Conformity with User Expectations on the Web: Are There Cultural Differences for Design Principles?

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Abstract. User-centered Web design essentially impacts a website's success and therefore directly or indirectly influences a classic or digital enterprise's prosperity. "Conformity with user expectations" as one of seven dialogue principles according to the ISO 9241-110 standard is one critical success factor as it regards efficient and effective task completion. Over the past ten years, numerous recommendations for designing Web elements have been published, and some of them deal with conformity of user expectations. However, there are cultural differences concerning how design principles should be applied on Web elements. In this paper, we outline examples of their implementation, followed by discussing the results of an eye tracking study, which indicates that not all recommendations for design principles provided in related work – especially from the Anglo-American area – are valid for European end users and, finally, that their validity may change over time.

Keywords: cultural differences, conformity, user expectation, eyetracking, intercultural design principles.

1 Introduction

The effective, efficient and user satisfying implementation of the seven dialogue principles, i.e. suitability for the task, self-descriptiveness, conformity with user expectations, suitability for learning, controllability, error tolerance, suitability for individualization; represent the ISO 9241-110 standard's core concept for user centered web design.

User interfaces that conform with user expectations are defined as "*predictable user concerns, emerging from the applicational context and in accordance with generally accepted conventions*".

However, when people interact with websites, the standard does not include the extent to which conformity with user expectations contributes to task efficiency.

The following paper outlines the methodology and results of an eye tracking study that compares different web designs which were implemented according to specific design principles and corresponding design recommendations. Thus, design recommendations,

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taken from pre-defined references, were tested on their qualification to allow a prompt orientation on different websites.

In corresponding usability literature, conformity with user expectations on websites is a common issue. Tirapat and Achalakul (2006) examined different hyperlink positions and were able to prove that users have very specific expectations on the position of web elements that need to be considered in web design. Cox and Fisher (2009) experienced, that confirmed user expectations, lead to an improved interaction quality that correlates positively with user satisfaction. Furthermore, Zhang and von Dran (2002) showed that users' expectations and their QoS criteria may vary according to different domains.

The following references provided the necessary design recommendations to prepare the study:

Nielsen and Tahir (2002), Jacobsen (2005), Nielsen and Loranger (2006), Shneiderman and Leavitt (2006), Cappel and Huang (2007), Angeli and Kundler (2008) and the European Committee for Standardisation (2006).

Subsequently, four exemplary web elements and their design recommendations have been chosen in order to conduct the eye tracking study and have been summarized in Table 1.

Table 1. Exemplary design recommendations

Web-Element	Design conformity with user expectations	Reference
I: Page Title	• Title should be unique and significant • Title should represent a site's content the best possible	Jacobsen, 2005
II: Logo	• To be positioned in the top left section of the page • Should be a hyperlink that leads back to the homepage	Shneiderman/Leavitt, 2006
III: Main Navigation **a) Link Title**	• Site content should be described as short and explicit as possible • No unnecessary additions • No repetition of the company's name • No addition of 'e-' or 'internet-'	Nielsen/Loranger, 2006
	• Target group should be familiar with the words used in a specific context	European Commitee for Standardization, 2006
b) Link Design	• Font color blue and underlined • Font color magenta after first visit	Cappel/Huang, 2007
	• Navigation menu has to be positioned on the left hand side	Shneiderman/Leavitt, 2006
c) Navigation tabs	• Designed like register menu of tabs • No simple bars with mouseover animation	Shneiderman/Leavitt, 2006
d) Navigation in Webshops	• Shopping cart-button (hyperlink) on the top right, below the basket's product list	Angeli/Kundler, 2008 Nielsen/Loranger, 2006
IV: Search Function	• Positioned in one of the top corners • White input field without any text • Describe the button with accurate terms such as 'search' or 'find' instead of 'go'	Nielsen/Tahir 2002 Nielsen/Loranger, 2006

Since eye tracking has been repeatedly approved as a reliable method in many studies (Duchowski, 2007), it is also appropriate in usability studies (Nielsen & Pernice, 2010). Furthermore, existing guidelines for usability need continuous reassessment with eye tracking technology (Cooke, 2004). Thus, eye tracking has been chosen for this study as the most reliable tool to measure efficiency.

2 Background and Related Work

User satisfaction is a very important aspect (Hassenzahl, 2001) (Stickel et al., 2009) and previous research indicates that the expectations of end users play a crucial role in their satisfaction. According to Tesch et al. (2005) this includes expectations regarding the skill levels exhibited by the providers of the IS services and products. Expectations are basically examined as gaps from perceived performance or as gaps from realistic expectations and although the interaction of these gaps has not been thoroughly researched, recent theories anticipate both gaps are crucial in meeting the desires of the end users. Previous studies indicate that expectations should be managed to higher levels and commonly understood across the end user and provider groups (Tesch et. al, 2005).

