Criteria for optimal web design (designing for usability)

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Designing a website that takes into account the human element requires both an understanding of our nature as well as our physiological limitations. Usable websites incorporate human tendencies and limitation into its overall design. The questions below are meant to address some of the more important human factors concerns in the design and building of usable websites.

How should information be positioned in a typical website?

The organization of information within websites is vital to its overall usefulness. In fact, a study by Morkes and Nielsen (1997)found that their experimental website scored higher in usability when text was

- written concisely (58%)
- easily scannable (47%)
- written in an objective instead of a promotional style (27%)

than web pages in their control condition. That is, viewers tend to move quickly from page to page. Instead they usually scan for information that is of direct interest to them. Accordingly, it is suggested that text should be:

- Very succinct
- Include only one key idea per paragraph
- Use highlighted keyword or phrases, and
- Use bulleted lists when possible

Users have grown accustomed to looking in certain areas on a screen to find specific items (Bernard, 2001). Analyzing users' expectations of where they expect specific web objects to be located revealed that generally,

- **Internal web links** were expected to be located on the upper left side of the browser window (Figure 1).
- **External web links** were expected to be located on the right side or lower left side of the browser window (Figure 2).
- **The "back to home" link** was expected to be located at the top-left corner and the bottom-center of the browser window (Figure 3).
- **The internal search engine** was expected to be located at the top-center of the screen (Figure 4), and

- **Advertisement banners** were expected to be located at the top of the browser window (Figure 5).

In follow-up study (Bernard, 2002) that analyzed participants who bought at least one item online revealed that:

- **The login/register button** was expected to be located at the upper-left corner of a web page (Figure 6).

- **The shopping cart** (basket) was expected to be located at the top-right corner of a web page (Figure 7).

- **The help button** was expected to be located at the upper-right side (Figure 8).

- **Links to specific merchandise items** were expected to be located at the left upper-center of a web page (Figure 9), and

- **The account/order button** was expected to be located at the upper-right of a web page (Figure 10).

The figure below shows the combined location expectations for the ten web objects.
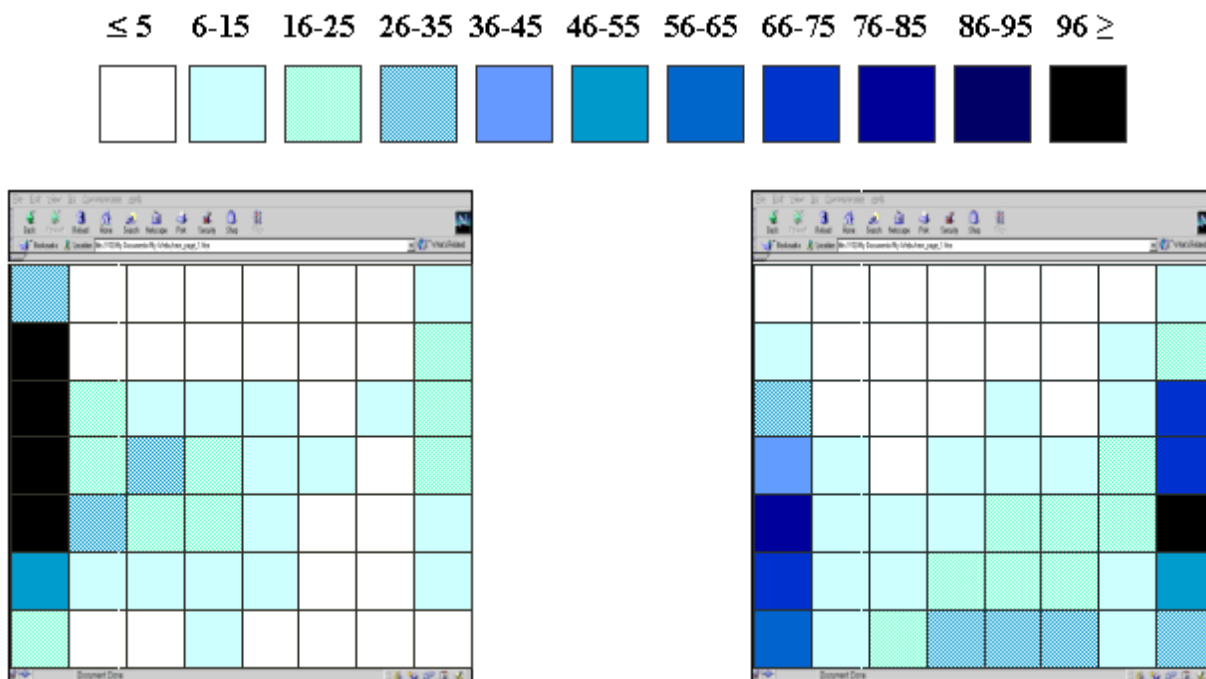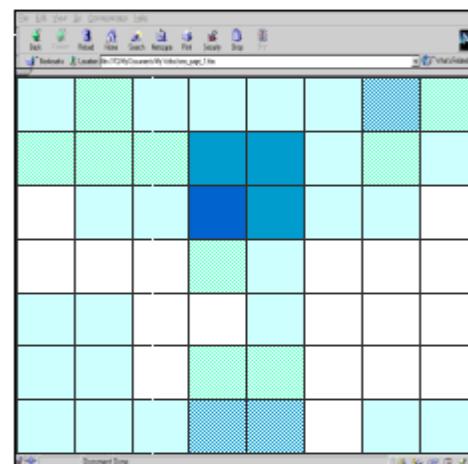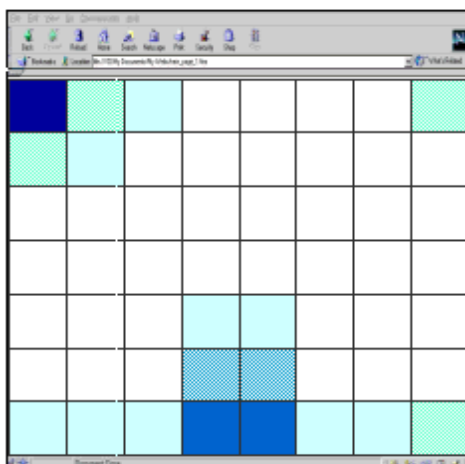
Figure 1. Location for internal web page links

Figure 2. Location for external website links

Figure 3. Location for "back to home" link
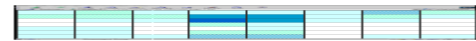
Figure 4. Location for internal search engine

Figure 5. Location for advertisement banners
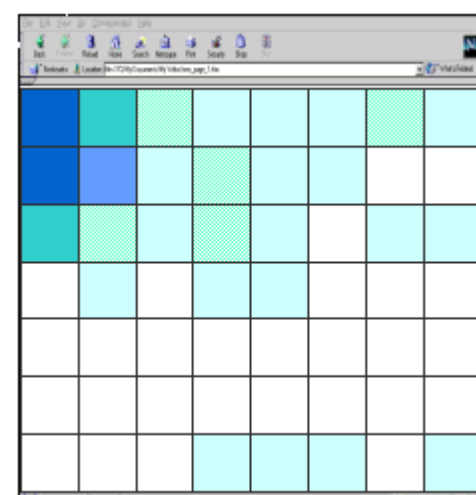
Figure 6. Location for the login/register button

Figure 7. Location for the shopping cart (basket) button
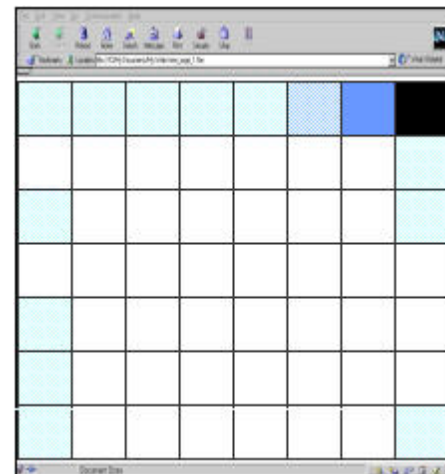
Figure 8. Location for the help button
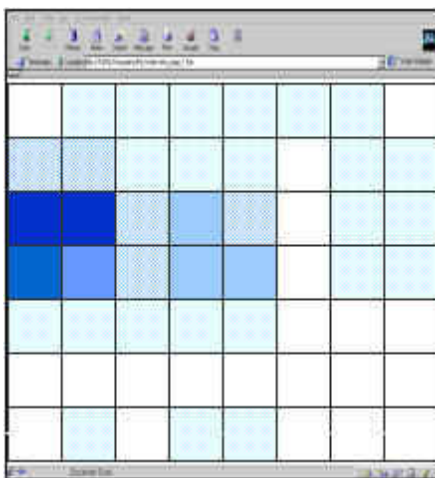
Figure 9. Location for links to merchandise items
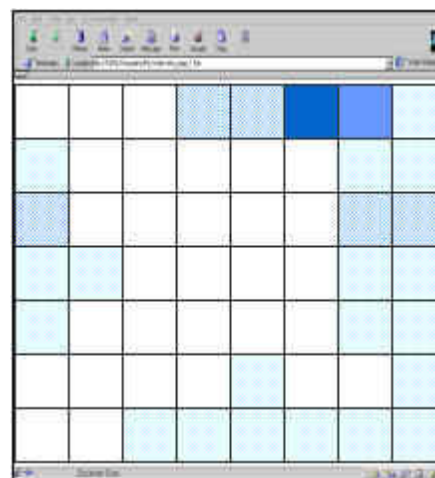
Figure 10. Location for the account/order button

Users often miss important pieces of information simply because it is not seen. This often occurs because they forget or are unwilling to scroll in a particular direction (especially horizontally), and thus do not see the information that is located outside of the primary viewing area. To reduce this problem, important website information should always fit within the typical horizontal viewing area of the screen. To do this, the rule is still to design for lower resolution settings. According to real-time analysis of Web surfers by MyComputer.com, 800 x 600 currently is the most frequently used computer screen resolution.

Average Computer Screen Resolution January 2001	
Resolution	% of Users
640 x 480	8.9%
800 x 600	49.5%
1024 x 768	22.5%
1280 x 1024	2.0%
Unknown	14.8%
(MyComputer.com, 2001)	

The actual usable size to avoid any scrolling at this resolution is 595 x 295 pixels (the safe width for printing at this resolution is 535 pixels). Most users however have their resolution set at 800 x 600 (31%). To avoid scrolling here, the usable size is 750 x 425 pixels. A compromise would be to place the most important information within areas that are visible at lower resolution settings, while placing less important information in areas visible at higher resolution settings.

In addition, when users do scroll, they may not see the information because it is placed in a typically low information-priority area, such as the bottom of a page (Nielsen, 1999) or placed in an area where users typically would not expect it to be placed.

Fluid layouts are significantly preferred to both centered and left-justified layouts. In a study by Bernard and Larsen (2001) participants indicated they perceived the fluid layout (which the margins are not fixed at any particular width) as being the best suited for reading and finding information, as well as having a layout that is most appropriate for the screen size (for both small and large screens). They also indicated that the fluid layout looked the most professional, and consequently preferred it to other layout conditions. Conversely, the consistently least preferred condition was the left-justified layout. A possible reason for the lack of preference for this layout is that

users had to horizontally scroll in order to see all the information on the page. As discussed above, users particularly dislike to horizontally scroll.

Links with summaries are perceived as the most usable and are preferred to links without summaries. A study by Baker, Bernard, and Riley (2002) found no statistical differences in search time across conditions with links with summary, links only, and full text. However, the summary condition was perceived as being the easiest in finding information, being visually pleasing, promoting comprehension, participants' satisfaction with the site, and looking professional. The summary condition was the most preferred, while the full text condition was the least preferred. The full text condition was perceived as being most difficult to find information, not promoting comprehension, not being visually pleasing, and not being satisfying.

Participants reported that they preferred the summary condition over the Links only condition because the brief summaries accompanying the links often guided them to the information they were searching for. Participants commented that, in the links only condition, they sometimes felt as if they were "jumping blindly" into the article. Several participants also reported that they did not like having to scroll through all of the articles in the full text condition. This study suggests that providing a small amount of information about an article on a page is superior to having long, scrolling pages filled with articles.

In presenting a list of links, we found that it is best if they are bulleted. For instance, as discussed in Usability News, Spain compared the accuracy rates for three link conditions: bulleted links, space between the links, and a no bullet/no space condition. It was found that the accuracy rate was

- 100% for bullets

- 89% for spaces, and

- 67% for no spaces.

All participants preferred either the bullets or spaces; no one preferred the no space condition (Spain, 1999). In support of this, Parkinson, Sisson, and Snowberry (1985) found that menus with spacing were searched 25% faster than menus without spacing.

What is the best way to arrange menus

People make fewer mistakes and find information more quickly if the menu structure of the site is broader rather than deeper (For a discussion, see Structure page).

Information is found more quickly in Index menus than in cascading menus. In a study by Bernard and Hamblin (2003), three menu layouts were compared for objective and subjective performance, as well as overall preference. The menus structures consisted of an index layout (like Yahoo.com), a vertical cascading layout, and a horizontal cascading layout. Significant differences in search time were revealed between the three menu item layouts that favored the index menu layout. In addition, there was a non-reliable trend that favored the subjective opinion that the index layout was less disorientating than the other two layouts. Moreover, participants selected the index layout as their first preference choice more than the other two layouts. The poorest performer, both objectively and subjectively, was the horizontal layout.

