A survey of cultural aspects in Human Computer Interaction Research

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ABSTRACT

Considering culture in human computer interaction research is an important issue since culture has a strong impact on many cognitive and affective processes, closed related to the design and evaluation of interactive systems. Also, people with different cultural backgrounds develop alternative interpretations and strategies and do not value their environment in the same way, and this reflects in their interactions and satisfaction with interactive technologies. In this survey we summarize some concepts of the cultural aspects related to human computer interaction research. After we discuss how HCI practices could address these cultural issues. Our intention is to establish background and some basic concepts for helping researchers incorporating cultural issues in their design and evaluation processes.

Author Keywords

HCI, cultural aspects, interaction design.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous..

INTRODUCTION

Human-Computer Interaction (HCI) is a multidisciplinary field focused on human aspects of the development of computer technology. As computer-based technology becomes increasingly pervasive – not just in developed countries, but worldwide – the need to take a human-centered approach in the design and development of this technology becomes even more important [1].

Human-computer interaction (HCI) is an area of research and practice that emerged in the early 1980s, as a specialty area in computer science embracing cognitive science and human factors engineering [2]. The initial research in the HCI field was motivated by the increase of personal computing that became manifest at an opportune time – personal computers were being used by end users who were not experts in computer science or engineering. As HCI developed, it moved beyond the desktop perspective. First, because of the growing influence of the Internet on computing and on society, and secondly, because HCI moved beyond the desktop through the continual, and occasionally explosive diversification in the ecology of computing devices. Nowadays, interactive systems can be anywhere and anytime. Therefore, today it is important to know how to deal with cultural issues, especially when developing or evaluating wide-access applications and interactive systems.

A deeper consideration of culture has now become a recognized topic in the design and evaluation of HCI. This survey discusses the place of culture in HCI research. Considering culture in HCI is important because it is known to have a strong impact on many cognitive and affective processes including those related to the field. Furthermore, people with different cultural backgrounds develop different interpretations and alternative strategies and do not similarly understand and appraise their environment, which naturally reflects in their interactions with computational systems.

In this survey we summarize some concepts of cultural aspects in HCI research. After we discuss how HCI practices could address these cultural issues. Our intention is to establish background and some basic concepts for helping researchers incorporating cultural issues in their interaction design.

CONCEPTUALIZING CULTURE

One of the most accepted definition of culture is "the collective programming of the mind that distinguishes the members of one group or category of people from others" [3] and is usually defined in Human Computer Interaction as the common values, attitudes and behavioral patterns shared by a group of people [4]. Cultural awareness involves becoming aware of cultural values, beliefs and perceptions. It´s become central when we have to interact with people from other cultures. Blanchard et al [5] refer culturally-aware system to 'any system where culture-related information has had some impact on its design, runtime or internal processes, structures, and/or objectives'.

The quality of user experience is intricately related to the users' cultural characteristics [6]. Cultural characteristics have been found to be an important issue because a user's cultural profile shapes his/her perception of a system features, e.g., a given culture profile will cause a user to focus on a set of information and ignore others, thus, system features appropriated for one culture may not be suitable for others; and system design needs to be adapted for different culture as well [6].

Cultural context includes user´s cultural background and may have a great impact on their ability and efficiency to learn a given set of content [7]. Cultural context is referred to different languages, values, norms, gender, social, ideological, political or ethnic aspects [8]. It describes cultural characteristics on different levels: national and regional aspects, organizational aspects, professional aspects and fields, social and individual aspects as presented in Figure 1. Thus, cultural profiles describe cultural and individual characteristics on diverse levels and modeling of culture profiles can be a means to improve cultural awareness in global knowledge sharing and learning processes.

Figure 1. Cultural dimensions based on [29]

Before discussing interests of integrating cultural aspects in HCI applications, we need to explore different cultural dimension proposed in literature. Cultural aspects are preferences and ways of behavior determined by the person's culture. It is the cumulative deposit of knowledge, beliefs, values and attitudes, the rules people's behavior in a society and distinguishes the members of one group from another. Culture is shared, learned behavior, which is transmitted from one generation to another [9]. Identifying cultural characteristics is difficult because we lack a robust measure that can identify the implicit levels of culture, and trying to address this issue, researchers have conceived culture as a set of dimensions that provide a framework for cross-cultural comparisons of users' behavior [6]. Different important works in defining cultural dimensions have been presented by Hofstede [3] and [10], Moran et al [11], Hall [12], Trompenaars and Hampden-Turner [13], Bond's Confucian Cultural Patterns [11]. These cultural models are explained in the next sections.

