A Study on the Impact of Ubiquitous Street Furniture on Human Behavior
- Based on Media Poles Installed on Seoul's Gangnam Boulevard

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Abstract
This study aims at investigating the impact on human behavior, of ubiquitous street furniture as represented by the media poles along Gangnam Boulevard. It attempted to predict the impact of media poles on human behavior by examining what constitutes the characteristics and functions of "ubiquitous" street furniture; by observing human street behavior; and by analyzing the installation process and functions of the media pole. In order to verify the predictions made, observational investigation and inquiry surveys were carried out targeting pedestrians on Gangnam Boulevard. According to the survey results, the demand for ubiquitous street furniture like these media poles was on the rise and among their many functions; their visual aspect had the most distinctive impact on human behavior. However, use of the media poles is on the decline, requiring their content to be upgraded, which will contribute to the development of a culture of communication.

Keywords: ubiquitous; street furniture; human behavior; street; media pole

1. Introduction
1.1 Background and Objectives of the Study
It is generally acknowledged that the surrounding environment greatly impacts the behavior of the humans who inhabit it, and that spatial planning that takes human behavior into account contributes to building better lives.

Since the street is an important venue in everyday life, human behavior should be taken into consideration in planning the elements of the street environment.

Ubiquitous street furniture1 has recently appeared to meet the demand and needs of a ubiquitous society. Since ubiquitous street furniture also serves as a street element, it is expected to impact human behavior.

To date, the bulk of research has been concentrated on the technologies and service content required to make street furniture ubiquitous, but only limited architectural research has investigated the manner in which ubiquitous street furniture influences human behavior.

This study attempts to examine the requirements under which ubiquitous street furniture such as media poles may take root as an innovative type of street furniture, by analyzing and assessing the impacts of media poles on people's walking, visual perception, and resting behaviors.

1.2 Scope and Methods of the Study
The scope and methods used in this study to investigate the impact of ubiquitous street furniture on human behavior are as follows:

Firstly, ubiquitous street furniture was defined by examining what constitutes ubiquitous street furniture and how it came to be introduced; by identifying its expected roles; by examining basic patterns of human street behavior and the relationship between the significance of street furniture and human behavior.

Secondly, the impact on people by media poles as street furniture was explored by examining both the background of their installation and their functions.

Thirdly, observational investigation and surveys were performed targeting users of the media poles on Gangnam Boulevard, in order to identify the characteristics of human behavior in response to ubiquitous street furniture.

Surveys were administered in this study in order to allow an analysis of how ubiquitous street furniture affects human behavior, but due to constraints in the execution of the survey, the quantity of the samples was limited. As a means to improve its reliability, the survey was conducted as person-to-person interviews combined with a self-administered questionnaire, thereby reducing statistical errors, and observational surveys were also introduced to add reliability to the results of the survey analysis.
2. Theoretical Review

2.1 Ubiquitous Street Furniture

The word ubiquitous is an English adjective, originating from the Latin ubiques, meaning "to be everywhere at the same time." As used today in such terms as "ubiquitous space," "ubiquitous city," or "ubiquitous society," ubiquitous is an abbreviation of the phrase "ubiquitous computing" proposed by Mark Weiser in order to describe an environment where computers are accessible everywhere and at all times. Devices such as sensors, processors, network devices, and displays are required for the realization of such an environment. (Oh, et al., 2009)

Street furniture is one of various tangible elements that comprise the street (see Table 2). Halprin (1975) states that "In the urban spaces between buildings is the paraphernalia of urban living—the furniture which makes these spaces inhabitable. They are the small scaled elements which we constantly use and see; they set the dominant quality of streets and plazas···," suggesting a close relationship between street furniture and people. His observation can be interpreted as emphasizing the necessity of planning in order to reflect human activities and behavior in the street. (Song, 2006)

As seen above, ubiquitous street furniture can be defined as street furniture that is equipped with functional devices such as sensors, processors, network devices, and displays in order to facilitate access to a computing environment on the street.

