

Chapter

CROSS-CULTURAL NEUROPSYCHOLOGY

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ABSTRACT

In this chapter, an attempt is made to summarize the major cultural variables affecting cognitive test performance. Initially, a definition of culture is presented. Further, it is analyzed why culture affects cognitive test performance; It is emphasized that five different cultural aspects can affect neuropsychological test performance: (1) patterns of abilities, (2) cultural values, (3) familiarity, (4) language, and (5) education. Each one of them is reviewed and discussed. In the following section issues related with the cognitive testing of so-called “minority groups” is analyzed, to conclude that there are not obvious answers to questions such as, how to carry the testing, what specific tests to use, and what conclusions can potentially be drawn from the testing results. In the final section the issue of norms in different national and cultural groups is reviewed to conclude that understanding the variables that can affect cognitive test performance seems to be as important as obtaining a large number of norms in different linguistic and cultural groups.

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INTRODUCTION

In neuropsychology, cognitive disturbances associated with brain pathology of a limited subsample of the human species --contemporary Western, and 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 the disturbances in cases of brain pathology, is therefore not only partial but, undoubtedly, culturally biased (Ardila, 1995, 2012; Fletcher-Janzen, Strickland & Reynolds, 2000; Uzzell, Pontón & Ardila, 2007).

Cultural and linguistic diversity is an enormous, but frequently overlooked, moderating variable. Several thousands of different cultures have been described by anthropology (e.g., Bernatzik, 1957; Rosaldo, 1993), and contemporary humans speak over 6,800 different languages (Grimes, 2000; www.ethnologue.com). 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 the brain organization and evolution of cognition.

A significant interest in understanding cultural variables in neuropsychology has been observed since the 1980's and particularly since the 1990's (e.g., Ardila, 1993, 1995; Boivin & Giordani, 2009; Chen et al., 2009; Choudhury et al., 2010; Ferraro, 2002; Fletcher-Janzen et al., 2000; Nell, 2000; Ostrosky-Solís & Öberg, 2006; Rendell et al., 2011; Uzzell et al., 2007).

Different questions have been approached including but not limited to: Bilingualism research; historical origins of cognition; studies on illiteracy; cross-linguistic analysis of aphasia, alexia and agraphia; research about the influence of socioeducational factors in neuropsychological performance; norms in different national and cultural groups; studies on cultural variables on handedness; neuropsychological assessment and treatment in diverse human groups; analysis of neuropsychological test bias; cultural application of different neuropsychological test batteries; legal and forensic significance of cultural factors; and cognitive abilities in different cultural contexts.

In this chapter, an attempt will be made to summarize the major cultural variables affecting cognitive test performance. I will attempt to integrate some ideas previously presented in different publications (Ardila, 1993, 1995, 1996, 1999, 2003, 2007; Ardila et al., 2000a, 2000b, 2010; Ardila, Rodriguez & Rosselli, 2003; Harris et al., 2001; Ostrosky et al., 1998; Puente & Ardila, 2000).

WHAT IS CULTURE?

Culture refers to the set of learned traditions and living styles, shared by the members of a society. It includes the ways of thinking, feeling and behaving (Harris, 1983). The minimal definition of culture could simply be, *culture is the specific way of living of a human group*.

Three different dimensions of culture can be distinguished: (1) *The internal, subjective or psychological representation of culture*, including thinking, feeling, knowledge, values, attitudes, and beliefs. (2) *The behavioral dimension*, including the ways to relate with others, ways of behaving in different contexts and circumstances, festivities and meeting, patterns of associations, etc. (3) *Cultural elements*: the physical elements characteristic of that human group such as symbolic elements, clothes, ornaments, houses, instruments, weapons, etc.

Culture represents a particular way to adapt to and survive in a specific context. Cultural differences are strongly related with environmental differences. Eskimo and Amazonian jungle culture differences are in a significant extent due to the geographical and environmental differences between the Arctic region and the Amazonian jungle. Cultures, however, are usually in some contact and a significant cultural diffusion is generally observed. Cultural evolution and cultural changes are found throughout human history, depending upon, (a) new environmental conditions, (b) contact with other cultures, and (c) internal cultural evolution. For example, Gypsies in Russia and Gypsies in Spain have many cultural commonalities, but also many differences.

Cultures can be grouped into branches using different criteria, but mainly, their origins (e.g., Latin cultures, Anglo-Saxon cultures, Islamic cultures, Amerindian cultures, etc.). When comparing two cultures, certain *relative distance* could be assumed. For instance, the cultural distance between Mediterranean cultures and Anglo-Saxon cultures is lower than the cultural distance between the Mediterranean cultures and the Amerindian cultures. This means that Mediterranean people have more attitudes, beliefs, behaviors, and physical elements in common with Anglo-Saxons than with Amerindians.