The use of the "breadcrumb" menus may help reduce user disorientation within the structure of a site. A breadcrumb menu organizes text links from the sites home page to the page's current location (see example below).

Homepage > First level > Second level > presently viewed level

For example, Maldonado and Resnick (2002) found that the use of breadcrumb navigation did reduce user search time, as well as reducing errors and clicks to a marginally significant degree in comparison to expanding hierarchies. However, Lida, Hull, and Pilcher (2002) found in their preliminary study, that participants rarely used breadcrumb navigation, and those who did were not any more efficient than users who did not use breadcrumb

navigation. Participants in this study used a variety of navigational tool, such as the Back button, left and top navigation bars, and searching to find information instead of or in addition to the breadcrumb tool. Thus, the benefits of breadcrumb navigation are still inconclusive.

Embedding links within a document is preferred to explicitly listing them near the document. A study by Bernard, Hull, and Drake (2001) compared links:

1. embedded within a document;

2. links positioned at a bottom of the document;

3. at the top-left of a document; and

4. at the same height to which it corresponded with the associative article.

No significant differences between the four link arrangements were detected in terms of search accuracy, time, or efficiency, suggesting that link arrangements for non-frame documents do not have a great affect on its actual navigability.

However, there were significant subjective differences between the link arrangements favoring the embedded links. That is, participants indicated that they believed that embedding the links within a document made it easier to navigate, easier to recognize key information, easier to follow the main idea of the passages, and promoted comprehension. Moreover, participants significantly preferred the embedded link arrangement to the other arrangements.

In a follow-up study, Bernard, Hull, and Chaparro (2002) examined the placement of links in four locations on a web page for user performance and preference. The link placements consisted of

1. links embedded (Embedded) within a document;

2. links embedded within a document and placed adjacent to the left side and at the same height as the corresponding embedded links (Left-Embedded) of the associative document;

3. links placed at the top-left (Top-Left) of a document; and

4. links placed within a vertical frame (Frame) to the left of a document.

In this study, participants using the Left-Embedded condition had significantly faster search times than the Top-Left condition. Participants also perceived the Left-Embedded and Frame conditions as easier navigate and to find information compared to the Top-Left condition. The Left-Embedded condition also was perceived as promoting higher levels of comprehension than the Top-Left condition. Overall, the Left-Embedded condition was most preferred and Top-Left condition was the least preferred

Categorical menus are superior in both search performance and satisfaction to alphabetized sitemaps. As found by Bernard and Chaparro (2002), McDonald, Stone, Liebelt (1983) and others, one of the main reasons for higher performance was that it was more difficult to find information in the Alphabetized sitemap because participants had to guess how this information was worded in the menu. Since index menus are generally based on the alphabetization of the first letter of the hyperlink names in the menus, users may have to guess the wording of the hyperlink name in order to search in the appropriate area, which may have led to lower levels of search performance and satisfaction.

Moreover, as long as the menu items are optimally grouped, the number of items placed on one page can be quite high. In fact, Paap and Roske-Hofstrand (1986) state that as many as 78 items can be placed on a single page without substantially decreasing performance.

Categorical menus arranged in columns are searched faster than menus arranged in rows. In fact, Parkinson,

Sisson, and Snowberry (1985) found that search time was reduced by 25% if the categorical menus were arranged by columns. They also found that if the menu links had one additional space between category groups resulted in even faster search times.

Menu Links accompanied with a summary text tend to be preferred to menus without summary text. That is, a study by Baker, Bernard, and Riley (2002) found that summary menus were perceived more positively in terms of ease of finding information, being visually pleasing, promoting comprehension, participants' satisfaction with the site, and looking professional.

How can I make my website's structure more navigable?

People often become lost within the structure. In fact, 58% of users will make two or more navigational errors while searching for information (Forsythe, et al., 1996) and 66.8% of users have stated that one of the greatest problems about the Web is "not being able to find the information that I am looking for" (GVU, 1998). Generally there are four major reasons for this occurrence (Foss, 1989):

First difficulty is disorientation or "lost-in-hypertext problems, which arises from an unfamiliarity with the structure or conceptual organization of the site. Here, users have difficulty deciding which node (which is typically one web page) to view next because they are unable to visualize where the information they are looking for could be. The decision concerning which node to view next first involves understanding one's current location within the site, then selecting the proper route. However, users may not even know their current location within a site.

A proper way to reduce this problem is to organize the site according to the typical users' mental model of how a site should be organized. This can be done by having representative users sort cards into several categorical piles in which each card represents the information that would be placed on the actual website. Each pile should indicate the information that would be clustered within each category and subcategory. This would give the designer knowledge on how users mentally organize the structure of a particular site -a technique that uses this method is discussed in Usability News (Bernard, 2000).

In addition, the placement of submenu titles may also help reduce disorientation. For example, Gray (1986) found that of the navigation errors made within a hierarchy, 40% of them were in the third and fourth levels with submenu titles. Without submenu titles, 59% of the errors were made in the third and fourth levels. Moreover, according to Bransford and Johnson (1972), participants who have read passages with titles recalled approximately twice as many items from the passages and had higher comprehension than participants who did not have passages with titles.

The use of navigational aids such as color coding and consistent logos and banners should also reduce disorientation (see the Yale Style Manual for a discussion of this) and the use of the "bread crumb" navigation technique (for a discussion, see [menu] page) may help in reducing the disorientation problem as well.

The second difficulty is the embedded digression problem. This occurs when users pursue digressive paths within websites and lose their place or forget to return to their original document. This can be lessened by reducing the number of links embedded in text by placing them instead at the end or on the side of the document. However, Knoved and Shneiderman (1986) found that users preferred and were more accurate in answering information using embedded links than an explicit grouping of links outside the text. Yet, they also stated that embedded links could be disruptive in that the user "may be inclined to examine a particular subject or subjects in detail without first getting an appreciation of the overall context" (p. 316).

A recent study by Bernard, Hull, & Drake (2001) examined the effects of embedding associative links with a document, as well as placing them at the bottom, at the top-left, and left, at the same height in which they correspond with the document. No significant differences between the four link arrangements were detected in terms of search accuracy, time, or efficiency. However, there were significant subjective differences between the links arrangements favoring the embedded links. That is, participants indicated that they believed that embedding the links within a document made it easier to navigate, more easily recognize key information, promoted

comprehension, and was easier to follow the main idea of the passages while searching for specific information. Moreover, participants significantly preferred the embedded link arrangement to the other arrangements. Conversely, placing links at the bottom of a document was perceived as being the least navigable arrangement, and was consequently least preferred.

Thus, while embedded digression may be a problem for some users, this should be weighed against the subjective perceptions that favor the embedded link arrangement.
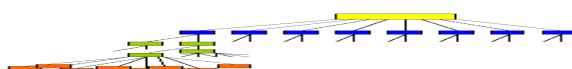
The third difficulty is the "art museum" problem. This refers to the lack of memory for the navigational details of a significant part of the site because the viewer is overwhelmed by the sheer amount of information. For instance, as when a patron visiting a museum cannot hope to remember the details of all the art work because of their great number, a large number and variation of navigational information (such as the various nodes they have visited) may consequently overwhelm the user. This often can have the effect of reducing a person's recall of the pages they have visited.

This can be lessened by reducing the amount of information presented at one time and properly organizing the navigational structure of the site. For example, in a study comparing three types of structures: pure hierarchical (web pages at one level can only access by a web page directly above or below it), nonlinear (links could be connected to any number of other web pages on the site), and mixed design (hierarchical structure with cross referential links) researchers found that participants recalled more information with the mixed design. The pure hierarchical structure was found to be too restrictive, and the nonlinear design presented too much information at one time (McDonald & Stevenson, 1998). Thus, sites should present only the amount of links that are necessary for navigation -superfluous links will increase the probability that the users will be confused and disoriented. Additional support for this conclusion can be derived from the Hick-Hyman law, which generally states that the greater the number of options (in this case navigational options), the longer it takes to find the appropriate one because of greater uncertainty.

Other aids that are beneficial to navigation are the use of sitemaps. Sitemaps may, if done properly, present the structure of a site in a more cognitively manageable way by showing a site's main structure and the various link to that structure. This is discussed in the previous issues of Usability News (Bernard, 1999).

The fourth difficulty may be the structure itself. That is, it is generally found that people make fewer mistakes if the hierarchical structure of the site is broader rather than deeper. In fact, research has generally found that ideally all information should be placed within three hierarchical levels from the initial homepage of the site. Specifically, the more levels users have to take in order to get the information they want, the less chance they will find this information. For instance, in placing hyperlinks on a web page, Larson and Czerwinski (1998) point out that a moderate level of breadth is optimal if it is preceded by a well-organized layout. In their study, they reported that a two-level site beginning with 16 sequential links on the first level, then 32 links on the other produced reliably faster searches for information and produced less confusion than a three-level site with eight sequential links in all three levels. The reasoning here is that the deeper the levels, the more a user has to rely on short-term memory. Deeper level sites also have more general (and consequently more vague) link descriptions at the top level, which makes it more difficult for users to figure out and remember the correct paths to a target (For a good discussion of the breadth versus depth issue see Larson & Czerwinski,1998).

However for sites that must have deeper structures (4 or more levels), Norman and Chin (1998) found in their study of different menu tree structures that users browsing for specific information will find this information faster if the structure is concave (breadth of 8 x 2 x 2 x 8 pages). That is, it should be broad at the top level and at the lowest or 'base' level, while the interior of the web structure should have a narrower level of breadth (see Figure 1 below). They argue that a broad top level gives the user enough specific information to formulate an idea as to the correct path to take, while concentrating much of the information (and the choices) at the base level will help the user find that specific item. A narrower breath interior will, in turn, reduce the likelihood of getting lost within the site because the user will have fewer choices, and consequently less chance of being disoriented.
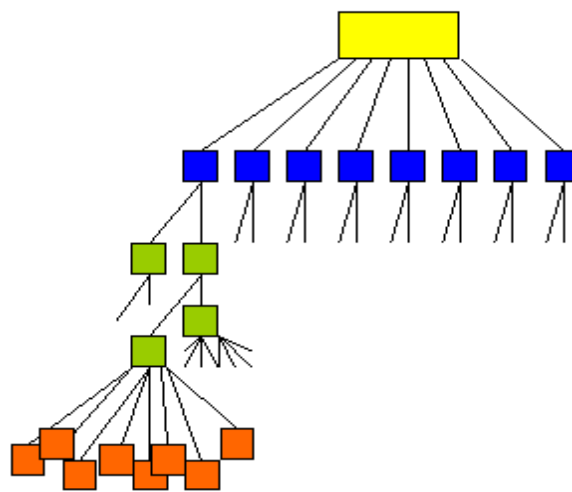
Figure 1. Concave (8 x 2 x 2 x 8) menu tree

As discussed by Bernard (2002), depth alone may not be the sole, or even the greatest determinate in predicting search performance. In fact, as was shown, the shape of a hypertext structure had at least as much to do with search efficiency than its depth. Indeed, a (4 x 4 x 4 x 4) structure was found to be not only less efficient than hypertext shapes of the same depth (i.e., a (6 x 2 x 2 x 12) structure), but structures that were deeper, such as a (3 x 2 x 2 x 2 x 12) structure. As discussed, much has been said about hypertext depth, in that the greater the depth, the less informationally efficient the structure should be (e.g., Jacko & Salvendy, 1996; Snowberry, et al., 1983). However, what seems to be occurring is that the search efficiency is at least in part, determined by the properties related to the overall shape of the hypertext structure. These properties, then, act to either help facilitate or impede hypertext efficiency by altering the general complexity of the structure. Accordingly, having an inefficient shape will decrease a hypertext's search efficiency.

Consequently, the goal should always be to reduce the complexity of the site as much as possible. Thus as shown in Figure 2, the ideal structure of a website would have much of the sites's information accessible at the first level (shown as the horizontal bar). Structures that have multiple levels should concentrate the information at the first level when possible, and at the level closest to the terminal nodes (at the bottom of the pyramid).

Figure 2. The ideal web structure with multiple levels

The arrangement of links can have a marked effect on search time and satisfaction. For example, it has been found that search time is significantly faster when links are grouped in columns rather than by rows (Nygren, 1996). However, as mentioned above, expandable link columns have been shown to decrease performance in terms of search time, errors, and number of clicks compared to bread crumbs, or simple link-column navigation (Maldonado & Resnick, 2002).

Moreover, as discussed in Usability News (Bernard, 1999), experienced and novice users found specific links faster

and were more satisfied with the structure of the site when the information is presented in columns according to their respective categories rather than when the links are presented in columns according to an alphabetical listing of links. This is believed to occur because users have a difficult time trying to guess the appropriate link name in order to know where to initially look within the alphabetized column listing.

