Navigational Challenges: Icons vs. Text
Concerns for the Digital Age

Kristin Adamczyk    Piyatida Buranatum
School of Computer Science, Telecommunications and Information Systems
DePaul University
243 S. Wabash, Chicago, Illinois 60604
United States of America

ABSTRACT
The study conducted in this paper is to determine whether users work more effectively with text-based or graphical/icon-based web navigation. An experiment was performed to investigate this issue. Four participants perform simple tasks on two low-fidelity paper prototypes. The tasks were based on navigating for and locating a particular subject. Time of completion, success rate, along with a few other factors were recorded and analyzed. The average times of the tasks for the text-based prototype were significantly faster than the icon-based prototype. Two users committed one error on the icon prototype, and one user committed one error on each prototype. All fours users preferred the text prototype because it was quicker to find what they were looking for, and all users said they thought it would be effective to use both icons and text together. The paper concludes with a discussion on the findings of the research and a set of guideline are developed.

KEY WORDS
World Wide Web, navigation, text, graphical, icon

1. INTRODUCTION
Since the World Wide Web has grown tremendously and designers are moving towards graphical/icon-base navigation (i.e. Flash navigation), users are provided with a limited amount of information to navigate a website. In many cases when users are not provided with enough navigational information (text, graphical or both) they can become lost in the website and ultimately leave and move to the next available website. One of the ultimate goals of the website designer is to provide the proper amount of information while keeping the design of the website as simple and clean as possible so their users can easily navigate and accomplished their task.

Generally websites are organized in with the following three basic structures as shown in Figure 1: (1) linear, (2) hierarchical, and (3) web or cross-linked [1].

![Figure 1. Three basic website organizational structures.](image)

Users on linear structured website are lead in a particular path. Their only option is to move forward and back. In the case of hierarchical websites users have the option to move in multiple directions. If the navigation is unclear to the user disorientation can occur. Disorientation is defined as "the tendency to lose one's sense of location and direction in nonlinear document" [2]. There are four types of disorientation that are relevant to website: not knowing where to go next, not knowing how one arrive at the particular page, not knowing where the information is, and not knowing how to get there [2]. When the user is navigating through a website he/she must perform many task simultaneously such as remembering the tasks and it sequence, searching for the target items, browsing the general topics and related items, surfacing the items of interest, comparing between items, moving from one item to others, etc.. When the user performs the above tasks simultaneously the user experiences a cognitive overhead, which leads them to get lost in the website [2].

A possible reason for disorientation on a website is the lack of context in the navigation. If the text or graphical/icon navigation lacks proper context or is visually unclear to the user may not choose next appropriate link to successfully navigate the website to complete their task.

The purpose of this paper to determine whether text-base or graphical/icon-base navigation is more effective and determine what the minimal amount of information is must be provided to the user for them to successfully navigate a website to complete their task. We will first present background information on the importance of web navigation, the cognitive limitations of the user, what types of navigational information needs to be provided to
the users, and current guidelines of web navigation. Next, we will present our experiment and the detailed analysis of our results and finally propose new guidelines for the type and the amount of information need for effective web navigation.

2. RESEARCH

2.1. Importance of Web Navigation

At least six factors may influence web users' success or failure in navigating a web site: (1) the web site interface design of individual pages—including navigational aids, (2) the organizational structure (organization) of the web site, (3) content and terminology of the web site, (4) web users' expertise in using the web, (5) web users' prior knowledge of the site's content, and (6) web users' cognitive processing abilities. [1] Designers must take the previous six factors into consideration because when the web navigation is properly designed the user can navigate the website with ease and ultimately complete the desired task.

2.2. Cognitive Limitations of the Web User

Chen and Want indicated that website navigation should be designed to overcome the limitations of short-term memory, limit the information relevant to users' goals, and assist users in selecting navigational paths. [1] Therefore when designing navigation for users designers must consider the cognitive their limitations.

A cognitive factor that designers must take into consideration is situational awareness. This is comprised of a person’s momentary knowledge of the surroundings and his or her presence in it [3], in our particular case where the user is in the navigation. Users can easily get lost in the navigational process and suffer from information overload and/or disorientation. When the user does not comprehend where they are on the website as a result of unclear navigation this will results from the user not knowing where they are coming from and where they are going. Therefore, the user will lose sight of his or her goal and will not accomplish the task.

