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Modeling a User's Culture

Katharina Reinecke[*], Sonja Schenkel[+], Abraham Bernstein[*]
[*] *Department of Informatics, University of Zurich, Switzerland*
[+] *Graduate Institute of International and Development Studies, University of Geneva, Rue de Lausanne 132, 1211 Geneva, Switzerland*

ABSTRACT

Localizing user interfaces has been proven beneficial for both user satisfaction and work efficiency; however, current localization methods disregard the many facets in the cultural background of today's typical user by simply adapting to a certain country. The chapter proposes a new approach to localization by modeling the user's culture according to its understanding in cultural anthropology. Contrasting this view with cultural influences on user interface perception and preferences, we obtain an intersection of aspects that need to be included in a cultural user model, and deduce which user interface aspects have to be adaptable. With this, the chapter turns towards the application of our approach with the help of adaptive user interfaces, which allow the flexible composition of different user interface elements. We describe one possibility for implementing such culturally adaptive systems, and exemplify the design of different gradations of user interface aspects with the help of our MOCCA system.

INTRODUCTION

User interface designs are a matter of taste as preferences vary from person to person. Commonalities in these preferences, however, can be found deeply-rooted in culture (Dormann & Chisalita, 2002). In support of this, research has shown that people considered to belong to the same cultural group also perceive and process information in similar ways (Nisbett, 2003). This phenomenon can be observed, for instance, when comparing locally developed web sites in Asia with ones developed by European designers: While Asian web sites tend to offer colorful and often animated user interfaces, Europeans seem to prefer a more factual and structured information presentation. Thus, the design of user interfaces in different countries indicates that culture bundles a variety of these partialities, such as concerning the amount of colors, navigational support, or the information density, and that many preferences are collectively shared by certain cultural groups.

In response to these findings, many companies have started to adapt their user interfaces to foreign markets in order to gain customer loyalty and increase their market share (Sheppard & Scholtz, 1999). Most of these so-called localized user interfaces are able to adapt to different countries by modifying aspects such as language, colors, or more rarely the content arrangement. The conventional approach to localization, however, bears several problems: Firstly, many web sites require the user to select a certain country at first entry, thus reducing culture to national borders, and disregarding culturally ambiguous users. A Chinese user who has lived in the United States for half his life, for example, might select the USA from the list of countries, but could be better off with a website adapted to Chinese preferences, or a mixture of both. Secondly, other web sites retrieve the user's IP address, and thus her current whereabouts, but do not consider users currently residing in a foreign country. In this case, a German visiting the Google website in South Korea, for instance, would be redirected to the South Korean version of Google, although this is most likely not the intent.

Implying that culture is equal to a nation, and thus, linked to national territory, it seems as if we could generalize user interface preferences for people of the same nationality. Yet there are many counterarguments to reducing culture to country borders, ranging from the world's globalization that

results in the exchange of cultural values, to the artificial definition of country borders in the first place. Likewise, it is questionable whether differences in user interface preferences can be merely ascribed to the level of national culture, seeing that the equation country equals nation equals culture is of limited validity.

In order to overcome this problem we propose to equip computers and their user interfaces with a human-like cultural intelligence (Earley & Ang, 2003). Moving beyond the concept of national culture, we shift localization to another level: to that of the single user. If we are able to model each user's cultural background, we will be able to adapt user interfaces more precisely.

The precondition for this approach to cultural user modeling is, however, to know which cultural aspects influence which user interface preferences. In what we believe is one of the first collaborations between researchers in human-computer interaction and cultural anthropology we have developed a more confound interpretation of culture for the field of user interfaces. The chapter deals with the alignment of this interpretation with cultural differences in perception and preferences, and further lists those cultural variables that are relevant to our approach to cultural user modeling. With that, we will conclude on a set of cultural aspects that influence a user's interface preferences. We then turn towards the knowledge acquisition process for cultural user modeling, discussing possibilities to ask the user explicitly, infer information from his or her interaction with the computer, or combining both. The remainder of this chapter describes how this approach can be employed in practice: We list user interface aspects that need to be adaptable in order to cater for different cultural backgrounds, and demonstrate a possibility to develop flexible user interfaces that are able to incorporate such choices of different aspects.

BACKGROUND

Culture influences perception, and thus, the way we see and think of the world. This also counts for our perception of user interfaces, our preferences, and how we generally receive and process information (Ito & Nakakoji, 1996). It raises the question on what we need to know about culture in order to understand its influence on user perception and preferences. Is it enough to use culture as a synonym for the user's country? Or do we need a more profound definition of the user's cultural background?

In the following, we will first introduce the term culture as seen in anthropology in order to establish an idea of its intangible nature while still communicating a conceptual outline of the term. The subsequent section then contrasts this view with details on how culture has been incorporated in human-computer interaction.

An Anthropological View of Culture

One of the greatest obstacles to an approach to culturally adaptive user interfaces is the elusive nature of culture. In anthropology, culture has been described numerous times without substantiating an accepted definition, or generally assessing a common understanding of its concept. Already in 1952, Kroeber and Kluckhohn (1952) found over 164 varying definitions of the term culture, one of the earliest academically recognized one being by Sir Edward Tylor who defined culture as a "complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society" (Tylor, 1920). From today's point of view, Tylor's definition does not take into account the dynamic nature of culture, nor how the view on its concept has changed with new findings and the spirit of the age. Indeed, the only constant of culture is change. Culture can therefore never be fully confined to a definite number of factors.

Furthermore, any concept of culture is biased by a set of assumptions on society that may not apply everywhere. In its most general sense, culture can be loosely described as based on shared values. People acquire values early in life through childhood socialization and education (Karahanna,

Evaristo, & Srite, 2005), influenced by such aspects as the language, or religion. Hofstede's definition of culture as a "programming of the mind" (Hofstede, 1997) accurately expresses how culture forms these fundamental values and subconsciously controls our collective behavior. Thus, definitions of culture mainly base on the understanding that there are commonalities in people, which can help to distinguish certain "cultural groups", each characterized by their own concept of identity. Anthropology further differentiates between confined definitions of culture, which are linked to ethnic or cultural groups, and ones that entail subcultures, such as groups found in youth culture, or in a company's business culture.

Albeit the differences in these definitions, all of them describe culture as a complex concept without setting boundaries to its meaning. Cultural anthropologists have found it increasingly difficult to define the term both on a theoretical level as much as in its methodological applications. The discussion has even led some researchers to call for an abolition of the term (Abu-Lughod, 1991).
As a consequence, many anthropologists have turned towards understanding culture and how it is influenced by the dynamics of globalization. As technical innovations linked to mobility and telecommunications have led to international work co-operations, worldwide communication, and migration, these new dynamics have resulted in an interchange of people, ideas, and resources, affecting the one on the move as much as the one staying at home (Appadurai, 1996). The result are cultural groups that maintain their identities across nations and different territories – a phenomenon that is often described with "transnational public spheres", which are independent of spatial proximity (Gupta & Ferguson, 1997).

The "deterritorialization of culture" (Appadurai, 1996) has had the effect that not only cultural references have been dispersed but that its actual practice finds different expressions. Culture cannot be seen as a homogenous whole but is exposed to inconsistencies. This is also true when excluding the context of migration. In many large countries, such as the United States or Brazil, people refer to a national identity but at the same time practice various regional or local customs and values.

In this regard, a person can belong to more than one culture, although we have to distinguish between affiliations as they are communicated within a social environment, in contrast to the individual negotiating his or her conscious or unconscious cultural practice. An Indian software specialist residing in London, for instance, may claim affiliation to several cultural groups depending on his current environment, work place, home in London, or home back in India. His international background allows him to handle different cultural practices and behavior depending on the situation. Asked about his cultural roots, however, he might immediately respond that he is Indian (especially when this question occurs outside of India). If someone poses the same question in India, he might name his state or city of origin. Cultural affiliation becomes a matter of context. In the context of a communicated cultural affiliation, it reveals that people generally think of culture as linked to geographical location, and, thus, relate it to a certain territory. On the contrary, anthropology has found that people handle their cultural references in much more flexible and intermingled ways. People move within a culture or cultures. With that, they also apply related values or behaviors to a cluster of cultural practices.

