

International Aspects of World Wide Web Usability and the Role of High-End Graphical Enhancements

Andrew Sears

Information Systems Department
UMBC

Julie A. Jacko

Department of Industrial Engineering
University of Wisconsin-Madison

Erica M. Dubach

Atraxis AG
Switzerland

Through 2 experiments, we examined both international differences and the effects of high-end graphical enhancements on the perceived usability of World Wide Web (WWW) sites. To accomplish this goal, we recruited Internet users from Switzerland and the United States to explore 1 of 2 versions of a Web site with the goal of retrieving specific information from the site. The first Web site was a self-contained subset of a large corporate Web site, and the second was a systematically simplified version of the first. After retrieving the required information from the site, participants responded to questions regarding their perception of the Web site's usability and its information presentation. Their responses provided detailed insights into significant differences between WWW users from 2 different cultures with respect to how they perceive the same Web sites. The importance of basic user demographics is documented, and empirical evidence is provided that devalues some high-end graphical enhancements.

1. INTRODUCTION

The growth in use of the World Wide Web (WWW) and the fact that WWW sites are inherently international makes it critical that we thoroughly explore the factors that affect both the usability and perceived usability of this important communications

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Requests for reprints should be sent to Andrew Sears, Laboratory for Interactive Systems Design, Information Systems Department, UMBC, 1000 Hilltop Circle, Baltimore, MD 21250. E-mail: asears@umbc.edu

medium. To date, many of these factors have been inadequately studied. For example, WWW sites are inherently international as soon as they are made available to the public, but few studies have carefully studied cultural differences as they relate to the perceived usability of the Web. A second example is the frequent use of high-end graphical enhancements (e.g., animated graphics, graphical hypertext links). Such enhancements are frequently employed in an attempt to convey a professional image, but little research has explored the relation between such enhancements and user perceptions of the resulting sites. In this article we begin to explore both of these issues.

1.1. Cultural Effects

Most research on Web site design and Internet use has explored the issue in the context of a single country—often the United States. Given the inherently international nature of the WWW, the lack of research that explicitly examines cultural differences as they relate to WWW usability is surprising. Our primary goal is to provide some initial insights into this important area by exploring differences between the opinions expressed by individuals in the United States and by those in Switzerland. We selected Switzerland for this initial study because of the relatively high penetration of the Internet in that country. Of the 6 million Swiss living in Switzerland, approximately 5% access the Internet daily. In the major cities, Zurich and Geneva, 32% of the population access the Internet daily. Internet literacy is particularly high among 29- to 39-year-olds, with 29% accessing the Internet “frequently” (Soland, 1998). In contrast, a recent survey found that 55% of adults in the United States had accessed the Internet in the previous 30 days (CyberAtlas, 1999).

Switzerland has four national languages, of which German, French, and Italian are dominant (in that order). Unlike the Canadian government, which prescribes that every Web site must be in both French and English, no official Swiss guidelines exist. Most commercial Web sites contain all information in German, French, and Italian, especially if the company or product is national (e.g., www.coop.ch). Swiss companies targeting international customers tend to use English as their primary language (e.g., www.ubs.com), as do sites that are trying to be “cool”, such as www.dekadance.ch.

Because no formal or academic work exists on Swiss Web site usability or design guidelines, an informal survey of four Web design companies was conducted. The goal was to gain insight into the inspiration behind existing Web site designs. The employees of SWeb AG, Smartmedia, Netiquette, and Hyper Stuff Works were interviewed. All interviewees reported that the primary inspiration for the design of their corporate Web sites came from the United States. Other countries listed as advanced in their use of the Internet were France, Sweden, and Norway, but these countries were viewed as trailing behind the United States in terms of design innovation and creative use of technologies.

A representative of SWeb AG estimated that the U.S. use of Web technology is about 2 years ahead of that of Switzerland. A Hyper Stuff Works representative perceives Swiss Web sites as being less advanced as well and regards them as being

generally more conservative. These opinions were also reflected in the choice of print media indicated, where most interviewees listed U.S.-based publications that are commonly available in English. Those Swiss and German publications mentioned tended to be smaller, fanzine-style magazines that are not Web-specific but rather focus on graphic design in general.

1.2. High-End Graphical Enhancements

A secondary goal for this research was to examine the benefits, or lack thereof, of including high-end graphical enhancements (e.g., animated graphics, graphical buttons) in a Web site. Designers often include such enhancements to ensure a professional appearance. Yet, limited empirical evidence exists regarding whether or not these enhancements affect the opinions of visitors to these sites.

1.3. Designing International User Interfaces

Many software products and international WWW sites are created by translating text from one language into another, but creating truly effective interfaces for an international audience requires more than just translating text (Russo & Boor, 1993). Date, time, and number formats must be converted; images, symbols, and colors must be adjusted for cultural differences; and flow and layout must be designed around locale-specific user models. A brief overview follows:

- **Text:** When text is translated from English to other languages, it often gets bigger (i.e., larger fonts) and as much as 40% longer (i.e., more letters are required to express the same content; Belge, 1995). Text selection menus, lists, and layout all need to be adjusted. Jargon must be avoided, and special care must be taken when translating domain-specific terminology that may not exist in the targeted language.
- **Numbers, currency, date, and time formats:** Most countries use the Arabic number system, yet formats vary between countries. Examples include the use of periods to denote decimals in the United States, whereas commas are used in much of Europe. Date formats vary, with months being listed first in the United States and days first in Europe. Time conventions are similarly varied.
- **Images:** Like words, images do not always translate. Common examples include the Macintosh “trash” icon, which British users confuse with a postal box. Social norms determine image acceptability in a culture, and great care must be taken when using images depicting religious symbols (e.g., crosses, stars), the human body, women, and hand gestures (Russo & Boor, 1993).
- **Symbols and icons:** Symbols and icons are often designed using knowledge of the local culture—making internationalization particularly difficult.
- **Colors and metaphors:** The interpretation of colors varies greatly between cultures, requiring a translation during the internationalization process. Although red represents danger in the United States, it represents happiness in China (Salomon, 1990). Similarly, because interface metaphors function as models that al-

low us to take knowledge of the familiar and apply it to more abstract concepts (Erickson, 1990), assumptions about what is familiar may not be accurate for a different culture.