Hofstede´s cultural dimensions

Geert Hofstede conducted detailed interviews with hundreds of IBM employees in 53 countries, which was later expanded to 74 countries totaling values. He was able to determine patterns of similarities and differences between the responses and developed a model which distinguishes five cultural dimensions [2], [10], and indeed his work seems the more common approach to culture in HCI [14]. His approach include values, cognitive structures and behaviors at the individual level, structures and rituals in the organization, and artifacts and attributes to social or national [15]. These dimensions are (1) Power Distance Index (PDI); (2) Individualism (IDV); (3) Masculinity (MAS); (4) Uncertainty Avoidance Index (UAI); and (5) Long-Term Orientation Index (LTO). Another dimension was recently included, Indulgence versus Restraint (IND).

Power Distance Index (PDI) is the degree of equality (or inequality), between people in the country's society. A High PDI ranking indicates that inequalities of power and wealth have been allowed to grow within the society. It is the degree to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally. *Individualism* (IDV) is the degree the society reinforces individual or collective achievement and interpersonal relationships. A High Individualism ranking indicates that individuality and individual rights are paramount within the society and a Low Individualism indicates a collective society. *Masculinity* (MAS) is the degree the society reinforces (or does not reinforce), the traditional masculine work role model of male achievement, control and power. A High Masculinity ranking indicates the country experiences a high degree of gender differentiation.

Uncertainty Avoidance Index (UAI) focuses on the level of tolerance for uncertainty and ambiguity within the society for unstructured situations. A High Uncertainty Avoidance ranking indicates the country has a low tolerance for uncertainty and ambiguity. Long-Term Orientation Index (LTO) is the degree the society embraces, or does not embrace long-term devotion to traditional, forward thinking values. High LTO ranking indicates the country prescribes to the values of long-term commitments and respect for tradition and Low LTO indicates the country does not reinforce the concept of long-term, traditional orientation. To these cultures, change can occur more quickly as long-term traditions and commitments do not become impediments to change. Nowadays Hofstede included a new dimension: *Indulgence versus Restraint* (IND). Indulgence stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun. Restraint stands for a society that suppresses gratification of needs and regulates it by means of strict social norms [3].

There are in the literature some criticism of Hofstede' dimension to model culture, e.g. [16]. It have been

suggested that Hofstede' sample from a single multinational company might insert some effects of organizational culture, nevertheless, there is broad empirical evidence to prove that Hofstede' dimensions are relevant and valid; and many studies have revalidated his dimensions [4].

Moran, Harris and Moran
Moran, Harris and Moran define culture as "a distinctly human means of adapting to circumstances and transmitting this coping skill and knowledge to subsequent generations" [11]. Culture gives people a sense of who they are, of belonging, of how they should behave, and of what they should be doing. It impacts behavior and productivity at work. According to Moran, Harris and Moran, "culture is dynamic, it changes. . . but slowly."

Moran, Harris and Moran present ten categories as a means for understanding either a macroculture or a microculture and that can be useful for studying any group of people, whether they live in the rural South of the United States, India, the bustling city of Hong Kong, Banglore, Arusha in Tanzania or Bagdad in Iraq. These categories are: (1) Sense of Self and Space; (2) Communication and Language; (3) Dress and Appearance; (4) Food and Feeding Habits; (5) Time and Time Consciousness; (6) Relationships; (7) Values and Norms; (8) Beliefs and Attitudes; (9) Mental Process and Learning and (10) Work Habits and Practices.

Hall
Hall suggests that the same problem can have a different solution depending on the culturally varying context of use. He classifies culture using different categories; instead of defining dimensions, he distinguishes cultural groups depending on their perception of space, time or context [12].

