The Influence of Culture on Usability

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Abstract

This research is grounded in the belief that culture is a discerning variable concerning the attitude towards usability. Software products and web applications in particular are used more and more outside the countries and cultures they have been developed in and designed for. But still, only some research has been carried out to investigate cultural influences on the usability of globally used software products.

In this study, a research model has been developed, according to Hofstede's cultural specific variables (Hofstede, 1980; 1991) and the ISO 9241-11 (1995) definition of usability. The research model for this study is derived from Davis' Technology Acceptance Model (Davis, 1989), which has been used in a lot of studies about user acceptance and human machine interaction.

The model developed for this study has been tested in two empirical online surveys. Data from the first, explorative survey have been analyzed qualitatively by using the ATLAS/ti software (Muhr, 1994), which is based on the Grounded Theory approach. In the second study, a questionnaire has been developed to measure the research variables concerning the usability components effectiveness, efficiency and satisfaction. In addition, the usability of a website has been assessed during the main survey by using the IBM Computer System Usability Questionnaire, CSUQ (Lewis, 1995). Regarding culture, I made use of the Value Survey Module to quantify Hofstede's cultural specific variables, (Hofstede, 1980; 1984).

In the main survey, 145 HCI students and professionals from 30 different countries have been asked to explore a globally used website (www.ibm.com) and then answer the questionnaires mentioned above. The survey has been conducted online via the internet, data have been stored automatically by using the CGI2SPSS – HTML form data converter. (Müller & Funke, 1998). The data of the main survey have been analyzed statistically with SPSS for Windows© 10.0.

The overall results indicate differences in the attitude towards usability across members of different national groups. Moreover, some indications for the research model's validity could be found. Individualism/ Collectivism (one of five cultural specific variables proposed by Hofstede) is significantly connected to the attitude towards satisfaction and the attitude towards product usability. But, as a whole, the research model could not have been confirmed as proposed. Further research is needed to estimate the value of Hofstede's variables for designing and evaluating the usability of software used across dissimilar countries and cultures.

Keywords

Culture, Usability, multicultural, Internet

INTRODUCTION

In today's increasingly global market, software products must be equally usable across different countries and cultures. Many American companies already sell more than half of their products outside their own country. This means on the one hand that software sells depend strongly on the international usability of products; on the other hand half of the world's software users are compelled to use products, which were originally designed in different countries and cultures (Nielsen, 1990). Designing software for a global audience will increase global acceptance of software products and therefore user's effectiveness, efficiency and satisfaction with the product. Truly intuitive cross-cultural software should reflect the cultural orientation of its users and accommodate user's cultural differences (del Galdo & Nielsen, 1996), concerning interface design preferences as well as the attitude towards software technology. Besides generally accepted findings relating to software internationalization and localization, further research is needed to investigate cultural influences on application design preferences and the perceived usability of software products for multicultural societies. The findings should be judged against established theories of cultural orientation (Hofstede, 1991; 1997).

RELATED RESEARCH

First research and practical guidelines on cross-cultural design emerged in the 1970's. The significance of national boundaries in science and business decreased, industrialization in emerging nations like India came up. Publications on culture and product design reached a first maximum in 1975 (Honold, 2000). In this era of intercultural usability engineering, the focus has been laid on cultural ergonomics. Between 1975 and 1990, the number of publications decreased dramatically. But since 1990, interest for the field of cultural issues, technology acceptance and software

development respectively has increased with a slightly different motivation, namely adapting software interfaces to a global audience, since "the computer is slowly but surely becoming ubiquitous" (Fernades, 1995, p.x). Important human-computer interaction conferences such as 'CHI' and 'Interact' increasingly cover topics such as localization, international user studies and cultural differences among users (e.g. see Proceedings of CHI 2001). Large software development companies such as IBM, Sun Microsystems, Microsoft and Apple Computers initiated research in internationalization and localization of software in the early 1990's for strategic and competitive reasons (Nielsen, 1990; Kano, 1995). Remarkably, these publications do not really continue the tradition of cultural ergonomics. Even though the prior fact that " … particularly American software is … enforcing a new kind of imperialism" (Fernandes, 1995. p.x), the focus is laid on the possibility to market software products globally with a minimum amount of modifications.

Parallel to this industrial contributions to the field of cross-cultural usability engineering, academic research continued to explore ethical, developmental and economic advantages of designing for culture throughout the 1990's (e.g. del Galdo & Nielsen, 1996; Evers & Day, 1997; Keniston, 1997; Nakakoji, 1994; Russo & Boor, 1993). As a new aspect, anthropological methods are used explicitly. However, researchers don't just copy existing anthropological theories, but try to adapt them to models of human-computer interaction to bring in cultural aspects (e.g. Evers & Day, 1997). From 1998 on, interest in cultural models replaced guidelines and checklists entirely (Honold, 2000).

Evers & Day (1997) examined the influence of culture on interface design preferences and on the attitude towards software technology. In addition, they reviewed whether these influences are consistent with established theories of cultural orientation. They used a research model proposed by Davis (1993), modified to incorporate cultural aspects. One of the key findings of Evers & Day (1997) is that there are "not only interface relevant cultural differences between Asians and Australians (as expected), but that significant differences also exist within Asian groups – specifically, between Indonesians and Chinese". For example, "Indonesians seem to like new technology and alternative input and output … more than do Chinese. On the other hand, the use off many different colors seems more appropriate to Chinese" (p. 264). Another key finding of the study was that the acceptance process towards software technology flows different between cultures. This is a very important finding on what del Galdo and Nielsen (1996) called the third level of international software products, that is producing "systems that accommodate user's cultural characteristics". Chinese attitude of satisfaction in using is directly influenced by preferences in interface design, whereas the anticipated system use behavior of Indonesians is influenced directly by there beliefs about system ease of use. That means that e.g. Chinese find an interface satisfactory when it meets their design preferences, even if the system is hard to use! This suggests a different attitude towards the overall usability of international software products between cultures, which does not only depend on different design preferences, but also on a different focus on usability in general. Over all, the correlations between the constructs of their research model were not very large, but the authors "found enough significant relationship to support the research model" (p.264). They relate these findings to cultural-specific variables described in anthropological literature such as Hofstede, (1991).

THEORETICAL FOUNDATION AND RESEARCH MODEL

This research is grounded in the belief that culture is a discernible variable in the technology acceptance process and influences the attitude towards the usability of globally used software products. The assumption is, that cultural specific variables are related to user's beliefs about usability when using international software. Depending on their cultural background, users my focus either on aspects concerning effectiveness, efficiency or satisfaction (or combinations of each) when using such products. Therefore, assuming there is a linkage between culture and attitude towards usability, software products should be modeled to the user's cultural background, in terms of producing "systems that accommodate user's cultural characteristics." (Del Galdo & Nielsen, 1996). Any interface that does not follow these characteristics is likely to be difficult to use.