This type of ubiquitous street furniture may exist in the street in various forms. Therefore, it can be expected that the street, extending beyond its conventional role, will in the future serve as a venue for people to exchange information, meet, and share their cultures. (Lee, et al., 2009)

In addition, streets with ubiquitous street furniture are likely to contribute significantly to creating the image of a city equipped with cutting-edge technology, as indicated in Jane Jacobs' remark (1992), "Think of a city and what comes to mind? Its streets ···if they look dull, the city looks dull." (Jeon, et al., 2007)

2.2 Human Behavior in the Street

Human behavior can be defined as the universal and habitual responses of humans in a given setting; it is displayed not through an unanimated, static scene, but in a dynamic manner. (Jung, et al., 2004) Following the remark of Wolfgang Preiser (1972) that most people tend to choose a certain route by selecting a road where they can avoid obstacles and find the fastest shortcut, it can be assumed that people behave similarly in similar settings. (Jung, 2009)

Jan Gehl (1987) classifies human behavior through activities performed in outdoor spaces. According to him, human behavior in an outdoor space can be divided into three categories: "mandatory activities" that must be performed, "selective activities" that people undertake at will and as time and space allow, and "social activities" that encompass all activities occurring in the public space, all of which require distinct physical settings. (Jung, et al., 2009)

Meanwhile, Jung (2009) classifies typical human behavior as shown universally and habitually by people on the street into three categories: walking, visual perception, and resting behaviors. These patterns of behavior can occur simultaneously, successively, and in combination. For example, at times people may observe something while walking somewhere (walking + visual perception behavior) or stand in one place while looking at something (resting + visual perception behavior). Walking and resting behaviors are incompatible, while visual perception is compatible with both walking and resting behavior. Therefore it can be assumed that if certain elements influence human visual perception in the street, then they also have the same impact on walking and resting behaviors.

Table 1. Basic Elements of a Ubiquitous Device

| Classification | Roles                                                                 |
|----------------|----------------------------------------------------------------------|
| Sensor         | Senses the physical properties of the outside environment and converts them into information that can be processed by observers or other devices |
| Processor      | Analyses and assesses information similarly to the human brain       |
| Network device | Connects a number of entities and enables them to communicate with one another |
| Display        | Displays a variety of information on a screen                         |

Table 2. Elements of the Street

| Tangible elements | Primary | Vertical | Buildings on streets |
|-------------------|---------|----------|---------------------|
|                   |         | Floor    | Road (floors), etc. |
|                   |         | Ceiling  | Skyline, etc.       |
| Secondary Street furniture | Benches, mailboxes, garbage bins, public phone booths, street signs, drinking fountains, street lights, etc. |

| Intangible elements | Natural | Long-term | Light, growth of animals and plants, changes of seasons, etc. |
| Human             | Short-term | Rain, snow, dew, wind, etc. |
| Behavioral         | Administration, economy, history, culture, etc. |

Table 3. Types of Human Behavior in an Outdoor Space

| Activity Type       | Definition                                                                 | Examples of Activity                                                                 | Impact of the outside environment                                      |
|---------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Mandatory activities| Activities that must be performed                                           | Going to work or school, waiting for someone or a bus, sitting down due to tiredness  | Not significantly impacted by the outside environment                  |
| Selective activities| Activities that people undertake at will and as time and space allow       | Wandering the streets, sitting down for a moment to enjoy the scenery, standing and watching the streets | Sensitive to the outside environment                                  |
| Social activities   | All activities that people undertake because they are in a public space     | Playing, saying hello or engaging in conversation, participating in a group activity or parade | More active in a conducive environment than in a poor one              |

(Source: Song, 2006)
Based on Gehl's (1987) and Jung's (2009) categorizations of human behavior observed in the street, human behavior can be further classified into nine groups: mandatory walking/visual perception/resting behavior, selective walking/visual perception/resting behavior, and social walking/visual perception/resting behavior (See Table 5.).

