Taiwanese People's Wayfinding Personas and Tool Preferences

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Abstract. Improving wayfinding system design is a challenge facing hospitals today, and as such this study seeks to improve the design of wayfinding systems by understanding patient routing patterns, wayfinding strategies, and wayfinder tool preference. The methodology of this study has three stages: The first is to administer the Wayfinding Strategies and Related Capabilities Survey [1] to a Taiwanese sample, and then to conduct a factor analysis to isolate important factors. Test subjects included 178 Taiwanese from different professional and education backgrounds. The second stage is based on the ratings of five wayfinding tools used by subjects (Google Maps, map signage, Hand-drawn maps, bystander assistance, and directional signage). A correlation analysis of the helpfulness of the tools and the factors isolated in stage 1 is conducted to separate the subjects into different wayfinding personas. The third stage is conducting interviews of exemplars of the personas found in the second stage. A factor analysis is conducted on the results of the survey, and important survey items are identified. Subjects are divided into one of the following 8 wayfinding personas based on their Wayfinding Ability and Wayfinding Strategy (survey or map strategy): Improvisational, Helpless, Capable, Brute Force, Orienteer, Road-Blind, Map Consultant, and Map-Blind. We advise that prospective designers of smart devices should, in addition to the current functions of Google Maps, consider the habit of hospital users to seek help, as well as the needs of the visually impaired.

Keywords: Wayfinding design · Wayfinding persona · Wayfinding strategy · Wayfinding tools · Wayfinding ability

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1 Introduction

Along with the great changes this generation has seen in the environment, many foreign medical centers are beginning to consider the importance and factors of innovation, and have thus begun rethinking their approach to improving user experience in a healthcare environment. When it comes to enhancing quality of care, now more than ever it is "out with the old and in with the new" when it comes to the development of medical processes, spaces, or products. Designers should, with a similar mindset, develop more innovative and practical designs for the medical field, such as management and inspection tools for assisting with medical decision-making, biometrics, home patient monitoring, healing environment design, etc. [2]. Wayfinding design is no exception. Recent advancements in science and technology have provided designers with many more choices of intelligent wayfinding tools. Future wayfinding designs will no longer be limited to additional floor plans in buildings, directional labeling, simple signage, and other such traditional wayfinding marking systems, but will also include technology such as smart wristbands, interactive signage, and iBeacon implementation [3].

Current interior space wayfinding equipment typically emphasizes information kiosks [4], indoor maps, and building markings. In recent years due to the popularity of the smart phone the availability of Google Maps has become more and more ubiquitous, and with modern people relying on it more and more, "smart" wayfinding design is an inevitable trend. However, while concerns about the development of hardware are well-founded, it is also important to match such hardware with user-centered software design. This requires the analysis and evaluation of the wayfinding behaviors, strategies, and tools utilized by users within indoor spaces. Doing so can only further enhance the user experience of the hospital.

2 Objective

This study's purposes are twofold: (1) To explore the wayfinding behaviors and wayfinding strategies of hospital visitors to classify Taiwanese hospital users into various wayfinding personas, and (2) to conduct interviews for each of the different wayfinding personas to help understand the wayfinding tool evaluation, expectations, and needs of each persona. We hope to care for the needs of a variety of hospital users in regards to wayfinding, and make recommendations for "smart" hospitals' future development of wayfinding tools.

3 Literature Review

In order to achieve the above objectives, we will first review the literature, including relevant articles for (1) understanding user wayfinding behaviors and how people choose wayfinding environmental information, (2) understanding user wayfinding strategies, (3) analyze the factors that influence user wayfinding, and (4) look for wayfinding strategy and capability literature to use as a reference for designing a questionnaire that can be added to the wayfinding survey tools currently used in modern indoor wayfinding design.

3.1 Wayfinding Behaviors

Wayfinding behaviors refers to all of the behaviors and cognitive responses of people in the context of purposeful travel [5]. When wayfinders are not familiar with the space they are in, and when they have done no preparatory work in advance (such as querying landmarks or obtaining a map), if there is time- or task-related pressure that causes anxiety, and the wayfinder will be forced to obtain useful information from the environment to and subsequently develop a wayfinding strategy.

