

# **Neuropsychological evaluation of 246 Portuguese normal subjects with Luria Nebraska Neuropsychological battery, MMSE, Clock Drawing Test, Luria's Graphic Series & Depression symptomatology questionnaire**

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## **Resumen**

Fueron evaluados un total de 246 sujetos adultos normales con la Bateria Neuropsicológica de Luria Nebraska – BNLN (versión experimental portuguesa – Maia y col, 2006), Test de Valoración de Estado Mental (MMSE), Test del Reloj de Luria, las Series Gráficas de Luria, así como un test de valoración de sintomatología depresiva (IACLIDE – anagrama para Inventário de Avaliação Clínica da Depressão); los sujetos fueron seleccionados al azar, de la población portuguesa que aceptó participar en este proyecto. Todos los sujetos seleccionados eran caucásicos y diestros. La escala de edades fue seleccionada siguiendo los procedimientos generalmente utilizados en Portugal (desde 18 años de edad hasta el máximo de 65 años de edad, con promedio = 35,80 y D.P. 13,869). Los resultados principales de las pruebas fueron evaluados teniendo como factores que agrupaban la edad, el sexo y el nivel de escolaridad. El análisis de los datos con el test de Chi Cuadrado, Tests T, ANOVA y correlaciones de Pearson presentaron correlación con los resultados conocidos mundialmente relativos a la validez interna de la BNLN. Creemos que este artículo puede ser de gran valor y ayuda para aquellos que están involucrados en procedimientos de valoración neuropsicológica y particularmente interesados en la validez de la diversidad de tests cognitivos utilizados específicamente para diferenciar de forma adecuada un funcionamiento neuropsicológico normal y anormal.

**Palabras clave:** Bateria Neuropsicológica de Luria Nebraska, Datos Normativos, Funcionamiento neuropsicológico normal y anormal.

## **Abstract**

A total of normal 246 adult subjects were evaluated with Luria Nebraska Neuropsychological Battery – LNNB (Portuguese Experimental Version – Maia et al, 2006), Mini Mental State Examination (MMSE), Clock Drawing Test, Luria's Graphic Series and Depression symptomatology questionnaire (IACLIDE – anachronism for the Portuguese denomination Inventory of Clinical Assessment of Depression); they were randomly selected from the Portuguese population that voluntarily accepted to take part in this project. All subjects selected had right hand specialization and were Caucasian. The age range was selected following the usual procedures in Portugal (18 old – 65 old, with average = 35, 80 and S.D. 13,869). The major results of tests were evaluated having as grouping factors the age, sex and scholar level. The analysis of data with Chi Square test, T tests, Anova and Pearson correlation showed great consistency with results around the world about the internal consistency of LNNB in strongly discriminating normal subject from neuropsychological affected patients. The concurrent validity with the other tests used shows again a great relation about the variables that were studied. Finally, the first Portuguese normative data about LNNB -in an experimental phase, with almost a quarter of thousand patients- were presented. We believe that this article could be of great value and help for those who are engaged in neuropsychological assessment and are principally interested in the viability of the plethora of cognitive tests particularly used to adequately evaluate normal and abnormal neuropsychological performance.

**Keywords:** Luria Nebraska Neuropsychological Battery, Normative Data, Normal and Abnormal neuropsychological data.

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## **Introducción**

According to Luria (1966, 1973), Neuropsychology's objective is to investigate how individuals' brain systems work through the complex forms of mental activity. According to several authors Luria-Nebraska

Neuropsychological Battery (LNNB) was the second most common neuropsychological test battery being developed to be used essentially with young and adults subjects (subjects with 15 years of age and older, Witsken, D'amato & Hartlage, 20081), after the Halstead-Reitan Neuropsychological Battery.

From our previous studies, the relevance of obtaining comparative data from LNNB with normative population have been stressed (Maia, Loureiro, Silva, Vaz-Patto, Loureiro, Correia, et al., 2003; Maia, Loureiro, Silva & Perea-Bartolomé, 2005; Maia, Perea-Bartolomé, Ladera, Silva, Loureiro, Vaz-Patto et al. 2005; Maia, Loureiro, Silva, Vaz-Patto, Loureiro & Bartalomé, 2005; Maia, Silva, Correia & Perea-Bartolomé, 2006; Maia, Silva, Perea-Bartolomé, Correia & Parrilla, 2007). Several authors, in different countries, have developed this line of investigation not only with normal adult subjects (Moses, Schefft, Wong & Berg, 1992; Agranovic & Puente, 2007; Hsieh & Tori, 2007) but also with normative neuropsychological data from children (Gustavson, Golden, Wilkening, Hermann, Plaisted, Macdnes, et al., 1984; Blair, Zelazo & Greenber, 2005).

### Study

With this paper we pretend to present the first Portuguese significant data about normative adult subjects when evaluated with the original LNNB (Form I). We aimed to study and analyze neuropsychological performance of normal subjects, both genders, adults (aged 18-65) from different academic levels. The principal variables crossed with results, were age, sex and academic background. At the same time we looked after some aspect that should be adapted from the English original to the Portuguese adaptation, particularly in terms of cultural bias, task difficulty, time given to realize each task, etc. Data was collected from May 2005 to January 2009.

### Sample

A total of normal 246 adult subjects were evaluated, randomly selected from the Portuguese population that voluntarily accepted to take part in this project. All subjects selected were Caucasian and right handed.

Inclusion criteria comprised: a) a normal score into the MMSE, using Portuguese standardization (normal in Portuguese MMSE >15 to none academic experience, >22 to 1 to 11 years of scholary and, >27 to academic formation superior to 11 years (Folstein, Folstein & McHugh, 1975; Guerreiro, 1993); b) absence of any known neurological condition, according to prior studies (Maia & de Mendonça, 2002); absence of any known psychiatric condition, according to prior studies (Maia & de Mendonça, 2002); be older than eighteen years of age.

From the final simple of selected subjects we evaluated 144 women (58.8%) and 102 men (41.5%). The age range (18-65; Average = 35, 80 s.d. = 13, 869) were selected following the usual procedures in Portugal, due to the fact that, in Portugal, only with 18 years if age one can be considered an adult and, in the superior limit, 65 are the age usually accepted to the final on normal adult age and the entrance in the elderly (Maia & de Mendonça, 2002). Considering the distribution of age differentiated by sex we can observe and average age of 35.12 and s.d. =13.414 to men and average age of 36.29 and s.d. = 14,254. This differences are not statistically significant ( $\chi^2= 0,451$ ,  $p=, 798$ ) with a strong equilibrium on the distribution concentration of age considering the variable sex. When variable sex is considered, based on the categories of Age and Academic levels (Table1), a statistically significant difference ( $\chi^2= 2.132$ ,  $p=, 344$ ) in none of the categories is verified.

