

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Task Complexity and Difficulty in Two Computer-Simulated Problems: Cross-cultural Similarities and Differences

Permalink

<https://escholarship.org/uc/item/4bm7r3d6>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 26(26)

ISSN

1069-7977

Authors

Guss, C. Dominik
Glencross, Emma
Tauson, Teresa
et al.

Publication Date

2004

Peer reviewed

Task Complexity and Difficulty in Two Computer-Simulated Problems: Cross-cultural Similarities and Differences

C. Dominik Güss (dguss@unf.edu)

Emma Glencross (eglencross@juno.com)

Ma. Teresa Tuason (ttuason@unf.edu)

Lauren Summerlin (lauren233axo@aol.com)

F. Dan Richard (drichard@unf.edu)

Department of Psychology, 4567 St. Johns Bluff Road, South
Jacksonville, FL 32224 USA

Abstract

Complex problems have often been described along certain dimensions, e.g. complexity, transparency, and dynamics. However, problem descriptions of the researcher and problem-characteristics perceived by the participant might differ. This study investigates subjective task complexity and its relationship to complex problem solving performance. Research questions are: Do problem perceptions differ a) between different complex problems? b) between cultures? and c) between participants' performance? Two hundred eighty three students from the US, Brazil, and India participated in this study. Participants played the two computer simulations, Fire and Coldstore, and filled out a problem-characteristics questionnaire after each simulation. Factor analysis revealed two factors; one labeled "Task Complexity", the other "Task Difficulty". Results indicate a) that Fire was perceived as more complex and more difficult than Coldstore in the Brazilian and US sample. The Indian sample perceived both problems as equally complex and difficult; b) a significant main effect of culture was found in Fire and Coldstore regarding Complexity; c) a significant main effect of performance was found for Task Difficulty in Fire and Coldstore, but not for Task Complexity. Cultural variables that could explain the results, such as uncertainty avoidance and differences in computer experience, are presented. Results are further discussed under a theoretical and applied perspective.

Complex Problem Solving and Culture

The study of complex problem solving has increased in the last decades especially in Europe (Frensch & Funke, 1995). Computer simulations of complex problems have been widely used to study human problem solving behavior (Brehmer & Dörner, 1993). The researchers were motivated to incorporate into their simulations characteristics common to real life situations, e.g. complexity, transparency, and dynamics (Dörner, 1996). A problems' complexity is derived from the inclusion of many interdependent variables. Complex problems are nontransparent in that the problem solver initially does not know or understand the nature of the hidden variables in the problem situation. The situations change dynamically with and without the actions of the problem solver. One might derive that the more complex, the more non-transparent, and the more dynamic a

problem objectively is, the more difficult it is. However, the described problem characteristics are not objective descriptions of complex problems, but are dependent on the knowledge and experience of the problem solver. Individuals differ in experiences regarding problem-related knowledge and strategic knowledge. The complexity, transparency, and dynamics of a situation interpreted subjectively might be completely different. Therefore, both the problem's specific characteristics and the experience of the problem solver will influence the subjective interpretation of the problem. This interpretation is a crucial aspect of the problem solving process and thus, one might expect individual differences.

Knowledge and experience of the problem solver is strongly influenced by one's cultural environment and several studies have shown how problem solving differs between cultures (Cole, Gay, Glick, & Sharp, 1971; Güss, 2002; Strohschneider & Güss, 1999). Culture is a broad term that can be defined in many ways (Kroeber & Kluckhohn, 1963). Under a psychological perspective it can refer to implicit and explicit shared knowledge that is transmitted from generation to generation (Smith & Bond, 1998). This knowledge is helpful for a specific group to adapt to specific conditions of the environment. Cross cultural differences in problem solving strategies validate that the people's knowledge base is strongly influenced and shaped by their cultural environment. In essence, the more interesting questions is why and how problem solving strategies are influenced by culture.