Certain cultural elements have been particularly successful and have tended to strongly diffuse across cultures. For instance, science and technology have been extremely successful in solving different human problems and have, in consequence, tended to spread throughout virtually all-existing worldwide cultures. In this regard, contemporary man has tended to

become more homogeneous and to share the culture of science and technology. To live in Peking and New York is not so different today as it was living in Tashkent and Rome several centuries ago. Furthermore, communication is faster today than it was anytime in history and cultural diffusion has become particularly fast.

Formal education and school have played a crucial role in the diffusion of science and technology and in the contemporary trend toward the relative cultural homogenization. In this regard, school can be considered as a subculture, the subculture of school (Ardila, Ostrosky & Mendoza, 2000). School not only provides some common knowledge but also trains some abilities and develops certain attitudes. Cognitive testing is obviously based on those assumptions as well as values of scientific and technologically-oriented societies. Schooled children usually share more scientific and technological values and attitudes than their lower educated parents, and schooled subjects significantly outperform illiterate individuals in cognitive testing (e.g., Ardila et al., 2010; Ostrosky, Ardila, Rosselli, López-Arango & Uriel-Mendoza, 1999; Reis, Guerreiro & Petersson, 2003; Rosselli, 1993).

WHY CULTURE AFFECTS COGNITIVE TEST PERFORMANCE?

Cross-cultural cognitive testing has been a polemic matter because cognitive assessment uses certain strategies and elements that are not necessarily shared by every culture (Laboratory of Comparative Human Cognition, 1983). Greenfield (1997) has pointed out that there are three different reasons to account why cognitive ability assessments do not cross cultures: (1) Values and meanings, (2) modes of knowing, (3) and conventions of communication.

“Values and meanings” means that there is not a general agreement on the value or merit of particular responses to particular questions. For example, some people may consider that in the Raven’s Progressive Matrices test, it is a better answer that one following an aesthetic principle (i.e., the figure that looks better in that position) than the one according to a conceptual principle (i.e., the figure that continues the sequence). Furthermore, the same items do not necessarily have the same meaning in different cultures, regardless of how appropriate and accurate the translation is. An item referring to the protection of animals may have a rather different

meaning in Europe than in a hunting society. The question “Why should people pay taxes?” may trigger quite different associations in a society where people consider that taxes are fairly expended than in a society where people think that taxes are misused.

“Knowing” may be a collective endeavor and not an individual task. Many collective societies find it surprising that the testing situation requires individual’s responses without the participation of the social group. If most activities are carried out in a collective way, why should answering a test be the exception? Many cultures, on the other hand, do not make a distinction between the process of knowing and the object of knowing. In consequence, questions such as “why do *you* think?”, or “why do *you* consider?” may be incomprehensible. The point is not what *I* think or *I* consider; the point is how *it is*.

“Conventions of communication” are highly culture-dependent. The test questions assume that a questioner who already has a given piece of information can sensibly ask a listener for the same information. To ask or to answer questions can be highly variable among cultures. American children, for example, learn that they should not talk to strangers, but they also learn that they should answer questions to “the doctor”, regardless that the doctor is a stranger. In many societies adults rarely talk with children (“What could you talk about with a child?”), and it is not considered appropriate for children to participate in adults’ conversations. Furthermore, relevant information is not always the same in every culture. Many types of questions can be difficult to understand. To copy nonsense figures (e.g., Rey-Osterrieth Complex Figure) can be suspicious for many people. It may be a relevant item for an American school child, but it is absurd for somebody living in a non-psychometrically oriented society. Certain question formats used in testing can be unfamiliar or less familiar in many cultures. For instance, after his first multiple-choice test, a college Haitian student in the US returned it to the instructor pointing out “I simply do not have the minimal idea of what I am supposed to do”. Conversely, I have found that American university students score notoriously lower in open-question exams than in multiple-choice formats.

Effect of culture is not limited to verbal abilities, but is also clearly found on nonverbal abilities too (Rosselli & Ardila, 2003). When nonverbal test performance in different cultural groups is compared, significant differences are evident. Performance on non-verbal tests such as copying figures, drawing maps or listening to tones can be significantly influenced by the individual’s culture.

Five different cultural aspects potentially affecting neuropsychological test performance will be emphasized: (1) patterns of abilities, (2) cultural values, (3) familiarity, (4) language, and (5) education.

Patterns of Abilities

While basic cognitive processes are universal, 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 its absence in the other (Cole, 1975). Culture prescribes what should be learned, at what age and by which gender. Consequently, different cultural environments lead to the development of different patterns of abilities (Ferguson, 1956). Cultural and ecological factors play a role in developing different cognitive styles (Berry, 1979).

Cognitive abilities usually measured in neuropsychological tests represent, at least in their contents, learned abilities whose scores correlate with the subject's learning opportunities and contextual experiences. Cultural variations are evident in test scores, as culture provides us with specific models for ways of thinking, acting and feeling (Ardila, 1995; Berry, 1979).