		SEX		TOTAL
		FEMALE	MALE	
AGE IN CATEGORIES	TILL 23	50	32	82
	24 TO 46	48	40	88
	47 TO 65	46	30	76
TOTAL		144	102	246
		FEMALE	MALE	
ACADEMIC LEVEL IN	LOW	54	32	86
	MEDIUM	54	32	86
	HIGH	36	38	74
TOTAL		144	102	246

Table 1: Distribution of sex variable by Age and Academic Levels categories

### Procedures

First, we informed the subject the purpose of the study asking for its written informed consent, to participate in the study. Next we made an anamnesis to obtain data on the socio-demographic area of the subject (age, schooling, profession, familiar history, etc.). The sessions were individual and realized in a room especially dedicated to clinical consultations, in General Hospitals and other Health Facilities, in Portugal. The duration of each session was approximately 90 to 120 minutes, with a rest of approximately 20 minutes. Each normal subject made two sessions of evaluation, preferably with a time interval of 3 to 7 days, to try to reduce a possible slant related to fluctuations of humour, demotivation, etc., as well as guaranteeing the possible next evaluation in an acceptable interval of time. After the collection of data the appropriate statistical analysis was made, considering the raised objectives.

### Major Results

It seems to us very important to represent in descriptive values and graphical representation a profile drawn up from the data of the subjects. That is to say, calculating the age and average schooling of the subjects it is possible to obtain a Critical average Level, which allows, as well, drawing up an average profile based on the accomplishments of the subjects in each one of the Clinical and Summary Scales. The fact that we have traced a profile only for the Clinical and Summary Scales is due, as referred by Moses & Pritchard (1999) and McKinzey, Roecker, Puente, & Rogers, (1998), these scales are those that the clinical ones are more concerned in a more pragmatic and immediate analysis of subject protocol. Thus, obtaining the average values for the variables in question, we drew up the respective average profile, presented in Figure 1.

	N	MINIMUM	MAXIMUM	AVERAGE	STAND. DEV.
AGE	24	18	65	35.80	13.689
SCHOLARITY IN YEARS	24	4	19	12.17	4.089
S1- PATHOGNOMONIC	24	0	20	9.59	4.317
S2 – LEFT HEMISPHERE	24	0	16	2.18	2.860
S3 – RIGHT HEMISPHERE	24	0	16	2.67	2.876
S4 – PROFILE ELEVATION	24	0	17	3.33	3.291
S5 - IMPAIRMENT	24	0	22	7.67	5.286
C1TOTAL – MOTOR CLINICAL SCALE	24	0	32	7.57	5.880
C2TOTAL – RHYTHM CLINICAL SCALE	24	0	7	1.66	1.536
C3TOTAL – TACTILE CLINICAL SCALE	24	0	18	2.86	2.958
C4TOTAL – VISUAL CLINICAL SCALE	24	0	17	7.26	3.767
C5TOTAL – RECEPTIVE SPEECH CLINICAL SCALE	24	0	17	4.66	3.638
C6TOTAL – EXPRESSIVE SPEECH CLINICAL SCALE	24	0	21	5.43	4.275
C7TOTAL – WRITING CLINICAL SCALE	24	0	10	1.49	2.038
C8TOTAL – READING CLINICAL SCALE	24	0	8	1.81	2.026
C9TOTAL – ARITHMETIC CLINICAL SCALE	24	0	21	3.20	3.272
C10TOTAL – MEMORY CLINICAL SCALE	24	0	16	4.40	3.352
C11TOTAL – INTELLECTUAL CLINICAL SCALE	24	2	46	16.15	8.228

Table 2: Descriptive values of Age, Scholaryity in years and Clinical and Summary Scales of LNNB

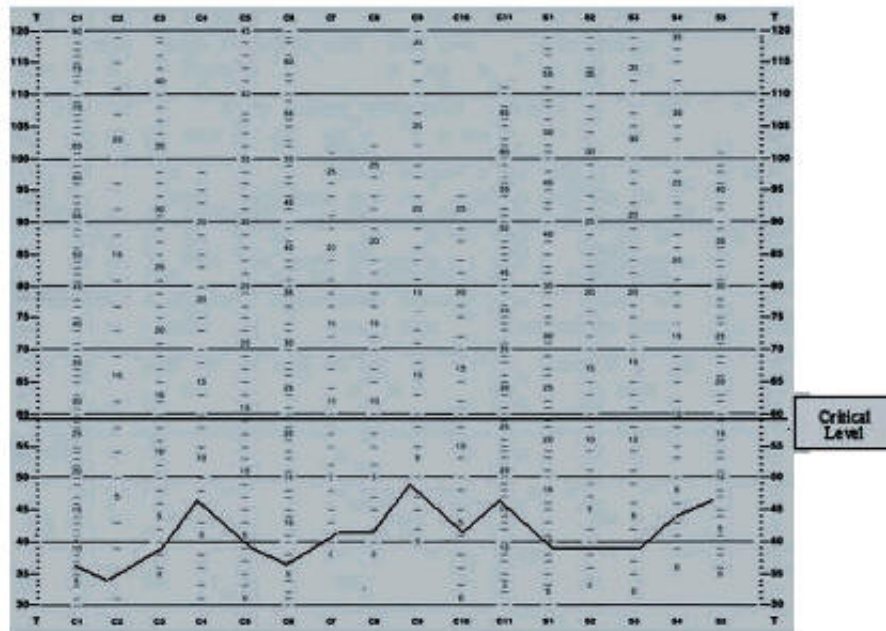


Figure 1: Average discriminative Profile in Clinical and Summary Scales.

As is possible to be verified in Figure 1, the average profile produced by the summation of the results of the subjects presents/displays a profile of a perfectly normal (hypothetical) subject. No scales rise above the critical level; the difference between the scale with smaller score (C2 = 1) and with greater score (C11 = 16) when respective notes T are adopted, produce a difference of scores T of 16 points. The greater score also corresponds to a T score of 47. As referred by Moses and Pritchard (1999) the scores of the subjects in the scales of the LNNB is transformed into a standard score, (called T score), to facilitate the comparisons between subjects and scales, so that into the original version of the LNNB-I all the total scores in each scale of the reference group are transformed so that each one has an average of 50 (T score) and Standard deviation of 10 points. Thus, according to Moses and Pritchard (1999), these transformations anchor the global level of each scale to a common level and normalize the alterations in the global scores in relation to that anchored level.

## ANOVA

We have made an analysis of variance of three factors (sex, age and scholar level) not only for each one of the described dependent variables in the previous section, but also for the remaining scales of the LNNB.

