Preliminary Experiment on the Effect of a Magic Circle on Behavior Change

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***Abstract*—In this paper, we investigated the effect of a magic circle projected on the ground as a shikake. The experiment was conducted for nine days under three conditions; nothing projected, projecting a circular light, and projecting a magic circle. We observed the behavior of pedestrians and found that the magic circle had no effect on changing the direction of movement, but it did have an effect on path; pedestrians avoided the projected circle, though not the circular light. Using the idea of semiotics, we concluded that the behavioral changes could have been caused by pedestrians' interpretations of the message of the magic circle.**

***Index Terms*—Shikakeology, semiotics, behavior change, magic circle**

I. INTRODUCTION

Proper flows of people in public spaces that include shops and shared spaces have an impact on stores' profits and space evaluation. Reducing congestion caused by excessive stagnation, high-density walking crowds, and diverse walking patterns creates more comfortable pedestrian spaces. In addition, from the viewpoint of visitors' satisfaction, it is essential to reduce walking loads by guiding pedestrians' behavior, such as route selection, stagnation, and avoidance.

Therefore, it is important to direct the flows of people to satisfy not only service providers but also the visiting people. This is often achieved by placing physical objects that restrict the pedestrians' route selection; however, this can impair pedestrians' enjoyment of the walking spaces.

In this study, to avoid this disadvantage, we employed an approach of Shikakeology to realize voluntary behavior change without using physical objects. Shikakeology has been advocated as a method of effective behavior change to replace forced intervention [1], [2]. In Shikakeology, a trigger that provides alternative and attractive behavioral choices is called as shikake. Effective shikakes guide people to change their behaviors.

In this context, a shikake fits three component definitions we call the FAD requirements:

- Fairness: No one suffers a disadvantage.
- Attractiveness: There is attractiveness to invite actions.
- Duality of purpose: The purpose of the person installing a shikake is different from the purpose of the users.

A shikake-based approach can solve problems without forcing people's actions: they voluntarily change their behavior by choosing an attractive option. Unlike with a compulsory approach that restricts behavioral options, the shikake-based approach is indirect in that it presents options that encourage changes in behavior.

II. SHIKAKEOLOGY AND SEMIOTICS

The principle of indirect behavioral change in Shikakeology can be interpreted through the lens of semiotics [3]. Charles Sanders Peirce, a founder of semiotics, defined a sign as follows [4]:

> A sign ... is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representation.

Based on this definition, communication is regarded as a transmission of messages composed of signs. In mechanical communication, a message from a sender is transmitted to a receiver based on codes without any noise in the path. Therefore, there is no difference, excess, or deficiency between a message encoded by the sender and a message decoded by the receiver.

However, actual human communication rarely adheres to this mechanism. Fiske [5] advocates a semiotic model that focuses on an interpretation through interaction among message participants. In human communication, in addition to decoding messages based on existing codes, receivers proactively interpret a context by through hypothetical reasoning (abduction). In other words, receivers create new codes. Human communication centers not only on the senders, who make the receivers decode messages depending on codes, but also on the receivers who interpret messages depending on the context. Such human involvements creates richer communication.

This principle applies not only to communication with words but with any objects with cultural value. As with communication by words, humans can communicate by decoding and interpreting anything that seems like words. Therefore, in

addition to an approach that directs the flow of people by using words (e.g., go, stop, left), there is another approach that uses what stand-ins for words (e.g., signs, arrows, bollards, gates). The shikake-based approach falls under the latter, involving communication that relies on the context in semiotics.

Specifically, the point of a connection between semiotics and Shikakeology is hypothetical reasoning. In hypothetical reasoning, codes referenced in the process of reasoning can have a cultural value. A physical characteristic perceived in this way corresponds to an "analogue," which is one of physical triggers in Shikakeology. In addition, a psychological influence on a recipient of the interpretation by hypothetical reasoning corresponds to a psychological trigger in Shikakeology.

As an example of a shikake employing the mechanism described above, there is a shikake that uses a replica of the Mouth of Truth popularized in the movie Roman Holiday [6] (according to legend, the mouth will close on the hand of anyone who lies while reaching inside). Inside the replica mouth is a dispenser of quick-drying alcohol to sanitize hands. We installed the Mouth of Truth replica at Osaka University Hospital and found that usage rates rose from 0.6% before control to 10.3% after our intervention.