Space refers to the boundary around an individual that is considered 'personal space.' For example, in the Indian culture, one's personal space is much smaller, both in terms of physical space and in objects perceived to be personal territory, than in the USA. The concept of Time orientation categorizes cultures based on their attitude toward time, monochrons and polychrons. Monochronic do one thing at a time and polychronic do many things at once. Monochronic cultures believe that time is a limited, restricted resource. Communication is direct and quick, work is planned, and execution within the time specified is seen as most important (e.g. Northern European and North American cultures). In contrast, polychronic cultures believe that time is infinite, and life is circular. One cannot control time, and so timescales are less strict and time-based planning seen as less important (e.g. the Buddhist cultures). Context is based on communication patterns within a culture. In high context cultures, both parties in communication process take much for granted. Collectivist cultures, e.g. Japan, score highly in this category. In contrast, in low context cultures such as the USA, communication is explicit, resulting in greater need for

documentation, in which both parties explain their conditions.

Hall built up the iceberg analogy of culture. If the society' culture was the iceberg, Hall reasoned, than there are some aspects visible, above the water, but there is a larger portion hidden beneath the surface: i.e., the external, or conscious, part of culture is what we can see and is the tip of the iceberg and includes behaviors and some beliefs. The internal, or subconscious, part of culture is below the surface of a society and includes some beliefs and the values and thought patterns that underlie behavior.

Trompenaars and Hampden-Turner
Trompenaars developed a set of seven cultural dimensions based on a study involving 30 companies in 50 nations [6], [17]. His model takes Persons and Shils's [18] five dimension scheme as a foundation and incorporates some Hofstede's model aspects. Trompenaars and Hampden-Turner [13] define seven culture value dimensions: 1) Universalism versus Particularism; 2) Individualism versus Collectivism; 3) Specific versus Diffuse; 4)Neutral versus Affective/Emotional; 5)Achievement versus Ascription; 6)Time perspective/orientation; and 7) Human-Nature relationship. For more details, see Trompenaars and Hampden-Turner [20].

Bond's Confucian cultural patterns
Another researcher, Michael H. Bond, believes that the taxonomies developed by Western scholars have a Western bias. In his research, he found four dimensions of cultural patterns: integration, human heartedness, interpersonal harmony, and group solidarity. The integration dimension refers in a broad sense to the continuum of social stability. If a person scores high on this dimension, he or she will display and value the behaviors of tolerance, non-competitiveness, interpersonal harmony, and group solidarity. Human-heartedness refers to the values of gentleness and compassion. People who score high on this dimension value patience, courtesy, and kindness toward others. Moral discipline refers to the essence of restraint and moderation in one's regular daily activities. If one scores high on this dimension, the behaviors valued are following the middle way, regarding personal desires as negative. The Confucian work dynamic refers to an individual's attitude and orientation toward work and life. According to Bond, the behaviors that are exhibited along this continuum are consistent with the teachings of Confucius [11].

CULTURE AND HCI RESEARCH
There are different terminologies and concepts about cultural issues in HCI. Heimgartner [30] makes a systematic study of literature. He raised different terminologies and concepts. Examples of key words and concepts are *intercultural, cross-cultural, culture-centered, culture-oriented, globalization, localization, glocalization,*

internationalization, iconization, culturalization, 'globalization of user-interface design', 'global and intercultural user-interface design', 'cross-cultural user-interface design', 'international and intercultural user interfaces', 'globalization, localization and cross-cultural communication in user-interface design', 'Cross-cultural user-experience design' [30]. His findings are related to the clarification of approaches and cultural issues in the HCI field and in establishing a conceptual basis for elucidating the different research approaches.

Internationalization is the process of developing an application whose feature design and code design do not make assumptions based on a single place; it is the process of creating a base design that can be modified or augmented for various audiences and markets worldwide. A properly internationalized product, which extracts all cultural context, can deal with multiple languages and cultural conventions and internationalized software products are easier to manage and expand to new markets for different countries. Internationalization can minimize time delay in reaching users, lower cost and maintenance in terms of bug both fixing and adding new features [19], it plans and implements products and services so that they can easily be localized (functionality, terminology, and design elements) for specific cultures. This process requires a combination of both international and technical expertise, and generally involves both deploying new systems and reengineering existing ones. Once the internationalized platform is in place, rollouts in new countries or cultures should be significantly more cost efficient, timely and market effective [20].

According Russo and Boor [21], internationalization refers to the process of isolating the culturally specific elements from a product. Internationalization occurs in the country where the product is originally developed. To the authors, localization refers to the process of infusing a specific cultural into a previously internationalized product. The range of cross-cultural elements that need to be considered during internationalization and localization is wide, and interface design must be aware of: text, number, date and time formats, images, symbols, colors, flow and functionality [21].