Cultural Values

Culture dictates what is and what is not situationally relevant and significant. What is relevant and worth to learn or to do for an Eskimo does not necessarily coincide with what is relevant and worth learning or doing for an inhabitant of the Amazonian jungle. A culture provides specific models for ways of thinking, acting and feeling, and cultural variations in cognitive test scores are evident (Anastasi, 1988).

Current neuropsychological testing uses specific conditions and strategies that may not be only unfamiliar to many people, but also may violate some cultural norms. At least the following cultural values underlay psychometrically oriented cognitive testing (Ardila, 2005):

- 1) **One-to-one relationship.** There is a tester and there is a testee. Hence, it is a one-to-one relationship between two people that very likely have never met before, are aliens, and will not meet again in the future.

- 2) **Background authority.** The testee will follow (obey) the instruction given by the tester, and hence, the tester has a background or situational authority. It is not so easy, however, to understand who and why this authority was conferred.
- 3) **Best performance.** The testee will perform at best. Performance “at best” is only done in those endeavors that are perceived and regarded as extremely important and significant. It is supposed in consequence that the testee has to perceive testing as a most important and significant endeavor. It may not be clear enough in many cultural groups why it is so important and relevant to repeat a series of nonsense digits or to draw an absurd figure.
- 4) **Isolated environment.** Testing is done in an isolated room. The door is closed and even locked. Usually, nobody else is allowed to be present, and in this regard it is a private and intimate situation. Private appointments with aliens may be quite inappropriate in many cultures. The testee has to accept this type of unusual social relationship.
- 5) **Special type of communication.** Tester and testee do not maintain a normal conversation. Tester uses a stereotyped language, repeating over and over again the same phrases in a rather formal language. Testee is not allowed to talk about him/herself. Nothing points to a normal social relationship and usual conversation. This is a type of relationship that can be different from any type of relationship existing in the subject’s past experience. For Hispanics, as an example, the personal relationship with the examiner may be more important than the test results (Geisinger, 1992). Dingfelder (2005) points out that “*The detached professional relationship that many therapists cultivate with their clients may seem alien to those Latinos that adhere to the value of close interpersonal relationship. Therapist might consider sharing some minor details of their lives with these clients, to make the clients feel more comfortable and welcome*” (p. 59).
- 6) **Speed.** In many tasks the tester warns that the testee must perform “as fast as possible” and even time is measured. In the middle of the task, however, the tester frequently interrupts saying, “stop!” For many cultural groups speed tests are frankly inappropriate. Speed and quality are contradictory, and good products are the results of a slow and careful process. Speed, competitiveness and high

productivity are most important cultural values in literate Anglo-American society, but that is not true in other cultural groups.

- 7) **Internal or subjective issues.** The tester may ask questions that can be perceived as a violation of privacy. Questions about cognitive issues (e.g., “How is your memory?”) are also questions about internal subjective representations, the most personal private sphere. Frequently, intellectual or cognitive testing may be perceived as aversive in some cultures. In Latin America, usually highly educated people dislike and try to avoid cognitive testing. Intellectual testing may even be perceived as kind of humiliating situation and disrespect to the privacy.
- 8) **Use of specific testing elements and testing strategies.** The tester uses figures, blocks, pictures, etc., and the reason for presenting them may not be easy to understand. That is, the reason may be evident for the tester (e.g., to assess memory) but not for the testee. Sometimes the tester explains that it is like a game, but there is no evident reason to come to play with this alien tester. Sometimes the tester refers to “exercises”, but exercises are by definition useless activities without any evident goal. “Exercises” are indeed “preparation for something”. Preparation for what? Furthermore, it they are just “exercises” why to perform “at best”? In brief, it is not easy to understand (and to explain) the reason to memorize meaningless digits or saying aloud “as many animal names as possible in one minute”, etc.

In summary, the rationale and the procedures used in cognitive testing rely on a whole array of cultural values that in no way can be regarded as universal values. “*When testers use tests developed in their own culture to test members of a different culture, testees often do not share the presumptions implicitly assumed by the test*” (Greenfield, 1997; p. 1115). It is not surprising that the members of the culture where the test was developed usually obtain the highest scores.

Familiarity

Familiarity with the testing situation includes not only the elements used in testing (bikes, houses, figures, stories, etc.) but also the testing environment (see above), and the cultural relevance (meaningfulness) of the

elements of the test (Ardila & Moreno, 2001). Familiarity also refers to the strategies needed to solve the task and the attitudes required to succeed. Competitiveness, for example, in many societies is viewed with suspicion. Cooperation and social ability may be far more important.

The Boston Naming Test (even the version adapted in Spain) includes naming a beaver and an acorn, an animal unfamiliar for people living in South America and a virtually unknown plant. North American people very likely would consider it unfair to be tested by naming South American animals and plants. The Boston Naming Test also includes a pretzel, a most typical American element but totally unknown in most countries. Obviously, it would also be frankly unfair to test naming ability in American subjects using tortillas or tacos as stimuli. Figures representing snow may be unfamiliar for people living in tropical and sub-tropical areas.

