

Uncertainty and Mental Workload Among Wayfinding Strategies

Yi Chia Chien, Po An Tsai, Yu Ting Lin, Ssu Min Wu,
Kuan Ting Chen, Yu Ting Han, and Philip Hwang^(✉)

National Taipei University of Technology, Taipei, Taiwan
{tokyol199203, jack78419, rock81222,
rockwu79, guantingdesign, fhjqwefa}@gmail.com,
phwang@mail.ntut.edu.tw

Abstract. Taiwan welcomed 8 million international visitors in 2013. In a study by Chang Hsuan Hsuan [3], subjects had 38 % failure rate in three wayfinding tests. It is obvious that travelers require guidance from time to time during the journey. Normally, travelers use maps; however once feeling uncertainty, they would seek for excessive reassurance from others [2].

This study summarized wayfinding strategies into two kinds. The first one is “turn-by-turn strategy”, in which travelers ask for directions as primary wayfinding information. The second is “map strategy”, in which visitors employ a map for wayfinding. As providing tourists with a piece of map seems to be a regular practice, this study intended to challenge it by examining efficiency, frequency of information inquiry and mental workload in the wayfinding journeys.

In the experiment, we employed “participant observation” and recorded wayfinding process of subjects such as wayfinding behavior and reassurance time and location.

Research findings are as follows:

Those using “turn-by-turn strategy” save time of journey, in other words, they are faster reach the destination than that of “map strategy”.

Those using “turn-by-turn strategy” inquired wayfinding information less frequently, which means less frequently bothered by intolerance of uncertainty.

Locating the position on the map is the major factor for those applying “map strategy” who have high frequency of reading map, and minor for navigation.

Keywords: Wayfinding · Navigation · Anxiety · Intolerance of uncertainty

1 Research Motivation and Purpose

To reduce the negative impact for travelers such as frequency of anxiety generated, this study identifies wayfinding behavior and travelers’ mental workload by using “turn-by-turn strategy” and “map strategy” which can be applied in unknown environments if the target direction is known.

Research aims:

Sorting and comparing wayfinding strategies / Integrating literatures about frequency of information inquiry of travelers.

Reasoning wayfinding behavior, which enables travelers reaching destinations with lower mental workload and less time. When intolerance of uncertainty (IU) increases, travelers tends to check their map/device again. This study aims to investigate the time taken for tourists to develop intolerance of uncertainty due to the inability to navigate, and to determine key factors for the time spent to reach destination.

2 Literature Review

When international travelers in an unfamiliar city to their tourist, the most people use map who accounts for 46 % of all experiments, and in these people also have 51 % would ask people for help, and another 35 % don't use the map just by ask people. The rest 19 % do not rely on these two [3].

Results show most travelers are really depend on local people's help and assistance even they have the map. It shall be noted that the travelers are on the right way as usual, they just have no self-confidence.

2.1 Wayfinding Behavior

Wayfinding is also defined as a behavior with purposiveness, directionality, and motivation. Passengers can choose and follow the designed path through different information and methods, than move to another place [1, 6].

The involved scope of the wayfinding, as how travelers to use the information, how to know where they are and move forward to the destination, how return to the starting point, and so on.

Travelers who want to find way have 21 % would carry map, 15 % would by landmarks, 9 % would use tourist guide book, and only 6 % would use GPS. So in this study, the first group of participants ask natives, the other group only can use map for wayfinding instead of Google map. The affiliated institutions are to be listed directly below the names of the authors. Multiple affiliations should be marked with superscript.

2.2 The Factor Affecting Wayfinding

The factor affecting wayfinding can be divided into external and internal factors [10–13, 18–21]. External factors including the complexity of the space environment, which affect the results of wayfinding is “the number of decision points”, and it's depending on space complexity. Overmuch crossroads or complex moving lines both will increase the wayfinding difficulty. Most external factors can't improve in short time because it along with urban development arising.