In the same study, users preferred to have all the menu links presented on one web page instead of initially showing only the link categories, which would then show the sub-category menus on mouse-over. We felt that the latter option of initially placing only the link categories would reduce "link crowding" on the screen to a more manageable number -thus improving accuracy and satisfaction by making it easier to acquire the proper link. However, no significant differences between the former and the latter category options were found. Interestingly, a large portion of users stated that they would prefer the latter option if they were more familiar with the menu structure and the menu terms. Thus, one may want to have a full categorical link organization, but also have an option to initially show only the link categories, which would show the sub-menus on mouse-over for frequent users of the site (Bernard, 1999).
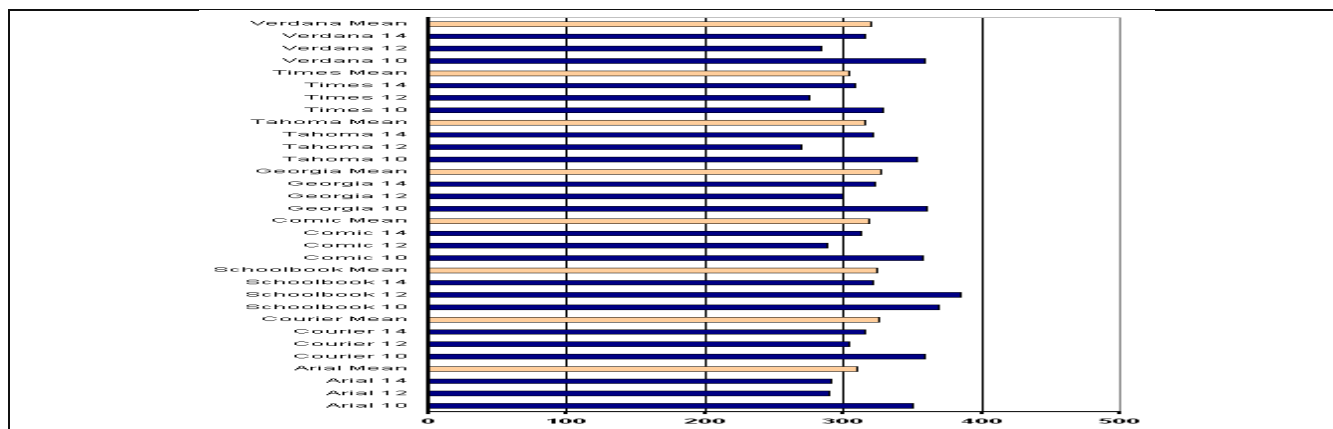
In the specific placement of links within the website structure, Kim and Yoo (2000) found in a study of Internet shopping mall sites that the combination of neighborhood links (links which move horizontally within the site), top links (links which move the user upward to a predetermined destination, such as the homepage), and index links (links which go to the lowest level regardless of the the current position, such as information on a specific product) significantly produce the greatest perception of navigation ease as well as general satisfaction. They also found that links which only moves up one level from its current position and down one level in a site causes a significantly lower perception of ease of navigation, as well as generally lowering the level of satisfaction with the site.

How should text be presented on a website?

Evidence suggests that the most commonly used fonts tend to be equally legible at the 10-, 12-, and 14-point size. Comparing four sans serif fonts (Arial, Comic Sans MS, Tahoma, and Verdana) and four serif fonts (Courier New, Georgia, Century Schoolbook, Times New Roman) at a resolution of 1024 x 768 revealed no difference in effective reading (font accuracy/speed of reading) between font types (Bernard, Lida, Riley, Hackler, & Janzen, 2002). This finding is supported by Bernard, Mills, Frank, and McKown (2001), which did not find significant differences as well.

This is not to say there is no objective differences between the fonts. In fact, there is some evidence that suggest that some serif fonts promote better comprehension than some sans serif fonts. For example, a study by Boyarski, Neuwirth, Forlizzi, and Regli (1998) found small but significantly higher levels of comprehension for the Georgia font over the sans serif font Verdana by people reading on a computer screen. However, it is really too early to draw any definitive conclusions from this. Studies need to further examine the effect of different fonts on reading comprehension.

Significant differences in reading time were found in that Times New Roman and Arial were read faster than Courier New, Century Schoolbook, and Georgia. Fonts at the 10-point size were read more slowly than fonts at the 12-point size (see Figure 1). The average difference between the fastest and slowest read font was 99.4 seconds.
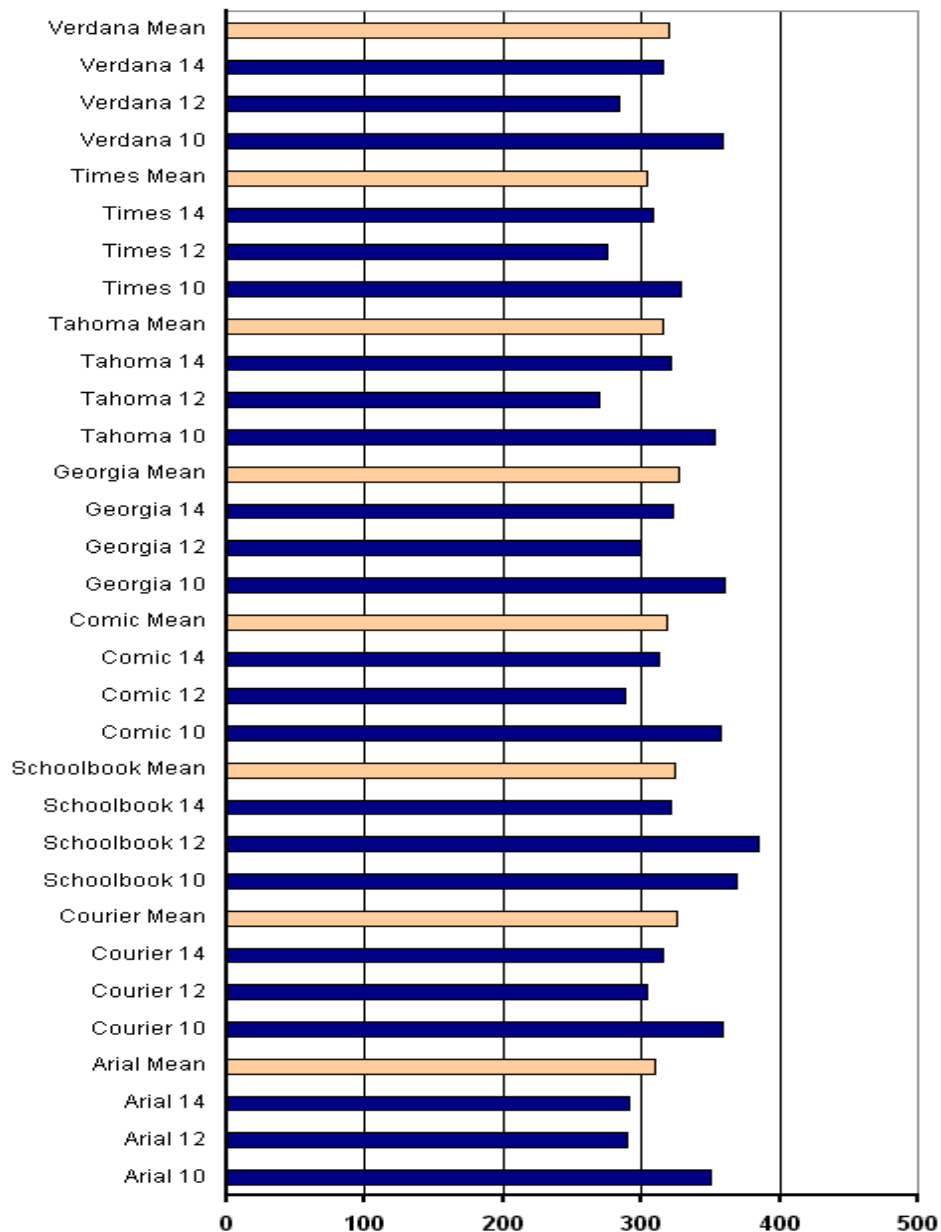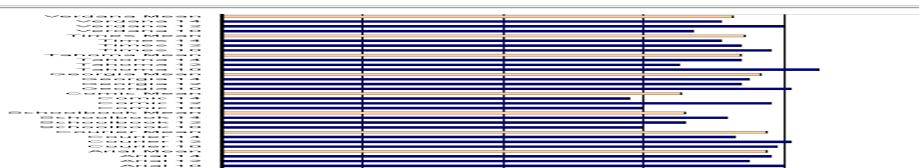
Figure 1. Reading time in seconds (longer bars indicated longer reading times)

Ten-point Tahoma was perceived as more legible than 12-point schoolbook. In addition, 12-point Verdana and Courier were significantly perceived as being more legible than 10-point Comic, Schoolbook and Verdana. Also, 12-point Courier was perceived as more legible than 12-point Schoolbook and Tahoma, as well as 14-point Comic. Interestingly, 10-point Georgia had a significantly higher perception of legibility than 12-point Tahoma and Schoolbook. Fourteen-point Arial was perceived as being more legible than14-point Comic, and 10-point Arial was perceived as more legible than 12-point Tahoma. Moreover at the 14-point size, only Arial was significantly perceived as being more legible than fonts at other sizes (10-point Schoolbook and Comic). Overall, Arial and Courier were considered the most legible fonts, whereas Comic was perceived as the most illegible font (see Figure 2).
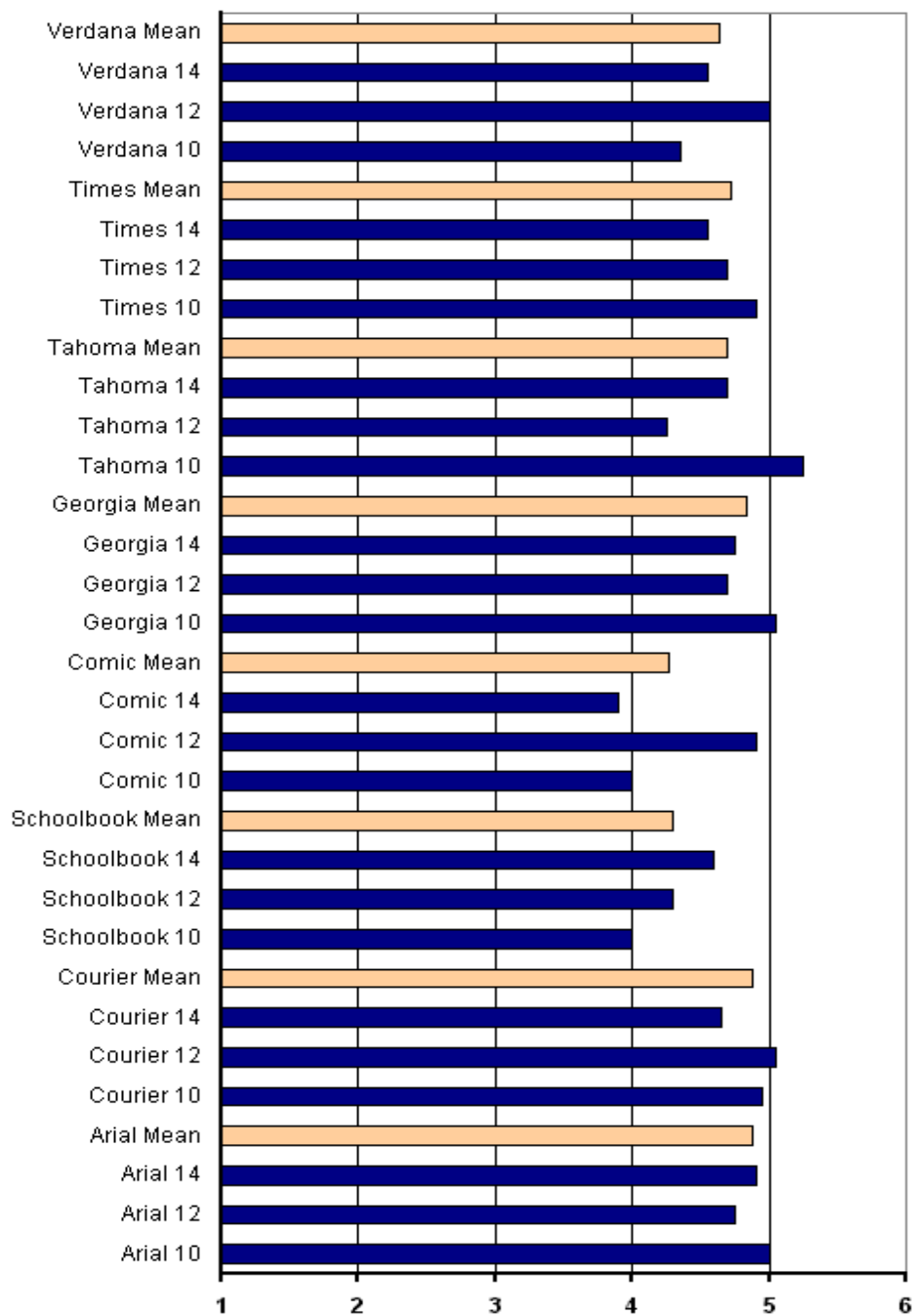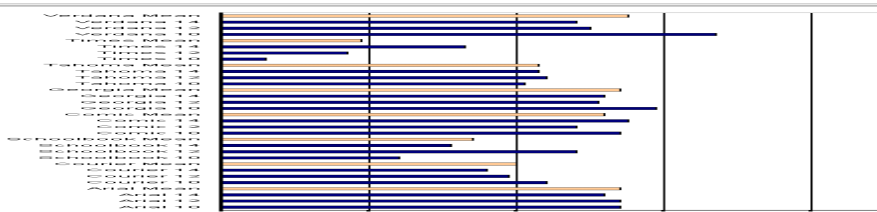
Figure 2. Perceived font legibility (1 = "Not at all" and 6 = "Completely")

