The Effect of Using a Mirror to Evoke Self-Consciousness in Bicycle Riding Suppression

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***Abstract*—It is important to protect the safety and comfort of both bicycle users and pedestrians. In this study, we investigated the effect of using a signboard with a mirror, which was expected to evoke self-consciousness. We conducted field experiments at an arcade shopping street. As a result, it was suggested that the effect of using the signboard with a mirror enhanced the manner of bicycle usage in situations where the bicycle decelerated or stopped.**

***Index Terms*—bicycle usage, pedestrian, shopping street, self-consciousness, mirror, shikakeology**

I. Introduction

A. Background

In recent years, the use of bicycles with high mobility has attracted attention due to increased environmental awareness resulting from global warming and the improvement of health-consciousness. In Japan, the Bicycle Utilization Promotion Plan [1] was approved by the Cabinet in 2018 with the aim of promoting the development of a bicycle use environment.

On the other hand, in Japan, most bicycle use space is either bicycle-pedestrian roads or bicycle-accessible sidewalks, so accidents between bicycle users and pedestrians have become a serious problem. According to statistics from the National Police Agency, the number of bicycle-related accidents declined from 2007–2017, but the composition ratio of bicycle-related accidents to all traffic accidents has remained flat. Moreover, according to the transition in the number of bicycle-related accidents by the opposing party, the decrease in bicycle-to-pedestrian accidents was small, and the number of bicycle-related accidents increased in 2017, compared to the previous year [2].

Therefore, it is necessary to protect the safety and comfort of both bicycle users and pedestrians.

B. Bicycle Problems in Shopping Streets

In arcade shopping streets in Japan, the danger of minor collisions between bicycles and pedestrians has become a problem.

Regarding this problem, Yamanaka [3] investigated the effects of installing a bicycle lane in an arcade shopping street. He confirmed that the danger and discomfort of bicycles and pedestrians were greatly reduced. However, the risk of collision between bicycles increased due to the concentration of bicycle traffic, and the lane blocked shopping space and became an obstacle to free traffic. Thus, his paper clarifies the problems caused by measures to separate bicycles from pedestrians when the road width of a shopping street is narrow.

In addition, Tamura et al. [4] studied the traffic safety awareness of visitors and shopkeepers in a shopping street using questionnaire surveys and analyzed their wishes to coexist with bicycle users and pedestrians in shopping streets. The shopping streets were narrow in road width, and visitors felt dangerous to bicycle users, so both visitors and shop owners wanted to enforce thorough bicycle traffic regulations. On the other hand, it is pointed out that traffic regulations are not thoroughly enforced out of convenience for bicycle users and for store owners out of concern about a decline in sales.

Therefore, the purpose of this study is to propose an approach in which bicycle users and pedestrians are mixed, without separating them in a narrow shopping street.

II. Using a Signboard with a Mirror

A. Outline of the Signboard with a Mirror

In order to realize the coexistence of bicycle users and pedestrians in arcade shopping streets, it is desirable that bicycle users voluntarily get off their bicycles and walk them through the shopping streets. In this situation, this study proposes using a signboard with a mirror, as shown in Fig. 1, as an approach against bicycle driving in shopping streets.

B. The Mirror and Self-Consciousness

When you look at yourself in a mirror or monitor or hear your own recorded voice, you are conscious of yourself. Duval et al. [5] define objective self-awareness as being conscious of yourself in such a self-focused situation. In addition, investigating the response of a subject who has improved their self-consciousness using a mirror or TV camera from various angles was systematized as a theory of objective self-awareness [6]. According to the theory, in a state of increasing self-consciousness, you evaluate the self by comparing the real self with the ideal self, and if there is a difference between them, you attempt to match the real self with the ideal self.