In this case, visitors to the hospital first looked at the shikake and referred to the cultural code that tells them that the device is the Mouth of Truth. They then make an interpretation using hypothetical reasoning, such as this: "If I am honest, I can stick my hand in the mouth; if I am untruthful (like the characters in Roman Holiday), my hand will get stuck." Thus, physical triggers such as the familiar visual and the analogy stimulated psychological triggers such as positive expectations and an urge to challenge the device.

III. MAGIC CIRCLE AS SHIKAKE

The purpose of this study was to verify whether pedestrians would spontaneously change their behavior by combining a semiotics framework and the shikakeological approach. For this experiment, we created a projector that shone a magic circle as a shikake, and we tried to change pedestrians' behavior by causing them to interpret the message of the magic circle projected on the ground. Focusing on route selection, avoidance, and retention as specific behavioral changes of pedestrians, we considered the following hypotheses:

Hypothesis 1:
: Projecting the magic circle will affect pedestrians' route selection.

Hypothesis 2:
: Projecting the magic circle will affect pedestrians' attention.

Hypothesis 3:
: Projecting the magic circle will affect pedestrians' avoidance.

The main reason for using the magic circle as our shikake was that this pattern is often used in media such as manga and animation, and so the context of this pattern is easily interpreted. There have been some shikake used for purposes similar to ours, such as a sticker imitating a bird dropping on the ground or a picture seemingly drawn by a small child. We thought that these approaches might cause pedestrians to feel visual discomfort, especially when the former one is used. Moreover, they raised the possibility of repulsion; pedestrians might read the senders' intentions as forcing them adopt socially normative behavior. In contrast, the magic circle has no negative connotations and so was not likely to make pedestrians uncomfortable , stimulating intense moral consciousness, or causing an unpleasant reaction (as bird droppings might). Therefore, we deemed the magic circle suitable as the shikake for this research.

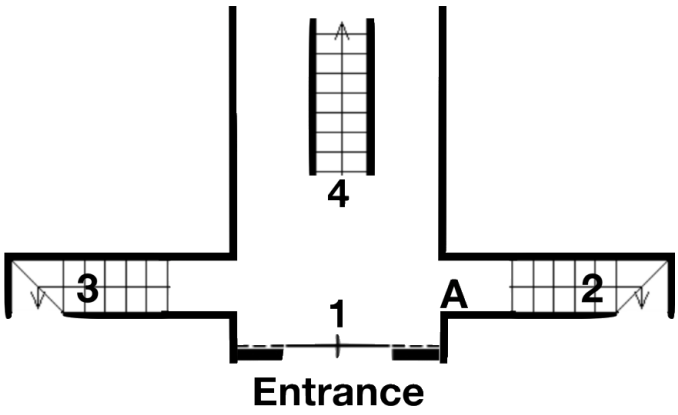

Fig. 1. Experiment place.

One reason we chose to project the magic circle rather than affix it somehow to the ground was that projection would make it easier to conduct the experiment; unlike a sticker or a magic circle drawn with art supplies such as chalk, a projected circle could be easily installed and then moved or modified if needed, and there would be no deterioration cause by passage of pedestrians. Another reason was that fantastical nature of the magic circle was more attainable through projection.

In the case of this shikake, the mechanism works in a similar manner as that described in the previous section. First, pedestrians refer to the cultural code that the shikake represents a magic circle. They then make an interpretation based on hypothetical reasoning that "something might happen if I go inside." As described above, the shikake would stimulate both physical and psychological triggers and prompt pedestrians to change their behavior.

IV. OUTLINE OF EXPERIMENT

The experiment was conducted at the entrance hallway of a lecture building at Osaka University (Fig. 1). This building is mainly used for lectures, and students can enter not only from the front entrance (**1** in Fig. 1) off the main street but also from a back door. To the right and left of the front entrance are stairs leading to the second floor (**2** and **3** in Fig. 1). There is also a route leading to the back of the building (**4** in Fig. 1), leading to the toilets, and to the stairs in the back of the building.

Fig. 2. Experimental condition: circular light of condition 2 (top) and magic circle of condition 3 (bottom).

In the experiment, we projected the light on the spot indicated by **A** in Fig. 1 and observed how pedestrians changed their behavior. The experimental conditions were as follows.

1) Nothing projected.
2) Projecting a circular light. (Fig.2 top)
3) Projecting a magic circle. (Fig.2 bottom)

We used a spotlight with a plate printed with the pattern of the magic circle to project shikake. To make it easy to observe pedestrians' behavior, the projection was performed with a slight shift away from the center of the passage.