The internal factors affecting wayfinding are many [7], like personal qualities, such as comprehension, emotion, sense of direction, preference wayfinding strategies, etc. People's own innate characteristics and ability is difficult to improve by design, but which strategies option is better, what factors can increase confidence and reduce anxiety is designers can observe and improve.

2.3 Wayfinding

According to Gary E. Burnett [5], route guidance systems can be classified according to the means by which information is displayed –see Fig. 1.

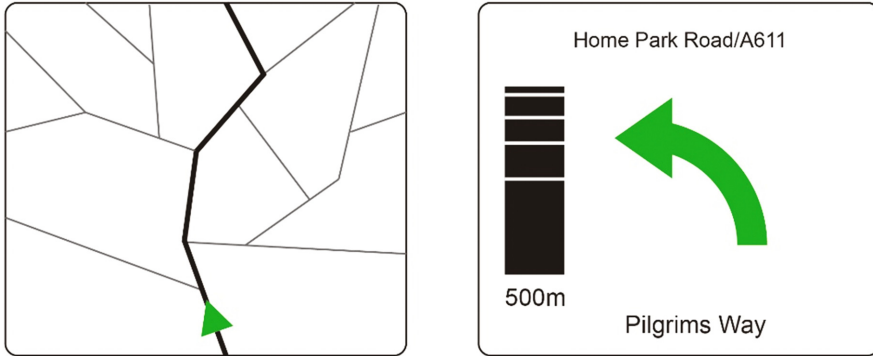


Fig. 1. Examples of route guidance systems: map-based and turn-by-turn-based (basic)

Map-based - the driver is presented with a scrolling map and the vehicle’s current location is indicated by an icon. Early route guidance systems (e.g. the American ETAK™, early versions of Bosch TravelPilot™) did not offer a specific route for the driver to follow, and have been referred to by Parkes et al. [17] as ‘route navigation systems.

Turn-by-turn based- The driver is given instructions (using symbols and often voice messages) relating to the location and direction of each manoeuvre. A system’s processor can choose how much information is extracted from the digitised map, how this is allocated between the modalities and how the information is then represented.

Route guidance strategy also can be used on wayfinding by walk, this study divided subjects into two groups, one is defined as “turn-by-turn strategy”, in which travelers ask natives for way-finding information, the other is “map strategy”, in which visitors employ a map for way-finding.

2.4 Confidence and Anxiety

The individual’s wayfinding confidence will influence their feelings, wayfinding decisions and judgment [4, 16, 22]. Lacking of confidence is prone to anxiety, and it may affect the performance of wayfinding. This study is assumed the wayfinding confidence is inversely proportional to the probability of being lost in an unfamiliar environment, and is directly proportional to the probability of reaching destination.

2.5 Intolerance of Uncertainty and Mental Workload

Intolerance of uncertainty (IU) is one of the Obsessive-Compulsive Disorder (OCD)-related dysfunctional beliefs, and is linked to compulsive checking [15]. Uncertainty usually with anxiety together, difference between the two is Intolerance of uncertainty affect cognition, anxiety affect mood [7].

Parrish & Radomsky and other researchers assumed excessive reassurance seeking is for preventing uncertain disaster. For instance, people will think “if I don’t do something to check, like seeking excessive reassurance, there will be a disaster”. This behavior can lower anxious temporarily, therefore, people are willing to seek excessive reassurance.

“Workload” covers a broad spectrum of activity, but in “mental workload” we limit these activities to the primarily mental and physical coordination ones, such that muscular fatigue is not an important factor [9].

The main aim of this study is to find out the factor which influence confidence and produce anxiety.

3 Research Methods

To compare “turn-by-turn strategy (ask for route)” and “map strategy (reading map)”, experiments conducted should show significant difference in mental workload and tolerance in anxiety tolerance frequency.

3.1 Measurement

In the experiment, there were twelve subjects who have never been to the task location. They were divided into two groups, and every subject had to finish task alone. In each task, there were one observer with a subject, recording the process by camera in 10-20 m away from the subject.