Interface consistency has been studied for quite a long time, actually since Graphical User Interfaces (GUIs) began to be used widely. Working with such user interfaces will be more efficient under the premise that a worker who is able to predict, what the system will do in any given situation, and can rely on the given rules (Nielsen, 2001). Consequently, the focus of research was on worker's productivity in order to achieve higher throughput and fewer errors. As a result of this goal, most early studies were on job performance of office workers, i.e. error rate and time to perform a task. The latter is the typical Human–Computer Interaction (HCI) approach and is usually considered in a transfer paradigm in which: *the higher the similarity between two tasks is, the higher the transfer, hence the consistency* (Tanaka, Eberts & Salvendy, 1991).

However, a strict establishment of the primary places of where consistency is most necessary is difficult. Grudin (1989) separated consistency into *internal* interface consistency and *external* interface consistency, wherein internal refers to consistency within a task and external means consistency among various tasks. Ozok & Salvendy (2000) classified it into three sub types, establishing the *three-dimensional model of interface consistency:*

(i) Conceptual consistency (language, stereotypes, task concept, skill transfer, output consistency, hierarchical order of concept, etc.);
(ii) Communicational consistency (moving between screens, menus, user conventions, between-task consistency, distinction of tasks and objects, etc.);
(iii) Physical consistency (color, size, shape, location, spacing, symbols, etc.).

Ad i) *Conceptual consistency* can be defined as the consistency of metaphor applied to an interface feature or an action that is embodied within a feature. Frequent and inconsistent use of synonyms, instead of using the same words for the same items, is unhelpful. Leaving something to students' conception and interpretation due to the lack of explicitness is also regarded as conceptual inconsistency (Grudin, 1989), (Ozok & Salvendy, 2000).

Ad ii) *Communicational consistency* can be defined as the consistency of both input and output of the interface. It deals with how the user interacts with the computer interface and whether the means of interaction are consistent for fulfilling the same or similar tasks.

Ad iii) *Physical consistency* can be defined as the consistency of the visual appearance of an interface feature and indicates that the features are supposed to be consistent with the users' mental models (Satzinger, 1998).

Although this has been known for quite a long time, research on the relationship between *consistency and human work and learning processes* has only recently been documented, and Satzinger & Olfman (1998) pointed out that very few studies have investigated the effects of interface consistency on work and learning performance. To design an appropriate user interface demands insight into the *behaviour of the end users* and the application of user centered development (Norman & Draper, 1986), (Holzinger, 2002), (Norman, 1986), in order to achieve a true interaction. This is of essential importance, since working with interactive media is generally highly demanding from the perspective of the limited cognitive processing capabilities of the end users (Holzinger, Kickmeier-Rust & Albert, 2008), (Holzinger et al., 2009). Daily practice shows that many end users have difficulty working with electronic systems, since they are often unable to form a mental model of the system and their current position within its complexity. However, when striving for a design following the "principle of the least surprise", we are faced with the problem that designers and developers are rarely able to predict exactly what the end users really expect (remember Steve Krug (Krug, 2000): "Don't make me think!").

In addition, related work in "*cultural usability*" (cf. Vatrapu & Suthers 2010) strongly focuses on the relevant aspects of user interface design:

(i) *Cultural conventions*: Research in the 1990's focused on localization and internationalization of user interfaces with respect to languages, colors and convention of data, time and currency (Fernandes, 1995, Khaslavsky, 1998; Russo & Boor, 1993).
(ii) *Cultural influences* on usability evaluation methods and usability processes were found in the usability assessment methods of focus groups (Beu, Honold, & Yuan, 2000), think-aloud (Clemmensen, Hertzum, Hornbæk, Shi, & Yammiyavar, 2009; Yeo, 2001), questionnaires (Day & Evers, 1999), and structured interviews (Vatrapu & Pérez-Quiñones, 2006).
(iii) *Cultural differences* with respect to usability processes were found in the understanding of metaphors and interface design (Day & Evers, 1999; Evers, 1998).
(iv) *Cultural Web design:* Finally, culture was found to affect web design (Marcus & Gould, 2000), objective and subjective measures of usability (Herman, 1996), and subjective perceptions and preferences in mobile devices (Wallace & Yu, 2009).

3 Methodological Design

The study was conducted with 22 test subjects from Austria between the ages of 17 and 28. The probands use the internet daily to several times a week, for business as

well as private matters. They were divided into two research groups of 10 and 12 subjects. Hence, each research group was shown one of two different layout designs containing specifically designed web elements; one of each was designed to conform to the chosen design recommendation concerning the design principle "conformity with user expectations"; one was not (test 1 to 4).