Environmental Information Relating to Wayfinding. Experts have divided wayfinding data into three types: building information, circumstantial information, and language messages. Building information refers to elevators, stairs, partitions, walkways, and other building structures. Circumstantial information is attached to the structure of the building, such as signs, landmarks, and drawings. Language information includes spoken messages communicated by management services or by others [6, 7].

Wayfinding Options. After obtaining wayfinding information, people face a choice. Typically speaking, under normal wayfinding circumstances, the choice includes the following four subtasks [8]:

- Positioning: Use surrounding objects and try to determine the location of oneself in relation to the desired destination.
- Select one's path in accordance with the general direction of the desired destination.
- Monitor the route and direction to ensure that the current path is the correct one.
- Confirm and identify the desired location.

Confirming the position of oneself is the starting point of spatial cognition. When people determine their location, they need both building and environmental characteristics [9]. Maps are an ideal source of information about one's current location, and Devlin and Bernstein [9] discovered that, while on a school campus choosing environmental information, wayfinders will choose a map (69.8%), followed by directional signage second (53.3%), and then following a crowd (32.6%) or asking for directions (27.9%) [10]. Landmarks are another important source of information students rely on to confirm their location [11].

Wayfinding Strategies. When people encounter wayfinding problems, in order to solve the problem they will use collected routing information. How this information is applied is known as "wayfinding strategies," and varies from person to person and according to local conditions [12, 13].

Wayfinding strategies include survey strategies and route strategies. In a series of studies related to wayfinding strategies, Lawton [14] found differences in the use of wayfinding strategies between men and women. Women used route strategies more frequently, while men tended to use survey strategies. Routing strategies rely on using a series of directional markers to help determine the correct direction of travel, such as using landmarks or distinctive buildings to identify the correct path. Survey strategies are also called orientation strategies, and utilize an entire cognitive map to organize information on places and the links between them [14].

Survey strategies and route strategies are independent but not mutually exclusive, and wayfinders typically use both but with a tendency towards one or the other, rather

than use one strategy exclusively. For example, Kato and Takeuchi [15] found that individuals who perform particularly well during wayfinding use both strategy types at the same time.

3.2 Individual Wayfinding Factors

Chen [16] found that factors affecting wayfinding effectiveness can be divided into individual factors, environmental factors, and social factors. Environmental factors include architectural design and environmental information, and social factors include group behaviors and education.

Among the above factors associated with indoor wayfinding, this study is primarily concerned with individual factors. Gärling et al. [17] and Kitchin [18] pointed out that an individual's ability to wayfind is affected by many factors, including their awareness of orientation, familiarity with their environment, wayfinding strategy preferences, gender differences, and others. Additionally, another individual factor influencing wayfinding ability is one's ability to read maps, which is related to reading speed, image memory, and cognition. Reading speed is, in turn, related to age, intelligence, and education. Image memory and cognition also affects how well one can apply wayfinding data [19].

By understanding individual factors of Taiwanese people's wayfinding as well as their preferred wayfinding strategies and tools, they can be sorted into categories of wayfinding personas. We expect an in-depth analysis of the differences in wayfinding strategies and mediums among these personas will allow us to put forward a more comprehensive and complete vision for future smart wayfinding systems.

3.3 Questionnaire Design

Chang and Ma [1] established a wayfinding behavior rating scale, developed measurement indicators of wayfinding ability, and, in different wayfinding situations, surveyed college students to collect wayfinding data and analyze it with Item Response Theory (IRT) and the Rasch model in a quantitative study of the difficulties and mental states encountered by wayfinders. The present study used the psychometric wayfinder questionnaire developed by Chang and Ma as its blueprint in measuring the wayfinding ability of (including awareness of orientation and route memory), participants' spatial anxiety while wayfinding, and wayfinding strategy preferences, in an attempt to, in accordance with the resulting individual wayfinding personas, facilitate the design of appropriate wayfinding markings, systems, and equipment to assist every type of hospital visitor.

4 Method

This study is divided into three stages:

1. In accordance with wayfinding psychometrics, we designed the Wayfinding Strategies and Related Capabilities Survey. We attempt to, through a factor analysis of the resultant data, induce the important factors of Taiwanese wayfinders.

