and canola flowers

Japanese nature

Image 5: Sea and rocks | Image 6: Sea from the mountain

Peaceful sea

Image 7: Wave on the coast | Image 8: Wave at seawall

Active sea

Image 9: Duck at Hiratsuka Hachimanguu shrine | Image 10: Waterbird in Shinobazu pond

Birds in nature

Figure 1: Ten images used in this experiment

3.1 Brain activity measurement by NIRS

We used a NIRS device, HOT-2000 [NeU Corporation, n.d.], manufactured by NeU Corporation for the experiment to observe the brain activity (the subconscious part). The HOT-2000 is a very light headset with two channels to measure cerebral blood flow change in the forehead area in real-time by using weak near infrared light. In order to record the brain activity, it can output the brain activity index and transmit the data wirelessly to smartphones or tablets. Since it is light and easy-to-adjust to the subject's frontal lobe, the brain activity can be measured without much stress on the subject.

3.2 SD method questionnaire

To evaluate how the subjects receive each image (the conscious part), a questionnaire with 12 adjectives was prepared as illustrated in Table 1. The adjectives were selected and categorized into the following four categories: interest, uniqueness, healing, and tradition, as shown in Table 2. Seven Likert scales were used for each bipolar adjective set and a score of 1 to 7 on each scale was given.

Table 1: Questionnaire to evaluate images

Scale	Very	Quite	Slightly	Neutral	Slightly	Quite	Very	
Score	1	2	3	4	5	6	7	
Boring								Interesting
Reluctant to visit								Eager to visit
Undesirable								Preferred
Special								Everyday
Unfamiliar								Familiar
Unrealistic								Realistic
Stimulating								Peaceful
Lively								Calm
Unsafe								Safe
Sophisticated								Unsophisticated
Modern								Traditional
Ordinary								Quaint

Table 2: Categories for adjectives

Category	Bipolar adjectives	
Interest	Boring	Interesting
	Reluctant to visit	Eager to visit
	Undesirable	Preferred
Uniqueness	Special	Everyday
	Unfamiliar	Familiar
	Unrealistic	Realistic
Healing	Stimulating	Peaceful
	Lively	Calm
	Unsafe	Safe
Tradition	Sophisticated	Unsophisticated
	Modern	Traditional
	Ordinary	Quaint

3.3 Procedure

The experiment consists of two parts: an experiment using NIRS to measure the brain activity toward the image, and an experiment using a questionnaire to evaluate the image subjectively. The whole experiment procedure is as follows. First, the experiment for the brain activity was conducted using NIRS. After one or two weeks, the questionnaire was given to the same subjects showing the same photos and videos used in the experiment with NIRS. In order to avoid the effect of memorization, the subjects were asked to answer the questionnaire one or two weeks after the experiment for brain activity.

For the experiment with NIRS, first, we explained the whole procedure of the experiment and about NIRS device to the subjects. When the subject agreed to participate in the experiment, they were asked to sign a document of intent to participate in the experiment. Next, we placed the NIRS headset to the subject's forehead and adjusted it so as to measure their brain activity. After checking that the brain activity was detected and recorded correctly on the tablet that was wirelessly connected to the NIRS headset, the subject was asked to start watching ten photos and ten videos on the PC screen. Each photo or video was shown for 12 seconds. This duration time was decided by referring to the previous study [Matsumoto et al., 2012]. While the subject watched the photo or video, we marked the starting point and finishing point where the subject was looking at or watching the image. To avoid the effect of the previous image, there was a 30-second interval between each image. The flowchart of the first part of the experiment is illustrated in Figure 2.

For the experiment using a questionnaire, the same photos and videos were used to be evaluated. The subject was asked to watch the image for 12 seconds and answer the questionnaire without wearing the NIRS headset. The subject watched the image on the PC screen but answered the questionnaire on paper (Table 1). After watching each image, the subject answered the questionnaire with 12 bipolar adjectives with seven scales to evaluate the image. Then, they clicked the screen to move to the next image by themselves. The flowchart of this experiment is shown in Figure 3.

4. Results and discussion

4.1 Results of the NIRS experiment

The results of the NIRS experiment are shown in Figures 4 and 5. Figure 4 illustrates the different amount of cerebral blood flow change during the watching time (twelve seconds) and these are the average amount of all subjects for 10 images in photos and videos. The amount means the difference between the first amount at the starting point (0 second) and the amount in each 0.1 second. The amount is subtracted at each 0.1 from the amount of 0 second.