Cultural relevance (meaningfulness) may be another significant confounding factor in cross-cultural neuropsychological testing. Items developed in a particular cultural context do not have the same relevance when translated to another culture. Spelling out words (frequently included in the Mini-Mental State Exam) is not used in languages with phonological writing systems (such as Russian, Italian or Spanish), and hence it is perceived as an artificial task. In many world cities, people get oriented using cardinal points (North, South, West, and East) but in no way is this strategy found in every culture. I personally do not know where is North, South, West, and East in my Colombian hometown simply because I never used it. People in Barcelona (Spain) use to spatial directions: “toward the sea” and “toward the mountain”. People in Colombia frequently use “up” and “down”, referring to the numbering system, but “up” and “down” in Guadalajara (México) mean “from downtown” and “toward downtown”. The Picture Arrangement subtest from the Wechsler Intelligence Scale may have different levels of difficulty in different cultural contexts, depending on the familiarity with the story’s elements. Something may be obvious in a culture, but unusual and weird in another.

Language

Language plays an instrumental role in cognition (Vygotsky, 1962, 1989). As a matter of fact, it represents the major cognitive instrument. Different languages differ in phonology, lexicon (semantic field of the words), grammar, pragmatic, and reading systems. These differences may

affect language test performance. Different languages conceptualize the world in a different way (Whorf, 1956). For instance, the notion of time is quite different in Latin languages than in Germanic ones. Latin languages have a significantly high number of tenses pointing to some temporal nuances. Slavic languages use perfective and non perfective tenses in verbs. Space and casualty are also coded different in different languages.

Language usage differs according to the cultural (and subcultural) background and strongly correlates with the subject's educational level. Sometimes, test instructions (and in general, the language used in testing) are given in a formal language, which may be very difficult to understand for individuals with limited education. Formal language represents a sort of academic language, most often found in a written form that many people neither use nor completely understand. A permanent effort is required to make test instructions and, in general, test language understandable for less educated people and appropriate for different cultural and subcultural groups.

Education

Education plays a double role in test performance: school, on one hand, provides some contents frequently included in cognitive tests; and school, on the other hand, trains some learning strategies and develops positive attitudes towards intellectual matters and intellectual testing. In consequence, school could be considered as a subculture into itself. Greenfield (1997) has emphasized that *“A major (probably the major) factor that makes a culture more or less different from the cultural conventions surrounding ability testing is the degree of formal education possessed by the participants”* (p. 1119).

Learning to read reinforces certain fundamental abilities, such as verbal memory, phonological awareness, and visuospatial discrimination (Ardila, Ostrosky & Mendoza, 2000; Ardila et al., 2010). It is not surprising that illiterate people underscore in cognitive tests tapping these abilities. Furthermore, attending school also reinforces certain attitudes and values that may speed the learning process, such as the attitude that memorizing information is important, knowledge is highly valuable, learning is a stepwise process moving from the simpler to more complex, etc. It has been emphasized that schooling improves an individual's ability to explain the basis of performance on cognitive tasks (Laboratory of Comparative Human Cognition, 1983). The fundamental aims of schools are equivalent for all

schools and school reinforces certain specific values regardless of where they are located. Hence, school could be seen as a culture unto itself, a transnational culture, the culture of school. School not only teaches, but also helps in developing certain strategies and attitudes that will be useful for future new learnings. Ciborowski (1979) observed that schooled and non schooled children can learn a new rule equally well, but once acquired, schooled children tend to apply it more frequently in subsequent similar cases.

Interestingly, education is not related with the ability to solve everyday problems. Cornelious and Caspi (1987) found that educational level has a substantial relationship with performance on verbal meaning tests but was not systematically related to everyday problem solving (i.e., functional criterion of intelligence). Craik, Byrd, and Swason (1987) observed that differences in memory loss during aging are related to socioeconomic status. Ardila and Rosselli (1989) reported that during normal aging the educational variable was even more influential on neuropsychological performance than the age variable. Albert and Heaton (1988) argue that, when education is controlled, there is no longer evidence of an age-related decline in verbal intelligence.

