# Towards a Cross-Cultural Neuropsychology

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ABSTRACT

This article suggests that cross-cultural neuropsychology may provide to behavioral neurosciences a more accurate understanding of brain organization of cognitive processes under normal and abnormal conditions. The influence of a vast array of moderating variables, including culture, ecological demands, and educational performance, is emphasized. Different cultural environmental contexts result in the development of different patterns of abilities. Taking as an example the spatial abilities, this article notes that the application of basic cognitive abilities may have evolved with new living and cultural conditions; and currently, they are applied to some previously non-existing conceptual abilities. Educational level has been observed to represent a crucial variable in neuropsychological test performance. However, as a consequence of the low ceiling of most neuropsychological tests, educational effects represent a negatively accelerated curve, tending to a plateau. Finally, this article emphasizes that the evaluation of an alien cultural group using our current neuropsychological instruments, procedures, and norms may result in serious conceptual errors in assessment.

## Introduction

During recent years, neuropsychology has tremendously advanced in some specific areas. The assessment of the sequelae of brain pathology (e.g., Lezak, 1995) and the establishment of clinical/anatomical correlations for different neuropsychological syndromes (e.g., Damasio et al., 1989; Kertesz, 1994) represent just two examples. However, our fundamental and basic knowledge about brain organization of cognition under normal and pathological conditions is still scarce. Theorization is evidently poor. Sufficiently strong mathematical procedures have not been applied yet to the analysis of the structure of cognitive activity in neuropsychology. Neuropsychology has barely dealt with individual differences in cognitive performance (e.g., Hartlage et al., 1985; Vernon, 1994). And our understanding of cultural differences is, to be optimistic, very limited (see Ardila, 1995; Helm, 1992). Matthews (1992, p. 421), in his International Neuropsychological Society presidential address, stated that "a very limited kind of neuropsychology, appropriate to only a fraction of the world's population, is presented to the rest of the world as if there

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could be no other kind of neuropsychology, and as if the education and cultural assumptions on which ... neuropsychology is based were obviously universals that applied everywhere in the world."

Cross-cultural neuropsychology represents a potentially important approach for neuropsychology. This cross-cultural analysis may give us a better understanding of brain organization under both normal and abnormal conditions (see Ardila, 1993a, 1995).

For many years, anthropology and linguistics have attempted to find out basic and universal ways of social organization in different human groups (see Van den Berghe, 1979), and fundamental language characteristics (see Greenberg, 1978; Hagege, 1982). Attempts have been made to infer social organization of prehistoric humans and languages existing before living languages. An excellent example of this last point is the reconstruction obtained for the Indo-European language (see Anderson, 1973; Lehmann, 1974; Martinet, 1975), whose last speaker passed away several thousand years ago. And efforts have been made to reconstruct even older proto-languages (see Shevoroshkin, 1990).

Anthropology and linguistics have used three different approaches in their attempts to reconstruct the way of life and the languages of prehistoric people:

1. Archeological findings are used as elements to reconstruct prehistoric ways of life.
2. Via comparison of prehistoric to existing human groups, we can find some common social, behavioral, and linguistic characteristics. Such characteristics probably are the result of our specific biological adaptation, and can be considered universals (see Greenberg, 1978; Wilson, 1975).
3. By taking existing cultures and/or living languages, similar in a specific parameter to prehistoric cultures and/or languages, we can project how prehistoric living forms and language characteristics might have been with regard to that particular parameter. The validity of this last approach is highly questionable, but it is still used due to lack of sufficient alternative methods.

All three approaches also have been used in neuropsychological research, although in a restricted way, as follows:

i. An attempt can be made to reconstruct how certain neuropsychological characteristics may have been several thousand years ago, based on some archeological findings. For instance, handedness in Neolithic humans may be analyzed from pictorial sites (see Spennenann, 1984).
ii. Commonality among existing groups can be analyzed. For example, aphasic language disturbances throughout different world languages can be compared—in pursuit of common characteristics, and, consequently, basic brain language organization (see Bates et al., 1987a, 1987b; Bates et al., 1988; Menn et al., 1990).
iii. Some neuropsychological variables in living human groups, similar in a specific parameter to prehistoric humans, may be studied. For instance, we might analyze illiteracy in an attempt to figure out how linguistic or praxic abilities were in pre-writing societies (e.g., Ardila et al, 1989; Rosselli et al. 1990; Lecours et al., 1987, 1988), or constructional abilities among stone age-like Amazonian Indians (Pontius, 1989).