This data was taken from the right side of the prefrontal area because the right brain is usually related to feeling. This

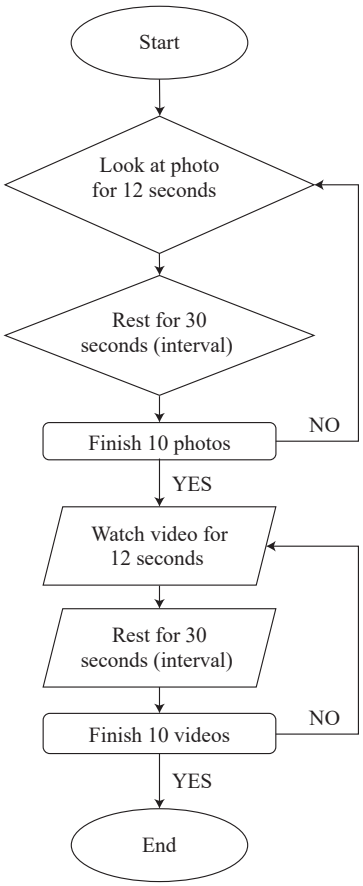

Figure 2: The flowchart of experiment using NIRS

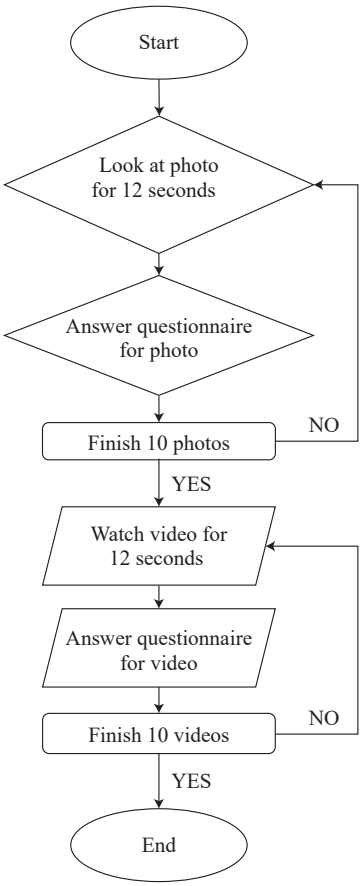

Figure 3: The flowchart of experiment using a questionnaire

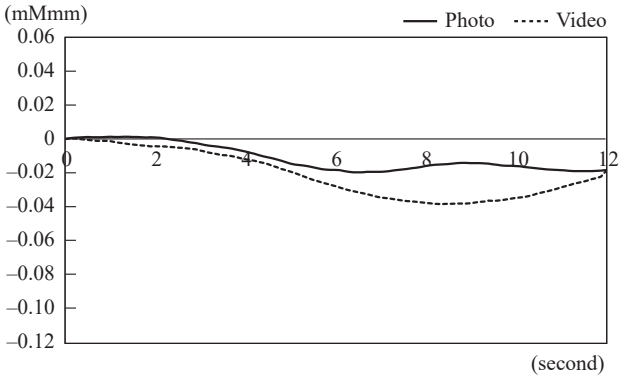

Figure 4: Average cerebral blood flow change (right side) in photo and video

measurement device can record both right and left prefrontal areas with two channels. In this experiment we dealt with only images and impressions on them. Therefore, the amount of cerebral blood flow change on right side is used to compare the difference during the watching time.

As shown in Figure 4, the amount of cerebral blood flow changes gradually lowered for both photos and videos. Moreover, the changes for photos and videos were similar. Muranaka et al. [2019] investigated the impact and feeling of listeners toward reading methods using the measurement of cerebral blood flow change and evaluation questionnaire. They showed the relationship between the lower change with relaxing feeling. Therefore, it can be said that the subjects were relaxing during watching the images. When the cerebral blood flow change in each image is observed, as shown in Figure 5, overall amounts of changes during the watching time on photos and videos were lowering except Image 3 (Daffodils). In the graph of Image 3, the amount of change for video increased around 9 seconds and over compared to the amount of the starting point.

4.2 Results of the SD method questionnaire

The results of the questionnaire using SD method are shown in Figure 6. They are illustrated with the values of twelve pairs of adjectives for photos and videos on each image. Except for Image 9 (Duck at Hiratsuka Hachimanguu shrine), the values for photos and videos are similar, which means that the impressions on each image in photo and video do not have a big difference.

In order to examine if there are any differences between the evaluation on photos and videos of each image by 12 subjects, we conducted the paired t-test with two-tailed test. The level of statistical significance was 5 %. The evaluation value of each subject used for this statistical test was calculated by taking the average of evaluation values for all twelve paired adjectives.

