Assess User Needs for Time-Related Information to Design an Airport Guide System

Yilin Elaine Liu(✉) and Jon A. Sanford

Georgia Institute of Technology, Atlanta, USA
y.elaineliu@gatech.edu, jon.sanford@design.gatech.edu

Abstract. Airport activity planning and navigation are challenging because they involve planning for complex activities, including the mandatory activities for someone to get on a flight (e.g. check-in, security check), the discretionary activities (e.g. shopping, dining) and the travels connecting different activity areas. In order to successfully plan the activities and navigate at airports, time is a factor that most travelers would consider. In this paper, a survey investigating the utility of time information was presented. Travelers with different abilities were included in the survey in order to investigate the effect of abilities on the perceived utility of time information. It provided evidence for integrating time information into navigation aids to better facilitate travelers with different abilities. It also suggested that further investigation is needed to identify additional information needs of travelers in situations where time is not considered as important.

Keywords: Navigation · Air travel · Disability · Time-related information

1 Introduction

Airports are complex constructions that support a variety of activities. Navigation, as one fundamental activity that one has to perform in order to get to areas for other activities, gets more complicated than just getting from point A to point B. According to Hoogendoorn and Bovy [4] travelers at airports as pedestrians, plan and navigate at three different levels: Strategic level (i.e. deciding departure time and activity pattern), Tactical level (i.e. activity scheduling, activity area choice and route choice to reach activity areas), and Operational level (i.e. walking behavior). The decisions travelers make at each level will have influence on their decisions at other two levels that the three levels are interrelated to each other. Unfortunately, the challenges and user needs regarding airport navigation have never been examined from this perspective. They are usually examined separately from each other and for different purposes. Traditional airport navigation research has been focusing on the operational level that signage [3, 6], maps [5, 6], asking other people [6] and airport navigation systems on kiosks [8] or handheld devices [7] have been identified as solutions to support the walking behavior. Research focusing on assessing travelers' experience with airports and investigating service needs for airports have identified the information needs at the strategic level and

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the tactical level. These needs include access of information regarding flight schedule, gate assignments/changes, and short waiting time [1, 2]. The separation of the three levels when examining the problems and user needs results in solutions and recommendations that address only a small piece of the challenge. For example, flight schedule and gate changes have a big impact on travelers planning of the activities. Travelers may have more time or less time for other activities at airport due to the schedule changes. Without the flight information (i.e. schedule and gate assignment), only knowing how to get to each gate by following the signage will lead travelers to nowhere. The integration of the information that supports each of the three levels is necessary for travelers to plan and navigate to different destinations effectively. A mobile guide application is developed to provide information to support all the three levels of pedestrian behaviors at airports. There were several important design research questions raised in the development of the application. These questions are: What time-related information travelers would consider to be useful? Are there any factors affecting its usefulness? In order to answer these questions, a survey was developed to investigate the utility of time information for travelers with different abilities and age under different situations.

2 Background

The existing navigation aids are usually focusing on how to aid someone to get from point A to point B without any planning facilitators for aiding travelers' decisions on their destinations. Unlike Hoogendoorn and Bovy [4] who examined navigation as a part of pedestrian's behaviors, the existing navigation aids do not consider navigation as a means for a traveler to get to a destination and achieve a higher-level goal at the destination (e.g. dining, shopping, check-in). The existing navigation systems, especially those designed for travelers with disabilities, usually only emphasize the communication of the directional information.

For travelers with mobility impairments, including those who have difficulties with mobility due to sensory impairments (e.g. visual impairments), navigation aids are developed to allow them to plan routes (to a pre-defined destination) and explore environments they are going to visit before the trip. Some navigation aids also incorporated ADA standards when suggesting routes to reduce the physical barriers travelers would encounter when navigation [9]. For travelers with visual impairments, some navigation aids utilize tactile feedback to communicate route information to travelers [10, 11], while others utilize auditory feedback to communicate those information [12, 13]. There are also navigation aids developed specifically for people with cognitive impairments. These applications are usually focusing on simplifying the provision of navigational information. Providing more direct and graphical navigation information is a common practice [14, 15].

Travelers with disabilities experience more difficulties about the environment when they try to plan their trips and navigate through the trips. They usually consider a set of environmental factors when planning trips. These environmental factors include barriers they want to avoid (e.g. stairs for wheelchair users) and facilitators they need (e.g. ramps). At airports, in addition to these environmental factors, time becomes a unique factor that the activity planning and navigation are all affected by it. Lacking of time information when planning and navigation may introduce more difficulties to travelers with disabilities than it does to those who without. Thus, there is a need for the investigation of the utility of time information, especially for travelers with disabilities. More importantly, the utility of time information should be investigated in the context of navigation, not only in the context of trip planning to ensure that its effectiveness could be investigated at all three levels of pedestrian behaviors to facilitate travelers at airports to achieve their high level goals (e.g. successful departure or arrival).