Based on this theory, in the study of Scheier et al. [7], they confirmed that the presence of a mirror made males follow the norm and reduce their attacks on females. In

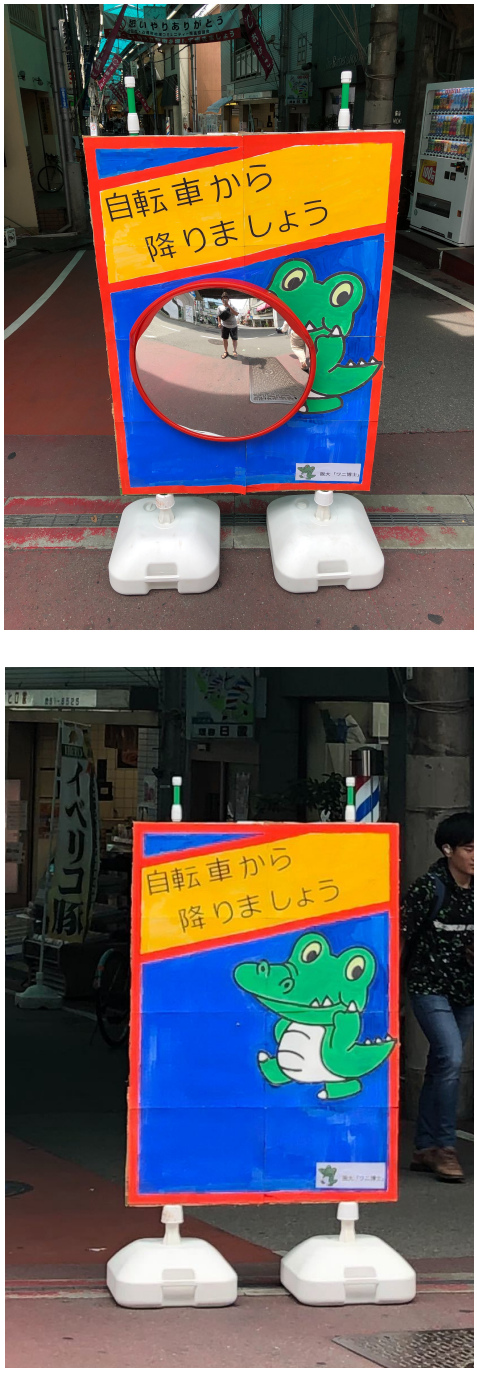

Fig. 1. Signboard with a mirror (top) and signboard only (bottom).

addition, the study of Carver [8] considered gender differences. He confirmed that the presence of a mirror made females follow the instruction and increase their attacks on males. Therefore, these studies suggest that the presence of a mirror affects human behavior, causing people to follow norms or instructions that are appropriate to the situation.

C. Behavior Change Approach of Shikakeology

Matsumura [9], [10] proposes Shikakeology as an approach that indirectly changes human consciousness and behavior to solve social or personal problems. In the context of Shikakeology, he defines a shikake to include the following three requirements (FAD requirements).

1) Fairness: A shikake will not cause anyone to suffer disadvantages.
2) Attractive: A shikake has the property of inviting action, not forcing it.
3) Duality of Purpose: The purpose of implementing a shikake (the problem you want to solve) does not match the purpose of using a shikake (the reason you want to act).

Using a signboard with a mirror promotes getting off a bicycle rather than a prohibition from riding it, so it is fair because pedestrians, bicycle users, and store owners of shopping malls do not suffer from disadvantages. In addition, the presence of a mirror is expected to affect human behavior, so it could be judged as attractive. Lastly, the purpose of the people who installed the signboard was to promote getting off and walking with the bicycles, while the purpose of the people riding the bicycles was to take actions in accordance with the norm by increasing their self-consciousness through the mirror. Thus, it also had duality of purpose. Consequently, it could be said that the signboard with a mirror is a shikake because it included the FAD requirements.

Therefore, in this study, as an approach to reducing the risk of minor collisions between bicycles and pedestrians in arcade shopping streets, we propose using a signboard with a mirror that encourages bicycle users to voluntarily get off and walk with their bicycles. Moreover, the purpose of this study is to investigate the effect of the signboard.

