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SOCIOCULTURAL EFFECTS IN NEUROPSYCHOLOGICAL ASSESSMENT

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The group selected for this evaluation consisted of 109 normal people with an average age of 25, coming from two different sociocultural levels (high and low) of Mexico City. All were completely evaluated by Luria's battery for neuropsychological assessment, adapted by Ardila, Ostrosky, and Canseco, 1981. This group of tests measures nine different areas: Motor Functions, Somatosensory Knowledge, Auditory Knowledge, Visuospatial Knowledge, Cognitive Processes, Language, Reading, Writing and Basic Calculations. For all of these, the higher performance standards were achieved by the subjects from the high sociocultural level. A significant interaction between sociocultural level and sex was observed. The differences between sexes appear only in subjects from the low sociocultural level. Factor analysis of the battery revealed that the most sensitive items to sociocultural level were those related on one hand, to the handling of complex structural and conceptual aspects of language and on the other hand, to the organization of motor sequences and in general motor programming. Research related to the differences found is reviewed and implications for clinical assessment are discussed.

The analysis of the incidence of sociocultural factors on performance in psychological and neuropsychological diagnosis is of enormous importance. Anastasi (1977), emphasized the fact that a test represents a measure of an indication of behavior and that when culture affects behavior, its influence is reflected in the performance achieved in the test. If all the cultural differences related to performance in a test were eliminated then we could determine its validity with relation to the criterion we are trying to predict.

Analysis and discussions relative to the incidence of sociocultural factors in the performance of intelligence and aptitude tests have been frequent (Havighurst, 1965; Netchine, 1967; George, 1972; De Lacey, 1972; Gitmez, 1972; Feurnstein, 1972; Sánchez-Nieto *et al.* 1976; Seisdedos, 1976; Young & Rearden, 1979; Cravioto & Arrieta, 1982; and others).

Unfortunately, few systematic attempts have been made to analyse the incidence of sociocultural factors in performance achieved in neuropsychological diagnostic tests.

Benton, Levin, and Van Allen (1974), studied the influence of educational level in a geographical orientation task in patients with unilateral cerebral lesions. They found that the educational level presented a general effect on performance and revealed an interaction with the diagnostic category in such a way that patients with a lower level of education and cerebral damage present a greater difference in relation to the controls than patients with a higher level of education.

Finlayson, Johnson, and Reitan (1977) applied a battery consisting of the Wechsler, Halstead's Neuropsychological Diagnostic Battery and the Trail Making Test, to a

group of normal adults and adults with cerebral damage from different sociocultural levels. The results indicated that both the sociocultural level and the cerebral damage had a pronounced effect on the measurements achieved. However, the educational level particularly influenced the results obtained with the Wechsler, and the cerebral damage factor influenced the results obtained with the Halstead Battery. Furthermore, certain subtests proved to be particularly sensitive to the sociocultural level (as is the case, in general, with the Wechsler Verbal Subtests) or particularly sensitive to cerebral damage (as with the Category and Trail Making Test).

Amante *et al.* (1977) suggest that the differences found among different socioeconomic groups are not only the result of different environmental experiences but that the neurological integrity level varies according to a socioeconomic gradient: obstetric pathology, pre and postnatal problems and nutritional deficiencies are always more usual among the low sociocultural groups which bears upon an increased prevalence of mental retardation, minimal cerebral dysfunction, learning problems and other similar pathologies. While studying 225 children in their third school year from different socioeconomic levels and using different psychological and neuropsychological tests (Wepman's auditory discrimination test, Frostig's development test and Bender's test), the authors found a significant correlation between the results of these tests and the sociocultural level. They interpret this as meaning that a whole neurological integrity gradient exists which goes through the different classes and is a result of the noted risk factors.

Some research projects in Mexico have shown that the low sociocultural groups provide quantitatively and qualitatively less stimulation at home in comparison with the high sociocultural groups. This differential stimulation contributes to the development of different behavioral styles in both sociocultural levels (Cravioto, 1966; DeLicardie & Cravioto, 1973; Cravioto & DeLicardie, 1975), and also to deficient levels in the acquisition of concepts in the low sociocultural levels (Cravioto & Arrieta, 1982).

