Towards a theory of cultural usability:
A comparison of ADA and CM-U theory

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Abstract. Cultural models in terms of the characteristics and content of folk theories and folk psychology have been important to social scientists for centuries. From Wilhelm Wundt's Volkerpsychologie to the distributed and situated cognition theorists in the global world of today, thinkers have seen human action as being controlled by cultural models. The study of cultural models for humans interacting with computers should thus be at the heart of the scientific study of human-computer interaction (HCI). This paper presents a theory of cultural usability that builds on the concept of Cultural Models of Use (CM-U theory). The theory is compared to existing Artifact Development Analysis (ADA) theory to identify its sensitivity to explain cultural usability phenomena. The conclusion is that a) the theory can account for empirical findings on cultural usability, and b) CM-U and ADA theories seem to fit different user populations' perception of usability.

Keywords: Cultural models, HCI, culture, usability

1. Introduction

Cultural models in terms of the characteristics and content of folk theories and folk psychology have been important to social scientists for centuries. From Wilhelm Wundt's Volkerpsychologie to the distributed and situated cognition theorists in the global world of today, thinkers have seen human action as being controlled by cultural models. The study of cultural models for humans interacting with computers should thus be at the heart of the scientific study of human-computer interaction (HCI). In this paper, we ask the question: Which kind of theory can explain cultural usability phenomena? The answer we give is to view usability as the outcome of distributed cognitions across different kinds of culturally specific models: individual models, tool models, and situation models. The perception of cultural models as elements in distributed cognitions across individuals, tools and situations is central for much of modern cultural psychology (situated cognition, distributed cognition, cultural schema theory, activity theory, etc., see e.g. [30]). In the extension of this approach to usability, individual cultural models of use consist of the goals, actions and emotions that in traditional usability definitions constitute the effectiveness, efficiency and satisfaction of interacting with a product [1]. Tools become affordances [20] designed into the interactive products, and situational models of use include established usability evaluation methods [11]. This paper sees the

combination of these models of use the Cultural Model theory of Usability (CM-U) theory. When compared with other theories of cultural usability, alternative understandings of quality-in-use and usability appear. This implies that what is understood as cultural usability may itself have cultural biases, and that researchers and practitioners should pay attention to which theory of cultural usability they apply.

2. Basic assumptions about culture and usability

Until recently the basic assumption among HCI researchers was that cultural issues could be treated as a practical matter of occasional and peripheral interest. Depending on the actual system to be designed, designers might consider the influence on the human-computer interaction from one or more factors on a long and incomplete list of cultural variables [7, 25]. The cultural models of HCI were understood as arbitrary, i.e., they could equally well have evolved into another form [21, 24]. For example, the use of red as a warning color on a display could equally have been yellow or some other color. Most of HCI was regarded implicitly as non-cultural, and something that easily could be transferred across different cultural settings. For instance, a common assumption in HCI was that all humans could distinguish between the different colors (e.g., red, green, blue) on visual displays) [3]. Consequently, the investigation of culturally determined usability problems was inappropriate [2].

In the past few years attempts have been made to come up with new axioms for culture and usability, such as cultural dimensions [18], cultural factors [28], cultural constraints [21], and cultural usability [5, 29]. These approaches are in many ways different. What is common to them is a focus on the diversity of users and use of technology around the globe on social-cognitive approaches to usability (as opposed to psycho-physiological approaches to usability) and also on a broad understanding of the utility of human-computer interaction. This last point, namely, a broad understanding of the utility of human-computer interaction, means seriously considering the experienced utility of interactive products, and not only considering instant measures such as immediate satisfaction, efficiency and effectiveness.

A major finding from the recent literature on culture in HCI is that there are differences in usability in the East (Asia) and in the West (USA, Europe), and that these differences predict the need for localized designs [18] and for local adaptations of usability evaluation procedures [28]. Specifically, empirical studies show that Chinese users adapt a more holistic approach to using software compared to European users [27]. The definition of culture that is used in these studies is national or regional culture, see [13]. Some authors [29, 30] have suggested that in addition to studying national or regional culture, HCI research should build on the cultural-psychological assumption that historically developed ways of thinking are embedded firmly in individuals' and small groups' everyday use of interactive computer and other design products. Cultural psychologists have in many empirical studies demonstrated basic cultural-historical differences in thinking and mental-self government. For example, it has been demonstrated that Easterners (people brought up in a Confucian ethical and philosophical system) tend to be context focused in their cognitive style, while Westerners (people brought up in an Aristotelian system) tend to be object focused.