Interest in obtaining a better understanding of cultural issues in the neuropsychology realm is not completely new (see, e.g., Luria, 1934, 1976). To summarize, during recent years a small but significant number of papers devoted directly or indirectly to the analysis of cultural variables on neuropsychological performance have been recorded in literature: bilingualism research (e.g., Albert et al., 1978; Dupont et al., 1992; Paradis, 1987; Vaid, 1986), studies on illiteracy (e.g., Ardila et al, 1989; Lecours et al., 1987, 1988; Matute, 1988; Rosselli, 1993; Rosselli et al, 1990), cross-linguistic analysis of aphasia (see above references for Bates et al., and for Menn et al.), research about the influence of socioeducational factors in neuropsychological performance (e.g., Ardila et al, 1992; Ardila et al, 1994a; Ostrosky et al, 1985), and studies on cultural variables on handedness (e.g., Ardila et al, 1989; Bryden, 1987; Bryden et al, 1993; Harris, 1990). We look at cultural variables in more detail in the next section.

## Cultural Variables in Neuropsychological Performance

Cognitive abilities usually measured in neuropsychological tests represent, at least in their contents, learned abilities; and scores will correlate with the subject's learning opportunities and contextual experiences. Furthermore, culture dictates what is and what is not situationally relevant. What is relevant, and worth learning for an Amazonian Indian, does not necessarily coincide with what is relevant and worth learning for an inhabitant of New York or Islamabad. A culture provides specific models for ways of thinking, acting, and feeling, and cultural variations in cognitive test scores are evident (see Anastasi, 1988; Irvine et al, 1988).

In neuropsychology, cognitive disturbances associated with brain pathology of a very limited subsample of the human species (contemporary Western—most often, urban middle-class, and literate—brain-damaged individuals) have been relatively well analyzed. Our understanding about the brain's organization of cognitive abilities, and their disturbances in cases of brain pathology, is therefore not only partial but, undoubtedly, culturally biased. Several thousands of different cultures have been described by anthropology (see Bernatzik, 1957), and contemporary humans speak over 3,500 different languages (see Swadesh, 1967) Just as an example, in Colombia, South America (population about 35 million inhabitants), 62 Indian languages, and 84 Indian cultural groups have been reported. In addition, four different "Hispanic" subcultures have been described by anthropology (Gutierrez de Pineda, 1965). Evidently, norms for performance in a sufficiently broad array of neuropsychological tests, and an extended analysis of cognitive disturbances in different cultural and ecological contexts, are necessary for us to understand and serve the neuropsychological needs of our constituency.

### *Cognition in Different Cultural Groups*

Supposedly, comparable cognitive disturbances are to be found in every human species member—regardless of the cultural background, educational level, and ecological demands—as a consequence of brain lesions. There are some fundamental characteristics in the human brain and in brain-behavior relationships that could be expected to be observed in every human subject. Basic cognitive processes are universal, and cultural differences in cognition reside more in the situations to which particular cognitive processes are applied than in the existence of the process in one cultural group and the absence in the other. Culture pre-

scribes what should be learned and at what age. Consequently, different cultural environments lead to the development of different patterns of abilities. Cultural and ecological factors play a role in developing different cognitive styles (see Berry, 1979).

Cultural variables can eventually influence the brain's organization of cognition. For example, it has been reported that the degree (not the direction) of brain lateralization of language can depend on literacy, and in general, on verbal training histories (Lecours et al, 1987, 1988; Matute, 1988). We can reasonably suppose that the degree of lateralization of other cognitive abilities will also depend on a person's learning history. At least some spatial disturbances (e.g., hemi-spatial neglect) have been reported to be more frequently associated with left-hemisphere pathology in individuals with a history of low verbal training (but normal, and sometimes superior, training in spatial abilities) (Rosselli et al, 1985).

