A CROSS-CULTURAL ANALYSIS OF THE IMPACT OF ENVIRONMENTAL DIMENSIONS OF COGNITIVE ABILITIES

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INTRODUCTION

While past research has investigated the impact of variables such as socio-historical, socialization process, SES, and educational facilities on test performance (Munroe & Munroe, 1985; Laosa, 1980; Goodnow, Cashmore, Cotton, & Knight, 1984; Kirk, Hunt, & Volkmar, 1975; Hughes, 1986; Rogoff, 1981; Armour-Thomas, 1992), few studies have attempted to examine the relationship between systematic patterns of micro-cultural contexts and different intellectual abilities. Research using the contextualist framework is often criticized for not stating hypotheses in a clear, specific, and testable manner in addition to a lack of systematic approach (Eysenck, 1984). The studies were often correlational in nature and failed to examine which features of the environment facilitate cognitive competence and which features may obstruct it (Ceci & Roazzi, 1994).

In seeking a better understanding of the source of differences in intellectual performance between cultural groups, this study focuses attention on the context that immediately surrounds individuals. This research differs from past cross-cultural cognitive studies in that it seeks to identify systematic contextual variables that might be different between cultures and how these variables are related to intellectual abilities in each culture. Based on

the model of the Seattle Longitudinal Study (SLS, Schaie, 1996), the present study investigated the degree to which environmental dimensions such as Status, Mobility, Social Network, and Physical Environment contribute to the prediction of cognitive performance within the Chinese and U.S. cultures.

METHOD

Samples

The Chinese sample consisted of 121 adults (56 women and 65 men) aged 20 to 80 years selected from Tianjin, People's Republic of China. The U.S. sample used for comparison included 242 males and 298 females (N=540, aged 20 to 80 years) from the Seattle Longitudinal Study (SLS). This longitudinal study has collected data for five testing waves at seven year intervals (1956, 1963, 1970, 1977, 1984, 1991). Subjects were randomly selected from the membership of a Health Maintenance Organization (HMO) in the Seattle, Washington, area. The U.S. sample included in the present study consisted of the first time participants in the 1984 assessment of the Seattle Longitudinal Study.

Measures

Intelligence measure. The five tests used to measure mental abilities of both U.S. and Chinese subjects were Inductive Reasoning, Number, Space, Verbal Meaning, and Word

Fluency (Thurstone, 1958). The tests for Numerical, Spatial, and Inductive Reasoning did not require modification for the Chinese participants. However, Verbal Meaning and Word Fluency abilities were modified and adapted in close consultation between the Chinese and American investigators.

Environmental measure. The Life Complexity Inventory (LCI) examines a broad range of adult activities and interests and includes data on interpersonal, work, social, structural, and cultural aspects of the participants' environment. These variables include basic demographic information, home environment questions, characteristics of the work or home-making environment, neighborhood composition, travel, mobility, reading activities, continued educational pursuits and social network data (see Gribbin, Schaie, & Parham, 1980 and Schaie, 1996, for greater detail). Table 1 describes the specific variables from the LCI used for this study.

The LCI questionnaire was also adapted and modified for the Chinese subjects. Several Chinese demographic characteristics (e.g., occupational status and income) of the LCI were modified to take into account cultural differences.

The instructions for these measures were translated using bilingual Chinese translators, and the Chinese testers were trained to administer the inventory following the same protocol as used in the Seattle Longitudinal Study (SLS).