Regarding to C1 Motor Clinical Scale, there are verifiable statistically significant differences in the factor Age ( $F= 9,272$ ;  $p=, 000$ ) and Scholaryity ( $F= 5,718$ ;  $p=, 004$ ) but not for Sex variable. In respect to C2 Rhythm Clinical Scale and C3 Tactile Clinical Scale statistically significant differences in this variables in the variables/factor studied sex and age are not verified, being nevertheless found significant differences at the level of variable Scholaryity. In the C4 Visual Clinical Scale statistically significant differences in this variable in the variables/factor studied sex and age are not verified, but found significant differences at the level of variable Scholaryity ( $F= 18,174$ ;  $p=, 000$ ). In the C5 Receptive Speech Clinical Scale statistically significant differences are verified in the variables/factor studied Age ( $F= 4,925$ ;  $p=, 009$ ) and Scholar Level ( $F= 3,204$ ;  $p=, 016$ ), but not for Sex variable ( $F=, 833$ ;  $p=, 363$ ). In the C6 Expressive Speech Clinical Scale statistically significant differences are verified in the variables/factor studied Age ( $F= 4,587$ ;  $p=, 012$ ) and Scholar level ( $F= 22,126$ ;  $p=, 000$ ), but not in the Sex variable ( $F=, 301$ ;  $p=, 585$ ). In the C7 Writing Clinical Scale statistically significant differences are only verified in the variables/factor studied Sex ( $F= 3,929$ ;  $p=, 881$ ) and Scholar level ( $F= 9,492$ ;  $p=, 000$ ). In C8 Reading Clinical Scale statistically significant differences are only verified in the variables/factor studied Age ( $F= 3,425$ ;  $p=, 036$ ), Scholar level ( $F= 34,604$ ;  $p=, 000$ ) and in the interaction between Age and Scholar Level ( $F= 11,280$ ;  $p=, 000$ ). In C9 Arithmetic Clinical Scale statistically significant differences are only verified in the variables/factor studied Sex ( $F= 4,630$ ;  $p=, 034$ ), Scholar Level ( $F= 6,648$ ;  $p=, 002$ ) and in the interaction between Sex and Scholar Level ( $F= 4,107$ ;  $p=, 004$ ). In C10 Memory Clinical Scale statistically significant differences are only verified in the variables/factor studied Age ( $F= 13,263$ ;  $p=, 000$ ) and Scholar Level ( $F= 12,940$ ;  $p=, 000$ ). In C11 Intellectual Clinical Scale none statistically significant differences are verified in the variables/factor studied Sex and Age, but a strong relation was found with the variable Scholar Level ( $F= 27,703$ ;  $p=, 000$ ).

In Summary Scale S1 (Pathgnomonic) statistically significant differences are only verified in the variables/factor studied Age ( $F= 9,194$ ;  $p=, 000$ ), Scholar Level ( $F= 6,220$ ;  $p=, 003$ ) and in the interaction

between Age and Scholar Level ( $F= 2,756$ ;  $p=, 032$ ). In the Summary Scale S2 (Left Hemisphere) none relevance for the implication of Sex variable was found, Scholar Level and Age. In Summary Scale S3 (Right Hemisphere) statistically significant differences are only verified in the variables/factor studied Age ( $F= 5,999$ ;  $p=, 003$ ) and Scholar Level ( $F= 3,963$ ;  $p=, 022$ ). In Summary Scale S4 (Profile Elevation) significant differences are only verified in the variables/factor studied Age ( $F= 5,111$ ;  $p=, 008$ ), Scholar Level ( $F=22,682$ ;  $p=, 022$ ) and in the interaction between Age and Scholar Level ( $F= 3,516$ ;  $p=, 033$ ), as well as between Age and Scholar Level ( $F= 3,084$ ;  $p=, 019$ ). In Summary Scale S5 (Impairment) none relevance for the implication of Sex variable was found, Scholar Level and Age.

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AGE CATEGORIES	SCHOLAR LEVELS	AVERAGE	STD. DEV.	N
TOTAL	LOW – TILL NINE GRADE	28,29	1,715	84
	MEDIUM – TILL 15 YEARS IN SCHOOL	29,53	,667	86
	HIGH – COLLEGE GRADE AND SUPERIOR (MSC, PHD)	29,65	,753	74
	TOTAL	29,14	1,307	244

Table 3: Differences between Scholar Levels with Scheffe F-test, to MMSE Global Score

### Global Scores in IACLIDE (Depression) and respective ANOVA

When variable sex is considered, based on the categories of normality in the IACLIDE (table IV), statistically significant difference of distribution by several categories is not verified ( $\chi^2 = 5.834$ ,  $p=, 054$ ). Although a slight tendency seems to be verifiable of slight depressive symptomatology in 18 subjects (7.38%) and of moderate depressive symptomatology in 6 subjects (women, 2.46%).

When the average results of the subjects are compared it can be verified that in all the Clinical Scales and Summary Scales, the subjects with a normal annotation in the IACLIDE (depression) present inferior results (smaller suggestion of deficit) than the 24 subjects that obtain a classification of Slight or Moderate Depression symptomatology. The test of difference of averages allows to verify that despite de higher difference in the subjects with “Slight” annotation in the IACLIDE be present in most of the referred scales of the LNNB, only the C3 scales (Tactile Functions;  $t= -4,291$ ;  $p=, 000$ ), S2 (Left Hemisphere;  $t= -2,423$ ;  $p=, 017$ ) and S3 (Right Hemisphere;  $t= -3,112$ ;  $p=, 002$ ) present statistically significant differences.

		SEX		TOTAL
		FEMALE	MALE	
Global score in IACLIDE –Categories in Depression levels	NORMAL	122	96	218
	LIGHT	16	2	18
	MODERATE	6	0	6
TOTAL		114	98	242

Table 4: Depression categories distribution separated by sex



In this variable there are statistically significant differences in an ANOVA of three factors in the variables studied sex ( $F= 8,928$ ;  $p=, 004$ ) and Scholar level ( $F= 3,636$ ;  $p=, 030$ ). No statistically significant differences in the variable age are verified ( $F= 2,739$ ;  $p=, 070$ ).

### **Luria's Graphic Series and Clock Drawing and respective ANOVA**

When variable sex is considered, based on the categories of normality in the Graphical Series of Luria - Form A (the easier form) and Form B (the more difficult form), it is not verified any statistically significant difference on the subjects, only two subjects has presented an abnormal performance (lack of attention). When variable sex is considered, based on the categories of normality in the Clock Drawing Test no statistically significant difference is verified ( $\chi^2= 288$ ,  $p= ,591$ ) being found a percentage 10 subjects (4,09%) with abnormal performances in the clock. Nevertheless, when the variable Age is considered, based on the categories of normality in the Clock Drawing Test, although a statistically significant difference is not verified ( $\chi^2= 3.139$ ,  $p=, 204$ ), there is a tendency so that the subjects with greater age present worse results than the subjects with smaller age. Thus, it is verifiable that in the category "until the 23 years" the totality of the subjects ( $n=41$ , 33.61%) displays a normal result; in category "24 to 46 years", 41 subjects (33.61%) presents a normal result but already 4 subjects (1.64%) present an abnormal result; finalizing, in category "47 to 65 years" 35 subjects (28.69%) display a normal result and 6 subjects (2.46%) present an abnormal result in the Clock Drawing Test.

When the variable age is considered, based on the categories of normality in the Graphical Series of Luria, once hardly one subject presented an abnormal performance, any significant difference cannot be calculated. When variable sex is considered, based on the categories of normality in the MMSE all the subjects presented normal scores. When the categorization of subjects performance in the Clock Drawing Test is presented, differentiated based on the "Normal" and "Slight" category in the IACLIDE none verifiable statistically significant differences were found ( $\chi^2 = 580$ ,  $p=, 748$ ).

### **Pearson's Correlations**

Next we will present some relevant correlations (Pearson) between the main variables measured in this study: Global results in the Clinical Scales, Summary Scales and global scores in IACLIDE and MMSE.