If, in addition to some existing basic characteristics in brain organization, oral and written language disturbances are associated with language idiosyncrasies (e.g., aphasia is not completely equivalent in Chinese and Spanish; alexia can be different in English and Japanese, etc.) (Sasanuma et al, 1971; Yamadori, 1975; Yu-Huan et al, 1990), then other cognitive abilities—for instance, spatial cognition disturbances—also depend on specific ability learning histories.

### *Spatial Cognition: Illustrative Examples*

Cross-cultural differences in spatial orientation under normal and pathological conditions could be illustrative. Furthermore, they could shed some light on the potential spatial abilities that contemporary humana possess. Brain organization of spatial abilities under pathological conditions has been extensively studied in contemporary schooled Western (particularly European and North American) people. To the best of my knowledge, however, no clinical observation about disturbances in spatial abilities associated with brain pathology in other (non-Western) culture has ever been reported.

Perceptual constancy (stability of perception despite changes in the actual characteristics of the stimuli) represents the most fundamental ability in the interpretation of the surrounding spatial environment (Ardila, 1980). Cross-cultural comparisons have in general demonstrated that size and shape constancy is more accurate in low-schooled and non-Western societies people than in literate and Westernized subjects (Pick et al, 1978). Beveridge (1940) demonstrated a greater constancy of shape and size among West African adults than among British adults. Myambo (1972) observed an almost perfect shape constancy in uneducated Malawi adults, whereas the educated Africans and Europeans did not perform so accurately. Perceptual constancy may be expected to have been high (and crucial for survival) not only in prehistoric people, but also in people currently requiring a complex interpretation of the surrounding spatial environment.

People living in different environments develop different systems of spatial reference (rivers, mountains, sun position, streets, buildings, etc.). Geographic features affect the terms of local reference systems, and differences in reference systems may, in turn, be related to differences in perception of spatial orientation (Pick et al, 1978). An analysis of different reference systems is useful.

Gladwin (1970) analyzed the system used by Puluwat sailors to navigate among clusters of islands in the Western Pacific. He found that many different features of the sea and sky comprise the information of which the system is based. Knowledge of the habits of local

sea birds provide cues for one's location. The sailors learn to detect changes in coral reef formation, which of course depend on conditions of weather, sea, and sky. Ability to detect change in the "feel" of the boat moving through the waves on a particular course is a skill used to maintain a course. There is a complex reference system based on the position and patterns of stars in the night sky; the rules for navigating between specific islands are described in terms of the star patterns and islands. Parallax information is also explicitly included in the system as descriptions of the way in which islands "move" as the boat passes around one or the other side of them (Pick et al, 1978).

Amazonian Indians simultaneously use a variety of different types of information to move around in the jungle. They use small rivers, orientation and color of trees, soil characteristics, sun position, animal routes, olfactory cues, and many other signals. Vegetation is mildly different when closer to rivers; moss grows differently in trees according to the sun's exposure; the direction of river-flows is different. Additionally, when moving in the jungle, the Amazonians break small bush branches in order to recognize later that they have already crossed that particular point, and approximately how long ago. All of these environmental signals are simultaneously interpreted for orientation in the jungle.

Members of different cultures and dwelling in different spatial environments operate in terms of complex spatial reference systems. Demands and geographic environment obviously were quite different in paleolithic times in comparison to contemporary city life. Spatial orientation and reference systems used by prehistoric people seem closer to those of Puluwat sailors or Amazonian Indians.

### *Cultural Differences in "Visuoperceptual" Abilities*

Brislin (1983) and Segall (1986) have applied cross-cultural studies in perception to help understand perceptual skills in prehistoric people (see also Laboratory of Comparative Human Cognition, 1983). Hudson (1960, 1962) studied depth perception using pictures that contained figures of an elephant, an antelope, and a man with a spear; the basic question referred to what the man was doing with the spear. There were four pictures differing with respect to the cues available for the interpretation of the picture. This set of pictures was used with different groups of people from Africa and Europe. It was observed that European children around seven to eight years have great difficulty perceiving the picture as three-dimensional. However, around twelve years of age, virtually all the children perceived the picture as three-dimensional. Not so with Bantu or Guinean children. Nonliterate Bantu and European laborers responded to the picture as flat, not three-dimensional. They cannot interpret represented-on-a-paper three-dimensional figures; this also holds true in general for illiterate people (Ardila et al, 1989). However, as mentioned above, illiterate African people do better than Western literate subjects in perceptual constancy tasks with real objects.

