How different travel media promote tourism activities
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ABSTRACT
This study was conducted in the city of Yokohama, which has featured several charming tourist attractions such as Chinatown and old Western-style historical buildings, as the place of study to investigate the difference between tourists using paper maps and those using digital maps in their movement behaviors. And both foreign and local participants were engaged in the study to explore the travel movement effects of participants with diverse experience and backgrounds. This study found that the paper map group traveled fewer repeated roads and had a higher circuitous movement rate in terms of walking distance. In terms of cognitive maps, the number of drafted attractions was larger in the paper map group than in the electronic map group. However, the attraction location accuracy as drafted by the electronic map group was higher than that of the paper map group. In the mirror-image discrimination test, the paper map group fully recognized more attraction photographs than did the electronic map group. The accuracy of the drafted attraction locations was higher for foreign participants than for local participants. The foreign participants had recognized more photographs than the local participants did.

1. Introduction
When pedestrians move in a specific environment, they learn about the geographic and spatial knowledge of the environment and search for their destinations through maps. This improves their circuitous movements and cognitive maps in urban spaces.

Typically, studies have contended that people familiarize themselves with unfamiliar environments through wayfinding (Chang 2015). Wayfinding involves moving from one spot to another with the least time and effort (Brunyé et al. 2010). To reach an unfamiliar destination, people find their way in an unfamiliar environment using the help of others or navigation tools (Hund and Minarik 2006; Chang 2015). Studies have reported that wayfinding behaviors vary in different cultures (Chang 2015; Ito and Sato, 2011). Tourists from Western countries find their way in a shorter time than do those from Eastern countries; during wayfinding, tourists from Eastern countries are more prone to feelings of being lost, nervousness, and anxiety than those from Western countries (Chang 2015). Ito and Sato (2011) indicated that Japanese participants identified their locations and directions more satisfactorily when using paper maps than when receiving only verbal instructions, whereas the opposite was true for US participants. In addition to cultural differences, media tools also differ in terms of their wayfinding efficiency (Ishikawa et al. 2008). According to Ishikawa et al. (2008), participants who use global positioning system (GPS) technology walk at longer distances than those using paper maps or verbal instructions. Compared with those using only verbal instructions, participants using GPS also walk slower and stop to determine their directions more frequently. Moreover, among the participants using paper maps, those with a better sense of direction tended to walk for shorter distances. Regarding wayfinding strategies, Xia, Packer, and Dong (2009) contended that tourists who are more familiar with an environment tend to use shorter routes and make fewer turns; in other words, tourists who are more familiar with an environment tend to adopt more practical wayfinding strategies.

Circuitous movement is interpreted in the Super Daijirin Japanese Dictionary (3rd edition, 2006) as “walking back and forth during travel.” In tourism studies, circuitous movement relates to when a person “comes and moves in the city or same area for a certain purpose, and circuitous movement occurs after a change in purpose” (Kawatsu 2015; Miyamoto and Yuzawa 2004). Recently, many circuitous studies have analyzed a range of related directions and categories. One such study revealed that tourists who first visited an attraction only walked along a simple path in a specific place. However, tourists who had visited that place for more times tended to walk along a complex path to many places (Tanaka and Wada 2005). Furthermore, a study in Japan compared the walking distance related to circuitous movement and the number of attractions tourists passed by (span) with and without maps. The results
showed that the walking distance of tourists with a map was longer than the distance walked without map because tourists without a map tended to walk more on main roads than alleys possibly due to concerns about getting lost. Moreover, tourists passed by more attractions when they used maps (Ikebe, Suzeshige, and Morozumi 2010). Visual information in a space is also a crucial factor in such movements because people seldom visit streets that are difficult to locate and enter (Suzuki et al. 2010). Some studies have also posited that maps with recommended routes can effectively help users improve their spatial cognition. Tourists with a recommended route stay longer in tourist areas, visit more tourist spots, and walk for a longer distance than those ones without a route (Chen and Zheng 2014; Zheng 2015). Research has indicated that four elements can enhance circuitous movement: (1) a specific urban space: in a city, pedestrians should be able to identify their position and direction clearly; (2) attractive tourist spots: having attractive tourist spots encourages tourists to perform circuitous movements; (3) continuousness of city: if a designer wishes to broaden tourists’ circuitous movement, some previously unconnected places should be connected; (4) information for walking in cities: of all the information frequently present in maps, tourists spots and shops most influence tourists’ circuitous movement. Thus, providing novel information on such spots will enhance tourists’ circuitous movement. Circuitous signs provide a more diverse range of choices than guide signs. However, they do not represent the shortest distance to destinations (Punnoi et al. 2010).