The result of this research indicates that development in an impoverished social environment as a consequence has insufficient stimulation which in turn alters the development of the central nervous system and therefore the development of higher psychological processes.

As Vygotsky (1978) and Luria (1979) have pointed out, all complex psychological processes such as oral and written language, decision making, the solution of problems etc. have a social origin and are internalized social relations. Therefore, living conditions and the social environment which surrounds human beings determine the function and organization of such processes.

As a consequence, it is necessary to carry out a detailed analysis of the effects that sociocultural factors and learning have on the performance in standard neuropsychological diagnostic tests.

METHOD

Subjects. 109 normal subjects of both sexes with an average age of 25.46 years from Mexico City were chosen and divided into two groups: (1) 44 subjects from a low sociocultural level (LSCL) with an average age of 27.88 and (2) 65 subjects from a high sociocultural level (HSCL) with an average age of 23.04.

The sociocultural level was determined according to the subject's occupation and education by means of the Havighurst's Socio-economic Index (1965). The average

formal education for the LSCL group was 7.06 years and for the HSCL group, 14.96 years (Table I). The LSCL was comprised of workmen, factory workers, office clerks and housewives. The HSCL comprised students and professionals with different university degrees. All the subjects had adapted themselves adequately to their environment and did not suffer from neurological damage or had a record that indicated neurological or psychiatric pathology (epilepsy, cranio-encephalic traumatism, etc.).

Material. The Neuropsychological Diagnostic Scheme developed by Ardila, Ostrosky, and Canseco (1981) was used. The Scheme is derived from the diagnostic procedures used by Luria (1977) and also items taken from different researchers and several neurological and psychological assessment tests. It explores nine different areas: (I) Motor Functions: including tasks which require the coordination, reproduction and repetition of complex and simple movements with the hand, the arm and bucofacial movements; (II) Somatosensory Knowledge: including the discrimination of tactile stimuli; (III) Spatial and Visuospatial Recognition: this section explores visuospatial perception, identification of shapes and objects and also the reproduction of drawings and designs; (IV) Auditory Knowledge and Language: evaluates the detection, discrimination and reproduction of syllables and verbal sequences and the recognition of natural sounds; (V) Cognitive Processes: including the exploration of logical reasoning, the classification of objects and comprehension of analogies; (VI) Oral language: it explores the production of simple and complex words, level of comprehension of language, recognition/recall; (VII) Reading: recognition of letters, syllables and words in two modalities: oral and silent, and also the level of comprehension in reading texts; (VIII) Writing: automatic, copying and dictation; and (IX) Calculus: this section explores aspects relative to mathematical notions and operations involving calculus.

The last four parts form an appendix to the test and were applied only in cases in which the subject had the necessary skills. Table II summarizes the Neuropsychological Scheme.

The scheme consists of 95 items from which 195 scores can be obtained that emphasize two aspects: (1) Quality of the mistakes: each item is assessed according to one or several criteria and not simply according to whether the subject performed the task or

TABLE I

Characteristics of the subjects from High Sociocultural Level (HSCL) and Low Sociocultural Level (LSCL), by sex, age (years), education (years) and laterality

		Sex		Age (Years)			Education (Years)			Laterality		
	N	Women	Men	$\bar{X}$	S.D.	Range	$\bar{X}$	S.D.	Range	Right Hand	Left Hand	Ambi-dextrous
LSCL	44	29	15	27.88	10.01	14–50	7.06	2.62	1–9	44	0	0
HSCL	65	35	30	23.04	6.46	14–50	14.96	3.24	10–20	60	4	1
Total	109	64	45	25.46	8.38	14–50	11.81	4.89	1–20	104	4	1