One aspect of this implicit knowledge are values that direct behavior, one such value is called *uncertainty avoidance*. A problem is by definition an uncertain situation as the problem solver does not know how to reach a goal state. Uncertainty avoidance refers to "the extent to which the members of a culture feel threatened by uncertain or unknown situations" (Hofstede, 2001, p. 161). Our expectation is that values of uncertainty avoidance influence the initial perception of a problem. For example Hofstede (2001) studied uncertainty avoidance in 53 countries. In his study, India and the United States showed weak uncertainty avoidance, whereas Brazil showed high uncertainty avoidance.

This study investigates the following questions: Do participants perceive different problems in different ways, i.e. is one problem regarded as more complex than another problem? Do perceived problem-characteristics differ between cultural groups? If so, can differences in uncertainty avoidance explain differences in problem perception? Might it be that those problems are created and described with a bias from a western point of view?

Method

Participants

Participants in this study were 283 students from three countries. In India (n=96), participants came from the University of Kerala in Thiruvananthapuram, and from Loyola College, Kerala. In Brazil (n=86), participants were from the universities of Gama Filho, Rio de Janeiro and Faculdade Roy Barbosa, Salvador da Bahia. In the United States (n=101), students were from Northern Illinois University and University of North Florida. Participants received either course credit or were paid for their participation. Students were from the schools of arts and sciences, social sciences, and business. None of the participants had taken part in other complex problem experiments prior to this study. Seventy percent of the participants were majors in psychology. One hundred seventy-six participants were female, and 107 participants were male. Their ages ranged between 18 and 38 years. The average age in the US sample was 22.6 years, in the Indian sample 23.8 years, and in the Brazilian sample 22.0. The mean ages in the three cultural samples were not significantly different. Samples were comparable according to course or major and gender. Data were collected in group sessions (2 hours) and individual sessions where Fire and Coldstore simulations were administered (2 hours).

Materials: Fire, Coldstore, and Problem-characteristics-questionnaire

Participants played two computer simulations, called "Fire" (Gerdes, Dörner, & Pfeiffer, 1993) and "Coldstore" (Reichert & Dörner, 1988). Instructions to each simulation were provided and test games were played before the actual simulation started. After each simulation, a questionnaire regarding simulation characteristics was completed. Instructions and questionnaires were translated from English in translation-backtranslation procedures into Brazilian Portuguese with the help of bilingual Brazilians. The material was presented in Brazilian Portuguese in Brazil and in English in the US and in India. Indian participants, as bilinguals, had no difficulties in answering the Likert-scale questions. The questionnaires consist of identical items and are labeled Fire-characteristics-questionnaire (FCQ) and Coldstore-characteristics-questionnaire (CCQ). This questionnaire is a modification of the one originally developed by Schaub (2001). It consists of 24 items which participants rate on a 7-point Likert scale regarding complexity, transparency, and dynamics. Examples of questions related to complexity are "I find the game

complex" and "There are many variables in this simulation". Examples of questions related to transparency are "Not everything is visible that you would like to see" and "The game developments were quite surprising". Examples of questions related to dynamics are "The simulation is dynamic with many changes", "Changes occur often without my intervention".

In the Fire simulation, the participant assumes the role of a fire fighting commander and has to try to protect three towns and the forest from approaching fires. In Coldstore, the participant takes the role of a supervisor in a grocery store with a coldstorage unit. The automatic temperature device has broken down and the participant has to manually control the temperature until the cooling trucks arrive. The goal is to keep the temperature stable at an optimal temperature in order to keep products from freezing or spoiling. Each simulation lasts about 12 minutes.

A comparison of the simulation characteristics of Fire and Coldstore shows that Fire is more complex and more dynamic, yet both are similarly non-transparent. On the screen of the Fire simulation, the participant sees the forest, three cities, fire fighting trucks, helicopters, water dikes, and stone area. In Coldstore, the participant sees the control wheel, the actual temperature, and the target temperature on the screen. Fire is not just more complex regarding stimuli on the screen, but also regarding possible actions. Fire offers 4 main (and a few other) command options for 3 helicopters and 9 fire fighting trucks at any time. These commands can be given to individual units or several units at the same time. At any given time, a person has the choice of a minimum of $4 \times (12!) = 312$ alternatives. (In fact, the participant has still some additional options). On the other hand, the participant can also just wait and watch what happens. Coldstore offers the participant only one option, a control wheel which the participant clicks with the cursor to regulate the temperature.