When asked to report on a scene, Easterners tend to mention the background, while Westerners tend to report the focal objects [19]. Such cross cultural differences in cognition lead us to expect cross cultural differences in HCI to be visible in usability evaluations [6].

One axiom remains unchallenged: Usability must be considered a universal phenomenon in order for HCI to move forward as a science. As HCI researchers from different countries, we cannot base our cooperation on evolutionism, i.e., the assumption that some cultures are simply more developed than others, not even in the technology-led area of usability. Relativism in its extreme form: where the concepts and theories based on research in one cultural setting which cannot at all be transposed to others settings, is also not adequate for cross cultural research on usability (although relativism could be adequate for a within-culture study of, for example, the use of symbols in Indian software). However, the sort of universalism that is needed to study cultural usability takes relativism and evolutionism into account as *empirical questions*. It thus follows the moderate universalism suggested by [23]: 1) There may or may not be cross cultural usability universals, but if not, we need empirical documentation; 2) universals in usability will be found on the level of theoretical principles rather than in the phenomena; and 3) we need to make assumptions about universals in usability to help organize data into general theories.

3. Derivation of new theory from basic assumptions

This section derives eight considerations from the axioms and assumptions presented above, and then presents them as a coherent cultural model theory of usability. First, from the axioms of East-West cultural differences in human computer interaction presented above, we can see that there are several cultural backgrounds that may be relevant to a user of technology. A new theory of cultural usability must explain how users with multicultural backgrounds interact with technology. Social psychological studies of multiculturedness in a global world (see for example [4], and in particular [14]'s theory of bi-cultural frame-switching) can assist, but need to be adapted to the usability domain. The theory assume that users hold one or more cultural meaning systems, even if the systems contain conflicting cultural models of technology use. The accessibility, availability and applicability of particular cultural models of technology use will then determine the usability of a product. For example, when one writes a letter to a friend, an icon showing the Indian elephant god, Ganesh, may be available from the word processor's clipart collection; it may be accessible for those with an Indian background or knowledge of India; and it may be applicable and appropriate to use if the receivers of the letter accept a Ganesh icon in letters. In other situations it may be prudent not to use the Ganesh icon because of the belief that the readers will not appreciate that. For those with a European background, using European word processors and writing for European readers, the Ganesh icon would not be available, accessible or applicable.

Second, usability is universal in the sense that it can be seen as a folk theory, which again may be developed to different degrees in different communities or regions in the world. The usability, i.e., effectiveness, efficiency and satisfaction of an

interactive product, is always an outcome of the human application of cultural models of technology use. It can be understood as a folk theory of what it means to interact with the product in one or more contexts. In one sense, a folk theory of what is an appropriate mixture of usability components for the product makes it meaningful to measure the usability of the product. In another sense, a particular folk theory may not be accessible, available or applicable to the target users and therefore leads to biased and useless usability measures. Folk theories of usability can be studied empirically.

A third consideration is that usability is universal in the sense that we want to be able to measure usability to compare across cultural settings. An accurate measure of usability should therefore build on the "culture X situation" approach [14] and consider both internal cognitions and external artifact affordances and usability evaluation situations. Internal models of use consist of the goals, actions and emotions that for an individual constitute effectiveness, efficiency and satisfaction of interacting with a product. The content and internal relations among effectiveness, efficiency and satisfaction when interacting with a product may vary across the world's population. The varying internal cognitions contribute in concert with external cultural usability models to measured usability. External cultural models of use can be distinguished into external artifacts, e.g., the affordance designed into the products themselves, and the usability evaluation situations ranging from formal usability evaluation methods to the end-users' own informal evaluation of their interactive product. The external cognitions built into the usability evaluation situation and into the computer artifacts are contributors to a measure of usability.