TABLE II

Summary of the Neuropsychological Scheme

Motor Functions	1–Motor Strength 2–Successive finger movement 3–Reproduction of hand positions 4–Coordination of the two hands in space 5–Alternate movements of both hands 6–Coordination of movements 7–Asymetrical rhythms 8–Changes in the position of the hand 9–Sequential drawings 10–Putting the tongue out as far as possible 11–Sequence of three movements 12–Whistle 13–Symbolic actions 14–Reaction choice 15–Conflictive reactions 16–Opposing reactions 17–Follow an object
Somatosensory Knowledge	18–Localization of tactile stimuli 19–Discrimination of number of stimuli 20–Recognition of shapes on the skin 21–Reproduction of hand positions 22–Position transference 23–Haptic recognition of objects 24–Recognition of meaningless shapes
Spatial and Visuospatial Recognition	25–Recognition of objects 26–Recognition of drawings 27–Simultaneous recognition 28–Recognition of figures in different positions 29–Reproduction of positions 30–Division of a line 31–Color matching 32–Reproduction of drawings 33–Drawing of a cube 34–Reproduction of designs 35–Object assembly 36–Block design 37–Use of objects
Auditory Knowledge and Language	38–Auditory acuity 39–Spontaneous speech 40–Discrimination of place of articulation 41–Oral-Nasal discrimination 42–Reproduction of rhythms 43–Sequence of sounds 44–Retention of meaningless syllables 45–Repetition of verbal sequences 46–Denomination of objects 47–Recognition of natural sounds
Cognitive Processes	48–Picture arrangement 49–Classification of objects 50–Figures completion 51–Similarities

continued TABLE II

Oral Language	52–Comprehension of verbal commands 53–Understanding the meaning of language 54–Automatized language (numbers, months) 55–Inverse series (numbers, days) 56–Repetition of words 57–Discrimination of stop bilabial voice/voiceless phonemes (i.e., "pa-ba") 58–Verbal memory 59–Retention of sentences 60–Completion of sentences 61–Construction of sentences 62–Denomination of body parts 63–Recognition of body parts 64–Loss of the meaning of language 65–Denomination of objects 66–Recognition of objects 67–Passive constructions 68–Understanding of complex grammatical relations 69–Subordinate clauses 70–Antonyms 71–Order of sentence 72–Prosodial interpretation 73–Comprehension of narrative speech
Reading	74–Reading of letters 75–Recognition of inverted letters 76–Reading of syllables 77–Reading of ideographic words 78–Reading of common words 79–Reading of low frequency words 80–Ordering of letters 81–Meaning of language 82–Oral reading 83–Silent reading 84–Reading of mathematical symbols
Writing	85–Signature 86–Dictation 87–Rhyming words 88–Copy 89–Change of letter type
Calculus	90–Reading of numerals 91–Reading of roman numerals 92–Writing of numerals 93–Greater-lesser relation 94–Successive substractions 95–Basic operations

not, and (2) a simple quantification is carried out under three categories for each criterium: 1 (normal performance); 2 (regular performance, moderately anomalous) and 3 (impossible performance).

Procedure. The Sociocultural Level Scale was applied initially. The subjects with a LSCL were taken mainly from the areas surrounding Mexico City and the subjects

with a HSCL from different faculties of the National Autonomous University of Mexico and professionals from different areas. The Havighurst Socio-economic Level Scale is based on a classification according to years of education and occupational level and consists of scores which go from 5 (high) to 30 (low); the subjects who obtained scores above 16 were classified as being of a LSCL and those who obtained scores of 15 or less were classified as being of a HSCL. Once the sample had been selected the Ardila-Ostrosky-Canseco Neuropsychological Diagnostic Scheme was applied. The application was on an individual basis and took an average of 50 minutes.

RESULTS

In order to compare the general results obtained by both groups, an average of the raw scores of all the subjects was taken for each section of the test and transformed into T scores with a mean equal to 50 and a standard deviation of 10. Figure 1 shows the general profile of the performance achieved by the subjects of both sociocultural levels. The dark lines show the mean and the limit of two standard deviations above the mean. The scores of the HSCL are lower than those of the LSCL group, but in some sections of the test the differences are more striking than in others.

