# APPLYING CULTURAL ERGONOMICS/HUMAN FACTORS

# TO SAFETY INFORMATION RESEARCH

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## ABSTRACT

Cultural ergonomics/human factors (CE/HF) is an approach that considers situation- and trait-based variations among cultures. Several trait and environmental factors that vary by culture have been shown to influence risk perception, risk-taking behavior, and compliance as well as other processes and behaviors. When applying a CE/HF approach to safety information research, researchers should pay careful attention to the planning and implementation of research activities. This paper discusses methodologies, recruitment strategies, and issues to consider when designing research intended to yield cross-cultural application.

## INTRODUCTION

Market globalization and national and international migrations have given rise to product consumer and labor groups that are more diverse than ever. With this added market diversity, more countries are being held accountable to international human rights codes, thus making human rights such as the right-to-know a borderless right (Saskia, 1999). The design of safety information is crucial to upholding workers' right-to-know by clearly communicating hazards, consequences, and instructions for safe use. Consequently, the design of safety information should consider the needs and capabilities of all potential users. In many hazardous environments, including environments outside the workplace, individuals and groups from varying cultures are exposed to hazardous products or processes. In order to effectively protect workers, safety information should not only reflect general user-centered values, but culturally centered values as well.

Current Western-centric methods used in safety-related research are not robust enough to account for cross-national differences (Chapanis, 1974), and often, do not emphasize the importance of culture. Researchers also tend to avoid culturally based research due to concerns of negative consequences or interpretations that may perpetuate further division and stigmatization of groups (Smith-Jackson, 1999). Culture can be defined as a collection of values, beliefs, traditions, and behavior patterns shared by a group (Berry, Poortinga, Segall, & Dasen, 1992). At present, research methods emphasize inter-group differences, that are typically independent of culture (i.e., gender). Cultural constructs such as language, values, and beliefs do not receive much attention. The complexities of quantification and application of culture-centered variables are often considered to be insurmountable. In addition, some researchers place low priority on universal design by because they incorrectly assume that universal design means designing for all. In contrast, universal design applies to design for the "widest range of users as is practical (Vanderheiden & Tobias, 1998, 584)."

CE/HF emphasizes cultural variables and applications that are cross-national (Kaplan, 1993), but has mainly focused on applications in aviation (Kaplan, 1995) and international user interfaces (Khaslavsky, 1998; Nielsen, 1993). The approach of CE/HF does not argue that biological differences associated with membership in specific cultural groups accounts for difference in behavior, but proposes that culture is a persistent situational phenomenon that is manifested through persistent patterns of interaction with the environment. These persistent patterns in behavior directly extend from beliefs, values, and mental models. Thus, cultural influences are environmentally, and therefore, situation-based. Some studies have found support for the situation-based foundations of culture by demonstrating greater similarities between assimilated cultural groups and the associated majority culture, than between assimilated cultural groups and non-assimilated groups from the same culture (Cuellar, Arnold, & Gonzalez, 1996; Neff & Hoppe, 1993). Similarly, current cognitive thought recognizes culture as shared cognitive representations and meanings among

individuals with shared ecological contexts (Berry, 1993; Romney & Moore, 1998)

Research on safety information (i.e., warnings, training manuals, Materials Safety Data Sheets, product usage instructions) has focused on Western-centered research philosophies that are usually quantitative. As a consequence, it is often not known whether the data are generalizable beyond the dominant cultural groups. Another frequently occurring problem is that of representation. Members of disadvantaged groups are typically not represented in human factors research (Fleming, Morrissey, & Kinghorn, 1997).

The purpose of this paper is to provide a general overview of important considerations when conducting safety research with cross-national applications and with culturally diverse groups, who are often not included in mainstream research. Consequently, addressing these issues should lead to safety research methodologies that are less ethnocentric and more cross-culturally and ecologically valid, increasing their generalizability to diverse users. In addition, modifications and efficient applications of methods and practices could also make it easier to incorporate disadvantaged users into human factors research.