As an additional point, anthropology views a person's culture as subject to change: People do not only acquire culture, but they are also part of its creation. In the context of globalization, change and exchange among different cultures are omnipresent. Analyzing the way people handle these exchanges and possible alterations of cultural identity, anthropologists have found that globalization does not transform different cultures into a homogeneous whole, and people do not automatically absorb new cultural influences (Sahlins, 2000). Instead, they either develop a certain resistance to external influences, or adapt these influences to their own cultural context, which sometimes even enhances the own cultural identity (Sahlins, 2000).

Contradicting ongoing discussions in cultural anthropology, however, the nation as a territorial concept remains today's most frequently used synonym for culture across various disciplines: The country of residence seems to persist as the most tangible factor that enables measurability between

different cultures. Based on this simplification, many researchers dealing with the operationalization of culture have attempted to find a set of tangible indicators of culture. One example is Hall (Hall & Hall, 1990) who described culture with the help of a number of values, such as Polychronic vs. Monochronic Time, meaning the ability to attend to multiple events simultaneously, or Context, which refers to the amount and specificity of information in a situation. In low context cultures, people expect each other to express information clearly, whereas people belonging to high context cultures usually put as much weight towards the context of a conversation, as to the communication itself (Hall & Hall, 1990).

Hofstede later described differences in national culture with the five cultural dimensions Individualism, Uncertainty Avoidance, Masculinity, Power Distance, and Long Term Orientation (Hofstede, 2003). His dimensions are an attempt to comprehend deeply anchored cultural values with the help of a tangible set of variables. Given the close association of nationality with the term culture, Hofstede's dimensions were often criticized for equating one country with one cultural background (see e.g. (McSweeney, 2002)). Nevertheless, or maybe because of this simplification, his dimensions have been widely used in various disciplines, such as to analyze cross-cultural communication between or within organizations, or to explain differences in learning style.

Partly building up on Hofstede's work, Trompenaar has coined the analogy of culture as an onion, which must be peeled to get to the core values (Trompenaars & Hampden-Turner, 1997). According to his understanding, the outer layer of an onion makes up people's first impression of another person. The middle layer concerns norms and values that control people's behavior. As the most intangible part of culture, the core of the onion describes basic assumptions that we automatically use for problem-solving. It is this inner part of the onion that is the key to understanding other cultures. In his work, Trompenaar describes seven cultural dimensions, which partly overlap with Hofstede's model, and partly add new concepts to a cultural classification (Trompenaars & Hampden-Turner, 1997).

Although various other anthropologists have attempted to narrow down the term culture, the classifications of Hall, Hofstede, and Trompenaar remain the most applied ones across different disciplines. While anthropologists mostly agree that none of these classifications can fully confine the complex nature of culture, these other fields of study often call for sets of cultural dimensions in order to pin down the influence of culture on various intercultural processes. We will describe this phenomenon in the next section, explaining the role of culture in human-computer interaction, and how cultural dimensions have been exploited in this field.

The Use of Culture in Information Technology

When considering effects of culture in human-computer interaction, it is crucial to understand the role of global software companies and their internationally expanding markets. Today, the world's largest software manufacturers, according to their sales revenues, come from the US (Software Top 100 Foundation). The number one and long-standing market leader Microsoft, for example, supplies a worldwide market with its operating systems and other software. The US also continues to lead the number of Internet users per country. The majority of users (81.7 %), however, come from countries other than the US (Computer Industry Almanac Inc., 2006). Reacting to the globalizing software market, companies have started to adapt their products to the local preferences of target countries. The localization usually involves adapting user interfaces to local languages, and taking account of different date and time formats. On top of this, many researchers have attended to more subtle variations in cultural preferences, such as to adapting colors and images for a better comprehensibility in a target country (Kondratova & Goldfarb, 2006). The software's functionality and flow, that is, the arrangement of elements, the level of guidance, and the general way of handling are mostly ignored (Kralisch, Eisend, & Berendt, 2005). This halfhearted adaptation becomes fatal if the user has a differing cultural background to that of the developers, who unconsciously integrate their cultural values into functionalities and aesthetics. In this case, the developers, who indirectly communicate with the users through different interfaces, are not able to respond to differences between their own and the users' cultural backgrounds. Contrasting the fragmentary localization, research conducted on

the usability of fully localized user interfaces has demonstrated notable improvements in work efficiency and user satisfaction (Ford & Gelderblom, 2003).

Two reasons are generally named for the lack of holistically localized user interfaces: Firstly, an adaptation to different target countries is time-consuming and expensive (Reinecke & Bernstein, 2007), and secondly, research has yet to determine which parts of an interface need to be adapted in order to take into account the elusive nature of different cultural backgrounds (Marcus, 2001a). Companies and researchers have therefore called for guidelines that map certain aspects of culture onto user interface adaptations. The main problem so far has not been the definition of adaptable user interface aspects, but finding a definition of culture that maps these aspects to cultural variables. Ignoring newly developed ideas of the term culture in anthropology, cultural usability research focused on applying the tangible definitions described in the previous section, such as Hall's cultural values, to user interface design. The effects of Hall's Monochronic Time on user interface design, for example, are a preference for linear navigation patterns, and for links emphasizing hierarchical structure (Kralisch, 2005). Polychronic cultures, in contrast, show non-linear navigation behaviour and tend to switch between several open pages (Kralisch, 2005). Although many researchers analyzed the relationship between Hall's cultural values and user interface preferences, navigation patterns, or existing user interface designs, Hofstede's dimensions have been employed many more times (cf. (Rogers & Tan, 2008)). One reason for this might be that his work produced five dimensions for 74 countries and regions each, enabling the comparison of concrete scores. Thus, analyzing the "cultural" differences between user interfaces from two countries can be simply made on the basis of number differences.

Evaluations applying Hofstede's dimensions indicate the significance of at least some of them to certain interface aspects (Ford & Gelderblom, 2003; Marcus, 2001b). His dimension of Uncertainty Avoidance, for example, relates to a person's tolerance for unstructured situations (Ford & Gelderblom, 2003). Thus, users from countries with a high Uncertainty Avoidance score usually prefer a linear navigation clearly indicating the current position (Baumgartner, 2003). Comparable mappings of dimensions to user interface aspects have been also made for the other four cultural dimensions (Marcus & Gould, 2000), laying the basis for first localization guidelines.

Research on cultural usability can, however, not presume that generic models of culture are universally valid. Smith and Chang (2003), for example, raised concerns over the significance of Hofstede's dimensions, which were originally developed for intercultural business communication, for the field of user interfaces. Generally, the applicability of Hofstede's dimensions seems to bring forward many discussions, which are often related to the process of localization itself: Is it enough to adapt user interfaces to a certain country and thereby rigorously restrict culture to a uniformity within country borders? According to the many discussions in anthropology, we can answer this question in the negative. Nonetheless, inconsistent results might be also due to the indefinable transition of cultural preferences to personal likes: In all cases above, culture is understood at a macro level, neglecting the individual, but focusing on nations and universal values (Rogers & Tan, 2008).

Our proposition to cultural user modeling could master these problems, if a user's cultural background included influences on culture beyond conventional approaches to localization. In the following, we will analyze such influences on user interface preferences.

CULTURE AND ITS EFFECTS ON USER INTERFACE PREFERENCES

The previous section has listed numerous perspectives on culture, yet their application to the field of human-computer interaction has raised the question what we need to know about a user's culture in order to localize user interface to cultural preferences. Answering this question once again poses the difficulty that culture is not a homogeneous construct.