A significantly decreased neuropsychological test performance has been documented in illiterate individuals (Ardila, 2000; Ardila et al., 1989, 2010; Goldblum & Matute, 1986; Lecours et al. 1987a, 1987b, 1988; Manly et al., 1999; Matute et al., 2000; Ostrosky et al., 1998; Reis & Castro-Caldas, 1997; Reis, Guerreiro & Petersson, 2003). Rosselli, et al., 1990). Lower scores are observed in most cognitive domains, including, naming, verbal fluency, verbal memory, visuoperceptual abilities, conceptual functions, and numerical abilities. Language repetition can be normal for meaningful words, but abnormal for pseudowords (Reis & Castro-Caldas, 1997; Rosselli et al., 1990). Similarly, copying meaningful figures can be easier than copying nonsense figures (Ostrosky et al., 1998). Furthermore, for illiterate people to use concrete situations can be notoriously easier than using non-real and abstract elements. When the information is related to real life, it can be significantly easier to understand. Thus, for the illiterate person, it is easier to solve the arithmetical operation “If you go to the market and initially buy 12 tomatoes and place them in a bag and later on, you decide to buy 15 additional tomatoes, how many tomatoes will you have in your bag?” than the operation: “How much is 12 plus 15?” Semantic verbal fluency is easier than phonological verbal fluency (Reis & Castro-Caldas, 1997; Rosselli et al., 1990), seemingly because phonological abstraction is extremely difficult

for the illiterate person. Semantic verbal fluency requires the use of concrete elements (animals, fruits) whereas phonological fluency is tapping a metalinguistic ability. The very low scores observed in neuropsychological tests in illiterates can be partially due to differences in learning opportunities of those abilities that the examiner considers most relevant, although, they are not the really relevant abilities for illiterates' survival. They can be also due to the fact that illiterates are not used to being tested. Furthermore, testing itself represents a nonsense situation that illiterate people may find surprising and absurd. This lack of familiarity with a testing situation represents a confounding variable when testing individuals with limited education.

Several studies have demonstrated a strong association between educational level and performance on various neuropsychological measures (e.g., Ardila, Rosselli & Ostrosky, 1992; Bornstein & Suga, 1988; Finlayson, Johnson & Reitan, 1977; Heaton, Grant & Mathews, 1986; Leckliter & Matarazzo, 1989; Ostrosky et al., 1985, 1986). However, some tests are notoriously more sensitive to educational variables (e.g., language understanding tests) than others (e.g., orientation tests). Extremely low scores in current neuropsychological tests are observed in illiterate people (e.g., Ardila, Rosselli & Rosas, 1989; Rosselli, Ardila & Rosas, 1990). Low scores in neuropsychological tests observed in illiterates can be partially due not only to differences in learning opportunities of those abilities that the examiner considers relevant (although, evidently, they are not the really relevant abilities for illiterates' survival) and to the fact that illiterates are not used to being tested (i.e., they have not learned how to behave in a testing situation), but also, that testing itself represents a nonsense (non-relevant) situation (Ardila, 1995).

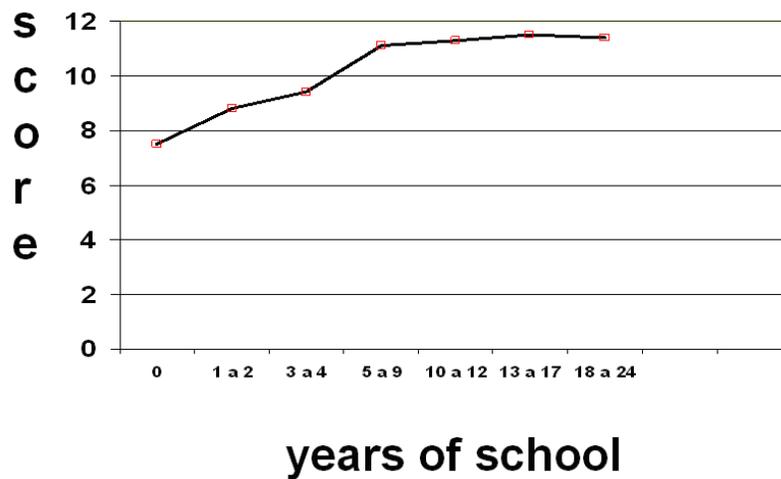
This educational effect, nonetheless, is not a linear effect, but rather it is a negatively accelerated curve, ending in a plateau. Differences between zero and three years of education are highly significant; differences between three and six years of education are lower; between six and nine are even lower; and so forth. And virtually no differences are expected to be found between, for example, 12 and 15 years of education. The reason is simple: the ceiling in neuropsychological tests is usually low (Ardila, 1998). Table 1 presents the differences in some cognitive tests between illiterates and subjects with one-two and three-four years of education and Figure 1 illustrates a specific example.

Table 1. Effect of education on test performance in some selected subtests of the NEUROPSI neuropsychological test battery (n=807)

Test	Years of education		
	0	1-2	3-4
Digits backwards	2.4	2.6	2.7
Verbal memory	4.2	4.2	4.3
Copy of a figure	7.5	8.8	9.4
Naming	7.3	7.3	7.5
Comprehension	3.7	4.4	4.6
Semantic fluency	13.5	14.6	15.4
Phonologic fluency	3.3	6.5	7.0

Note: mean scores are presented

Adapted from Ostrosky et al., 1999.



Adapted from Ostrosky et al., 1999.