MMSE is negatively related in a statistically significant form with mentioned variables with the exception of the C2 scale (Pearson= -0, 98,  $p=, 453$ ). IACLIDE, is only negatively correlated in a statistical significant form with MMSE - Global Scores (Pearson= -0,303,  $p=, 027$ ), and positively with Scale C3 of LNNB (Pearson= 321,  $p=, 019$ ). Regarding to Summary Scales (S1 to S5) all the scales are correlated positively (statistical significance) with each other. In which it concerns the correlation of the Summary Scales with each one of the Clinical Scales it is verified that the S1 Scale is statistically related in a significant form to all the scales, with exception of the C3 scale (Pearson= 144,  $p=, 268$ ) being the same verified in relation to the Summary Scale S5 and C2 (Pearson= 155,  $p=, 234$ ). Regarding to Clinical Scales that scales were related with any of other Clinical Scales were C1, C3, C4, and C5. Clinical Scale C2 is not statistically related with Clinical Scales C6, C7, C8, C9, C10, and C11. Furthermore, considering the Clinical Scales C6 and C11, the only Clinical Scales that do not present a significant statistical correlation is again the C2 Scale.

The correlations concerned between the grouped Clinical and Summary Scales and its comparison with Age, Scholasticity and IACLIDE exist a positive, statistically significant correlation between the variable Age and each one of the Summary Scales as well as with the Global Score in IACLIDE. Nevertheless, a negative correlation, statistically significant, of the variable Age and level of Schooling in years is verified. The Global Score in the IACLIDE is correlated negatively, in a statistical significant form, with each one of the indicated variables with the exception of a positive statistical significant correlation with Age and negatively with the variable level of Schooling in Years. Finally, none significant relation was verified between IACLIDE and any of the Summary Scales. A positive correlation exists, statistically significant, between the variable Age and Global Score in the IACLIDE, verifying, nevertheless, and as already referred, a statistically significant negative correlation of the variable Age and level of Schooling in Years. The variable Level of Schooling in Years is negatively correlated in a statistically significant form, with Age and Global Score in the IACLIDE.

Rhythmica Scale can be verified that a positive correlation exists, statistically significant, between the variable Age and each one of the Clinical Scales, with exception of the C2 Scale. The Global Score in the IACLIDE, relatively to the Clinical Scales, only is correlated, in a statistically significant form with the C3 variable - Scale of Tactile Functions (Positive Correlation).

The variable level of Schooling in Years is correlated in a statistically significant form, in negative sense,

with each one of the Clinical Scales of the LNNB, with exception of the scales C2 and C9.

## Discussion

We will draw up to the discussion of the results considering a set of aspects that seems to be of crucial relevance in this study.

With respect to time of application of the LNNB, although the average time of administration presented by Golden, Freshwater & Vayalakkara (2000) for neurological populations is about 3 hours, and for Hebben and Milberg (2002) it is of 1, 5 to 2, 5 hours the average administration of the time in the subjects evaluated by us was around 3.5 hours in normal population. To that time we must add than 2 1/2 the process of annotation, construction of the graphical profiles, interpretation, etc. Nevertheless, our work is based on a deep and comprehensive investigation, receiving clinical contributions of other specialists (neurologist, psychiatrist, general practitioner, etc.) in the entire evaluation process. With regard to a primary analysis of the results, an evaluator always verifies if the evaluated subject presents a high profile (indicator of impairment), specifically in the Clinical and Summary Scales.

These data are reinforced by the fact that in the ANOVA of the three factors (Sex, Age and School Levels) with the clinical scales (C1 to C11) and the Summary Scales (S1-s5) it is not verified any significant statistically effects. In other words, in this sample of normal subjects, the variables Sex, Age and Scholar Level, considered jointly, do not seem to contribute for the differentiation between the subjects; that is to say, in these normal subjects, the scores do not present a great variance, in each one of the referred scales. This suggests, at the level of an initial analysis that LNNB like previously sustained by McKinzey, Roecker, Puente & Rogers (1998), is very strong in the classification of normal subjects, not presenting, in our study, identification of any subject like False Positive. These results are in conformity with Golden, Freshwater & Vayalakkara (2000) that sustain the strong battery psychometric characteristics. In agreement with the authors, the first factor to consider in this field of analysis points to its validity and reliability: agreement between evaluators, internal consistency and validate test-retest. Previously Golden, Hammeke & Purisch (1978) compared LNNB profiles by five independent pairs of evaluators, with respect to the application of the battery to five subjects. A high level of agreement between evaluator has been verified, with 95% of agreement between the evaluations. Another study presents an internal consistency (alpha) that varied from 0,82 in the C2 scale to 0,94 in the C1 scale, for the 14 principal Scales of LNNB of 146 patients with cerebral injury and 74 controls (Mikula, 1981; Moses, Johnson & Lewis, 1983). In another sample of patients with cerebral damage and without cerebral damage has been examined (n= 559), jointly with separated groups of clients with cerebral dysfunction (n= 451) and with schizophrenia (n= 414), a mixed set of psychiatric patients (n= 128) and a normal sample of 108 subjects (Maruish, Sawicki, Frabzen & Golden, 1984, In Golden, Freshwater & Vayalakkara, 2000). The correlations for all the groups, except for the sample of the normal subjects, were clearly elevated, varying from 0,81 to 0.93. Still in agreement with Golden, Berg & Graber (1982), the test-retest validity of the clinical scales vary of 0, 78 in the C3 scale to an elevation of 0, 96 in the C9 scale. Palisted and Golden (1982 In Golden, Freshwater & Vayalakkara, 2000) analyzed the test-retest confidence degree for the 14 original scales, and the confidence degree varied from 0, 83 to 0.96. In conformity with our works, MacInnes, Paul and Schima (1987), stressed necessity to come to an adjustment of the results of the normal data at the age of the subjects. In a longitudinal study with groups of normal subjects, throughout four years (59 voluntary, old normal subjects, throughout 4 years) the clinical scales showed tenuous alterations during the 4 years of the test. The main evidences of the study were: the correlations test-retest of the clinical scales that varied from 0,32 to 0.82; low differences between male and female subjects; the fact to belong to a sub-group younger-older did not affect the pattern of alteration in the performances; in spite of the state of health of the subjects to present few alterations throughout the four years, the state of health at moment 2 of evaluation appeared like strongly predicting the performances in 16 of the 17 principal scales of LNNB, at moment 2. As final conclusion of this study, the authors refer that LNNB appears like a trustworthy instrument in the identification of old normal subject, since the performance of such subjects has presented little significant variations throughout the four years.

Garmoe, Schefft and Moses (1991) postulated the diagnostic validity of LNNB Form II in the differentiation between normal subjects (55) and brain damaged subjects (55), matched by age and school levels. The authors still refer that these results confirm the traditional idea that the age and the academic level strongly interferes with performance of the normal subjects (variable sex was presented like having any implication in the variability of major performances).

In conclusion we referred that if we considered that the average results of the normal subjects of our sample it seems to represent the typical performance of a normative subject, that is to say, the not-elevation of these scales superior to the Critical Level, or the single elevation of one or two scales being, nevertheless, understood by a typical particular aspect, within normality levels, previously reinforces the idea that this

battery presents discrimination of nonclinical subjects from the neuropsychological point of view, confirming prior results (Maia, 2006).

An aspect that must be studied is the specific difficulty of items. So, we will focus our attention on the results of the normal subjects of our sample. Authors like Akhutina & Tsevetkova (1983), Christensen (1975) and Golden et al. Vol. 18, No1-2, 2009 / Revista Ecuatoriana de Neurología 43 (1982) calls the attention for the question of the evaluation of a certain item in their specific context. Said of another form, if we considered the results of the subjects in each item of the battery is possible to verify the percentage of subjects that solved a certain item suitably, nevertheless, what is the meaning of that isolated percentage?

