Designing Flight Information Displays for Quick Information Access: A Case Study of an International Airport

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Increased air travel has made the provision of the optimal amount of information to travelers a necessity. Flight information is shown on electronic or mechanical display boards, but finding the required information can take some time depending on the display layout and content. This paper investigates the information configuration for quick access of flight information. Seven potential grouping methods were tested. Search time depends on the layout of information ($p < 0.001$). Search was fastest when the information was arranged in the order of airline logo, airline name and arrival or departure time.

INTRODUCTION

With increased globalization, the movement of people is relatively high. Over 18,000 commercial aircrafts are in service in over 1192 international airports (Upham et al., 2003) all around the world and more than 4000 billion passenger kilometers have been traveled in 2008 (ICAO, 2009). The forecasts are that there will be further increases of 3.8% and 5.5% in passenger kilometers in 2010 and 2011 respectively (ICAO, 2009). With these growing trends and tight flight schedules, providing quick access to flight number, boarding gate, and departure or arrival time is a challenging usability issue.

International airports such as Hong Kong have large electronic display boards to improve visibility. The information screens generally show airline, flight number, check-in area, boarding or arrival gate, and departure or arrival time. Frequent travelers who fly on e-tickets, may remember only a limited amount of information related to their flight. Consequently, finding the required information to board an aircraft may take time.

The density of words, font type, font size, font color and many other characteristics of the text can influence search strategy. Ojanpää et al. (2003) found that decreased spacing between words resulted in longer but fewer fixations and Vlaskamp et al. (2005) reported that the search time increased dramatically with decreasing item spacing due to long eye fixation and increase number of fixations. People tend to maximize the efficiency of visual search by increasing the information gain (Tseng and Howes, 2008). Gestalt rules of proximity, similarity, continuity, and figure and ground can help improve the usability of information screens. Displays that are well-designed will help minimize errors and reduce search time (Green and Anderson, 1956; Duncan and Humphreys, 1989; Humphreys et al., 1989; Sanders and Donk, 1996; Pashler, 1998; Brumby and Howes, 2004; Wolfe et al., 2009).

The main objective of this study was to find the layout of flight information on display boards so that the ordering corresponds with the items held in memory. It is hypothesized that matching the items remembered most of the time will result in faster search of boarding information.

METHODOLOGY

Pilot Survey

With ever-changing technology, it is vital to know what information travelers remember in relation to his or her flight. Thus a pilot survey was conducted at Hong Kong International airport (HKIA) to know more about traveler mental models related to flights. Sixty passengers who were to fly out of HKIA were interviewed on a voluntary basis. The questionnaire asked the following information in relation to the flight they were to board:

1. Airline
2. Destination
3. Airline code
4. Time of flight
5. Flight number

After they had responded, their flight information was checked with their tickets. A summary of the participant responses are shown in Figure 1.

The survey results showed that most passengers knew the airline (98%) on which they were to fly and their destination (96%) quite accurately. The incorrect destinations were primarily from those with multiple destinations. Even though the passengers thought they knew the time of flight, it had the least number of correct responses (68%).

Based on the pilot survey seven potential designs, for flight information displays, were developed (Table 1). The existing display of information at HKIA was also included for comparison purposes.

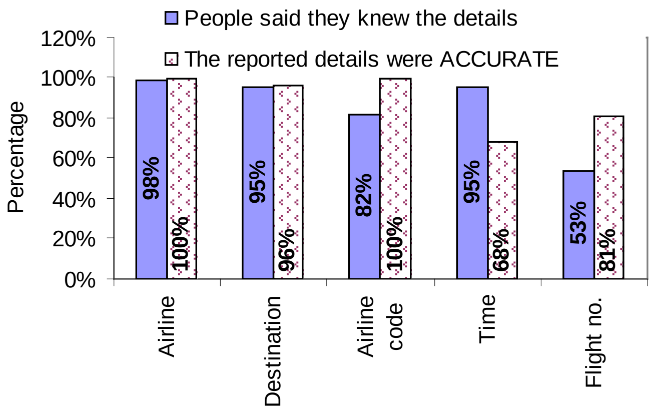

Figure 1. Results of the pilot survey (N=60).

Table 1. *Proposed designs*

Design	Information Layout	
	First column	Second column
A (Existing)	Time	Airline code
B	Airline Name	Time
C	Airline Logo and Name	Time
D	Airline Name	Airline code
E	Airline Logo and Name	Airline code
F	Destination	Airline code
G	Airline Code	Time
H	Airline Code	Destination

Experiment

Participants. Twenty-nine subjects from the Hong Kong University of Science and Technology with self-reported normal or corrected-to-normal visual acuity and normal color vision voluntarily participated in the experiment. The experiment duration was approximately 50 minutes.