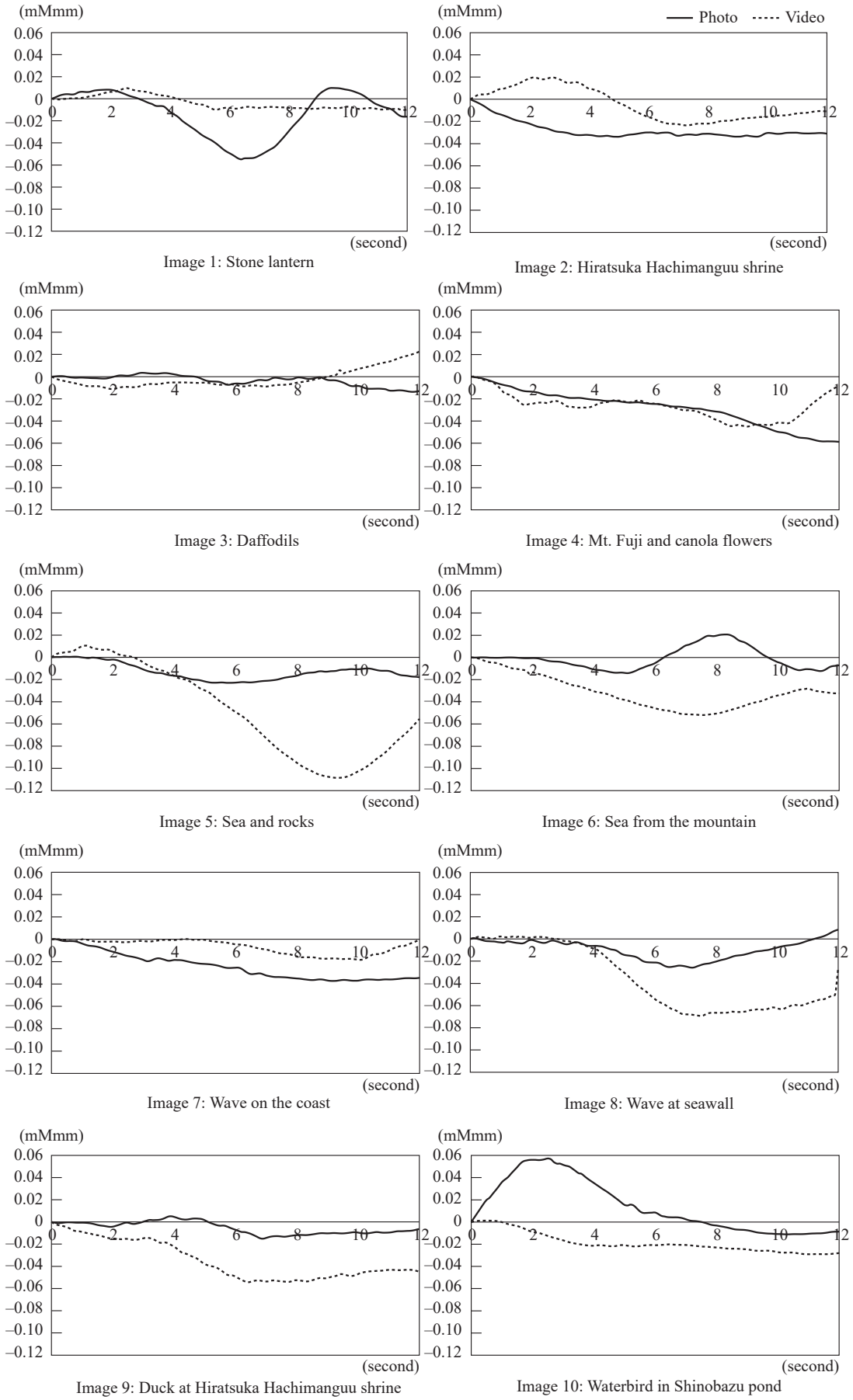

Image 1: Stone lantern

Image 2: Hiratsuka Hachimanguu shrine

Image 3: Daffodils

Image 4: Mt. Fuji and canola flowers

Image 5: Sea and rocks

Image 6: Sea from the mountain

Image 7: Wave on the coast

Image 8: Wave at seawall

Image 9: Duck at Hiratsuka Hachimanguu shrine

Image 10: Waterbird in Shinobazu pond

Figure 5: Cerebral blood flow change of each image

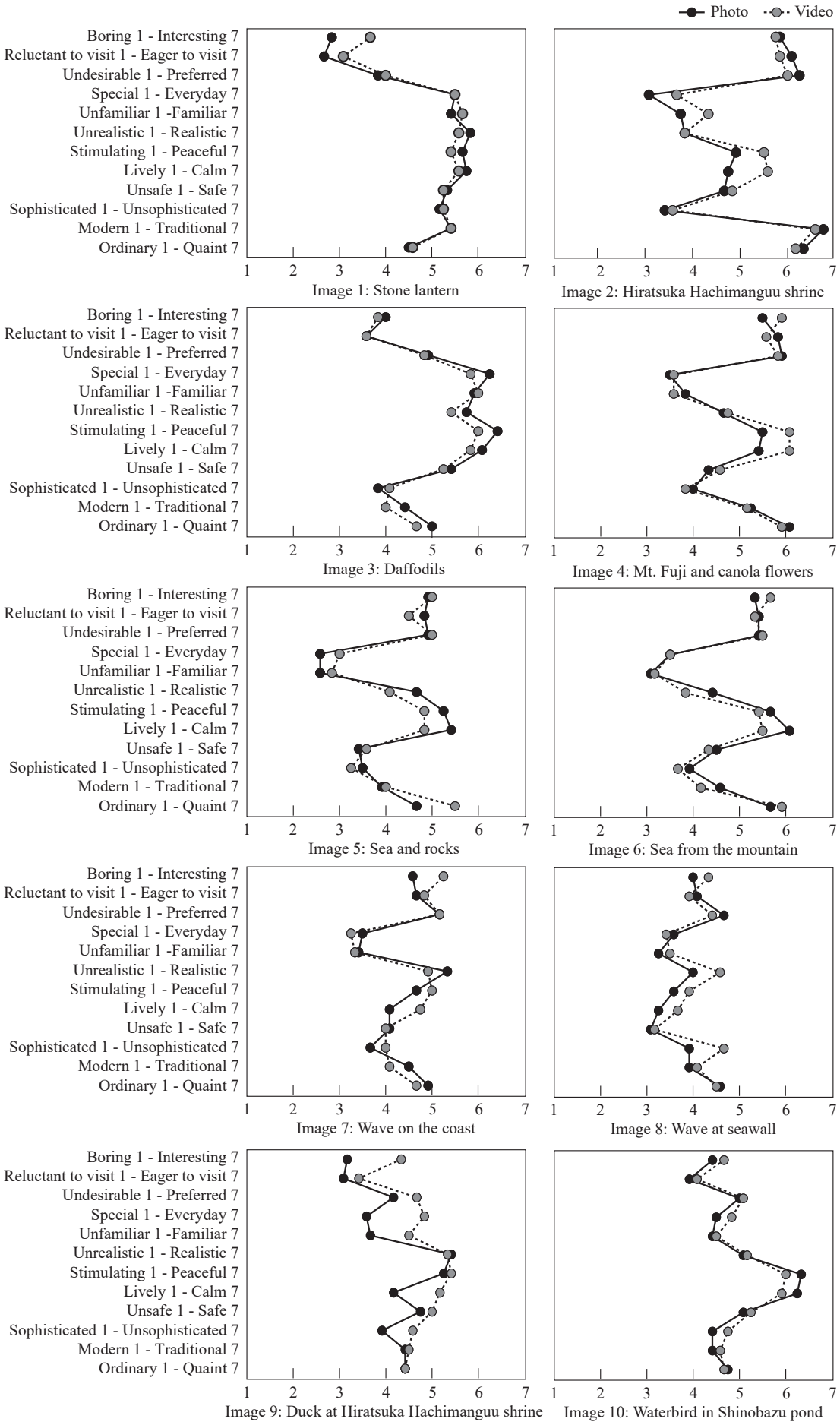

Figure 6: Impression results on each image in photo and video

As a result, only on Image 3 (Daffodils), the difference between the average evaluation value for photos and that of videos was significant (t (11) = 3.23, $p < .01$). From the results of cerebral blood flow change on Image 3, the change for videos was increased and it was different from other images as in Figure 5. We can assume that this image is very familiar with the subjects for this experiment and easier to be concentrated on. In Figure 6, the evaluation values for the adjectives, "everyday," "familiar," and "peaceful," were higher than others. Furthermore, the tone of the photo and video is relatively white, and it is different from other images. Therefore, these factors might have affected the cerebral blood flow. For other images, there were no significances on the average evaluation values for photos and videos. This means that all the images except Image 3 were evaluated similarly on both photos and videos.