Usability

Unfortunately, there is no common definition of usability, which is generally accepted in the "HCI community". Englisch (1993) cites about twenty different definitions of usability, including nearly twenty different (overlapping and contradicting) components. The definition of usability used in ISO 9241-11, which is related to the use of the product (effectiveness, efficiency and satisfaction), is applied in many subsequent related ergonomic standards (Bevan, 2001). Since ISO 9241-11 is widely accepted in the software engineering community, it forms the basis of the characterization of the term usability in this research.

Culture

Similar to Usability, there is no agreement to a specific definition of culture. Traditionally, the topic of culture has been addressed by anthropologists who used the term culture to describe a group of people who have certain aspects of life in common. In search of a more focused definition, there are almost as many definitions as there are anthropologists. That is why finding a suitable description of culture for the purpose of evaluating cross-cultural influences on the attitude towards technology is difficult. Therefore, it seems appropriate to find a definition that serves

a specific area of research. According to Honold (2000a), some basic assumptions can be made to define culture for the purposes of human-computer interaction:

- Culture manifests itself in cultural models. These may be internal cognitions or external artifacts and institutions.
- Culture models may differ in their scopes and therefore in their significance to a culture.
- Culture does not determine the behavior of individuals but it does point to probable modes of perception, thought, and action.

Cultural models consist of cultural variables, which can focus on easy-to-research objectives like political and economic contexts, reading directions and formats for dates and numbers. Cultural variables can also focus on subjective information, like value-systems and behavioral patterns (e.g. attitude towards authority and technology). To analyze and study these cultural variables, I refer to Hofstede's known and tested model of culture (Hofstede, 1980, 1984, 1991).

Similar to other authors, Hofstede's model consists of several variables, by which groups of people can be evaluated and classified. Such a model of culture allows for a more empirically view on culture as variables can be present in any given culture in various strength and therefore can be measured and used to distinguish one culture from another. His cultural model includes the following variables:

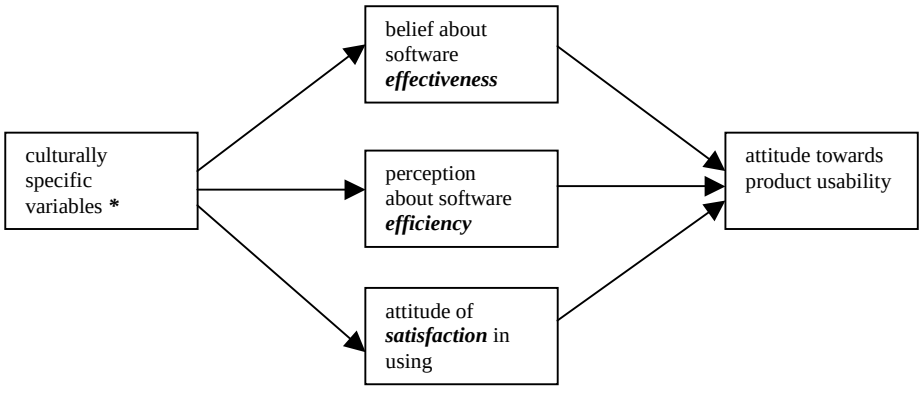
Table 1: Hofstede's cultural variables *(aus Evers Diss???)*

Variable	Opposite	Meaning
Power Distance	N/A	A measure of the interpersonal power in society as perceived by the less powerful.
Collectivism	Individualism	A measure of the relationship between the individual and the collectivity.
Femininity	Masculinity	A measure of the implications of gender on social roles.
Uncertainty avoidance	N/A	A measure of uncertainty about the future that is perceived as threatening.
Long-term orientation	Short-term orientation	A measure of the concern about the past/future in society.

Research Model

For this research, I adapted a model first proposed by Davis (1993) and modified by Evers & Day (1997) according to Hofstede's cultural specific variables and the ISO definition of usability. Figure 1 shows the research model used in this study.

Figure 1: Global Software Usability Model



* according to Hofstede (1991)

When using any given computer system, culturally specific influences are important context variables. It is not possible to interact with any given technical system without these culturally specific influences being part of the interaction. Hence, the attitude towards the technical product is influenced by the cultural background of the user. In case of computer systems, the attitude towards the product can be described as its perceived usability. As described above, usability can be subdivided (per ISO 9241-11 definition) into effectiveness, efficiency and satisfaction in using. I

want to investigate, if culturally specific variables are directly correlated with user's belief about software effectiveness, user's perception about software efficiency, and user's attitude of satisfaction in using. These subjective measures constitute the attitude of the overall usability of any given software product or computer system.

Research Propositions and Research Variables

Based on the research model described above, four research propositions can be developed:

- Culturally specific variables influence user's belief about software effectiveness while using globally marketed software.
- Culturally specific variables influence user's perception about software efficiency while using globally marketed software.
- Culturally specific variables influence user's attitude of satisfaction in using while using globally marketed software.
- User's belief about software effectiveness, user's perception about software efficiency, and user's attitude of satisfaction in using correlate with the attitude towards the overall usability of a globally marketed software product.

Table 2: Research Variables

Predictors (X)	**Criterions (Y)**	
X_1:Power distance	Y_1: belief about software effectiveness	Y_4:
X_2:Collectivism/Individualism	Y_2: perception about software efficiency	Attitude towards product usability
X_3:Femininity/Masculinity	Y_3: attitude of satisfaction in using	
X_4:Uncertainty avoidance		
X_5:Long-/short-term orientation		

