Methodological Triangulation to Assess Sign Placement

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Abstract

This paper presents a study that investigated the potential effect of an additional sign on people’s simulated wayfinding behavior in a transfer situation at an airport. Participants were presented with photographs of the status quo and digitally edited images of the potential redesign. Path choice behavior, gaze behavior and confidence ratings were analyzed. The combination of the three methods proved to capture the situation better than any of the methods alone. The results provide evidence that the re-design has a positive effect on passengers’ wayfinding behavior.

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1 Introduction

When creating signage for a complex wayfinding system, a high number of constraints have to be taken into account in order to come up with a viable solution. After the signage system has been planned globally, the following decisions must be made for each individual signboard:

1. the sign’s content, i.e. which information should be displayed
2. how the information should be communicated (e.g. symbols, icons, text)
3. how the information should be displayed (e.g. icon and text sizes, single or multiple signboards)
4. the selection of a location for the sign in the environment (e.g. at or before a decision point)

Since these decisions are not independent from each other and the number of options for each decision is virtually unbounded, this poses a challenge for the designer.

Environmental Designers have great expertise in creating and placing signs in different environments. By applying standard guidelines and knowledge about best-practices in particular environments, with particular users in mind, they often come up with ideal or nearly ideal solutions. However, some environments are architecturally and geometrically complex and, in addition, may have a high amount of traffic. Moreover, different user groups with different goals or motivations may have to be served. Under such circumstances it can be difficult to predict which of a number of potential designs for a particular signboard or which of a number of alternative sign locations renders the best usability. It’s often not even clear whether an additional sign will support users or simply add to visual clutter. In this paper we focus on the latter question.

Recently a number of authors [Uebele 2006, Calori 2007, Gibson 2009, Bauer and Meyer 2009, Meusers and Pogade 2010] have described best practices and visual guidelines for designing signs, but these approaches provide only limited definite advice for solving complex, sometimes confusing, settings like a large hub of entrances and exits in the key interchange of a transit terminal. Arthur and Passini’s [1992] book is now considered a classic, and it is based on behavioral studies in complex environments. Yet it too provides general guidelines rather than a methodology for empirically comparing a set of competing design solutions. The approach described in the present paper is in the tradition of human factors approaches like Corlett et al. [1972], but it takes part of the empirical data collection from the field into a lab-based environment, combining visual attention data with observations of behavioral decision making and self-assessment.

This is where Cognitive Psychology and Environmental Psychology can contribute by empirically evaluating alternative solutions. In this paper we present a case study in which we combined a forced choice paradigm, questionnaires, and eye-tracking techniques – all methods widely used in cognitive and environmental psychology – to evaluate alternative design solutions for wayfinding signs that were judged by professional designers to be equally plausible. Comparing participants’ behavior – i.e. performance and response time – their gaze behavior and confidence ratings allowed us to make an educated decision about the placement of signage.

2 Test Sites and Signage

The location under investigation is a transit hall at Frankfurt Airport (> 50 Million passengers/year) which passengers enter through four different entrances and, depending on their goal, leave through one of three exits. Since inbound and outbound corridors are distributed all around the hall, passengers’ walking paths necessarily cross. In peak times, the area quickly becomes crowded making it even more difficult for passengers to make a quick, but correct decision. Accordingly, this is one of the locations within the airport where support staff are frequently asked for directions by passengers. The existing signage was mostly installed above each of the exits. Passengers entered the area, had to search for the sign matching their goal and then had to move towards the exit. While passengers were searching for the correct exit, they spent time standing in the area. These standing passengers hindered incoming passengers from entering the area, leading to congestions in the inbound corridors.
The goal of redesigning the hall was to support passengers during the decision making process with adequate signage enabling them to make a quick and correct decision and feel confident about their decision so that they could leave the area quickly.

Frankfurt Airport and our team of cognitive scientists approached this challenging environment as a joint research and consulting project, and we contributed to the design process with a combination of methods in an iterative manner. The status quo was analyzed by informal observations at the critical site, and was compared to traffic counts and reports from local employees.

Professional environmental designers from the airport’s signage department developed several suggestions as to how to improve signage at the various locations. For some locations this was straightforward, but for others several solutions were judged to be equally good. Cognitive scientists and signage designers together conducted another expert appraisal at the site. For some difficult key locations we decided to run a laboratory-based eye-tracking study to support the selection of design alternatives, looking at visual attention, behavioral preferences and subjective confidence of test participants. One of the most important questions was whether an additional, large central sign (Figure 2, right) would help passengers find their way more quickly. On the one hand the sign might help because it would give additional information and through its size the information would be available to the passengers earlier allowing them to make their decision accordingly.