First of all, cultural preferences are certainly biased by personal preferences, blurring the borderline between personality and culture, and culture and human nature (Hofstede, 1997). But does this mean that we cannot model the users' cultural backgrounds excluding their personal preferences?
Second, culture is a dynamic construct. As discussed in the previous section, cultures influence each other, and people can also adapt to other cultures to a certain extent. The dominance of US software manufacturers and English web sites, for example, might influence users worldwide in that they adopt Western values (Nunberg, 2002). If this is the case, how much of a user interface do we have to adapt, and where can we expect users to adapt themselves without impairing usability?
Third, people do not necessarily belong to just one culture, but can be part of several different (forms of) culture. Thus, a user might belong to a certain national culture, but could differ from his neighbor by incorporating another business culture. Do all of the different forms of culture influence user interface preferences and perception?

Again, the overall matter in question is what culture can tell us about the user's perception. Imagine a typical scenario in interpersonal communication, where two persons from a different cultural background meet. Both of them will subconsciously observe each other's behavior, such as movements, habits, wording, or looks. In our mind, this information automatically forms an impression, which usually results in a stereotypical view of the other person. Such "container thinking", however, enables us to form cultural patterns, to which we respond by adjusting our behavior. Thus, the process of interpersonal communication converts various information to internal adaptation rules – a procedure that we could adopt for an approach to cultural user modeling. *Could* - if we knew which information it is that we actually collect in our mind, and if we knew how humans respond to single variables contained in the overall information about other people.

In interpersonal communication, the ability to observe and adapt to other cultures is often measured in cultural intelligence (Earley & Ang, 2003). Cultural intelligence for computers and their user interfaces requires knowing the user's culture, and knowing how this information can be turned into adaptation rules in order to trigger culturally personalized user interfaces. The computer can acquire knowledge about the user's cultural background in different ways: (1) implicitly by observing the user's behavior, or (2) explicitly by directly asking him about his cultural background, or about certain preferences. Both of these knowledge acquisition processes are also possible for interpersonal communication. The difference, however, is that the computer has to be told how to compose this information and how to transform it into adaptation rules.

In order to establish this connection between information about the user's cultural background and the adaptation rules, we have investigated the most common variables that ethnologists regard as part of culture and extracted those ones known to influence perception. Note that cultural background can be influenced by variables that do not constitute culture, but further refine cultural groups, or connect people of different cultural backgrounds and regions (such as the Portuguese language, which is spoken in Brazil, Portugal, and many other countries). Some other aspects are not directly cultural factors, but stand for affiliated cultural norms. Gender and age, for example, do not represent culture, but are often seen as connecting variables across various cultures. They can determine the affiliation to an additional cultural group, or specify a person's culture with their underlying norms, which in turn affects user interface preferences and perception. In the following, we will list these influencing aspects of culture and detail on their effects on human-computer interaction.

Nationality

The use of nationality as a synonym for culture implicates two different meanings: Nationality describes the affiliation of a person to a certain nation, or it characterizes people with comprehensive traits, such as language, traditions, or customs. Hence, nationality could be equated with a certain country and its territory, but it can also refer to a person's ethnicity. Migrants, for example, can be affiliated with a certain country by citizenship, although their identity might be linked to a different country and/or ethnicity. Thus, on the one hand, equalizing nationality with culture reduces culture to country borders, but on the other hand, the use of culture in this setting expresses possible affiliations to an ethnic group within or in more than one country. The ambiguous meaning of this equation

reflects the "space and place" discussion (Gupta & Ferguson, 1997) in cultural anthropology: While place refers to where a person is situated (meaning the nationality as a territorial concept), space describes the mental affiliation, which could differ from the country and/or nationality that the person's current whereabouts describe.

Consequently, characterizing a cultural background by nationality requires knowing a person's cultural identity across nations and territorial concepts. While we will not be able to cover the user's space, and thus, the mental affiliation, in all details, different territorial influences on the users' culture, such as information about a person's current, but also former residences, could be a more definite hint on their preferences than conventional localization was able to provide. In order to reveal these differences between single countries, researchers have often used Hofstede's cultural classification, because, as previously mentioned, its five dimensions per country facilitate the comparison of cultural differences between countries. In several studies, all of Hofstede's dimensions have been related to certain preferences, revealing that his generalizing dimensions might not be applicable for all people in one country, but can still be used as a predictive means.
The majority of surveys have compared countries with a high score in a specific dimension, with countries that have been assigned a low score in the same dimension. According to this, we have compiled a list of adaptation rules for users with a high and a low score, which summarize the findings for Hofstede's dimensions by (Callahan, 2004; Callahan, 2005; Corbitt & Thanasankit, 2002; Dormann & Chisalita, 2002; Ford & Gelderblom, 2003; Gould, Zakaria, & Yusof, 2000; Hodemacher, Jarman, & Mandl, 2005; Hofstede, 1986; Hofstede, 2003; Kamentz & Schudnagis, 2002; Kamentz & Womser-Hacker, 2003; Kamentz & Mandl, 2003; Kralisch, et al., 2005; Marcus & Baumgartner, 2004; Marcus, 2001a; Marcus & Gould, 2000; Sheppard & Scholtz, 1999; Sturm, 2005) . Table 1 shows the most important rules gained from this literature review as applicable for different cultural preferences in user interface design.

Table 1: Adaptation rules as derived from related work on the effect of Hofstede's dimensions on user interface design

Hofstede's Dimensions	Adaptation Rules	
	Low	High
Power Distance	Non-linear navigation preferred	Users expect to get instructions, high level of support and many navigational cues
	High information density, most information at first sight	Low information density
	Less structured data	Strong hierarchy in the information presentation
	Many options of functionalities	Reduce choice of functionalities
Individualism	Use traditional colors	Color-code objects that belong to each other
	Multimodal interfaces possible	High text to image ratio
	Colorful interfaces preferred	Use monotonous colors
	Colors do not necessarily have to structure the interface	Use contrasting colors to distinguish between different interface areas
Masculinity	Non-linear navigation preferred	Navigation oriented towards exploration and control
	Design for aesthetics	Explanatory images (rather than just attractive)
	Less saturated and contrasting colors	Complementary colors (e.g. to structure the user interface)
Uncertainty Avoidance	Complex user interfaces	Focus on simplicity
	Non-linear navigation, leave room for	Provide linear navigation paths

	exploration	
	Maximal content and choices in functionality (code colors to maximize information)	Spatial organization of the screen can be complex, but has to be clearly arranged (e.g. use redundant color cues)
Long Term Orientation	Low information density	High information density, most information at first sight, menus should have only few levels
	Strong hierarchy in the information presentation	Less structured data

Unlike Hofstede, Hall never assumed such a strong connection of culture to nationality. Lacking tangible scores, his cultural values have been mainly employed for describing user interface differences, rather than for predicting preferences. The preference of polychronic cultures for non-linear navigations, for example, can be roughly generalized for users living in Asia and Africa, but Hall never defined a list of countries that can be assigned to the one or the other. This might be one reason why applying Hofstede's dimensions has been the basis of much more research than Hall's dimensions.

With the information about a user's nationality as a combination of space and place we have localized the users' cultural background based on their affiliation to certain countries. The following variables provide further information, refining users' mental affiliations, and describing additional influences on their thinking and behavior.

Language

Language is known to shape a person's thinking (Nisbett & Masuda, 2003). Languages are not culture-specific, and can certainly not serve as a synonym for culture (Rhoads, 2008). Quite the contrary, one cultural group can inherent different languages, such as in multilingual Switzerland. Switzerland, however, is also an example of how different language groups form sub-cultures of their own, suggesting that culture is less dependent on country borders than on language.

Languages differ in the way they combine words, and their words differ in the way they are formed. It suggests itself that language plays an immense role in the cultural adaptation of content; but does it also influence the perception of different arrangements of user interface elements?