- **Flow:** Text and graphical components of an interface are usually arranged to depict a logical flow of information as defined by the order in which words are read. Using a left-to-right, top-to-bottom layout works fine for those individuals who read English, but this layout may fail when users are more familiar with other languages—such as Chinese (O'Donnell, 1994).
- **Functionality:** Features can implicitly contain cultural values that are not shared in other locales. One example is a poetry teaching tool developed for use in France. It was designed to accept the teachers' comments but not any comments by students (Russo & Boor, 1993). This was acceptable in France, but was not well received in Scandinavia, where students' independent discovery is greatly valued.

There are many issues involved in internationalizing an interface. Simply translating the text is not enough. Many of the issues just mentioned are well explored and documented in the software engineering or human-computer interaction literature on internationalization. Most literature on internationalization is only a few years old, indicating how recently global markets and marketing have become a priority. Within this literature, discussions of internationalizing Web sites are virtually nonexistent. For example, two exhaustive books on internationalization (Luong, Lok, Lok, & Driscoll, 1995; O'Donnell, 1994) make no mention of the WWW. Although documents on the technical details exist (published mainly by standards bodies, such as the World Wide Web Consortium), work on usability issues surrounding the internationalization of Web sites is sorely absent.

2. OBJECTIVE

Research has been conducted on users' perceptions of the Internet (Jacko, Sears, & Borella, in press), and a thorough discussion of internationalization issues can be found in the software engineering literature. However, a search of current literature failed to reveal research on the intersection of these two topics. In this article, we present one of the first studies to explicitly examine international aspects of perceived Web site usability. At the same time, we investigate the efficacy of incorporating high-end graphical enhancements in Web sites to ensure a professional appearance of the site and a positive reaction from visitors to the site.

Individuals living in different cultures are likely to display different behavior and values (Hofstede, 1991). We investigate the interaction between cultural background, the media incorporated in a Web site, and how users perceive the site after using it to gather information. Four specific hypotheses are explored:

- H1: The media used in the documents will influence users' perceptions of WWW sites.

Previous work has shown that media influences users' perceptions of WWW sites (Jacko et al., in press; Sears, Jacko, & Borella, 1997). Furthermore, work by Russo and Boor (1993) has shown that user interfaces should cater to international audiences in more ways than just adapting to the language spoken in a specific country. Instead, number formats, color, symbols, images, and metaphors require adjustment. This implies that users from two different countries may express different opinions about the same Web site.

H2: The cultural background of users influences their perceptions of WWW sites.

Prior research confirmed that the media used to convey information on a Web site can affect the perceived usability of the Web site when the users are from the United States (Jacko et al., in press; Sears et al., 1997). Given the results of basic internationalization research, including explorations into different perceptions of images (Russo & Boor, 1993), we explore the relation between cultural background, the media utilized in a Web site, and the users' perceptions of the site.

H3: The cultural background of users interacts with the media used in the documents to influence their perceptions of WWW sites.

Differences in perceived usability of Web sites have been observed based on Internet experience, age, and command of the English language (Jacko et al., in press). A natural extension is to add computer experience and gender of the users. In addition, basic research on individual differences shows that user characteristics matter and therefore should be examined as part of the study.

H4: Specific user characteristics including age, gender, previous and current exposure to the Internet, computer literacy, and command of the English language will influence perceived usability of sites on the Internet.

3. EXPERIMENT 1: INTERNATIONAL EFFECTS

3.1. Method

Participants. The first study was conducted in Zürich, Chicago, and Miami. In Zürich, 53 participants were recruited at a major bank. One hundred ninety-three participants were recruited in Chicago and Miami, from DePaul University and Florida International University, respectively. All participants received a token reward sufficient to encourage participation in this study.

The U.S. and Swiss participants exhibited significant differences in several demographic characteristics, as shown in Table 1. U.S. participants were younger than the Swiss participants, and the ratio of women to men was significantly higher than in the Swiss sample. Women were in the minority in both groups.

Table 1: T Test and Chi-Square Analysis on Demographic Differences Between the U.S. and Swiss Participant Groups

Characteristic	U.S.		Swiss		Results	Scale Description
	M	SD	M	SD		
Age	25.2	7.2	36.3	9.3	$t(249) = 9.4^{***}$	Age in years
Command of English	6.3	1.0	4.9	1.2	$t(250) = -9.1^{***}$	Likert scale; 1 (<i>low</i>) to 7 (<i>high</i>)
Gender	124 men, 74 women		48 men, 5 women		$\chi^2(1) = 15.1^{**}$	Nominal scale
Computer experience	4.5	0.9	5.0	0.0	$\chi^2(1) = 26.3^{**}$	1 (<i>never</i>), 2 (<i>1–6 months</i>), 3 (<i>6–12 months</i>), 4 (<i>1–3 years</i>), 5 (<i>over 3 years</i>)
Internet experience	3.7	1.0	4.2	0.9	$\chi^2(1) = 3.8^*$	1 (<i>never</i>), 2 (<i>0–6 months</i>), 3 (<i>6–12 months</i>), 4 (<i>1–3 years</i>), 5 (<i>over 3 years</i>)
Internet use frequency	2.3	0.8	2.6	0.7	$\chi^2(1) = 7.8^*$	1 (<i>less than 1 time per week</i>), 2 (<i>1–3 times per week</i>), 3 (<i>4+ times per week</i>)

* $p < .05$. ** $p < .01$. *** $p < .001$.

