Preliminary Comparison of a Curved Public Display vs a Flat Public Display

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Abstract. In this paper, we describe how passers-by are affected by a curved public display compared to a flat public display. Through observing social behaviors of people around a curved public display, we found that firstly more people tend to stop in front of a curved display than a flat display. Secondly, a certain number of audience members viewed the public display at the nearest distance, and audience members at closer dwelling positions to the display tended to dwell longer than those who stay farther from the display. Furthermore, our observations reveal that, for both the curved display and the flat display, more passers-by were attracted and stopped to view the display when there was already an audience standing in front of the display, which is known as the honeypot effect. However, these audience members have shorter dwelling times than those of other audience members.

Keywords: Public display · Social behavior · Field study · Non-flat display · OLED · OEL display · Curved display

1 Introduction

Public displays that show digital content using various displays are currently installed in public spaces such as airports, stations, commercial facilities, and buildings. Recently, display panels have been improved so that they can be installed in various shapes. Consequently, displays with different shapes have become available in addition to large displays. Furthermore, non-flat displays can now be used in various situations and spaces, and so the use of non-planar display panels is increasing dramatically and will continue to grow.

On the other hand, research studies on non-planar public displays have just started. In particular, very few research results on non-planar, large-size public displays are available. As use of public displays that need to be in harmony with the surroundings is becoming more and more important and is practically required, it is necessary to understand what effects and characteristics are specific to non-planar large-size public displays for better space design. Curved type displays are typically important when considering installing large-size displays in public spaces, because they are easily

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installed into or on a wall or ceiling. Therefore, we launched our study focusing on a curved public display.

This research aims to clarify the characteristics of curved displays through observation of people's social behaviors in front of displays. In this paper, we will introduce the preliminary observed social behaviors of passers-by for a giant non-planar, arch-shaped public display (hereinafter called a "curved public display") installed at a station concourse. With our observation results, we will discuss the characteristics of the curved public display and differences from a general, flat-shaped public display (hereinafter called a "flat public display").

2 Related Work

Due to the thinning of display panels and the narrowing of bezels, there are many existing research studies focusing on using and connecting multiple displays into one screen. Some studies were carried out on these types of displays, and typical research studies are introduced in [1–4]. Koppel et al. [1] introduced a constructed system called a "Chained Display", which connects flat, hexagonal or concave type displays, and found the influences on users with the different types. From these kinds of studies, it is known that the "honeypot effect" [5] of hexagonal and concave Chained Displays is lower than flat type public displays [1].

Recently, studies have been performed by creating a cylindrical public display with a non-planar display panel. According to these research studies, cylindrical public displays are more adoptable for moving audience members. Meanwhile, it is also known that fewer users stopped compared with a planar type, and their viewing time of public displays was shorter [2, 3].

Previous in-the-wild studies that evaluated behavior of people around public displays were conducted in different contexts: museums [6–11], urban public spaces [12–14], aquariums [15], public transportation [16], construction sites [17], universities [18].

However, these research studies were not carried out with large-sized displays exceeding human height, so these research results are insufficient for large-size displays that need to be designed and installed in harmony with the surroundings.

3 Research Questions

Based on a prior study [6], we established the following two research questions.

3.1 Attractiveness

How strongly does a curved public display attract passers-by? That is, how many passers-by will view the display or stop to view the display? Are there any differences in attractiveness between a curved public display and a flat display?

If there is an audience in front of a curved public display, how will it influence the attractiveness to passers-by? For example, will the honeypot effect appear? If yes, are there differences in the honeypot effect compared to a flat display?

3.2 Engagement

How much are passers-by engaged by a curved public display? To answer this research question, answers to the following questions need to be made clear. How far do most audience members view a display? How long is their dwelling time? Are there any differences in engagement between a curved public display and a flat display? Is dwelling time influenced by the dwelling position?

4 Field Observations

In this study, we carried out two observations. In one, we observed and collected data with our target curved public display installed at a terminal station concourse as shown in Fig. 1. In the other, we observed and collected data with a flat public display installed at a subway station concourse for comparison.

Fig. 1. Overview of the curved public display. This arch-shaped display has a total of 36 (6 × 6) 55-in. OLED curved display panels made by LG.

4.1 Environment

The curved public display was installed on the ground floor of a station concourse in Fukuoka city in Japan and was 4 m in height and 7 m in width, as shown in Fig. 1. About 124,000 railway passengers pass through per day, and the curved public display is visible from a wide range on the concourse.