Figure 1. The educational effect is not a linear effect, but rather it is a negatively accelerated curve, ending in a plateau. Example of the Copy of a Semi-Complex Figure test.

Although it is well established that there is a significant correlation between cognitive test scores (e.g., IQ) and school attendance (e.g., Matarazzo, 1972) interpreting this correlation has been polemic (Brody, 1992; Finch et al., 2011; Neisser et al., 1996). The really crucial question is:

Do cognitive (intelligence) tests indeed predict school performance? Or rather, does school train those abilities appraised in intelligence tests? To answer these questions is not easy, even though frequently the interpretation has been that IQ predicts school performance (e.g., Hunter, 1986). Other researchers, however, consider that IQ scores are to a significant extent a measure of direct and indirect school learning (e.g., Ardila, 1999; Ceci, 1990, 1991).

Ceci and Williams (1997) presented an impressive and detailed review of the available data in this area. Seven types of historical evidence for the effect of schooling on IQ were examined:

- 1) **The effect of intermittent school attendance:** several studies have provided converging evidence that the longer youngsters stay out of school, the lower their IQs.
- 2) **The effect of delayed school start-up.** Different studies have demonstrated that children whose schooling was delayed experienced a decrement in several IQ points for every year that their schooling was delayed.
- 3) **The effect of remaining in school longer.** As a result of extra schooling (to avoid military service), men born on a particular date (July 9 instead of July 7) earned approximately a 7% rate of return on their extra years of schooling. The authors point out that this figure of 7% is very close to the estimate of the return on an extra year of schooling derived from studies of being born early or late in a given year.
- 4) **The effect of discontinued schooling.** There is a well-established detrimental effect of dropping out of school before graduating. For each year of high school not completed, a loss of 1.8 IQ points has been observed.
- 5) **The summer school vacations.** A systematic decline in IQ scores occurs during summer months. With each passing month away from school, children lose ground from their end-of-year scores on both intellectual and academic scores.
- 6) **The effect of early-year birth dates.** Given the age limits to enter school in the US, within a given year, the number of years of schooling completed is the same for those born during the first nine months of the year. But the amount of school attendance drops off for those born during the final three months of the year. After coming of age, some individuals leave school, and students with

late-year births are more likely to stay in school one year less than students with early-year births. It has been observed that for each year of schooling that is completed there is an IQ gain of approximately 3.5 points.

- 7) **Cross-sequential trends.** A correlation between the length of schooling completed and intellectual performance among same-age, same-SES children has been observed.

The general conclusion is that school attendance accounts not only for a substantial portion of variance in children's IQ but also apparently some, though not all, of the cognitive processes that underpin successful performance in IQ tests. The magnitude of this influence ranges between 0.25 to 6 IQ points per year of school (Ceci, 1991). In consequence, the association between IQ and education cannot be interpreted assuming that IQ predicts school success. Intelligence and schooling have complex bi-directional relationships, each one influencing variations in the other (Ceci & Williams, 1997).

According to our results (e.g., Ardila et al., 2000b) even though bi-directional relationships between intellectual test performance and schooling may exist, the really significant relationship is between schooling and cognitive test performance. That is, attending school significantly impacts cognitive test performance.

CULTURE MINORITIES GROUPS

Cognitive testing of so-called "minority groups" represents a special situation in neuropsychology assessment. Minority groups constitute a culture or subculture within a mainstream culture. Quite often, the tester belongs to the majority culture and may have a limited understanding of the minority culture or subculture. Testing is likely interpreted from the majority culture perspective. To be a member of a minority group, however, has significant implications that can affect the testing situation and the testing results.

There are over 120 million people living in a country different from that one where they were born. They are "minorities" in the new host country: Turkishes in Germany, Moroccans in Spain, Hindus in England, Colombians in Venezuela, Greeks in Switzerland, Rwandans in Zaire, Mexicans in US, Greeks in France, etc. There are also some ethnic groups that are "minorities"

in their own countries: African-Americans in US, Kurds in Turkey, Ameridians in Colombia (and virtually in every country), etc. Finally, there are some groups that are “minorities” everywhere because they do not have a country. Currently Gypsies are the best example, but until recently, Jews were also a peoplehood without a country.

To be different from the mainstream people has a significant psychological impact. Patterns of behavior, beliefs, and attitudes may be different. Language can impair normal communication with the majority group. Even physical appearance and dressing can separate and distinguish the minority people. In the US there are hundreds of groups that can be regarded as “minorities”.