Fourth, the universality of usability can be explained by viewing the function of the computer artifacts as a basic characteristic of usability across cultures. Computer artifacts have, to varying degrees, built-in a model of use. An artifact can frequently be used for one specific thing in one specific way in one specific context only by a human user. This was found by the German gestalt psychologist, Karl Duncker, in 1934 and labeled 'functional fixedness,' and has been confirmed many times since then. Recently, it has been shown that universally a design's function may be a core property of an artifact concept within human memory, even in technologically sparse cultural communities [9]. This focus on artifacts' built-in models of use is also central for recent distributed and situated cognition theorists and is based on the assumption that *"the tools of thought…embody a culture's intellectual history….Tools have theories built into them, and users accept these theories—albeit unknowingly—when they use these tools"* (Resnick, 1994, pp. 476-477, in [19]). From this follows that if the ways of doing things differ in various cultures, the computer artifacts will also have to be different; conversely, the computer artifacts, to some degree, define a culture by defining ways to do things (for example the mobile phone culture).

A fifth consideration is that from the idea that usability is universal, we can deduct that usability must be built on widely accessible knowledge produced by the use of usability evaluation methods. When using an established usability evaluation method, information about usability problems are propagated across test users, evaluators, moderators, clients, notes, video screen recordings, think aloud protocols, and other units present in that concrete situation, in a way similar to the propagation of information about an airplane's speed suggested by the analysis of [15]. The usability evaluation method serves to produce and maintain culturally specific models of usability. Initially, knowledge of what problems are usability problems is embedded

in meaning systems that are widely shared among the members of the cultural group doing the usability test. This 'usability problem knowledge' is frequently used in communication among members of that group and thus becomes chronically accessible within the group. In the usability test situation, where people under time pressure look for readily available and widely accepted solutions to a problem, the chronically accessible knowledge will be used, and typical cultural group conceptions of usability will emerge.

Sixth, since we know from cultural psychology that the human mind is complex and can contain conflicting cultural knowledge, usability must be seen as being primed by the computer artifact, language or other parts of the situation. It is not sufficient to have user task conditions that favor the activation of chronically accessible 'usability problem knowledge' in a usability test situation; the knowledge also must be available to the individual. Since individuals in a society increasingly are poly-cultural in their background and thus have more than one implicit theory of how to perceive and act in a given situation, the individuals choose or implicitly apply the theory that is available in that situation. The availability of culturally accessible knowledge is primed by culturally specific materials such a religious icons and pictures of local sights, etc. More precisely, a test of localized software applications that contains culturally specific icons and pictures may prime evaluators' and test users' culturally specific knowledge systems at a time when they complete a behavioral strategy such as a think aloud usability test.

Seventh, from cultural social psychology we derive that usability depends on what is socially appropriate. The appropriateness of applying accessible and available cultural knowledge becomes particularly questionable when evaluators and users have different socio-cultural backgrounds, for example, when they have different 'home grounds' such as China, India and Europe, but considerations of appropriateness is also relevant for other social situations (e.g., consider the nerdy technology user who tries to explain his love for his computer or his mobile phone to a technophobia-friend). Sharing knowledge of usability problems and coordinating descriptions of usability problems depend on the mutual perception of group belonginess. The participants may ask themselves implicit questions about the appropriateness of the available knowledge, such as 'if I tell them about this usability problem, will they understand that this is a problem, or will they think that I am ridiculing them?'

The eighth and final consideration is that while we must build on the idea that usability is universal, we cannot know exactly to what degree it is universal without doing empirical studies of human work and leisure in different organizational, social and cultural contexts. The usability of a computer artifact is hypothetical knowledge to be confirmed by actual use. A standard usability evaluation of a product with a particular built-in cultural model in a situation with one or more particular groups of users will result in a particular list of usability problems. To avoid these usability problems, it is not always enough to localize a product to fit cultural traits and/or demographic criteria. Because an established usability evaluation method functions as a mediator of the meanings of cultural models and the perceived reality of interactive systems, individual evaluators may find the cultural context foreign (the meaning of the cultural models), but still go on to identify well known types of usability problems (the perceived reality of the interactive system). Hence, a usability evaluation of a product for a market that is foreign to the evaluator may lead to the identification of

the major usability problems that the target future users will experience, but this is not always the outcome of the usability evaluation.
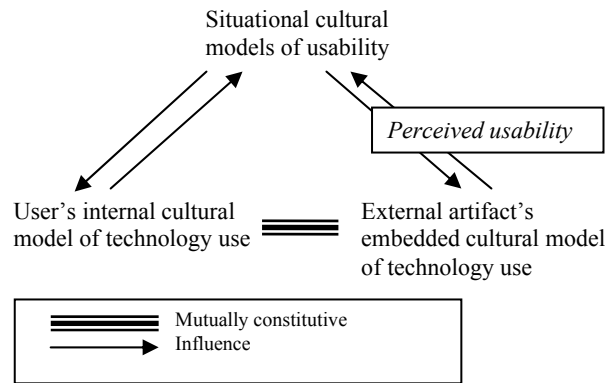