The metaphorical representation of spatial characteristics is termed cognitive mapping (Tolman 1948). Cognitive mapping is a process composed of a series of psychological transformations by which an individual acquires, codes, stores, recalls, and decodes information about the relative locations and attributes of phenomena in their daily spatial environment (Downs and Stea 2011). A cognitive map is the representation of environmental psychology in the brain, and the formation of such a map requires experiences (Tolman 1948). Thus, a cognitive map can be considered, to a certain extent, as the accumulation of personal experiences. In other words, this map represents a person’s knowledge about a certain place (Kaplan and Kaplan 1982). It can also be regarded as an essential connection point between subjective human experience and that of the external world (Lee 1990). If people do not have a cognitive map, they must find a location without having any purpose to do so (Lee 1990). People move according to cognitive maps. A more precise cognitive map can reduce the likelihood of a person getting lost (Takata and Watanave 2015). Evans et al. agreed that the sources of humans’ cognitive map are: (1) spatial knowledge of the map, (2) personal experience, and (3) other messages from various sources (Evans and Pezdek 1980). Cognitive maps can be classified into route maps and survey maps. A route-map is presented from a ground view, whereas a survey-map type is presented from an aerial view (Asamura 2006). Generally, people with route maps can easily get lost. By contrast, people with survey maps can better guide their directions because they can identify their position from the entire map; they are both good at giving directions and less likely to get lost (Takata and Watanave 2015; Shingaki and Nojima 2001). Some studies have also highlighted that cognitive maps are developed from route maps to survey maps after the reading of maps (Takata and Watanave 2015; Wakabayashi 2008). Moreover, individual differences in spatial cognitive maps are greater for actual movement than map learning (Wakabayashi 2008; Evans and Pezdek 1980; Thorndyke and Hayes-Roth 1982; R. Lloyd 1989; R.1997). In addition, some studies have shown that differences between the sexes exist in the interpretation of map content (Chen and Zheng 2013). In summary, personal experiences and the influence of individual differences in map content cause differences in cognitive maps.

Technological advancements have allowed the provision of electronic geospatial information by mobile phones and networks. Paper maps are used to receive messages, but this one-way reception has changed. Users now can freely process and collect the information on electronic maps to expand the visual information obtained (Table 1) (Wakabayashi 2008; MacEachren 2004). Moreover, electronic maps are not limited by drawing scale and size, and can be combined with three-dimensional animations and sound effects to create multimedia maps. Because the information can be updated easily, interactions between users and map producers can be improved to generate a more flexible map in terms of performance and application (Wakabayashi 2008; Longley et al. 2001). However, electronic maps are limited by resolution, and do not have the features of paper maps that all pieces of information can present in front of the reader all at once (Table 2) (Murakoshi and Wakabayashi 2008). Based on the aforementioned studies, electronic maps still have room for improvement but are more convenient than paper maps. Thus, paper maps are currently used less than paper maps.

Maps have a considerable influence on pedestrians when they are moving around and searching for their destinations. Different maps result in different circuitous

| Table 1. Communicative and visual expression of maps. |
| Map representation | Communication | Visualization |
|---------------------|---------------|---------------|
| Users interaction   | Low           | High          |
| Use of map          | Open          | Personal      |
| Map information     | Prompt for known information | Identify unknown information |

From: (MacEachren 2004; Wakabayashi and Suzuki 2003)
movements and individual cognitive maps. Individual cognitive maps vary from person to person, but cognitive maps are more complete and spatially representative when they are produced by people with more familiarity with local areas. With the emergence of electronic maps, the amount of geographic information received by pedestrians has expanded. Moreover, the convenience of electronic maps has reduced the usage of paper maps. Few recent studies have addressed the differences between domestic and foreign tourists in terms of using paper maps and electronic maps in their circuiting movements. Therefore, this study compared the differences in circuitous movements caused by these two maps and proposed suggestions for improving paper map designs. This study was conducted at actual tourist attractions. Differences between the circuitous movements of the two types of maps were compared by analyzing the accuracy of cognitive maps and identifying the numbers of streetscapes and attractions visited.