Overall analysis of the participants' font preference revealed that Times was significantly less preferred to all fonts except Schoolbook. Schoolbook was significantly less preferred to Verdana. Overall, Verdana was the most preferred font, while Times was the least preferred font (see Figure 4).
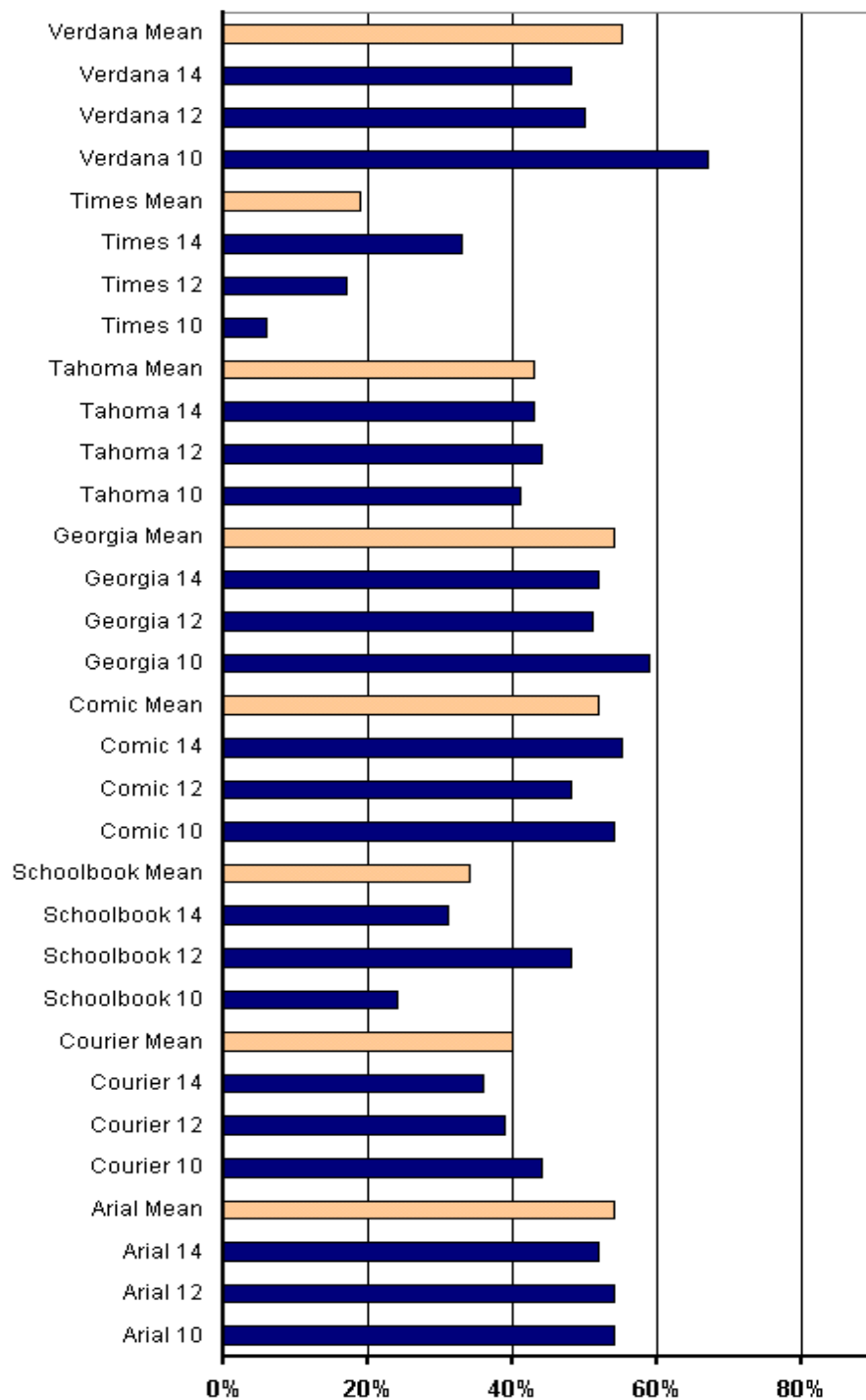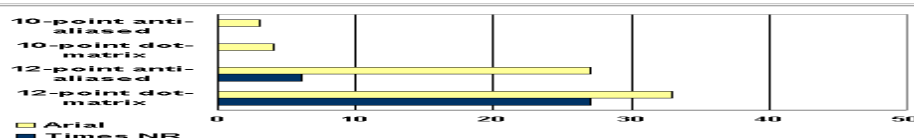
Figure 4. Font preference (longer bars indicates more preferred font choice).

For anti-aliased fonts, Arial may be the best font choice. Comparing aliased and anti-aliased Times New Roman and Arial fonts at 10- and 12-point sizes found that the 12-point anti-aliased Arial font tied for second in preference, as well as being judged as the third to most legible font presented (Bernard & Mills, 2000). The 10-point Times New Roman font was not ranked first or second by any participant (See Figure 5).
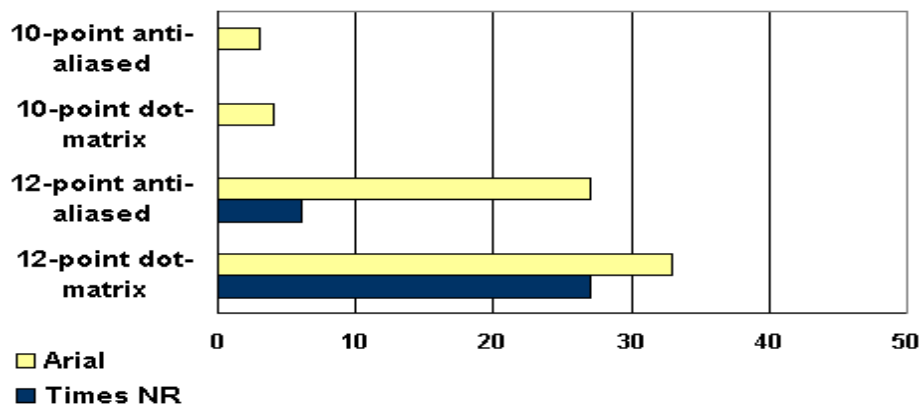
Figure 5. The percentage of times each font was chosen as the 1st or 2nd preference choice

However, one should use caution in creating anti-aliased text that is based on a graphical image, such as with a JEPG or GIF, because they are "fixed" at a particular font size that may be too small to be read by a certain population of users (i.e., vision impaired). It is therefore recommended that text which cannot be size-adjusted (because it is part of an image, etc.) should be at least 3 mm in height. In addition, all graphics should make use of the alternative text function (alt =" ") so that users who cannot see the text images can have the text image descriptions presented or read to them by a text reader.

Older Adults are more accurate with, and prefer larger font sizes. They also prefer sans serif fonts over serif fonts. As discussed by Bernard, Liao, and Mills (2001) reading online documents (about 2 pages), older adults significantly preferred the larger, 14-point font size (see Figure 4 below). In this study, serif fonts (Georgia and Times New Roman) were compared to sans serif fonts (Arial and Verdana) at 12- and 14-points. The 14-point fonts were found to be more legible, promote faster reading, and were preferred to the 12-point fonts. Also, at the 14-point size, serif fonts tended to support faster reading (see Figure 6). Examining participants' 1st and 2nd preference choice further shows the popularity of the 14-point size (see Figure 7).

The sans serif fonts were, however, generally *more* preferred than the serif fonts. This finding is supported by Sorg (1985), which found that older adults preferred to read Helvetica, which is a sans serif font similar to Arial, compared to Century Schoolbook, which is a serif font.
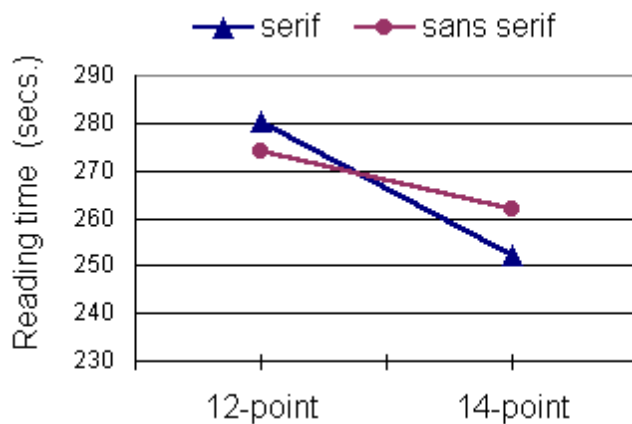
Figure 6. Mean reading time in seconds
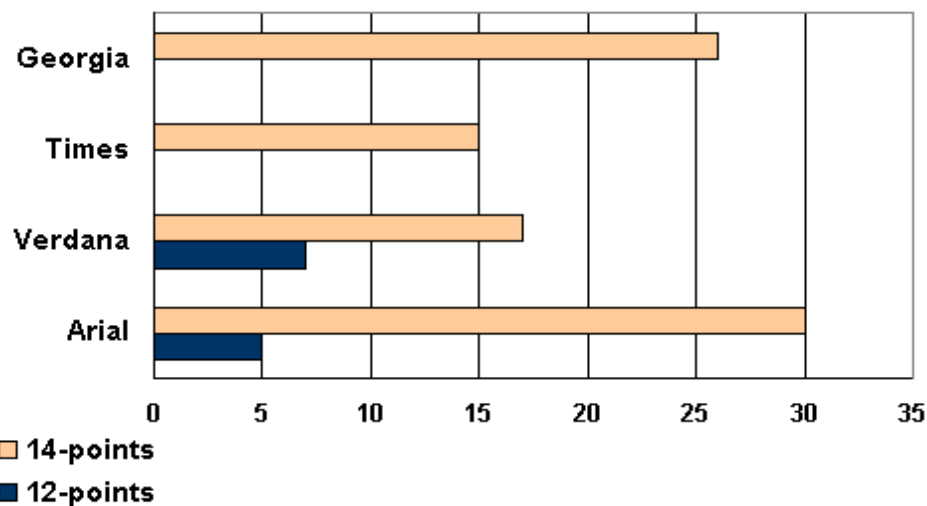
Figure 7. The percentage of times each font was chosen as the 1st or 2nd preference choice.
Both 12-point Georgia and Times were not selected as a 1st or 2nd choice.

There is evidence that children prefer sans serif fonts (Arial & Comic) over serif fonts. For instance, Bernard and Mills (2001) found that fourth and fifth graders (mean age of 10) significantly preferred the 14-point Arial and the 12-point Comic Sans MS font over the 12-point Times New Roman and Courier New fonts. Examining participants' 1st and 2nd preference choice further shows the popularity of the Comic font (see Figure 8 below). No difference in reading speed or accuracy between the font types were found, however. This may be due to the fact that 12-point font sizes and above tend to produce the same level of performance, as long as the font types are designed for legibility.
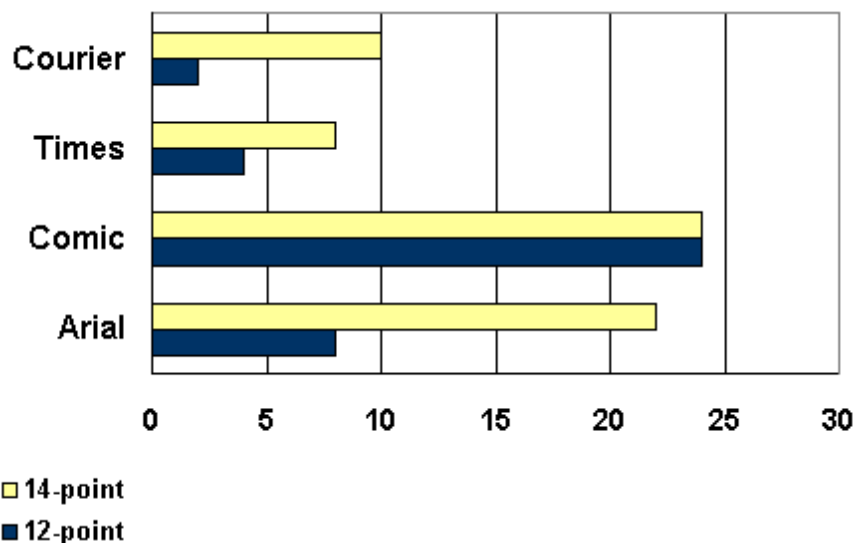
Figure 8. The percentage of times each font was chosen as the 1st or 2nd preference choice.

The optimal text line length is dependent upon several factors. It is commonly recommended that shorter line lengths (about 11 words) should be used in place of longer, full-screen lengths. This is because longer line lengths require greater lateral eye movements, which make it more likely to loose one's place within the text (Horton, 1989;

Mills & Weldon, 1987). It also has been pointed out by Horton (1989) that longer line lengths are more tiring to read. Horton recommends that lines should be limited to lengths of around 40 to 60 characters, which is approximately 11 words per line. A study by Huey (1968) tends to support this in his finding that shorter line lengths or approximately 4" (10 cm) are more accurate on the return sweep than longer line lengths. Moreover, Gregory and Pouton (1970) state that people with poor reading ability performed better when the line length was approximately seven words. This suggests that young readers who have not mastered reading online, as well as readers who have vision deficits, may be most benefited by having shorter line lengths.

As far as reading time, a study by Youngman and Scharff (1999) found that with 0.5 inch margins, the fastest reaction times were for the shorter, 4-inch (10 cm) lengths over the 6- and 8-inch lengths (15 and 20 cm, respectively). The 4-inch lengths were also preferred over the other lengths. However with no margin widths, the 8-inch line lengths had the fastest overall reaction times. A study by Duchnicky and Kolers (1983), found that full screen lengths resulted in 28% faster reading times over lengths of 1/3 of a screen. It was also found that full and 2/3 screen lengths were read significantly faster than the 1/3 screen lengths.