At least six different variables can potentially distinguish the minorities groups. They may also affect intellectual test performance and the “psychology of minority”:

- 1) **Nationality**: is that person regarded or not as an alien? Intermediate possibilities can exist. For instance, Hispanics in the US have five different possibilities: US born (2 possibilities: from the mainland or from Puerto Rico), acquired citizenship, legal immigrant, and illegal immigrant. It makes a significant difference if the country where you are living in is legally your country or you are a non invited alien.
- 2) **Culture** (relative distance). Irish immigrants in US have a closer culture to mainstream American way of life than Ethiopians. The larger the cultural distance, the more separated you are to understand the new culture and appropriately behave in it.
- 3) **Language** (relative distance). Minorities may speak a different language, may speak a dialect of the majority language, or may simply speak the same language. The ability to communicate, and hence, participate (e.g., to have a job) in the host culture highly depends on the ability to speak. Language distance between English and German is lower than language distance between English and Spanish. Language distance between English and Chinese is huge. Age also plays a crucial role in the ability to learn the new language. Young Moroccan people in Spain can easily learn Spanish and improve in social status, whereas adults have to accept low qualified and paid jobs.
- 4) **Normality** (how frequent -- normal-- is your group in your living environment). To be different depends on the community you live in. Hispanics are the “normal people” in Miami, but very unusual

people in Fargo. To be unusual may be associated with suspiciousness in the majority group and paranoia in the minority people.

- 5) **Reference group** (How many people are like you are). It depends upon with what specific group is the identification. Hispanics for instance, can consider that their reference group is Latin America or other US Hispanics. In the first case the reference group is even larger than the majority US group. In the second one it is a notoriously smaller and weak social reference group. Finally,
- 6) **Social image**: Positive or negative attitudes in the majority group toward the minority people. Even though minorities have in general a low social image (e.g., they are poor, with low education, inappropriate behaviors, etc.) some times positive attitudes are also associated with the minority group. For instance, Oriental people are frequently regarded in the US as “intelligent and hard-working people”.

Neuropsychological testing of minority groups have progressively become a more and more important question in neuropsychology, particularly in some countries with a significant immigration flow (e.g., some European countries). It is not easy for a Spanish neuropsychologist to test a Moroccan patient, or for a Danish neuropsychologist to test a Somalian client. There are not obvious answers to questions such as, how to carry the testing, what specific tests to use, and what conclusions can potentially be drawn from the testing results.

NORMS IN DIFFERENT NATIONAL AND CULTURAL GROUPS

A tremendous effort has been devoted in neuropsychology to obtaining test performance norms (e.g., Ardila et al., 1994; Lezak, 2004; Spreen & Straus, 1998). Currently, many neuropsychological tests possess relatively solid and reliable norms. Nonetheless, norms have been obtained in most cases in white English-speaking, middle-class subjects with a high-school or college level of education.

In cognitive testing it is usually assumed that norms are always required. Otherwise, no comparison is reliable. This idea, however, is more a

desideratum than a reality. Furthermore, it does not seem to be a completely realistic idea. As a matter of fact, in the future, the search for norms may be coordinated with the search for understanding the sources of variation. Two evident problems with norms are readily observed:

- 1) **Language.** To obtain norms in English or Spanish (each one with about 400 million speakers) seems realistic. But English and Spanish are just two out of the three largest existing languages accounting together for no more than 15% of the world's population. Worldwide, there are about 6,800 different languages (<http://www.ethnologue.com/>), most of them, with a limited number of speakers. As an example, in Mexico 288 Amerindian languages are currently spoken (<http://www.ethnologue.com/>). In the USA, over 300 languages are found, when counting both Amerindian and immigrant languages (<http://www.ethnologue.com/>). To obtain norms for all these 6,800 different languages is simply unrealistic. Furthermore, most of the world languages are small languages, and obtaining a reliable database would mean testing a high percentage of the speakers. If we assume that the average language has one million speakers (the real number is lower), and we want to normalize the neuropsychological instruments using just 200 stratified subjects in each language, it would mean that about one and half million participants would be required. This is a nonrealistic endeavor for contemporary neuropsychology. It seems more realistic to determine the linguistic factors potentially affecting cognitive test performance. A diversity of languages could be selected, comparison established, and significant variables distinguished. Language idiosyncrasies seem most important in understanding potential sources of variations. Obtaining norms is a realistic endeavor in English, Spanish, Quechua or Bengali, but does not seem realistic for the 288 Amerindian languages spoken in Mexico.
- 2) **Culture.** There are solid bases to assume significant cultural variations in psychological and neuropsychological test performance (e.g., Ardila, 1995; Fletcher-Janzen et al., 2000; Nell, 2000; Uzzell et al., 2007). Thus, the question becomes, how many cultural groups should be separated? Although several thousand different cultures have been described by anthropology (e.g., Bernatzik, 1957), obviously, there is not a definitive answer to this question. Cultures frequently represent a continuum, and cultures can partially overlap.