PRE-STUDY

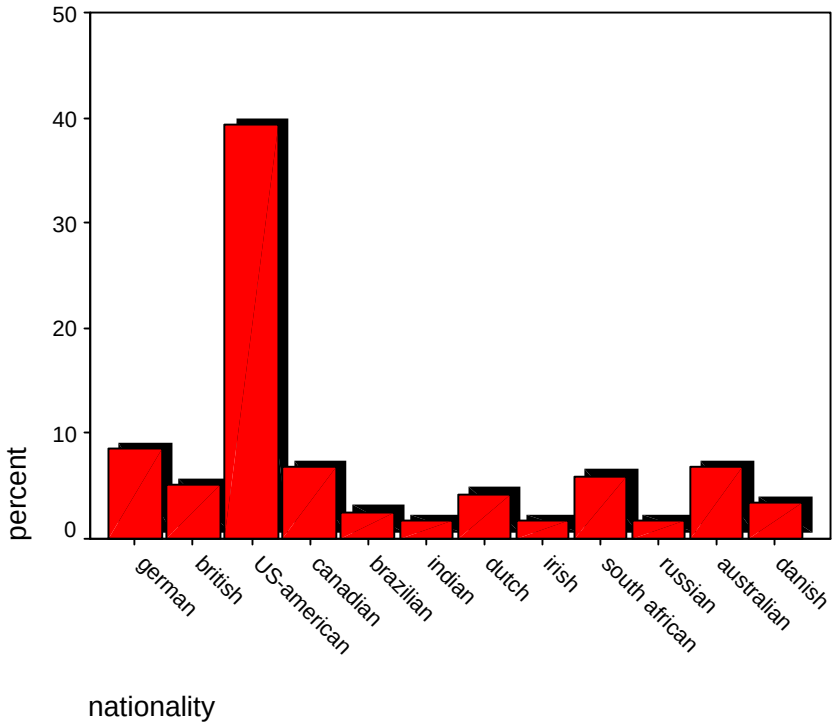
The major aim of the pre-study was the following: First I needed a large Item pool to generate the main data collecting instrument for the main study, namely the Cross-Cultural Usability Questionnaire. This questionnaire should measure the attitude towards the components of usability according to the ISO 9241-11, effectiveness, efficiency and satisfaction. Therefore the questions in the pre-study were open questions; I wanted the participants to produce as much ideas and suggestions of definitions of usability and its components as possible. I used every statement as a starting point to formulate Items (which means statements that can be rated on a standardized scale) for the final data collecting instrument. Finally, I selected five Items per variable (usability component, respectively) out of this pool to create the Cross-Cultural Usability Questionnaire.

A second goal was testing the technical methodology of collecting data online via the internet. Storing the data is important point when doing online research. Concerning the pre-study, I decided to apply a simple solution, which can be realized easily, and made use of a publicly available cgi-script to have the data send to my email account when the "submit" button had been pressed by the participant. After that, the data could have been copied into a word processor and can be stored in any given format.

Sample

The sample consisted of 117 HCI and usability students and professionals from 26 different countries. They were recruited via HCI related mailing lists and newsgroups and inside IBM corporation. 35,9% were of the age-group 20-29; 37,6% were between 30 and 39; 15,4% were between 40 and 49; and 11,1% belonged to the age-group 50-59; equally distributed between male (49,6%) and female (50,4%). Nearly all participants had few (55,6%) or much (42,7%) contact with other cultures, all participants read from left to right.

Figure 2: Nationalities, pre-study (shows nationalities with N>1)



Material

The material of the pre-study consisted of a questionnaire with five sections. Each section was made up of several questions or statements; three sections included open questions, the others had given answer categories. The survey was introduced by a first page, including the title, aim and procedure of the survey. After section 5, participants had the option to provide their name and/or email address, if they were interested in the results of the survey or in participating in the main study.

In the first section, the ISO 9241-11 definition of usability "Usability = the extend to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." was presented, and participants were asked for their definitions of effectiveness, efficiency, satisfaction and context of use. They had the possibility to provide their answers in their own words in any given length in text boxes, which were proffered after each question. At the end of the screen, a click button lead to the following page.

On the following screen, four statements were presented, each followed by a 6-point Likert scale. The single points of the scale were labeled as follows: – strongly disagree – moderately disagree – mildly disagree – mildly agree – moderately agree – strongly agree –. The statements referred to each single component of usability again, and the participants were asked to rate each statement on the presented scale. (e.g. "Please rate the following statement on a scale from 'strongly disagree' to 'strongly agree': Effectiveness is the main influence on the usability of a computer system."). Again, a click button at the end of the screen lead to the following page.

In section three, participants were asked for system or interface components, which they consider to be essential or mostly influence the effectiveness, efficiency or satisfaction of or with a computer system. Textboxes after each question provided space for answering these questions. The screen layout corresponded to the previous pages. Again, a click button at the end of the screen lead to the following page.

The next section only consisted of a single question: "Please mention all other aspects or attributes of 'usability' that you consider to be essential." In the textbox, two examples were given: learnability and interface quality. Below the textbox, a click button at the end of the screen lead to the following page again.

In the last section, participants were asked for their age-group (20-29, 30-39, 40-49, 50-59, 60-69), their gender, their nationality (free text entry), which city and country they live in (free text entry), the direction they use while reading scripts, and their contact to other cultures than their own. At the end of the screen, a click button was positioned, on which the participants had to click to submit the questionnaire. After that, they were lead to the contact form to provide their name and email address.

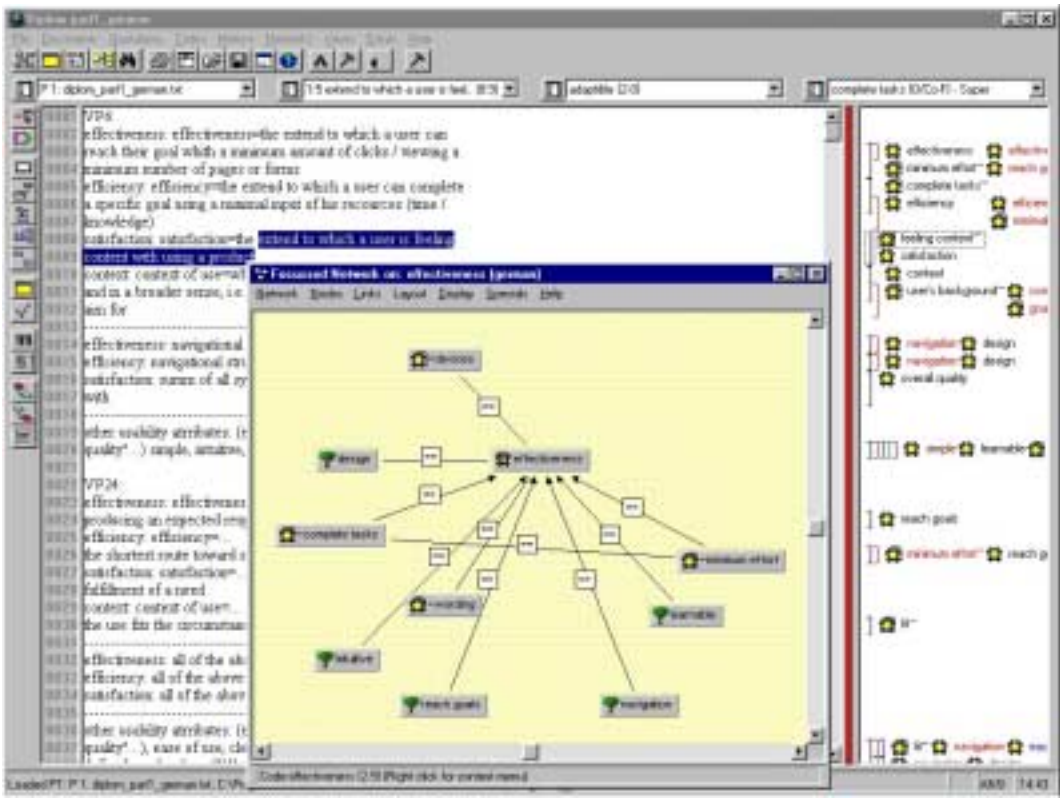
Data Analysis and Results of the pre-study

The open questions of the pre-study of the "cross-cultural usability survey" are likely to produce data which are of qualitative nature. Therefore I had to make use of a qualitative data evaluation technique to analyze these data. By using a transparent process of analysis, the verification of qualitative data interpretation and results can be ensured. A possible technique to do so is by using the approach of the so called "Grounded Theory". This theory has been developed by Barney Glaser and Anselm Strauss during the 1960s (Glaser & Strauss, 1967; Strauss, 1994). The overall objective of this method is to develop new theories and models, based on a detailed micro-analysis of social occurrences. Structures of empirical phenomena are generalized to theoretical outlines by an inductive way of discovering, contrasting and reasoning on the basis of the underlying empirical data.