The flat public display was installed in a subway concourse in Sapporo city in Japan and was 2 m in height and 3.2 m in width, as shown in Fig. 3. About 80,000

railway passengers pass through per day. The flat public display was also visible from a wide range on the concourse. As shown in Figs. 2 and 3, there was enough space around both displays so that audience members could stop easily in front of the displays to view them (Table 1).

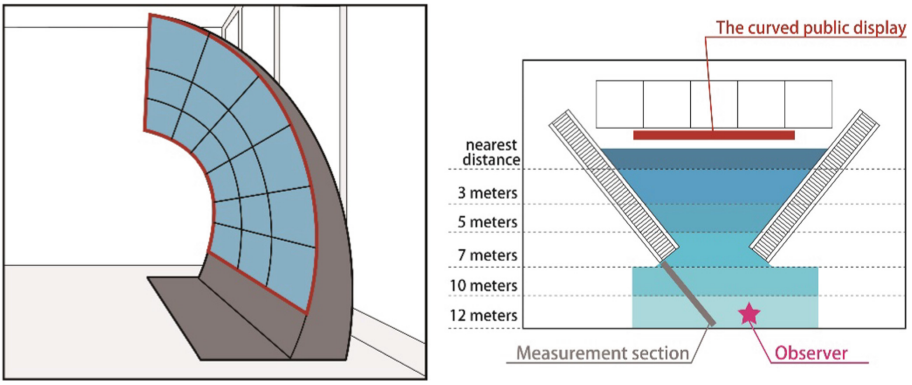

Fig. 2. Installation location of the curved public display.

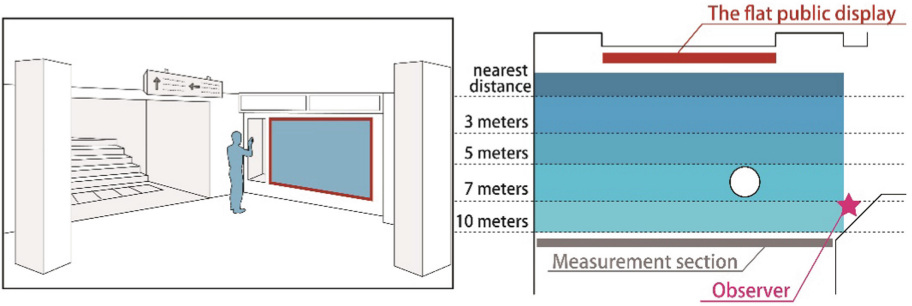

Fig. 3. Installation location of the flat public display.

Table 1. Installation locations of the curved public display and flat public display.

	Curved public display	Flat public display
Display size	7 × 4 m	3.2 × 2 m
Location	Fukuoka City, Japan Terminal Station Railway passers-by: 124,000/day	Sapporo City, Japan Subway Station Railway passers-by: 80,000/day
Display panel	LG OLED (Curved type)	Flat LED
Observation period	June 14–16, 2018 (3 days)	July 10, 2018 (1 day)
Observation time	9:30–17:00 Total: 650 min	15:00–17:00 Total: 110 min
Observed passers-by	5,492	778

4.2 Data Collection

In this study, people passing through the measurement sections shown in Figs. 2 and 3 were observed and called "passers-by". As shown in Fig. 4, we define two specific types of passers-by. One is defined as a "viewer" who walked through and looked at the display or stopped to view the display for fewer than 10 s. The other is defined as an "audience member" who stopped to view the display more than 10 s. Also, in order to observe the behaviors affected by the honeypot, we defined "prior audience" as an audience already in front of the display. In order to evaluate Attractiveness, percentages of viewers and audience members out of all people that passed by were adopted. A larger percentage indicates a more attractive display. At the same time, to evaluate Engagement, the distance (hereinafter called the "dwelling position") from the display where the audience stopped, and the time period (hereinafter called the "dwelling time") from when the audience member started to view the display to when they started to leave were adopted.

As shown in Fig. 2, the dwelling positions for the curved public display were set as follows: nearest distance, 3 m, 5 m, 7 m, 10 m, and 12 m. In Fig. 3, the dwelling positions for the flat display were set as follows: nearest distance, 3 m, 5 m, 7 m, and 10 m. One of the authors, as the observer, stood at a position about 10 to 12 m away from the public display. The observer inferred from the directions of the viewer's face, eyes, body and so on whether the screen of the public display was viewed. Simultaneously, the audience's dwelling position and dwelling time were recorded manually.