Swiss participants' self-reported command of the English language was lower than that of the U.S. participants. Because English was not the primary language for most of the Swiss participants, this is not surprising. However, the multilingual working environment of the Swiss participants requires frequent and sophisticated dealings in English. Further, the Swiss participants did not have difficulties understanding the task sheet, questionnaire, or Web site, all of which were entirely in English.

The Swiss participants have been using computers significantly longer than the U.S. participants and access the Internet more frequently. Both groups, however, have been using the Internet for about the same amount of time.

Experimental design. This experiment used a 2×2 between-subject design, with Web site version and the country where the participant lived as independent variables. Each participant accessed one of two Web sites that were delivered by a WWW server that simulated delays users would encounter if the documents were being retrieved from the Internet (Sears & Borella, 1997). The construction of the two versions of the Web site is described in the following section.

Materials. A demographics questionnaire was used to gather basic information, including gender, age, command of the English language, use of computers, and Internet experience and usage.

The task worksheet contained four questions that could be answered using information in the Web site. Each question required the participant to locate a specific fact related to a product or news story contained within the site. The answer to each question could be located by following two or three links from the home page. As a result, participants only needed to explore a small fraction of the Web site to complete their tasks. In fact, all answers could be found by following three of the nine major links contained on the home page. Completing these tasks did not require any interaction with the graphics that were modified to create the simplified Web site. Finally, the four tasks were presented at one time and could be completed in any order.

A usability questionnaire was used to assess the participants' perceptions of the design and information organization of the Web site. This questionnaire consisted of 19 questions about the usability of the Web site that participants had just used. The questionnaire was divided into two sections. The first section made no explicit references to network delays or to the kind of media used in the Web site. For example, one question stated, "I never felt lost when searching for information at this site." The second section of the questionnaire explicitly mentioned delays and the media used, including statements such as "I found myself getting frustrated waiting to obtain the information I needed." The participants responded to each question using a Likert scale of 1 (*strongly agree*) to 7 (*strongly disagree*). The usability questionnaire has been used in previous studies (e.g., Jacko et al., in press), where the reliability of the questionnaire was assessed using Cronbach's coefficient alpha ($\alpha = 0.91$). Similar values for Cronbach's coefficient alpha were obtained using the data from this study ($\alpha = 0.90$). This high level of reliability suggests high construct validity and further substantiates the robustness of the results described in subsequent sections of this article.

The delays participants experienced when retrieving documents were generated using a trace-driven simulation, which is based on calculations using actual Internet delays and page-dependent factors such as document size (Sears & Borella, 1997). These delays were representative of those encountered in the United States when accessing a large corporate Web site during the middle of a business day using a 28.8 Kbps modem.

The two Web sites in these studies were based on a large subset of the Microsoft Web site as it existed in June 1997, starting with the Microsoft home page. The site was copied with permission. The Web pages were modified by removing links to documents outside the subset, resulting in a self-contained Web site referred to as the original Web site. The original site consisted of over 1,400 HTML documents and 1,100 graphics. The experimental Web site was designed to be sufficiently large to ensure that participants would not explore the boundaries of the site and therefore would not recognize that this was not actually Microsoft's Web site. Answering the four questions listed on the task worksheet required participants to visit only nine of the over 1,400 HTML documents that existed within the site.

The second, simplified, Web site was created by applying the following five guidelines:

- Remove moving, animated, or changing graphics and replace with simple graphics.

- Replace graphical buttons that have underlying hyperlinks with simple HTML hyperlinks.
- Optimize graphics when possible by saving them with a reduced color palette or appropriate compression to produce a more compact image. (Most images were optimized. For GIF images, this involved determining the number of colors actually used in the image and resaving the image with a smaller color map. For JPEG images, this involved adjusting the compression ratio while making a judgment regarding the acceptability of the more compact image.)
- Reduce the physical size of larger graphics by either reducing the graphic's size or modifying the graphic to contain similar information in less space.
- Eliminate graphics that are not necessary to maintain the message conveyed or professional appearance of the page.

Experimental procedure. Participants completed the demographics questionnaire before interacting with the Web site. Next, participants were instructed to obtain the information required to complete the task worksheet using the Web site. No time limit was imposed, though completing the worksheet required approximately 15 min. Finally, the participants completed a usability questionnaire.

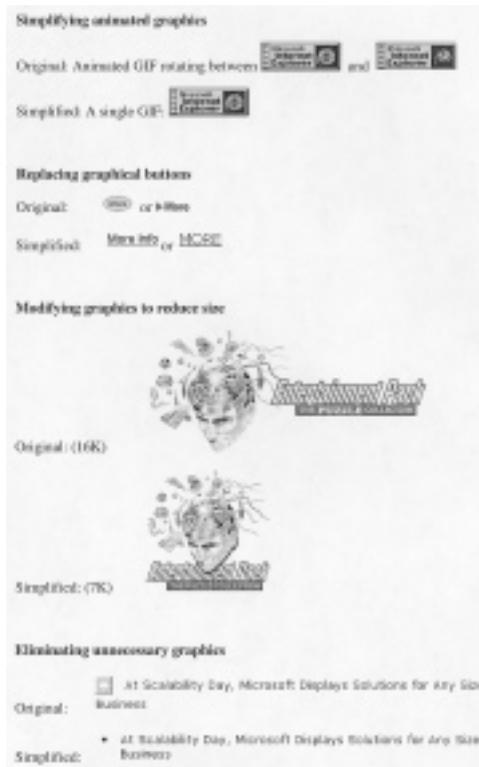


FIGURE 1 Examples of the guidelines for simplifying graphics.