Localization is the process of adapting applications, services and products for an specific international market, to enable its acceptability for a particular culture, which includes translating the user interface, resizing dialog boxes, customizing features (if necessary), and testing results to ensure that the program still works, i.e., it is the process of making a specific version of the product for a target market [19]. Translation is the central activity of localization. Localization goes beyond literal translation, in addition to idiomatic language translation, numerous locale details such as currency, national regulations and holidays, cultural sensitivities, product or service names, gender roles, and geographic examples among many other details

must all be considered. A successfully localized service or product is one that seems to have been developed within the local culture [20]. A properly localized product allows users to concentrate on exploiting the software in their own language and appropriate cultural context. Localized software is not only easy to understand and meet customers' needs but also has no impact on the original development team and minimal system performance degradation compared with internationalized software [19].

Localized interfaces are supported by the idea that the existence of different cultural meanings impedes a successful standardization, the communication between a sender and a receiver will not work smoothly, or will be affected negatively when they belong to different cultures, as they rely on different sets of values and meanings; and by the perception of products, UI, websites forms part of and is influenced by a network of socio-cultural variables. Localization takes into account visual design, terminology, culture, date/time/currency formats, and many other technical aspects of a product.

The different evaluations of international usability have been improved and then user acceptance has been increased through manually localized interfaces. However, they were not yet able to persuade the software industry of the positive economic effect of an increased consumer acceptance [22]. Furthermore, people from different countries/cultures use user-interfaces in different ways, expect different graphical layouts, and have different expectations and patterns in behavior. Therefore user-interfaces have to be *adapted* to the needs of different locales, i.e. they are then called culturally adapted.

Research conducted on the effect and usability of culturally adapted web sites and interfaces has already shown enormous improvements in working efficiency [22]. Adaptation process is system initiated and oriented, and it can dynamically adapt the content, the presentation, the interaction design, and the assistance offered to users, according the user model.

Globalization can be seen as an umbrella term that refers to all the issues involved in designing or modifying products for audiences worldwide, In other words, globalization combines all aspects of internationalization and localization. Sometimes, authors refer globalization as an equivalent to internationalization process, e.g. Fernandes [23] who abstains from using the latter term. The effects of globalization are becoming increasingly evident. Globalization has achieved a level of homogeneity of cultures through the influence of multinationals and of mass media communication and information. On the one hand, it could be said that globalization strives for cultural compatibility and destroys its diversity in the process, by denying or ignoring cultural identity. On the other hand it could also be argued that some originally homogeneous societies are becoming heterogeneous by becoming multicultural societies [19].

Another term in the field was invented by Barber and Badre [24], *culturability*, used to emphasize the importance of the relationship between culture and usability in WWW design, but it can be expanded to apply to any software designed for international use. It´s a merging of culture and usability, directly impacts on the user's perception of credibility and trustworthiness of websites, and provide a detailed list of cultural markers corresponding to web design elements such as color, spatial organization, fonts, shapes, icons, metaphors, language, geography, sounds, motion, preferences for text vs. graphics, flags, directionality of how language is written (left vs. right), help features and navigation tools. Some key words can be easily described and are well established in the HCI field. However, other concepts can be applied differently in diverse contexts [30], e.g. the connotations of Intercultural HCI design, the differences in meaning between the concepts "intercultural" and "cross-cultural", and so on.

HOW CULTURAL ASPECTS ARE TREAT IN HCI FIELD?
Many user research methods in HCI field were originally focused to a singular user or group of people, and their experience with a software, product, service, or technology. They assumed some basic commonalities between the researcher and the research population, such as a shared language, or similar experiences with technology [44]. The problem is that what is acceptable in one culture, can be unthinkable in another [45]. When working with people from different regions from your own you may find unfamiliar organization, aspirations, values, economic and political circumstances, family structures, social statuses, levels of literacy, available technical infrastructures, and expectations. You will need to recognize these differences and determine if and how they affect user's experience with your software. You may need to consider how their experiences differ on several levels: as individuals, as members of a family or neighborhood, and even across an entire population [44]. This section discusses how culture aspects can be applied in a meaningful way to interaction design by presenting empirical studies presenting the influence of cultural aspects into interaction design.