Figure 1. Cultural Model theory of Usability (CM-U)

In the cultural model theory of usability in Figure 1, the relation between the internal cultural models of technology use (cognitive, psychological: to write a letter, do so-and-so) and the external artifact cultural models (how-to-use-this-product) is considered to be mutually constitutive (one makes no sense without the other). In contrast, the external usability evaluation situation is considered a loosely coupled mediator that creates the perception of a specific set of usability problems in much the same way as other views on technology use, such as system design methodologies or user participation approaches. The psychological sense of usability is a product of the usability evaluation-enabled communication about the references between the user's expectations of a technology and the specific artifact. A combination of specific internal cultural models and the specific artifact's cultural models may suggest a list of major usability problems, but the list may not necessarily be similar to the typical usability problems found by the established usability evaluation methods.

4. Comparison between CM-U and ADA theory

This section discusses the CM-U theory in relation to other theories and definitions of usability to see its sensitivity to the description and explanation of the phenomenon of cultural usability. It would be beyond the scope of this paper to take on a full review of theories behind usability, but [10] can be seen as an excellent review of usability as a science. This paper focuses on comparing the cultural model theory of usability with the Artifact Development Analysis (ADA) theory of cultural usability [17], based on the idea that the evaluation criteria of a theoretical derivation is that the new theoretical derivation must be better than its best challenger [16].

ADA theory purports that conscious human behavior aims to achieve a goal, and the artifact is that which people use for achieving the goal. The artifact includes the hardware, software, and humanware. These may vary in both the time and spatial dimensions of creating a diversity of artifacts. Reasons for varying belong to three

categories: goals, manufacturing, and people. The relations between people and artifacts are numerous, and one of these relations is usability. Usability is a value attitude towards the artifact. Different people may have different attitudes such as: Functional Value Attitude (put emphasis on a new function and/or the multi-functionality), Usability Value Attitude (put emphasis on the effectiveness and the efficiency), Aesthetic Value Attitude (put emphasis on the appearance and the good-looking design), Sensibility Value Attitude (put emphasis on the attachment or the emotional relationship), Economic Value Attitude (put emphasis on the cost (initial cost and maintenance cost)), Quality Value Attitude (put emphasis on the qualities such as the reliability, the safety, and the compatibility), and Ethical Value Attitude (put emphasis on the environmental aspect and the sustainability). As a value attitude, usability is composed of: 'small' usability (Jacob Nielsens and others' focus on efficiency or 'ease of use'), 'big' usability (ISO 9241-11 definition that includes utility/effectiveness/functionality), plus more subjective characteristics of users, such as emotions, motivation, values and others. All of this has to be seen also in terms of time, e.g., long term usability, and universality/diversity among users and situations. In ADA theory about usability, satisfaction is the ultimate criterion of an artifact [17]. In Table 1, CM-U theory is compared with ADA theory. The first column lists some general areas that describe cultural usability with respect to current practice.

Table 1. Evaluation of cultural usability with usage of theory

Comparison point:	ADA theory	Our proposal (CM-U theory)
Usability definition	Certain value attitude	Shared model of use
Cultural perspectives on usability	Culture as a social trait	Culture as models of use
Provide Guidelines for cultural specific design	Designers normative model includes culture as a diversity item in the design calculation	Focus on adapting usability evaluation methods to capture a diversity of models of use
Can be used to assess the extent of users experience of quality with artifact	The extent the usability of some artifact can give the core satisfaction to the user	The degree of alignment between relevant models of use
Provide a definition of the ultimate criterion of usability	Satisfaction	Alignment with models of everyday use