An analysis of covariance was carried out with the 9 sections of the test. The age was entered as the covariate and the sex and sociocultural level as factors. Age did not show any significant effect. The sociocultural level showed statistically significant differences for all the 9 sections (however, these differences are greater in some sections than in others), and the sex showed differences in Motor Functions, Cognitive Processes and Oral Language. Table III shows the results obtained. It is important to note that there was a significant interaction between level and sex in eight of the nine sections (except Somatosensory Knowledge).

An a posteriori analysis of the simple effect of these interactions using the method of Tukey (Kirk, 1968) showed that the differences between sexes appear exclusively in subjects of LSCL, while the scores obtained by men and women with HSCL are practically identical. In other words, the differences according to sex are maximum and significant in the lower strata, and disappear completely as we go up in the sociocultural scale (see Table IV).

In order to detect which items were subject to sociocultural level, a crosstabs analysis was carried out for the sociocultural level (high and low) and performance score (1, 2, 3) of each item. The value of chi square was obtained and it was found that 46 items were sensitive to sociocultural level. A factorial analysis of these 46 items was subsequently carried out showing three underlying factors (see Table V).

The first factor includes complex linguistic aspects, reading and certain aspects of calculation; the second factor includes a large number of motor tasks, related in particular to motor programming (asymetrical rhythms, reaction to choice, etc.); the third factor basically comprises two movement coordination tasks as well as certain aspects of memory (retention of sentences) and complex aspects of language comprehension (comprehension of the meaning of language).

To summarize, the most sensitive items to sociocultural level are those which refer on one hand to highly complex, elaborate aspects of language (the handling of passive constructions; construction and completion of sentences; use of antonyms etc.) plus certain elaborate aspects of reading (the reading of low frequency words; recognition of inverted letters, comprehension, etc.) and of calculus, and on the other hand, the organization of motor sequences and in general motor programming.