Observations were conducted in 10-min sessions. All observations of the curved public display were carried out over 3 days (June 14–16, 2018) from 9:30 to 17:00 for each day. Observations of the flat public display were carried out on 1 day (July 10, 2018) from 15:00 to 17:00. We collected the number of passers-by, viewers, and audience members and summarized these three numbers as the traffic volume. At the same time, the dwelling time and dwelling position of the audience were also recorded. For the curved public display, the first type of observation (traffic volume) was performed for 1 or 2 sessions per hour for a total of 20 observation sessions over 3 days. The second type of observation (audience behavior) was carried out for 3 or 4 sessions

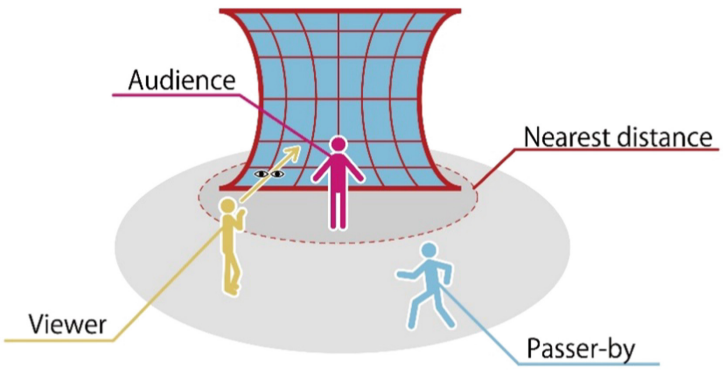

Fig. 4. Definitions of passer-by, viewer, and audience in our study.

Table 2. Definitions.

Passer-by	Person who passed through the "Measurement section" close to the display
Viewer	A passer-by who watched the display while working or stopped to view the display for less than 10 s
Audience	A passer-by who stopped to view the display for longer than 10 s
Prior audience	A person who was viewing a display earlier in front of the display
Dwelling time	Time from when the person stopped to watch until the person started to leave
Dwelling position	Position while viewing the display. Set at nearest distance, 3 m, 5 m, 7 m, 10 m, and 12 m from the display

per hour for a total of 45 sessions. For the flat public display, similar observations were carried out in one day. Observations for traffic volume were held for 1 session per hour, for a total of 2 sessions. Observations for audience behavior were carried out for 3 or 4 sessions per hour, for a total of 9 sessions. For the curved public display, we collected the number of audience members and their dwelling positions and dwelling time under two situations, one with a prior audience and one without a prior audience (Table 2).

5 Results and Discussion

5.1 Attractiveness

Figure 5 illustrates the percentages of audience members out of passers-by for the curved public displays and flat public displays. It's clear that 842 viewers out of 5,208 passers-by (16.1%) viewed the curved public display as viewers, and 140 people (2.6%) were recognized as audience members. Regarding the flat public display, of the 756 people who passed by, 113 people (14.9%) viewed the display as viewers, and 8 people (1.0%) were audience members. The ratio of audience members is slightly higher for the curved public display than for the flat public display. Also, more passers-by tend to stop. In other words, more viewers were observed in the case of the curved public display.

Figure 6 shows the number of audience members in two situations: with or without prior audience members. For the curved display, the average number of passers-by per session of the curved public display was 260.2 people. The average number of audience members was 5.8 people (2.2%) without prior audience members and 7.5 people (2.8%) with prior audience members. For the flat public display, the number of passers-by per session was 378.0 people. The average number of audience members was 1.3 people (0.4%) without prior audience members and 4.3 people (1.1%) with prior audience members.