3.2. Results

The independent variables were country and Web site version (i.e., whether the participants were using the simplified or the original Web site). Because user characteristics were expected to influence the results but were not controlled, the analysis used a two-way analysis of covariance (ANCOVA). The covariates were gender, age, self-reported command of the English language, computer experience, Internet experience, and frequency of Internet use. In this article we report all statistically significant main effects, interactions, and correlations using the adjusted means and standard errors as generated by the ANCOVA. All main effects and interactions correspond to large-effect sizes as determined by Cohen's (1969) technique for evaluating effect sizes. Correlations are reported using Pearson correlation coefficients. The 19 items on the usability questionnaire cover five aspects of WWW usability detailed below: information organization, Web site appeal, latency issues, Web page graphics, and WWW usability.

Information organization. Five items in the questionnaire assessed how the participants perceived the quality and organization of information contained in the Web site. Four of the five questions produced statistically significant results.

There was a significant main effect for Web site version, $F(1, 236) = 4.957, p < .027$, for the question regarding the ease of finding information. Participants who were given the simplified site found it more difficult to locate the desired information (adjusted $M = 4.055, SE = 0.180$) than did the participants using the original site (adjusted $M = 3.540, SE = 0.169$).

There was a significant main effect for country for two of the four questions relating to information organization (Table 2). The Swiss participants rated the ease of information retrieval significantly lower (adjusted $M = 4.145, SE = 0.267$) than did the U.S. participants (adjusted $M = 3.450, SE = 0.116$), $F(1, 236) = 4.772, p < .030$. Further, Swiss participants were more likely to disagree that the information provided was of high quality (adjusted $M = 4.196, SE = 0.264$) than were the U.S. participants (adjusted $M = 3.158, SE = 0.115$), $F(1, 236) = 10.890, p < .001$.

A significant correlation existed indicating that female participants were more likely to agree that it was easy to find information than male participants were ($r = -.172, p < .007$). There were several significant correlations related to age (see Table 3). In each case, older participants were more likely to provide negative ratings. Older participants were more likely to disagree that it was easy to find information ($r = .210, p < .001$) and to disagree with the statement that the information provided

Table 2: The Countries Main Effects for Questions on Information Organization

Question	U.S. Participants		Swiss Participants		F Value
	M	SE	M	SE	
Easy to find information (Q1)	3.450	0.116	4.145	0.267	$F(1, 236) = 4.772, p < .030$
Information of high quality (Q8)	3.158	0.115	4.196	0.264	$F(1, 236) = 10.890, p < .001$

was well organized ($r = .186, p < .003$). They were also likely to disagree with the statements that the information provided was of high quality ($r = .141, p < .027$) and that the company that developed the site understands issues related to designing for the WWW ($r = .136, p < .033$).

Site appeal. The participants were asked five questions about different aspects of the Web site’s appeal. There were significant main effects for country on four of the five questions. In each case, Swiss participants were more negative than U.S. participants. Table 4 presents the adjusted means, standard errors, and *F* values associated with the country main effect.

A significant correlation was found between gender and answers to four of the five questions regarding Web site appeal (see Table 5). In all cases, female participants were more likely to agree with the positive statement about Web site appeal. Specifically, women were more likely to agree that the site compared favorably to other sites they visit ($r = -.128, p < .046$) and that they liked the site ($r = -.162, p < .011$). They were also more likely to agree that the site was very interesting ($r = -.128, p < .046$) and that they would visit the site on a regular basis ($r = -.132, p < .039$).

One significant correlation was found with regard to age, indicating that older participants were more likely to disagree with the statement that the site was interesting ($r = .156, p < .015$).

Latency issues. Five questions directly addressed the users’ reactions to the delays (latency) they experienced while retrieving documents. Only two questions produced significant results. There was a significant main effect for country, with

Table 3: Age Correlation for Information Organization

Question	Age Correlation
Easy to find information (Q1)	$r = .210, p < .001$
Information well organized (Q2)	$r = .186, p < .003$
Information of high quality (Q8)	$r = .141, p < .027$
Company understands issues (Q9)	$r = .136, p < .033$

Table 4: Countries Main Effects for Questions on Site Appeal

Question	U.S. Participants		Swiss Participants		F Value
	M	SE	M	SE	
Site was very interesting (Q4)	3.633	0.111	5.074	0.256	$F(1, 236) = 22.376, p < .001$
Like this site (Q5)	3.777	0.104	4.695	0.239	$F(1, 236) = 10.404, p < .001$
Would visit site regularly (Q6)	4.404	0.120	5.446	0.276	$F(1, 236) = 10.052, p < .002$
Would recommend site (Q7)	4.009	0.115	4.967	0.265	$F(1, 236) = 9.216, p < .003$

Note. Ratings based on a Likert scale from 1 (*strongly agree*) to 7 (*strongly disagree*).