Table 5. Categories of Human Behavior in the Street

| Classification of Walking Space | Characteristics of basic human behavior | Characteristics of fundamental actions performed based on basic behavior |
|---------------------------------|----------------------------------------|---------------------------------------------------------------------|
| Dynamic Space                   | Walking behavior (going)                | Walking / Running  
|                                 |                                        | Walking while carrying something  
|                                 |                                        | Walking while dragging something  
|                                 |                                        | Walking while eating something  
|                                 |                                        | Walking while talking  
|                                 |                                        | Walking while talking over the phone  
|                                 |                                        | Walking up / Walking down  
|                                 |                                        | Entering / Exiting  
| Visual Space                    | Visual perception behavior (seeing)     | Seeing / Looking / Staring  
|                                 |                                        | Seeing while carrying something  
|                                 |                                        | Seeing while dragging something  
|                                 |                                        | Seeing while eating something  
|                                 |                                        | Seeing while talking  
|                                 |                                        | Seeing while talking on the phone  
|                                 |                                        | Glancing around / Looking around  
| Static Space                    | Resting behavior (standing)             | Standing / Stopping / Sitting  
|                                 |                                        | Standing while carrying something  
|                                 |                                        | Standing while eating something  
|                                 |                                        | Stopping walking while talking  
|                                 |                                        | Stopping walking while talking on the phone  
|                                 |                                        | Staying / Waiting  
|                                 |                                        | Walking up and down / Hesitating  

(Source: Jung, 2009)

The media poles studied in this paper are 12.4 meter high pillar-shaped street furniture. Twenty two are positioned at regular intervals throughout the area of the U-Street Construction Project. The Gangnam-gu Office describes the media poles as not simply street decoration, but as public media artworks that incorporate cutting-edge technology into various pieces of equipment. The composition of the media poles and the content they offer.

The upper portion of a media pole consists of a surveillance video camera, streetlamp, and wireless Internet router. The surveillance video camera and streetlamp contribute to ensure pedestrian safety, while the wireless Internet equipment provides public Internet access. People can connect to the Internet via their own devices anywhere within 50 meters of a media pole. Since media poles are erected in rows, Internet service is fundamentally available along the entire U-Street area.

The lower portion of the pole is equipped with a touch screen on the sidewalk side, allowing users to search local, social, economic, and cultural information as well as enjoy casual games and email photos.

The middle portion between the upper and lower sections is equipped with an LED display on both the
roadway and sidewalk sides, broadcasting media art and public advertisements (See Table 6).

To sum up, the media pole can be described as a street installation employing ubiquitous Internet access technology. Among its various functions, it is equipped with a touch screen that senses contact and offers information upon request, as well as a wireless Internet router that creates a Wi-Fi bubble in the vicinity.

3.2 Predictions on the Effects of the Media Pole on Human Behavior

The media poles have the appearance of giant black square monoliths that stretch in rows at regular intervals between roadways and sidewalks, each providing dynamic visual images and information. This is a relatively unfamiliar urban scene that can create a strong visual impact. Indeed, street facilities offering visual information are not something new, but the media poles are distinct in that they present repeated images across a broad area.

Table 6. Composition and Content of a Media Pole

| Composition | Upper | Middle | Lower |
|-------------|-------|--------|-------|
|             | • Surveillance video camera | • Two LED displays (on the roadway/ sidewalk sides) | • Touch screen |
|             | • Streetlamp |             |       |
|             | • Wi-Fi network router |             |       |
| Size        | • 12,380 × 1,433 × 650mm (H×W×D) |             |       |
| Content provided | • Media art | • News | • Assorted information etc. |
|             | • Photo emailing and casual games | | |
|             | • Entertainment | | |

(Source: Gangnam-gu Office)

It can be surmised that the visual image generated by the media poles will have both a direct and an indirect influence on walking and resting behaviors. This can be verified if people are found to slow their pace or pause to rest in front of the media poles.