Stimuli. Eight display designs (Table 1) with the same font type, font size and color combination were the independent variables. The recommended font for electronic display monitors of Microsoft Sans Serif was used (Davidov, 2002; Williams, 2008). The colors were the same as the existing display at HKIA. Sample screens from each of the designs are shown in Figure 2.

The mean vertical and horizontal visual angles when standing close to the real information displays at HKIA are 25° and 40° respectively. Thus, these angles were maintained during the experiment.

Apparatus. A large display of four (2x2) 40" high definition (resolution of 1366 x 768 pixels) LCD monitors formed the information display. A Flash program was written to display the required information and each type of display was presented to the subject in a random order.

Procedure. Subjects were given cue cards with destination, time, airline code and flight number and asked to remember it and search the information on the display as quickly as possible and click on the row showing the information using a mouse pointer. Stimuli appeared in the display when the subject pressed the "ready" button and the information disappeared as soon as they clicked the identified row. If the subject chose the incorrect information, he/she was asked to restart the search from the beginning. A 8 (design) x 10 (searches) within-subject factorial design was used.

ANALYSIS AND RESULTS

Minitab®15 Statistical Software was used for the data analysis. The repeated measure ANOVA showed that the type of design significantly affected search time ($F_{7,224} = 9.35$, $p < 0.001$). Figure 3 illustrates the variation of mean search time for the differing designs.

A post-hoc Student-Newman-Keuls (SNK) test showed that the designs, C, E and F were similar and had the lowest search time. The designs with airline code in the first column (G and H) had highest mean search time. The existing design (A) at HKIA was not the best.

DISCUSSION

Search time, a measure of usability, for eight different designs was evaluated. The design, C with Airline Logo and Name in the first column and Time in the second had the lowest search time. However, displays E and F were not statistically different from C. The existing display at HKIA had a higher search time than the designs C, E and F.

Even though eye tracking information was not collected, we hypothesize that the differences in search times may be related to search strategy (Tseng and Howes, 2008) based on the most appropriate piece of information in memory, which in this case is the airline and/or destination. Possible types of search may be classified as 'L' or 'Z' or a combination of the two. It is hypothesized that a vertical search is first performed (Lau et al., 2001) to locate the airline followed by a second search ('L' type) to locate the time. In contrast, the existing design where the first column is time followed by airline code may have a mismatch with the limited items in memory due to possibly a 'Z' type search. The 'L' types may be hypothesized to be more efficient than the 'Z' type.

Information close together tend to be seen as one group and spacing between pieces of information are important to break the rule of Gestalt proximity. The designs, C, E, and F may have had low search time as a result of more obvious breaks between the two groups. This behavior was also reported by Ojanpää et al. (2003) and Vlaskamp et al. (2005), where the search time was lower with higher item spacing due to a lower number of fixations and short-duration eye-fixations. Search was faster when the displays had the airline logo (Design C and E) when compared to those without (Designs B and D), confirming Paivio and Begg's (1974) findings that visual search is faster when the targets are pictures rather than text. Prior knowledge of airline logo may have also influenced the search time, because searching familiar targets is faster even in the presence of distractors (Körner and Gilchrist, 2007).

The results clearly show that the usability and access of information are dependent on information layout. The existing design at HKIA is not the optimal, but designs such as C, E, and F are more suited for travelers.

Figure 2. Sample screens from each of the designs: (a) Design A (existing); (b) Design B; (c) Design C; (d) Design D; (e) Design E; (f) Design F; (g) Design G; and (h) Design H.

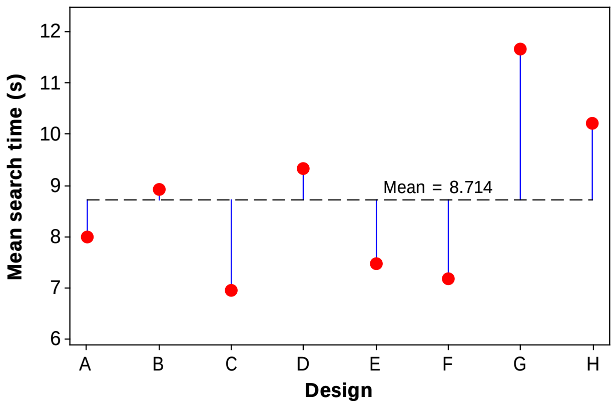

Figure 3. Mean search time of each design (N=29)

The experiment does have some limitations. Even though we matched the visual angles of the experimental screen and the display board at HKIA, there could be issues related to distance from screen. Furthermore, the time of search was based on a mouse click and the movement time associated with mouse clicking could have affected the results in this experiment even though it may have been consistent across all designs.

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