Culture should be considered from the beginning of the design process [31]. If the functions and data will be important for an audience outside of the original market, it is important to plan international and intercultural factors during the early stage of development, so that the product/service can be efficiently customized later, as seldom a product reaches a global acceptance for a 'one-size-fits-all' solution.

For the design process of globalized interfaces, Marcus and Gould [31] highlight a checklist for specific tasks, related to: (1) user demographics, the identification of culture and nationality of the target user population; (2) technology; verbal versus visual content, etc.; (3) metaphors, determining the number of concepts, terms, and primary images to achieve the needs of users; evaluation of potential

misinterpretation of communication and understanding, due to differences in language and culture; (4) mental models, determining the variety of options in content organization and analyzing how the hierarchy should be changed; and, according to the authors, the cognitive styles are also affected by culture; (5) navigation, which verifies the need for variations navigation to meet user requirements; (6) interaction, which determines the variations of input and feedback ; and (7) appearance, which determines the variations of visual and verbal attributes, such as layout and orientation, icons, symbols and graphics, typography, color, aesthetics, language and verbal styles.

Cultural aspects identified in most HCI research are related to the direct manipulation interfaces designed for individual use, and do not consider cultural issues in the design of social interaction [32]. Evers and Day [33] believe that cultural factors influence the acceptance of human-computer interfaces. They highlight a set of cultural elements that should be considered by the interface designer, such as text, numbers, date and time, images, symbols, colors, flow and functionality. The design of user interface can be a matter of preference which varies from person to person, however, one can find common preferences that are deeply rooted in culture [34], and research in this direction show that people considered belonging to the same cultural group also perceive and process information in similar ways [35], [36].

There are different researches placing cultural issues into interaction design. Eune and Lee [37] present a framework for comparing cultural issues in the design of mobile interfaces, highlighting four categories: the attitude of the user regarding to time, the nature of user motivation, human relations and communication. Each category has some cultural variables, e.g. in relation to how they handle tasks (synchronous versus sequential values), time perception (in the future or in the past) and human relation (individualistic or collectivist relationship). Shen, Woolley and Prior [38] present the Culture-Centred Design, which incorporates cultural metaphors for Chinese groups. A demo of the interface with groups of Chinese users evaluates the success of the proposal in terms of interactivity, usability and cultural significance.

Pereira et al [46] agree that values and cultural aspects must be considered for providing design solutions that make sense to people, but, there is still a lack of principled and light-weighted artifacts and methods to support designers in this task. They propose two artifacts for supporting designers in making explicit both stakeholders' values and system's requirements in design. They present a case study where the artifacts were used to support the design of seven prototypes of applications for Interactive Digital Television in the Brazilian context. Salgado et al [47] present a conceptual design tool to help organize the HCI designers' communication of culture-sensitive interaction with/through

computer systems called *Cultural Viewpoint Metaphors* (CVM).

Barber and Badre [24] compiled cultural markers, Web design elements (color, icons, and symbols) that are associated with a particular culture, from existing Web sites. They presented the Culturability Inspection Method about usability and how such a concept might change given different cultural backgrounds and international users. They affirm that design elements that are appropriated to one culture may not be for another. They evaluated web sites of 18 countries, with 13 languages in these fields: Government, News & Media, Business, Travel, Society & Culture, Education, Health, Science, Art & Humanities. They discovered patters related to cultural practices and preferences in web sites, influenced by country and fields.

Callahan [25] examined cultural similarities and differences in design of university websites using Hofstede's model of cultural dimension. They observed the graphical elements on a sample of university home pages from Malaysia, Austria, USA, Ecuador, Japan, Sweden, Greece and Denmark and compared using content analysis methods. The home pages were analyzed on the basis of two criteria: organization and graphical design. Element frequency scores were correlated with Hofstede's indexes and interpreted on the basis of the existing literature. Their findings suggest that similarities and differences in web site design can be brought out through Hofstede's cultural model. Culture analysis offers a way to understand, even measure, differences and similarities of user experience [26]. In Marcus [26] research, he related Hofstede's cultural dimensions with implications for a global user experience design and user-interface interaction.