2. Method

This study investigated the difference between tourists using paper maps and those using digital maps in their movement behaviors. This study was conducted in the city of Yokohama, Japan. Yokohama features several charming tourist attractions such as Chinatown and old Western-style historical buildings, which are distributed at multiple locations rather than concentrated in a single area.

The participants of this study were requested to move around Yokohama, Japan, by using the provided travel media. The experimental media were classified into two categories, namely paper maps (Figure 1) and electronic maps (Figure 2). The participants were divided into three groups: the electronic map group used electronic maps to go sightseeing in the experimental area, with only electronic maps allowed (excluding other applications) during the experiment; the paper map group used a paper map to engage in sightseeing in the experimental area; and another group was allowed to use both electronic and paper maps. The study area was between Nihondori and Yamatecho in Yokohama.

The starting point was Ishikawacho Station and the first attraction was the Yokohama Customs Museum. After the first attraction, the participants were required to plan their own routes for sightseeing and return to the starting point when the mission has ended. The experiment took approximately 2 hours. During the experiment, participants were not allowed to ask for directions, but guide books were provided to them as a reference for sightseeing spots (Figure 3). The paper map adopted in this study was A3-sized with color print; an 11-pt font was used

![Figure 1. Paper map.](image)
for the names of the attractions. The digital map was viewed using Google Maps version 5.6 on an iPhone 6s. The guidebook featured three single-sided A4 paper sheets. The guidebook contained 318mm*363mm photos and brief description of each attraction. The font of the title and body text was 12 and 10 points, respectively.

The routes and attractions visited by the participants were recorded during the experiment. After returning to the starting point, the participants were required to draw the routes and attractions that had just respectively walked and visited to compare the differences in the cognitive maps of participants. In addition, participants were asked to select the attractions that they passed by from 104 streetscape photographs to analyze the extent to which they recognized the surrounding areas. Finally, interviews were conducted to obtain feedback from participants on the media used.

The entire process was recorded by the camera, and notes were taken using pen and paper. To further increase the prevalence of navigation systems in pedestrian environments, both domestic and foreign participants were recruited for this study. According to the Japan National Tourism Organization (2018), Taiwanese tourists constituted the highest percentage (82.4%) of repeat visitors of Japan in 2018. Therefore, Taiwanese tourists were recruited as foreign participants in this study. A total of 28 people have participated in this experiment: 12 were in the electronic map group, 12 were in the paper map group, and 4 in both maps group. Half of participants of each group were foreign nationals and the other half were locals (Japanese). The participants were 14 Taiwanese exchange students in Japan, who had visited the site no more than once prior to the experiment. The
Taiwanese participants were aged 20–29 years, and their average score on the Santa Barbara sense-of-direction (SBSD) scale was 4.14 (out of the full score of 7). This study also recruited 14 Japanese participants who had a score of no more than 2 on their self-assessed familiarity with the site (1 = completely unfamiliar; 4 = extremely familiar). The Japanese participants were also aged 20–29 years, and their average SBSD score was 3.83 (Table 3).

In addition, this study used a relative accuracy score (RAS) to understand whether different travel media resulted in judgment-related differences in tourists. The calculation is as follows: objective angle segments (OAS) are the angles between attraction spots and Ishikawacho Station on the original map, whereas cognitive angle segments (CAS) are the angles between attraction spots and Ishikawacho Station in the map drafted by the participants (Kitchin and Blades 2002). The estimated value (n) represents the number of angles in the cognitive maps that correctly represented actual map angles. The value will be presented in the form of sign and number. Plus sign means CAS is smaller than OAS, while minus sign means CAS is bigger than OAS. The smaller the number is, the smaller the difference between CAS and OAS is.