Another excellent aspect is the validity of content and construct associated to items, as proposed by Cronbach & Meehl (1955) in their historical article (Cronbach, 1957). Thus, of now in ahead, whenever we use the expression "Success" we will be making reference to an accomplishment whose annotation is 0 and "Error" when the annotation is different from 0 (that is to say, 1 or 2, with base in McKinzey at al. (1998).

Beginnings by the C1 Scale, the percentage of success in each item vary from 95.2% to 39%. We must consider that we are evaluating normal subject and, by that, the awaited percentage of success must be sufficiently safe to guarantee to the evaluator that the item is minimally discriminative of a suitable accomplishment or no. Having this in mind, when we verified what specific items presents inferior levels of 50% success (percentage selected by convention, with base in Golden et al. (1982), we found items that are related with time used by the subjects for the accomplishment of a set of copy drawings or by free oral order. Its accomplishment, in graphical terms is normal, but they consume more time than the necessary to obtain a score of "0" in the variable "time of accomplishment". In summary, the subjects make the pointed tasks suitably, but consuming in average more time than the subjects of base for the American normalization. These data suggest probably the variable time, in the accomplishment of these tasks, will have to be re-calculated for the Portuguese population, avoiding the elevation of profiles due to a possible misalignment of the time limits to this sample.

In the C2 Scale, the percentage of success in each item varies from 95.2% to 75, 8% when we considered only subjects 246 normal. These data suggest all items of these scale present levels of quite high probability of success, when used next to normative subjects. In the C3 Scale, the percentage of success in each item varies from 96.8% to 48.4%. The only item that presents levels of inferior success to 50% is the C3-nº85. Once again, it is not the accomplishment of the task (item nº 84) that is in deficit, but the time of accomplishment. These data reinforce the relevance of the necessity of re-estimation of the variable time of accomplishment, for the Portuguese population.

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The item C4-nº89 with a percentage of success so reduced (19, 4%), considering that we are evaluating normal subject, it demonstrates the clear difficulty that this item presents. In fact, when the partial success is considered the percentage of success is of 29%. Of this form, the subjects that completely present an inadequate accomplishment in the two tasks of the item represent 49% of subjects (verifying 6 subjects which did not respond, 4.8%). This item seems of very high difficulty, lacking of interpretation on the performance of the subject, of special attention by evaluator. About the interpretation of these results, a mistaken clinician could interpret like "Injury of the frontal lobes", according to a rigid reading of the manual of Christensen (1975, p. 76-77). Nevertheless Golden et al. (1982) refer that this item must be considered jointly with items 86 to 91. In the absence of errors in the images of relatively simple identification of medium complexity or (it could indicate severe problems in basic visual analysis like visual agnosia, p. 53-54), which reduces the difficulty to identify the images at issue. If by a side we can raise the hypothesis that exists in fact some factors that contribute of global form for the moderate elevation of the C4 scale (score T = 46) in these subjects (e.g. difficulty to organize complex visual stimuli), we also must consider that at least, the card with the telephone seems to us inadequate for our population. In a future adaptation, such image will be replaced by a more suitable figure. A form to try to perceive if the subject is not able, in fact, to identify the presented stimuli is to do, at the end of the application of the LNNB, the reapplication of these items. For example, if the subject is not able, in the beginning, to evoke correctly that in the first card there is represented a telephone, the evaluator (if is convinced that the subject will not be able, by any means, to guess right by itself) can ask " Could you see a telephone here?" In our sample, when this question is



presented, the absolute majority (approximately 80% of the subjects) is able to identify the figure, in both cards. Thus is verifiable that, even not being able to evoke it initially, it is able to structure the complex visual stimulus with a determined meaning (visual). If, the other way around, the subject is not able to identify the stimulus, saying to him what represents, that will be able to indicate an elevated degree of deficit in the evaluation of complex visual stimuli, needing to integrate that result with the remaining accomplishment of the battery. Golden, et al. (1982) sustain that this item is strongly employed in denomination functions, being of high sensitivity for alterations in the left temporoparietal regions. They still refer that when subjects fail in items of visual reconnaissance that can reflect phenomena like visual ignorance or difficulties of denomination, affecting to the rest items that imply visual modality.

In the item C4-n°95 with 35.5% of successes in the normal subjects, suggest that we must analyze these results. In this test, it is requested to the subject that puts the needles in the clocks so that are, in each one of them, respectively, 11:50, 4:35, 11:10. What is verified is that most of the subjects are not able to put the needles of the clock in the indicated points. Nevertheless the subjects usually put the leaders near the numbers that indicate the hours and evoked minutes, without having in consideration that the needle of the hours usually is located between the indicating numbers of a certain hour, and next to a specific number. In addition one often verifies that the patient is incapable to program his conduct in form to the leaders are designed specifically from the center of the clock. One remembers that the subjects that have been able to solve the three tasks of this item, of suitable form, were 35, 5%. A direct analysis of which Christensen (1975) in the manual of the LNI postulates would indicate "Injury of the inferior parietal areas or parieto occipital areas of the brain" (p.79). Nevertheless is not foreseeable that our subjects present in fact such injuries. One more a phenomenological and integrative does not allow to recover the possibilities raised by Golden et al. (1982). The authors refer that these items imply Viso-Spatial skills that depend on a great variety of factors as is the capacity to say the hours, being able this ability to be in deficit in people with low educational levels. Although the authors refer that this particular item is placed in a pool of items which constitute the scale of Left Parieto occipital Location, reflecting its analytical and viso- spatial capacities, they seem to be more cautious in the possible interpretation of the results. In general absence of elevation of the C4 scale, or as the analysis of the acceptable results of the subjects in the specific rest items for "Viso-spatial Orientation" (items 94 and 96) seems us that this item, in this sample of normal subjects is suffering of a any type of slant or it is not adapt to our population in comparison with the American population that has served as reference for the original scale. As for the educational level, in the normal subjects, statistically significant differences are not verified relatively to the number of errors, being seen that the greater percentage of subjects commits one to two errors (23 – 39%), followed by the subjects that do not commit any error (22–37, 3%) and finalizing itself with 28 subjects (23.7%) that present failures in the three tasks of item 94. Thus, the total of normal subjects that it is not able to make this task suitably is of 62, 7% (in a total of 118, with 3 missing values).

From our knowledge, in addition to which it was exposed, this task is very sensible to considerable changes in structural terms (e.g. cortical pre-frontals alterations, dementias, etc.) but it is also very frequent when the attention mechanisms in normal subjects are not properly activated, reason why their analysis always needs special consideration, so that it was known if the failure is due to lack of attention, incapacity to organize drawn stimuli in a flat plane, pre-frontal planning, etc. (Christensen, 1975; Golden et al., 1982).