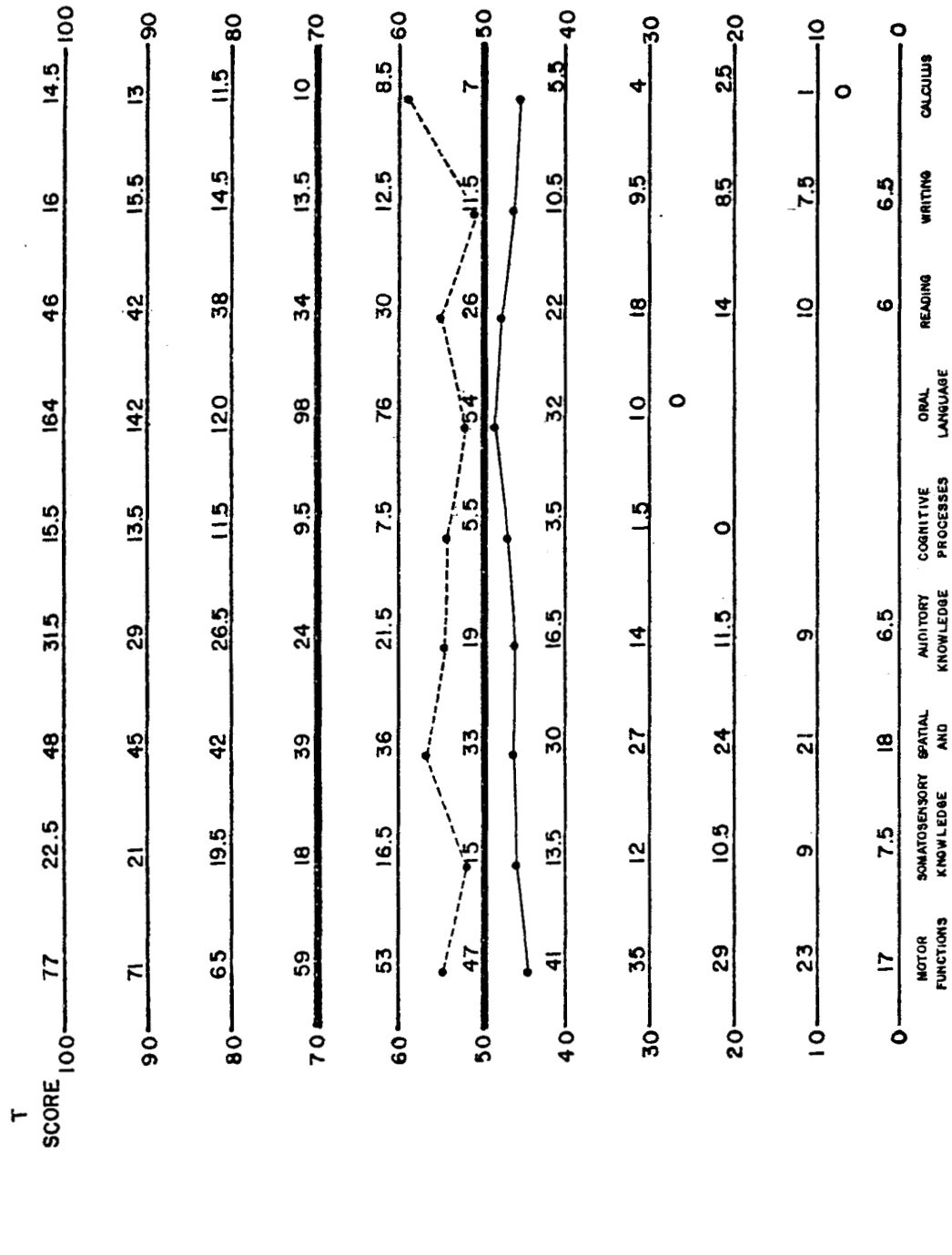

FIGURE 1 Profiles of the High Sociocultural Level (HSCL) and the Low Sociocultural Level (LSCL) in the nine sections of the Neuropsychological Scheme.

TABLE III
Analysis of covariance for the 9 sections of the Scheme, effects of sociocultural level and sex

Sections	Sociocultural Level		Sex	
	Degrees of Freedom	*F*	Degrees of Freedom	*F*
Motor Functions	1,107	30.452[a]	1,107	6.201[b]
Somatosensory Knowledge	1,108	4.499[c]	1,108	3.487
Spatial and Visuospatial Recognition	1,105	37.916[a]	1,105	1.287
Auditory Knowledge and Language	1,106	37.256[a]	1,106	3.328
Cognitive Processes	1,107	39.305[a]	1,107	5.715[b]
Oral Language	1,99	30.119[a]	1,99	6.083[b]
Reading	1,98	22.366[a]	1,98	3.385
Writing	1,96	4.673[c]	1,96	0.965
Calculus	1,95	31.646[a]	1,95	2.214

[a]$p<0.001$ [b]$p<0.01$ [c]$p<0.05$

TABLE IV
Interaction between sociocultural level and sex for the 9 sections of the scheme

Sections	Sociocultural Level	Men $\bar{X}$	Women $\bar{X}$	Degrees of Freedom	*F*
Motor Functions	Low	1.12	1.24	1,107	4.580[c]
	High	1.06	1.08		
Somatosensory Knowledge	Low	1.04	1.11	1,108	2.032
	High	1.04	1.05		
Spatial and Visuospatial Recognition	Low	1.09	1.16	1,105	7.990[b]
	High	1.04	1.03		
Auditory Knowledge and Language	Low	1.09	1.22	1,106	16.655[a]
	High	1.07	1.05		
Cognitive Processes	Low	1.30	1.73	1,107	10.769[a]
	High	1.16	1.16		
Oral Language	Low	1.10	1.24	1,099	5.991[b]
	High	1.04	1.06		
Reading	Low	1.16	1.34	1,098	7.822[b]
	High	1.13	1.12		
Writing	Low	1.00	1.07	1,096	6.413[b]
	High	1.02	1.01		
Calculus	Low	1.21	1.40	1,095	4.128[c]
	High	1.07	1.08		