The goal was to complete a task by using those pre-defined design elements/ hyperlinks positioned on the web site and to confirm them by a mouse click to finish the particular task (see table 2).

Apart from the different positions and designs of the Web elements, respective design principles to be tested, the websites were completely identical. The eyetracking data was recorded by a 120Hz eyegaze eye tracking system from "Interactive Minds". It enabled a comparison of the proposed Web site alternatives regarding general indicators and ratios, as well as required times for task completion and hit rates.

Table 2. Tested Web elements

	Web-Task	Alternative 1	Alternative 2
Test I: **Position of the Main Navigation**	Find the hyperlink "Product Overview" as a part of the main navigation	Positioned on the left hand side → ***conforming*** to user expectations	Positioned on the right hand side → ***not conforming*** to user expectations
Test II: **Position of the Search Function**	Find the search function and click on the search-button	Top left → ***conforming*** to user expectations	Middle right → ***not conforming*** to user expectations
Test III: **Position of the Website Logo**	Find a link back to the homepage without clicking the "Homepage"-button or the browser's "Back"-button	Top left → ***conforming*** to user expectations	Top right → ***not conforming*** to user expectations
Test IV: **Design of Navigation Tabs**	Find the hyperlink "About TopZoo" as a part of the navigation tabs	Tabs look like real-world tabs → ***conforming*** to user expectations	Bar with hyperlinks and mouseover animation → ***not conforming*** to user expectations

4 Results

In order to be able to calculate the relevant indicators, areas of interest were defined with the eyetracking analysis software Nyan 2.3.5 for each web site. Additionally, it was possible to calculate the average time to finish each task.

Test 1: Position of the Main Navigation. In comparison, the time to the first fixation of the main navigation took about 0.84s longer with the alternative 2 (alt1:1.56s | alt2:2.4s). The average fixation duration for the main navigation (alt1:0.49s | alt2:0.6s) and the product overview (alt1:0.47 | alt2:0.66s) was nearly the same for both alternatives. Both times, alternative 1 was fixated more often and more securely (alt1:90% | alt2:81.8%). Furthermore, the test subjects using alternative 1 could finish the task 0.89s faster (alt1: 4.73s | alt2: 5.59s). Thus, alternative 1, which was designed according to user expectations, allows a more efficient handling of the task.

Test 2: Position of the Search Function. Results show that the time to first fixation of the search function took place 2.3s *sooner in alternative* 1 (alt1:1.35s | alt2:3.6s). The average fixation duration differs with 0.75s (alt1:2.25s | alt2:3s). Greater differences appeared in the task completion time, where alternative 1 with its search function on the bottom left was completed 2.79s more quickly (alt1:4.22s | alt2:7.01s). Figure 1 shows exemplary heat map screenshots of the implemented design prototypes for testing the search function.

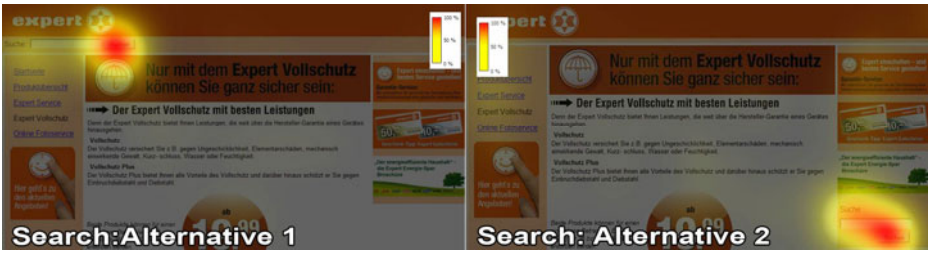

Fig. 1. Heatmaps of test 2 "Position of the search function"

Test 3: Position of the Website Logo. Only three people in each group used the website-logo as a backlink function (Shneiderman/Leavitt, 2006) within an acceptable period of time. The average time to the first fixation in *alternative 2* happened more quickly than in alternative 1 (alt1:5.31s | alt2:4.26s), however the fixation duration (alt1:1.62s | alt2:0.83s) as well as the number of fixations (alt1:6 | alt2:2) proved to be more reliable in alternative 1. In view of the large number of people (75%) who were not able to finish this task and the longer thinking time, it can be concluded that the *backlink function* of website logos, according to the literature (Shneiderman & Leavitt, 2006), *is not very well-known* within the tested probands group from Austria.