Reinecke, Reif, Bernstein [27] present a Cultural User Model Ontology - CUMO that contains information such as different places of residence, the parents' nationality, languages spoken, and religion. Furthermore, CUMO contains information about Hofstede's [3] five dimensions and their values: (a) MAS, (b) UAI, (c) PDI, (d) IDV and (e) LTO. However, according Reinecke, Reif and Bernstein, the scores assigned to a user and his cultural dimensions are not static to everybody residing in the same country, and thus, do not resemble a "national culture", as suggested by Hofstede. Instead, they take into account all places of residence and calculate their influence on the user's dimensions according to the duration of the user's stay at those places. Reinecke and Bernstein [28] have proposed a culturally Adaptive To-Do Tool namely MOCCA that is a web-based to-do list tool that allows users to manage their tasks online. Its goal is to automatically adapt to the cultural preferences of its users. They present ten different aspects of user interaction and they looked at the influence of culture on User Interface (UI) perception, compiled a list of general adaptation guidelines.

As different cultures require different versions of the same product or software, we may need different usability methods for different cultures [32]. For example, culture affects focus groups functionalities, the protocol of thinking aloud, questionnaires, the understanding of metaphors and interaction design, and the effectiveness of interviews [32]. Especially the effect of culture in structured interviews, Vatrapu and Pérez-Quiñones [39] present a controlled experiment, consisting of reviews of usability of a website with two independent groups of Indian participants. Each group had a different interviewer; one belonging to Indian culture, and another belonging to Anglo-American culture. Results indicated that participants found more usability problems and made more suggestions for a member interviewer from the same culture (Indian) than the foreign interviewer. The results of this study indicate that culture significantly affects the effectiveness of structured during an international usability test interview.

Smith [40] deals with the adaptation of usability methods and tools developed by a particular culture to other parts of the world. The author also indicates Hofstede's work as a point of reference for researchers starting their research on cultural influences on design. Clemmensen et al [41] discuss the impact of cultural differences in evaluations of usability that are based on the thinking aloud method and highlight the importance of the relationship between the presentation of the task according to the cultural background, the differences in the protocol effect on task performance among people of east and west, the differences in nonverbal behavior that affect usability problem detection , and also the general relationship between a user and an evaluator of different cultural background.

Winschiers and Fendler [42] present an empirical study for the cultural adaptation of the methods and processes of usability engineering. They present ethno-centric software development framework which incorporates a contextual redefinition of usability. This framework interacts with the project manager and process development through continuous reviews of usability within the cultural context.

Rau, Plocher and Choong [43] present recommendations for the design of different cultures, about their language, the use of jargon, abbreviations, translations, support for multiple languages, the content and spacing, methods of sequence and ranking lists, colors, icons and images, layout and presentation formats, the representation and organization of information, and navigation links. They also present a set of heuristics and guidelines for the assessment across different cultures.

CONCLUSION

Culture is a common but complex term, and it is not always clear what it means. Indeed, 'culture' is very difficult to define and most of general-purpose definitions are inadequate. Culture-aware systems are those that use cultural aspects to influence or to provide information and/or services relevant to a task execution. It is important to consider fundamental cultural differences when dealing

with members of cultures interacting with technologies. Thereby, an important issue is to bridge the gap between cultural issues and HCI design and evaluation.

Designing a culture-aware system is not a trivial task, since it is necessary to deal with issues associated to: which kind of information should be considered as cultural aspect, how to represent this information, how to assess the most appropriate representation structures to model culture and to provide culture-awareness, how it can be acquired and processed and how to design the culture usage into the application. Thus, culture-awareness is nowadays an interesting research area and receives increasing attention in Human Computer Interaction (HCI) community.

This survey focused on how HCI practices address cultural aspects. Although cultural aspects is becoming increasingly important to HCI, many of these concepts, techniques and approaches are not known by the designers, and their common practice leads to designs that are informal, ad hoc, unmaintainable, and handcrafted. There is no systematic holistic approach integrating the benefits of all approaches to yield synergy effects and resulting in the universal basic approach that could be used by HCI researchers to deal with cultural issues in interaction design.

Our objective was not point out what is the best cultural model nor even the best approach (if this answer is possible or desirable) but to discuss HCI practices that address cultural dimensions and cultural issues for helping researchers incorporating cultural aspects in their interaction design process. Surely, the success and effectiveness of each concept described here are the result of cumulative expertise and insights we should understand and apply appropriately in order to design and evaluate culture-aware interactive applications.