2. In accordance with those important factors, subjects were classified into several different wayfinding personas.
3. Interview an exemplar of each wayfinding persona to understand the differences and similarities between indoor and outdoor wayfinding, typical assessments of existing wayfinding tools, and recommendations for future wayfinding tools.

4.1 The First Stage: The Wayfinding Strategies and Related Capabilities Survey

The Wayfinding Strategies and Related Capabilities Survey is composed of three parts: (1) First, subjects are asked for standard descriptive statistics such as age, gender, and education; (2) the second part uses the five-point Likert items from the questionnaire for the wayfinding ability of college students designed by Chang and Ma [1] to assess subjects' ability to deal with wayfinding problems (6 awareness of orientation items and 10 route memory items), the degree of anxiety in dealing with wayfinding problems (7 items), and wayfinding strategy (8 survey strategy items and 5 map strategy items). Because we are only concerned with indoor wayfinding strategies, items relating to the outdoors were revised[1] or deleted[2]. (3) In the third part, subjects were assessed with four-point Likert scale focused primarily on the degree each different type of wayfinding tool assisted with wayfinding behaviors.

Subjects included 178 people ranging between the ages of 18 to 80 years from either Taipei or HsinChu, Taiwan, separated into four generational categories: 18–30 (N = 91), 30–50 (N = 46), 50–60 (N = 26), and 60 and up (N = 8). In the sample, 71 were male, 106 female, and 1 undesignated. Education was divided into three categories: middle-school graduates (N = 3), 10th grade through some college experience (N = 82), bachelor degrees (N = 84), and other (N = 9).

The first part of the study was primarily focused on gathering the data necessary for stage 2 from the 178 subjects, including data on 36 items covering 36 variables. However, we believe that when it comes to dividing subjects into wayfinding personas, 36 is too many, and thus whenever possible attempted to reduce the number of items (please see Sect. 5.1 for the process and results).

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[1] Items that were revised include: In item I-5, "While traveling, I kept track of the relationship between where I was and the center of town," "the center of town" was changed to "my destination"; in item I-6, "I make a mental note of the distance I had traveled on different road." "On the different road" was changed to "in the different corridor"; in item I-7, "While traveling, I visualized a map or layout of the area in my mind as I drove," "as I drove" was changed to "as I went"; in item II-2, "I made mental note of landmarks, such as buildings or natural features, that I passed along the way." was changed to "I will remember any special landscapes or wall patterns (or works of art) I see along the way".

[2] Items deleted include the following four: "I kept track of where I was in relation to the sun (or moon) in the sky as I went"; "I find it difficult to find where I parked my car in a large parking lot"; "When finding my way to an appointment in an unfamiliar area of a city or town, I find it difficult to locate the correct roads"; "When I take the bus, train, or mass rapid transit system, I will often take the wrong car and end up going in the opposite direction".

From the above factor analysis we found that there are in total four important factors that can be used to categorize Taiwanese wayfinding personas. We named these four factors Wayfinding Ability, Wayfinding Anxiety, Survey Strategy, and Map Strategy.

4.2 The Second Stage

In order to categorize wayfinding personas, this study used a Pearson correlation analysis to compare the relationships between the four major factors (Wayfinding Ability, Wayfinding Anxiety, Survey Strategy, and Map strategy) and subject wayfinding tool preference (for the process and results please see Sect. 5.2). From the four factors, three were significantly correlated with wayfinding tools subjects found useful, and all subjects were subsequently categorized into eight different wayfinding personas according to these three (for the process and results, please see Sect. 5.4). Additionally, the Pearson analysis was used to compare the correlations between various wayfinding tools in the hopes of discovering synergistic effects, if any (for the process and results, please see Sect. 5.3).

4.3 Stage 3

For each of the wayfinding personas, we tried to find one subject that could act as an exemplar and participate in a semi-structured interview. Within the study's time limit, we were only able to find and conduct individual interviews for six different exemplars.