Berry (1971, 1979) proposes that hunters with specific ecological demands usually have a good capacity for visual discrimination and excellent spatial skills. The embedded figures test, for instance, is better performed by cultural groups for whom hunting is important for survival. Berry emphasizes that ecological demands and cultural practices are significantly related to the development of perceptual and cognitive skills. An example of a specific culture-dependent cognitive skill was reported by Gay and Cole (1967): when Kpelle farmers are contrasted with American working class, the former are considerably more accurate in estimating the amount of rice on several bowls of different sizes containing different amounts

of rice. By the same token, any cattle farmer is able to calculate accurately the weight of a cow; any dactilographist can easily and quickly distinguish two different fingerprints; any neurologist can distinguish a Parkinsonian patient at one glance. Demands and training history are strongly associated with "visuoperceptual" abilities.

Nonetheless, the spatial abilities of contemporary city people are not necessarily inferior to those of prehistoric or Amazonian peoples. Spatial abilities may have evolved with new living and cultural conditions just as spoken language has evolved and been extended via the development of new cultural conditions, e.g., through written language. Spatial abilities can be required in many contemporary conceptual, and historically recent, skills (Ardila, 1993b). I had the opportunity to study a chemistry university professor who suffered a small right-parietal infarction. Although she did not have any evident spatial difficulty in her everyday activities, she could not continue teaching chemistry because she was "unable to have a spatial representation of molecules and all the time got confused." Mathematics (see Ardila et al, 1990, 1994b; Luria, 1977), painting, playing chess (see Chabris et al, 1992), reading and writing (see Ardila et al, 1993; Ardila et al, 1994c; Benson et al, 1995), mechanics (see Benton, 1989), and even music all represent, at least partially, spatially-based skills. Such capacities can be impaired in cases of right hemisphere damage -- to those very same areas that in an Eskimo or Amazonian Indian might result in an inability to move around the snow or the jungle (Ardila, 1993b).

## Educational Variables

Educational level has been observed to represent yet another influential variable of neuropsychological test performance (Ardila et al, 1989; Ardila et al, 1994; Lezak, 1995; Ostrosky et al, 1985, 1986; Rosselli et al, 1991, 1993; Rosselli et al, 1990; Spreen et al, 1991). However, some tests are notoriously more sensitive to educational variables (e.g., language tests) than are others -- for example the Wisconsin Card Sorting Test (Rosselli et al, 1993). Extremely low scores in currently used neuropsychological tests are observed in illiterate people (Rosselli, 1993). But low scores in neuropsychological tests observed in illiterates result partially from not only differences in learning opportunities but also because illiterates are not used to being tested (i.e., they have not learned how to behave in a testing situation). For many illiterates, testing itself represents a nonsense (nonrelevant) situation.

Frequently, educational and cultural variables are not clearly distinguished, and differences resulting from educational variables are often attributed to cultural (and even ethnic) factors. Differences in test performance between "Anglos" and "Hispanics" (or other cultural or subcultural groups) in the United States are easily attributed to cultural variables. But most often, differences are simply the result of differences in educational levels.

The influence of educational variables on test performance represents a well established observation not only in psychology (see, e.g., Anastasi, 1988; Cronbach, 1990) but in neuropsychology. This influence has been demonstrated not only in normal (e.g., Ardila et al, 1994; Lezak, 1995; Spreen et al, 1991) but in brain-damaged populations (e.g., Matute, 1988; Lecours et al, 1988).

When neuropsychological tests are administered to normal subjects with diverse educational levels, a highly significant educational effect has usually been found (see Ardila et al, 1989; Ardila et al, 1994; Finlayson et al, 1977; Lecours et al, 1987; Ostrosky et al, 1986; Rosselli et al, 1991, 1993; Rosselli et al, 1990; Spreen et al, 1991). This educational effect,

nonetheless, is not a linear effect. Differences between zero and three years of education are highly significant; differences between three and six years of education are lower; between six and nine are even lower; and virtually no differences are expected to be found between twelve and fifteen years of education. This means that educational effects are a kind of negatively accelerated curve, tending to a plateau. The reason is simple: the ceiling in neuropsychological tests is usually low.