Table 5: Gender Correlation for Questions on Site Appeal

<i>Question</i>	<i>Gender Correlation</i>
Site compares favorably (Q3)	$r = -.128, p < .046$
Site was very interesting (Q4)	$r = -.128, p < .046$
Like this site (Q5)	$r = -.162, p < .011$
Would visit site regularly (Q6)	$r = -.132, p < .039$

Swiss participants more likely to disagree with the statement that the site would be better if it were more responsive (adjusted $M = 4.509, SE = 0.268$) than were the U.S. participants (adjusted $M = 3.735, SE = 0.115$), $F(1, 236) = 5.944, p < .016$.

A significant correlation for age indicated that older participants were more likely to disagree with the statement that the speed of downloading affects a person's ability to obtain useful information from the WWW ($r = .147, p < .021$).

Web page graphics. Participants were asked to indicate if they thought that sites with graphics were more attractive than sites with text only (Table 6). A significant interaction between Web site version and country was identified $F(1, 236) = 4.875, p < .028$. Fisher's LSD was used for post hoc comparisons of the adjusted means. The results show that the version of the site used had a significant effect on how Swiss participants reacted ($p < .025$). The results also indicate that users from the two countries reacted differently when presented with the original version of the site ($p < .036$). No other significant differences were identified. To summarize, Swiss participants reacted differently when the media changed, whereas U.S. participants did not, and all participants felt that sites that include graphics were more attractive than sites that used only text.

Age was significantly correlated with preference for graphics, showing that older participants were more likely to disagree that sites with graphics were more attractive than text-only sites ($r = .185, p < .004$).

World Wide Web usability. Three questions explored the participants' general attitude toward the usability of WWW sites, without referring to the site used for this study. There was a significant main effect for country when participants were asked if their ideal Web site should contain general links to unrelated sites $F(1, 236) = 12.593, p < .001$. The Swiss participants disagreed more strongly with this suggestion (adjusted $M = 5.638, SE = 0.316$) than the U.S. participants (adjusted $M = 4.306, SE = 0.137$).

Numerous significant correlations were identified (Table 7). A significant correlation exists for gender, showing that female participants were more likely to agree that an ideal site should contain links to related sites ($r = -.128, p < .045$). Female participants were also more likely to agree that an ideal site should contain links to unrelated sites ($r = -.145, p < .023$).

A significant correlation exists for age, indicating that older participants were more likely to disagree that an ideal site should contain many links to other related

Table 6: The Significant Interaction of Country and Web Site Version Main Effect for the Question on Web Page Graphics (Q16)

Response	U.S. Participants		Swiss Participants	
	M	SE	M	SE
Simplified site	1.876	0.132	1.732	0.274
Original site	1.791	0.136	2.514	0.296

Table 7: Gender, Age, Computer Experience, Internet Experience and Internet Use Correlation for Questions on WWW Usability

Question	Gender	Age	English	Computer Experience	Internet Experience	Internet Use
Should have related links (Q17)	$r = -.128,$ $p < .045$	$r = .149,$ $p < .019$	—	—	—	$r = .133,$ $p < .037$
Should have unrelated links (Q18)	$r = -.145,$ $p < .023$	—	—	$r = .135,$ $p < .035$	$r = .156,$ $p < .014$	$r = .142,$ $p < .026$
Intimidated by complexity (Q19)	—	—	$r = .194,$ $p < .002$	$r = .250,$ $p < .001$	$r = .267,$ $p < .001$	$r = .289,$ $p < .001$

sites ($r = .149, p < .019$). The participants who access the internet more than three times per week were also more likely to disagree that an ideal site should contain many links to related sites ($r = .133, p < .037$).

Computer experience, Internet experience, and frequency of Internet use variables all showed significant correlations. Participants with more than 3 years of computer experience were more likely to disagree with the statement that the ideal site should contain general links to unrelated sites ($r = .135, p < .035$) than were those with less experience, as were the participants with more than 1 year Internet experience ($r = .156, p < .014$) and those who access the internet more than three times a week ($r = .142, p < .026$).

The participants with more computer experience ($r = .250, p < .001$), those with more than 1 year of Internet experience ($r = .267, p < .001$), and those who access the Internet more than three times a week ($r = .289, p < .001$) were also more likely to disagree that they felt intimidated by the complexity of the Internet. A significant correlation was also found for participants who rated their command of the English language higher: They were more likely to disagree that they felt intimidated by the complexity of the Internet ($r = .194, p < .002$).

4. EXPERIMENT 2: EFFECT OF HIGH-END GRAPHICAL ENHANCEMENTS

4.1. Method

Participants. This study was conducted in Chicago and Miami. A total of 397 participants were recruited from DePaul University and Florida International Uni-

versity. Participants were students and staff from the two universities. Participants received a token reward sufficient to encourage participation in this study.

Experimental design. This experiment used a 2×2 between-subject design, with Web site version and the level of delay as independent variables. Each participant accessed one of two Web sites that were delivered by a WWW server that simulated delays users would encounter if the documents were being retrieved from the Internet (Sears & Borella, 1997). Participants encountered one of two levels of delay as they retrieved documents.

Experimental materials and procedure. The Web sites, demographics questionnaire, task worksheet, and usability questionnaire were identical to those used in Experiment 1. The experimental procedure was also the same. During this study, participants experienced one of two levels of delay corresponding to the delays encountered when accessing a large corporate WWW site during the middle of a business day. The long delay condition corresponded to using a 28.8 Kbps modem (the same as those experienced by participants in the internationalization study). The short delay condition corresponded to a T1-line (1.5 Mbps). As in Experiment 1, all delays were generated using a trace-driven simulation, which is based on calculations using actual Internet delays and page-dependent factors such as document size (Sears & Borella, 1997).