Although both simulations can be described as highly dynamic and changing in a non-linear way, Fire is significantly more dynamic than Coldstore. Fires break out at certain times in the simulation, in different locations. Wind strength, wind direction, and interventions of the participant all influence how the fire spreads. Subjectively, participants experience time pressure. In Coldstore, the development of the temperature changes but with delayed effects.

Both simulations can be described as moderately non-transparent. In Fire, participants see the fire, and see wind direction and strength. However, many participants have problems operating the commands. Even if participants have played a test game and have read the instructions, many don't understand the impact of the consequences and long-term effects of some of the commands. In Coldstore, transparency is related to delayed feedback. Participants have the impression, and are often surprised, that the temperature does not immediately react to changes on the control wheel. For many participants, the reasons behind the temperature fluctuations are hard to understand. Analysis of participants' questionnaire responses will show if Fire is indeed described as more complex, more dynamic, and similarly non-transparent as Coldstore. Data analysis will

reveal a universal or a culture-relative perception of problem characteristics.

Initially, the reliability of the two game characteristics-questionnaires (FCQ, CCQ) was studied. Exploratory factor analysis was conducted to investigate the underlying theoretical structure of the instruments, and measurement equivalence was studied with item analysis. Data regarding participants' subjective evaluation of simulation characteristics was then compared between the three cultural groups and related to performance in the two simulations.

Results

In cross-cultural comparisons, data must be analyzed for equivalence before any meaningful cross-cultural comparisons can be made. Cronbach's alpha was used to assess the instrument's reliability. The Cronbach's alpha coefficients of 13 complexity items were .632, .552, and .802 for the Indian, Brazilian, and US samples respectively. The internal consistency for complexity items is adequate for the US sample, but not for the Indian and Brazilian samples. The Cronbach's alpha coefficients of the 7 transparency items and 4 dynamics items in all three cultural samples were relatively low, i.e. between .242 and .551. This was the case for the Fire- and the Coldstore-characteristics-questionnaire (FCQ and CCQ). The Cronbach's alpha coefficients for all 24 items in Fire were .762, .691, and .827, for India, Brazil, and the US, and indicate a one-dimensional construct. Further investigation of the measurement's structure using exploratory factor analysis was conducted for the overall sample and for each cultural group. Results indicated two main factors (overall and in each cultural sample). The first factor "Task Complexity" refers to items indicating complexity, transparency, and dynamics. The second factor "Task Difficulty" refers to the subjective impression of the participant on the situation. To compare the factor structure and loadings between the different cultural groups, the coefficient of congruence (MacCallum, Widaman, Zhang, & Hong, 1999) was calculated. Results indicate a similar factor structure in all the cultural samples in both simulations. In a next step, item analysis was conducted following van de Vijver and Leung (1997) approach. Items showing cultural bias were excluded from further analysis.

Items of Factor 1 and Factor 2 are significantly correlated in both simulations (Fire-complexity and Fire-difficulty, $r = .189^{**}$; Coldstore-complexity and Coldstore-difficulty, $r = .178^{**}$). Moreover, items of Factor 1 in both simulations are significantly correlated (Fire-complexity and Coldstore-complexity, $r = .361^{**}$) and items of Factor 2 in both simulations are significantly correlated (Fire-difficulty and Coldstore-difficulty, $r = .130^*$). Factor 1 in one simulation and Factor 2 in the other simulation are not significantly correlated. Cronbach's alpha coefficients for the new scales "Task Complexity" and "Task Difficulty" were calculated for the cultural subgroups and for the overall sample. The Cronbach's alpha coefficients ranged between .606 and .833 in the two Fire item subscales and between .648 and .795 in the two Coldstore item subscales. These reliability measures can be considered satisfactory considering the small number of items in each scale.