5. Discussion

This paper has presented the CM-U theory of cultural usability. From newer axioms for dealing with culture in HCI research and practice we have derived eight considerations. These were then presented as a coherent framework for perceived usability that can explain cultural usability phenomena. One of the potentials of CM-U theory is explaining the gap between users' and artifacts' cultural models of technology use, a gap that has been noted by other empirical studies [2]. For example, a study carried out in England of interculturally shared-systems design, asked a small group of users with diverse cultural backgrounds to participate in a think-aloud evaluation of a www system in order to identify breakdowns linked with: cultural

factors in user-task interaction (language, humor, icons and jargon), user-tool interaction (understanding the tools representations), user-environment interaction (working habits, institutional practices, technological milieu) and user-user interaction (understanding the intended meaning of utterances). It was in user-tool interaction and user-task interaction that the majority of cultural breakdowns occurred. The authors proposed that cultural factors, such as religion, government, language, art, marriage, sense of humor, etc. are present in every culture, but it is the ways in which cultural factors are represented in interfaces that vary from culture to culture, and it is these that matter in HCI [2]. CM-U theory alternatively suggests that the results (the task and tool focus of usability problems) were: the effects of doing the intercultural study in one country only (all participants were primed to use their knowledge of English culture, e.g., to try to be effective) and letting all participants go through the same usability evaluation method (which biased the results in one direction, e.g., focus on foreground objects such as the interface instead of the larger work situation). Further, a nation-wide survey in a multi-cultural and multi lingual English speaking country, Botswana, [22] showed end-users having overwhelming preferences towards localized interfaces, but little need for localized icons and no agreement as to which language – not even the nationally adopted local language – was to be used for the interfaces. The little need for localized icons could be explained by the users' willing adaptation to the work environment, to the extent that they did not perceive their 'home' environment as relevant to their work environment [22]. This study supports CM-U's point of including both users' and artifacts' model of use and additionally suggests that the usability evaluation method used (at home or at work) may have had an influence on the results. Finally, a study in China [26] developed and evaluated a culturally specific metaphor (a Chinese traditional garden) to replace the western desktop metaphor for personal computing. Heuristic evaluation and user evaluation with a group of Chinese users of a metaphor based prototype suggested that background knowledge of language, logic and taboos was essential to the anticipation of user behavior in heuristic evaluation. CM-U theory points to this relation between users' model of use and the model of use built into a particular instantiation of an usability evaluation method.

The comparison of ADA and CM-U theories of cultural usability suggests differences that have implications for current usability practice. In ADA the focus is on values and social traits, and how the designer should include these as diversity items in the design process to ensure a high degree of satisfaction to the user. The CM-U focus is on shared, culturally specific models of use, and how usability evaluation methods can capture a diversity of cultural models of use to ensure a high degree of alignment between models of use involved in usability evaluation, as well as in everyday use. One issue worthy of discussion is whether the two theories of cultural usability are both relevant, albeit to a varying degree, depending on the cultural perspective from which cultural usability is seen. Empirical studies of quality-in-use and users' perception of usability show that the notion of usability is not constant across cultures. In a survey of 145 students and professionals from 30 different countries, it was found that usability professionals from various countries show different attitudes towards usability components, such as efficiency, effectiveness, and satisfaction, i.e., usability professionals from different countries have specific inclinations towards one of these components and for them any usability

study primarily concerns that specific component [31]. This finding is supported by our own empirical studies. For example, Chinese users appear to be more concerned with visual appearance, satisfaction, and fun than do Danish users; Danish users prioritize effectiveness, efficiency, and lack of frustration higher than do Chinese users [8]. Danish, and to some extent, Indian end-users and system developers tend to make more use of constructs traditionally associated with usability (e.g., easy-to-use, intuitive, and liked) compared to their Chinese counterparts [12]. ADA with its focus on values and satisfaction seems to provide a good fit with Chinese users' perception of usability as visual appearance, satisfaction and fun, while CM-U with its focus on cultural models of everyday use fits with Danish users' preference for effectiveness and efficiency. Our evaluation methods may have cultural bias built-in [6], and we have to accept that there may also be a cultural bias in our theories of usability.

6. Conclusion

On basis of the comparison of CM-U and ADA, and the discussion of empirical studies of usability phenomena, we conclude that both theories are able to explain and describe cultural usability phenomena. CM-U will be best in cross cultural or cultural comparisons, if we from the beginning focus on task performance. ADA will be preferable in situations where we see emotional and aesthetic preferences as the basis for comparing usability problems. Future research should focus on collecting more evidence both on attitudes and cultural models of use, and perhaps suggest ways to combine the two theories.

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