The research method applied in the Grounded Theory approach can be described as follows: After collecting field data on a certain objective, the data are analyzed word by word or line by line and are coded along with their conceptual content (first step: *open coding*). According to the arising findings, the researches decides which empirical phenomenon (which case) is of further interest (*theoretic sampling*). Special attention is lead to the construction of comparisons and contrasts. The coding is repeated and structured forms are developed (*axial coding, selective coding*). While doing this, the researcher works out categories and constructs to structure the objectives of interest and relates and connects them to each other. During the whole process, the researches writes so called *memos*, where arising ideas about categories, relations, methodical approach etc… are recorded. (Breuer, 1996).

The software used in this study for qualitative data analysis is called ATLAS/ti (Muhr, 1997). It supports all steps of the grounded theory approach. Figure 3 shows a screenshot of ATLAS/ti:

Figure 3: Interface of the software package ATLAS/ti (Muhr, 1997)



The major aim of the pre study was generating a large item pool to develop a new questionnaire for the main study. In addition, the qualitative analysis of the data provided insight in the structure of differences between nationalities regarding the definitions and understanding of each usability component.

By using the grounded theory approach, some assumptions about the different meanings of the construct usability between members of different nationalities can be made. Here, I describe some results for nationalities with N>1.

For Americans, using minimal resources and having minimal effort when using an interface are the most important aspects of its usability. Both concept are associated with the usability component "effectiveness" and "satisfaction". "Reaching goals" and "learnability", which are associated with effectiveness and efficiency, are also very important, whereas "error resistance" and "feedback" are least essential.

For Germans, navigation is the most important aspect of usability. Navigation is associated with effectiveness, efficiency and satisfaction as well. “Reaching goals” and “completing tasks” follow, both being associated with effectiveness. “Wording” and “design” are also important aspects of usability, whereas “learnability” and “hedonistic quality” are least important for the German sample in this study.

“Navigation” is also the most important aspect of usability for the Australian sample, followed by “minimal resources” and” minimal effort”, which are related to efficiency, and “completing tasks”, which is linked to effectiveness. In contradiction to the German sample, “hedonistic quality” is a rather important aspect to Australians.

In the British sample, “reaching goals” and “navigation” are the most important elements. Both are connected to each of the usability attributes effectiveness, efficiency and satisfaction; therefore the assumption can be affirmed, that British users set great store by the overall usability of an interface. This supposition is supported by appearance of a special element in the British sample, namely the importance of the “cognitive environment” for the overall usability. Aspects of only one usability attribute, for instance “minimal resources” (efficiency) and “hedonistic quality”, play minor roles.

In the South African sample, navigation is also the very important aspect of usability. It is followed by “minimal resources”, which is associated with efficiency, and “design”, which is associated with satisfaction. Aspects of effectiveness, such as “completing tasks” or “accuracy” are somewhat underrepresented.

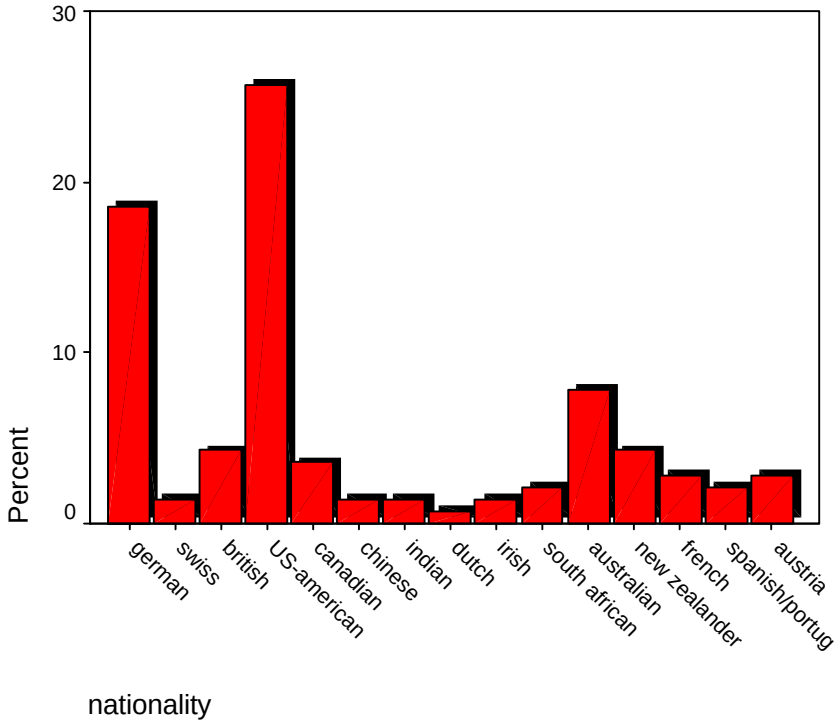
In the Dutch sample, “reaching goals” is the most important factor, followed by navigation, which is more connected to efficiency here than to effectiveness or satisfaction, respectively. “Hedonistic quality” also plays some role, while aspects like “overall quality” or “design” are rather unimportant.

MAIN STUDY

Sample

The sample of the main study consisted of 145 HCI students and professionals of 30 different countries. They were partly recruited via HCI related mailing lists, partly work inside IBM corporation and partly consisted of participants of the explorative survey, who were invited to take part again. 38,6% were of the age-group 20-29; 32,4% were between 30 and 39; 12, 4% were between 40 and 49; 8, 3% were between 50 and 1,4% were between 60 and 69. Nearly all participants had few (39,9 %) or much (51,0 %) contact with other cultures.Figure 4 shows the distribution of their nationalities:

Figure 4: Nationalities, main study (shows nationalities with N>1)



Material and Setting

As in the pre-study, data of the main study were collected online via the Internet. Subjects were asked to search for information on a website (www.ibm.com) in three short scenario based tasks and afterwards were ought to fill out several questionnaires. The intention was to measure their attitude towards the overall usability of the website by filling out the Computer System Usability Questionnaire (CSUQ) and secondly to determine their subjective belief about effectiveness, their perception about efficiency and their attitude of satisfaction in using a website with the new developed Cross Cultural Usability Questionnaire (CCUQ). The later has been developed on the basis of the results of the pre study (for psychometric details see below). Additionally, their parameter values on the culturally specific variables were measured with the Values Survey Module (VSM), a questionnaire developed by Hofstede (1984). This last questionnaire includes demographic enquiries about gender, age, nationality and contact with other cultures. The US version of the IBM-website served as a model for an international used, information containing website. Participants were asked not to switch to the local IBM sites during tasks to ensure that all participants use and evaluate the same product.