Task Complexity and Task Difficulty in the US, Brazilian, and Indian Samples

In a next step, Fire and Coldstore were compared regarding Complexity and Difficulty. Results showed that Fire was perceived as more complex and more difficult than Coldstore (see Figure 1). Lower mean scores indicate high complexity and high difficulty. Dividing the overall score of 18 by 7 (7 items), gives an average of 2.6 on a scale from 1 to 7. This means that overall, the Fire simulation was considered quite complex and quite difficult [Complexity: $M_F = 17.59$, $SD_F = 6.43$; $M_C = 22.97$, $SD_C = 8.80$; $F(1, 551) = -67.36$, $p < .001$, $\eta^2 = .11$] and [Difficulty: $M_F = 18.57$, $SD_F = 5.98$; $M_C = 21.74$, $SD_C = 6.96$; $F(1, 557) = 33.25$, $p < .001$, $\eta^2 = .056$].

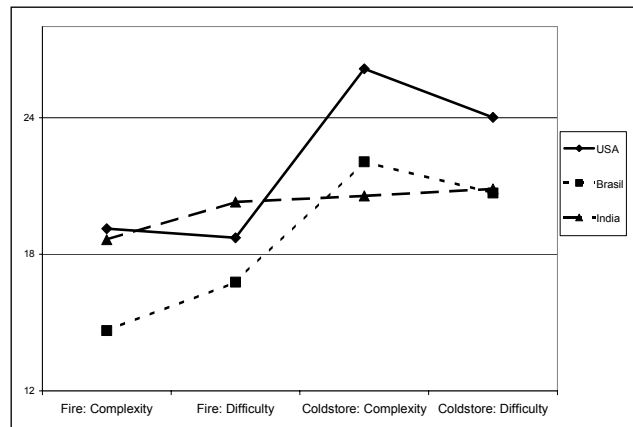


Figure 1: Mean values of US, Brazilian, and Indian participants in Complexity and Difficulty in Fire and Coldstore (Complexity and Difficulty scores are inverted).

In a next step, Complexity and Difficulty in Fire and Coldstore were compared among the three cultural groups using ANOVAs. Scheffé post-hoc tests were calculated to compare differences in the mean values between the three cultures. Comparisons of mean values between cultures in Fire showed that the US and Indian samples had significantly higher average scores regarding Complexity and Difficulty than the Brazilian sample. Brazilian participants perceived the Fire simulation as more complex and difficult (low scores indicate higher complexity). US participants perceived Coldstore as significantly less complex and less difficult. Interestingly, Indian participants' ratings in Coldstore did not differ significantly from their ratings in Fire. These findings show how participants from different cultures view problems quite differently. In the following parts, we will analyze Complexity and Difficulty in relation to task performance.

Fire: Task Complexity and Difficulty in Relation to Actual Task Performance

The performance variable in Fire was the percentage of protected forest at the end of the simulation. Among all the participants, the percentage of protected forest ranged from 41.97% to 97.45% ($M = 63.91\%$, $SD = 19.36$). The overall scores were distributed in percentile ranks: 25th percentile at 46.61%, 50th percentile at 52.92%, and 75th percentile at

83.01%. Every participant was assigned a score from 1 to 4 according to his or her performance, with higher scores indicating higher performance. Separate two-way ANOVAs were calculated with the two independent variables culture (3 levels) and performance score (4 levels). Dependent variables were Complexity and Difficulty.