In a recent study by Bernard, Fernandez, and Hull (2002) that compared three links lengths (24.5, 14.5, and 8.5 cm, respectively) for both children and adults supported the finding that shorter line lengths are preferred more than full-screen line lengths. As far as the perception of reading efficiency, the results were mixed. For adults, the Full-length condition was perceived as providing the optimal amount of scrolling in comparison to the two other conditions—presumably because this condition required the least amount of scrolling. The Narrow-length condition was perceived as promoting the highest amount of concentration, while the Medium-length condition was considered to be the most optimally presented length for reading.

Overall these results suggest a trade-off between faster reading times of the longer lengths and a more preferred reading arrangement of the shorter lengths. Possibly the best arrangement is somewhere between the two. More research needs to be done, however.

Background textures and colors can affect the readability of text. For example, Hill and Scharff (1999) found that plain backgrounds produce faster search times than medium textured backgrounds. An important determinant, though, is the contrast between the text and the background -- the more textured the background, the greater the contrast should be between them.

Moreover, textured backgrounds that are subtle at true-color (24-bit) settings, often become very noticeable at lower-color settings (i.e., 8-bit), thereby reducing the contrast between the text and the background even further. Thus, if one is to use a textured background, it is recommended to be very careful by testing it in different color settings.

As for color, as long as there is sufficient contrast between the text and the background, many color combinations are possible. However, most studies have shown that dark characters on a light background are superior to light characters on a dark background (when the refresh rate is fairly high). For example, Bauer and Cavonius (1980) found that participants were 26% more accurate in reading text when they read it with dark characters on a light background. Moreover, a survey by Scharff, et al. (1996) revealed that the color combination perceived as being most readable is the traditional black text on white background. However, it is common for websites (such as this one) to have an off-white background in order to reduce the flicker and glare associated with white backgrounds.

In the Scharff et al. (1996) study, other color combinations that ranked high were white on dark blue and red on yellow. However, one should be cautious in using colors such as red on yellow that are pure or 'saturated.' Saturated colors create visual fatigue and make it difficult to focus on the text. It is best to de-saturate colors by adding white or combining them with other colors.

The least readable combination were green on yellow, white on fuchsia, red on green, and fuchsia on blue. Also, for all combinations, the lighter backgrounds with darker text was considered to be more readable than darker backgrounds with lighter text.

Approximately 8% of males and a little less than 0.5% of females have a color deficit of some kind. In fact, one study found that around 4% of Internet users are visually impaired in some way (GVU, 1998). Thus, it is important to note that different font sizes and font color combinations can have a dramatic effect on the readability of a site.

For text colors, it is important to have a good contrast difference between colors that need to be distinguished. Some color combinations generally frustrate users and make it virtually unreadable for color deficit or "colorblind" users (Nielsen, 1996). That is, for many color deficit users, red, green, brown, or purple may look the same if these colors have the same contrast. Since color deficit users cannot distinguish between a large spectrum of colors, it is therefore advised to strongly contrast the colors (make sure one color is darker than the other) between the foreground and background, as well as between other colors that need to be distinguished (see Wolfmaier, 1999, for a good description of the proper font-color mixture).

How can I effectively use images on my website?

Users often may "instinctively" ignore the graphics that are presented on a website. For example, according to the Poynter Institute, it was found that users were twice as likely to fixate on the text than on the images in their initial visit to a site. In fact, they found that users did not look at the images until the second or third visit to the site. This effect has been found to have the greatest impact on effectiveness of banners. For instance, the Poynter Institute found that only 22% of ads and promotional icons were viewed, 45% of the banner ads presented were viewed, and 64% of photos that were presented were viewed (Poynter.org, 2000).

To determine where users generally expect ads to be located on a typical web page, 304 participants were examined. It was and found that they expect ads to be located at the top-half of a web page. As seen in Figure 1, the darker shades of blue indicate higher expectations for them to be located in that particular area.
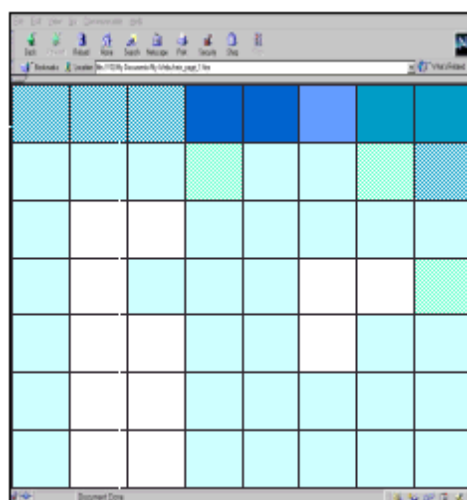
Figure 1. Where people expect ads to be located. The darker the shade of blue, the greater the expectation.

However, an important factor in increasing the effectiveness of banner ads may be to place them where they are generally not expected, since people tend to ignore these areas. That is, it is possible that ads may be more effective if they are placed in an area where they are generally not anticipated. This is because individuals may tend to ignore areas where they believe advertisements are typically placed. Supporting this argument, Benway (1998) found that banners located at the top of a web page tended to be ignored more often than banners located lower down on the page. Another study found a higher click-through rate for advertisements placed 1/3 of the way down the page as opposed to the top of the page (WebReference.com, 1997). Thus, it is generally recommended to place ads lower down on the web page - particularly at the middle-center of the page.

Benway and Lane (1998) also found that participants identified graphical banners only 58% of the time, compared

to 94% for the text-based link alternative. It also took more time to find the banners than the text-based links. Interestingly, Benway's (1998) study also showed that extremely colorful and obvious banners tend to be ignored by users. Reasons for this may be that viewers have learned to ignore these types of graphics.

Another consideration is the type of browsing that is taking place. According to a study by Pagendarm and Schaumburg (2001), recall and recognition of banners were higher when viewers were browsing aimlessly than if they were searching for specific information. Thus, it is possible that with aimless or unstructured browsing (which is often done with online magazines), viewers are more prone to perceive banners and respond to them.

In addition, banners should be much larger than the surrounding text for viewers to initially notice them. In fact, Faraday (2001) found that if the size of the text and image is approximately equal, then the text will be attended to first and will be more preferred.

It should be noted that graphical images can easily be distracting and may increase load time, which is the greatest complaint of Internet users (GVU, 1998). However, it has been shown that visual information such as graphics is generally more persuasive for simple messages than textual information, while textual information is more persuasive for more complex messages (see King, Dent, & Miles, 1991).

Animating the graphics may not help as well. In a study by Benway and Lane (1998), animated graphics showed no advantage over non-animated graphics. Moreover, there is some evidence that animated graphics may even reduce text retention by serving to distract the user from attending to the textual information around the graphic (Wright, Milroy, & Lickorish, 1999). Studies have also been mixed about whether animated graphics are preferable to only text-based interfaces. It has been suggested that animated graphics should be kept at a minimum in order not to distract the user from the main points of the page, as well as to reduce the download time.

Importantly, graphics that look like banners should normally not serve as important links. This is because users tend to ignore animated graphic because they are generally associated with advertisements. The graphics that are presented should convey a simple message to portray the intended mood of the site or to catch the 'eye' of the user for a brief moment. Any animation that is presented should animate only for several seconds in order not to annoy and distract the user.
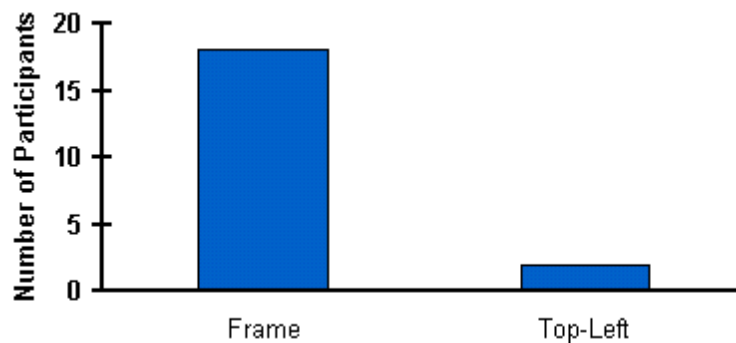
Colored images are more easily remembered than black and white images. That is, Gilbert and Schleuder (1990) compared black and white to colored ads and found that the colored ads were more readily recalled and were processed with greater speed.

Are frames ever appropriate?

Frames have the potential to confuse users by breaking the user's model of a website. For instance, instead of the concept of a node as being a single unit of information, framed pages may consist of many units that can go in any direction, which may make it difficult to later go back to the original node. Also, viewers cannot bookmark frames, frames are not accessible to many users who employ assisting technology such as screen readers, and some search engines reject the framed pages outright, so what is left is only the main or dominant frame (However, there are some ways around this, see http://searchenginewatch.com/ webmasters/frames.html); And, of course, users hate poorly designed, framed web pages (Nielsen, 1996).

Proper and parsimonious use of frames may, however, be appropriate for websites if it promotes easier navigation. (see Priestley, 1997, for a more detailed discussion of this). One way to use frames is by using a navigational menu frame (also called an inline frame, which is a frame dedicated to displaying the main navigational links within a site). A menu frame can solve the problem of the disappearing menu when users scroll down a non-framed page because the menu frame will always be visible (these are normally placed on the left side or top of the screen). Drawbacks of using menu frames is that the amount of information placed in the menu page must be rather small in order for the entire menu to fit within the frame. That is, forcing the user to scroll to see the entire menu frame defeats the purpose of having one -which is to always have a visible menu.

Frames might also be used to allow users to follow an external link while keeping the original, initial site in view. To do this, typically the top frame shows the initial site as a reminder to return to that site and the lower frame shows the sites that are external to the initial site (hotmail.com uses this technique). However, there should be an option to completely leave the initial site. In addition, links that exit the site should use the TARGET="_top" tag to ensure that users can leave the initial site without being embedded within the frameset of the initial site.

In a study we examined performance and preference of framed versus non-framed pages in which participants were presented with four documents, each with a different link arrangement. For each arrangement they were instructed to search for specific information pertaining to ten questions related to that document (such as, "*Who found evidence linking tribes from Siberia to the Americas?*"). In one condition the links were embedded within a document, as would be found with many online documents (see Figure 1). This was accomplished by using an original online article with embedded links. A second condition placed links at the upper-left of the document (see Figure 2). Another condition placed links within a horizontal, top frame above the document (see Figure 3) and a fourth condition placed the links within a vertical frame at the left of the document (see Figure 4).

Figure 1. Links embedded in the document

Figure 2. Links at top-left

Figure 3. Links within a horizontal frame

Figure 4. Links within a vertical frame

An analysis of the results revealed no significant differences in search performance (accuracy, search time, and search efficiency) or preference between the four conditions. Interestingly, the participants had rather strong preferences towards the top-left and horizontal framed layouts --which, in effect, canceled each other out.

In a follow-up study (Bernard & Hull, 2002) that only compared the top-left with the vertical frame conditions in terms of preference did reveal significant differences that favored the frame condition [z = -3.58, p < .001]. Examining the number of participants' ranking either the Frame or Top-Left (no fame) conditions as their first

choice further illustrates the preference for the Frame condition (see Figure below).

How can I design a visually pleasing interface that follows usability principles?

Much has been said about the design process of websites, such as establishing the proper mood or "feel" to create user interest or even excitement with the site. This is a very important concern, but ultimately users tend to be far more satisfied and stay with websites that are designed for their use in mind (see Tedeschi, 1999). Considering this, three core principles concerning interface design are presented:

1) Keep the interface simple - To quote Mies van der Rohe, "less is more." Organize the interface by reducing un-needed visual elements as much as possible. That is, remove all unnecessary visual "noise." This will make the important objects that are there stand out even more. Moreover, as Edward Tufte stated, "it is not how much space there is, but rather how it is used. It is not how much information there is, but rather how effectively it is organized" (Tufte, 1990, p. 50). The use of open space is generally more effective in organizing and grouping information than using imposed, artificial structures such as visually nested frames or bars. It is also more aesthetically pleasing. In fact, we found empirical support for the notion that the proper use of open space can increase satisfaction with a website (Bernard, Chaparro, & Thomasson, 2000).

2) Make action-objects visible - According to Donald Norman, a design should a) make it easy to determine what actions are possible at any moment, b) make things visible, including the conceptual model of the system, the alternative actions, and the results of actions, and c) make it easy to evaluate the current state of the system. On a web interface, one of the chief mechanisms to do this is the proper use of perceived affordances (Norman, 1988).

An affordance refers to the "properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used" (p. 9). Affordance provides us with clues as to the operations of things. More importantly for interfaces, however, are the perceived affordances which provide visual feedback that advertise affordances. For example, a link button may be perceived to afford clicking because of its '3-D' or 'raised' appearance. Consequently, it is often helpful to give link buttons the physical appearance of a button, or any object that affords clicking, in order for them to be seen as a button to be clicked (Norman, 1988). Thus, it is important to make navigation buttons look like they should be clicked as well as follow the convention of underlining links when they are text-based links. Conversely, non-navigation objects should not look like they could be clicked in order not to 'trick' the user into thinking they are links.

Generally, buttons serve as primary object for initiating actions, such as submitting or confirming information. Buttons also can act as the primary link for movement to other web pages, usually within the same website. When this occurs, text-based links often serve as a less important, secondary or supplemental link for the buttons. Normally, however, text-based links are the primary link to other internal web pages.