The scenario based tasks

After two introductory pages, participants were lead to three tasks they should accomplish before answering the questionnaires, and that was searching for information on the IBM website. Three questions have been asked, based on the scenario of a web user searching for some special and detailed information about a company by exploring its website. The three questions were:

1. What is the research focus of IBM Research in Beijing, China?
2. What is the IBM learning village?
3. What is the IBM incubator series?

The idea was, that participants should go into a deeper level of the IBM US-website to get an impression of its overall usability. After each task, an answer frame appeared after 5 minutes at the latest to ensure a comparable depth of familiarity with the site.

Figure 5. Screenshot of the first task (question) main study

Figure 6. Screenshot of the first task (answer) main study, *accessed on May, 6th 2002*

By clicking on www.ibm.com, participants were lead to the US web-page of IBM corporation, which appeared in the lower frame, while the question in the upper frame was still visible. After five minutes or by clicking on the next button, an answer frame with a text entry area appeared and replaced the question.

The Questionnaires

The Cultural Values Questionnaire (Values Survey Module)

This questionnaire is used in this study to obtain reliable and valid information regarding the cross-cultural differences of the sample besides the current nationality of each participant. It has been developed by Geert Hofstede between 1968 and 1972 (Hofstede, 1980). During this time, Hofstede administered two rounds of an international survey at subsidiaries of IBM corporation in several countries. His database was extensive, covering IBM employees in 72 national subsidiaries, 38 occupations and 20 languages. The questions originally dealt with the employees' personal values related to their work situations and had been collected as part of a larger survey material on employee attitudes.

Hofstede's initial analysis of the IBM data was done on the 50 largest subsidiaries; 14 countries were grouped into 3 regions and eight of the subsidiaries had to few native employees to be included in the analysis. Therefore 53 cross-cultural units remained for data examination. The factor analysis of 32 values questions produced the dimensions power distance, individualism vs. collectivism, masculinity vs. feminity and uncertainty avoidance. These four dimensions explained 49% of the variance in data; according to Hofstede, the remaining 51% are due to country specific factors and cannot be associated with any worldwide factor. Later on, he found another cultural dimension in the data, which he called long- vs. short-term orientation. These five cultural dimensions have been validated against many conceptually related measures from other sources (Hofstede, 1980, pp. 326-331).

Although IBMers obviously do not form representative samples from national populations, Hofstede stresses that employees of multinational companies such as IBM form valuable sources of information for examining cross-cultural differences, because they form a very well matched sample and are very similar in respects other than nationality.

Several replications (e.g. Bosland, 1985b; Hofstede & Bond, 1984, 1988; Hoppe, 1990; Ng, 1982) showed some limitations of the VSM: For some populations (e.g. depending on education, age, type of work organization etc…), Items such as "… have an element of variety and adventure in the job…" mean something else than for IBM employees. Besides that, the absolute value of the national culture scores has no meaning itself. Scores obtained from surveys in only a few countries can not be compared with the scores Hofstede has published (except the sample is a match for the original IBM population, which is rather impossible). Therefore, the VSM is useful only for investigations with matched samples for all cultures of interest, showing sufficient similarities in all respects except nationality.

On the other hand, the VSM is based on an unusually extensive database. It has been replicated more than 30 times and Hofstedes cultural dimensions show sufficiently strong correlation with related cross-cultural measures. Additionally, the participants of my cross-cultural usability survey build such sufficient similar samples, because of the online setting and recruitment via HCI-related mailing lists and inside IBM corporation. Regarding this aspect and the psychometric quality of the VSM, this instrument is suitable for assessing cross cultural differences among the web users taking part in my study.

The Cross Cultural Usability Questionnaire

The probationary scales of the Cross-Cultural Usability Questionnaire (CCUQ) had been developed according to the research model and the ISO definition on usability to measure participants belief about the effectiveness of culturally adapted software, their perception about culturally adapted software efficiency and their attitude of satisfaction in using culturally adapted software. The single variables were measured on 5-point Likert scales (with the anker points 1=strongly disagree and 5=strongly agree), operationalized by 5 Items per variable. To design the Likert scales for the several variables, I generated an Item pool out of the answers to the questionnaires of the first part of this survey.

The idea was to use the main study of this survey as a pretest for the CCUQ and present the three probationary sub-scales to a representative cross-cultural sample via the internet. Afterwards, an Item analyses has been conducted. When showing adequate psychometric quality, the CCUQ can be used besides the CSUQ for the investigation of the survey's research model

Item Performance

Regarding Item means as an index for Item difficulty, all 18 Items show medium difficulty, varying from 2.96 (Item 12) to 3.57 (Item 18). Only Item 3 shows a lower mean (2.31). Since the standard deviation of single values around the mean for each Item is low, Item means are eligible as an equivalent for Item difficulty. Item variance is another valuable attribute for a scale Item. Here, for all Items, variances are rather small, which indicates a weak power to discriminate between inter individual differences on the other hand.

The mean of the interitem correlations indicates the homogeneity of a scale. Table 3 shows the values for each anticipated subscale. The subscale "satisfaction" shows the best homogeneity (.68), followed by subscale "overall usability" (.65), subscale "effectiveness" (.54) and subscale "efficiency" (.48). The latter value is even acceptable, while higher inter-item correlations indicate that all Items assess similar information, which positively affects scale reliability, but indicates on the other hand that not all Items are required.

The Item-scale correlation indicates the representation of the overall result of the test by each single Item. As shown in Table 16, Item 3 and Item 10 have unacceptable low values, while Item 16-18 are low, but acceptable.

Scale reliability

Coefficient alpha has been calculated for each subscale. The coefficient alphas range from .83 to .91, which is surprisingly high for scales containing only five Items. The alpha for the overall summative scale is .93.