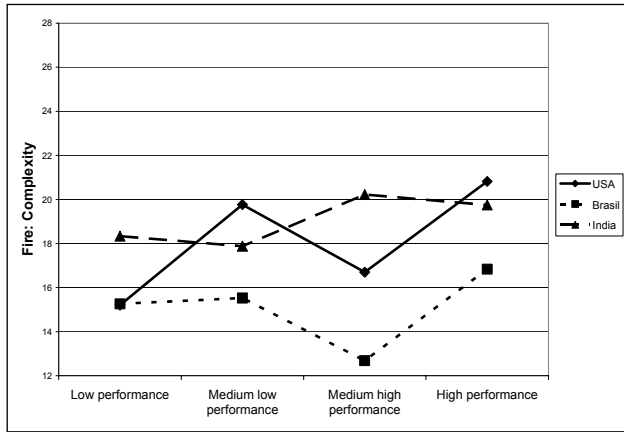


Figure 2: Mean Complexity values of US, Brazilian, and Indian participants according to performance in Fire (Complexity scores are inverted).

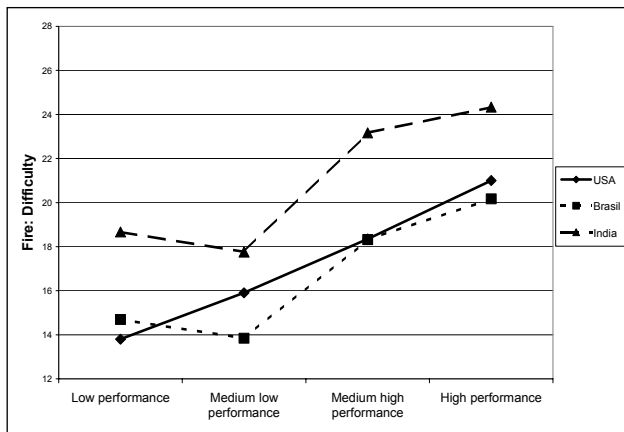


Figure 3: Mean Difficulty values of US, Brazilian, and Indian participants according to performance in Fire (Difficulty scores are inverted).

Regarding the Fire simulation, a significant main effect of culture was found in both Complexity, $F(2, 260) = 8.66, p < .001, \eta^2 = .065$, and Difficulty, $F(2, 260) = 14.11, p < .001, \eta^2 = .10$ (see Figures 2 and 3). Post-hoc Scheffe tests showed, that Brazilian participants rated the Fire simulation as significantly more complex and more difficult than US and Indian participants. A significant main effect of performance was found for Difficulty, $F(3, 259) = 17.69, p < .001, \eta^2 = .175$, but not Complexity. Those who performed better tended to rate the Fire simulation as less difficult. However, regardless of their actual performance on the Fire task, the Fire simulation was viewed with similar

complexity. Regarding complexity, interaction effects between performance and culture were not significant.

Coldstore: Task Complexity and Difficulty in Relation to Actual Task Performance

In Coldstore, the sum of the absolute deviations (SAD) from the target temperature was the performance criterion. The minimum of SAD was 134.82, the maximum 1360.85 ($M = 632.99, SD = 263.71, N = 288$). The overall SAD scores were distributed in percentile ranks: 25th percentile at 434.80, 50th percentile at 667.41, and 75th percentile at 826.29. The SAD was recoded into values of 1 to 4 according to performance, with higher scores indicating the least deviations, and thereby better performance.

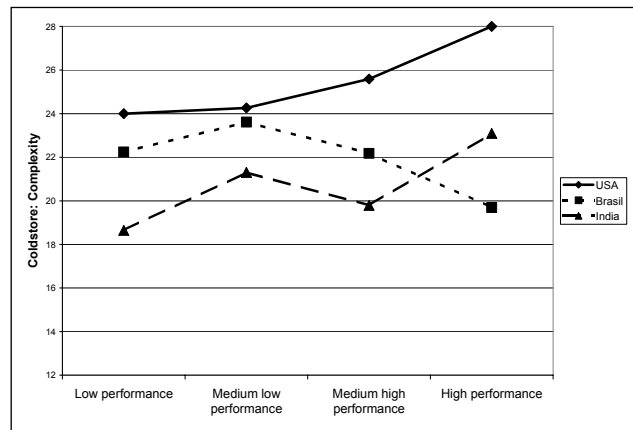


Figure 4: Mean Complexity values of US, Brazilian, and Indian participants according to performance in Coldstore (Complexity scores are inverted).