Table 1: Life Complexity Variables

Variable Description	Variable Label
Marital status (Married or Unmarried)	Marriage
Occupation	Occupation
Income	Income
Educational level	Education
Changes in households during the last 5 years	Household
Changes in jobs during the last 5 years	Job
Changes in professions during the last 5 years	Profession
Number of neighbors you confide in	Neighbor
Number of visits to people not in your neighborhood	Visit
Number of people you can confide in	Confidant
Number of friends	Friend
Ownhome	Ownhome
Types of home	Housing
Amount of art objects in home	Art
Number of books in the home	Book
Number of rooms in home	Room
Quality of air in the neighborhood	Air
Number of trees in neighborhood	Tree
Noise level in the neighborhood	Noise
Live near transportation	Transport
Number of books read in the last month	BookRead
Number of magazines read in the last month	Magazine
Read newspapers	Newspaper
Number of educational courses taken	Courses
Work status (coded as working vs. not working)	Worknow
Percentage of work hours spent reading	HourRead
Percentage of work hours using hands	HourHand
Percentage of work hours spent with people	HourPeople
People work with	Employee
Work speed	WorkSpeed
Work under time pressure	Pressure
Place where work occurs	WorkWhere
Variety of work tasks	WorkTask
Variety of work methods	WorkMethod

RESULTS

The study attempted to derive a measurement model for the structure of the LCI questionnaire that fits well for both the Chinese and the American data sets. Exploratory factor analysis was conducted first on the U.S. group using SAS with a maximum likelihood solution. Confirmatory factor analysis was also conducted to determine how well each indicator fits the underlying concepts. LISREL 8, (for further discussion of the method, see Jöreskog, 1971; Jöreskog & Sorbom, 1984, 1993), the software package for structural equation modeling, was used to confirm factor structures. Results revealed several identifiable factors that represented the expected environmental dimensions. The factors were labeled Status, Physical Environment, Social Network, and Mobility (see Table 2 for description of these factors).

The final LCI LISREL model was replicated in the Chinese sample to confirm factor structures and evaluate equivalence between the two cultures. Factorial invariance analyses were conducted as a test of equivalence of measures across cultures. Given the expected differences between the two cultures, the pattern of loadings was found to be moderately invariant (RMSEA=.03; NNFI=.83; CFI=.86). Because the likelihood ratio test is sensitive to sample size, the

Chi-square significance test was not relied upon as an indication of model fit (Cudeck & Henly, 1991; Bollen, 1990).

Table 2

LISREL Maximum Likelihood Estimates for Final LCI Model for U.S. Sample

Variable	Status	Mobility	Social Network	Physical Environment	Unique Variance
Marriage	.56				.67
Occupation	.45				.80
Income	.62				.62
Housing	.21				.95
Household		.84			.30
Job		.63			.60
Profession		.38			.63
Neighbor			.42		.83
Visit			.42		.82
Confidant			-.54		.71
Air				.27	.93
Tree				-.95	.10
Noise				-.39	.85
Transport				.01	.98

Factor Intercorrelations

	Status	Mobility	Social Network
Status			
Mobility	-.01		
Social Network	-.01	-.03	
Physical Environment	-.06	.14	.03

Another model was tested to see if the magnitude of the factor loadings could be constrained to be equal across the two groups. Results indicated a statistically significant reduction in fit (RMSEA=.06; NNFI=.50, CFI=.57). Confidence intervals around individual factor loadings were examined to identify parameters causing differences. Several loadings

were identified as responsible for the cross-cultural differences. In particular, they were marital status, types of home, changes in household, changes in profession, neighbors confide in, people confide in, and number of trees. These markers differed in their magnitude of loadings across the groups (see Table 3 for a reported set of loadings for both groups).

Once factorial invariance had been established across the two groups, factor scores were calculated for each subject. Orthonormal transformations were used to obtain the factor scores. Hierarchical regression methods were then used to predict variations in cognitive ability for U.S. and Chinese participants. Separate hierarchical regression analyses were conducted for each cultural group with Status, Physical Environment, Mobility, and Social Network as predictors. To calculate the regression weights, factors were entered in two blocks. Status and Physical Environment were entered as the first block, followed by Social Network and Mobility as the second block to assess their unique contribution to predicting test performance.