Those interviewed mainly ranged between 30–55 years of age, with 5 men and 1 woman, all of which had bachelor degrees. The goals of the interview were threefold: (1) to understand the differences among subjects in outdoor and indoor wayfinding, as well as their wayfinding tool preferences; (2) to understand the assessments and recommendations from each type of wayfinder for each specific type of wayfinding tool (Google Maps, map signage, Hand-drawn maps, bystander assistance, and directional signage); and (3) to collect recommendations for future wayfinding tools from each wayfinding persona. The process and results are listed in Sect. 5.4.

5 Results and Discussion

5.1 Questionnaire Analysis Results

As for the second set of data gathered by the questionnaire, that is, the subjects' wayfinding ability and strategy self-assessment, we conducted a five-stage factor analysis, where we conducted five separate factor analyses, each time reducing the number of variables. Of the first four factor analyses, the worst results from KMO tests were KMO values that were more than 0.888, and Batlett's spherical test values always surpassed the .01 significance threshold, meaning that the data were suitable for a factor analysis. Factor extraction was performed by principal component, and factors were extracted one at a time. Because statistical analyses are not the focus of this study, only the final factor analysis will be reported (see Table 1).

Table 1. Final factor analysis results

	Factor 1	Factor 2	Factor 3	Factor 4	Communality
Eigenvalues	7.272	3.074	1.474	1.063	.764
% Variance explained	38.274	16.178	7.755	5.597	.719
Cumulative % variance explained	38.274	54.452	62.207	67.805	.769

Examining the resultant data using the KMO and Batlett's tests reveals that the KMO value of the final factor analysis is .902, the Batlett Spherical test value is 1860.319, and the degree of freedom is 171, which achieves a .01 level of significance, and means the data is suitable for factor analysis. To obtain results, factors were extracted by principal component analysis, along with the Varimax method (see Table 5): Only four factors were extracted with eigenvalues greater than 1. After the elemental matrix was rotated, it was confirmed that there are no items with a maximum factor load of less than 0.6, and therefore we maintained a total of 19 variables.

From the above factor analysis, we reduced the original 36 items on wayfinding personas to a mere 19, and we found that there are four important factors that can be used to classify Taiwanese wayfinder personas. We named these four factors, in accordance with their inherent qualities, as Wayfinding Ability, Wayfinding Anxiety, Survey Strategy, and Map Strategy: Wayfinding Ability is the ability of the subject to deal with wayfinding problems, including their awareness of orientation and route memory; Wayfinding Anxiety is the degree of spatial anxiety the subjects feel when confronted with any sort of wayfinding task (5 items); a Survey Strategy is any strategy where someone seeks to understand the distance and direction of the overall path, as well as each individual path, during wayfinding (4 items); Map Strategies include those where subjects use a map to gain information on where they are and where to go (2 items).

5.2 Factors Correlating to Wayfinding Personas

We used a Pearson's correlational analysis to understand any relevance and degree of benefit between the four individual factors and the five wayfinding tools presented in the third part of the questionnaire (Google Maps, map signage, Hand-drawn maps, bystander assistance, and directional signage; see Table 2). It was found that there was no significant correlation between Wayfinding Anxiety and the four important wayfinding factors, that is, whether a subject feels anxiety during wayfinding has no significant correlation with what tool they prefer. The other three categories (Wayfinding Ability, Survey Strategy, and Map Strategy) were more-or-less relevant to the tools subjects considered useful (See Table 2). Therefore, we used Wayfinding Ability, Survey Strategy, and Map Strategy to classify Taiwanese people's wayfinding personas.

Wayfinding Ability (Potential to Become Lost). Items associated with Wayfinding Ability are all inversely scored, that is, they let subjects assess how likely they are to get lost, including their awareness of orientation and route memory. On these items a

Table 2. Wayfinding factors and their correlations with wayfinding tools

		VI-2. Google map	VI-3. Map signage	VI-4. Hand-drawn maps	VI-5. Bystander assistance	VI-6. Directional signage
Wayfinding ability	Pearson correlation	−.125	−.182*	−.143	.071	−.173*
	Significance (two-tailed)	.100	.016	.060	.353	.023
Wayfinding anxiety	Pearson correlation	−.022	−.140	−.100	−.062	−.072
	Significance (two-tailed)	.778	.065	.188	.415	.345
Survey strategy	Pearson correlation	.324**	.141	.185*	.032	.120
	Significance (two-tailed)	.000	.063	.014	.679	.115
Map strategy	Pearson correlation	.040	.305**	.210**	.110	.171*
	Significance (two-tailed)	.596	.000	.005	.150	.025