[a]$p<0.001$ [b]$p<0.01$ [c]$p<0.05$

TABLE V

Items sensitive to sociocultural level included in each factor

FACTOR I		FACTOR II	FACTOR III
Alternate movements of both hands	Antonyms	Reading of Roman numerals	Picture arrangement
Reaction choice	Order of sentence	Successive substractions	Classification of objects
Picture arrangement	Prosodial interpretation	Basic operations	Completion of sentences
Similarities	Comprehension of narrative speech	Alternate movements of both hands	Construction of sentences
Understanding the meaning of language	Recognition of inverted letters	Coordination of movements	Coordination of movements
Repetition of words	Reading of low frequency words	Asymetrical rhythms	Understanding the meaning of language
Retention of sentences	Ordering of letters	Changes in the position of the hand	Retention of sentences
Completion of sentences	Meaning of language	Reaction choice	
Construction of sentences	Oral reading	Opposing reactions	
Recognition of objects	Silent reading	Recognition of meaningless shapes	
Passive constructions	Reading of mathematical symbols	Recognition of figures in different positions	
Subordinate clauses	Dictation	Reproduction of positions	
		Object assembly	
		Retention of meaningless syllables	
		Repetition of verbal sequences	

DISCUSSION

Over the last few years, the development of neuropsychological tests and techniques for the diagnosis of patients with cerebral lesions has advanced. However, there are few studies which characterize the performance of normal people belonging to different sociocultural levels. Our results show that there are quantitative and qualitative differences in performance of various cognitive and motor functions between normal subjects from different sociocultural levels. To be able to analyse these results it is necessary to consider the elements which intervene in each sociocultural level. For this reason, the analysis of the results will start with the following considerations:

1) The experiences of the people in each sociocultural level are different.

2) There is a greater incidence of perinatal and nutritional problems in the LSCL.

The first consideration could influence the LSCL in an independent way, since it is characterized by poor stimulation, while the high index of perinatal and nutritional problems is generally associated with poor stimulation.

The differences found in this research lead us to the following considerations:

I. For the Motor Functions, the items which come under the effect of the sociocultural level are: alternate movements of both hands, coordination of the movements,

asymetrical rhythms, changes in the position of the hand (spatial coordination), reaction of choice and opposing reactions. For the majority of these items it is necessary to carry out a sequential integration.

These data indicate that such a sequential integration of motor acts comes under the effect of the sociocultural level. The hypothesis which could be put forward is based on the experiences of one group or the other: the HSCL group usually carries out activities which permit a good sequential integration of voluntary controlled movements. For example, learning to write is the result of highly specialized training, is consolidated bit by bit and does not become an automatic process until formal studies are reached (Luria, 1977; Azcoaga, 1977). Writing is an indispensable tool for all activities, but this is not true for the LSCL group.

Vygotsky (1978) refers to writing as a psychological tool. He suggests that writing is an extension of the mind in the same way that a tool is an extension of the hand. By being included in the process of behavior, the psychological tool alters the entire flow and the whole structure of mental functions. That is, once acquired, it changes all cognitive functions, for example, writing relieves and increases your memory; it changes conceptualization by allowing you to see what you think; it changes perceptions and changes language itself.

II. For Somatosensory Knowledge, the item which comes under the effect of sociocultural level is the recognition of meaningless shapes. The analysis of mistakes in this section showed 32 mistakes for the LSCL and 23 for the HSCL. However, the differences arise from the hand used in the performance of the items. With the right hand, no differences existed in the number of mistakes, while with the left hand we observe a greater number of mistakes in the LSCL, as is shown in Table VI. Since in the somatosensory modality there is a contralateral cerebral representation, these data could suggest that for the subjects in the LSCL there is a bilateral cerebral representation, while in the HSCL there is a right cerebral hemisphere dominance. Milner (1971, 1975) using normal subjects with the same meaningless shapes that were utilized in this test, also reported a right-hemisphere superiority in tactile pattern recognition and in the appreciation of spatial patterns.

III. For Spatial and Visuospatial Recognition, the items which come under the effect of sociocultural level are: recognition of shapes in different positions (visual memory), reproduction of shapes and assembly of shapes.