The formula is as follows: \( RAS = \frac{\sum_{i=1}^{n} \frac{(OAS - CAS)}{180}}{n} \times 100 \)

Where:
- RAS = Relative accuracy score
- OAS = Objective angle segments
- CAS = Cognitive angle segments

### 3. Results

The experimental results can be divided into two parts: (1) a comparison of media differences, and (2) a comparison of experience differences. This study investigated (1) the number of turns, walking distance, and walking speed on the same road; (2) walking paths; (3) cognitive map differences; and (4) a mirror-image discrimination test.

#### 3.1 Comparison of media differences

Media differences analyzed the effects of participants’ movement differences resulting from the use of different media.

#### 3.1.1 Related data analysis on walking path

This study calculated the number of turns and total walking distance of each group. Furthermore, the ratio of repeated path distance to total walking distance was calculated to understand the circuitous movement rate of each group.

According to Table 4, the group that used both maps made more turns than the other two groups, and the electronic map group and the paper map group exhibited small differences in the number of turns and walking distance. Furthermore, the paper map group has a lower same-road walking rate than the electronic map group, indicating that the paper map group passed by fewer repeated paths and traveled a shorter distance than the electronic map group (0.06 < 0.13).

This study drafted the participants’ walking paths and calculated its ratio in relation to the number of visitors at each attraction on the guide book provided during the experiment (Figures 4 and 5).

Apart from Yokohama Customs Museum, which was visited by all participants, the top 3 most visited attractions by the electronic map group were the Yokohama Archives of History (83%), Yokohama Red Brick Warehouse (75%), and Yokohama Marine Tower (66%); the top 3 most visited attractions by the paper map group were Yokohama Marine Tower (83%), Yokohama Red Brick Warehouse, Kanagawa Prefecture Hall, and Yamashita Park (75%), and Minatonomieruoka Park (66%). Among them, Yokohama Marine Tower and Yokohama Red Brick Warehouse were revealed to be highly popular with the two individual map groups (Figure 6).

In addition, Yamashita Park, Bluff No. 111 Residence, and the Yokohama Archives of History had notable differences in the number of visitors. The routes of the electronic and paper map groups were compared, which were 33% < 75%, 0% < 41%, and 83% > 41%, respectively. In terms of the number of attractions, these attractions had more visitors from the paper map group than the electronic map group.

In summary, the paper map group visited more attractions labeled on the guide book. It can be inferred that the paper map group referred to the guide book and the attractions labeled on the paper map when planning tourist spots to visit and visiting sequences, indicating that for the paper map group, the labeled attractions in the guide book were useful for planning visiting attraction routes (Figure 6).

### Table 4. Number of turns, walking distance, same-road walking rate.

|                      | Electronic map | Paper map | Both (electronic and paper maps) |
|----------------------|----------------|-----------|----------------------------------|
| Number of turns      | 19.5           | 18.42     | 23.75                            |
| Walking distance (km)| 6.01           | 6.35      | 6.05                             |
| Same-road walking rate| 0.13           | 0.06      | 0.09                             |
3.1.2 Cognitive map analysis

Based on the calculation formula by Kitchin and Blades in *The Cognition of Geographic Space*, the RASs of the location drafted by participants and the actual location of attractions was obtained.

According to Table 5, errors occurred in the attraction locations drafted by the participants: when the RAS average value of the paper map group was negative, the average values of the other two groups were positive. This indicated that for average drafted attraction location accuracy, CAS scores were higher than OAS scores for the paper map group. CAS scores were less than OAS scores in average drafted attraction accuracy for the other two groups. Moreover, the angle error value of the electronic map group was smaller than that of the paper map group ($|1.38| < |−2.49|$), revealing...
that the location accuracy score of the electronic map group was higher than that of the paper map group.

According to Table 6, the walking distances of the three groups were similar. In addition, the number of attractions drafted and number of attractions remembered per kilometer drafted by the paper map group was more than the electronic map group (12.17 > 6.5; 1.97 > 1.11). This implied that within the same walking distance, the number of attractions that the paper map group formed impression of was larger than that of the electronic map group. In summary, although the electronic maps presented more information than the paper map did for areas within the same distance, the number of attractions that left an impression on the participants in the paper map group was larger than that for the electronic map group.

### 3.1.3 Mirror-image discrimination test

This study calculated the ratio of remembered photographs to the total number of photographs from actual walking path, thereby calculating the participants’ correct photograph selection rate of each group. In addition, this study used the calculation formula of the number of people remembered divided by the number of people passed by to obtain the ratio of each recognized photograph and further obtain the number of attraction photographs recognized by each group of participants.