In order to closely look at the difference in the impression of each image, the values for the mean and standard deviation for each image were analysed, as in Table 3. As can be seen in Image 5 (Sea and rocks) and 8 (Wave at seawall), the values of standard deviation between photo and video varied widely. Which means that each subject evaluated differently. In addition, the difference on evaluation for photo varied from that of video in Image 9 (Duck at Hiratsuka Hachimanguu shrine) as shown in Figure 6. This is because there was a relatively big difference between the mean value of photo and that of video for this image (see Table 3). However, the difference on the values of mean and standard deviation were similar for other images.

Table 3: Mean and standard deviation values for each image

Image	Mean		Standard Deviation	
	Photo	Video	Photo	Video
1	4.826	4.917	0.439	0.419
2	4.972	5.139	0.565	0.583
3	5.132	4.944	0.397	0.441
4	4.986	5.076	0.365	0.403
5	4.222	4.201	0.318	0.653
6	4.799	4.667	0.522	0.556
7	4.382	4.438	0.641	0.577
8	3.826	4.014	0.773	0.423
9	4.167	4.681	0.674	0.626
10	4.882	4.958	0.462	0.457

In Figure 5, the cerebral blood flow changes on the videos of Image 5, 8, and 9 were decreased. These changes were different from other images. The impressions on four different images of sea were different from subject to subject because of their experience or images they have of the sea. Also, the duck in the video of Image 9 included a swimming scene and fluttering scene during the watching time. However, the photo was the scene of fluttering only. Therefore, the video contained different scenes and it might have affected the evaluation of each subject. Thus, we assume that the difference on the cerebral blood flow change between photo and video can be affected by the characteristics of the image, the personal experience and interest.

Moreover, the images chosen for this study were relaxing images. This is proved by the evaluation from each subject on the SD method questionnaire. Table 4 explains the mean values of adjectives for images in photo and video. As can be seen in the table, the mean for interest category and relaxing category were high. Therefore, these images were relaxing and interesting sceneries.

5. Conclusion

In this study, we conducted a preliminary experiment to investigate the difference between photo and video as a promotion tool by using brain activity measurement and impression measurement. In the experiment, the cerebral blood flow change in the right side of the prefrontal area was gradually

Table 4: Mean values of adjectives for images in photo and video

Category	Bipolar adjectives	Mean		Category Mean	
		Photo	Video	Photo	Video
Interest	Boring 1 - Interesting 7	4.458	4.842	4.633	4.769
	Reluctant to visit 1 - Eager to visit 7	4.417	4.417		
	Undesirable 1 - Preferred 7	5.025	5.050		
Uniqueness	Special 1 - Everyday 7	3.958	4.142	4.264	4.344
	Unfamiliar 1 - Familiar 7	3.933	4.142		
	Unrealistic 1 - Realistic 7	4.900	4.750		
Healing	Stimulating 1 - Peaceful 7	5.325	5.358	4.972	5.058
	Lively 1 - Calm 7	5.125	5.292		
	Unsafe 1 - Safe 7	4.467	4.525		
Tradition	Sophisticated 1 - Unsophisticated 7	3.975	4.167	4.608	4.642
	Modern 1 - Traditional 7	4.758	4.658		
	Ordinary 1 - Quaint 7	5.092	5.100		

lowering for both photo and video. The changes were similar. As for the impression the evaluations on photo and video for each image were also similar. When there were some characteristics on brain activity and impression evaluation, some unique factors on images were seen as a reason.

In conclusion, it is possible to say that there are not so significant differences toward photos and videos in brain activities (subconscious part) and in impressions (conscious part). Furthermore, the subjects were relaxing during watching because of the reduction in cerebral blood flow changes and the result that the images were evaluated as relaxing ones. It can be said that relaxing images either in the form of photo or video can be effective to motivate prospective tourists to visit the sites. Additionally, either photos or videos can be useful as a promotion tool, but photos possibly have more advantages considering the cost performance. However, since this study was preliminary, and the subjects were only 12 Japanese university or graduate students, it is difficult to confirm the relationship between the conscious part and subconscious part.

For further research, it is necessary to conduct experiments with more subjects to verify the results from this study. Since the motivation of this study is to investigate the effective promotion tool for inbound tourism, it is important to collect many foreign subjects with different nationalities to see the differences between nationalities so as to analyze the effective promotion for each nationality.

Moreover, foreign tourists seek relaxation for travelling in Japan. Although this experiment focused on the difference between photo and video, it is also important to focus on factors of each image to investigate the elements for relaxing or interesting. It is possible to use a variety of photos and eye exposure time on each photo to see the factors for relaxing and interesting.

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(Received March 17, 2021; accepted April 30, 2021)