4.2. Results

The independent variables were delay length and Web site version. As in Experiment 1, the analysis used a two-way ANCOVA. The covariates were gender, age, self-reported command of the English language, computer experience, Internet experience, and frequency of Internet use. We report all statistically significant main effects, interactions, and correlations using the adjusted means and standard errors as generated by the ANCOVA. All main effects and interactions correspond to large-effect sizes as determined by Cohen's (1969) technique for evaluating effect sizes. Correlations are reported using Pearson correlation coefficients. No significant effects were found for the questions related to site appeal, latency, or the use of graphics on Web pages.

Information organization. Only one significant effect was identified for these five questions. Feelings of being lost while using the Web site were explored by asking participants to respond to the following statement: "I never felt lost when searching for information at this site." A significant main effect was found for delay length, $F(1, 346) = 4.05, p < .045$, with longer delays (adjusted $M = 4.04, SE = 0.130$) resulting in users' feeling more lost than shorter delays (adjusted $M = 3.66, SE = 0.130$).

WWW usability. Several significant results were identified for these questions. There was a significant main effect for the version of the Web site (original site adjusted $M = 6.03$, $SE = 0.107$; simplified site adjusted $M = 5.71$, $SE = 0.105$) on responses to the statement, "I'd like to use the Internet, but I'm intimidated by the complexity," $F(1, 364) = 9.06$, $p < .05$. There was also a significant two-way interaction between delay and Web site version (see Figure 2) on responses to the statement that "my ideal Web site should contain general links to other unrelated sites" $F(1, 364) = 28.89$, $p < .01$.

5. DISCUSSION

The aforementioned results clearly show that basic demographics (i.e., age, gender, and country) strongly influence perceptions of Web site usability. Numerous factors must influence how individuals evaluate the usability of a Web site, many of which should be related to the technology used, media encountered, and the design of the Web site. Therefore, it is not surprising that the correlation coefficients reported here are not larger. In fact, the ability of basic demographics such as age and gender to explain even a small fraction of the variation in the responses provided by our participants is important. Further, contrary to expectations, these basic demographics appear more important than computer experience, Internet experience, and frequency of Internet access. This is demonstrated by the numerous significant correlations associated with age and gender; the limited significant correlations for computer experience, Internet experience, and frequency of Internet access; and the magnitudes of the corresponding correlation coefficients.

Interestingly, the participants' self-rated command of the English language was a significant correlation only for the one question regarding whether the participants felt intimidated by the complexity of the Internet. This means that surpris-

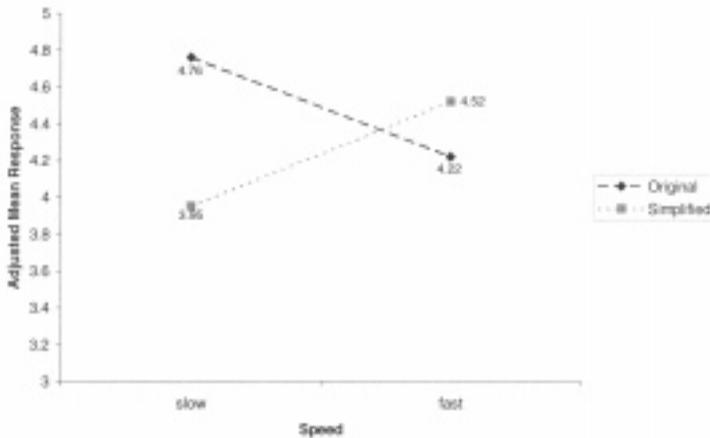


FIGURE 2 Adjusted mean responses for "my ideal Web site should contain general links to other unrelated sites" (1 = *strongly agree*, 4 = *neutral*, 7 = *strongly disagree*).

ingly, command of the English language was not correlated with responses for information organization or Web site appeal. We assert that this is due to the fact that the participants were either living in the United States (and therefore can be assumed to have a reasonably good command of the English language) or were employees of a multinational organization, where English functions as the common language, especially for computer or Internet-related discussions.

The Swiss participants generally rated the sites lower for all questions, regardless of which version of the site they experienced. A likely explanation is that the original site was developed primarily for the U.S. audience. Because the sites (both original and simplified) were not internationalized in any way, it is not surprising that Swiss participants did not respond as positively about the sites as the U.S. participants.

We make a similar argument for the older participants, who tended to rate the sites lower: The Web site used an aggressive layout and color style that is likely to be more familiar to a younger audience.

In general, female participants rated the sites more positively than male participants. Female participants were either less inclined to offer negative feedback, or the site may have had more appeal to women than to men. This study did not explore the underlying causes of these gender differences. Future research should address this and other significant effects in more detail.

5.1. Information Organization

Country and age were significant in most questions regarding information organization. The Swiss participants generally rated the sites lower, as did the older participants. Web site version was only significant for one question, which addressed how easy it was to find the needed information. The participants who were given the original site agreed that the information was easy to find, but participants using the simplified site were less positive. One interpretation is that the graphics present in the original Web site helped users locate information, even though the information content was the same in both sites. One example is the replacement of graphical buttons with HTML links. Although both lead to the same information, the graphical buttons may be easier for users to locate and may therefore make it easier to locate the desired information.

5.2. Web Site Appeal

On each question regarding Web site appeal, Swiss participants gave lower ratings than U.S. participants. As mentioned earlier, this is likely to be due to cultural differences and to the fact that the original Web site was designed for the U.S. audience.