Furthermore, Fig. 7 illustrates the ratio of audience members at different dwelling times for both the curved display and the flat display. For the curved display, without a prior audience, 23.8% of audience members had a dwelling time longer than 120 s. However, with a prior audience, only 8.4% of audience members had a dwelling time

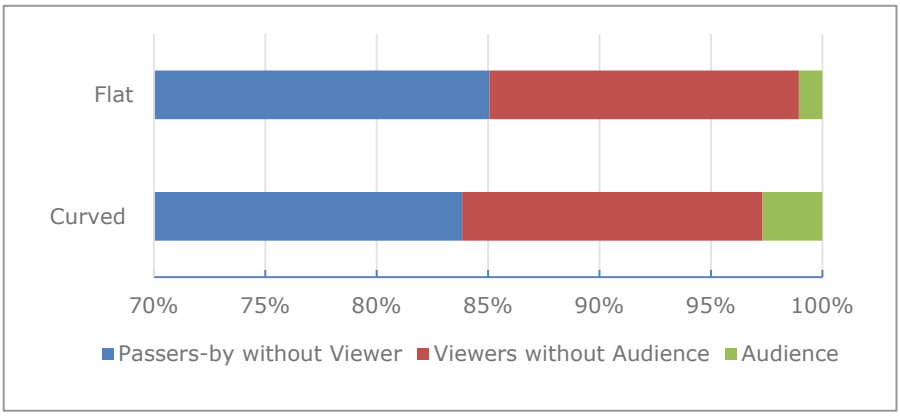

Fig. 5. Percentages of viewers and audience members of passers-by.

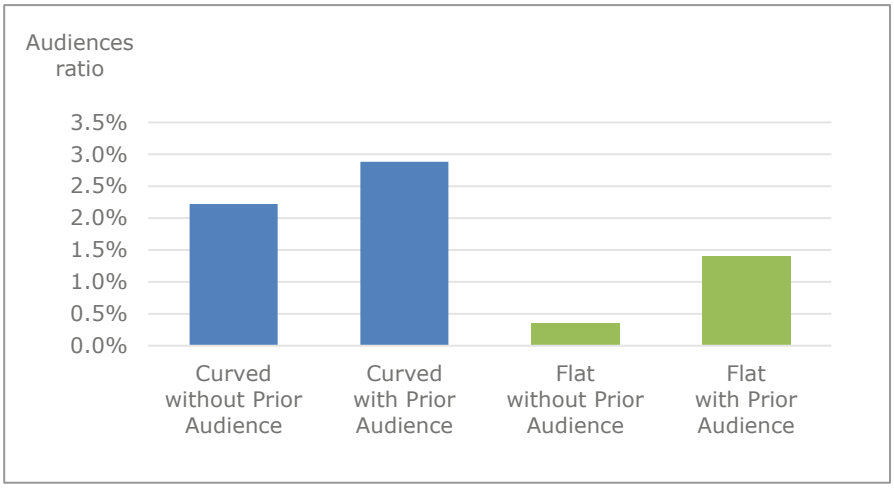

Fig. 6. Percentages of audience members under two situations: with and without a prior audience.

longer than 120 s. For the flat display, without a prior audience, 30.8% of audience members had a dwelling time longer than 120 s. However, with a prior audience, 11.1% of audience members had a dwelling time longer than 120 s. Thus, it's clear that for both displays, the number of audience members with long dwelling times was lower with a prior audience.

Regarding Attractiveness, Figs. 5 and 6 suggest that more passers-by tended to stop in front of the curved public display than the flat public display. At the same time, it's clear that for both displays, the proportion of audience members is higher when there is a prior audience, which proves very well the honeypot effect.