Metaphors and mental models are other cognitive limitations that designers must understand and deal with when designing proper effective website navigation. A metaphor “mean what the words, in their most literal interpretation, mean, and nothing more” [4]. In the case of navigation, a metaphor is given either in text or graphic/icon. The designer must convey to the user clearly the navigational options to successfully get the user to their desired location to complete their task. If the user does not understand the text or graphic/icon, he or she can navigate unsuccessfully to different location and ultimately leave to website.

A mental model can be defined as “the bridge between the work environment to be controlled and the mental processes underlying this control” [4]. Each user has a mental model created from previous experiences and have certain expectations of how navigate a website. Therefore the designer must understand how the user perceives information and how it is possibly organized in order to design effective web navigation.

2.3. Navigational Information Required from the Web User

Juvina and van Oostendorp indicate there three main types of navigational information required from users to effectively design web navigation: (1) ‘syntactic’ means structural, topologic information, (2) ‘semantic’ refers to the content of visited pages, and (3) ‘pragmatic’ information indicates what are the reasons and (expected) gains for the user of visiting certain pages [5]. The question the designer should ask in order to determine what information is required includes:

- “Syntactic information: How do users navigate? In which manner do they move across the information space? Which links are followed, in which order, what does the navigation graph look like (e.g. linear or nonlinear)? [5]”

- “Semantic information: What is the meaning of the information that the user encountered during navigation, which of this information was processed/found relevant by the user? [5]”

- “Pragmatic information: What are users’ goals and tasks? What are their interests, preferences, and (potential) actions? [5]”


There are several guidelines currently used by many designers. The following are the most common ones followed:

1. Clearly identify the target of each link [6]
   - Link text should be meaningful enough to make sense when read out of context—either on its own or as part of a sequence of links. Link text should also be terse.

2. Be Consistent [6]
   - Ensure that documents are clear and simple so they may be more easily understood.
   - Consistent page layout, recognizable graphics, and easy to understand language benefit all users.
3. Clustering [6]
   - Group related links

4. Use clearest and simplest language possible [6]
   - Do NOT information overload

   - Make sure users know where they came from, where they’re at and where they are going.

3. Experiment

Based on our review of navigation, we would like to propose an experiment to test the feasibility of using icons for web navigation. Currently, many websites use solely text for navigational purposes. However, with the addition of new technologies and the added frequency that they are being used, some websites are beginning to steer away from the traditional text navigation in favor of utilizing technologies such as Flash. At times, these websites use rollovers or icons as a means of navigation. Unfortunately, these navigational methods are not always clearly or easily recognized by the user. There are many different facets of web navigation that can be tested; however, for the purpose of this class, we have decided to examine the possibility of using icons for web navigation. Part of our interest in this particular area of navigation is the idea that icons can be confusing. If you have ever visited a foreign country, you may have experienced confusion as to what some of their signs mean. If icons are to be used in web navigation, it is important to remember that the audience can be very diverse. Websites have the potential of having visitors from all over the world. If icons only are used for navigational purposes, it is important that they are clearly understood.

3.1. Objective

To determine if icons-only can be used for successful web navigation.

3.2. Design

A small group of participants was randomly selected to participate in this preliminary experiment. The one requirement of the participants is that they must know how to use the internet. This determines whether all participants are familiar with hyper-navigation (clicking on an object leads to a display of more information). For this preliminary experiment, we tested 4 people. While this is an extremely small sample size, we have chosen to use this number for several reasons. First of all, there is a time constraint to this experiment and paper. Secondly, this is only a preliminary study. We can quickly identify and rectify any potential problems that arise from this experiment before proceeding to test on a larger number of participants. Finally, we believe that four participants will give us a basic idea of whether or not this topic is worthy of further research.

To begin, each participant was given a pre-test questionnaire to fill out in order to make sure that they met our criteria. Each participant was asked their age, gender, information about internet usage, their education level, and their preference of identifying objects (via pictures or words). As long as the participant is familiar with the internet, they are allowed to participate in the experiment.