For example, if asked whether separate norms should be used when testing Caucasians and Hispanics in the US, most neuropsychologists might answer “YES”. Nonetheless, a diversity of conditions may separate Caucasians and Hispanics: primary language (for many Hispanics, their primary language is English; most Hispanics are bilinguals, some are monolingual; the degree of mastery of Spanish and English is tremendously variable), “acculturation” (degree of assimilation of the modal American culture values is highly variable), etc. So, there does not seem to be an obvious and direct answer. To be “Hispanic” or “Caucasian” is not a dichotomy. Another question: In the US, can the norms obtained in San Francisco be used to test people in Boston, San Antonio, Honolulu, or Anchorage? San Francisco is a quite heterogeneous city and the question becomes what specific San Francisco norms are going to be used with what specific population in Boston, San Antonio, Honolulu or Anchorage? The same type of question can be raised everywhere. For instance, can we use the norms obtained in Barcelona, Spain to test people in the Canary Islands, Santiago de Compostela or Bilbao? The answer in all these cases may be, partially yes, partially no. This is indeed an endless question. If we move to the worldwide situation (with thousands of cultural variations!), we may conclude that this is also a nonrealistic endeavor for psychology and neuropsychology. I am proposing that this question has to be re-stated, and instead of looking for norms in every existing human group, we should try to understand why culture may impact and how culture impacts cognitive testing, i.e., which are the specific cultural variables that may affect the performance in a psychological or neuropsychological tests. For this purpose, it seems more reasonable to select a series of rather different cultural groups, representing enough cultural dispersion, in an attempt to pinpoint those cultural variables potentially affecting cognitive test performance.

In brief, understanding the variables that can affect cognitive test performance seems to be as important as obtaining a large number of norms in different linguistic and cultural groups. (Ardila, Ostrosky & Bernal, 2006).

For example, there does not seem to exist any reason to find differences in verbal fluency in pre-school and school children when using an equivalent semantic category in Spanish and English. If the familiarity with the testing

condition is equivalent (both are small children with little or no familiarity with testing), the level of education is the same (none or whatever), the age is the same, and the semantic category has the very same semantic field in both languages, no differences in performance are expected. Table 2 presents the norms obtained by Halperin et al. (1989) in the US and Ardila and Rosselli (1994) in Colombia. Even though the age groups were divided differently (Halperin et al. used one year range; Ardila & Rosselli used two-year range) it is evident that performance was virtually identical.

Table 2. Semantic verbal fluency (ANIMALS) in US and Colombia

Halperin et al., 1989 (USA)				Ardila and Rosselli, 1994 (Colombia)			
Age (years)	n	M	SD	Age (years)	n	M	SD
6	34	10.74	2.40	5-6	49	9.33	3.65
7	40	12.43	2.90				
8	32	12.31	2.70	7-8	63	11.49	2.87
9	38	13.76	3.70				
10	22	14.27	3.70	9-10	56	14.09	3.99
11	28	15.50	3.80				
12	10	18.90	6.20	11-12	65	16.75	4.64

Table 3. compares performance in two verbal fluency tests (phonological and semantic verbal fluency) in Spanish and English monolingual speakers. As anticipated, performance is virtually identical, if confounding variables are controlled. English speakers do a little better when using some letters; Spanish speakers do a little better when using other letters, very likely depending upon the frequency of words beginning with that particular letter in each language, the potential ambiguity existing between homophone letters, and some other uncontrolled confounding variables. Performance in semantic verbal fluency using the category ANIMALS was virtually identical.

Nonetheless, unexpected confounding variables can exist. Digit span looks like a relatively culture-fair test, and similar performance might be anticipated in people from different human groups. Nonetheless, that is not the case. A significant variability has been observed. Digit span varies from 5.4 (Poland) to 9.0 (China) (Dehaene, 1997; Nell, 2000). The reason for this

variability is not totally clear, but both linguistic and training factors seem to exist (Dehaene, 1997). The phonological length of digits (number of phonemes included in digit words) as well as previous exposure to similar tasks (e.g., to say phone numbers using digit-by-digit strategy) may play a significant role in digit span. In the Sikuani language spoken in the Amazon jungle digits are: *kae* (one), *aniha-behe* (two), *akueyabi* (three), *penayanatsi* (four), *kae-kabe* (five), *kae-kabe kae-kabesito-nua* (six), *kae-kabe aniha-kabesito-behe* (seven), *kae-kabe aniha-kabesito-akueyabi* (eight), *kae-kabe aniha-kabesito-penayatsi* (nine). With such long words, it can be conjectured that digit span will be very low.

Table 3. Semantic verbal fluency (ANIMALS) in Spanish and English monolinguals (60-65 years; 13-16 years of education)

	English	Spanish
F	12.9 (5.4)	11.7 (4.1)
A	10.7 (5.1)	11.8 (4.6)
S	13.8 (5.4)	11.4 (3.8)
Animals	16.8 (5.2)	16.7 (3.8)

Note. Mean scores and standard deviations are presented. According to Rosselli et al., 2000.

What is proposed is that understanding the variables potentially affecting (and confounding) test performance may be as important as obtaining norms for different human groups.

No doubt, understanding cultural variables in cognition represents a major research area during the twenty-first century.

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