III. EXPERIMENT 1

A. Location of Experiment 1

Experiment 1 was conducted at the Ishibashi shopping street located in the north of Ikeda City in Osaka. This is a regional shopping street that was developed in front of Ishibashi Station on the Hankyu Takarazuka Line and comprises approximately 160 different stores. The width of the shopping street is about 3 meters, so it is not wide enough to pass through safely when crowded.

Visitors to the Ishibashi shopping street come not only for shopping purposes but also for commuting or attending school, so the density of pedestrians on the road is high, and there is a high risk of minor collisions between bicycles and pedestrians. In order to deal with this problem without regulating the entry of bicycles, on the banners and posters in the arcade, the shopping street calls for bicycle users to get off and walk with their bicycles from 7:00–21:00.

However, there are still many bicycle users entering the shopping street without getting off their bicycles, and they pass at high speeds, so there is still a high risk of minor collisions.

B. Methods of Experiment 1

On July 10, 2019 (Wednesday), Experiment 1 was carried out at the entrance of the Ishibashi shopping street as shown in Fig. 2. A signboard saying, “Let’s get off the bicycle” was

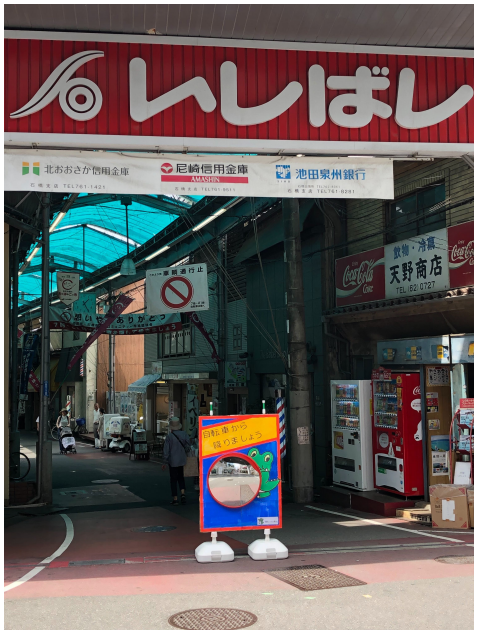

Fig. 2. Signboard with a mirror at the entrance of the Ishibashi shopping street.

TABLE I
EXPERIMENTAL CONDITIONS.

	Experimental condition
12:00–13:00	Signboard only
13:05–14:05	Signboard with a mirror
14:10–15:10	Signboard only
15:15–16:15	Signboard with a mirror
16:20–17:20	Signboard only
17:25–18:25	Signboard with a mirror

installed in the middle of the entrance. We observed bicycle users passing through the shopping street entrance.

As shown in Table I, the experimental conditions were performed alternately every hour with the "signboard only" and "signboard with a mirror."

We subjectively observed the behaviors of bicycle users using the following checklists:

- Bicycle users' attributes (male/female, teens and under/20s/30s/40s/50s/over 60)
- Bicycle users' action (whether they got off their bicycles and passed)

IV. RESULT OF EXPERIMENT 1

Table II and Table III show the results of the experiment. From this, we can see that the ratio of people who got off their bicycles and passed through the shopping street was 1.2 times higher in the "signboard with a mirror" condition than in the "signboard only" condition. However, there was no significance difference between the two conditions ($\chi^2(1) = 2.48$, n.s.).

In addition, a logistic regression analysis was performed to examine the attributes of people who got off their bicycles. The objective variable is an action dummy variable (getoff), and the explanatory variables are a shikake dummy variable (signboard with a mirror), female dummy variable (female), under 10 dummy variable (under 10), 20s dummy variable (20s), 30s dummy variable (30s), 40s dummy variable (40s), and 50s dummy variable (50s). As shown in the results in Table IV, only "under 10" and "female" were positively correlated, and "signboard with a mirror" and "over 20" had no effect on people who got off their bicycles.