Alvarez (1983) compared the performances of the LSCL and the HSCL and found that the subjects belonging to the HSCL obtained better performances in their ability to orient themselves in space and in the reproduction of positions. It would therefore seem that there is a small effect of sociocultural level on this activity.

TABLE VI

Differences between the High Sociocultural Level (HSCL) and the Low Sociocultural Level (LSCL) in frequency of errors made with right and left hand in the Somatosensory Knowledge Section

	Errors		
Groups	Left Hand	Right Hand	Total
HSCL	6	17	23
LSCL	15	17	32

IV. For Auditory Knowledge and Language, the items which come under the effect of sociocultural level are: retention of meaningless syllables (retention and recall curve) and repetition of verbal sequences. The hypothesis put forward to explain these differences is that the activities carried out during formal education emphasize memorization and the combination and use of less frequent syllables and words. Other researchers (Bernstein, 1962, 1974; Lawton, 1968; Robinson, 1974; Luria, 1979) have reported existing differences relative to the language used by the LSCL and the HSCL.

V. For Cognitive Processes the items which come under the effect of sociocultural level are: picture arrangement, classification of objects and similarities between them. Some research indicates that these differences are largely due to the educational level and the person's living conditions. For example, Luria (1977) showed that people who live in relatively poor socioeconomic conditions and are illiterate, classify objects predominantly through their inclusion in "real, concrete situations"; and it is only with literacy and the transition to complex social forms of production that people easily dominate the "categorical way of generalizing objects." In this same direction, Furth (1981) demonstrated that children from a rural environment need three more years to reach optimum performance in a liquid conservation test than children from the middle class.

The tasks in this section require an analysis of the figures presented and the relation of one to another in such a way that they have coherent logic. It is necessary to go from real-concrete forms of generalization to abstract forms of generalization. This transition is achieved by means of activities which are carried out during formal education and for this reason people with little or no education achieve a lower performance than those who have finished formal studies.

VI) For Oral Language, Reading, Writing and Calculus the items which come under the effect of sociocultural level are: understanding the meaning of language, repetition of words, retention of sentences (performance and contamination), completion of sentences (preposition and conjunction), construction of sentences, recognition of objects, passive constructions, subordinate clauses, antonyms (prefix and root), order of the sentence, prosodial interpretation and the repetition of a text (performance with sentences, nouns, verbs and concordance of elements), understanding the meaning of language, recognition of inverted letters, reading of low frequency words, ordering of letters, the meaning of language, oral reading (intonation, fluency, union of elements and comprehension of meaning), silent reading (comprehension and reading habits), reading of mathematical symbols, dictation, reading of Roman numerals, successive subtractions and basic operations. As can be observed, these are items which require the handling of the most complex aspects of language. Several researchers have reported significant differences in the use of language, depending on the socio-cultural level (Lawton, 1968; Bernstein, 1974; Robinson, 1974; Solomons, 1981). Even more, experimental evidence has shown that extreme environmental conditions can produce changes in brain organization. For example it has been reported that cases with poor linguistic stimulation like congenitally deaf children (Neville, 1977); children with poor environmental stimulation (Geffner & Hochberg, 1971) or with extreme environmental deprivation as in case of Genie who was not exposed to language until puberty (Fromkin *et al.* 1974) the pattern of cerebral lateralization differs from that reported in normal children.

Here we can formulate the following hypothesis: the divergent level of home environment and schooling between the two groups are the determinants of the difference between them. On the one hand, there is evidence that in the LSCL the

strategies used with children in family relationships, are basically nonverbal, while in families from the HSCL, predominantly verbal strategies are generally used (Robinson, 1974). On the other hand, the learning of notions and concepts is carried out by means of language and for this reason, we are going to find differences in most language areas, and mainly, in its most complex aspects. For example, reading, writing and calculus are activities which require highly specialized training, are learned gradually, and do not become an automatized process until the last years of study (Luria, 1977). Language, therefore, becomes the highest regulator of behavior (Luria, 1974).