According to Table 7, more than half of the photographs selected by the three groups of participants were correct (electronic map group: 0.52, paper map group: 0.51, both maps group: 0.53), implying that more than half of the photographs were of attractions that participants had actually passed by while walking.

According to Table 8, the paper map group fully (100%) recognized more photographs than the electronic map group did (15 sheets > 2 sheets). More than 50% of participants recognized the photographs of attractions they had passed by (33 sheets for the paper map group; 13 sheets for electronic map group). The results revealed that the paper map
group used surrounding landmarks to move around, thus enhancing their memory of surroundings.

3.2 Differences in experience

The comparison of experiential differences analyzed the travel movement effects of Japanese and foreign participants with diverse experiences and backgrounds.

3.2.1 Related data analysis on walking path

Based on Table 9, the number of turns taken by foreign participants was 19.5; such participants had a walking distance of 6.18 km and same-road walking rate of 0.09. By contrast, number of turns taken by local participants is 19.78 times; such participants had a walking distance of 6.13 km and same-road walking rate of 0.09. The results revealed small differences between foreign and local participants in terms of the number of turns, walking distance, and same-road walking rate.

All foreign participants visited Yokohama Customs Museum. Other than that, their top three most visited attractions were Kanagawa Prefecture Hall, Yokohama Red Brick Warehouse, and Yokohama Marine Tower (71%); Yokohama Port Opening Memorial Hall (64%); and the Yokohama Archives of History (66%) (Figures 7 and 9). However, for local participants, except for the Yokohama Customs Museum which was visited by all participants, the top 3 most visited attractions were the Yokohama Archives of History (71%); Yokohama Red Brick Warehouse and Yamashita Park (64%); and Yokohama Port Opening Memorial Hall, Kanagawa Prefecture Hall, Yokohama Marine Tower, and Minatonomieruoka Park (57%) (Figures 8 and 9).

After the routes taken by the two groups of participants were compared, it was revealed that the proportion of people who visited Zounohana Park was notably different between participant groups (35% of foreign participants; 7% of local participants). In addition, the

| Table 8. Comparison of photograph recognition. |
|-----------------------------------------------|
| Recognition rate | No. of photographs | Photograph number | No. of photographs | Photograph number |
|------------------|--------------------|-------------------|--------------------|-------------------|
| 100%             | 2                  | 34, 97            | 15                 | 5, 19, 23, 31, 32, 35, 59, 63, 88, 92, 96, 97, 98, 102 |
| 90%-99%          | -                  | -                 | 1                  | 5, 99             |
| 80%-89%          | 1                  | 1                 | 4                  | 11, 26, 36, 3     |
| 70%-79%          | 1                  | 47                | 3                  | 7, 16, 28         |
| 60%-69%          | 3                  | 28, 38, 19        | 2                  | 40, 27            |
| 50%-59%          | 7                  | 5, 11, 23, 31, 32, 35, 55 | 8                  | 1, 17, 18, 34, 39, 47, 51, 95 |
| Total            | 13                 |                   | 33                 |                   |

| Table 9. Number of turns, walking distance, same-road walking rate. |
|---------------------------------------------------------------|
| Number of turns       | Foreign participants | Local participants |
|-----------------------|----------------------|--------------------|
| Walking distance (km) | 6.18                 | 6.13               |
| Same-road walking rate| 0.09                 | 0.09               |

Figure 7. Ratio of foreign participants’ walking routes to the number of visitors at each attraction.
number of foreign participants that visited attractions (e.g., Iwasaki Museum) after Minatonomieruoka Park was smaller than that for local participants. Local participants visited more attractions than foreign participants.

### 3.2.2 Cognitive map analysis

According to Table 10, errors occurred in the attraction locations drafted by the participants in terms of accuracy: the average values of foreign participants were positive, whereas the average values of the local participants were negative. This indicates that the average drafted CAS value of the attraction locations was less than the OAS value for foreign participants, and greater for local participants.