In addition, according to materials distributed by the Gangnam-gu Office, one expectation for the media poles was the establishment of a "culture of communication." However, the media poles must be utilized by pedestrians before such a culture of communication can be created. Examining the extent to which the functions are being used will therefore show the impact of the media poles on human behavior.

4. Survey Results on the Influence of Ubiquitous Street Furniture on Human Behavior

Two research methods can be employed to serve the purposes of this study: observational investigation and inquiry survey. Observation enables researchers to capture a glimpse of the subjects' unconscious behavior and conduct, but it requires drawing speculative conclusions from the results. Inquiry surveys may generate objective data, but include the possibility of respondents deliberately providing inaccurate information.

This research employed both observation and inquiry, mutually complementing the limitations of each for a more objective analysis.

4.1 Overview and Results of Observational Investigation

Observational investigation was conducted twice in order to determine what impact the media poles had on walking and resting behaviors and whether citizens experience the so-called "culture of communication" by using them. The first investigation was performed on a weekday in June 2011, first from 10 to 11 a.m. and then from 2 to 3 p.m., by repeatedly traversing the area where 22 media poles have been installed. Accompanied by video recording, the second investigation was repeated twice on a weekday in February 2012, from 10 to 11 a.m. and 2 to 3 p.m., in two locations found during the first investigation to attract relatively more media pole users than other sites.

The observation of the entire area where the media poles were positioned revealed that the visual elements of the media poles affect pedestrians' walking and resting behaviors to a certain degree. The size and location of the media poles was appropriate for the creation of a visual impact upon pedestrians. To view the video image provided by the displays, which were installed parallel to the sidewalks, one had to purposely turn the eyes or interrupt walking to look at it, and many people were observed exhibiting such behavior. In addition, it was noted that most people showing resting behaviors, such as waiting for someone or for a bus, were clustered around media poles rather than other locations. This indicates that media poles...
influence the walking and resting behaviors of people to a certain degree.

Even though media poles were found to affect walking and resting behaviors, use of the touch screens was found to be infrequent: touch screens could have been used for games or searching for local information, but people were seen to be simply observing from a distance without using them.

4.2 Questionnaire Items and Results of the Survey

Two inquiry surveys were administered, in accompaniment with the observational investigations. The first survey was conducted as a three-day pilot survey on two weekdays and one weekend day between June 9 (Thursday) and June 11 (Saturday), 2011, by means of person-to-person interviews with subjects of diverse age groups within the area between the Gangnam Station and Kyobo Tower intersections. The complete survey was carried out over five days between January 31 (Tuesday) and February 4 (Saturday), 2012. During the complete survey, conducted after analyzing and modifying 60 questionnaires collected during the pilot survey, 100 valid questionnaires were gathered.

The questionnaire was composed of three groups of questions: general information, level of awareness and use, and roles of media poles on the street. The questions are listed in Table 8.

(1) Respondent Profile

Respondents interviewed in the survey showed a relatively even gender distribution (64 male and 54 female respondents) but the percentage of respondents was highest in the youth group, as 90 percent are in their 20s. The occupation breakdown shows 70 students, 17 office workers, three salespersons, and ten respondents from other professions. Sixty seven replied that they visited the area where the media poles are installed for recreational purposes, while ten reported for the purpose of study.