Moreover, physical appearance of objects such as icons can significantly affect navigational performance. For example, Rogers (1987) found that icons with abstract but simple symbols that represented concrete objects resulted in the fewest number of errors and requests for help. In addition, Byrne (1993) found that large and simple icons outperformed complex ones by a significant margin. Byrne suggests that icons need to be simple, large, and easy to

discriminate in order to be effective. Complex icons tend to clutter the screen with unnecessary information. Moreover, Norman (1985) suggests that icons are best used to represent graphic tools and objects. Verbal labels, such as "to save" are best for formal commands (for a checklist on designing effective icons, see Horton, 1997).

3) Balance and unify the interface - Balance and unity has always been a key component in good design. Humans on a preconscious level seek structure in the things they see. If there is no intentional structure, we will impose our own. Seeking the appropriate balance among things, as well as unifying those things that are related will generate structures that are not only pleasing to the eye, but will make the interface more understandable (see Mullet & Sano, 1995, for an excellent discussion on design and visual interfaces). Empirical studies have supported this claim by finding that the position within a plane (as well as size and contrast) to be one of the most perceptually important variables in visual search tasks (Cleveland, 1985).

One of the fundamental concepts of balance is the notion of the Golden Section. The Golden Section is a ratio of a rectangle in which the smaller side to the larger is the same as that of the larger to the sum of both -which is a ratio of approximately 0.618 to 1.000 or a standard 8.5 x 11 page. Examples of the Golden Section are almost ubiquitous in art as well as in nature (from the Parthenon to a nautilus shell). A web page that structures its graphical layout according to this ratio will look more appealing and will have a greater impact than other ratios, such as a ratio of 1 to 1.

Also, when placing several objects on a web page, one should take into account the "visual mass" of these objects (its size and presence). For example, ideally the placement of objects should be positioned in the same way as you would balance solid objects on a fulcrum. That is, a larger object should be placed closer to the center of the screen to offset the smaller object(s). This will create an equilibrium between the objects, and will be more appealing (see Tufte, 1990).

The unity of the interface is important because it has the potential to link concepts and objects together that belong together. For example, Wickens' (1986) compatibility of proximity principle states that tasks that necessitate mental integration of information should be in close proximity. However, tasks that require focused attention on specific variables will be harmed by this close proximity. This can be applied to things such as the organization of links. For instance, care should be made to group links that belong together, as well as separate those that do not belong.

Ngo and Byrne (2001) have taken this notion several steps further by identifying characteristics that define an aesthetically appealing interface. Of the 14 characteristics identified, balance, equilibrium stability, and sequence (shown in Figures 1 - 3) scored high in aesthetic correspondence.
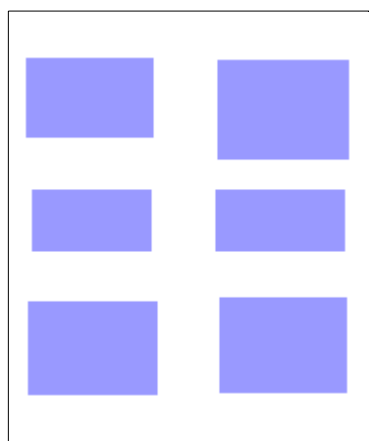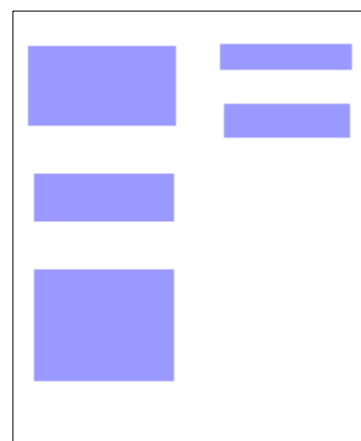
Figure 1a.   **Figure 1b.**

Figure 1 is an example of a well balanced (a) and poorly balanced (b) interface.
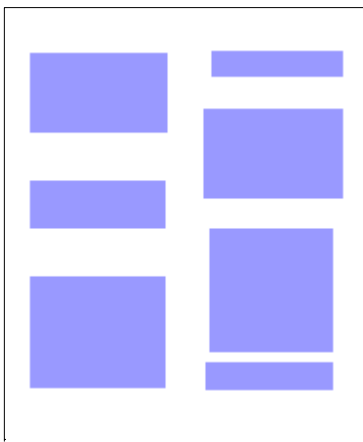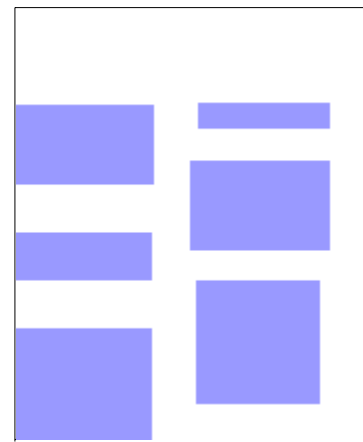
Figure 2a.

Figure 2b.

Figure 2 is an example of a interface with stable (a) and unstable (b) screen. Equilibrium consists of the general centering of the interface itself to make it a stable arrangement.
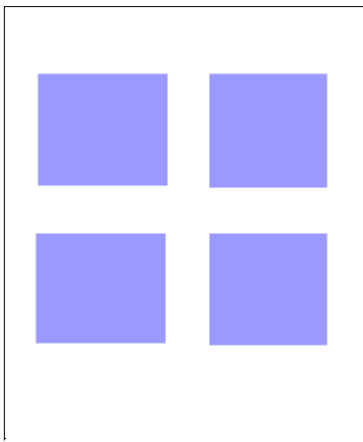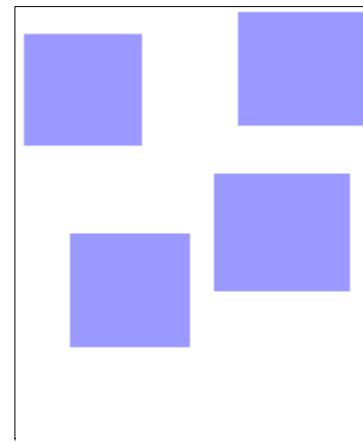
Figure 3a.

Figure 3b.

Figure 3 is an example of a interface with a sequential (a) and non-sequential (b) screen.

Measuring subjective differences between well and poorly balanced interfaces, Brady and Phillips (2002) found no statistical differences in user satisfaction, suggesting that user satisfaction is related more to successful navigation than aesthetic appearance. However, both Brady and Phillips, and Tractinsky (1997) indicated that participants did perceived aesthetically pleasing sites as having a higher degree of usability.

4) Be aware of Fitt's Law - Formally, it states that pointing time is a function of the distance and the width of a target (Fitts, 1954). Generally speaking, it states that the smaller and farther away an object is, the longer it will take to reach that object. Several researchers have argued that important buttons should be placed on the right side of the screen because the mouse arrow pointer is usually resting next to the scroll box, and thus it would take less time to click the object. However, what is important here is that knowledge that if there are several different buttons that need to be clicked in succession, the smaller and the farther apart they are, the longer it will take to click them. (For more information related to this topic see, Plamondon & Alimi, 1996).

How can I reduce the major user annoyances on my site?

For online shoppers, advertisements tend to be the most frustrating factor in using the Web. According to Retail Forward (2002), the top five online shopping frustrations are:

Pop-up boxes with visiting/shopping a site	52%
Banners advertisements	50%
Congested web pages (e.g., too many ads, images, etc.)	35%
Slow load times	26%
Difficult to find a specific product	20%

General Web user surveys have found that most dissatisfying web experiences are, a) not being able to find specific information, b) using websites that are confusing, and c) websites with slow download time, **respectively** (10th GVU survey, 1998). The fist two major annoyances are addressed in the navigation and the positioning of information discussion, respectively.

The third annoyance, slow downloads, are a very common complaint, which have been known to negatively affect user satisfaction, and ultimately sales. In fact, it has been estimated that as much as $4.35 billion in e-commerce sales have been lost each year due to user frustration related to slow downloads (Zona Research, 1999). In fact, ZDNet reported that a survey of 12,000 online customers found that 48% of them gave up trying to purchase an item online because the web pages took too long to load (ZDNet, 2000). Moreover, it has been found that slower web pages were significantly judged as being less interesting than their faster counterparts (Ramsay, 1998), and were thought to have lower quality products, as well as having compromised security (Bouch, et al., 2000).

Currently, the average connection speed is approximately 5Kbps (kilobytes per second). Thus, a 40 Kb web page will take approximately eight seconds to download. This just fits within the so-called 'eight second rule', which is considered the recommended loading time for web pages. That is, it has been suggested that users will tolerate no more than around eight seconds for a web page to download.

There are some studies which back up this suggestion. For example, a study by Bouch et al. (2000) found that participants' average load-time tolerance was 8.57 seconds. However, the standard deviation was 5.9 seconds. Another study by Zona Research (1999), which examined a website with a homepage of 40 Kb, had a bailout rate of 30%, while other pages with 32-35 Kb ranges in the same site had bailout rates of 6% to 8%. Reducing the load time for the home page to 34 Kb decreased bailout rate to the same range as the other pages.

According to Dillart and Kahn (1999), the factors that determine users' frustration with a downloading a website are:

- *How long they have to wait*

  This is obviously a very important fact. Moreover, the frustration associated with waiting tends to be highest when there is a lot of gratuitous graphics. Placing images that do not add to the site will decrease rather than increase user satisfaction with the site. However, there is no hard-fast rule about download speed and annoyance. Just factoring in the time it takes to load a web page does not take into account other variables that determine users' frustration with the site.

- *Whether the consumer experiences uncertainty about the wait*

  Not knowing how long to wait for a page to load is often very frustrating to users. In fact, Hui and Tse (1996) found that users reported negative effects on mood if they had no information concerning how long they have to wait, which affected their overall service evaluation. Thus, for longer waits it is recommended to inform the user how long the wait should generally take.

-
  The kind of information that is provided about the wait

Providing adequate information about their expected wait time is important. To do this, it is recommended to specify by the link the Kbs for those pages (especially large PDF pages). For very long waits, it is recommended to do this, plus use countdown information at regular intervals that indicated how much of the site has been downloaded, and thus how much longer they have to wait (Dillart & Kahn, 1998).

- *Where the waiting occurs within the Internet episode*

  According to Dillart and Kahn (1998), consumers can separate the download experience from their retrospective evaluation of sites if the the waiting occurs in expected times, such as the initial download stage, then the negative carry-over effects of waiting will be minimal.

- How long the wait is compared to the consumers' expectations

  The old expression, 'a watched pot never boils' seems appropriate for users perceptions of waiting time. That is, users more often than not just stare at the screen until the page is loaded. However, Dillart and Kahn suggest that the duration of the download often has little effect on retrospective evaluation of the site if the wait is not salient to the user. To lessen the saliency of the wait, it is recommended not to place large (Kb) images at top of the screen or imbed important text within the images.

Another cause of slow browsing is due to a poorly defined structure. A lack of careful consideration as to where information should be placed often produces unnecessary or unexpected delays ultimately slowing down browsing within the site -sometimes to a point where it would be faster to find the information by other means - which often causes the user to leave the site. For example, Selvidge found that the average time to complete an information search task across certain airline sites was about 17 minutes. Time to complete the same task by calling the airline by telephone averaged 3 minutes (Selvidge, 1999). Not surprisingly, these types of delays have a strong negative effect on the overall satisfaction of these sites (see Briley & Stoltz, 1999).

However, it does seem as though people are more tolerant in waiting than they were in the past (see 9th GVU survey, 1997). As discussed in Usability News, Selvidge found that users were frustrated by 30 and 60 second delays in page loading time, but would tolerate the 20 second delays (Selvidge, 1999). Again, many factors are at play, such as the provided information, the expected waiting time, their motivation, and their general tolerance for delays.

Users also consistently rate non-working hyperlinks as one of the most annoying aspects of web browsing. An easy way to reduce this problem is to use free services such as websitegarage.com, which tests websites for such things as download time, non-working links, and browser capability.

How can I make my site more accessible to children?

Children tend to explore websites because they seek to have fun as well as to learn. Thus, websites should try to to be playful and exploit their general curiosity by making the site's content attention-grabbing and, to a small degree, challenging in order to entice them to go through the site. For example, children may seek to explore certain areas within a site because exploring it satisfies a curiosity need that is enticed by the content of the site. MaMaMedia.com™ did this by offering children the opportunity to make their own customizable cartoon character, thereby satisfying both the children's playful and curiosity needs.

Children often seek out interactivity with the site, again to be creative and to have fun. This can be in the form of coloring pages that can be printed out. In fact, coloring pages can be more popular than games on a site (Fishler, 1998). Other popular methods are to allow children to create music or draw pictures.

In addition, children are much more attracted to animation than adults. Animation adds a great deal to the "fun factor" if it is done well, but too much animation will distract and disorient them (Sullivan, Norris, Soloway, &

Peet, 2000). For instance, Halgren, Fernandes, and Thomas (1995) found that children often click visible features on a screen just to see what would happen. If there is a resulting animation or sound, children often repeatedly click that area of the screen just to continue the animation or sound. Therefore, gratuitous animation or sounds may distract the child from finding more relevant information (Halgren, Fernandes, & Thomas, 1995).

Children do not have the attention span for longer downloads. According to Dave Lewnzi, an author of an online children's site, "A lot of children expected to see a picture when they hit a button, and they were disappointed if they didn't see one." Thus, he recommends placing many multi-colored pictures that load relatively quickly (Fishler, 1998).

In another study by Sullivan, et al. (2000) children tended to wait for images to completely load on a page before navigating to another in the belief that a complete loading was mandatory. This wait produced signs of frustration.