TABLE II
RESULT OF EXPERIMENT 1 FOR BICYCLE USERS' ACTION.

	Don't get off	Get off	Sum
Signboard only	214	106	320
Signboard with a mirror	182	119	301
Sum	396	225	621

TABLE III
RESULT OF EXPERIMENT 1 FOR BICYCLE USERS' ATTRIBUTES.

	Age	Male	Female	Sum
Signboard only	**Under 10**	13	19	32
	20s	51	22	73
	30s	13	34	47
	40s	9	39	48
	50s	18	47	65
	Over 60	34	21	55
	Sum	138	182	320
Signboard with a mirror	**Under 10**	34	20	54
	20s	64	30	94
	30s	4	27	31
	40s	7	34	41
	50s	14	24	38
	Over 60	22	21	43
	Sum	145	156	301

V. DISCUSSION OF EXPERIMENT 1

As a result of the analysis, we could not find a significant difference in the ratio of people who got off their bicycles with the signboard with a mirror.

One reason no significant difference was found is that the bicycle users' gaze time on the mirror was short. According to the study of Aichi et al. [11], bicycle users look closely at the signboard as it got closer, so it is effective to install it in a place where the speed of the bicycle decreases in order to improve its visibility.

At the place where the experiment was carried out, the speed of bicycle users when entering the shopping street was high, and the tendency to reduce the speed of the bicycle in the shopping street was observed.

In other words, in order to enhance the effect of the signboard with a mirror—that is, in order to make bicycle users look at the mirror and increase their self-consciousness—it is thought that it is necessary to install the signboard with a mirror in a place where bicycle users slow down or stop and increase the time spent watching the mirror.

In Experiment 2, the same experiment was carried out in a place where bicycle users slow down or stop in the shopping street.

TABLE IV
RESULT OF LOGISTIC REGRESSION ANALYSIS FOR EXPERIMENT 1.

	Coef.	Std. Err.	
Signboard with a mirror	0.212	0.172	
Female	0.486	0.187	**
Under 10	0.782	0.313	*
20s	0.430	0.277	
30s	0.015	0.335	
40s	0.053	0.323	
50s	0.007	0.312	

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

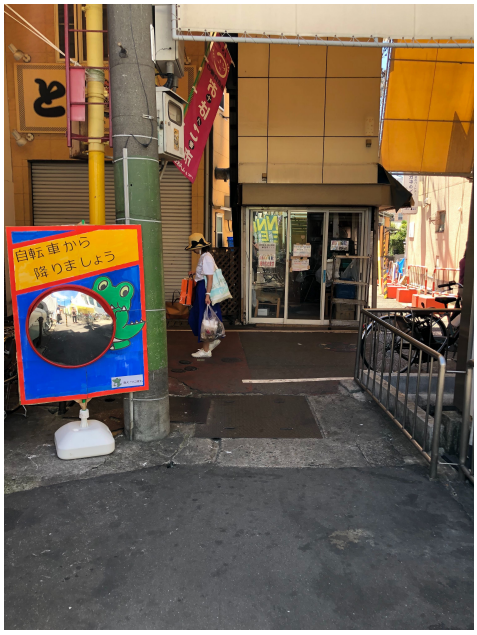

Fig. 3. Signboard with a mirror at the passage from the adjacent bicycle parking lot to the Ishibashi shopping street.

VI. EXPERIMENT 2

A. Location of Experiment 2

Experiment 2 was conducted at the Ishibashi shopping street located in the north of Ikeda City in Osaka, as in Experiment 1.

Based on the discussion of Experiment 1, it is desirable that the subjects are bicycle users who pass through the shopping street and that the location of the experiment is where they slow down or stop. In selecting the location, we considered a bicycle parking lot to be a suitable place. In the bicycle parking lot adjacent to the Ishibashi shopping street, bicycle users always pass through the passage leading to the shopping street, so they should get off and walk their bicycles. Therefore, it is reasonable to select the bicycle parking lot as the location of the experiment.