Separate ANOVAs were calculated with the independent variables, culture (3 levels) and performance score (4 levels). Dependent variables were Complexity and Difficulty. Again, a high score stands for low complexity and low difficulty (inverted, e.g. "I find the game complex" 1-Yes, 7-No).

In the Coldstore simulation, a significant main effect of culture was found for Complexity, $F(2, 258) = 6.64, p = .002, \eta^2 = .051$, but not for Difficulty (see Figures 4 and 5). US participants found the Coldstore simulation less complex compared to Brazilian and Indian participants. A significant main effect of performance was only found for Difficulty, $F(3, 257) = 3.391, p = .019, \eta^2 = .039$ but not for Complexity. As post hoc Scheffe tests reveal, the American participants rated the simulation's complexity as well as the simulation's difficulty significantly lower than the Brazilian and Indian participants. No significant differences between the Brazilian and Indian samples were found.

As evident in Figure 5, the Difficulty scores in Coldstore are relatively similar among the low, medium low, and medium high performance groups with an unusual pattern in the American sample. Only high performing participants viewed the simulation as less difficult. This means that participants who performed well in Coldstore (group 4), rated the simulation as less difficult than those who did not

perform as well. We found this trend in the American and Brazilian samples, but not in the Indian sample. The interaction effect between performance and culture was significant for Difficulty, $F(6, 254) = 2.585, p = .019, \eta^2 = .059$.

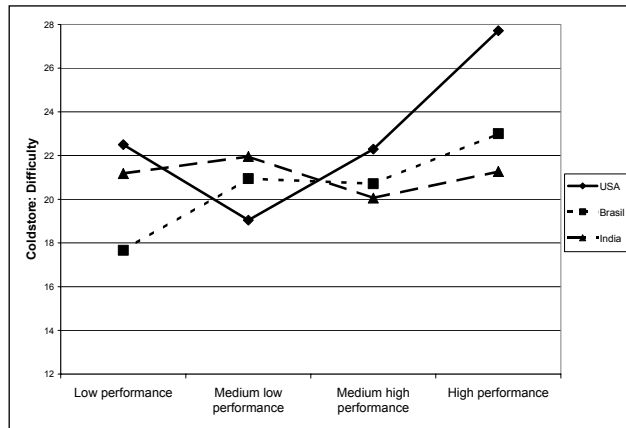


Figure 5: Mean Difficulty values of US, Brazilian, and Indian participants according to performance in Coldstore (Difficulty scores are inverted).

Discussion

In this study, we asked whether problem-characteristics-perceptions differ between complex problems, between cultures, and between performance levels. These questions were studied by administering the simulations Fire and Coldstore and the problem-characteristics-questionnaires to US, Brazilian, and Indian participants. The questionnaires assessed Task Complexity and Task Difficulty. Overall and as expected, Fire was perceived as more complex and more difficult than Coldstore.

In both simulations, no differences were found regarding participants' perception of Task Complexity in relation to performance. Regardless of whether a participant performed in the low, medium or high level, the perception of the simulations' complexity was relatively similar. However, Task Difficulty in both simulations was dependent on performance levels. Participants who performed better regarded the simulations as less difficult compared to those who performed less well. The participant's perception of the task, whether difficult or easy, is related to their actual performance.

This study showed that task complexity and difficulty assessment is an essential step if one wants to compare performance in specific problems. If these simulations are administered in an applied setting or in training programs, it is important to know how the characteristics of these simulations are perceived.

Data analysis also revealed interesting cross-cultural differences. Brazilian participants, compared to Indian and US participants, found the Fire simulation more complex. US Americans, compared to Brazilian and Indian participants, found Coldstore less complex and less difficult. Brazilian and US participants found Fire more complex and difficult compared to Coldstore. However, Indian

participants found Fire and Coldstore equally complex and difficult.