Table 3 Item Analysis CCUQ

Subscale	Item	Item Ø	Item std.dev.	Item-scale correlation	Ø interitem correlations	Alpha
effectiveness					**.55**	**.86**
	1	3,04	1,03	.80		
	2	3,16	1,05	.83		
	3	2,31	0,94	-.15		
	4	3,14	1,02	.83		
	5	3,25	1,08	.85		
efficiency					**.48**	**.83**
	6	3,25	1,08	.80		
	7	3,21	1,08	.82		
	8	3,24	1,15	.70		
	9	3,32	1,02	.81		
	10	2,51	0,89	-.20		
satisfaction					**.68**	**.91**
	11	3,08	1,04	.71		

	12	2,96	0,99	.72		
	13	3,31	0,97	.78		
	14	3,25	1,00	.83		
	15	3,06	0,96	.79		
overall usability					**.66**	**.85**
	16	3,44	0,87	.46		
	17	3,51	0,89	.55		
	18	3,57	0,92	.39		

The psychometric evaluation of the CCUQ indicates, that Item difficulty is medium. Homogeneity for each anticipated subscale proved good values. Such high interitem correlations suggests, that some Items can be eliminated from the instrument. Regarding item-scale correlation, Items 3 and Item 10 have very low values, while Item 16-18 are low, but acceptable. Internal consistency of the whole scale is respectable. After having dropped Item 3 and Item 10, the overall scale reliability can be considered as excellent.

The Computer System Usability Questionnaire

The Computer System Usability Questionnaire (Lewis, 1995) is an instrument to measure user satisfaction with computer system usability in the context of scenario based usability studies. It is recommended to use this questionnaire in nonlaboratory settings and field research. It has been developed and evaluated by IBM Corporation.

The CSUQ is made up of four subscales: the overall satisfaction score (OVERALL: all 18 Items), the system usefulness score (SYSUSE: Items 1-8), the information quality score (INFOQUAL: Items 9-15) and the interface quality score (INTERQUAL: Items 16-18). Due to the anchors used in the 7-point scales, low scores are better than high scores. Regarding scale reliability, coefficient alpha exceeded .89 for all subscales in the evaluation study, indicating acceptable scale reliability.

In my study, I used a slightly modified version of the QSUQ. First, I only used the subscales for system usefulness (SYSUSE) and interface quality (INTERQUAL). The Items for the subscale information quality (INFOQUAL) are not applicable for remote usability evaluation and for measuring the satisfaction with the information quality of a website online. As reported in Lewis (1995), the type of computer system that participants used significantly affects their responses to the information quality subscale. In the setting at hand, this interrupting variable, (the type of computer system used), can not be controlled. Secondly, I reversed the polarity of the Likert scales in order to adapt it to the other questionnaires used in my survey. Therefore, regarding the results below, high scores are better than low scores. Correspondending to the administration and scoring rules, scores from the appropriate Items were averaged to obtain the scale and subscale sores.

Procedure

As in the explorative survey, I coded the introductory pages, the task pages and the questionnaires into HTML and loaded the files on the university server. Then, I posted an invitation letter (email, respectively) with the Link to the introducing page on several HCI-related mailing lists. Besides that, IBM HCI professionals of worldwide IBM locations and the participants of the explorative survey were invited to participate in the second part of the survey. To save data, I used the “CGI2SPSS – HTML form data converter” (Müller & Funke, 1998). This cgi-script has been developed to store online survey data directly on the server into an corresponding SPSS data file. Therefore, no transcriptions of data is necessary; after termination of the survey, the researcher has an analysis ready SPSS file at hand. The script is a shareware program for university research purposes and can be downloaded from:

http://www.uni-jena.de/svw/methaeval/Projekte/Evaluation/CGI2SPSS/ .

Data Analysis and Results

Descriptive Results

a.) Computer System Usability Questionnaire

The attitude towards the usability of the IBM website has been measured with the Computer System Usability Questionnaire and the subscales System Usefulness (SYSUSE) and Interface Quality (INTERQUAL), respectively. Table 4 show the descriptive results for the CSUQ.

Table 4: Mean and Standard Deviation for the CSUQ

	Total Score CSUQ	Score CSUQ SYSUSE	Score INTERQUAL
Valid N	145	145	142
MEAN	3,39	3,32	3,55
SD	1,18	1,31	1,11

In the overall analysis, the overall usability of the IBM website is considered as slightly above average, as well as the system usefulness and the interface quality.

b) Cross-Cultural Usability Questionnaire

The attitude towards the single usability components effectiveness, efficiency and satisfaction has been measured with the Cross-Cultural Usability Questionnaire and its subscales. Items 3 and 10, which demonstrated bad performance during Item analysis, have been excluded for data analysis. Table 5 show the descriptive results for the CCUQ.

Table 5: Mean and Standard Deviation for the CCUQ

	Total Score CCUQ	Score CCUQ effectiveness	Score CCUQ efficiency	Score CCUQ satisfaction
Valid N	135	135	135	135
MEAN	3,25	3,27	3,31	3,15
SD	0,80	0,85	0,82	0,88

In the overall analysis, the attitude towards the single usability components is slightly above average, which means that, over all, each components is considered to be as important as the others and none of the components is considered to be more essential for the overall usability of a software product.

Correlations

For calculating the correlation between the CSUQ and the VSM subscales, the Spearman Brown coefficient has been used, except for correlations of the CSUQ with Individualism/Collectivism, Uncertainty Avoidance and Masculinity/Feminity, respectively. Table 6 shows the results for the significant correlations of the latter, using the Pearson correlation coefficient.

Table 6: Significant correlation between CSUQ and VSM (Pearson Correlation)

	Total Score CSUQ	Score SYSUSE
Individualism/Collectivism	r = .187*	r = .193*

* $p < .05$

Unfortunately, no other significant correlations for other components of the research model could be found!

Distribution of Control Variables

To explore the distribution of the control variables age-group, gender, contact with other cultures and stay in other countries longer than one month across the nationalities of participants, I calculated crosstabs and computed a chi-square test to examine if the control variables are equally distributed between the national groups. This has been done in preparation of the next step in data analysis, namely analysing differences between national groups regarding the scores on the CSUQ and CCUQ. If the control variables are not equally distributed across the nationalities, they have to be included in the multivariate ANOVA as covariates. To examine these differences, the nationalities of participants have been sorted into several regional groups of approximately equal size.

To explore differences between national groups on the CCUQ and CSUQ scales, a multivariate ANOVA has been calculated. Dependent Variables were the subscales of the CSUQ (SYSUSE, INTERQUAL, OVERALL) and the subscales of the CCUQ (Effectiveness, efficiency, satisfaction, overall). According to the findings of the chi-square tests, the control variables "age-group" and "contact with other cultures" have been used as covariates.