![Figure 8. Ratio of local participants' walking routes to number of visitors at each attraction.](image_url)

![Figure 9. Ratio the number of visitors at each attraction.](image_url)

|   | Foreign participants | Local participants |
|---|----------------------|--------------------|
| 1 | 6.694                | 3.627              |
| 2 | 5.850                | −12.567            |
| 3 | −4.694               | −4.818             |
| 4 | −7.214               | −3.120             |
| 5 | −1.095               | −3.150             |
| 6 | −2.254               | −1.585             |
| 7 | −4.372               | 0.034              |
| 8 | 7.974                | −0.900             |
| 9 | −3.118               | 0.194              |
| 10| 9.898                | 4.965              |
| 11| 6.159                | −0.894             |
| 12| −0.180               | 0.125              |
| 13| −4.265               | −2.140             |
| 14| 1.943                | −1.776             |
| Average | 0.809 | −1.572 |
whereas the CAS value was higher than the OAS value for local participants. In addition, the angle error values of foreign participants were smaller than those of local participants (0.8 < |−1.57|). In short, the accuracy of the attraction location drafted by foreign participants was higher than that of local participants.

As shown in Table 11, both groups walked a similar distance. Moreover, the number of drafted attractions did not differ considerably between the two groups (8.6 for foreign participants; 9.5 for local participants), and the number of remembered attractions per kilometer were 1.39 for foreign participants and 1.6 for local participants. This signified that no notable differences were observed in the number of drafted attractions between the two groups.

### 3.2.3 Mirror-image discrimination test

According to Table 12, more than half of the photographs selected by the two groups of participants were correct (0.51 for foreign participants; 0.52 for local participants). In other words, more than half of the photographs selected by the two groups were of actual attractions they had passed by.

Based on Table 13, the number of photographs that were fully recognized by both foreign and local participants was 15 each. More than half of all participants could recognize the attractions they had passed by in the photographs, (44 sheets for foreign participants and 33 sheets for local participants). This indicated that foreign participants used surrounding landmarks to help them travel and improve their memory.

| Table 11. Comparison of number of drafted attractions. |
|---------------------------------------------------------|
| Foreign participants | Local participants |
|----------------------|--------------------|
| Walking distance (km) | 6.18 | 6.13 |
| Number of drafted attractions | 8.6 | 9.5 |
| Number of remembered attractions per kilometer | 1.39 | 1.6 |

| Table 12. Correct rate of photograph selection. |
|------------------------------------------------|
| Foreign participants | Local participants |
|----------------------|--------------------|
| Number of selected photographs | 28.42 | 21.14 |
| Number of correct photographs | 14.57 | 11.14 |
| Correct rate of photograph selection | 0.51 | 0.52 |

| Table 13. Comparison of photograph recognition. |
|------------------------------------------------|
| Foreign participants | Local participants |
|----------------------|--------------------|
| Recognition rate | No. of photographs | Photograph number | No. of photographs | Photograph number |
| 100% | 15 | 5,19,23,28,31,32,35,36,41,47,77,88,92,97,102 | 15 | 5,6,16,19,23,31,32,33,34,35,49,56,62,90,102 |
| 90%-99% | 2 | 3,99 | - |
| 80%-89% | 4 | 11,55,16,46 |
| 70%-79% | 1 | 18 |
| 60%-69% | 10 | 7,26,39,59,63,75,96,98,21,38 |
| 50%-59% | 12 | 1,10,17,22,25,34,60,64,67,69,70,95 |
| Total | 44 |

The following findings were made based on the experimental results:

1. In the comparison of media differences, the paper map group traveled fewer repeated roads and had a higher circuitous movement rate in terms of walking distance. In addition, the paper map group visited more attractions labeled on the guide book compared with the electronic map group. In terms of cognitive maps, the number of drafted attractions was larger in the paper map group than in the electronic map group. However, the attraction location accuracy as drafted by the electronic map group was higher than that of the paper map group. In the mirror-image discrimination test, more than half of the photographs selected by both groups were correct, but the paper map group fully recognized more attraction photographs than did the electronic map group.

2. In the comparison of experiential differences, the walking distance and circuitous movement rate did not differ considerably for both groups. Nevertheless, local participants visited more attractions labeled on the guide book than did foreign participants. In terms of cognitive maps, both groups had a similar number of drafted attractions, but the accuracy of the drafted attraction locations was higher for foreign participants than for local participants. In the mirror-image discrimination test, more than half of the photographs selected by both groups were correct, but the foreign participants had recognized more photographs than the local participants did.