One of the key distinctions between languages is the writing system orientation, which has evolved differently for many languages of this world. Some languages are generally written and read from left to right, some others from right to left, and some from top to bottom starting on the right. In each case, the writing system influences the spatial routines literate humans apply, which impacts expectations about the visual attention (Chan & Bergen, 2005). The writing system orientation a user is familiar with does not only require to be implemented for textual parts of a user interface, but has to be also applied to the layout of user interface constituents. Röse (2005), for example, found out that the writing system orientation influences the centre of attention on a screen. Thus, if a system wants to draw the user's attention to a certain part of the user interface (e.g. such as the case for error messages), the placement has to consider the user's writing system orientation. These results were supported by Chan and Bergen (2005) who demonstrated that the first visual attention is placed at the start location of the person's writing system orientation.

In addition, language has been found to influence the perception of focal and background elements (Nisbett, 2003). Western languages, for example, seem to "force a preoccupation with focal objects as opposed to context" (Nisbett, 2003). Hence, languages do impact the way people observe the world (and thus, parts of it such as a user interface). As Nisbett (2003) points out, however, the tendency to perceive things as given by Western or Eastern languages also depends on how the brain has been

trained to think in other languages. Asking participants from China and the US to group a number of words, they received different classifications for Chinese participants tested in their native language, and Chinese participants tested in English. In the latter case, participants seemed to adopt the Western way of thinking merely due to using another language. In further studies with two groups of bilinguals who had either learned a second language early or later in life, Nisbett (2003) found that Chinese who learned a Western language early in life also shifted towards Western thinking. Considering these findings, it is advisable to incorporate knowledge about a user's first language, but also about his or her second language as well as how early this language has been learned.

Religion

Religious affiliation in user interface design is often expressed with symbols or colors. Analyzing this, Siala et. al (2004) have conducted a study on the influence on religious affiliations on consumer trust in e-commerce. Muslim participants tended to prefer online shops that provided cues of the same religion, and also stated that religion highly affected their general purchasing decisions. This was not the case for Christian participants, who preferred the neutral online bookshop www.bol.com. Their study suggests that religion can result in a more positive attitude towards web sites showing the same religious affiliation; however, they also found that this finding depends on the religious commitment (Siala, et al., 2004). Their findings imply that a culturally intelligent system should inquire about the user's religion, but also about the religious commitment. Adaptation rules could then relate religious meanings to color preferences, offering versions of user interfaces that feature those colors associated with a positive meaning.

Education

Cultural differences emerge from varying education levels, but also from the form of education someone is most used to. Students who have mainly received teacher-centered instruction, as opposed to participatory learning, such as with group work, are thought to also appreciate detailed instructions later in life (Reinecke, 2005). Additionally, they are more prone to the "lost-in-hyperspace" feeling often felt navigating in non-linear hypertext structures. Thus, a dominance of teacher-centered instruction at school seems to result in a preference for linearly composed web sites, a higher level of support, and more instructions on subsequent options (Reinecke, 2005). In contrast, students who are used to participatory learning, e.g. where they are able to propose own thoughts in discussions, are more likely to appreciate the freedom of a non-linear navigation, and prefer exploring information themselves.

As opposed to the form of education, the education level mainly influences the intensity of cultural characteristics in a person. It is assumed that people who have rarely been exposed to other cultures have stronger cultural traits than culturally ambiguous people, that is, people who have interacted with other cultures or experienced them in another way. People become more aware of differences between cultures if they visit other countries, mix with friends of various cultural backgrounds, or have parents of another nationality. In this regard, the level of education can be a good predictor of the amount of international travel; the higher the education level, the higher the amount of times someone has been abroad (Siaya, 2005).

As previously described, anthropologists note another important aspect of cultural influence: different forms of media such as the TV and the Internet that play an enormous role in cultural exchange today. If a higher education level usually results in more exposure to other cultures, we could also assume that those people with a high education level are also more open to adopt foreign cultural traits. Although more research is needed on the effects of UI acceptance, we can roughly assume that the higher the education level, the less users are impaired by non-localized web sites.

Furthermore, the education level is often strongly related to computer literacy. In fact, education also amounts to the rule: the higher educated a person is, the more he or she uses the computer (Microsoft, 2004). If high computer literacy results in less need for navigational cues and support, a higher education level could indicate this too. Keeping in mind the difficulty of acquiring information about users without requiring them to fill in long questionnaires, we therefore suggest to include one

or the other in the acquisition process. The missing information in the user model can later be filled in by inference.

Political Norms and Social Structure

While the political orientation is understood to be part of culture (Hofstede, 2003), its influence on user interface design has mostly been indirectly investigated with the help of Hofstede's dimension Individualism versus Collectivism. In related work, communism has been mostly regarded as a form of collectivism, and thus, collectivistic traits have been assigned to communist states such as the People's Republic of China, Republic of Cuba, or Democratic People's Republic of Korea (North Korea). In contrast, the division between "Eastern cultures" and "Western cultures" is often used to refer to Asia and Europe (sometimes with the addition of North America and Oceania). Instead of distinguishing between political systems, this division arose from religious affiliations, assigning "Western cultures" to Christianity, and "Eastern cultures" to Eastern religions, such as Buddhism, Hinduism, or Confucianism (Ankerl, 2000). It is therefore difficult to determine whether differences found in perception between Western and Eastern cultures, or collectivistic and individualistic societies are a result of religion, politics (e.g. through politically intended educational concepts), or both.

However, differences in perception between those two coarse classifications were indeed found in that people belonging to Eastern cultures paid more attention towards interdependent relationships among items shown to them, while Westerners seemed to focus on individual objects (Nisbett, 2003). Similarly, Westerners were found to categorize objects much more than East Asians, who preferred non-hierarchical structures between objects referring to them in their broad context (Nisbett & Masuda, 2003). As a result, they also seemed to have "greater trouble separating an object from its context" (Nisbett, 2003).

With regards to the arrangement of user interface elements, these last results are also reflected in differences in web site design between Eastern and Western cultures. Chinese web sites are often more complex, featuring various independent spaces of content. In contrast, Western web sites are mostly organized around one main content area as a focus point, with additional images illustrating the content (Schmid-Isler, 2000). These differences also mirror further preferences: While people belonging to Eastern cultures often opt for user interfaces with high information density, where they can browse through the information, many Westerners prefer less, but strongly structured information at once. In accordance with this, Nisbett (2003) notes that "the feeling in control is not as important for Asians as it is for Westerners".

Such results have been also shown to relate to Hofstede's dimensions Uncertainty Avoidance and Power Distance (e.g. (Baumgartner, 2003)) and can, therefore, not simply be explained with the dimension Individualism. However, Asia has received mostly low to medium scores in the dimension Individualism as measured by the world average scores (Hofstede, 1997). Europe, North America, and Oceania, in contrast, mostly obtained a high score in Individualism. While this distribution indicates the possibility to predict aforementioned preferences in information density and control with Individualism only, we suggest using this dimension as an initial predictor of user interface preferences. The information about the user's political orientation and habitual social structure could then be used to refine adaptations of the user interface. Further research is needed to reassess the exact effect of this information on user interface preferences.

Age

As described above, age cannot be seen as a part of culture, but it can certainly connect people of different cultural groups. An elderly person in Japan, for instance, could feel much more understood by elderly people in the US, simply because in some respect cultural differences are less important and outweighed by age similarities. Although we cannot make generalizations on this, studies on differences in perception between younger and elderly people did demonstrate that these groups could have their very own partialities in handling computers (Shneiderman, 1986).