3 Method

An online survey was designed to collect the opinions of travelers with different abilities toward the utility of time information given by a mobile guide application when planning activities and routes at airports. The time information was specified as the combined time of the waiting time at the destination to start an activity (e.g. get security check) and the walking time to get to a destination. In the survey, two departure scenarios were introduced to the participants and two different tasks were described in each scenario. The factor that varied between scenarios was time pressure. The two tasks that were introduced in each scenario were: Task 1, mandatory activity, going to the security check point and Task 2, discretionary activity, finding a restaurant. These two tasks represented the two types of activities one would do at airports: mandatory activities and discretionary activities. In Scenario A, participants were asked to rate the helpfulness of the time information for the two tasks when they did not have much time before boarding. In Scenario B, participants were asked to rate the helpfulness of the time information for the two tasks when they had plenty of time before boarding. The demographic information such as age, travel experience, and disabilities were also collected.

There were three hypotheses made in this survey study:

- **H1:** The information about walking time (indicating physical effort) and waiting time is useful for travelers with various abilities when planning activities and routes at airports.
- **H2:** Different time pressures (varied in different scenarios) and different types of activities (represented by different tasks in each scenario) have impact on travelers' ratings for the helpfulness of time information.
- **H3:** The rating for the helpfulness of time information will vary with individual's abilities.

The inclusion criteria for this study is anyone aged over 18 years old and had at least traveled by air once in the past two years. The survey was sent to a local university and to a list of 193 older adults to collect responses. The responses were analyzed to test the above hypotheses and help researchers and designers to further understand the needs of users with different abilities (and age) for time at airports.

4 Results

There were in total of 42 participants responded to the survey and 36 of them completed all the questions. These completed responses were used in result analysis. Overall, participants rated very positively for the utility of the time information. Difference between the ratings for each scenario and each task were observed and the differences were tested for their significance level. There was only one paired comparison between scenarios and tasks (Scenario A-Task 1 vs. Scenario B-Task 1) had the difference that seemed to be significant with the p-value less than 0.1 (See Table 1 for "Pair 3" comparison). Participants were categorized into different groups based on their demographic information. The impact of group differences on the average rating for the utility of time information in all four conditions (i.e. two tasks in two scenarios) was tested. The detailed results are presented as below.

Table 1. Gender and age information of 36 participants

	Total	<65 y/o	>=65 y/o
Female	27	9	18
Male	9	3	6

4.1 Demographics

There were 9 males, 27 females responded to the survey. One third of the participants were younger adults who were younger than 65 years old and two thirds of the participants were older adults who aged 65 and older (see Table 2).

Table 2. Disability information of 36 participants. *Included participants with multiple disabilities (who were repeatedly counted). The numbers in the parentheses indicate the numbers of respondents with only one type of disabilities.

Total	None	Vision impairments	Hearing impairments	Mobility impairments
36	16	10 (7)*	9 (4)*	7 (4)*

Among the 36 participants, 16 of them did not have any disabilities. Ten of them identified themselves as having vision impairments, nine of them identified themselves as having hearing impairments, and seven of them identified themselves as having mobility impairments (see Table 3). In total there were **five** participants who had multiple disabilities. There was one participant (P38) had all three types of disabilities: Visual Impairments, Deaf in both ears, Serious difficulties walking without using a walking aid. Two participants (P18, P35) reported to have both hearing and mobility impairments. Two participants (P34, P41) reported to have both hearing and visual impairments.

Table 3. Travel experience information of 36 participants

	Less than or equal to 8 times	More than 8 times
<65 y/o	6	6
>=65 y/o	22	2
Total	28	8

Regarding the travel experience, there were 8 participants (which was less than one fourth of the participants) who had traveled more than 8 times in the past two years and they were considered as frequent air travelers in this survey.

4.2 Time Pressure Effect and Activity Type Effect (Within Participants)

Participants gave ratings for the helpfulness of time information in four conditions:

- Condition 1. Going to a security check point when time pressure is high (Scenario A, Task 1)
- Condition 2. Finding a restaurant (on the airside) when time pressure is high (Scenario A, Task 2)
- Condition 3. Going to a security check point when time pressure is low (Scenario B, Task 1)
- Condition 4. Finding a restaurant (on the airside) when time pressure is low (Scenario B, Task 2)

The ratings were on a five-point scale in which “1” was for “not helpful at all” and “5” was for “extremely helpful”. Participants rated the time information to be the most helpful for condition one with a mean score of 4.25. They rated the time information to be the least helpful for condition four with a mean score of 3.94. The average ratings of four conditions (i.e. variable “Helpfulness_OverallAvg”) were calculated by adding up the ratings in four conditions and divided by four. The mean of the average ratings of four conditions was 4.0694, which indicated the participants considered the time information to be very helpful overall (see Tables 4 and 5).