high score indicates that subjects have a poor awareness of orientation or bad route memory, and thus easily feel confused during wayfinding. Low scores indicate that the subject has a strong awareness of orientation and a superior route memory, and is less likely to get lost. The Pearson correlation coefficients showed that the wayfinding tools most associated with Wayfinding Ability were map signage ($r = -.183^*$, $p = .016$) and directional signage ($r = -.173^*$, $p = .023$). This shows that for those with high Wayfinding Ability, their preferred tool is map signage followed by directional signage. Please see Table 3 for the related items.

Table 3. Wayfinding ability related questionnaire items and results

Factors related to awareness of orientation	
1	I can't make out which direction my hotel room faces
Factors related to route memory	
1	I have a lot of difficulties reaching the unknown place even after looking at a map
2	I have poor memory for landmarks
3	I become totally confused as to the correct sequence of the return way as a consequence of a number of left-right turns in the route
4	I often can't find the way even if given detailed verbal information on the route
5	I often (or easily) forget which direction I have turned
6	I cannot remember landmarks found in the area where I have often been
7	I can't verify landmarks in the turn of the route

Survey Strategy. For Survey Strategy, high-scoring subjects are those who make good use of survey strategies, tend to understand their entire journey before venturing forth, and will prepare mental maps of their destination and how to get there. The Pearson correlation coefficient showed that the wayfinding tools correlated with Survey Strategy include Google Maps ($r = .324^{**}$, $p < .001$) and handheld maps ($r = .185^{*}$, $p = 0.14$). People who tend to use a survey strategy are more likely to select Google Maps as their wayfinding tool of choice, followed by using Hand-drawn maps. Please see Table 4 for the related items.

Table 4. Survey strategy related questionnaire items and results

1	Before starting, I asked for directions telling how far to go
2	I make a mental note of the distance I had traveled in different corridors
3	I visualized a map or layout of the area in my mind as I walked
4	Before starting, I asked for directions telling me whether to go east, west, north or south at particular streets or landmarks

Map Strategy. Subjects with a high score in Map Strategy use maps well, and tend to find a map before departure for wayfinding reference. The Pearson correlation coefficient showed that the wayfinding tools associated with a subject's Map Strategy include map signage ($r = .305^{**}$, $p < 0.001$), Hand-drawn maps ($r = .210^{**}$, $p = 0.005$), and directional signage ($r = .171^{*}$, $p = 0.025$). The more people are inclined towards using route strategies, the more they tend to find traditional wayfinder tools, such as maps and labels, useful. Please see Table 5 for the related items.

Table 5. Questionnaire items correlated to map strategy

1	Before starting, I asked for a hand-drawn map of the area
2	I referred to a published map

70% of subjects felt that Google Maps was helpful while wayfinding. 41% felt that map signage was helpful. 38.8% of subjects thought Hand-drawn maps were helpful. 55.6% found bystander assistance helpful. 54.5% felt that directional signage was helpful (Table 6).

Table 6. Helpfulness of wayfinding tools

	Wayfinding tool	Helpful	Unhelpful
1	Google map	70%	30%
2	Map signage	41%	59%
3	Hand-drawn maps	38.8%	61.2%
4	Bystander assistance	55.6%	44.4%
5	Directional signage	54.5%	45.5%

5.3 Correlations Between Wayfinding Tools

The results of the correlational analysis show that, besides the relationship between Google Maps and bystander assistance, all the other tools showed significant relationships. Of these, only map signage and Hand-drawn maps achieved a strong correlation ($r = .785^{**}$, $p < .001$), whereas bystander assistance and directional signage ($r = .506^{**}$, $p < .001$); and bystander assistance and map signage ($r = .462^{**}$, $p < .001$) achieved moderate strength correlations. Bystander assistance and Hand-drawn maps ($r = .253^{**}$, $p = .001$); Google Maps and Hand-drawn maps ($r = .159^{*}$, $p = .034$); and Google Maps and directional signage ($r = .199^{*}$, $p = .008$) only demonstrated weak correlational relationships. Please see Table 7 for details.