The interest in the site however will last as long as the contents are innovative and fun. Thus, it is advisable that websites geared toward children frequently have new features in order for the site to be inventive and interesting to the children. It is also recommended that children be rewarded with different and interesting features at each level within the site. This will help draw them deeper within the site.

Research has consistently shown that most children under the age of five will have an attention span of only around 8 to 15 minutes. Many children will have even less. Thus, the layout and content of a site should reflect the low attention span of children by being designed to be accessed quickly. Directions should be very short, uncomplicated, and easily read (children tend not to read directions voluntarily), and games should not take longer than their attention span.

Children under eight generally do not think in abstract terms. For example, children may find it easier to recognize actual pictures of objects than to use symbols to represent them. It is important to be as 'concrete' as possible when explaining directions. Moreover, since children view the world in more concrete terms, icons should reflect this by being as concrete as possible.

Children have different background knowledge than adults. Children are typically unfamiliar with many business-related concepts, such as file folder (Jones, 1992). Therefore, great care should be taken to create metaphors that reflect the understanding, environment, and language of children (Schneider, 1996). For example, after a series of usability studies with children, designers for the word processing program, Creative Writer2 used a button with the word, "oops" instead of using the traditional downward-curved arrow to signify an undo action button (Hanna, Risden, Czerwinski, & Alexander, 1998).

Children can make the distinction between a 'fun' website and a usable one. Buttons should represent familiar things to children, easily convey their purpose, and should be fairly large - the size of a quarter to accommodate their poorer hand-eye coordination. Buttons should indicate when they are being moused over, such as being highlighted (see Hanna, Risdan, Czerwinski, & Alexander, 1998).

Another important concern is the actual language of the site. For instance, the website's language should lie somewhere between being understandable -don't use computer lingo - and fun, but not too childish for the intended audience or they will resent it. Also, the younger the intended audience, the more concrete the language should be. That is, young children have difficulty in understanding abstract concepts. In addition, the content should be free of words that may cause the website to be blocked by web filtering agents. Even statements such as, "King Arthur wore a silver breast-plate to protect him in battle" could cause the site to be blocked from children because it has the word, "breast." Therefore, it is recommended that the content's language be examined for words that would cause the site to be blocked from viewing.

The font type of the text may also be a factor in the attractiveness of a website. For instance, Bernard and Mills (2001) found that fourth and fifth graders significantly prefer the 14-point Arial and the 12-point Comic Sans MS font over the 12-point Times New Roman font and 12-point Courier New. Examining participants' 1st and 2nd preference choice further shows the popularity of the Comic font (see Figure 3).
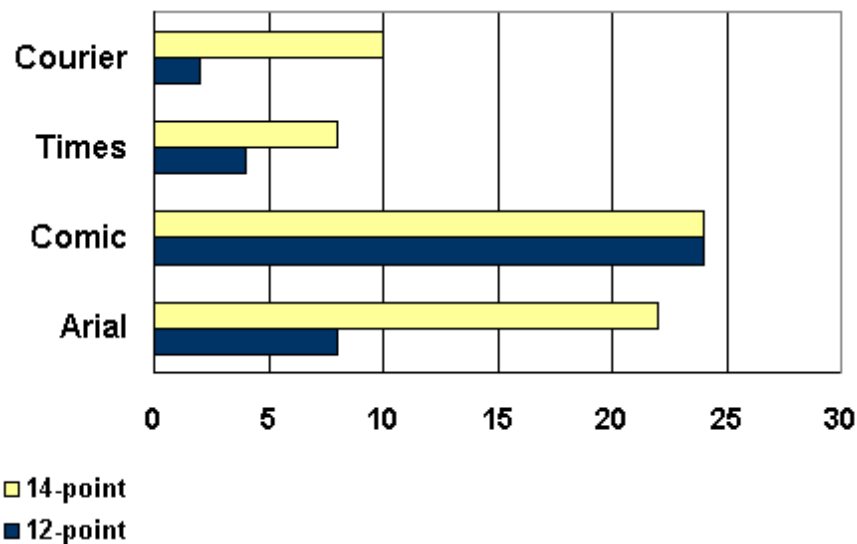
Figure 3. The percentage of times each font was chosen as the 1st or 2nd preference choice.

Children prefer narrower to broader line lengths. A study by Bernard, Fernandez, and Hull (2002) that compared three online links lengths (24.5, 14.5, and 8.5 cm, respectively) found that children significantly prefer narrower lengths to the other compared line lengths (see Figure 4). No difference was found for reading speed. Moreover, assessing children's perception that the amount of scrolling was optimal for a particular line length condition, that a particular line length was preferable or, a particular length was perceived as promoting easier concentration also revealed no significant differences between any of the line length conditions.
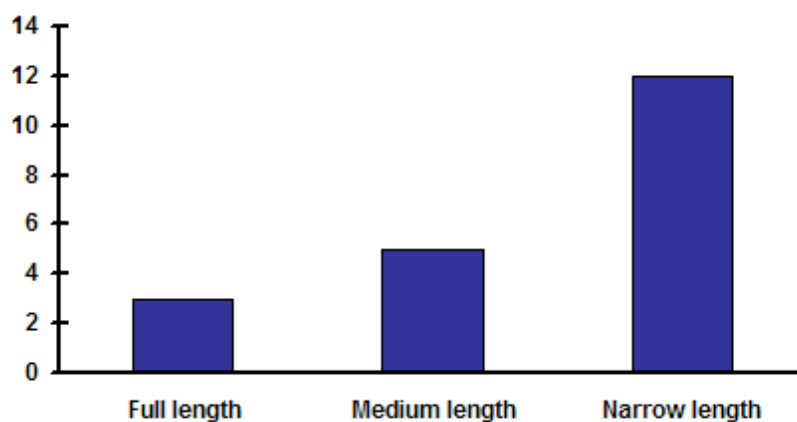
Figure 4. Number of time each line length was chosen as the 1st, 2nd, or 3rd preference choice.

Teenage boys and girls largely surf the Web for different reasons. According to a survey of 1,520 respondents by Jupiter Communications (2000), boys are more interested in playing games (62% to 41%), building web pages (35% to 24%), downloading software (74% to 48%), and downloading music (68% to 74%) than teenage girls.

Teenage girls on the other hand, tend to read more online magazines (36% to 19%), send e-greetings (75% to 48%), and do homework online (74% to 63%) more than teenage boys. In appealing to this audience, it thus may be beneficial to provide one or more of these features.

How can I make my site more accessible to older adults?

Older users generally take more steps than younger users in finding the same amount of information. For example, Meyer, et al. (1997) found that this occurs because older adults tend to revisit already viewed pages. Furthermore, Mead, et al. found that older users' success at finding information declined significantly when they had to follow more than 3 to 6 hyperlink paths to get to the desired information. It is believed this decline in performance occurs because older users tend to have greater trouble remembering their location within a site because of a decrease in working memory efficiency. Therefore, if the site is geared towards an older population it is especially important not to have a very deep hierarchy. It is also important that the site's contents be explicit at the beginning of the site (at the homepage level) instead of relying on exploration. This could be done by placing a site index or sitemap at the homepage level. It is also recommended to use clearly visible navigational aids to help them visualize the structure of the site.

In another study, Groff, Liao, Chaparro, and Chaparro (1999) found that older users were slower than college-age users in finding information. In general, older users took the time to carefully read the text on a web page before continuing the tasks, which tended to slow them down. This finding is supported by the research of Youngs (1999) who found that older users tended to carefully read information before exploring, which further supports the idea of placing a site index at the homepage level.

Older adults also prefer the text to have very clear headings (see Hartley, 1994). Clear and large headings help orientate users as well as help those who have difficulty reading because of degraded or impaired vision by giving them obvious signposts.

Usually the greatest factor affecting older web users is their decline in vision. For example, Weale (1961) stated that there is a 50% reduction in the amount of perceived light at age 50 compared to age 20, and this reduction increases to 66% at age 60. It is therefore recommended that all sites, but particularly those directed towards older users, have high contrast between the text and the background, as well as between darker and lighter colors in general. In addition, as lenses thicken, there is a reduction in the transmission of blue light through it. For this reason, older people have more trouble sorting or matching colors, and make more errors in the blue-green and red regions than in the other color regions. Fortunately, there are many resources available to help designers create websites that are accessible to degraded or impaired vision users. One of the better resources is the Web Accessibility Initiative (see in reference section).

Older adults also tend to have a reduced field of view. Consequently, more important information and links should be placed closer to the center of the screen in order for them to be more easily detected (Hawthorn, 2000). This is particularly true if there are many objects on the screen. That is, older adults generally have trouble locating a specific object if there are many other objects on the screen (Plude & Hoyer, 1981), especially if the targeted object is located on the screen's periphery.

Studied examining the reading performance of older adults have found that colored text on a colored background typically reduces their reading performance compared to reading black text on a white background (Charness & Bosman, 1990). Moreover, research has shown that dark text on light backgrounds is generally superior to light text on dark backgrounds (Tobas, 1987). However, older adults do have an increased sensitivity to glare. Thus, it is recommended that backgrounds not be pure white, but some form of off-white color (such as background presented here).

Because of a general decline in acuity, the size of text within a site should also be larger (14-points or more). For example, older adults (mean of 70) have also been found to be more accurate, read faster, and prefer 14-pont font sizes (see Figure 1). They also tend to read faster with serif fonts (Bernard, Liao, & Mills, 2001)
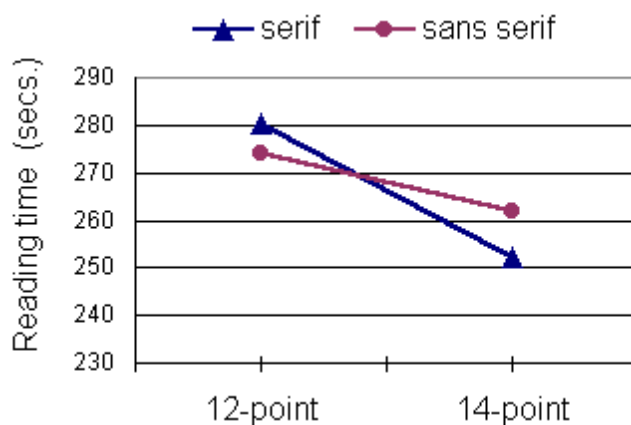
Figure 1. Mean reading time in seconds

Note:: an examination of font preference for children and older adults is discussed in the <u>How should text be presented within a website</u> link

Older adults usually have a reduction in motor coordination. This can greatly affect their interaction with a website. For example, Hawthorn (2000) suggest that older adults may have difficulty with certain actions such as moving and clicking a mouse or using a scroll bar. Indeed, a study by Ellis and Kurniawan (2000) found that older adults indicated that it was easier to click a link to a number of web pages than to scroll longer pages because the scroll bar was considered too difficult to manage due to its small size. Also, the scroll bar did not give them an adequate cue that more information was provided below the screen. In addition, the older adults had difficulty clicking the standard-sized links. As a consequence, the size of the link targets were increased by making them into graphic buttons (180 x 22 pixels). To reduce errors further (caused by tremors, etc), dead space around each link button was added to clearly separate one button from another. Moreover, older adults indicated that the standard feedback signifying that a link is active (an arrow changing into a hand) did not provide enough visual feedback. Thus, they made the link buttons turn into a lighter shade and appear to rise up when moused-over, giving them further indication that the button was clickable.

Older adults have reduced attention spans. According to Vercruyssen (1996), older adults have difficulties in attention over long periods of time. For instance, Hawthorn (2000) suggests that older adults may be especially distracted by extraneous visual noise, such as background graphics. Other distractions may include such things that obscure the screen-even if it is only temporarily visible. Consequently, items such as pop-out ads and multiple windows may tend to distract and disorient them to a greater extent than younger adults.

How can I make sure my site follows general Web conventions?

Users overwhelmingly prefer sites which employ common Web conventions (Nielsen, 1997). However, common standards are very rare in web design. Some of the few that exist are:

- Follow the standard hyperlink colors: **<u>blue</u>** for non-visited hyperlinks, **<u>purple</u>** for visited hyperlinks, and **<u>red</u><> <>** for active hyperlinks (but if you have a site with a blue background -or any dark color- please choose a color that can clearly be contrasted from the background color. That is, if the choice is to either violate the standard or not be visible, choose visibility!).

- Place a navigational link to the homepage at the upper left corner and bottom of each page.

- Place the site's internal hyperlinks at the bottom of each page (in addition to other places).

- Images and text space should not cause horizontal scrolling on lower resolution screens.

- At the bottom of each page, place the date that the page was updated and the URL address.

- The text should facilitate the scanning of information.

- Use ALT-Tags for graphics, especially for graphics that serve as hyperlinks.

For an excellent and more detailed discussion of general Web conventions, see the Yale Style Manual website: http://info.med.yale.edu/caim/manual/contents.html

Other fine guidelines include:

- IBM: http://www-3.ibm.com/ibm/easy/eou_ext.nsf/EasyPrint/572

- W3C Accessibility Guidlines 1.0: http://www.w3.org/TR/WAI-WEBCONTENT/

- Usable Web Design for the Disabled http://www.lib.auburn.edu/~madd/AlaLA/rasrt_disabled.html

- Vorburger, M.: http://www.vorburger.ch/kissfp/styleguide/index.html

How can my website promote customer sales and loyalty?