It is not surprising to discover that the most complex verbal tasks are precisely those tasks which are found to be most directly dependent on the subject's sociocultural level. Our formal education consists, to a great extent, of learning to handle a system of meanings for words, using complex linguistic structures and, in general, achieving a training in linguistic skills. The sociocultural differences in spatial and visuoperceptual skills tend to be fewer (Amante *et al.* 1977) and even in cases of extreme deprivation, as is the case of Genie, (Fromkin *et al.* 1974) the most dramatic retardation is found in all those processes which depend on language and not in the handling of and orientation in the surrounding spatial medium.

The fact that a difference of consideration appears among the sociocultural levels in aspects related with fine motor coordination, motor programming and, in general, organization of response sequences, was not completely unexpected either. Golden (1981) in his standardization of the Luria-Nebraska Battery, found that the scale which required greater correction depending on the educational level of the subject was precisely the motor scale, and the Luria-Nebraska Battery includes motor tasks similar to those used in the Ardila-Ostrosky-Canseco Diagnostic Scheme, such as: imitation of actions, simultaneous utilization of both hands, the performance of sequential movements and movements with the mouth and tongue. In general, the fine motor skills constitute a characteristic of certain professional activities, the most important of which, naturally, is writing. A subject with a high level of education can spend several hours a day writing, while a subject with a limited socioeducational level centers his work activity on the performance of much grosser hand movements, activities which taken over one year or during the life of a person, represent thousands of hours of training.

However, the tasks used by Golden or by ourselves with relation to the motor scales are not limited to the performance of fine movements; other tasks such as coordinating movements with both hands, changing the position of the hand or reactions to choice are shown to be equally sensitive to the socioeducational variable. These types of response imply a complex motor programming, a control of response sequences, a permanent change in motor sequences and a verbal control over behavior.

In consequence, the differences between socioeducational groups cannot only be interpreted in the sense of differences in the handling of complex structural and conceptual aspects of language, the utilization of categorical systems and fine motricity, but also in the sense of control of sequences, organization and changes in responses.

The limiting conditions to stimulation and learning, the high levels of illiteracy, the conditions of increased risk of involvement of the nervous system and malnutrition are shown not only in standard evaluation procedures of the integrity of the nervous system such as neuropsychological assessment batteries, but also in other more traditional procedures like the EEG, in which the possibility of finding anomalous recordings also follows a sociocultural gradient with probability being less in the high levels with adequate perinatal care and good nutritional conditions, and greater in the

low levels with an increased risk of perinatal pathologies and, in general, pathologies of the nervous systems (Hughes, 1971).

On evaluating the integrity of the nervous system, these differences become more evident not in complex motricity but in fine motricity, not in basic aspects of language, but in its structured complex aspects, not in evident sensorial and motor changes which depend on primary areas of the cerebral cortex, but in more subtle changes in the processing of information, and in the control of the responses which depend on more associative zones, on a more integrated nervous activity and are more dependent on complex stimulation and learning.

All the above have enormous implications for neuropsychological diagnosis and even more so if we bear in mind that one of the objectives that the construction of the Ardila-Ostrosky-Canseco Neuropsychological Diagnostic Scheme tried to achieve, was precisely to find neuropsychological diagnostic procedures which would in some way minimize the incidence of cultural factors. The results achieved in no way confer trustworthiness on neuropsychological diagnosis; on the contrary, they confirm that the application of a series of standard procedures, as are included in a neuropsychological examination, are highly sensitive to subtle changes in nervous system activity; and they also affirm that their interpretation must be extremely prudent.

In neuropsychological practice, it can frequently be difficult to distinguish a case of mental retardation from important sociocultural deprivation, from dementia or from depression. To all practical ends, performance can be similar in all cases and appears as a diffuse, generalized commitment of intellectual functions. Only the patient's history, the subtle differences between the different tests, the quality of the mistakes and modifications in the presence of changes in the conditions of the tests, can give an answer. However sensitive and powerful a diagnostic instrument can be, its value is notoriously limited when it is found in the hands of nonexperts.

We consider that the results achieved emphasize the fact that neuropsychological diagnostic procedures can be powerful and subtle but the interpretation of their results must be equally cautious and prudent.

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