## Cross-Cultural Comparisons

The evaluation of an alien cultural group using our current neuropsychological instruments, procedures, and norms may result in the following conceptual or procedural errors (see Ardila, 1955):

1. The "norm" refers to the performance of a particular group. Although raw scores can be nonequivalent in different educational and cultural groups, standard normalized scores are equivalent. Each group itself represents its own norm. Tests must be standardized and norms obtained not only for different age ranges, but also for different educational and cultural groups. Otherwise, what is normal for one group might be interpreted as pathological for another. As an illustration of these differences in neuropsychological performance across different groups, a normal twenty-year-old subject with twelve or more years of formal education requires an average of 3.2 trials for recalling ten high frequency nouns sequentially presented; but a sixty-year-old illiterate individual requires on average 6.5 trials (Ardila et al, 1989).
2. A psychometric test represents a typical task, a sort of paradigm. It supposes that the task somehow exists, and furthermore, that it can be relevant for the examinee. The most relevant motor task for Amazonian Indians can be fishing (not writing), whereas for an inhabitant of New York City, it can be writing (not fishing). Nobody would suppose that spelling represents a significant task in the Chinese language (due to the fact that spelling simply does not exist in Chinese ideograms). In the Spanish language, spelling is a totally artificial and irrelevant task (because Spanish is a phonographemic writing system). In other words, we have to know what is relevant, and even, what is extant, in a particular neuropsychological domain. Most often, psychological and neuropsychological tests reflect the examiner's cultural demands and his/her own interpretation of the world. Cultures must be analyzed "from inside." Therefore, native but well-trained members of other cultures or subcultures should always be included when carrying out cross-cultural analyses. Whenever a cross-cultural comparison is established, better scores are observed in the cultural group responsible for the development of the test. The reason for this seems quite obvious.
3. If a different cultural or subcultural group obtains decreased scores in a neuropsychological test battery, this may simply mean that the examiner has failed in finding the relevant tasks to be used with that new cultural or subcultural group. At the same time, most likely the examiner's own cultural group will obtain decreased scores in those tasks that are relevant and well-learned in the alien cultural or subcultural group. If an Amazonian Indian neuropsychologist developed a test battery

including tests such as fishing, going around the jungle, using a spear, and naming jungle animals, most likely North American subjects would score several standard deviations below the Indian norm. The North American subjects, however, would do better in those tests generally used by mainstream neuropsychologists: recognizing people in photographs, memorizing digits, naming a baseball bat, spelling a difficult word, or telling time on a clock.

4. People in European and North American countries commonly accept testing. This is not the case in other countries and cultures. Furthermore, one's attitude toward the testing situation can significantly influence one's test performance (Anastasi, 1988).
5. Testing itself supposes that the subject will try to perform the different tasks in order to obtain a good score; that is, that some achievement motivation exists. This is not necessarily true to the same extent in every culture.

No doubt, cross-cultural neuropsychology represents a critical new direction of research, and will challenge neuropsychologists in the 21st century.

## Some Tentative Conclusions

In view of the above mentioned considerations, we can conclude that:

1. Some methods used in anthropology and linguistics research may also be potentially useful in neuropsychology research.
2. Scores in neuropsychological tests correlate with the subject's learning opportunities and cultural experiences. Culture dictates what is and what is not relevant, and worth learning.
3. Basic cognitive processes are universal, and cultural differences in cognition reside more in the situations to which particular cognitive processes are applied. Cultural and ecological factors play a role in developing different cognitive styles.
4. The application of basic cognitive abilities may have evolved with new living and cultural conditions. As an example, spatial abilities, formerly used simply to get oriented in various three-dimensional areas such as fields and jungles, may now be required by city people for many historically recent skills, including mathematics, playing chess, painting, reading, writing, chemistry, mechanics, music, etc.
5. Educational level has been observed to represent an influential and highly significant variable in neuropsychological test performance. This educational effect, nonetheless, is not a linear effect. As a consequence of the low ceiling of the neuropsychological tests, it is rather a negatively accelerated curve, tending to a plateau.
6. The evaluation of an alien cultural group via our neuropsychological instruments, procedures, and norms may result in serious conceptual errors.

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