Interestingly, the version of the Web site (simplified vs. original) made no difference in how the U.S. or Swiss participants rated the Web sites' appeal. Designing an appealing Web site requires consideration of factors that differ from the issues that need to be considered for efficient information presentation. According to these

data, the site’s appeal is influenced more by the country the user is from and basic demographics than it is by the simple omission or addition of graphics. A successful internationalization effort must consider demographics as well as underlying cultural issues.

5.3. Latency Issues

Older participants indicated less concern with the speed of downloading documents. Interestingly, the Swiss participants, who tended to rate every other aspect more negatively than the U.S. participants, indicated that the site would not be better if it were more responsive. In general, the Swiss participants were accustomed to longer delays than the U.S. participants. Therefore, from the perspective of the Swiss participants, the delays were relatively short already. This explanation is supported by informal comments by participants about the “surprisingly fast” speed of the Web site.

5.4. Web Page Graphics

A significant interaction exists between country and Web site version when it comes to the user’s perception of graphics on Web pages. The interaction shows that Swiss participants reacted differently when presented with different media, whereas the U.S. participants’ responses remained flat. The Swiss ratings were more positive when using the simplified site as compared to the original site. See Figure 3 for an illustration of this relation.

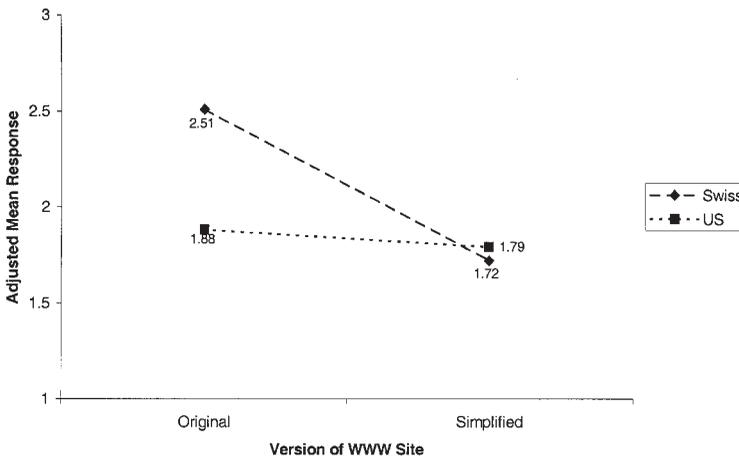


FIGURE 3 Participant ratings for Question 16: “Sites with graphics are more attractive than sites that include text only” (1 = strongly agree that Web sites with graphics are more attractive, 4 = neutral, 7 = strongly disagree that Web sites with graphics are more attractive).

Both Swiss and U.S. participants agreed that sites with graphics are more attractive. Swiss participants who used the original site were significantly less likely to think that graphics make a Web site more attractive than were Swiss participants who used the simplified site. One interpretation is that although Swiss participants like Web sites with graphics, they did not appreciate the additional graphics that were incorporated in the original site. This would indicate that Swiss participants prefer simpler Web sites.

The post hoc analysis also indicated that reactions from U.S. and Swiss participants exposed to the original site were significantly different. U.S. participants felt more strongly than Swiss participants that sites that include graphics are more attractive. This is likely to be due to Swiss participants being used to lower bandwidth and therefore associating more graphics with slower download times and a decrease in usability.

These results provide support for the view that internationalizing a Web site requires more than simply translating the text. Instead, additional factors such as the use of graphics must be addressed as well. These issues and the trade-offs involved in adding more graphics to a site are discussed next.

5.5. WWW Usability

Participants with more computer or Internet experience and those who access the Internet more than three times per week were more likely to disagree that an ideal site should contain links to other sites (whether they were related to the current site or not) than were less experienced participants. This may be due to the fact that experienced users are familiar enough with the Internet and the search engines to locate information without “surfing” from one site to the next. Less experienced users are more likely to use links to other sites as a way to explore the Internet. Similarly, Swiss participants, male participants, and older participants were less likely to agree that the site should contain links to other sites. Experience with the Internet and with computers in general was strongly correlated with whether the users felt intimidated by the complexity of the Internet or not. The users’ self-reported command of the English language also correlated, showing that individuals with more confidence in their English skills and users with more experience were less likely to feel intimidated by the complexity of the Internet.

Although a Web site designer cannot control experience or language proficiency, these user groups can be catered to by using a mechanism similar to internationalization, except that the “localization” in this case would not be bound to a physical locale, but rather to user groups.

6. CONCLUSIONS

Our results clearly demonstrate that there are significant differences between how U.S. and Swiss users rated the same Web site. Just as a company must evaluate the international markets it is targeting for a product or an advertising campaign, com-

panies must also address cultural differences when developing Web sites. More research is needed to understand cultural differences. This issue is especially pressing because a Web site, unlike a traditional product, is internationally accessible the moment it goes live on the WWW.

Further, our results suggest that some high-end graphical enhancements, such as those explored in this study, may not provide the benefits anticipated. The simplified site resulted in equivalent ratings under most circumstances and superior ratings when Swiss participants evaluated the use of graphics in a Web site. Web site designers may need to reevaluate whether or not it is worth the additional time and expense involved in incorporating these enhancements. The additional time users must spend downloading these graphical elements should also be considered. At the same time, adding high-end enhancements resulted in improved ratings in assessments of how easy it was to locate the required information. This implies that some of these enhancements, quite possibly the graphical buttons that provided access to more related information, may have aided users during some navigational activities.