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REFERENCES

1. Douglas, I; Liu, Z. (Eds). Global Usability. HCIS, Springer London, 2011.

2. Carroll, John M. Human Computer Interaction - brief intro. In: Soegaard, Mads and Dam, Rikke Friis (Eds.). The Encyclopedia of Human-Computer Interaction, 2nd ed. The Interaction Design Foundation, 2013.

3. Hofstede, Geert, Hofstede, Gert Jan and Minkov, Michael. Cultures and organizations. 3th ed, McGraw-Hill, 2010.

4. Vatrapu, R; Pérez-Quiñones, M. A. Culture and Usability Evaluation: The Effects of Culture in Structure Interviews. Journal of Usability Studies, 2006, 1(4), 156-170.

5. Blanchard, E.,Mizoguchi, R., Lajoie, S. P. Structuring the Cultural Domain with an Upper Ontology of Culture. In E. G. Blanchard and D. Allard (Eds.), chapter 9, IGI Global, 2010.

6. Lee, I. et al. Cultural Dimensions for User Experience: Cross-Country and Cross-Product Analysis of Users' Cultural Characteristics. 22nd British HCI Group Annual Conference on People and computers: Culture, Creativity, Interaction, BCS-HCI'08, 2008, 3 -12

7. Chandramouli, K. and Stewart, C. and Brailsford, T. and Izquierdo, E. CAE-L: An Ontology Modelling Cultural Behaviour in Adaptive Education. 3th Intern. Workshop on Semantic Media Adaptation and Personalization, IEEE Computer Society, 2008, 183- 188.

8. Pawlowski, J. M. Culture Profiles: Facilitating Global Learning and Knowledge Sharing. The 16th ICCE, 2008, 537- 544.

9. Angeli, A. de; Kyriakoullis, L. Globalisation vs. localisation in e-commerce: Cultural-aware interaction design. AVI '06, 2006, 250-253.

10. Hofstede, Geert. Culture's Consequences: comparing values, behaviors, institutions, and organizations across nations. 2001, 2nd ed. Thousand Oaks, CA: SAGE Publications.

11. Moran, R. T., Harris, P. R., & Moran, S. Managing cultural differences - Global Leadership Strategies for the 21st Century. 7th ed., Elsevier, 2007.

12. Hall, E.T. Beyond Culture. 1976, Anchor Books, Garden City, NY.

13. Trompenaars, F.; Hampden-Turner, Ch. Riding the Waves of Culture. 1997, Nicholas Brealey Publishing, London.

14. Clemmensen, T et al. Cultural Cognition in Usability Evaluation. Interacting with Computers, 2009, 21(3), 212-220.

15. Zaharias, P. Cross-Cultural Differences in Perceptions of e–leaning Usability: An Empirical Investigation. International Journal of Technology and Human Interaction, 2008, 4(3), IGI Global.

16. Huo, Y.; Randall, D. Exploring Subcultural Differences in Hofstede's Value Survey: The Case of the Chinese. Asia Pacific Journal of Management, 1991, 8(2), 159-173.

17. Lee, I. et al. Measurement development for cultural characteristics of mobile Internet users at the individual level. Computers in Human Behavior, 2010, 26, 1355–1368.

18. Parsons, T.; Shils, E. A. Toward a general theory of action. 1951, Cambridge, MA: Harvard University Press.

19. Shen, S. T. et al. Towards culture-centred design. Interacting with Computers, 2006, 18(4), 820-852.

20. Globalization, Localization, Internationalization and Translation (GLIT), Available online at http://philip.pristine.net/glit/

21. Russo, P.; Boor, S. How Fluent is Your Interface? Designing for International Users. Proceeding INTERCHI, ACM, 1993, 342-347.

22. Reinecke, K.; Bernstein, A. Culturally Adaptive Software: Moving Beyond Internationalization. The 2nd UI-HCII'07, Springer, LNCS 4560, 2007, 201-210.

23. Fernandes, T. Global Interface Design. A Guide to Designing International User-Interfaces, 1995, San Diego, Ca: Acad. Press.

24. Barber, W.; Badre, A. Culturability: the merging of Culture and Usability. The 4th Human Factors and the Web Conference, 1998.

25. Callahan, E. Cultural similarities and differences in the design of university websites. Journal of Computer-Mediated Communication, 2005, 11(1), 12.

