

Design of Guiding Lines on the Tactile Map for Campus in Taiwan

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Abstract

This pilot study aimed at the evaluation of three different designs of guiding line, ruler-line, dot-line, and tangent-line, for tactile floor map that might fit in the campus of Tatung University. There were 14 visually impaired persons (VIPs), 11 males and 3 females, with mean age of 39.6 years touched those three tactile floor maps with different guiding line on it. The experiment task was to reach a specific room from a start point on a tactile map by his dominate index finger. An *ANOVA* reveals that the completion time among those three designs show no significant difference. It hints that three designs are all strike enough for those participants. Our researcher team is designing other possible designs now in order to get the faster and more favorite design for VIPs.

Keywords: tactile map, guiding line, floor map, campus guidance system, visually impaired person

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Introduction

According to WHO (updated on October 2017), an estimated 253 million people live with vision impairment: 36 million are blind and 217 million have moderate to severe vision impairment. Globally, chronic eye diseases are the main cause of vision loss. Uncorrected refractive errors and then un-operated cataract are the top two causes of vision impairment. Un-operated cataract remains the leading cause of blindness in low- and middle-income countries (Who, 2017). It shows that there are lots more visually impaired people than before around all countries, and the rate is increasing year by year. For instance, in China, there are 75.5 millions of people suffered the visual impairment. In the population of China, 1344.9 million, the blindness are 8.24 million (11%) and the number of 67.26 million (89%) is for low vision. The ratio between totally blind and impaired is about 9 to 1. In a clearer way of saying, there is one blind person and five low vision persons in every one hundred people in China, even saying in all over the countries (Pascolini, & Mariotti, 2010). This condition is also happened for Taiwanese.

It can be realized that designing suitable tools for those visual impaired persons is much more important than ever. The impaired person usually need to have a person who near him to assist him to travel from home to any place he want to go. There is some what a time that visually impaired person (VIP) need some other resources to lead him to new and unfamiliar place. The tactile map is designed for this moment. And VIP might need to have a tactile map in hand while he travels indoor of the target place. So, it is an emerging issue for designers to create more efficient tactile map for VIPs.

A well accepted tactile map need to have many kinds of information. Lin, Gee, & Young investigated eighty-seven participants who profession in the information application, in 2010. Their research showed that a well-designed map for public art, need to consider: the current location of user, important landmarks in the way, location reference, emphasis of the destination, and the recommended travel rout. Though this study was a pilot study at the sighted users, those findings still had some hint for the tactile map designer. For instance, the design of icon or graphic in a tactile map is very vital to VIPs. Some reports demand that the graphic should be clarified as the implication of it's actually means. For example, a trail must locate on the actual location and must simulate the real situation. But some other studies suggested that the icons on the map should be as simple as possible because the sensation of the finger of human is not so precise. Not to mention, user always want to have their information as fast as they desire (Challis & Edwards, 2001; Perkins, 2001). So the time for our finger to follow the tactile map is usually a short one and it is normal to drop some less important cue of the map in order to have a simple condition for finger to touch.

In 2017, Bardot, Serrano, Oriola, & Jouffrais tested five types of raised-line diagrams, including Common drawings, Perspective drawings, Mathematical graphs, Neighborhood maps, and Geographical maps. Their participants were 6 blindfolded sights (BFs) and 6 VIPs. The exploration time, among them, showed that VIP subjects are faster than BF subjects in all five types of diagrams. The accuracy of those five types were (BF% : VIP%): Common drawings (58.6% : 41.3%), Perspective drawings (93.7% : 5%), Mathematical graphs (62.5% : 75%), Neighborhood maps (11% :

31%), and Geographical maps (27.7% : 70.5%). The result hints in the accuracy rate, those VIP subjects had better performance than BF group at Neighborhood maps, and Geographical maps. This evidence reports that VIP subjects have the expertise on the exploring of maps than drawings. In addition, drawings rely on visual conventions that are less significant to VIPs.

By our design team, we had focused on those issues and achieved some results. On 2007, Tu and his design team found that at a situation of groove (8mm width) with Braille dots. At the condition of the height gap between higher surface and lower plat is 2.5 mm, the index finger of participants might not able to distinct the symbol represented by those Braille dots. In that paper, experimenter provided three different grooves edges (bulge curve, hollow curve, and slant line), three different groove shapes (straight-line, multi-wave, fold-line) for those subjects. Evidence showed that straight-line had the best mean recognition rate and lowest response time among all conditions. It is an evidence that to make a simple design is a good design policy (Tu, Wu, Leung, Wang & Lin, 2007).