Test 4: Design of Navigation Tabs. As outlined in table 2, alternative 1 shows register menus of tabs while alternative 2 makes use of a simple bar with mouseover animated hyperlinks. A comparison shows that the fixation duration (alt1:1.29s | alt2:1.07s) and the number of fixations (alt1:3 | alt2:2.7) is better in alternative 2. Also the time to the first fixation (alt1:4.14s | alt2:2.22s) as well as the time to finish the overall task (alt1:14.82s | alt2:10.53s) shows better results in alternative 2. In conclusion, the implementation of navigation tabs as proposed by Shneiderman and Leavitt (2006) does not comply with the tested probands expectations.

Are there Cultural Differences? Effective image design on websites is central for successful international communication (Amant, 2005). The results of tests 3 and 4 leave room for interpretation. The implemented design recommendations of tests 3 and 4 were proposed by Shneiderman and Leavitt (2006). They did not work persuasively with the conducted 22 test subjects from Austria. Are there cultural differences in how to implement specific design principles and how the probands use them in Austria, which should be valid for the German-speaking Europeans, in contrast to the Anglo-American room?

Table 3. Results of the Eyetracking Study

	Test 1				Test 2	
	AOI: Main Navigation		AOI: Link "Product Overview"		AOI: Search Function	
	alt.1	*alt. 2*	*alt. 1*	*alt. 2*	*alt. 1*	*alt. 2*
Time to First Fixation [s]	1.56	2.4	1.92	2.71	1.35	3.64
Fixation Duration [s]	2.44	2.07	0.95	1.57	2.25	3
Ø Fixation Duration [s]	0.49	0.6	0.47	0.66	0.48	0.5
AOI Hit Rate [%]	90.0	81.8	90.0	81.8	90.0	90.9
Number of Fixations	5	3.5	2	2.4	4.7	6
Task Completion [s]			4.73	5.59	4.22	7.01

	Test 3		Test 4			
	AOI: Website-Logo		AOI: Tab Navigation		AOI: Link "About TOP/ZOO"	
	alt. 1	*alt. 2*	*alt. 1*	*alt. 2*	*alt. 1*	*alt. 2*
Time to First Fixation [s]	5.31	4.26	2.09	1.02	4.14	2.22
Fixation Duration [s]	1.62	0.83	4.52	2.68	1.29	1.07
Ø Fixation Duration [s]	0.27	0.41	0.35	0.3	0.43	0.4
AOI Hit Rate [%]	100.0	66.7	100.0	90.0	91.0	70.0
Number of Fixations	6	2	13	8.9	3	2.7
Task Completion [s]	8.77	9.86			14.82	10.53

Ad test 3: In test 3, only 6 of 22 probands used the backlink function in an appropriate period of time. Accordingly, 16 probands did not use or even know about this functionality.

Ad test 4: In the case of test 4, it apparently seems, that German-speaking Europeans are not used to explicit register tabs for menu design in the same dimension that people in the Anglo-American room are. Shneiderman and Leavitt (2006) recommended the following menu tab design example in their "Research Based Web-Design & Usability-Guidelines" (Fig. 2):

Fig. 2. Recommended register menus (Schneiderman & Leavitt, 2006)

The probands located the wanted menu option during both test alternatives in an appropriate period of time but were significantly faster in completing the task with alternative 2 (alt1:14.82s | alt2:10.53s). They seemed to feel uncertain and were not used to register menus and obviously have adopted modern menu design elements with dynamic menu options and mouseover effects in the German-speaking room, which were explicitly not recommended as design principles.

Hence, design principles are not generalisable (as proposed by Shneiderman and Leavitt 2006) and seem to depend on the intercultural context. To overcome this

deficiency, design principles and the corresponding recommendations, need to be evaluated in different cultural environments all over the world and validated explicitly concerning the cultural context where they are intended to be implemented.

5 Discussion and Conclusion

The four tested design recommendations for web elements to fulfil the design principle "conformity with user expectations" show considerable differences concerning adequateness of task completion.

The results for the typical position of the main navigation and the search function show compliant operating speed and confirm the recommended design suggestions for conformity with user expectations. The website logo as a back-link function has surprisingly been used only by a very small number of sophisticated internet users.

The suggestion to design register menus of tabs seems to be out-of-date and dependent on the cultural area where it is applied, as the indicators showed a completely contrary result. We may interpret, that German-speaking users have rather adopted their expectations to dynamic menu designs with mouseover effects, and they are able to use them in an efficient and effective way.

In conclusion, there will always be cultural differences, necessary adaptations of design and colour and design adaptations according to a specific target group that have major priority for accurate implementation. The validity of common recommendations needs to be continuously reassessed and evaluated for their specific cultural context, as the dialog principle "conformity with user expectations" may change in the course of time and may be interpreted dependent on cultural differences.

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