Thus, while we cannot assume that age superposes cultural difference, it does seem like an important indicator for user interface preferences and needs. Sjolinder (1998), for example, provided a detailed review on individual differences in spatial cognition and way finding. Age differences were found in spatial memory, with older adults tending to have a less holistic view of their environment. Older users might therefore need "explicit verbal instructions to focus attention on the path or route" (Sjoelinder, 1998). Similar recommendations have been made by Shneiderman (1986), who encouraged software designers to increase online help and clear navigation mechanisms for elderly users.

In the Western world, age can be also used as a predictive variable of computer literacy: Computer usage is highest around 30 years of age, and steadily decreases with an older age (Microsoft, 2004). Inferring computer literacy from the user's age could therefore be used to initially predict user interface preferences, such as the need for more support. With different levels of computer usage in different occupational groups, however, this assumption could be strongly biased. We therefore recommend to hedge against false assumptions about users by providing the possibility to judge their computer literacy themselves.

Gender

As with age differences, gender does not represent culture, nor does it influence it, but it can create similarities across cultures. Cultural differences, however, are usually more important than gender differences (Nisbett, 2003). As an example for this, consider the interpretation of color: While females in the Western world often prefer lighter, less contrasting colors, males tend to like strong colors better. Nevertheless, the use of colors should always correspond to their interpretation in a certain culture, because their attributed meaning varies heavily across cultures (Thorell & Smith, 1990). As a first measurement, user interface designers should therefore adhere to partialities of target cultures, before addressing gender-related preferences. For this reason, we have discarded gender as a predictive variable from our cultural user model. More research is needed, however, to compare the preference prediction with and without this variable.

CULTURAL USER MODELING

The two previous sections described the viewpoint of cultural anthropologists on the term culture, and investigated the influence of cultural variables on user interface perception and preferences. The outcome is *an intersection of cultural variables and aspects that impact preferences*, and thus, human-computer interaction. This intersection neither describes the semantic boundaries of culture, nor does it qualify to be a comprehensive set of influences on user preferences. In particular, we will not be able to draw a line between cultural and personal preferences; and consequently, we will also not be able to predict user interface preferences with 100 % certainty. What we will be able to do is to move away from the stereotypical approach of providing one interface per country. Thus, we extend conventional localization (which usually equates with national culture) with the following aspects that model the user's cultural background for our purposes:

- Country of current residence
- Former residence(s)
- Nationality
- Nationality of both parents
- Mother tongue
- Second language
- Main reading/writing direction
- Age
- Education level
- Most familiar form of instruction in education
- Computer literacy
- Political orientation/social structure
- Religion

Comprised in a cultural user model, this list of aspects could reference many user preferences – provided that we know the details on all aspects about every user. The next section therefore elaborates on the problem of acquiring this information about the user in order to feed the user model.

Acquiring Information about the User's Cultural Background

User modeling postulates knowledge acquisition in both static and dynamic ways. Static knowledge acquisition usually stands for information that is explicitly provided by the user, e.g. in an initial registration process. Mostly, this information does not change over time. In contrast, dynamic knowledge acquisition describes the process of learning while a user interacts with the system; it is this dynamic part of user modeling that accounts for the system's intelligence.

Naturally, information provided by the user in a static knowledge acquisition process is most accurate. There is, however, one major reason why static knowledge acquisition has only limited capabilities: Users generally avoid filling in long questionnaires, and could even restrain from registering. While we could argue that a one-time registration process should be bearable, the benefits of personalized user interfaces are simply unknown to most users. On the one hand, it is therefore crucial to limit the registration process to a minimum. On the other hand, insufficient information about a user risks that the personalized user interface does not adequately cater for the user's preferences, in which case the user might also refrain from using it.

We suggest to balance this conflict by limiting the registration process to three questions about the user's current residence, former residences, and the respective durations he or she has lived in those countries. Hofstede's dimensions can then serve as a predictive measurement of the user's national culture, but it can also cater for some parts of anthropology's "place and space" discussion (Gupta & Ferguson, 1997) if we calculate the percentage influence of each residence by its duration (Reinecke & Bernstein, 2009). This approach assumes that the sum of all durations roughly equates to the user's age. If a Chinese user, for example, has lived in Sweden for 18 years, and in China for 24, we can calculate the influence of Sweden and China according to these durations, and assume his or her age to be 42. Thus, from these three questions, we acquire information about the person's nationality, exposure to other countries and cultures, and age. Inferences (though rather vague) can be additionally made on the user's computer literacy.

Referring to our variables that define the user's cultural background, this approach covers the current and former residences, age, and vaguely the computer literacy. Because Hofstede's dimension Individualism is automatically included in this approach, we could even compensate information about the user's political orientation and social structure. However, in order to approximate the view of culture in anthropology, we need additional information about the parents' nationality, which can have a strong influence on the person's "nationality of mind", especially if different from someone's own nationality. Additionally, the compilation of culture-related influences on user interface perception has shown that we need further knowledge about the user's language(s), reading direction, education level, and religion.

One method for refining the cultural user model is another form of static knowledge acquisition, where the user can manually correct adaptations, or enter more information about his or her cultural background in a user model editor. Both would trigger new adaptations of the user interface. Another option is the dynamic knowledge acquisition, which observes the user's behavior and infers mistakes and/or improvement possibilities. For example, if a user moves the mouse pointer for a certain time without clicking, this could indicate that he or she is looking for something, and hence, needs more support. Thus, such adaptation rules link certain user interaction patterns to suitable user interface adaptations. So far, work on inferring user interface adaptations from mouse movements or other user input has classified users into novice or expert (Hurst, et al., 2007), or catered for people with different motor impairments (Gajos, Wobbrock, & Weld, 2008). Inferences on cultural user interface preferences have not yet been made. However, this inference part of the user modeling process does not include static knowledge acquisition, and is therefore independent of previous information

contained in the user model, in our case of culture. We propose to observe the user in order to derive information on improvement possibilities of the initial adaptation; thus, further inferences from user interaction are not necessarily restricted to the user's cultural background, but should include an upper level of observation: "Is the user able to cope with the adaptations? Are there behavioral restraints that might point to a need for correcting those initial adaptations?" Hence, this user interaction tracking could substitute some information in the cultural user model. As shown in (Kralisch, et al., 2005), it is likely that we can derive certain cultural patterns in the user's navigation behavior, but such observations do not necessarily point towards preferences.

We therefore suggest to combine both approaches to add information to the knowledge derived from the first questionnaire. In the following, we will take up the cultural aspects influencing user preferences from the previous section again, and discuss ways user interfaces can adapt to this information acquired in the user modeling process.

Cultural User Modeling in Action: Adaptive User Interfaces

According to the previous list of cultural influences and their effects on user interface preferences, we have compiled a list of interface aspects that correspond to particular features of a user's cultural background. These interface aspects, listed in Table 2, define the required flexibility of a culturally adaptive user interface. As previously suggested, country and nationality have been combined and both related to the effects of Hofstede's dimensions on user interfaces. Table 2 shows that the user's country and nationality also reveal most information on possible adaptations of the user interface. Further knowledge about language, age, education, computer literacy, and political orientation/social structure might provide the means to refine or verify this information, but these influences do not necessarily add new knowledge about possible user interface adaptations. However, additional information about user interface preferences could be gained by knowing the user's reading direction, and his or her religion.

The finding nicely coincides with our suggestion to limit the initial acquisition process to only few questions: Disregarding the alignment of user interface elements, as well as certain aspects of religion, the information about influencing countries could result in a suitable first adaptation of the user interface. In other words, we suggest acquiring the user's current and former residences, in order to calculate their influences on the user's (national) culture with the help of Hofstede's dimensions. Additionally, the parent's nationality could provide information about additional influences.