26. Marcus, A. Cross-Cultural User-Experience Design. Diagrammatic Representation and Inference, LNCS 4045, 2006, 16-24.

27. Reinecke, K., Reif, G., Bernstein, A. Cultural User Modeling With CUMO: An Approach to Overcome the Personalization Bootstrapping Problem. Workshop on Cultural Heritage on the Semantic Web, ISWC, 2007.

28. Reinecke, K. and Bernstein, A . Tell Me Where You've Lived, and I'll Tell You What You Like: Adapting Interfaces to Cultural Preferences. The 17th UMAP, 185-196, 2009.

29. Gasparini, I. ; Pimenta, M. S.; Palazzo M. de Oliveira, J.; Bouzeghoub, A. Combining ontologies and scenarios for context-aware e-learning environments. The 28th ACM SIGDOC, 2010. 229-236.

30. Heimgärtner, Rüdiger. Intercultural User Interface Design –Culture-Centered HCI Design –Cross-Cultural User Interface Design: Different Terminology or Different Approaches?. DUXU/HCII 2013, Part II, LNCS 8013, 62–71, 2013. Springer-Verlag.

31. Marcus, A; Gould, E. W. Globalization, Localization, and Cross-Cultural User-Interface Design. Human–Computer Interaction Handbook Fundamentals, Evolving Technologies, and Emerging Applications, 3th ed, Julie A Jacko (ed), CRC Press 2012, Chapter 15, 341–366.

32. Vatrapu, R.; Suthers, D. Culture and Computers: A Review of the Concept of Culture and Implications for Intercultural Collaborative Online Learning. In: T. Ishida, S.R. Fussell, and P.T.J.M. Vossen (Eds.): IWIC 2007, LNCS 4568, 260–275, Springer-Verlag.

33. Evers, Vanessa; Day, Donald. The role of culture in interface acceptance. INTERACT, 1997, 260-267, Springer.

34. Dormann, C.; Chisalita, C. Cultural Values in Web Site Design. European Conference on Cognitive Ergonomics, 2002.

35. Reinecke, K.; Schenkel, S.; Bernstein, A. Modeling a User's Culture. In: The Handbook of Research in Culturally-Aware Information Technology: Perspectives and Models, IGI Global, 2010.

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

37. Eune, JuHyun; Lee, Kun-Pyo. Cultural dimensions in user preferences and behaviors of mobile phones and interpretation of national cultural differences. LNCS 5623, 29-38. Springer Berlin Heidelberg, 2009.

38. Shen, Siu-Tsen; Woolley, Martin; Prior, Stephen. Towards culture-centred design. Interacting with computers, 18(4), 2006, 820-852.

39. Vatrapu, R.; Perez-Quinones, M. A. Culture and usability evaluation: The effects of culture in structured interviews. Journal of usability studies, 1(4), 2006, 156-170.

40. Smith, Andy. Issues in adapting usability testing for global usability. In: Global Usability, 23-38. Springer London, 2011.

41. Clemmensen, T; Hertzum, M; Hornbæk, K; Shi, Q; Yammiyavar, P. Cultural cognition in usability evaluation. Interacting with Computers 21(3), 2009, 212-220, Elsevier.

42. Winschiers, H.; Fendler, J. Assumptions considered harmful. In Usability and Internationalization. HCI and Culture, 452-461. Springer Berlin Heidelberg, 2007.

43. Rau, P.-L.P.; Plocher, T.; Choong, Yee-Yin. Cross-cultural design for IT products and services. CRC Press, Taylor & Francis, 2013.

44. Goodman, E; Kuniavsky, M.; Moed, A. Observing the User Experience - A Practitioner's Guide to User Research. 2nd edition, Elsevier, 2012.

45. Quesenbery, W.; Szuc, D. Global UX - design and research in a connected world. 2012, Elsevier.

46. Pereira, R; Buchdid, S.B.; Baranauskas, M.C.C.V alues and Cultural Aspects in Design: Artifacts for Making Them Explicit in Design Activities. In: Enterprise Information Systems, 7911, Springer, 2013, 358-375.

47. Salgado, L. C. de C.; Leitão, C. F.; de Souza, C. S. A Journey Through Cultures - Metaphors for Guiding the Design of Cross-Cultural Interactive Systems. HCIS (2013), Springer.