There are several possible explanations for these cross-cultural differences. One most plausible reason for the differences among the three cultures is uncertainty avoidance. We expect that low scores in uncertainty avoidance will result in low ratings of complexity and difficulty. In our study, we assessed uncertainty avoidance with the same three questions Hofstede used, but applied them to the school context instead of the work context. In Hofstede's study (2001), India and the United States showed weak uncertainty avoidance scores, whereas Brazil showed high uncertainty avoidance. Surprisingly in our samples, India showed the strongest uncertainty avoidance, Brazil the least uncertainty avoidance, and the US scores were between the Indian and Brazilian ones. The differences between the countries were statistically significant. The different results of our study and Hofstede's study might be related to the samples. Whereas Hofstede's samples consisted of IBM managers, our samples consisted of students. Our participants were also significantly younger and Hofstede has shown significant correlations between age and uncertainty avoidance. A final reason for the different results might be related to changes in cultures. Most of Hofstede's data were collected between 1967 and 1972, i.e. more than 30 years ago and having undergone significant political, economic, and societal development. India, for example, underwent many economic and political changes, especially since the opening of its borders in the 1990s to the world market.

Data analysis revealed that differences in uncertainty avoidance cannot explain cultural differences in problem perception. Brazilian participants, for example, had the lowest uncertainty avoidance scores but the highest Complexity and Difficulty scores in Fire.

A seemingly obvious influence on Complexity and Difficulty scores may be attributed to differences in computer experiences, familiarity with such computer simulations, and motivation to play and succeed in the simulations. However, current results show that although these variables were assessed, none of them can explain the cross-cultural differences in Complexity and Difficulty. The correlations between these variables and task Complexity and Difficulty were not statistically significant.

Why do Brazilian participants compared to US and Indian participants find Fire more complex and difficult? Brazilians perception of Fire as more complex and difficult might be related to the Brazilian time-orientation (Milosevic, 2002). Cross-cultural studies show lower punctuality in Brazil compared to the US (Levine, West, & Reis, 1980) and a more impulsive present-orientation in Brazil (Strohschneider & Güss, 1998). Dealing with a highly dynamic situation like Fire puts the participant under time pressure. Thus, Brazilians with a culture of less strict time orientation may regard the situation as complex and difficult, since their focus is mostly on the immediate, current situation and not on actions in a course of time.

Another question related to the results is why Indian participants view Complexity and Difficulty of Fire and Coldstore similar and Brazilian and US participants view

Fire more complex and difficult than Coldstore. Some studies describe on a general level Western thought as analytic and Eastern thought as holistic (Nisbett, Peng, Choi, & Norenzayan, 2001). A more detailed look at this dichotomy in empirical studies about thinking patterns might reveal more detailed intra- and cross-cultural variations on this general theme. It might be that Brazilian and US participants pay more attention to the details and characteristics of the problems. In a current study (Glencross & Güss, 2004) we find that Indian participants inquire less about problem situations and show more optimism regarding successful planning than US participants. Indians seem to accept the situations as they are, without asking many questions. We find this acceptance of the problem also in other cross-cultural studies between India and Germany (Güss, 2000; Strohschneider & Güss, 1999). These findings could explain why Fire and Coldstore are perceived similarly by the Indian participants.

To summarize, this study stresses the importance of cross-cultural research in the field of cognition. This study showed how perception of task complexity and difficulty can differ between participants of different cultures. For further research, these problem-characteristics-perceptions could be related to strategies that participants use to deal with the complexity and difficulty of the task. It is likely that individuals use different strategies to deal with different perceptions of task complexity and difficulty. The perception of problem characteristics is often the start of the problem solving process, and one can expect and be amazed by the interesting and relevant cross-cultural differences during the next problem solving stages.