4. Discussion

Table 14 shows the feedback (interview results) of participants on media use after the experiment.

The feedback related to paper maps from the participants is detailed as follows: (1) they could grasp the overall space of the experimental area; (2) the specially marked attractions were clear and readable; (3) they often did not know their current location and moving direction; (4) the detailed content could not be enlarged for further information; (5) it was difficult
5. Conclusions

According to the experimental results, the paper map group repeated routes less, passed by more attractions that they remembered, and recognized more streetscapes along the routes. However, interview results revealed that paper maps make it difficult for users to confirm their current location, the content cannot be enlarged to obtain detailed information, and such maps are difficult to store when traveling around.

In addition, the use of paper maps is more time-consuming in terms of understanding the corresponding relationships between symbols, signs, and current environments than electronic maps. For foreign and paper map participants, a lack of experience or limited information on paper maps may have caused them to repeat the confirmation of surrounding landmarks, but the information obtained was rendered more complete by active exploration. As stated in a related study, active participants were better able to recognize the correct orientation of visual scenes from the study route than passive travelers and participants became more sensitive to the orientation of images in general after active navigation, perhaps by priming their navigational systems (Afrooz, White, and Parolin 2018).

In summary, instead of relying on the convenience of electronic maps, promoting or inducing the active comparison of information by tourists may be more conducive to a better travel experience. The design of paper maps that allows tourists to feel at ease and actively explore attractions requires further exploration.

This study had several limitations. First, two-factor between-subject ANOVA was used to test the effects of travel media and nationality on same-road walking rate, number of attractions remembered per kilometer, RAS, and correct rate of photograph selection. However, the p-value for the homogeneity of variances test on the same-road walking rate and the number of attractions remembered per kilometer was <.05. Moreover, because no interactions were identified between RAS and the correct rate of photograph selection in the two-way ANOVA, only the main effects were considered.

Table 14. Comparison of paper and electronic maps.

| Pros | Paper maps can be rotated in any direction. |
|------|-------------------------------------------|
|      | * Crucial attractions are marked clearly and easy to recognize. |
|      | The viaduct location helps users to confirm their current location. |
|      | Real-time current location and direction the user is facing can be obtained. |
|      | Convenience stores can be instantly located. |
|      | Information of attractions can be obtained in advance. |
|      | Station exit numbers and locations are indicated. |
|      | No zebra crossings labeled. |
|      | Can zoom in and out of images to reveal detailed information and new attractions. |
|      | A blue sign marks a user’s current position to clearly confirm their moving direction. |
|      | Real-time current location and direction the user is facing can be obtained. |
|      | Convenience stores can be instantly located. |
|      | Information of attractions can be obtained in advance. |
|      | Station exit numbers and locations are indicated. |
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|      | Real-time current location and direction the user is facing can be obtained. |
|      | Convenience stores can be instantly located. |
|      | Information of attractions can be obtained in advance. |
|      | Station exit numbers and locations are indicated. |
|      | No zebra crossings labeled. |
effects could be examined. In the one-way ANOVA of travel media, the p-value for the homogeneity of variances test on the same-road walking rate and the number of attractions remembered per kilometer was <.05; no statistically significant differences were observed in the RAS and the correct rate of photograph selection of each participant. In the one-way ANOVA on nationality, no statistically significant differences were identified in the same-road walking rate, number of attractions remembered per kilometer, RAS, and correct rate of photograph selection of each participant. Second, the participants recruited in this study were Taiwanese and Japanese, who both belong to the East Asian cultural sphere; this may have affected the experimental results. Third, the quality of the sketch map might have been affected by the participants’ drawing abilities. Despite these admitted weaknesses, this study provided useful insights into visitor behavior and the spatial cognizance of their environments. The findings can be used to improve sign designs and navigational information in pedestrian environments, thus increasing the ease of movement around cities and enabling visitors to more quickly and efficiently identify and experience new scenic spot if they are from a place with a different language and culture.

Disclosure statement

No potential conflict of interest was reported by the authors.

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