Results indicated that environmental factors are related to cognitive functioning; however, the degree of the association is different within the two groups. Whereas Status and Physical Environment factors significantly accounted for some variance across the five PMA tests and Social Network and Mobility factors accounted for additional

small increases in variance for U.S. group, the pattern was not similar for the Chinese group. The Status/Physical Environment block did not significantly contribute to the prediction of Chinese PMA performance. However, the Social Network/Mobility block was significant in the prediction of test performance for the Chinese verbal, number, word fluency, and reasoning abilities (see Table 4 for patterns of prediction).

Table 3 Solution for Two-Group Analyses

Factor/Variables	U.S.	China
	Factor Loadings	
Status		
Marriage	.56	-.01*
Occupation	.45	.23
Income	.62	.44
Housing	.21	.08*
Mobility		
Household	.84	.56*
Job	.63	.95
Profession	.38	.55*
Social Network		
Neighbor	.42	.24*
Visit	.42	.69
Confidant	-.54	.78*
Physical Environment		
Air	.27	.21
Tree	-.95	-.86*
Noise	-.39	-.16
Transport	.01	-.17

* Differs significantly ($p<.05$) from U.S. group.

Table 4

Hierarchical Regression of Environmental Factors on Ability

	U.S				China			
Variable	B	*B*	R^2	ΔR^2	B	*B*	R^2	ΔR^2
Verbal								
1.Status	.39**	.82**	.16		.05	.09	.02	
Physical Environment	-.07	-.09			-.10	-.17		
2.Social Network	-.05	-.07		.05	-.14	-.17		.07
Mobility	.22**	.25**			.24**	.26**		
Space								
1.Status	.14**	.30**	.03		.04	.07	.02	
Physical Environment	-.12**	-.15**			-.11	-.18		
2.Social Network	.04	.06		.06	-.04	-.05		.02
Mobility	.25**	.28**			.15	.16		
Reasoning								
1.Status	.37**	.77**	.15		.08	.13	.08	
Physical Environment	-.07	-.08			-.09	-.14		
2.Social Network	-.09*	-.13**		.13	.04	.04		.07
Mobility	.36**	.41**			.26**	.28**		
Number								
1.Status	.23**	.47**	.06		.03	.05	.03	
Physical Environment	-.06	-.07			-.15	-.24		
2.Social Network	-.03	-.04		.00	-.05	-.06		.06
Mobility	.01	.01			.24**	.26**		
Word Fluency								
1.Status	.31**	.64**	.10		.12	.19	.01	
Physical Environment	-.09*	-.12*			-.07	-.11		
2.Social Network	.01	.01		.04	-.07	-.08		.05
Mobility	.19**	.21**			.21*	.22*		

China N = 121
U.S. N = 540

* $p < .05$
** $p < .01$

DISCUSSION

In summary, the pattern of prediction was dissimilar across cultures. This difference could either mean that the environmental dimensions serve different functions between the two cultures, or it could simply be the result of some methodological artifacts such as sampling and measurement techniques. For example, sample size could be a legitimate reason in explaining the cross-cultural differences. Perhaps results may reveal a more similar pattern if the Chinese sample size was larger or the cell sizes were the same as the U.S. group. Another potential explanation could be attributed to the partial invariance observed in the magnitude of loadings. These differences may point to some important distinctions between the forms of the LCI environmental factors, and consequently, could lead to some difficulties in comparing measures and interpreting results. Thus, caution is warranted when making interpretations of these causal directions.

Perhaps the environment plays an important role in the prediction of cognitive ability, but it could be even more important for other domains. Environment may effect other areas of life such as personality, life and work satisfaction, or health. There needs to be much better documentation of the extent and type of environment that

describes the complexities of the relationships among environmental factors and other aspects of personal functioning. This study represents only an initial step toward the cross-cultural analysis of cognitive functioning as predicted by environmental factors. Further research may take many different directions. However, one such direction would be to replicate the current study in other countries other than the United States and China. Hence, confirming and increasing the culture-general nature of the LCI environmental dimensions.

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