Table 7. Correlations between wayfinding tools

		Google maps	Map signage	Hand-drawn maps	Bystander assistance	Directional signage
Google maps	Pearson correlation	1	.253**	.159*	.076	.199**
	Significance (2-tailed)		.001	.034	.313	.008
Map signage	Pearson correlation	.253**	1	.785**	.425**	.462**
	Significance (2-tailed)	.001		.000	.000	.000
Hand-drawn maps	Pearson correlation	.159*	.785**	1	.464**	.496**
	Significance (2-tailed)	.034	.000		.000	.000
Bystander assistance	Pearson correlation	.076	.425**	.464**	1	.506**
	Significance (2-tailed)	.313	.000	.000		.000
Directional signage	Pearson correlation	.199**	.462**	.496**	.506**	1
	Significance (2-tailed)	.008	.000	.000	.000	

These results mainly reflect three phenomena: (1) Subjects that use Google Maps and subjects that believe in the usefulness of bystander assistance are unrelated. (2) Subjects that rely heavily on maps of any kind can be considered one social group, and this group, based on previous data demonstrating that these subjects also tend to have high Survey Strategy scores, can be shown to be able to convert abstract map data to real-world wayfinding information. (3) Subjects will interact with a multitude of wayfinding tools. For example, while subjects are asking bystanders for directions, they will simultaneously check maps and directional signage.

5.4 Wayfinding Personas

Because the above Pearson correlational analysis demonstrates that subjects do not feel there is any relationship between whether or not subjects found any particular way

finding tool to be useful and wayfinding anxiety, we excluded wayfinding anxiety variables and only used Wayfinding Ability, Survey Strategy, and Map Strategy to categorize the subjects into the following eight types of wayfinding personas (see Table 8): Improvisational, Helpless, Capable, Brute Force, Overall Wayfinding Strategist, Road-Blind, Map Consultant, and Map-Blind.

Of these eight personas, subjects categorized into Improvisational, Capable, Overall Wayfinding Strategist, and Map Consultant all include subjects with Wayfinding Ability scores of less than zero, meaning they don't get lost easily; whereas Helpless, Brute Force, Road-Blind, and Map-Blind all include subjects with Wayfinding Scores above zero, meaning they get lost easily.

Wayfinding strategies can be divided into two types: survey strategies and route strategies. Of subjects that did not make use of any strategy, those with positive Wayfinding Ability scores were categorized into Improvisational, whereas those with negative Wayfinding Ability scores were categorized as Helpless. Of subjects that made use of route strategies, those with positive Wayfinding Ability scores were categorized into Map Consultant, whereas those with negative Wayfinding Ability scores were categorized into Map-Blind. Of subjects that made use of survey strategies, those with positive Wayfinding Ability scores were categorized into Overall Wayfinding Strategist, whereas those with negative Wayfinding Ability scores were categorized into Road-Blind. Of subjects that used both types of strategies, those with positive Wayfinding Ability scores were categorized into Capable, whereas those with negative Wayfinding Ability scores were categorized into Brute Force (see Table 8).

Table 8. The eight wayfinding personas

Wayfinding persona	Improvisational	Helpless	Capable	Brute force	Orienteer	Road-blind	Map consultant	Map-blind
Wayfinding strategy	None		Both survey and map strategies		Survey strategy		Map strategist	
Wayfinding ability	High	Low	High	Low	High	Low	High	Low
N	27	20	26	24	29	14	20	18
Percentage of total sample	15.2%	11.2%	14.6%	13.5%	16.3%	7.9%	11.2%	10.1%

5.5 Wayfinder Persona Interview Results

If hospitals of the future wish to develop smart wayfinding devices, we need to first understand what tools people use during wayfinding. Therefore, the last stage of this study was interviewing eight exemplars of each of the wayfinding personas to understand their views on wayfinding tool usage and their expectations for the future implementation of indoor smart wayfinding tools within hospitals. Because of time restraints, we were only able to interview six of eight exemplars. All of the exemplars were between 30 and 50 years of age, and had attained a university degree. Five were men, and one was a women. They each belonged to one of the following six

wayfinding personas: Improvisational, Overall Wayfinding Strategist, Capable, Helpless, Map-Blind, and Road-Blind. The outline of the interviews are detailed below:

1. Wayfinding persona self-assessment: The wayfinding tools utilized at each stage of wayfinding and the wayfinding process for each wayfinding persona in a hospital setting.
2. Wayfinding tool evaluation: Individual evaluations by the exemplars for each type of wayfinding tool (Google Maps, map signage, Hand-drawn maps, bystander assistance, and directional signage).
3. Imagined future wayfinding tools: Suggestions by the exemplars for the creation of future wayfinding tools.