Table 2: Requirements for adaptable interface aspects according to different aspects in the cultural user model

User Model Aspect:	User Interface Adaptations:
Country & Nationality (according to the effects of Hofstede's dimensions on user interfaces)	Variable complexity/information density
	Different levels of hierarchy in the information presentation
	Variable complexity/information density
	Non-linear navigation versus linear navigation with instructions
	Objects in focus, versus objects embedded in context
	Different levels of content structuring
	Different color schemes: colorfulness, brightness & contrast
	Different levels of support
	Variable amounts of navigational cues
	Amount of images
	Representative versus explanatory images
Language	Objects in focus, versus objects embedded in context
Reading/writing direction	Left-to-right alignment, right-to-left alignment, or right-to-left-top-to-bottom alignment of all interface elements
	Right or left alignment of all elements that require full attention

Age	Objects in focus, versus objects embedded in context
	Different levels of support
	Non-linear navigation versus linear navigation with instructions
Education level	Different levels of support
	Variable amounts of navigational cues
Instruction form in education	Non-linear navigation versus linear navigation with instructions
	Different levels of support
Computer literacy	Different levels of support
	Variable amounts of navigational cues
Political Orientation/Social structure	Objects in focus, versus objects embedded in context
	Different levels of hierarchy in the information presentation
	Variable complexity/information density
	Amount of images
	Representative versus explanatory images
	Non-linear navigation versus linear navigation with instructions
Religion	Different amounts of religious symbols, replaceable for each religion
	Different color schemes: colorfulness, brightness & contrast

After explicitly acquiring this information from the user, the system can trigger initial adaptations of the user interface. In contrast to usual localized applications, however, computers and their user interfaces have to be capable of adapting to more than language, date and time formats, and thus, culturally adaptive user interfaces have to be extremely flexible in the composition of different user interface elements. Previous research on adaptive systems has mostly concentrated on adapting to different learner types (Hurst, et al., 2007; Kamentz & Womser-Hacker, 2003), or to special needs of people with disabilities (Gajos, et al., 2008; Stephanidis, et al., 1998). These systems concentrate on adapting their content to the learning progress, offer different levels of support, increase the size of buttons, or move interaction elements closer to each other, to name a few. Interfaces that adapt to cultural preferences can certainly adopt some of these adaptations; however, they still require to be more flexible in their arrangement of user interface elements, for example with regards to preferences that might not solely improve the work efficiency but rather support aesthetical preferences, such as by adapting to different color schemes.

One example of such a culturally adaptive system is our MOCCA prototype (Reinecke & Bernstein, 2009). MOCCA (see Figure 1, 2, and 3 for different versions of its user interface) is a web-based to-do list tool, similar to the online service remember-the-milk[1]. For each aspect listed in Table 2, the application offers three different increments, which we call *choices*. All aspects and their choices are defined in an *adaptation ontology* that is connected to the system. Hence, the system offers three degrees of information density, three levels of support, etc. The on-site help, for instance, is subdivided into a low level of support (Figure 1), a more comprehensive medium help, or an extensive help function in form of a wizard, as shown in Figure 2 and 3.

In the adaptation ontology, all adaptable interface aspects are assigned to specific elements of the user interface that they have an effect on: The upper level is partitioned into the layout elements header, footer, and content area, the latter being further divided into navigation and work area. With the help of this structuring, the adaptation ontology clearly specifies which parts change if a certain user interface aspect has to be adapted to another option. It is therefore defined that changing to another color scheme, for instance, affects footer, header, and content area, whereas changes in the amount of support only relate to the content area.

[1] http://www.rememberthemilk.com

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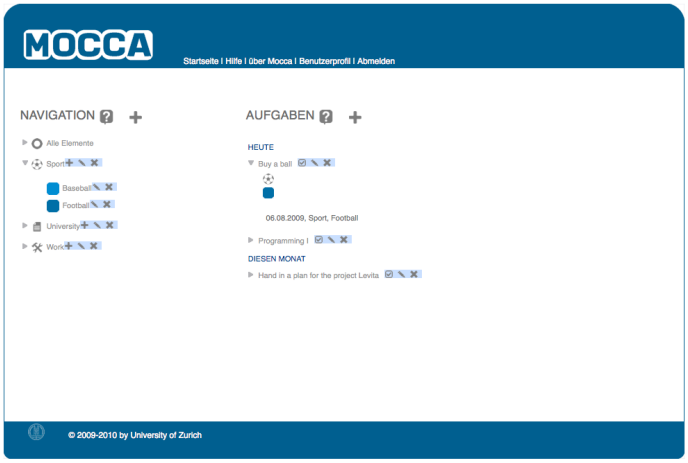

Figure 1. The culturally adaptive application MOCCA with a low level of support and low content structuring.

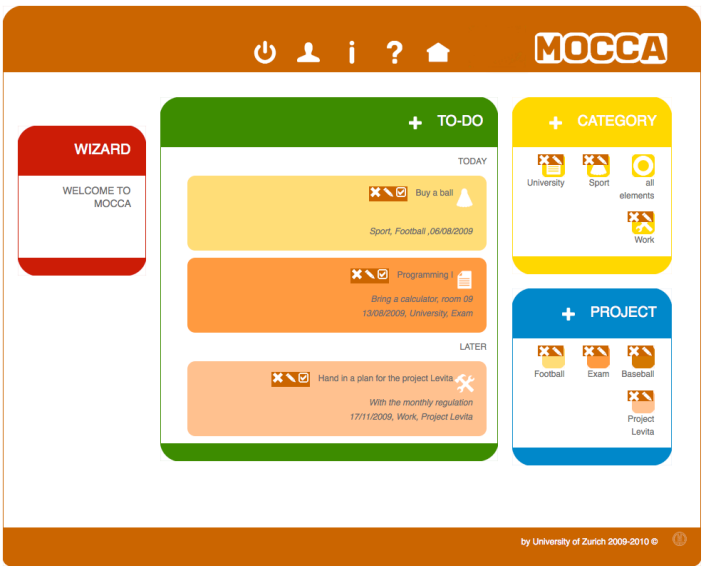

Figure 2. MOCCA’s user interface with right-alignment, a high level of support, and many colors.

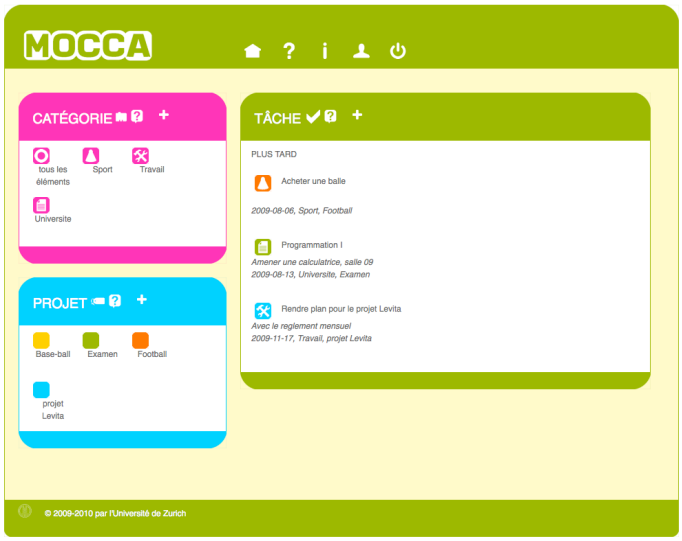

Figure 3. MOCCA’s user interface with medium content structuring and bright colors.

All layout elements are described with their dependencies among each other (e.g. header icons can be only placed if a header has been placed already), as well as their possible positions. The maximum and minimum needed size of the specific interface element is further defined as part of the space within the possible positions. Depending on the alignment and the amount of interface elements that have to be presented at the same time, this placement information helps to calculate the best possible arrangement of interface elements.

As a precondition for triggering adaptations, we have to relate one of three choices per interface aspect to the user. The adaptation ontology is therefore also connected to the cultural user model ontology, from which the application retrieves the user's cultural dimensions. According to the adaptation ontology, each interface aspect is directed at one cultural dimension. Furthermore, the range of scores at which the respective choice applies is defined. If the user's cultural dimension assigned to a certain aspect falls into this range of one of the three choices, the application will automatically adapt its user interface to that choice (Reinecke & Bernstein, 2009).