A within-groups design was used. All participants are asked to navigate through two paper prototypes. For one test, the participants used text only as a means for navigation. In the other test, they used icons only as a means to navigate. Half of the participants were randomly selected to use the text navigation first, and the other half will use the icon navigation first in order to reduce the order effect. Both prototypes consisted of similar questions, asking the participant to find four items. The participants will be given a short break (one minute) in between the two tests. This allowed the participant a chance to have a break between the tests and if for some reason the participants find the tasks very difficult, it should reduce the potential fatigue. Each prototype consisted of the same objects, either written out in text or shown in the form of an icon. The experimenters tried to choose icons that would be clear to the participants; however, it is impossible to expect there to be no confusion as to what the icons represent for every participant. Dissimilar categories were used to reduce further confusion: food, animals, sports, and transportation.

Each participant was given four tasks to complete. The experimenters noted the steps the participant used to accomplish the task, the amount of time it takes them to complete the task, and the number of errors, if any, that were committed during the completion of each task.

At the end of the experiment, the participants were given a post-test questionnaire to fill out. They were asked to identify all of the icons. The purpose of this is was to determine if there was any confusion as to what any of the icons represented. It was made clear that they are not being “judged” on the number they correct; it was also stressed that the purpose of this is to determine if the experimenters chose clear enough icons for the purpose of this experiment. If participants were only asked if any of the icons were confusing, they might not mention any icons for fear of feeling stupid. This method, along with asking if any of the icons were unclear, hopefully gave a better perspective on the clarity of the icons chosen. The participants were asked if any of the icons were confusing, if they preferred the text or icon navigation, if they think using both text and icons would be more effective, and any comments.
3.3. Findings and Analysis

The experiment was completed by four participants. Two of the participants were male and two were female. Two of the participants were older, in the age range of 50-59, and had their Master’s Degree. The other two participants were younger, in the age range of 20-29; one had a Bachelor’s Degree, and the other had a high school diploma. All of the participants used the internet daily. Two of the participants preferred to identify objects by pictures, and two preferred to identify objects by words (text). Two of the participants performed the test using the icon prototype first, and the other two used the text prototype first.

The four tasks for the text prototype were:
1) Find “grapes”
2) Find “cat”
3) Find “figure skating”
4) Find “bat”

The four tasks for the icon prototype were:
1) Find “apple”
2) Find “swimming”
3) Find “helicopter”
4) Find “squid”

The users were shown an initial page with either four icons or four words on it. Then they would select one of the items (categories), and then they were presented with another piece of paper that had three objects on it in their chosen category. Finally, after selecting an object (category), they were taken to the last piece of paper, which had three items on it. These were objects in the chosen category. For example, the initial page had four categories on it: animals, food, sports, and transportation. If the user selected animals, they were given another page that had land, air, and water on it. If the user selected land, they were shown a dog, cat, and horse. The initial page of the icon prototype is shown below:

Three of the users committed at least one error during the testing. Two users committed errors during testing of the icon prototype, and one user committed errors during both the text and icon prototypes. All three of the errors committed on the graphical interface occurred on the second task (find “swimming”). During the post-test questionnaire, the participants were asked to identify all of the icons. The only problem that any of the users had was trying to name the icons under the sub-category of sports. The correct names of the sub-categories are: individual, team, and both. This was the most confusing portion of the prototype to the users. The icon for individual was a person riding a bike, the icon for team was four hockey players, and the icon for both was the person on the bike with a plus sign with the four hockey players. One person suggested that if we had used the same sport, it would have been easier to identify; the person stated that the icons were associated with hockey and with bicycling instead of individual and team.

Because one of the users took a lot longer (almost double the amount of time) to complete three of the four tasks on the icon prototype that the other three users, we have decided to compare the median times instead of the mean times in order to get more accurate results. The median values for each user for each prototype are shown in the table below:

<table>
<thead>
<tr>
<th>User</th>
<th>Icon Prototype (seconds)</th>
<th>Text Prototype (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41.1</td>
<td>20.4</td>
</tr>
<tr>
<td>2</td>
<td>20.4</td>
<td>17.7</td>
</tr>
<tr>
<td>3</td>
<td>17.6</td>
<td>10.8</td>
</tr>
<tr>
<td>4</td>
<td>18.9</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Using these values, we performed a paired t-test, which provides confidence limits for normally-distributed data. For the icon prototype, the mean was 24.5 seconds, with a median of 19.9 seconds. The 95% confidence interval ranges from 6.799 to 22.51 seconds, with a standard deviation of 11.1 seconds. The 95% confidence interval means that if we conducted this same test, 95% of the time, the times should fall between the 6.799 and 22.51 seconds. A high standard deviation (relative to the data) such as in the above case, indicates that there is a high degree of variability in the data. For the text prototype, the mean was 15.2 seconds, with a median of 14.8 seconds. The 95% confidence interval ranges from 7.491 to 22.51 seconds, with a standard deviation of 4.58 seconds. Our null hypothesis was that there was no difference between the text and icon prototypes. The alternate hypothesis was that there is a difference between the text and icon prototypes. Using the results of this paired t-test, we found t = 2.36 with three degrees of freedom. The probability, assuming the null hypothesis was equal to 0.100. In other words, at the 5% level (the probability must be larger than 0.05), we could reject the null hypothesis and assume the alternate hypothesis, that the text and icon prototypes were different, was true.
In order to give a better understanding of the results, the median times for each task, on both prototypes, is shown in the table below:

<table>
<thead>
<tr>
<th>Task</th>
<th>Icon Prototype (seconds)</th>
<th>Text Prototype (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16.7</td>
<td>15.3</td>
</tr>
<tr>
<td>2</td>
<td>34.8</td>
<td>11.8</td>
</tr>
<tr>
<td>3</td>
<td>16.1</td>
<td>19.1</td>
</tr>
<tr>
<td>4</td>
<td>20.9</td>
<td>14.8</td>
</tr>
</tbody>
</table>

At the end of the experiment, we asked users which prototype they preferred. Three of the four users said they preferred the text prototype because it was quicker to find what they were looking for. All four of the users said it would be more effective to use both icons and text together.

Based on these results, we have come to the conclusion that this topic does warrant further research. Our preliminary findings indicate that using text for navigation is faster than using icons for navigation, even if the icons are relatively easy to identify.

4. PROPOSED GUIDELINES

Currently, there are minimal guidelines for designers to follow when creating navigation for the Web. While many common practices are followed, there are very few actual rules that must be followed when designing Web navigation. As technologies continue to rapidly change, it is inevitable that the Web will change with it. Graphic use on the Web is still in its infancy, and the use of icons for navigation is still relatively new. In order to help address some of the issues that are beginning to arise from Web navigation, we have come up with several recommendations for designers to follow when constructing navigation. Our proposed guidelines are as follows:

1. Use Alternate Tags for icon only navigation
   - Designers can have a clean design layout of graphical icons and still provide a hidden text description of the link. Currently, this is required for websites of all organizations and companies that receive government funding due to Section 508. However, this is a good design practice that should be used by all Web designers.

2. Minimize the steps in navigation.
   - The less steps users have to take, the less likely they are to get lost or disoriented.
   - It is a basic design principle that users should be able to find what they are looking for in as few steps as possible.

3. Provide both types of navigation on separate web pages.
   - Icon-only navigation with alternate tags (for users who prefer a more graphical interface).
   - Text-only navigation (for users who use assistive technologies and those who connect to the internet using older technologies i.e. modem).

4. Use clearly identifiable icons.
   - Icons must be easily understood by the intended audience; otherwise users will get lost in the navigation and go to a different website.
   - When using icons for navigation on a website used in multiple countries, be especially careful in choices because icons can have different meanings in different cultures.

5. CONCLUSION

Even though the Web has been used by the general public for over a decade now, the guidelines for Web navigation are still limited. The Web is a vast entity, and because there are so many aspects to navigation design, we chose to focus on text-based and icon-based navigation. There are only suggested and recommended guidelines to follow when creating Web navigation. One of the only laws in regards to web design is that organizations and companies that receive money from the government must have alternate tags on graphics in order to accommodate people with disabilities. Other than that, there aren’t really any hard and fast rules. We have therefore proposed a set of guidelines in regards to Web navigation. Additionally, we performed a preliminary experiment to test the feasibility of icon-based navigation. The results favored text-based navigation, but it also gives a basic understanding of the fundamental problems of icon-based navigation. Some of these problems include unclear or unidentifiable icons and the extra time it takes to complete tasks using icons only for navigation. The findings of our experiment showed that text-based icon was quicker and preferred for all of our participants. However, because our sample size of four was so small, we would like to perform the same experiment with a larger number of participants to give a better idea. Eventually, it would also be interesting to test the experiment based on age groups. Perhaps certain age groups will be able to use the icon-based navigation better than text-based navigation. The extensions of this experiment will provide better understanding of web
navigation and hopefully allow designers to better develop web navigation for their target audience.

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REFERENCES