On the other hand, an additional sign would contribute to the visual clutter. Also, the status quo involved information distributed in space, creating affordances [Gibson 1977] for people to move to the exits to which they had to go. This should, at least in theory, automatically draw participants in the proper direction.

Other research questions included the placement of a sign at one of two possible locations, the presentation of the information on three or four signs and the arrangement of information on the sign in two lines or three lines.

3 Methodological Approach

The study was conducted in a laboratory and made use of different experimental approaches. Thirty participants (14 of them female), scarcely or non-familiar with Frankfurt Airport, between 19 and 30 years of age took part in the study and received monetary compensation.

At the beginning of each trial, participants were informed about the goal location (a gate number) through a text message on the screen. Participants then viewed a sequence of three images (three steps) simulating an approach to the hall where the way-finding decision had to be made (see Figure 1). After each image they had to indicate as quickly and as accurately as possible the direction they would follow in order to reach the goal gate. Responses and response times were recorded through the arrow keys on the keyboard. At the same time participants’ gaze behavior was recorded using an SR Research EyeLink 1000 eye-tracker with remote tracking. They were also asked to rate how confident they felt about their decisions on a 9-point-scale.
Half of the participants first saw the pictures of the situation as it is (status quo) and then the pictures including the additional sign (redesign) (cf Figure 2). For the other half of the participants it was vice versa. The additional sign was added to the original photograph using digital image editing [Orland et al. 1992].

4 Results

In this short paper we focus on one specific result from the larger study to illustrate the procedure and applicability.

Qualitative analyses of the eye-tracking data revealed the distribution of attention for each image. When searching for gate C15 in the last image of the status quo situation, participants paid only little attention to the sign that contained the required information. Instead they were primarily attending to the sign straight ahead from their current positions (Figure 3 left). With the redesign, however, they fixated on the correct information on the added sign (Figure 3 right). The analysis of responses (Figure 4) showed that participants made almost random decisions when viewing the initial images (steps 1 and 2) that lead to the hall. However, when reaching the hall (presentation of the third image at step 3) the number of correct responses increased and was significantly above chance level for the redesign ($t(26)=3.16$, $p=.004$), but not for the status quo ($t(28)=1.62$, $p=.117$).

Response times for the redesign at step 3 were shorter (~1100 msec) than for the status quo ($t(26)=1.97$, $p=.06$) (see Figure 5). With respect to the confidence rating we found a higher confidence for the redesign than the status quo (Figure 6) at all three steps.

5 Discussion

The overall aim of this study was to establish whether empirical investigations using methods from cognitive and environmental
psychology could aid in the design and placement of wayfinding signage in complex environments. In this paper we concentrated on one specific question from a larger study, the placement of an additional wayfinding sign in a central location of a large hall through which passengers – coming from different entrances and leaving through different exits – traverse. Participants were presented either with the status quo or the redesign and were asked to quickly indicate the direction to different gates. Results from all measures suggest an advantage of the redesign as compared to the status quo:

1. Response times are significantly shorter with the redesign
2. Participants’ performance, in terms of correct responses, shows a numerical advantage for the redesign as compared to the status quo for the central location (step 3).
3. The reason for the redesign’s advantage is that gaze is more strongly focused on the relevant information
4. Participants rate their confidence in their decisions as significantly higher with the redesign than with the status quo

Although in this case the behavioral data dominate the results, the eye-tracking data not only confirm the results but reveal the reason for participants’ lower performance with the status quo: They do not focus on the correct information. Participants may have based their decision on other factors indiscernible with the current methodology. However, most importantly the data show that the re-design attracts participants’ attention to the relevant information.

These results suggest we can reliably differentiate between alternative design solutions and demonstrate how methods from cognitive psychology can be utilized to inform the process of designing and improving wayfinding signage systems. Based on these results the design suggestion has now been implemented.

With respect to cost-effectiveness we can state that with state of the art eye-tracking systems like the one we used, additional eye-tracking is not much more costly than a behavioral study alone, if the eye-tracker already exists. The slightly increased effort of collecting eye movement data has the benefit of gaining more detailed data about cognitive processes that lead to the observed behavior and thus allow a more accurate judgment of what in the environment needs to be changed in order to evoke the desired behavior.

We are currently running a study in which we use the same methodological triangulation to assess different designs. Instead of photographs, the stimuli are rendered from a virtual model of a to-be-built passenger pier, realizing different design options. This technique allows us to investigate wayfinding behavior and spatial decision making before the site is actually built. The design that proves to be most suitable for participants can then be installed right from the beginning.

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