Subjects in the first group used “turn-by-turn strategy”, which means travelers mostly ask whoever they can find for destination information. While subjects in the other group had to rely on “map strategy”, in which visitors did not have interaction with other people but only the map.

The research method was “participant observation”, in which we recorded a video, observing difference between two strategies. According to the results from experiment, we may calculate the minimum anxiety tolerance frequency in wayfinding process, and factors affecting the frequency.

3.2 Procedure

Normally, the task route should not be too easy to achieve or too short. According to a study by Jian Liang Liou and Ting-Wei Wu, the acceptable walking distance for ordinary people is approximately 400 ~ 800 m. In addition, it must be a regular tourist Route.

From the above suggestions, we chose a task route from “MRT Houshanpi Station” to “Raohe Street Night Market”, about 1 km along Fig. 2.



Fig. 2. Task route (source: google map)

From an interview with an observer (turn-by-turn strategy), it is noticed that a subject asked for people more frequently while taking more turns. It was seasoned to correlate with disturbing the sense of direction.

A subject (turn-by-turn strategy) expressed that, during the experiment, if he got an uncertain sign such as walking along certain direction for 5 min, he would feel quite unreliable. Nevertheless, once he was given a sign as traffic light or a convenience store, he had great confidence to find it and executed the next step. He also indicate that asking people for the destination is not only for knowing the destination but for knowing where he was.

Thus it is significant to have recognizable signs while finding destination in an unfamiliar area.

4 Analysis

In the experiment, subjects are divided into two groups to complete the wayfinding task, one group use “map strategy”, the other use “turn-by-turn strategy”. Then, record the time respectively when subjects reading map or asking directions. Identify the difference between two strategies, and analysis the time interval of rechecking and asking direction respectively. Task Analysis of Using Map Strategy for Wayfinding.

4.1 Task Analysis of Using Map Strategy for Wayfinding

In the experiment of map strategy, frequency of reading map consider as checking frequency, 6 subjects participated in this experiment, the frequency of map reading is: 68, 30, 28, 21, 12, 16, and the average of spent time is 20:36 min (Table 1).

Table 1. Results of map strategy

Experimental groups	Subjects number	Frequency of map reading	Spent time
Using map strategy for wayfinding	A	68	17:50 min
	B	30	20:21 min
	C	28	26:03 min
	D	21	16:46 min
	E	12	20:36 min
	F	16	23:20 min
	average of spent time		20:36 min

There’re some extremely short and long interval among the Time Interval Record (Fig. 3):



Fig. 3. Time interval record (subjects A-F) (Color figure online)

As the Fig. 3 above shows, if the time interval is shorter than 30 s, the information called short-term memory. In the situation of no recheck and no rehearsal, the duration of short-term memory seems to be between 15 and 30 s [8].

Peak position (marked as blue circle) is “Attention Span”. Attention span is the amount of concentrated time one can spend on a task without becoming distracted. Most educators and psychologists agree that the ability to focus attention on a task is crucial for the achievement of one’s goals. From interview with subjects after the experiments, it is revealed that subjects have a tendency to remember a series of order after reading a map. Once finish this task or feel anxious, they will repeat this action for several times until reaching the destination. The time before peak may represent the path is simple, therefore, the subjects didn’t need to ask for the information, and it took longer time before feeling uncertainty. The time span of the above action is described as frequency of “intolerance of anxiety” [2]. As shown by graph, the average cycle of intolerance of anxiety is 2 min 44 s.

4.2 Task Analysis of Using Turn-by-Turn Strategy for Wayfinding

In the experiment of turn-by-turn strategy, subjects would ask for direction as checking frequency when they being intolerance of uncertainty. 6 subjects participated in this experiment, the frequency of ask for directions is: 3, 3, 5, 2, 2, 3, and the average of spent time is 19:26 min (Table 2).