Table 4. Helpfulness ratings in four conditions and the average rating scores for all four conditions

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Helpfulness_ScenarioATask1	36	4	1	5	4.25	.161	.967	.936
Helpfulness_ScenarioATask2	36	4	1	5	4.08	.175	1.052	1.107
Helpfulness_ScenarioBTask1	36	4	1	5	4.00	.144	.862	.743
Helpfulness_ScenarioBTask2	36	4	1	5	3.94	.173	1.040	1.083
Helpfulness_OverallAvg	36	4.00	1.00	5.00	4.0694	.14037	.84221	.709
Valid N (listwise)	36							

Table 5. Paired samples test of utility ratings for four conditions

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Helpfulness_ScenarioATask1 - Helpfulness_ScenarioATask2	.167	.941	.157	-.152	.485	1.063	35	.295
Pair 2	Helpfulness_ScenarioBTask1 - Helpfulness_ScenarioBTask2	.056	.674	.112	-.172	.284	.495	35	.624
Pair 3	Helpfulness_ScenarioATask1 - Helpfulness_ScenarioBTask1	.250	.841	.140	-.035	.535	1.784	35	.083
Pair 4	Helpfulness_ScenarioATask2 - Helpfulness_ScenarioBTask2	.139	.762	.127	-.119	.397	1.094	35	.281

The within-participants differences between the ratings in four conditions were tested in paired comparisons for their significance. None of the comparisons had significant differences. There was one comparison between different time pressure for the same mandatory activity (Paired 3 in Table 1) turned out to have a trend for being significant (p = 0.083). This suggested that travelers may consider time information to be less helpful when they do not need to worry about time when planning for mandatory activities.

4.3 Group Comparisons (Between Participants)

Group differences were also tested for their significance. There were five between-participants comparisons being carried out to test their differences. The groups were categorized based on participants' abilities, age, and air travel experience. Detailed group descriptions can be found in Table 6.

The only significant group difference of the ratings was between the group of individuals with mobility impairments and those without. Participants with mobility impairments considered the time information to be less helpful compared to

Table 6. Group comparisons of the average ratings for the helpfulness of time information

Variable	Value		Significance level (p)
	1	2	
Group_Mobility	None	Mobility impairments	0.032*
Group_Vision	None	Visual impairments	0.683
Group_Hearing	None	Hearing impairments	0.193
Group_Age	<65 y/o	>=65 y/o	0.583
Group_TravelExperience	1–8 times	More than 8 times	0.836

participants who without mobility impairments. There was no observed significant difference of the ratings between other groups.

5 Discussion

The results of this study indicated that the time information (i.e. walking time and waiting time) is helpful for travelers with different abilities to plan activities and routes at airports. Our first hypothesis was thus tested to be true. It is an important piece of information that could facilitate the overall navigation at airports. This information is currently not available to travelers and this could contribute to their navigational and planning difficulties. The existing ways of communicating time-related information are placing signs of estimated waiting time at destinations or putting signs about the estimated walking time to a specific location. They tend to be less effective than the way of providing time information that was presented in the survey (i.e. through a mobile application). For example, having the waiting time to be available at a destination is not effective at all when someone is trying to plan for their destinations based on the waiting time. Regarding our hypothesis two, it was tested to be partially true because we only observed slightly significant difference between scenarios and tasks. It suggested that time pressure could be a factor affecting travelers' attitudes towards time information. In some situations, where the time pressure is low, travelers may consider other information to be more helpful than time. From a design perspective, it is worth further investigating about the type of information travelers would need in those situations. Our third hypothesis about the difference of ratings caused by abilities, it was also tested to be partially true that we only observed travelers with mobility impairments having significant different ratings than others. For travelers with mobility impairments, the time information was found to be less important. This may suggest that for travelers with mobility impairments, they may consider other information such as accessibility to be more critical than waiting time and walking time when planning for activities and routes. It is possible and promising to integrate this information into the design of airport guide systems to aid travelers with different abilities to better plan activities and navigate at airports.

6 Future Work

Given the relatively small sample size, the data collection is still ongoing to collect more responses to further investigate traveler's needs and test the hypotheses. We hope to find strong evidence to support the design decision of integrating time information as a part of navigation aids for airports. This finding could be generalized to other indoor navigation scenarios when time is important, such as navigation in hospitals. This study emphasized the importance of planning in navigation, which is generally overlooked in existing navigation studies. The next step will be to collect more data and other information that travelers consider to be important. These findings will be used to design a context-aware guide system for air travelers.

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