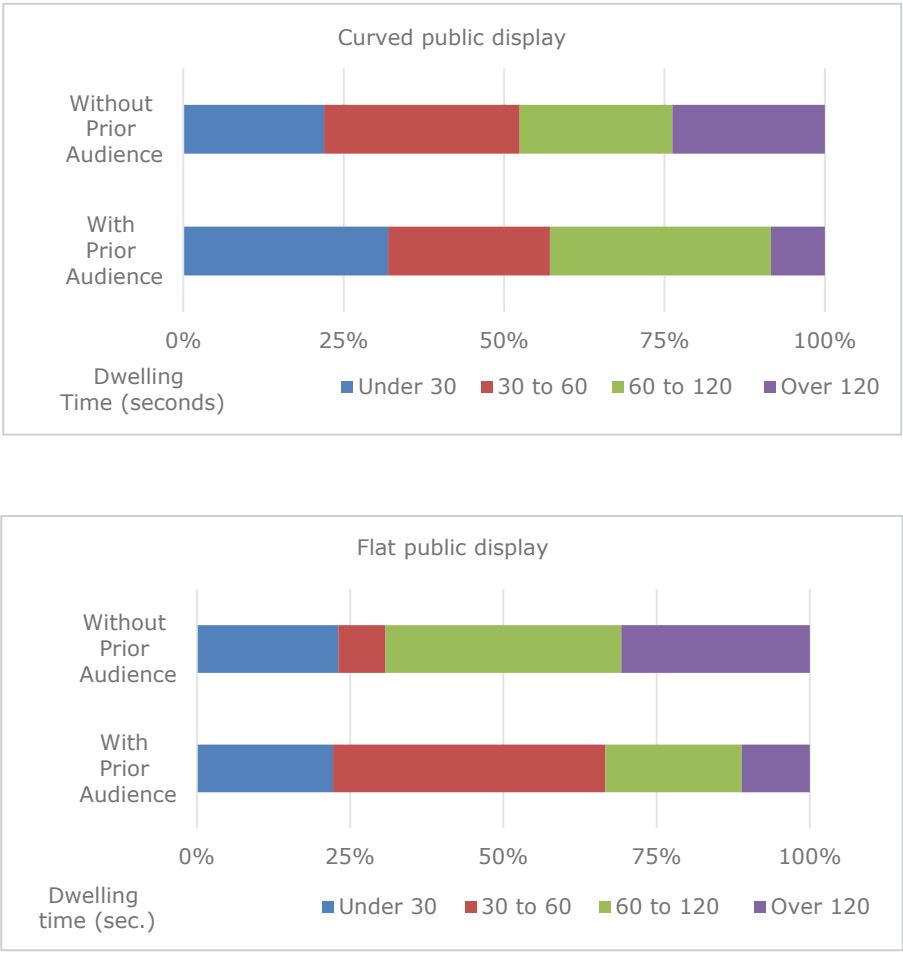

Fig. 7. Differences in dwelling time with and without a prior audience

Figure 7 indicates that there was no difference between the curved public display and flat public display under both situations with and without a prior audience. However, for both displays, audience members dwelled for a shorter time, and the number of audience members who viewed for a long time was lower with a prior audience. Traditional research studies on the honeypot effect often discuss the effect of attracting passers-by. However, our results indicate that audience members attracted by the honeypot effect tended to have shorter dwelling times than other people. This is one of our most important findings and is valuable information regarding general public displays.

5.2 Engagement

Figure 8 shows the audience dwelling positions of the curved public display and the flat public display. For the curved public display, the dwelling position for most audience members (40.5%) was at 7 m. Of all audience members, 43.8% viewed from inside 5 m, 18.0% viewed from inside 3 m, and a few people (6.3%) viewed the display at the nearest distance. For the flat public display, the dwelling position for most audience members (50.0%) was at 5 m. Of all audience members, 68.0% viewed from inside 5 m, 18.2% viewed from inside 3 m, and nobody viewed the display at the nearest distance.