Only a small percentage of people actually purchase merchandise online. In fact, the percentage of people that actually buy online is approximately 3 to 5 percent (Slatalla, 2001). There are several reasons for this:

First, shoppers often do not feel secure in purchasing products online. According to a study by Tilson, et al. (1998), participants indicated from a list of 40 items that credit card security is the most important deterrent for them to buy online. (The other top deterrents were easy return/exchange methods, detailed descriptions of items, price, secure personal information, pictures of merchandise, and simple to search, respectively). Obviously, using a secure web server to collect customer data (and communicating that it is secure) promotes the feeling of security. It is also the standard for conducting business online. Moreover, Tilson et al. further suggests providing a privacy policy on every page and highlight this policy before customers are expected to give personal information. Other suggestions are to explain the benefits from sharing personal information, provide mechanisms for controlling how this information is used, and provide a background on the company.

Second, is a lack of specific information related to the product and store. Since online shoppers cannot physically interact with the product itself, potential customers generally require more extensive information about the product - in the form of links to detailed pictures or descriptions of the product. However, according to Spiller and Lohse (1998), over 50% of the e-commerce sites that they studied had less than three lines of text describing the products. It is argued by Lohse and Spiller (1998) that e-commerce sites should take advantage of the interactivity of the web and "offer hyperlinks to more extensive product information such as product testimonials (book reviews at www.amazon.com) and product demonstrations (software downloads)" (p. 82).

For example, according to a survey by PricewaterhouseCooper (2001), providing more detailed information about the products can significantly increase the likelihood of the purchase being made (see Figure 1 below).

Feature	% of shoppers indicating Feature increases purchase likelihood
Close-up product images	44%
Product availability	39%

Product comparison guides	34%
Search function	30%
1-800 Number to contact customer service representative	25%
Product reviews/evaluations by online shoppers	24%
Catalog quick order	24%

Figure 1. Features most likely to increase the likelihood of online purchase

Moreover, many online stores also do not provide information related to the site itself. In fact, Spiller and Lohse found from the surveyed e-commerce sites that 95% did not have links to related products on the same site and only 25% had a help link to product-size selection. In addition, only 9% of the sites had a FAQ section, even though it has been shown that online stores with a FAQ section generally have more visits that those without them (Spiller & Lohse, 1998). The survey also found that 47% of the sites did not have an email link. This is a vital (perhaps only) way for customers and potential customer to interact with the store. It is essential to provide ways to promote customer/store interactions in order to reduce the physical and psychological separation between the customer and the store.

Furthermore, in a review of past studies Jarvenpaa and Todd (1997) gave recommendations for presenting online product information:

1. Offer discounts, except for unique products

2. Focus on products that have low delivery costs

3. Benchmark the e-store against traditional retail stores and catalog stores

4. Emphasize brand name products and product quality

5. Reduce shopping effort by providing search techniques

6. Respond promptly to questions

7. Provide no-cost/no-hassle return policy

8. Provide rich product descriptions including images and words

9. Emphasize security measures

10. Provide customer testimonial

Lastly, many online stores do not provide adequate service information. That is, in the e-commerce websites studied by Lohse and Spiller (1998), close to one-third did not provide company policies, background, or history.

Moreover, most of the sites that did provide information provided less than 10 lines of text.

Third, shoppers must feel comfortable in viewing the shopping items before buying. As with any store, shoppers should feel free to examine the merchandise without having to give out personal information before committing to buy. In other words, placing items into a shopping cart should be effortless and anonymous. This will allow them to feel at ease and safe while shopping online. Not doing this can have dire consequences. For example, in a study of e-commerce sites, Chaparro, Childs, Praheswari, & Rappard (2000) found that sites requiring the users to register with the site before adding items to a shopping cart deterred them from adding items to the cart. It also had the effect of producing a low amount of satisfaction with the site.

Conversely, a well designed shopping interface can promote the shopping experience (see Dack.com (1999) for a nice overview of shopping carts and checkout interfaces. Other studies such as by Rohn (1998) provide further information pertaining to e-commerce usability dos and don'ts).

Fourth, websites should be 'credible' to the shoppers. Fogg, et al. (2001), conducted a study that surveyed over 1,400 participants and found two elements that affected the credibility of a site: commercial implications and amateurism. The items that most negatively affected the commercial implication of sites were ones that:

- *makes it hard to distinguish ads for content*
- *automatically pops up new window with ads*
- *has one or more ads on each page*
- sites that *require a paid subscription to gain access*.

Importantly, the item *site makes it hard to distinguish ads from content* received the lowest score in the entire study, and thus it is recommended to make that distinction within a site.

For the amateurism scale, sites that:

- *are rarely updated with new content*
- *has a link to a site that is perceived as "not credible"*
- *has a link that doesn't work," is "sometimes unexpectedly unavailable"*
- *has has a "typographical error"*

were considered the most amateurish, respectively. Sites that have been:

- *updated since your last visit*
- *offers information in more than one language*

were considered to be more professional. Other items that had a positive effect on website credibility were sites that:

- *provide a quick response to your customer service questions*
- *lets you search past content*
- *looks professionally designed*
- *send emails confirming transactions you make*

From their results Fogg et al. (2001) made several credibility recommendations:

1. Include elements that highlight the brick-and-mortar nature of the organization it represents, such as listing a physical address.

2. Make the site easy to use.

3. Convey expertise, such as including credentials, citations, and references.

4. Convey trustworthiness by stating a policy on content, etc.

5. Tailor the site to the visitor and acknowledging their presence.

6. Avoid overly commercial elements on a website (see above).

7. Avoid amateurism (see above).

How can I make my site more appealing to international users?

Today, a majority of the world's Web traffic is generated outside of the United States. However, many websites in western countries--particularly in the US--do not take the idea of a global audience into consideration, even though a substantial portion of their revenue may be foreign. What is needed is an understanding of how different cultures respond to various website designs.

Attention should to paid to regional languages and customs. For instance, in Chinese, Coca-Cola means "bite the wax tadpole." Wisely, the Coca-Cola company changed their name in China to the phonetic equivalent of "happiness in the mouth" (Hendrix, 2001). Unfortunately, even common web elements have various names, depending not only upon the language of the country, but also its current conventions. For example, in the United States the "shopping cart" button is indicative of a means to purchase an item. In England, however, this element is referred to as a "basket."

Color has psychological effects on users that are different across cultures. According to Russo and Boor (1993), color can present opposite meanings, such as yellow for cowardice in the United States, and Grace and Nobility in Japan. See Table 1 for some cultural associations of color.

Culture	Red	Blue	Green	Yellow	White
United States	Danger	Masculinity	Safety	Cowardice	Purity
France	Aristocracy	Freedom/Peace	Criminality	Temporary	Neutrality
Egypt	Death	Virtue/Faith/ Truth	Fertility/ Strength	Happiness/ Prosperity	Joy
India	Life/Creativity		Prosperity/ Fertility	Success	Death/Purity
Japan	Anger/Danger	Villainy	Future/Youth/ Energy	Grace/ Nobility	Death
China	Happiness	Heavens/Clouds	Ming Dynasty/ Heavens/Clouds	Birth/Wealth/ Power	Death/Purity

Table 1. Examples of cultural associations of color. (From Russo & Boor, 1993).

Various cultures respond to layout designs differently. Research examining multicultural differences and their interaction with website design is sparse--mostly coming from Marcus and Gould's (2000) application of Hofstede's (1991) research on world culture to web design. Hofstede stated that world culture consists of five dimensions, four of which are relevant to the Web.

The first dimension, power-distance, refers to the degree in which individuals with less power expect and accept unequal distributions of power within a culture. Cultures with a high amount of power-distance (PD) tend to have centralized political power and deep hierarchies. According to Hofstede, these types of societies emphasize hierarchical relationships, authority, experts, certifications and official logos, leaders, security, and an acceptance for restrictions to information access. Cultures with low PD emphasize flatter hierarchies and greater equality in relationships. Thus cultures with a high PD may typically feel comfortable with a greater emphasis on highlighting the accomplishments of high-ranking individuals within a company, as well as providing a greater hierarchical relationship between different divisions and positions within the site. Low PD cultures, such as Denmark, would tend to be more comfortable with sites that showcase 'common' individuals or both genders. They would also tend to de-emphasize hierarchical differences between individuals within the same company (see Table 2 for scores of countries that were studied).

The second dimension, individualism, refers to the degree to which a culture emphasis the self and immediate family over the society at large. Cultures with large amounts of individualism (IND), such as the United States, value personal freedom and rewards, privacy, and diversity of opinion. Here freedom of the press and self-actualization are prized. According to Marcus and Gould, cultures that are high in IND will emphasize images of personal success, youth, change. The converse of this, collectivism, emphasizes group harmony, experience of older and wise leaders, and tradition and history. Thus, individuals in countries such as in the United States should feel more comfortable visiting sites that promote a very modern-looking, youthful, and individually successful looking design. Collective cultures, such as in Guatemala, should feel more comfortable with sites that promote the history of the company and how it helps the Guatemalan society at- large. Images could reflect this view by prominently showing company leaders working together with the Guatemalan people.

The third dimension, masculinity, refers to the degree to which traditional masculine roles of assertiveness and competition are emphasized. Cultures with high masculinity (MAS) stress and value these values, whereas cultures that de-emphasize them tend to stress mutual cooperation and family support. Thus Japan, which has the highest MAS index, may as a society be more comfortable with sites that promote traditional male and female roles, as well as have certain sections of a site specifically dedicated to each gender. Countries such as Sweden, on the other hand, should probably not have sites that emphasize gender roles because they have a very low MAS score.

The fourth dimension, uncertainty avoidance, refers to the degree to which individuals have anxiety about uncertain events. Hofstede points out that cultures with a high amount of uncertainty avoidance (UA) tend to be expressive, have more formal and simple rules, and desire structure in organizations. Low UA cultures tend to desire more informal business arrangements and are more relaxed. Thus, individuals within countries with a high UA, such as Greece, would tend to prefer sites with limited, simple, and redundant navigational devices, whereas individuals in Hong Kong would tend to prefer greater complexity and less control over navigation.

	PD		**IDV**		**MAS**		**UA**	
	rank	**score**	**rank**	**score**	**rank**	**score**	**rank**	**score**
Arab Countries	7	80	26/27	38	23	53	27	68
Argentina	35/36	49	22/23	46	20/21	56	10/15	86
Australia	41	36	2	90	16	61	37	51

Austria	53	11	18	55	2	79	24/25	70
Belgium	20	65	8	75	22	54	5/6	94
Brazil	14	69	26/27	38	27	49	21/22	76
Canada	39	39	4/5	80	24	52	41/42	48
Chile	24/25	63	38	23	46	28	10/15	86
Columbia	17	67	49	13	11/12	64	20	80
Costa Rica	42/44	35	46	15	48/49	21	10/15	86
Denmark	51	18	9	74	50	16	51	23
East Africa	21/23	64	33/35	27	39	41	36	52
Ecuador	8/9	78	52	8	13/14	63	28	67
Finland	46	33	17	63	47	26	31/32	59
France	15/16	68	10/11	71	35/36	43	10/15	86
Germany	42/44	35	15	67	9/10	66	29	65
Great Britain	42/44	35	3	89	9/10	66	47/48	35
Greece	27/28	60	30	35	18/19	57	1	112
Guatemala	2/3	95	53	6	43	37	3	101
Hong Kong	15/16	68	37	25	18/19	57	49/50	29
India	10/11	77	21	48	20/21	56	45	40
Indonesia	8/9	78	47/48	14	30/31	46	41/42	48
Iran	29/30	58	24	41	35/36	43	31/32	59
Ireland	49	28	12	70	7/8	68	47/48	35
Israel	52	13	19	54	29	47	19	81
Italy	34	50	7	76	4/5	70	23	75
Jamaica	37	45	25	39	7/8	68	52	13
Japan	33	54	22/23	46	1	95	7	92
Malaysia	1	104	36	26	25/26	50	46	36
Mexico	5/6	81	32	30	6	69	18	82
Netherlands	40	38	4/5	80	51	14	35	53
New Zealand	50	22	6	79	17	58	39/40	49
Norway	47/48	31	13	69	52	8	38	50
Pakistan	32	55	47/48	14	25/26	50	24/25	70
Panama	2/3	95	51	11	34	44	10/15	86
Peru	21/23	64	45	16	37/38	42	9	87
Philippines	4	94	31	32	11/12	64	44	44
Portugal	24/25	63	33/35	27	45	31	2	104
Salvador	18/19	66	42	19	40	40	5/6	94
Singapore	13	74	39/41	20	28	48	53	8
South Africa	35/36	49	16	65	13/14	63	39/40	49
South Korea	27/28	60	43	18	41	39	16/17	85

Spain	31	57	20	51	37/38	42	10/15	86
Sweden	47/48	31	10/11	71	53	5	49/50	29
Switzerland	45	34	14	68	4/5	70	33	58
Taiwan	29/30	58	44	17	32/33	45	26	69
Thailand	21/23	64	39/41	20	44	34	30	64
Turkey	18/19	66	28	37	32/3	45	16/17	85
Uruguay	26	61	29	36	42	38	4	100
USA	38	40	1	91	15	62	43	46
Venezuela	5/6	81	50	12	3	73	21/22	76
West Africa	10/11	77	39/41	20	30/31	46	34	54
Yugoslavia	12	76	33/35	27	48/49	21	8	88

Table 2. The scores for the four dimensions of world culture. (From Hofstede, 1991).

Note: If you see an 'international' focused website that violates the conventions of your culture, please email me the type of violations so I can report them.   mber@acm.org

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