The visually impaired person usually has to ask a person guiding him to unfamiliar place. Or, he might choose to generate tactile map for him to establish the mental map about the space. Some researchers suggested that though by the leading of a sighted person, a VIP can reach the target place in a normal time as a sighted person do. Many VIPs thought this is a regular but not a normal way for them because they all feel this kind of trouble some other person is not a suitable way of daily life not only for them but also those helpful assistants.

Traditionally, tactile map was graphics printed on a thermos paper and those graphics was raised by heat. Users has to prepare graphics from map database, such as Google map, or by hand made drawing, and copy the map or drawing into thermo-paper by a special printing machine (Perkins, 2001).

The research aim for this study is to know which type of raised line has the better performance of path leading on tactile map. Our design team had designed three types of guiding lines that had some advantage for each. First type, Solid line, is a traditional design that everyone's index finger can smoothly follow it. The benefit for this Solid type is the familiarity to VIP users, so it is assumed that this type might have the best performance. Second type, Dash line, the gain of this type is that user can feel the direction of the line more exactly and clearly than continuous line for its serial awareness of line edge on the finger. The third, Dot line, is a line filled of serial dots on the direction of it. As researchers said, those dots might cause a stronger mechanoreceptor response and they provide repeated presentation of edges as the finger traces the line (Jehoel, et al., 2009).

To make comprehensive and easy tactile map, the graphic on the map should have some following features, suitable elements and thickness; clarified graphic forms; distinguishable elements; resistance of material; and bright color, strong contrast for low vision user to facilitate the clue (Ecchiarelli, 2009). The tactile map can be categorized into two types for its function: 'place map' and 'path map'.

On leading persons to a specific location, the 'path map' is a main type for users. It is a local map that has a guiding line on it and the user can follow the guiding to the

repeatedly visited point, such as famous building, information center, toilet and other frequently asked locations. The map might be established on a fixed desk, easily touched wall, or at the end of paving, and it could be located inside a house or outside of a building. The path map is especially important for a public place such as park, famous scene and campus (as our topic). The 'path' on the guiding map is the most crucial cue for the user to explore the whole area and finding the direction. So in this study, we designed three path (guiding lines) and design an experiment for VIPs to give their preference to our design team.

Some researchers recommended that there should be Braille text on the tactile map in order to support more clue during user's exploration procedure. While some other studies argued that information on the tactile map should be simplified as easy as possible (Challis & Edwards, 2001). In this pilot study, the 'room number' and 'toilet' were signed on our materials.

In this paper, we are looking forwards for searching a good design of guiding line on tactile map for VIP, in campus as a pilot study. The result might affects the performance of exploration on tactile map. With the better guiding line, VIPs could touch their destination faster on tactile map, and, in the same time, they will have a good experience of wayfinding which encouraging them go outside of their house to have more social action with the public.

Method

Fourteen subjects were recruited from two rehabilitation centers, including 5 blinds including 3 later blinded and 9 low visions, mean age of 39.6 years. The material was three sheet of tactile floor maps that had same floor rooms and floor shape but differed at the type of guiding line for the VIP user to follow. Each of the type of guiding line, see *Fig. 1*, had its own benefit.

Firstly, the Slant-joint (A) type, the design was as similar as a ruler which one straight line with tangent lines evenly located on the joint. In this design, user might find the same joint quickly by ones fingertip. Secondly, the Circle-joint (B) type, the joints were a solid circle and a larger circle was located on the fifth joint as a hint for user to count the number of circles. In this Circle-joint, user might count the amount of circles faster than other types, for the circle could be sensed in all direction when a finger following the direction of guiding line. Finally, the Cross-joint (C) type, there were cross lines evenly setup on the line. By the Cross type of joint, user can touch the guiding line from all direction. It is especially useful when user have to touch the map from unfamiliar direction.