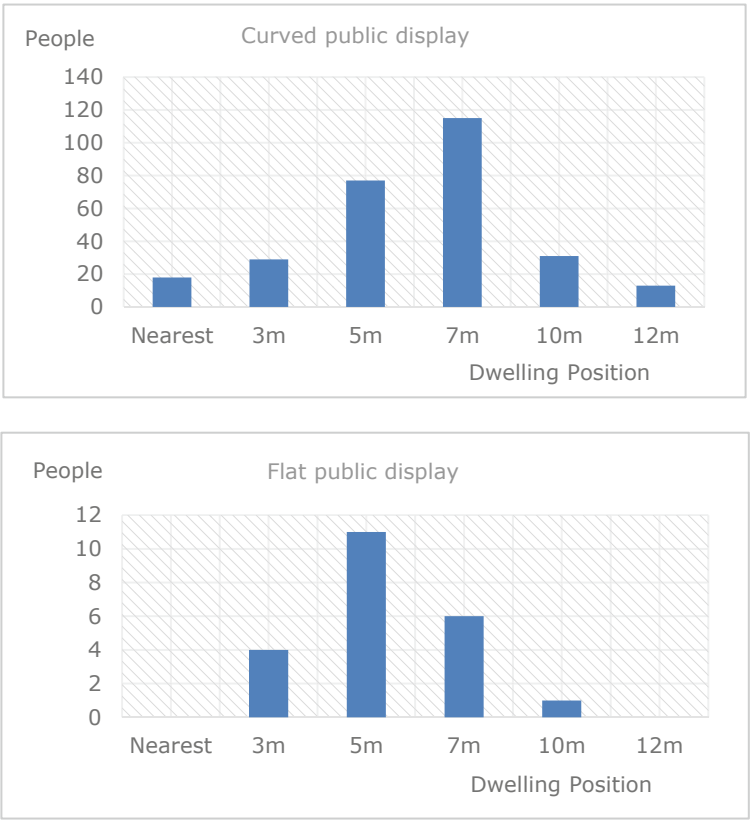

Fig. 8. Dwelling position for curved and flat displays

Comparing the data for the curved public display and flat display, we can see that despite the large size of the curved public display, many people viewed it from within 3 m. This phenomenon did not appear for the flat public display, even though it is smaller. Therefore, it can be said that people prefer to view a curved public display over a flat public display at a close dwelling position, which in this case was less than 3 m.

Figure 9 shows the relationships between audience's dwelling position and dwelling time. For the curved public display, when the dwelling position was closer than 7 m, the dwelling time increases the closer people stand. The results were similar for the flat public display.

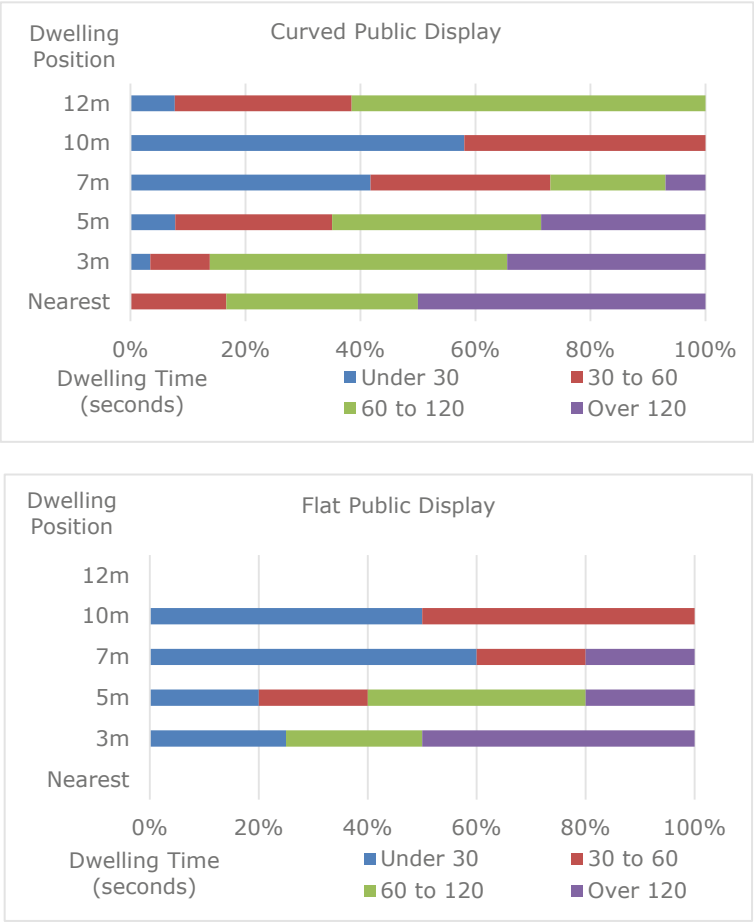

Fig. 9. Relationships between audience dwelling position and dwelling time.

With these results, we can say firstly more audience members viewed the curved public display and had a longer dwelling time. Secondly, audience members tended to view the curved public display at a close dwelling position.

5.3 Discussion

One of the known problems of large-size displays is how to attract people to come and stop right in front of the display in order to make a display interactive. Our field studies

indicate that people moved much closer to the curved display than the flat display. Also, the honeypot effect occurred with the curved display to the same extent as the flat display. These findings will be further studied for large-size and interactive displays.

6 Conclusion

In this study, we found that the curved public display tended to be more attractive to people than the flat public display. Also, people prefer to view a curved display at a close dwelling position. Closer dwelling positions have longer dwelling times. Regarding the honeypot effect, our collected data not only proves its known attraction effect, but also shows that attracted audience members tend to have shorter dwelling times compared to normal audience members. We will investigate these new characteristics of this honeypot effect in the future. In addition, further research will be carried out to improve the attractiveness and engagement of interactive curved and flat public displays.

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