The aspects listed in Table 2 can be interpreted to a certain degree, and will naturally result in different implementations depending on the application. In MOCCA, we have realized different levels of *complexity* and *hierarchy in the information presentation* by presenting the user with a condensed to-do list which requires to expand a to-do in order to get more information on notes and exact due dates (Figure 2), versus all information about the to-do being visible at first sight (Figure 1). In Figure 3, we have additionally increased the *complexity* by placing to-dos in a matrix, rather than in a list, thereby creating the possibility to see more to-dos at once. Figure 3 also shows an increase in the *amount of images*, as well as in the *level of support*, by offering a wizard to guide the user through the application. Furthermore, the *level of content structuring* can be varied from little structure with different parts of the interface being solely separated by white space (Figure 2), to a highly structured interface that color-frames the different interface areas (Figure 1).

While the adaptation ontology can be easily adapted and extended to more aspects in order to suit different application domains, the design implications of different levels of content structuring, for instance, cannot be defined in the adaptation ontology. Thus, if developing a new culturally adaptive application, we will have to design new concepts that interpret the gradations for each aspect and its three (or more) choices. In the future, facilitating the design process for culturally adaptive user interfaces will be one of the main challenges.

FUTURE TRENDS

Until today, efforts to localize user interfaces have adhered to national culture, ignoring the dynamics of culture that emerged from globalization. With that, localization ignores one of the important findings of anthropology: that a person can belong to several cultural groups. Multiple cultural affiliations, however, provide the difficulty of isolating relevant indicators of culture. First, there is the question which collective – if not the nation – could represent cultural identity. Second, how can we incorporate the fact that a person may maintain strong bonds with more than one culture? In the future, some of these questions could be answered if more research was conducted on (1) how to describe cultural groups, and (2) how to detect multiple cultural affiliations.

In general, research on the localization of user interfaces should react to globalization, as it has long been suggested in anthropology. Thus, instead of adapting user interfaces to single countries, users should be given their personal "cultural passport", which holds knowledge needed for web sites and other applications to adapt to their preferences. In addition to the information that we have suggested for a cultural user model, this passport should incorporate the influence of globalization: The number of international chat partners, social network buddies, or visit to foreign web sites, could, for example, indicate different cultural influences. As proposed by many anthropologists, such

personal passports would also attach more importance to the individual and its personal handling of cultural references.

The other question is about the benefit of such individual passports of the user's culture. Although it has been demonstrated that personalized user interfaces can improve usability, research on culturally intelligent user interfaces is still in its infancy. Future evaluations are needed to determine the effect of a more precise cultural user model on user interfaces. In the same direction, we will also need further work on personal preferences and whether they interfere with culture.

CONCLUSION

Until today, localization is based on the adaptation to specific countries, or even whole continents.
The chapter introduced a new approach to localization by modeling the user's cultural background more precisely according to research in anthropology. In what seems to be one of the first collaborations between researchers in human-computer interaction and anthropology, we have established an understanding of the term culture as a dynamic and intangible construct, outlining important aspects that have so far been ignored in localization. Extracting key influences from different approaches to classify culture, we analyzed their effect on user interface perception based on a thorough literature review. The outcome was an intersection of aspects that relate to culture and have been shown to highly influence user interface preferences. We have shown how these aspects can be used as a basis for cultural user modeling, discussing the pros and cons of static and dynamic knowledge acquisition processes in order to feed such cultural user models.
The chapter continued with another aspect needed to realize this new approach of "personalized localization": flexible user interfaces that are able to adapt to cultural preferences and offer various composition possibilities of their user interface elements. We have introduced a possible solution to such culturally intelligent systems, and, with the help of a first experiment, demonstrated that such systems could indeed predict user interface preferences. Although more research is needed in order to turn culturally intelligent systems into real-world applications, our approach provides first steps towards (1) comprehensive cultural user models, and (2) flexible user interfaces that are able to turn this knowledge into a personalized arrangement of user interface elements.

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REFERENCES

Abu-Lughod, L. (1991). Writing against culture. In R. G. FOX (Ed.), *Recapturing Anthropology: Working in the Present*. Santa Fe, New Mexico: School of American Research Press.

Ankerl, G. (2000). *Coexisting Contemporary Civilizations: Arabo-Muslim, Bharati, Chinese and Western*: INU Press.

Appadurai, A. (1996). Here and Now *Modernity at Large. Cultural Dimensions of Globalization*. London, Miinneapolis: University of Minneapolis Press.

Baumgartner, V. (2003). *A Practical Set of Cultural Dimensions for Global User-Interface Analysis and Design.* Fachhochschule Joanneum, Germany.

Callahan, E. (2004). Interface Design and Culture. *Annual Review of Information Science and Technology, 39*, 257-310.

Callahan, E. (2005). Cultural Similarities and Differences in the Design of University Websites. *Journal of Computer-Mediated Communication, 11*(1).

Chan, T. T., & Bergen, B. (2005). *Writing Direction Influences Spatial Cognition*. Paper presented at the Proceedings of the 27th Annual Conference of the Cognitive Science Society. from http://www.cogsci.rpi.edu/CSJarchive/Proceedings/2005/docs/p412.pdf

Computer Industry Almanac Inc. (2006). Worldwide Internet Users Top 1 Billion in 2005, from http://www.c-i-a.com/pr0106.htm

Corbitt, B., & Thanasankit, T. (2002). *A Model for Culturally-Informed Web Interfaces*. Paper presented at the Internet Management Issues: A Global Perspective.

Dormann, C., & Chisalita, C. (2002). *Cultural Values in Web Site Design*. Paper presented at the European Conference on Cognitive Ergonomics.

Earley, P.C., & Ang, S. (2003). *Cultural Intelligence: Individual Interactions Across Cultures*: Stanford Business Books.

Ford, G., & Gelderblom, H. (2003). *The effects of culture on performance achieved through the use of human computer interaction*. Paper presented at the Annual research conference of the South African Institute of Computer Scientists and Information Technologists on Enablement Through Technology. from http://portal.acm.org/citation.cfm?id=954014.954038

Gajos, K. Z., Wobbrock, J. O., & Weld, D. S. (2008). *Improving the performance of motor-impaired users with automatically-generated, ability-based interfaces*. Paper presented at the Conference on Human Factors in Computing Systems (CHI).

Gould, E., Zakaria, N., & Yusof, S. A. M. (2000). *Applying Culture to Website Design: A Comparison of Malaysian and US Websites.* Paper presented at the Joint IEEE International and 18th Annual Conference on Computer Documentation.

Gupta, A., & Ferguson, J. (1997). *Anthropological Locations: Boundaries and Grounds of a Field Science*. Berkely: University of California Press.

Hall, E., & Hall, M. (1990). *Understanding Cultural Differences*. Maine: Intercultural Press.

Hodemacher, D., Jarman, F., & Mandl, T. (2005). *Kultur und Web-Design: Ein empirischer Vergleich zwischen Grossbritannien und Deutschland*. Paper presented at the Mensch und Computer 2005: Kunst und Wissenschaft - Grenzüberschreitungen der interaktiven Art.

Hofstede, G. (1986). Cultural Differences in Teaching and Learning. *International Journal of Intercultural Relations, 10*, 301-320.

Hofstede, G. (1997). *Cultures and Organizations: Software of the Mind*. London: McGraw-Hill.

Hofstede, G. (2003). *Culture's Consequences: Comparing values, behaviours and organisations across nations*: Sage Publications Inc.

Hurst, A., Hudson, S. E., & Mankoff, J. (2007). *Dynamic detection of novice vs. skilled use without a task model*. Paper presented at the Human factors in Computing Systems (CHI).