B. Methods of Experiment 2

On August 8, 2019 (Thursday), Experiment 2 was carried out at the passage from the adjacent bicycle parking lot to the Ishibashi shopping street as shown in Fig. 3.

TABLE V
RESULT OF EXPERIMENT 2 FOR BICYCLE USERS' ACTION.

	Don't get off	Get off	Sum
Signboard only	55	53	108
Signboard with a mirror	46	83	129
Sum	101	136	237

TABLE VI
RESULT OF EXPERIMENT 2 FOR BICYCLE USERS' ATTRIBUTES.

	Age	Male	Female	Sum
Signboard only	**Under 10**	7	7	14
	20s	11	3	14
	30s	7	16	23
	40s	3	16	19
	50s	4	14	18
	Over 60	9	11	20
	Sum	41	67	108
Signboard with a mirror	**Under 10**	10	11	21
	20s	11	13	24
	30s	6	18	24
	40s	1	12	13
	50s	5	11	16
	Over 60	14	17	31
	Sum	47	82	129

Using the same methods as in Experiment 1, we observed bicycle users who passed through the passage from the bicycle parking lot to the shopping street in both the "signboard only" and "signboard with a mirror" conditions.

The experimental conditions and observation items for bicycle users were the same as in Experiment 1.

VII. RESULT OF EXPERIMENT 2

Table V and Table VI show the results of the experiment. From this, we can see that the ratio of people who got off their bicycles and passed through the shopping street was 1.3 times higher in the "signboard with a mirror" condition than in the "signboard only" condition. In addition, there was a significance difference between the conditions ($\chi^2(1) = 5.00, p < 0.05$).

In addition, a logistic regression analysis was performed to examine the attributes of people who got off their bicycles. The objective and explanatory variables were the same as in Experiment 1. As shown in the results in Table VII, "signboard with a mirror" and "female" were positively correlated, and "20s" was negatively correlated. Moreover, "ages other than 20s" had no effect on people who got off their bicycles.

VIII. DISCUSSION OF EXPERIMENT 2

As a result of the analysis, we found a significant difference in the ratio of people who got off their bicycles with the signboard with a mirror.

Compared to Experiment 1, the ratio of people who got off their bicycles increased, and we found a significant difference. Therefore, in order to enhance the effect of the mirror on bicycle users, it is suggested that it must be installed in a place where the speed of the bicycle is slow. From this, as mentioned in the discussion of Experiment 1, the duration time

TABLE VII
RESULT OF LOGISTIC REGRESSION ANALYSIS FOR EXPERIMENT 2.

	Coef.	Std. Err.	
Signboard with a mirror	0.680	0.279	*
Female	0.496	0.295	.
Under 10	-0.732	0.463	
20s	-1.103	0.458	*
30s	-0.612	0.434	
40s	-0.577	0.491	
50s	-0.049	0.488	

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

to watch the signboard was long, and self-consciousness easily increased when the speed of the bicycle was slow. As a result, it seems that bicycle users attempted to match the desired self of getting off and walking with their bicycles, and the number of people who got off their bicycles increased.

IX. CONCLUSIONS

In this study, as a behavior change approach, we investigated the effect of using a signboard with a mirror on bicycle users in an arcade shopping street.

From the results of the experiments, we concluded that the signboard with the mirror proposed in this study can be effective in situations where bicycle users slow down or stop from the viewpoint of the self-consciousness evoked by the mirror and the gaze when riding the bicycle.

This signboard with the mirror is low in installation cost and requires little space, so it can be widely installed, regardless of the road width of the shopping street. However, it should be noted that the effect is enhanced only where bicycle users slow down and stop. Moreover, how much more enhanced the effect is of using the signboard with the mirror is a challenge to be tackled in the future.

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