Wayfinding Personal Self-assessment and Wayfinding Tool Evaluation. The results of the interviews showed that the wayfinding tool preferences of the exemplars can be roughly divided into two parts: before wayfinding and during wayfinding.

Before Wayfinding. The large majority of the exemplars would, before departing, look up data relevant to their journey. Before Google Maps was released, these data were divided into "directions from friends or relatives" (as described by the Helpless exemplar) and "finding a map" (by the Orienteer exemplar). However, in the current Internet age, every single exemplar admitted to first checking Google Maps before departing. The only differences existed in whether or not they printed out a copy of the map, or wrote down detailed notes.

During Wayfinding

- Google Maps

  1. The large majority of respondents agreed that accessing Google Maps on their handheld device was helpful, and that smart wayfinding devices will continue to trend into the future. If future hospital wayfinding design includes an indoor map application like Google Maps, so long as the data is accurate, download is convenient, and the user interface is clear, wayfinders will definitely download and use it.
  2. The most helpful part of Google Maps was its ability to key in the desired destination directly, thus allowing the user to display a representation of where the destination was in relation to where the user was located.
  3. Subjects with low Survey Strategy scores preferred to follow the route pre-planned by Google, while subjects with high Survey Strategy scores had no need to rely on such assistance, and just maintained a mental map that would allow them to walk in the correct direction, according to their own preferences.
  4. Subjects with high Map Strategy scores liked to reference the map and possible route functions, whereas subjects with low Map Strategy scores relied on the textual instructions and street view features of their device. Subjects with low Map Strategy scores reported that they could not translate the two-dimensional map into the three-dimensional world, and thus could not rely upon the Google Maps overview or visualized route-planning functions. Instead, they use Street View to try and find landmarks to verify that their route was correct.

5. When it comes to subjects whose Wayfinding Ability is high, maps, Google Maps, and directional signage were all highly effective wayfinding tools. However, when it came to the three personas with low Wayfinding Ability, because their route memory and awareness of orientation are poor, they rely more upon step-by-step textual instructions, and need a reference to guide them through turns. The Map-Blind and Road-Blind exemplars hoped that future smart wayfinding design will have sounds or vibrations that report their future steps in advance and notifies them whenever they take a wrong turn, as well as clearly marked elevators and important intersections.

- Asking for directions

1. The interviews revealed that, although most of the exemplars used some form of navigational device indoors, that within a hospital they habitually seek out information-services personnel. Because, typically speaking, finding one's way indoors is a simple matter, they often only had to ask for directions once or twice before finding their destination. It is so convenient that, currently, spending the extra effort to download a new APP would be uneconomical.
2. Four of the six exemplars would, in a hospital, seek out information-services personnel or bystanders for directions. Only the Capable and Overall Wayfinding Strategist exemplars preferred not to do so. Both of these personas have excellent wayfinding abilities, the ability to understand maps, trust in their passing investigations, and trust in the planning and designs behind official information, and thus would only ask for directions when they are in a rush.
3. Effective ways to guide: When bystanders were offering directions, the exemplars hoped that the bystander could inform them of the floor, distance, direction of their destination, as well as relevant landmarks and signboards that would be nearby.
4. The exemplars pointed out that if all of the information presented by the bystander would lead them past three or more turns, they would have trouble remembering the directions. If bystanders sent them on a route with more than three turns, the exemplars hoped that these bystanders would be able to provide them Hand-drawn maps or written notes for reference, otherwise they'd end up having to ask someone else for directions later on. We refer to this phenomenon as the "three-turn rule."