Table 8. Questionnaire

| A. General information |    |
|------------------------|----|
| Gender/Age/Occupation/Residence |    |
| Purpose of visit/Frequency of visit/Time of the first visit to Gangnam Boulevard |    |
| Use of smartphone |    |

B. Level of Awareness and Use of Media Poles

| Are you aware of the media poles? | Yes: 73 | No: 27 | Total: 100 |
|----------------------------------|--------|--------|------------|
| Do you know what services the media poles provide? |        |        |            |
| Have you ever used one of the media poles? |        |        |            |
| When was the last time you used a media pole and which service did you use? |        |        |            |

C. Evaluation of Media Poles in the Street Space

| Do you think devices like media poles are necessary for the streets? |        |        |            |
| Do you think the number of the media poles is appropriate? |        |        |            |
| Do you think the installed locations of the media poles are appropriate? |        |        |            |
| Do you think the size of the media poles is appropriate? |        |        |            |
| Do you think the color of the media poles is appropriate? |        |        |            |
| Do you think the media poles are easy to use? |        |        |            |
| Do you think the services provided by the media poles are useful? |        |        |            |
| Do you think the media poles enhance the streetscape? |        |        |            |
| Do you think the media poles have improved the pedestrian environment? |        |        |            |
| Do you think the media poles relieve boredom in the streets? |        |        |            |
| Do you think the media poles are an iconic construction along Gangnam Boulevard? |        |        |            |

Fig. 8. Respondent Profile

 Asked when they had visited the area, 65 respondents had visited prior to the media poles being installed in 2009, while 34 people had visited after 2009. In terms of frequency, 33 out of the 100 respondents visited the area three to four times per month, while 30 men and women reported less than a single visit per month. Twenty one respondents said they visited one to two times per week, while those who visited every day totaled 15. Ninety six percent of all respondents turned
Table 10. Evaluation of Media Poles

| Questionnaire | N | Min | Max | Mean | SD |
|---------------|---|-----|-----|------|----|
| Do you think devices like media poles are necessary for the streets? | 71 | 1   | 5   | 3.51 | .993 |
| Do you think the number of the media poles is appropriate? | 71 | 1   | 5   | 3.08 | .999 |
| Do you think the installed locations of the media poles are appropriate? | 71 | 1   | 5   | 3.52 | .826 |
| Do you think the size of the media poles is appropriate? | 71 | 1   | 5   | 3.25 | 1.038 |
| Do you think the color of the media poles is appropriate? | 71 | 1   | 5   | 3.34 | .990 |
| Do you think the media poles are easy to use? | 71 | 1   | 5   | 3.44 | .937 |
| Do you think the services provided by the media poles are useful? | 71 | 1   | 5   | 3.49 | 1.054 |
| Do you think the media poles enhance the streetscape? | 71 | 1   | 5   | 3.46 | 1.053 |
| Do you think the media poles have improved the pedestrian environment? | 70 | 1   | 5   | 2.64 | .993 |
| Do you think the media poles relieve boredom in the streets? | 71 | 1   | 5   | 3.08 | 1.025 |
| Do you think the media poles are an iconic construction along Gangnam Boulevard? | 71 | 1   | 5   | 2.89 | 1.178 |
| Overall average score | | | | 3.33 | - |

out to own a smartphone. (See Fig.8.)

(2) Level of Awareness and Use of Media Poles

Table 9. shows that 73 of the respondents were aware of the media poles, while 27 claimed to be unfamiliar with such street facilities. Considering that it had been almost three years since the installation of the media poles and that the area boasts a large floating population, 27 respondents who reported being unaware of media poles cannot be considered a small proportion.

Among the various services offered by the media poles, respondents were most familiar with digital galleries and advertisements, followed by photo e-mailing, map searching, games, Wi-Fi, streetlamps, and the surveillance camera.

Among the 73 respondents who knew of the media poles, 57 reported having used one, while 15 had never used any of the functions provided by the media poles. Most turned out to be single-time users who had only accessed its functions several months ago. Seemingly, the frequency of media pole use is on the decline, as indicated in the survey results.

(3) Evaluation of Media Poles in the Street Space

A survey for an evaluation of the media poles in the street space was conducted targeting those 73 respondents who reported being aware of the media poles. The questionnaire was composed of 11 items asking respondents to score each question on a scale of 1 to 5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree). The average score of each question was calculated to facilitate the analysis of responses and the results were as shown as in Table 10 (Two out of the 73 respondents who refused to respond to an additional interview were excluded).