In the course of this article, it has become apparent that there is overlap between traditional software engineering internationalization, internationalized user interface design, and Web page design. However, internationalization issues on the WWW pose their own set of challenges.

6.1. International Web Site Design

This research suggests that users rate Web sites differently depending on their country, and that their age and gender also have a significant impact. Ideally, a company would design multiple, fully internationalized Web sites, one for each target market. A more economical approach is to simply translate the Web site into several languages or attempt to design one Web site that is meant to fit all. These three possible solutions are detailed next, followed by a discussion on the testing and deployment of internationalized Web sites.

“Internationally aware” Web sites. For a company not interested in investing in a fully internationalized Web site, some guidelines can still be followed to ensure the highest possible acceptance worldwide:

- **Language:** English is the common language of the business world today. Many international users can be expected to have a rudimentary understanding of English. Keeping the text on the Web site simple by using common words and avoiding jargon will help users understand the content of the site. This will also increase the quality of automatic translations, which are available from the many on-line translation services.
- **Graphics:** The three main issues to consider in using graphics are how many to use, how big they are (i.e., file size), and what their content is. Some graphics should be included, because even though the importance of graphics is cul-

ture-dependent, both U.S. and Swiss participants indicated that sites with graphics are more attractive than text-only sites are. Graphics that assist during navigation, such as graphical buttons that appropriately attract the user's attention, can also be useful. A Web page designer should pay attention to the file size for all graphics, because larger files increase download times, which increases the likelihood of a user feeling lost (Jacko et al., in press). Finally, the human-computer interaction (HCI) literature points to the importance of modifying the content of graphics to fit the targeted culture. In a situation where one site is meant to address all countries, graphics need to aim for a common denominator, particularly with regard to potentially sensitive issues, such as religious symbols, the human body, women, and hand gestures (Russo & Boor, 1993).

- **Layout:** When presenting information in a sequence or as a logical flow, the designer must not assume that the user will intuitively read the page from left to right and top to bottom (O'Donnell, 1994). Instead, the flow of information should be depicted using arrows or other directional indicators.

Translated Web sites. To reach a set number of target markets, a Web site can be translated. The same issues that confront software localization apply here: Either the translation is done by the designer in the country where the Web site is being built, a specialized team translates the text, or each translation is done by a translation team in the target country. A decision needs to be made whether the Web site should contain the localized information or whether it should be read from a database. The trade-offs of these methods focus on skill management and are the same for Web pages as for traditional software. More detailed discussions of these trade-offs can be found in the software engineering literature on internationalization.

For the Web site designer, the organization of these Web pages is of importance, because users should be given a choice of what language they prefer. Solutions include providing a globe or map to click on or a menu to choose from that links users to the appropriate part of the Web site. Users can set language preferences in their browsers, allowing a server to automatically send a Web page in the correct language. Though this is technically feasible today, it is not yet a widely used option. Other solutions, such as automatically determining users' preferred language based on Internet Protocol (IP) addresses, are less successful, because users may prefer a different language from the one spoken in the country where their IP address is located.

The aforementioned guidelines for internationally aware Web sites also apply for translated Web sites, though the language-specific Web pages allow for culturally adjusted graphics. These graphics should follow the HCI recommendations on internationalizing interfaces (e.g., Erickson, 1990; Russo & Boor, 1993).

Fully internationalized Web sites. The most elaborate internationalization effort aims for the highest possible acceptance from the users in all target countries. In addition to adjusting the graphics and text, as detailed earlier, attention needs to be given to information organization and other cultural aspects, such as use of color and flow of information.

Ideally, usability testing should be done in each target country to identify the specific requirements of each user group. As this study shows, information organization is a major issue that differs between countries. The information presentation (e.g., graphics, colors, and layout) influences how easily users find the information and how professional they rate the Web site. Swiss users, for example, rated information quality low on the U.S.-centric Web site used in the study. Adapting the Web site to Swiss tastes would probably increase the Swiss users' perceptions of the Web site's information quality.

Graphics are an essential issue in internationalizing a Web site. In this study, Swiss users who were given a relatively simple Web site with few graphics rated the importance of graphics on the Web site lower than U.S. participants. The desire to create an attractive Web site with many graphics must be weighed against the risk of having too many graphics, which may make it harder for users to find the information they need, increase download times, or make users feel lost.

6.2. Testing and Deployment

Fully internationalized Web sites that appeal to all users in the target countries are theoretically attainable through careful research and usability studies. The current realities of the software market add complexities for the testing and deployment of internationalized Web sites. Testing a single Web site today is already difficult, because technical differences between browsers and platforms mean that every Web page must be tested on all the possible combinations of browser and platform. For thorough testing of an internationalized Web site, the explosion of browser and platform combinations in different languages must be managed. Traditional software engineering testing methods will work in conjunction with the internationalization practice of localizing software by setting up teams in each target country. These teams would be responsible for the translation of text on the Web site, the usability studies on users in that country, and finally the testing of the internationalized Web site on the locally common platforms and browsers.

Deploying Web sites stands in contrast to deployment of software, where the scheduling of releases is staggered for different countries and coordinated with marketing efforts. Users around the world can access a Web site the minute it goes live. A company must make the choice between releasing the internationalized parts of a Web site all at once or on a staggered schedule. This decision, however, may be a question of marketing. Because creating fully internationalized Web sites is a significant effort, time-to-market considerations may dictate that the first release of a Web site will only target the primary market, followed by internationalized versions as they become available. In this case, an internationally aware Web site is a good solution for the first release, because it aims to be understandable for the largest possible number of international users.

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