Acknowledgements

This research would not have been possible without the support of friends and colleagues in Germany, the US, Brazil, and India. We would like to thank especially Prof. Dietrich Dörner in Germany for providing the two simulations; Prof. Charles Miller in Illinois; Prof. Cristina Ferreira, Prof. Cilio Ziviani, Prof. Nadia, and Dr. Miguel Cal in Brazil; Prof. Krishna Prasaad Sreedhar, Dr. S. Raju, Dr. Ajay Kesavan, and Mr. Ibrahim Syed in India, and the many students who participated.

This research would also not be possible without funding. This study is based on work supported by the National Science Foundation under Grant 0218203 from 2002 to 2005 with the title "Cultural influences on dynamic decision making".

References

Brehmer, B., & Dörner, D. (1993). Experiments with computer-simulated microworlds: Escaping both the narrow straits of the laboratory and the deep blue sea of the field study. *Computers in Human Behavior*, 9, 171-184.

Cole, M., Gay, J., Glick, J., & Sharp, D.W. (1971). *The cultural context of learning and thinking*. New York: Basic Books.

Dörner, D. (1996): *The logic of failure*. New York: Holt.

Frensch, P., & Funke, J. (Eds.) (1995). *Complex problem solving: The European perspective*. Hillsdale, NJ: Erlbaum.

Gerdes, J., Dörner, D. & Pfeiffer E. (1993). *Interaktive Computersimulation "Winfire"* [The interactive computer simulation "Winfire"]. Otto-Friedrich-Universität Bamberg: Lehrstuhl Psychologie II.

Glencross, E., & Güss, D. (2004). *Values, problem solving, and planning strategies in India and the United States*. Manuscript under preparation.

Güss, D. (2000). *Planen und Kultur?* [Planning and culture?] Lengerich, Germany: Pabst.

Güss, D. (2002). Decision making in individualistic and collectivist cultures. In W. J. Lonner, D. L. Dinnel, S. A. Hayes, & D. N. Sattler (Eds.), *OnLine Readings in Psychology and Culture, Western Washington University, Department of Psychology, Center for Cross-Cultural Research*. Web site: <http://www.wvu.edu/~culture>

Hofstede, G. (2001). *Culture's consequences* (2nd ed.). Thousand Oaks: Sage.

Kroeber, A. A. & Kluckhohn, C. (1963): *Culture. A critical review of concepts and definitions*. New York: Vintage Books.

Levine, R. V., West, L. J., & Reis, H. T. (1980). Perceptions of time and punctuality in the United States and Brazil. *Journal of Personality and Social Psychology*, 38(4), 541-550.

MacCallum, R. C., Widaman, K. F., Zhang, S., & Hong, S. (1999). Sample size in factor analysis. *Psychological Methods*, 4, 615-618.

Milosevic, D. Z. (2002). Selecting a culturally responsive project management strategy. *Technovation* 22(8), 493-508.

Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review*, 108(2), 291-310.

Reichert, U., & Dörner, D. (1988). Heurismen beim Umgang mit einem „einfachen“ dynamischen System [Heuristics in handling a „simple“ dynamic system]. *Sprache & Kognition*, 7(1), 12-24

Schaub, H. (2001). *Persönlichkeit und Problemlösen* [Personality and problem solving]. Hertsbach. Beltz.

Smith, P. B., & Bond, M. H. (1998). *Social Psychology across cultures* (2nd ed.). London: Prentice Hall.

Strohschneider, S., & Güss, D. (1998). Planning and problem solving: Differences between Brazilian and German students. *Journal of Cross-Cultural Psychology*, 29(6), 695-716.

Strohschneider, S. & Güss, D. (1999). The fate of the Moros: A cross-cultural exploration of strategies in complex and dynamic decision making. *International Journal of Psychology*, 34(4), 235-252.

van de Vijver, F., & Leung, K. (1997). Methods and data analysis of comparative research. In J. W. Berry, Y. H. Poortinga, & J. Pandey (Eds.), *Handbook of cross-cultural psychology. Volume 1: Theory and method* (pp. 257-300). Needham Heights, MA: Allyn & Bacon.