The experiment was conducted for nine days: July 3–4, 9–11, 16–18, and 23, in consideration of differences that might arise depending on the day of the week. The experiment time was divided into two time slots: 10:10–10:40 and 12:40–13:10, before and after classes for each day. In addition, we set up the experimental conditions for each day as shown in Table I.

TABLE I
EXPERIMENTAL CONDITIONS.

	Experimental Condition
June 3	Nothing
June 4	Circular light
June 9	Circular light
June 10	Magic circle
June 11	Nothing
June 16	Nothing
June 17	Circular light
June 18	Magic circle
June 23	Magic circle

TABLE II
EXPERIMENTAL CONDITIONS.

	Progress to 2	**Progress to 3**	**Progress to 4**	**Sum**
Magic circle	110	99	526	735
Circular light	140	115	544	799
Nothing	129	125	470	724

There were two focuses of our observations: gender and behavior. For behavior, we counted the number of people who proceeded from point **1** to **2**, **1** to **3**, and **1** to **4**, respectively, to understand the flow of people. We also counted the number of people who stopped at the projected area ("Interested") and who avoided the projected area ("Avoid and pass") to understand the reactions of pedestrians.

V. RESULTS AND DISCUSSION

Table II shows the number of people who proceeded from **1** to **2**, **3**, or **4** for each experimental condition. Based on these results, we examined our three hypotheses.

First, we investigated Hypothesis 1 by conducting logistic regression analysis where we set the number of people who proceeded to **2** as an objective variable and set the presence of the circular light and the magic circle, gender, and pedestrians' crossing behavior as explanatory variables. As shown in Table III, there was no significant effect on the flow of people regardless of the presence or absence of the circular light or the magic circle. The magic circle did not affect pedestrians' route selection.

Next, we investigated Hypothesis 2. Based on the data in conditions 2 and 3, we conducted logistic regression analysis by setting the number of people who showed interest in the magic circle as objective variables and setting the presence of the magic circle, gender, and their crossing behavior as explanatory variables. As shown in Table IV, there was no significant effect on pedestrians' attention in condition 3 (magic circle) compared to condition 2 (the circular light). Projecting the magic circle did not affect pedestrians' attention.

TABLE III
LOGISTIC REGRESSION ANALYSIS: HYPOTHESIS 1.

	Coef.	Std. Err.	
circular_light	0.009	0.150	
magic_circle	-0.290	0.163	.
gender	-1.198	0.258	***
circular_light × gender	-0.174	0.366	
magic_circle × gender	0.471	0.351	

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, . $p < 0.10$

TABLE IV
LOGISTIC REGRESSION ANALYSIS: HYPOTHESIS 2.

	Coef.	Std. Err.
magic_circle	-0.573	0.616
gender	0.200	0.575
magic_circle × gender	0.921	0.854

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, . $p < 0.10$

Finally, we investigated Hypothesis 3 by applying the chi-square test to Table V. The results showed that the number of people avoiding and passing significantly increased when the magic circle was projected compared to when the circular light was projected ($\chi^2(1) = 7.1141, p < 0.01$). We concluded that this behavior change occurred because the pedestrians were considering the projection and making the semiotic interpretation that it was a magic circle. Thus, projecting the magic circle did affect pedestrians' avoidance.

One of the reasons for the above results is that the pedestrians in this place were university students; their routes were already decided by their class schedules. Projecting the circular light or magic circle was not enough to change their behavior, although it did change students' behavior to the extent that they avoided the magic circle.

VI. CONCLUSIONS

In this study, we experimented to see if projecting a magic circle would change the behavior of pedestrians. Our analysis showed that the magic circle had a weak effect—that is, it did not change the flow of people but it did make people more inclined to avoid the projected area then when they saw just the projected circular light. From this, we concluded that it might be possible to cause behavioral changes by letting pedestrians interpret the message of a shikake. However, the results of this experiment applied only for a limited setting and the attributes of the university students.

As a future work, we should consider experiments with more diverse age groups. Also, it will be necessary to consider different representations, such as adding colors or actions. It will also be important to consider this shikake from a more practical aspect by applying it to a real place without predetermined routes (e.g., paths chosen according to class schedules) to better understand the flow of people.

TABLE V
EXPERIMENTAL RESULTS: REACTIONS OF PEDESTRIANS.

	Avoid and pass	Have an interest
Magic circle	52	11
Circular light	42	13

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