## OVERVIEW OF THE CE/HF FRAMEWORK

### Research Method

Qualitative methods should be an integral part of culture-centered research on safety information. Purely quantitative methodologies may not be as effective and may even undermine the quality of information provided by users, because the reporting methods are vastly different from users' habitual reporting behaviors (Manfredri et al., 1997; Miller, 1999; Moggridge, 1993). Similarly, some methods may not be effective in acquiring information that may be organized differently among different users (Lin & Schwanenflugel, 1995; Shih & Goonetilleke, 1998). Standard rating scales are often difficult to administer, because many were designed and standardized on research-savvy and text-biased groups (i.e., European-American middle- to upper-class college students).

A particularly useful qualitative method is ethnography. Some user needs and characteristics can only be validly acquired through ethnographic methods (Jordan & Henderson, 1995; Kanis, Weekels, & Steenbekkers, 1999; Nardi, 1997). Unlike quantitative assessment such as quantitative measurement of performance, ethnographic methods center on recording the unique experiences of individuals. Originating from anthropology, ethnographic research involves some degree of immersion in the users environment, in order to capture context-based information. Convenience sampling and in-house laboratory experimentation are contradictions of ethnography. Methods such as participant-observation, interviews, and focus groups are all forms of ethnographic research when conducted in the actual, real-world environments of the target groups. To supplement interview-based data, tasks such as rank ordering or concept sorting are methods that can be easily adapted to different languages and interactive styles.

Ethnographic research does not have to be implemented in the manner in which it is implemented in anthropology (i.e., long-term and time-intensive). Quick implementations of one or two focus groups or interviews (using skilled translators if necessary) can provide rich data to be used to capture important concepts. If the research context and population requires the use of a translator, it is important to acquire a translator who is not only highly proficient in the language, but one who understands the cultural context and specifics such as idioms and culture-specific values and behavioral scripts. A skilled translator should also be trained to deliver questions or responses in a manner required by the research design (such as stating questions the same way for each participant or using probes rather than encouraging specific types of answers or "leading" the participants).

Knowledge elicitation methods can also be modified to ease administration demands. For example, storytelling, which is common to all cultures, is really another way to report scenarios. Storytelling can be used to develop scenarios that might be applied to fully understand how users interact with hazardous products or to assess their awareness of warning labels or safety procedures. Encouraging storytelling may be more efficient than approaching the research event using more formalized methods, and can be easier for participants who may fear repercussions from employers (i.e., migrant workers).

### Participant Selection and Involvement

Participant recruitment and retention within cultures whose members are traditionally underrepresented in research can be a difficult if not impossible task unless properly planned and implemented. Many countries, such as the United States, have a history of events involving abuse and mistreatment of disadvantaged groups by research scientists (e.g., Tuskegee Syphilis Experiment). Because of this history, ethnic, class, or language minority groups hold perceptions of scientific research as useless or even dangerous. These negative attitudes produce resistance to research participation and can make it difficult for researchers to gather information.

Various strategies have been offered to facilitate research planning and implementation that require the involvement of disadvantaged groups. Bowman (1991) described effective strategies such as using indigenous interviewers and data collectors, establishing community consultants or advisory groups, using trade-offs or exchanges to provide incentives, and ensuring that the research specifically meets the needs of the group. Similar to Rogers' (1983) product champions, indigenous research champions who are members of the target culture(s) should be utilized early in the process in order to overcome barriers to cooperation and trust. This role is similar to Grudin's (1997) description of mediators who bridge the gap between developers and users. Likewise, indigenous research champions can act as mediators between researchers and participants, and may be more effective in communicating the benefits of study participation and in building and maintaining trust and rapport.