Ito, M., & Nakakoji, K. (1996). Impact of culture on user interface design *International User-Interfaces* (pp. 105-126). New-York: John Wiley & Sons.

Kamentz, E. , & Schudnagis, M. (2002). Lerntheorie und kultureller Hintergrund - Einflussfaktoren bei der Gestaltung von Lernsystemen. In R. Hammwöhner, C. Wolff & C. Womser-Hacker (Eds.), *Information und Mobilität, Optimierung und Vermeidung von Mobilität durch Information. Proceedings des 8. Internationalen Symposiums für Informationswissenschaft (ISI 2002)* (pp. 85--106). Regensburg: UVK Verlagsgesellschaft mbH.

Kamentz, E., & Womser-Hacker, C. (2003). Defining Culture-Bound User Characteristics as a Starting-Point for the Design of Adaptive Learning Systems. *Journal of Universal Computer Science, 9*(7).

Kamentz, E. , & Mandl, T. (2003). *Culture and E-Learning: Automatic Detection of a Users' Culture from Survey Data.* Paper presented at the Designing for Global Markets 5: Proc. Fifth International Workshop on Internationalization of Products and Systems (IWIPS 2003), Berlin, Germany.

Karahanna, E., Evaristo, R., & Srite, M. (2005). Levels of culture and individual behavior: An integrative perspective. *Journal of Global Information Management, 13*(2), 1-20.

Kondratova, I., & Goldfarb, I. (2006). *Cultural Interface Design: Global Colors Study*. Paper presented at the On the Move to Meaningful Internet Systems 2006: OTM 2006 Workshops. from http://www.springerlink.com/index/352687007t2v0058.pdf

Kralisch, A., Eisend, M., & Berendt, B. (2005). *The Impact of Culture on Website Navigation Behaviour*. Paper presented at the Proc. HCI-International. from http://www.wiwi.hu-berlin.de/~berendt/Papers/HCI_Abstract_2004_09_28.pdf

Kralisch, A. (2005). *The Impact of Culture and Language on the Use of the Internet: Empirical Analyses of Behaviour and Attitudes.* Unpublished Doctoral Thesis, Humboldt University Berlin.

Kroeber, A. L., & Kluckhohn, C. (1952). *Culture: A Critical Review of Concepts and Definitions*.

Marcus, A. , & Baumgartner, V.-J. (2004). *A Practical Set of Culture Dimensions for Global User-Interface Development*. Paper presented at the Asia-Pacific Conference on Computer Human Interaction (APCHI).

Marcus, A. (2001a). *Cross-Cultural User-Interface Design.* Paper presented at the Human-Computer Interface Internat. (HCII) Conf., New Orleans, LA, USA.

Marcus, A. (2001b). *Cultural Dimensions and Global Web Design: What? So What? Now What?* Paper presented at the Conference on Human Factors and the Web, Austin, Texas, USA.

Marcus, A., & Gould, E. (2000). Crosscurrents: Cultural Dimensions and Global Web User-Interface Design. *ACM Interactions, 7*(4), 32--46.

McSweeney, B. (2002). Hofstede's model of national cultural differences and their consequences. *Human Relations*. Retrieved from http://hum.sagepub.com/cgi/content/abstract/55/1/89

Microsoft (2004). Factors that Influence the Use of Computers. Retrieved from http://www.microsoft.com/enable/research/factors1.aspx

Nisbett, R. E. (2003). *The Geography of Thought*. New York: Free Press.

Nisbett, R. E., & Masuda, T. (2003, Jan 1). *Inaugural Articles: Culture and point of view.* Paper presented at the National Academy of Sciences.

Nunberg, G. (2002). Will the Internet Always Speak English? *The American Prospect Online*. Retrieved from http://www.prospect.org/cs/articles?article=will_the_internet_always_speak_english

Reinecke, K. (2005). *Conceptual Design and Development of an XML-based Ergonomic Multimedia Information and Learning Platform for the Education of Agricultural Advisers in Rwanda.* Master Thesis, University of Koblenz.

Reinecke, K., & Bernstein, A. (2007). Culturally Adaptive Software: Moving Beyond Internationalization. In *Proceedings of HCI International 2007*, Beijing, China.

Reinecke, K., & Bernstein, A. (2009). Tell Me Where You`ve Lived, and I`ll Tell You What You Like: Adapting Interfaces to Cultural Preferences. In G.-J. Houben, G. McCalla, F. Pianesi, M. Zancanaro (Eds.), *Proceedings of User Modeling, Adaptation, and Personalization (UMAP) 2009, Lecture Notes in Computer Science, Vol. 5535, Springer.*

Rhoads, K. (2008). The Culture Variable in the Influence Equation *The Public Diplomacy Handbook*.

Rogers, P., & Tan, J. (2008). *Fifty Years of Intercultural Study: A Continuum of Perspectives for Research and Teaching*: Ross School of Business

Röse, K. (2005). *Aspekte der interkulturellen Systemgestaltung*. Paper presented at the Mensch und Computer 2005: Kunst und Wissenschaft - Grenzüberschreitungen der interaktiven Art.

Sahlins, M. (2000). Goodbye to Tristes Tropes: Ethnography in the Context of Modern World History *Culture in Practice*. New York: Zone Books.

Schmid-Isler, S. (2000). *The Language of Digital Genres: A Semiotic Investigation of Style and Iconology on the World Wide Web.* Paper presented at the Hawai'i International Conference on System Sciences (HICSS 2000).

Sheppard, C., & Scholtz, J. (1999). *The Effects of Cultural Markers on Web Site Use*. Paper presented at the Conference on Human Factors and the Web.

Shneiderman, B. (1986). *Designing the User Interface: Strategies for Effective Human-Computer Interaction*. Boston, USA: Addison-Wesley Longman Publishing Co., Inc.

Siala, H., O'Keefe, R. M., & Hone, K. S. (2004). The Impact of Religious Affiliation on Trust in the Context of Electronic Commerce. *Interacting with Computers, 16*, 7-27.

Siaya, L. (2005). Public Experience, Attitudes, and Knowledge: A Report on Two National Surveys About International Education. Retrieved from http://www.acenet.edu/AM/Template.cfm?Section=Search&template=/CM/HTMLDisplay.cfm&ContentID=9433

Sjoelinder, M. (1998). Individual differences in spatial cognition and hypermedia navigation. *Exploring navigation: Towards a Framework for Design and Evaluation of Navigation in Electronic Spaces*, 61-72. Retrieved from http://www.sics.se/humle/projects/persona/web/littsurvey/ch5.pdf

Smith, A. , & Chang, Y. (2003). *Quantifying Hofstede and Developing Cultural Fingerprints for Website Acceptability*. Paper presented at the Designing for Global Markets 5: International Workshop on Internationalization of Products and Systems (IWIPS 2003).

Software Top 100 Foundation, from http://www.softwaretop100.org/

Stephanidis, C., Paramythis, A., Sfyrakis, M., Stergiou, A., Maou, N., Leventis, A., et al. (1998). *Adaptable and Adaptive User Interfaces for Disabled Users in the AVANTI project*. Paper presented at the International Conference on Intelligence and Services in Networks: Technology for Ubiquitous Telecom Services.

Sturm, C. (2005). *Approaches for a Successful Product Localization*. Paper presented at the Workshop-Proceedings der 5. fachübergreifenden Konferenz Mensch und Computer.

Thorell, L. G., & Smith, W. J. (1990). *Using Computer Color Effectively: An Illustrated Reference*. New Jersey: Prentice Hall.

Trompenaars, F., & Hampden-Turner, C. (1997). *Riding the Waves of Culture: Understanding Cultural Diversity in Business*: Nicholas Brealey Publishing Ltd.

Tylor, Edward (1920). *Primitive Culture* (Vol. 1). New York: J.P. Putnam's Sons.