The respondents' evaluation of the media poles was processed using a statistical package program for the social sciences, PASW (SPSS) Statistics 18 (Table 10.), and analysis was carried out with ANOM and ANOVA.

Prior to the analysis of the evaluation results, the reliability of the questionnaire was measured by means of Cronbach's alpha. An alpha value of 0.6 or more is generally viewed to represent good reliability, and analysis showed that the alpha value for the questionnaire was 0.874 (11 question items) indicating that the survey results can be considered reliable.

The overall average score of 3.33 serves as a reference figure, such as if an average score on a question is higher than 3.33, the response is considered positive, while if it is lower, the response is assumed to be negative. In addition, a meaningful analysis was attempted by using respondent profile information.

The average score on the question, "Do you think installations like the media poles are necessary for the streets?" turned out to be 3.51, indicating that respondents are aware of the necessity of the media poles to some degree.

The location of the media poles was a central factor, since this kind of street furniture is designed for selective activities and affects walking and resting behaviors. The average score of 3.52 for the question, "Do you think the installed locations of the media poles are appropriate?" indicates that they think positively about the current locations of the media poles (See Fig.9.).

Meanwhile, the lowest average score among all questions, 2.64, was associated with the question, "Do you think the media poles have improved the pedestrian environment?" This finding leads to the somewhat mixed conclusion that, taking into account the average score of 3.52 to the question, "Do you think the installed locations of the media poles are appropriate?", people consider the media poles' installation location to be appropriate but that they do not contribute to improvement of the pedestrian environment.

Fig.9. Location of the Media Poles and Pedestrian Environment

Apparently, this result stems from the manner in which people make use of the media poles. The use of the media pole can be divided into "(simply) perceiving" and "(first-hand) usage." This leads to the reasonable interpretation that the media poles are located in the appropriate spots to be seen but are not proper to be used within the pedestrian environment.
The response to the question, "Do you think the number of the media poles is appropriate?" was rather negative according to its average score of 3.08, which was lower than the overall average. What people consider to be the optimal number of media poles in the street was difficult to calculate since this question was not included in the survey. However, it can be assumed that a number of people consider the 22 media poles installed along Gangnam Boulevard to be too many, as noted in their feedback to the survey such as "I guess there are too many…", "It is a waste of public funding to install more media poles than necessary…" "In the middle of a busy street …" (See Fig.10.).

In addition, the responses to "Do you think the size of media poles is appropriate?" and "Do you think the color of media poles is appropriate?" were considered neutral, with average scores of 3.25 and 3.34, respectively, similar to the overall average. This demonstrates that people hold an overall neutral position in regard to the color and size of the media poles.

Seemingly, however, people do believe that media poles contribute to an improved street atmosphere, as the average score of 3.46 on "Do you think media poles enhance the streetscape?" surpasses the overall average. This question is closely related to the number, size and color of the media poles. Thus, it is difficult to assume that these factors are significant in the assessment of street atmosphere as seen in Fig.10. It can be interpreted that the media poles are believed to have improved street atmosphere, but that the number, size and color of the media poles were not the major contributing factors. From this finding, it can then be inferred that it is the media poles' other functions and services that may be bringing about a positive change in the street atmosphere. The poles provide a dynamic digital gallery service using LED display, and the visual effects might have served as the main factor that led people to perceive an improvement in the streetscape.

Fig.11. shows that people believe the media poles to be easy to use and include useful functions, with the average scores on "Do you think media poles are easy to use?" and "Do you think the services provided by media poles are useful?" marking 3.44 and 3.49, respectively. However, when taking into consideration the average score of 3.08 for the question "Do you think media poles relieve boredom in the streets?" it can be assumed that people did not experience great interest in the media poles despite the fact that they found the street furniture to be easy to use and containing useful functions. This indicates what stands in the way of the continued use of the media poles.