The rapport extending from the involvement of indigenous research champions can assist in developing research tools. Indigenous research champions can provide valuable guidance on appropriate social protocols, expectations of the target groups regarding study participation, and language and wording of interview and focus group topics and questions, as well as written questionnaires. If the target group is a language-minority, the indigenous research champion can provide guidance on specific language-based rules, wording, or jargon specific to the target culture or community. This added use of appropriate language will enhance the quality of responses and avoid the common problem of collecting meaningless data.

*Culturally-relevant Variables*

Regardless of the study, a researcher who has an interest in targeting specific cultural groups or in making generalizations that extend to those cultural groups should give careful consideration to the influence of culturally relevant variables. The extent of consideration depends upon the research question. For instance, a researcher who is interested in examining accident or injury rates among ethnic and/or class minority groups should design-in a research component that addresses cross-cultural variation in risk perception or risk tolerance, and should use these variables as predictors, correlates, covariants, or qualitative categories. In contrast, a researcher who is only interested in the influence of perceptual speed and working memory capacity on the retention of safety-related information may not need to design- in factors accounting for cultural variation, since these two cognitive processes have not been shown to vary by culture.

Lawton and Parker (1998) provide an extensive review of individual differences related to accident involvement, some which vary by culture. Marin et al., (1990) found that collectivist cultures, which emphasize collaboration, shared effort and group ownership, tend to perceive health and safety information as favorable when the consequences benefit the group. It is feasible that risk communications that emphasize group consequences may, in fact, be more effective for collectivist cultures compared to risk communications that target consequences to the individual.

Previous research has also shown that cultural differences may influence variables such as risk perception (Wogalter et al., 1997; Wogalter et al., 1998), risk tolerance, stress vulnerability, and decisions to report injuries or accidents. Particular attention has been given to research on risk perceptions or connoted hazards of icons, symbols, and signal words used in warnings and other safety-related information. For instance, Wogalter, Frederick, Magurno, and Herrera (1997) found that Spanish-language users did not give the highest hazard ratings to PELIGRO, a signal word commonly used in U.S. warning labels to communicate the highest hazard level. Four other words, EXPLOSIVO, MORTAL, VENENO, and PELIGROSO had higher hazard connotations to Spanish-language users. This finding underscores the need to make sure that a diversity of cultures are represented not only in empirical studies to determine effective language use, but in decision-making efforts regarding the design of safety information that targets them.

Trait variables such as fatalism (pessimistic acceptance, defeatism), self-efficacy, locus-of-control, and religiosity have been shown to vary by culture and also to indirectly influence attitudes and risk perceptions (Earley, Gibson, Chen, & Chao, 1999; Neff & Hopp, 1993; Schulz & Heckhausen, 1999). When combined with environmental constraints that are more common among specific groups such as lack of resources, culture-based trait variables may strongly influence risk-taking or compliance (Ajzen & Fishbein, 1980).

Although few descriptive and explanatory models exist which address the complex interactions between culture and safety-related behaviors, attitudes, or cognitive processes, individual researchers should still give priority to collecting empirical data to contribute to enhance the knowledge base. Also, researchers should be aware that attitudes such as fatalism might impact user motivation to participant in a study or to report safety-related issues.

Although qualitative measurement such as ratings of independent observers can be used to categorize individuals into groups representing trait levels, trait measurement is one activity that is best administered using quantitative scales. However, the current formats of many trait measures can be unusable for various groups, since they were developed using majority group members. These quantitative measures will require some degree of modification, and pilot testing before they can be fully implemented. Such modifications should be publicized through print or web-based media.

## CONCLUSIONS

It should be noted that although optimizing the applicability of safety information designs to other cultures is an important goal, some designs must not be generalized to other cultures, because they are irrelevant and not intended to be implemented in a certain environments. Choices of methodology, participant involvement, and the consideration of culturally relevant variables are all crucial to conducting safety information research. Development of models that account for effects of culture will optimize explanatory and predictive accuracy. The application of cultural ergonomics will increase the ecological validity of safety research, and ultimately, the degree to which knowledge can be applied in various environments and across various groups.

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