Finally, the C4-n°99 item with 41.9% in the normal subjects, point also for a task with some degree of difficulty. This task implies Intellectual Operations in the Space (Christensen, 1975) of general form and Complex Viso-Spatial Abilities as Integrated Actively Visual Processes (Golden et al., 1982). Christensen makes a particular reference to this item, referring that item 99 (jointly with the 97) is not always solved easily by healthy or ill subjects (Christensen 1975, p.81). The author refers that it is important to understand as the subject makes the task, the type of difficulties found and how the subjects looks for the solutions for the tasks. This is one of the scales where the differences are more significant. The percentage of success varies from 10% to 90%. Items with inferior levels of success to 50% is the C4-n°89, 5%; C4-n°93, 45%; C4-n°93, 20%; C4-n°94, 37.5%; C4-n°95, 12.5%; C4-n°97, 32.5%; C4-n°98, 32.5%; C4-n°99, 10%. Another item with low levels of success is the C4-n°88, 50%.

In the C5 Scale, the percentage of success in items varies from 96.8% to 53, 2%. Although no item has inferior percentage to 50% of success we would like to indicate that the items with inferior percentage of success are item C5-n°128 (62, 9%), n°131 (69, 4%) and n°132 (53, 2%). All these items imply a set of complex verbal problems (Golden et al., 1982) in which a question is divided in two or three complex segments, whose understanding is of crucial relevance for the suitable resolution of the task. These results suggest that, even for normal subjects the levels of success in such items are not accentuated as for the rest of the items of this scale, having also this accomplishment to be taken in special consideration. In the C6 Scale, the percentage of success of the normal subjects, in items varies from 95.2% to 29%. The item that contributes for this reduced percentage of success (29%) is the item C6-n°170. This percentage remits for the average time that the subjects take to realize the task. Nevertheless, its accomplishment in the

respective tasks is adapted (C6-nº171 items, 82.3%). The result in the C6-nº166 item reaches a second position with 62.9% of successes. These data reinforce, more once what it was exposed for time of accomplishment for the American population, in comparison with Portuguese subjects. In this scale, the item with inferior level of success is the C6-nº170, 7.5%; like the C6-nº156, 30%; C6-nº165, 32.5%; C6-nº165, 42.5%; C6-nº157, 47.5%. Others items with levels of reduced success are the C6-nº155, 55%; C6-nº164, 62.5%; C6-nº165, 65%; C6-nº166, 60%; C6-nº169, 67,5%. In C7 Scale - Written, the percentage of success in items vary from 96.8% to 69, 4%. These data suggest that all items of this scale present levels of quite high probability of success, when used in normal subjects.

In the C8 Scale, the percentage of success in items vary from 95.2% to 37, 1%. The item that contributes for the percentage of 37.1% is the C8-nº201. We consider ourselves that in this scale, the second item with greater level of error is the C8-nº200, with 79%, it is reinforced once again what it was exposed for the time of accomplishment for the American population, in comparison with the Portuguese subjects.

In the C9 – Scale, the percentage of success in items vary from 95.2% to 51, 6%. Items with smaller percentage of success are the C9-nº212 and C9-nº221. Relatively to the C9-nº212 item, Golden et al. (1982) refer that most of the subjects are able to solve by memory the inferior levels of result prone to suggest attentional affectations, difficulty of understanding of which it is being asked or, in extremis, injuries in the left hemisphere and, in specify, the parietal regions. If we conjugate these results with the other two items less good solved, C9-nº221, and C9-nº222, we must consider that Golden et al. (1982) refer that these two items are most sensible to low schooling, not being due their failure to be considered like as relevant as in other parts of the test. However, we decided to evaluate if these differences of accomplishment in these tasks depends of the schooling levels of the subjects. Nevertheless, the accomplishment of the item C9-nº222, presents 33 subjects that do not display any error, verifying that 15 subjects of the School Level “Low”, 6 of Medium School Level. And 6 of the “High” School Level present scores different from zero (it is to say 1 or more errors), forming a statistically significant distribution with differences ( $\chi^2 = 12.514$ ,  $p = .014$ ). In this last task, are the subjects of low School that present reduced scores. Thus, the variable schooling seems to have clearly influence in the results of these subjects, having to be considered at the time of interpreting its results, once this particular task (Serial Seven Test – SST) being indicated like a trustworthy test at the time of valuing concentration levels, nevertheless, its accomplishment is strongly influenced by academic and particularly arithmetical competences (Kaczmarek, 1999).

In the C10 Scale, the percentage of success in items vary from 90.3% to 41, 9%. The only item with inferior percentage to 50% of success is the C10-nº232, Memory of words with interference (41, 9%). All the rest items present percentage of successes superior to 56, 5%. This scale presents varied results enough once it is constituted by items of memory of different modalities (visual memory, auditory memory, associative memory, etc.). The results suggest that even in normal subjects, this scale must be valued with great care, once memory factors usually are affected by diverse processes or mechanisms. Of particular form, items like C10-nº232, Memory of words with interference is strongly by what Slamecka (1960, In Butters & Delis, 1995, p.496) characterized of retroactive interference: the effect of disruption of future learning's in the capacity to evoke information previously learned. Other items of this scale are influenced reason by proactive interference (Andrés, 2003; Romine & Reynolds, 2004): the difficulty of memorize new learning's due to the effect of information previously codified (Landry, 1999). As referred by Golden et al. (1982) these tasks with interference usually are not affected in normal subjects. Considering the acceptable results in the rest items of the scale, these results in this particular item could better be understood by lack of attention or lack of training in this type of task or still, as referred by Ruiz González, Muñoz Céspedes and Tirapu Ustaroz (1999) by secondary effects “to other processes that generically have been associated with the operation of prefrontal cortex, like organization, planning and lack of inhibition, among others...” Is also to refer that item 232 consists of the repetition of three words (“man-hat-door”), followed of 3 seconds of interval, where the evaluator evokes the words “light-stove-cake” that must be repeated by the subject. Next it is requested to the subject repeat the first set of 3 words and the second set of three words. Although it seems a task relatively simple, we cannot forget that this item is preceded of a similar task. Thus, in item nº 231 it is requested to the subject to repeat and to memorize three words, followed of an interval of 15 seconds of heterogeneous interference (Golden et al, 1982) – the description of an image. Next the subject is requested to repeat the three words that were previous memorized. It is possible then that this first task (of interference – in item nº231) Works like a task of interference for item nº 232.

As referred by Altmann and Gray (2002), the mnemonic tracks that are stored in our daily life memory are constantly eliminated in agreement with a set of factors: relevance, frequency, repetition, etc. Nevertheless, in evaluation situation it seems exist a direct relation between interference and decay of the information (Altmann & Gray, 2002; Mitchell, Macrae, Schooler, Rowe & Milne, 2002). In fact, items that subjects fail more in tasks with interference are those with isolated words or with phrases they are items of the second

series that produce retrograde interference. In the C11 Scale, the percentage of success in items varies from 95.2% to 9.7% (!). This scale is the one that presents the greater variability between the levels of success in items. This seems due to the fact that the scale is composed by a great variety of items that deal with different complex cognitive functions (e.g. interpretation of what is occurring in a card - photography of common events, until complex arithmetic problems). Items which imply greater difficulty of accomplishment, although is solved by most of the subjects are those that imply the activation of the executive pre-frontal attentional functions. For example the item in which it is said to the subject "Exists 18 books in two shelves. How would you distribute them so that in one shelf exists the double that the other?". Luria (in Fasotti, 2003) refers that to make such function we needed to start up pre-frontal mechanisms of programming, regulation and verification of mental activity. The result in these tasks depends considerably on the habit, cognitive abilities, schooling, repetition, etc. More once, the item with the most reduced percentage is an item that implies the accounting of the response time - C11-n°265 – Calculating Square meters of Property - response time. That is to say, invariably, in almost all the scales, items that seem misadjusted more to the normal accomplishment of the Portuguese subjects are those that aim for the standardized data of time used by the population of reference for the original uniformity (American).