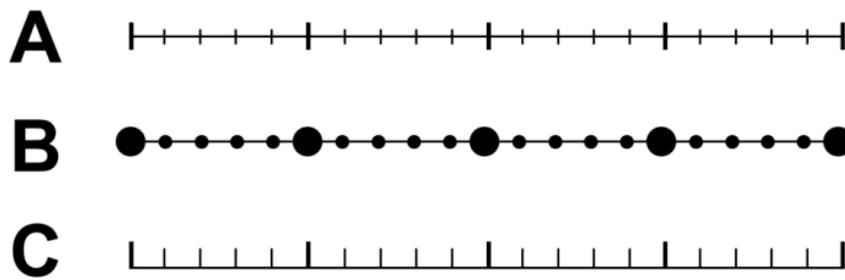


Figure 1: Three types of guiding line for this study

One practice tactile map was established upon a desk first. The experimenter asked the subject to practice the tactile information that were examples for this test with the oral explanation from the experimenter. When the subject said that he had already known those information. Three type of floor maps were brought to the subject from a randomly assigned order. On the floor map, there was a start point (a solid circle) on the right-down side. The experimenter led subject's index finger to the start point, and told the subject to move his finger and follow the guiding line to the left side until it reached the endpoint (room 308A), see *Fig. 2*.

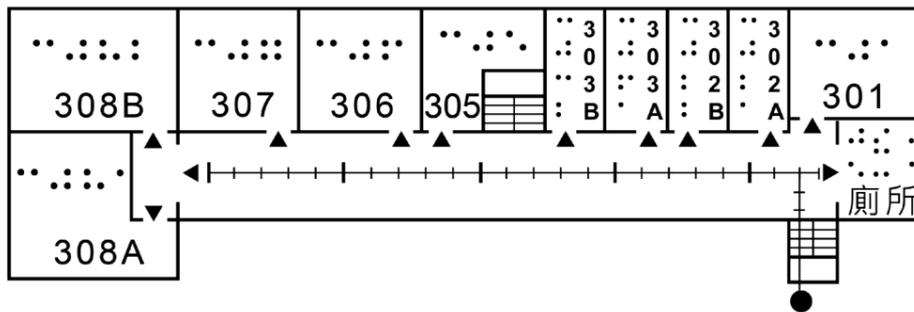


Figure 2: An example of tactile map with guiding line for this study

When the subject finished a task, the experimenter recorded the time period of the task on a recording sheet. During the experiment, subject might take a rest between each task as he wish to. After the subject finished all tasks, the experimenter asked him to evaluate the preference of each guiding line, in a 5-level of Likert Scale that '1' meant 'very unpleasant', '2' meant 'unpleasant', '3' meant 'even', '4' meant 'pleasant', and '5' meant 'very pleasant'. All of the data were input into SPSS for knowing the difference of preference scores among those three guiding lines.

The result told that among those mean response times, there was no significant difference found by an *ANOVA* test. Among those mean preference scores, another *ANOVA* said also that no difference can be found. And by the one mean *t-test*, all of those three types of line have significantly larger mean scores than 3 point. The results tell that those three types of line have the evidence to be the well design element for VIPs at the tactile map.

Conclusion

We designed three types of guiding line for people with visual impairment to follow at the tactile map. Evidence shows those guiding lines are acceptable to the subjects in our first experiment. Though there were no difference shown among task time of them, the subjective opinion rating were all significantly above middle score. The result encourages our design team to design further and also better graphic elements for leading the VIPs to a more suitable environment of using the tactile tool.

In 2009, Johoel, Sowden, Ungar & Sterr revealed that symbol elevation positively inferred the speed and accuracy of symbol identification. They suggested the lower symbol elevation for identification tactile symbol should be 0.040 to 0.080 mm. and the higher the elevation the better the identification rate. In our experiment, the elevation of those tactile lines were 0.5 mm, the 'feeling' of tactile line must be more significant than Johoel's experiment. Those three type of guiding line should be good enough for practical tactile map, we believe. Maybe the next step of research for us could be the design concept of using the suitable type of guiding line at different usage of guiding function, such as one type of line represents the road for car path, another one suggests trail for people. Such test might prime a well design map for VIPs.

Another possible issue is the shape of unit point on the guiding line. From some subject of this test, the graphic on the unit point is important for them to realize how far away to the end point form start. How to get a clear sensation of the unit at the fingertip of user is the question. Of our design team, the answer is not far away because the work at 2016 from us told that a shape with outline circle has the better identification rate than three other outline shapes. Though the pick-up shapes were not many at that investigation, the best shape for the unit point will be identified in the future by our study (Tu and Wu, 2016).

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