Table 2. Results of Turn-by-turn Strategy

Experimental groups	Subjects number	Frequency of ask for directions	Spent time
Using turn-by-turn strategy for wayfinding	G	3	18:55 min
	H	3	16:40 min
	I	5	25:09 min
	J	2	17:00 min
	K	2	23:20 min
	L	3	18:00 min
	average of spent time		19:26 min

As the Fig. 4 above shows, there will be tendency that a period of adjacent destination inquire getting longer. This phenomenon can also be psychological literature “reinforcement” to explain.

In behavioral psychology, reinforcement is a consequence that will strengthen an organism’s future behavior whenever that behavior is preceded by a specific antecedent stimulus. This strengthening effect may be measured as a higher frequency of behavior, longer duration, greater magnitude, or shorter latency. The behavior with positive consequences tends to be repeated, and the behavior called “Reinforcement. For example: A father gives candy to his daughter when she picks up her toys. If the frequency of picking up the toys increases, the candy is a positive reinforcement (to reinforce the behavior of cleaning up).

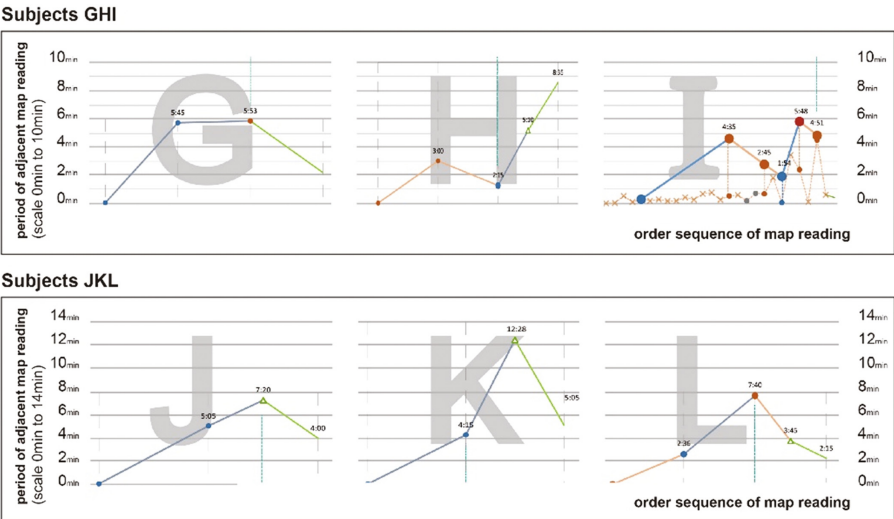


Fig. 4. Time interval record (subjects G-L)

In the task of using turn by turn-strategy for wayfinding, the behavior of “finish the indication from other” is reinforcement, when subjects finish the indication successfully would produce confidence, and anxiety will decrease so it makes time of feeling intolerance of uncertainty longer.

In this experiment, period of adjacent destination inquire is about 5 min.

4.3 Summary of Experiment

According to the experiment result, the time of using map strategy is longer than using turn-by-turn strategy. Furthermore, the rechecking times of using map strategy is more than using turn-by-turn strategy, in other words, the mental workload of reading a map is higher (Table 3).

Table 3. Comparison of Two Strategies

	Average of spent time	The rechecking times	Period of intolerance of uncertainty
Using map strategy for wayfinding	20:36 min	29	2:44 min
Using turn-by-turn strategy for wayfinding	19:26 min	3	5:00 min

5 Conclusion

Wayfinding is every traveler will happen when they in unfamiliar environment, this behavior also necessary to do in the trip for promote Taiwan tourism industry, designers can think how to give them a better wayfinding experience. This paper analyze “turn-by-turn strategy” and “map strategy”, compare which strategy is more suitable for use and has lower mental workload in unfamiliar environment.

Based on the synthetic study result above, the study found out:

1. Those using “turn-by-turn strategy” save time of journey, in other words, they are faster reach the destination than that of “map strategy”.
2. Those using “turn-by-turn strategy” inquired wayfinding information less frequently, which means less frequently bothered by intolerance of uncertainty.
3. Locating the position on the map is the major factor for those applying “map strategy” who have high frequency of reading map, and minor for navigation.

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