Let us remember what we referred at the beginning of this discussion in which, with regard to a primary analysis of the results, specifically in the Clinical and Summary Scales, in our sample of 246 normal subjects no one presents a typical profile of a neurological patient. Even considering the exception conditions of evaluation of the profile (re-estimation of the critical level, elevation of two clinical scales, etc.) does not classify any subject with a "Clinical Profile" (suggestion of neuropsychological affectation) (Moses & Pritchard, 1999).

We finalize this section with a brief reflection about the average results reached by the subjects. As it is possible to be verified, the average profile produced by the accumulation of the results of the subjects presents a profile of a subject (hypothetical) perfectly normal. No scale rises above the "Critical Level"; the difference between the scale with smaller score (C2 = 1) and with greater score (C11 = 16) when respective notes T are adopted, produce a difference of scores T of 16 points. The greater score also corresponds to a score T of 47. As is referred by Moses & Pritchard (1999) the scores of the subjects in the scales of the LNNB is transformed into a standard T score, to facilitate the comparisons between subjects and scales, so that into the original version of the LNNB-I all the total scores in each scale of the reference group are transformed by form to that each one has an average of 50 (note T) and Standard deviation of 10 points. Thus, transformations anchor the global level of each scale to a common level and standardize the alterations in the global scores in relation at that anchored level.<sup>2</sup>

In fact, in our study, when we evaluated the scales that are anchored around T Score 50 (with one Stand. Dev., under or above) we verified that all the Clinical and Summary Scales are under the Critical Calculated Average Level. Still more, of the 11 Clinical Scales the Scales C3 to C11 are within the rank of under a Stand. Dev. (T from 40 to 47). Only the rest three clinical scales present greater S.D., being, nevertheless, two of them (C1 with 37 Note T = and C6 with Note T = 38) little significant. The only scale with more reduced T Score is the C2 (T=31).

These values are perfectly acceptable, like referred in the Manual of the LNNB, in which it concerns the accomplishment of normal subjects (Golden et al., 1982). Moses (1995) refers that the waited presentation of normal subjects with high schooling and low age (in our sample, very young subjects but also of average age, and with an average of schooling of 12 years) is a critical level reduced enough and one performance indicating much reduced elevations of the scales. Other authors reinforce this aspect stressing that the valuation of protocols of neuropsychological patients usually present strong scores (worse) in comparison with normal subjects, considering variables as intellectual level and socio-demographic characteristics (Benedet, 2003). In our work we have used, not only the LNNB, but also the MMSE, Clock Draw and the Graphical Series of Luria, with the sense to try to secure validity of construct, particularly when a new test (LNNB) is presented to subjects when it was never previously validated for Portuguese Population (Vaz Serra, 1994). As for the results of the subjects in the MMSE, none of our subjects presents an inferior result indicator to serious considerable cognitive deterioration (minimum score of 25, maximum of 30, 29.30 average score, and standard deviation of 1.085). Although some authors present for this test a diagnoses capacity level of 100% in subjects with dementia (Cué, Gómez, Suárez & Villamizar, 2000), the author of the Portuguese adaptation, Guerreiro (1993), refers that the MMSE is a test of brief cognitive deterioration screening more used in epidemiological studies (e.g. Derrer, Howieson, Mueller, Camicioli, Sexton & Kaye, 2001); nevertheless, regarding to its psychometric characteristics, the author of the Portuguese adaptation refers that this test does not have to be used like an unique instrument of diagnosis. Nys, gvan Zandvoort, de Kort, Jansen, Kappelle & de Haan (2005) refers the fact of this test to be used to evaluate other clinical conditions like for example vascular brain damage. Guerreiro (1993) suggests that this test must be used like a brief test of screening for areas that normally are related to executive functions, as spatial-temporal orientation, memory, language and constructive capacity. An aspect that was considered of clear relevance

in its Portuguese adaptation was the schooling of the subjects, like in the works of Brucki, Nitrini, Caramelli, Bertolucci & Okamoto (2003) and Almeida (1998) in Brazil. In its study with 137 subject controls and 151 patients with different types of dementia, Guerreiro (1993) verified that schooling was correlated in quite sensible form (Pearson,  $r = 0,64$ ), being the difference of results between groups, when considered the schooling, highly significant ( $t_s = 11,11$ ;  $p = 0,000$ ). The variables sex and age were not correlated with the global results in the test. According to the bipartition method, to find out the guarantee and validity of the test, Guerreiro (1993) has found a value of 0,82 Alpha Cronbach Coefficient, when the comparison of two halves of the test were made, well like the Coefficient of Guarantee with a value of Correction of Guttman of 0.88. Through the study of Concurrent Validity Criterion (the results obtained by such subject, when compared with the results of such subject, in the period, in another measurement of recognized value) with the Raven Progressive Matrices (with the existing adaptation for Portugal) has been verified a strong association between the two measures ( $r = 0,70$ ).

The variation of the results of our subjects, from 25 to 30, heightens the idea that the diagnose potentialities of this test only presents its maximum potential when consideration about aspects like the level of formal schooling and the age of the subject where stressed (Cossa, Sala & Musicco, 1997; Malloy, Cummings & Coffey, 1997; Bertolucci, Brucki & Campacci, 1994; Guerreiro, Silva & Botelho, 1994; O'Connor, Pollit & Hyde, 1989; Cavanaugh & Wettstein, 1983; Chandler & Gerndt, 1988). In our sample, most of the scales of the LNNB appear clearly correlated with the results in the MMSE (index of correlation of Pearson) with exception of the Rhythmical Scale (C2) in the Clinical Scales. This result appears like awaited, once we are assessing normal subjects. By their turn Horton & Alana (1990) tried to evaluate the concurrent validity MMSE with other neuropsychological measures, comparing the results of 20 neurological patients in the LNNB with the results in the MMSE. They conclude that the greater correlations were between the global result in the MMSE and sub-scales like expressive language, arithmetic, written and finally motor and tactile abilities.

In its turn, Faustman, Moses and Csernansky (1990), publishes an article with the objective of the previous cited article. The tests were administered to a varied set of entered psychiatric patients in a psychiatric establishment (90 subjects). What these data suggest, is that, in spite of the global results of the MMSE is significantly correlated form with LNNB, MMSE, alone, and would not be able to detect a considerable number of patients who presented evaluated significant deficits when evaluated with LNNB.

The IACLIDE was used with the objective to evaluate levels of depressive simptomatology, once depression, and of a more global form, humor disturbances, have appeared like in great co-morbidity with diverse neurological pathologies (Rosenstein, 1998). Thus, the evaluation of this dimension rose like of crucial importance when one wishes to evaluate the normative population, looking for to understand the relations of the possible levels of depressive pathology with the results verified in the neuropsychological tests. The option by the IACLIDE was based essentially by the fact that this test was originally created from the Portuguese population: thus, and given the recognized scientific quality of the author (Vaz Serra) we thought that this test is ecologically next of the evaluation of the dimensions at issue. In fact, this test was used in varied studies published in magazines of recognized scientific value in the clinical field, like of the drug addiction (Macedo, Relvas, Fontes Ribeiro, Pinto, Gomes, Luck, at al., 2000, Annals of the New York Academy of Sciences; Vicente, Nunes, Vines, Freitas and Saraiva, 2001, Magazine Clinical Psychiatry), well like the evaluation of associated depressive simptomatology due to organic disturbances, amongst other conditions.