- Hand-drawn maps

1. Exemplars noted that if the directions for their route surpassed three turns, hand-held maps would be useful.

Suggestions for Future Wayfinding Devices

- Device aspects

1. Of the six exemplars, five felt that in the future, should an indoor navigation device be released, that they would try using it. The only exception was the older woman exemplar of the Helpless persona, who said she would not use it.

2. As for opinions on wristbands or health-insurance cards with built-in chips, in addition to the potential added costs to the hospital, the extra work of renting or fixing the equipment may affect the willingness of wayfinders to utilize such tools.
3. Camera equipment in hospitals could be enhanced with facial recognition software that could pick up on an individual's face. This method does not require many external costs to the hospital, as they already have camera systems in place. However, this would raise privacy issues such that if facial recognition software was to be used, hospitals would need privacy protection mechanisms in place.

- Aspects of service design

1. Functions that allow for one to ask for directions: Five of the exemplars would, more than half the time, seek out service personnel whenever asking for directions. The results of our study show that subjects who use Google Maps do not ask for directions, and that those who ask for directions don't use Google Maps. Among the six exemplars, the exemplar for Capable did not like to ask for directions because the information they gather from their own planning efforts tends to be more reliable. In summary, when developing future smart wayfinding equipment, besides the functions already available on Google Maps, the ability to ask for directions or other humanized systems could be integrated into any new smart navigation equipment. This would help hospital wayfinders in the habit of asking for directions get official information.
2. Notification sounds and vibrations. Future smart wayfinding devices should, in advance, provide notification sounds or vibrations to report which direction wayfinders' should go and notify them whenever they take a wrong turn. These functions would also help the visually impaired.
3. Functions beyond wayfinding: Suggestions for the elderly included adding features for homecare, appointment reminders, and registration inquiry into the wayfinding device. The exemplar for Map Consultant also suggested that future devices could include a group positioning function, to allow for friends and family to find each other within the hospital.

6 Conclusion

6.1 Wayfinding Personas

We found that there are, in total, four major factors that can be used to categorize Taiwanese wayfinding personas: Wayfinding Ability, Wayfinding Anxiety, Survey Strategy, and Map Strategy. Of these, only three were correlated to wayfinding tool preference: Wayfinding Ability, Survey Strategy, and Map Strategy. From these three factors, we separated all of the surveyed subjects into one of the following eight personas: Improvisational, Helpless, Capable, Brute Force, Overall Wayfinding Strategist, Road-Blind, Map Consultant, and Map-Blind.

6.2 Wayfinding Tool Preferences

According to the questionnaire results, we found the following results surrounding wayfinding tool preferences: (1) 70% of Taiwanese believe that smart navigational devices are useful when wayfinding. 55.6% of Taiwanese felt that bystander assistance and directional signage were useful. (2) Subjects that used Google Maps do not think that bystander assistance is helpful, and vice versa. (3) Wayfinders who used map signage and Hand-drawn maps were strongly related, such that they can be combined into a single group. (4) Subjects will use a variety of tools when wayfinding, such as both asking for bystander assistance and looking at directional signage and maps.

6.3 Wayfinder Recommendations

Finally, the six exemplar interviews provided the following recommendations for future smart devices:

1. Google Maps already includes functions for inputting one's destination, routing, maps, and providing directions, such that the Capable, Overall Wayfinding Strategist, and Improvisational exemplars were all satisfied. However, for those exemplars with weaker wayfinding abilities, other functions may be necessary. For instance, an ability to ask for directions, or notification sounds beyond those associated with maps.
2. Consider the user persona before deciding on whether or not to give a wide range of map information. Survey strategists, before departure, tend to try and understand their journey as a whole, as well as the relative distances between each section of their travels. Users who make use of route strategies will, before departure, find a map to collect any relevant information. Thus, smart wayfinding tools should first identify what the user's style is, and then, if they are a survey strategist, give them more general information, and if they are a map strategist, provide a map.
3. For wayfinders who are not good at using either survey strategies or map strategies, they typically need detailed textual instructions for their route. Because of the "three-turn rule" we discovered, we recommend that for this type of user, wayfinding instructions should be given in stages, with three turns per stage.
4. Health care management and tracing functions could be integrated into future wayfinding tools for hospitals.

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