Table 9 shows the results of the multivariate ANOVA on the CSUQ & CCUQ with the design age-group*contact with other cultures*national groups:

Table 9: Result of the multivariate tests

Effect	Test Statistic	Value	F	df	sig
National Group	Pillai's Trace	,437	1,796	32	0,006**
	Wilks' Lambda	,617	1,844	32	0,004**
	Hotelling's Trace	,536	1,883	32	0,003**
	Roy's Largest Root	0,308	4,505	8	0,000**

Source of Variance: National Groups
Test statistics of the multivariate ANOVA for the dependent variables SYSUSE, INTERQUAL, CCUQ efficiency, CCUQ effectiveness, CCUQ satisfaction and CCUQ overall with the covariates age-group and contact with other cultures.
** p < .01.

Overall, the results indicate highly significant differences between national groups on the CCUQ and CSUQ scales.

Regarding the between subject effects, the subscales CCUQ efficiency, CCUQ satisfaction and CCUQ overall (total score) are "responsible" for this effect. Table 10 shows the results for the tests of between subject effects for these subscales.

Table 10: Tests of between subject effects (CCUQ efficiency, CCUQ satisfaction, CCUQ overall)

Effect	Dependent Variable	Sum of Squares	df	Mean Square	F	sig
National Group	CCUQ efficiency	13,276	6	2,213	3,84	0,002**
	CCUQ satisfaction	10,816	6	1,803	2,48	0,027*
	CCUQ overall (total)	4,650	6	0,775	2,90	0,011*

Results of between subject effects of the multivariate ANOVA for the dependent variables CCUQ efficiency, CCUQ satisfaction and CCUQ overall with the covariates age-group and contact with other cultures.
* p < .05, ** p < .01.

To determine the indicated differences in detail, several U-Tests have been calculated to compare the national groups with one another. Germans/Austrians show significant differences with US-Americans/Canadians and Western Europeans on the CCUQ efficiency scale. Germans/Austrians and Australians/New Zealander even show highly significant differences. Australians/New Zealander and Others also show highly significant differences.

Table 11: Significant differences on the CCUQ subscale efficiency

National Groups	N	Mean Rank	Mann-Whitney U	Z	Asymp. Sig.
Germans/Austrians	31	41,08	431,5	- 2,071	0,038*
US-americans/Canadians	39	31,06			
Germans/Austrians	31	32,5	263,5	-2,075	0,040*
Western Europeans	25	23,54			
Germans/Austrians	31	30,16	119,0	-3,340	0,001**
Australians/New Zealander	18	16,11			
Australians/New Zealander	18	12,92	61,5	-3,04	0,002**
Others	17	23,38			

* p < .05, ** p < .01.

US-Americans/Canadians differ significant, Australians/New Zealander and Others differ even highly significant on the CCUQ subscale satisfaction.

Table 12: Significant differences on the CCUQ subscale satisfaction

National Groups	N	Mean Rank	Mann-Whitney U	Z	Asymp. Sig.
US-Americans/Canadians	39	25,41	211,0	-2,183	0,029*
Others	17	35,59			
Australians/New Zealander	18	13,32	70,5	-2,747	0,006**
Others	17	22,85			

* p < .05, ** p < .01.

Germans/Austrians and Australians/New Zealander show significant differences on the total score of the CCUQ. Australians/New Zealander and Others even show highly significant differences.

Table 13: Significant differences on the CCUQ total score

National Groups	N	Mean Rank	Mann-Whitney U	Z	Asymp. Sig.
Australians/New Zealander	18	19,03	171,5	-2,234	0,026*
Germans/Austrians	31	28,47			
Australians/New Zealander	18	13,69	75,5	-2,565	0,010*
Others	17	22,56			

* p < .05, ** p < .01.

Interpretation of Results

Overall, the results of the CCUQ and CSUQ scores indicate, that participants considered the overall usability of the inspected website as slightly above average. The fact that at least the CSUQ scores were normal distributed mirrors this tendency. Regarding the correlations according to the research model, only small correlations could be found. Only one cross cultural variable is significantly connected to the other components of the research model; namely Individualism/Collectivism. This variable is slightly correlated with the CSUQ total score and the CSUQ SYSUSE scale.

Separate from the VSM variables, at least differences between national groups can be assumed. The distribution of the control variables indicates differences according age groups and contact with other cultures across national groups. Therefore, these variables have been used as covariates when calculating the diversity of national groups on the CCUQ and CSUQ scores. Significant differences between national groups on the subscales CCUQ efficiency, CCUQ satisfaction and CCUQ total have been found. Regarding the CCUQ subscale efficiency, Germans score higher than US-Americans & Canadians, other Western Europeans, and Australians/New Zealanders, respectively. Additionally, Australians/New Zealanders score higher than others (Middle East & Asia, Middle & South America, South Africa). This means, that efficiency seams to be more important to Germans than to US-Americans, Canadians, Australians, New Zealanders and other Western Europeans.

Regarding the CCUQ subscale satisfaction, US-Americans & Canadians and Australians/New Zealander score higher than others. That means, that satisfaction seams to be more important to US-Americans, Canadians, New Zealanders and Australians than to others.

DISCUSSION

Pre-Study

The major objective of the pre study was generating a large item pool for scale development of the Cross-Cultural Usability Questionnaire, which should measure the attitude towards the single components of usability during the main survey. Additionally, the unexpected amount of provided answers to the open questions enabled qualitatively exploring the different definitions of usability, applied by members of different nationalities, by structuring the material using the grounded theory approach.

First, the associations of codes or quotations, respectively, about each usability component can be interpreted. Secondly, the number of quotations allows conclusions about the importance of each citation.

Key results have already been discussed in section 4.3., to prevent redundancy, I will focus on major similarities and differences between nationalities here. One expression, which appears over every nationality regarding *effectiveness* is the term “reaching goals”. Nevertheless, “reaching goals” is not considered to be the most important usability aspect by all nationalities. For Americans and Europeans it is much more important than for Australians and South Africans. “Completing tasks” has also been mentioned over all nationalities, in contradiction to “reaching goals” no differences concerning its importance could be found. “Navigation” is considered to be quite important to all nationalities and is linked to effectiveness as well as to efficiency. It even is very important to Germans, Australians, South Africans, Danish, Dutch and British experts. Only Americans consider navigation to be of average importance. Regarding efficiency, “minimal resources” is mentioned by members of all nationalities. It is important to Americans, Australians, South Africans, rather important to the British, and less important to Germans, Dutch and Danish participants. “Learnability” is associated with all three usability components by some nationalities. It is mentioned only by Americans, Germans and Australians. Satisfaction is mainly made up of two factors: Design or hedonistic quality and error-resistance. The latter is also central for efficiency. The overall importance of hedonistic quality seams to be less for Dutch and Danish, for all other nationalities it appears more or less frequently.

Overall, major differences can be found between Americans and Europeans on the one hand, and Australians and South Africans on the other hand. For the latter, navigation, minimal resources(which are mainly associated with efficiency), and hedonistic quality seem to be more important than reaching goals. In other words, Australians and South Africans focus more on efficiency and satisfaction than on effectiveness. For Americans and Europeans, reaching goals and completing tasks are most important. These two are clearly associated with effectiveness.