To be sure, there may be other factors hampering the continued use of media poles, such as the rising smartphone penetration rate. Just as the proliferation of cell phones erased public phone booths from the streets, the increasing use of smart devices may dampen the need for ubiquitous street furniture.

However, the preference for the media poles differed depending on how long respondents had used a smartphone. Those who had been using a smartphone for 18 months or longer were found to be more in favor of the media poles than those using them for less than 18 months. Seemingly, long-time smartphone users were more familiar with cutting-edge facilities like the media poles. Therefore, ubiquitous street furniture has the potential to serve as a more useful street facility if well-designed plans, installation and operation policy for ubiquitous street projects are provided (See Fig.12.).

Lastly, the average score on "Do you think the media poles are an iconic construction along Gangnam Boulevard?" turned out to be 2.88, which indicates that the media poles have yet to achieve a distinctive impact on location identity. However, Fig.13. illustrates the difference in the awareness of media poles according to when respondents visited the area for the first time.

While those who had visited the street prior to the installation of the media poles marked an average score of 2.69, those who first encountered the area after their erection demonstrated an average score of 3.32. This indicates that the former group was more familiar with other places or facilities in the area than they were
with the media poles, while the latter were more likely to have received a strong impression from new street furniture. This finding serves as the basis for predicting that the media poles could establish themselves as an iconic facility for the area in the future.

Third, ubiquitous street furniture needs to provide customized services—for example, offering information or entertainment features—that correspond to the characteristics of the location where the street furniture is installed, as well as a physical form—either an open or closed format—that is complementary to the type of service.

5. Conclusion

In order to find out how ubiquitous street furniture affects human behavior, this research examined materials such as studies on ubiquitous computing technology, street furniture, and human street behavior. Observational investigation and inquiry surveys were conducted regarding the media poles along Gangnam Boulevard, which were a representative type of ubiquitous street furniture in South Korea. The results were as follows:

Firstly, people were aware of the need for ubiquitous street facilities in the street space, such as the media poles. They are likely to grow further accustomed to such cutting-edge facilities in the future.

Secondly, the media poles’ visual functions (LED display and touch screen) impacted the walking and resting behaviors of pedestrians, contributing to the improvement of the streetscape. Meanwhile, other services provided by the media poles, including Wi-Fi hotspots, surveillance cameras, and streetlamps, did not have much effect on the behavior of the people in the streets.

Lastly, a majority of the pedestrians merely notice the media poles rather than use them. The poles were designed with the purpose of creating a "culture of communication," but this lack of usage appears to pose a considerable challenge to the future of the media poles. Therefore, further studies on appropriate content for the media poles are called for in order to encourage greater numbers of people to interact with these street facilities.

Based on this study, guidelines for designing ubiquitous street furniture are proposed as follows.

First, ubiquitous street furniture should be installed at a right angle to the direction of pedestrian movement for optimal conformance with the visual perception behavior of pedestrians.

Second, in locations that draw heavy foot traffic, the media pole's touch screen would be best situated in an alcove so that the use of the touch screen does not obstruct the movement of other pedestrians.

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Notes

1. In this study, ubiquitous street furniture refers to a street facility that incorporates IT and digital technologies.
2. Outdoor space as referred to by Jan Gehl is a concept that includes the street space addressed in this study.
3. In 2007, Seoul City implemented the "Design Seoul Street" construction project for 30 streets in Seoul. The project was intended as a complement to previous plans that had focused on each street element's individual function, resulting in a lack of organic integrity among the elements, as well as to create streets where life and local culture are harmonized and elements of culture and communication are embraced. (design.seoul.go.kr)
4. For example, a poor pedestrian environment, lack of pedestrian space, illegal signage, absence of street culture, etc.
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