On the whole, main differences can not be found regarding the definitions of each usability component. The most interesting findings are related to the number of quotations as an indicator for the significance of each single statement. Most participants corresponded more or less with the ISO definition of usability. This is probably due to the sample, which mainly consisted of HCI experts, who are familiar with the ISO “Guidance on Usability”. Additionally, there might have been some self selecting tendencies. Since the ISO definition of usability has been presented at the beginning of the survey, it served as a kind of signpost for the whole survey. Maybe it hindered participants with different attitudes towards usability from taking part in the survey.

Nevertheless, the explorative survey allows interesting insights and assumptions, which can help interpreting the results of the main survey.

Main Study

In the overall analysis, the usability of the inspected IBM website has been considered slightly above average. This implies, that variances on the criterions are not biased by effects, which are due to the “stimulus” in the quasi-experimental setting of the main survey. More precisely, this is true for the evaluated concepts “system usefulness” and “interface quality”, which have been measured by the “Computer System Usability Questionnaire”. The results of the “Cross Cultural Usability Questionnaire” are comparable, which means that, overall, none of the single usability components is considered to be more essential. I have to admit, that the CCUQ has not been validated against any

external criterion; first, it is not definitely clear if the assumed constructs are really quantified, secondly the responses might have been influenced by the answers to the CSUQ. But, at least, the two questionnaires do not correlate significantly. One other problem of the CCUQ is the "don't know/neutral" category, which might be responsible for the average results here. The standard deviation for all subscales of the CCUQ is rather small, which point towards little variance in the answering to the CCUQ Items.

The latter fact might have also influenced the weak correlations of the single components of the research model. Both the CSUQ and the CCUQ produced little variance in the overall analysis, therefore there was little chance to find significant correlations between the latter and the VSM variables. Keeping that detail in mind, the finding of at least a weak, but significant, correlation between Individualism/Collectivism and two of the CSUQ subscales is even more remarkable.

The fact, that some differences between national groups and two CCUQ subscales have been found, indicates that differences between national groups can not be associated with differences between cultural groups. Overall, the results don't indicate that Hofstede's cultural variables are compellingly eligible to help designing culturally sensitive websites or other software.

Relation to Hypotheses

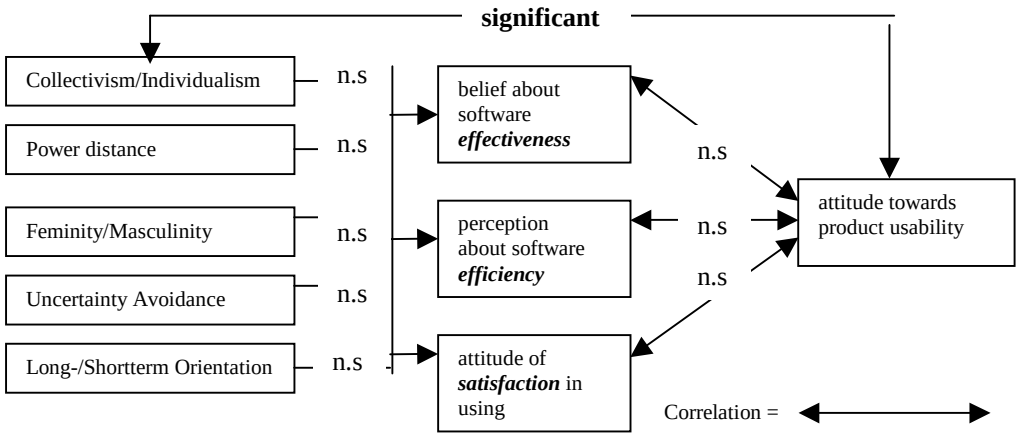
The aim of this study was to investigate, if culturally specific variables are directly linked to user's belief about software effectiveness, user's perception about software efficiency, user's attitude of satisfaction in using and the attitude towards the overall usability of a given software product. Therefore, a research model has been developed, and several research propositions have been derived from this model.

The research propositions were the following:

- Culturally specific variables influence user's belief about software effectiveness while using globally marketed software.
- Culturally specific variables influence user's perception about software efficiency while using globally marketed software.
- Culturally specific variables influence user's attitude of satisfaction in using while using globally marketed software.
- User's belief about software effectiveness, user's perception about software efficiency and user's attitude of satisfaction in using correlate with the attitude towards the overall usability of a globally marketed software product.

Regarding the correlation between the culturally specific variables and the components of usability, no statistical significant relations were found. In addition, no significant correlations between the attitude towards the usability components and the attitude towards the overall usability (here SYSUSE and INTERQUAL) could be found. Significant correlations were found between culturally specific variables and the attitude towards the overall usability of the evaluated product, namely between Individualism/Collectivism and the total score and the SYSUSE score of the CSUQ.

Figure 7. Results related to the research model



Besides the research propositions derived from the research model, the influence of the control variables has been investigated. Significant results have been found for the influence of national groups on the CCUQ scores. The differences in scoring on the CCUQ between national groups might be a sign of the general value of the research model used in this survey, even though the model couldn't be confirmed as proposed, especially regarding Hofstede's cultural specific variables.

Conclusion

In this section, I will resume some aspects of the discussion and want to try to give an outlook on possible further research questions.

As a result of the pre-study, differences in the definitions of usability between single nationalities occurred. The differences are more due to the number of statements than to essential differences in the understanding of the usability components effectiveness, efficiency and satisfaction in general. On the whole, the findings are a product of a structuring process of the material by the researcher. It follows an well accepted theoretical approach, nevertheless other researchers may find slightly different evidences. Therefore, the conclusions I have drawn had to be validated by the main study. However, by coming back to the findings of the explorative survey, valuable insights might be found during later research on topics on the subject of culture and usability.

Some of the findings suggested by the explorative survey could also be found in the results of the main study. Regarding the usability component satisfaction, Australians seem to focus on this aspect more than other nationalities. Regarding the usability component effectiveness and efficiency, the indications of the explorative survey couldn't be confirmed. This applies also to the research proposition, that differences between nationalities about usability are due to different cultural values. Overall, the research model could not be reinforced by the results of the main survey of the cross-cultural usability survey. But, some evidences could have been established, concerning single parts of the model and the derived research propositions, respectively. Individualism/Collectivism is connected to and has an effect on usability. But further research is needed to deepen the value of Hofstede's cultural specific variables to cross-national and cross-cultural design and evaluation of software and web applications. At least the results of this study could indicate some usefulness of linking together the construct culture and usability as suggested. One strength of this study was dispense the questionnaires to participants in their own cultural environment. This hasn't been done in comparable surveys yet, where participants took part in surveys outside their home country

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