Of the 246 normal subjects, and like referred, when variable sex is considered, based on the categories of normality in the IACLIDE, any statistically significant difference of distribution by the several categories is not verified, being sustained the possibility of depressive simptomatology in 12 subjects (9.67%; 10 women and 2 man) and depressive moderate simptomatology in 2 subjects (women). Nevertheless, we considered of all relevance to weave some considerations to the specific results of these normal subjects. When average results are compared (t tests) between "the Normal" subjects and "Slight" (in the IACLIDE) it is verified that the average difference, not being statistically significant in any Clinical or Summary Scales, with exception of the C3 scale, is always superior in the group of normal subjects with indicators of depressive simptomatology. These results are in conformity with the suggestion of the recent revision of Rozenthal, Laks & Engelhardt (2004), in which in subjects with some depressive simptomatology, is usual to be verified neuropsychological alterations at the attention level, capacity of visuo-spatial sequence, immediate memory, short, medium and long term memory, capacity to maintain cognitive and motor activity, to change the center of attention or, like bradifrenia (cognitive and motor slow activation), executive functions, etc. Jointly the results makes possible to raise the hypothesis that, in these subjects, the classification in the IACLIDE does not have be considered isolated as form of exclusion in a study of this nature, without to be considered the global evaluation aspects (tests, interviews, etc.). In fact, already Newman and Silverstein (1987) had evaluated the effect of the variable Depressive State and Age in the performance of 100

depressive patients in the LNNB. One of the main conclusions was that the depressive normal subjects with more age presented a slow performance in the tasks of the LNNB in which time of accomplishment is noted. Of this form, these results seem very important to us at the time of evaluating the results of normal subjects, depressed or no, once it seems to exist, in fact, an effect of the depressive symptomatology in the neuropsychological results of the LNNB. So, the neuropsychological evaluation must, whenever possible, to be the most integrated and comprehensive evaluation, so that the greater set of factors than contributes for one given clinical condition could be considered.

When variable sex is considered, based on the categories of normality in Clock Drawing test, a percentage of 8, 06% (10 subjects, 6 female and 4 males); none significant difference is verified. Still in which says respect to the results of our subjects in the Clock Test it is verified that when the variable Age is considered, based on the categories of normality in Clock Test, although a statistically significant difference is not verified reinforcing previous studies of Cacho, García-García, Arcaya, Vicente & Lantada (1999), in our study we found a tendency so that the subjects with greater age present worse results than the subjects with smaller age. These results are in conformity with the results of the revision of Royall, Mulroy, Chiodo & Polk (1999) in which it is sustained that in some categorizations of the Clock Test, the age is a variable that is correlated positively to deficits found in this test.

A last reference must be made to data relative to the correlations between the evaluated variables. With this preoccupation we verified that the variable age is negatively related to the scores of our subjects in all the Clinical and Summary LNNB, with exception of Rhythmical C2-Funciones Scale. These results are in conformity with other studies with the LNNB, like referred of Vannieuwkirk and Galbraith (1985) in which the variable age is correlated strongly with 13 of the 16 principal scales, and the study of MacInnes et al. (1987) or other instruments of analyses based on Lurian Models, and with the same methodology that the LNNB, as it is Luria-UCV, developed by Gómez of the Central University of Venezuela (see additional descriptions in Gómez, Roca, Esaá, Sanchez & Ruiz, 2004; Gómez, Roca and Esaá, 1999a; Gómez, Roca and Esaá, 1999b).

About the Summary Scales (S1 to S5) all the scales are correlated positively of statistically significant form between each other. This is in conformity with the methodology of construction of the Summary Scales (items predetermined of the C1 scales to C11), being verifiable that the elevation of a determined S1 scale to S5 usually is interrelated with an elevation in conformity with the scales that contributed for the elevation of the Summary Scales (Golden et al., 1982).

In which it concerns the correlation of the Summary Scales with each one of the Clinical Scales the S1 Scale is related of statistically significant form to all the scales, with exception of the C3 scale (Tactile Functions), the same in relation to the Summary Scale S5 and C2 (Rhythmical Clinical Scale). These data added to the analysis of the correlations of the Clinical Scales between it, allow verifying the scales that present statistically significant positive correlations with the remaining clinical scales: C1-C5. The Clinical Scale C2 does not present statistically significant correlations with the C6-C11 scales. In the C6 scales to C11 the only Clinical Scale with which statistically significant relations are not verified is C2 Scale. This aspect is in conformity with the idea that the LNNB is an extensive and comprehensive battery that evaluates several dimensions of the neuropsychological processes of the subjects, with independent functions and factors (Golden et al, 1978, 1982). The remaining correlations between the variable level of schooling and elevation of the Clinical and Summary Scales, in our sample, sustain the use of estimation factors and ponderation of the results in agreement with the schooling (and the already referred age) through a formula like computation of LNNB critical level (Golden, Hammeke & Purisch, 1979). The results of the correlations in the depression test (IACLIDE), suggest that the factor Age is related positively to a greater presence of such symptomatology (even in subjects with levels of humor within normality). On contraire, these indicators are related negatively to the schooling. These data better seem to be explained if we consider the three variables jointly. The newest subjects are part of a generation of young people in active labor age and/or end of superior schooling. Said of another form, our older subjects present considerably less years of schooling, more numerous families and with no specialized professions (like rural workers, disqualified employees, etc.), so, of lower socioeconomic statute and everything that usually it is to that aspects (poor conditions of professional, social and familiar accomplishment). This could be a factor that could be able to lead older subjects and with less schooling present greater indicators of depressive humor. The same could be said for the correlations with each one of the scales of the LNNB and variables IACLIDE, years of schooling and age. By this, the idea that in a work in which so many variables are evaluated, more important than to try describe theoretically all the aspects that could be behind such data it is the integrated understanding of such.

## **Conclusion**

We think that some limitations of this study must be analyzed. The performance of a subject in LNNB (Golden, Hammeke & Purisch, 1985) presented represented in a brute way the gross scores of the subtests of the battery. These gross scores later are transformed into T scores, so that comparisons between the scales and the several subjects in analysis can be established. Moses & Pritchard (1999) remembers that, with this procedure it is tried to establish a standard score T (originally from gross scores) in a form that these present average of 50 and one standard deviation of 10 - such transformations anchor the total level of each scale in a common value and standardize the deflections of the gross scores to return of a fixed value. Thus, and like also referred by Moses & Pritchard (1999) the direct meaning of those gross scores transformed into T Scores are always dependent of the nature of the used original group of reference to calculate the transformations and the forms of distribution of the scores transformed into standard values.

From another perspective, McKinzey, Roecker, Puente & Rogers (1998) call the attention for another problematic of the use of test with standardized norms, specifically those which have not been used in a comprehensive and qualitative form. The authors refer that three great questions can be indicated when a battery like the LNNB is used: the index of identification of false positives, the qualitative analysis of quantitative items and the acuity of the formula of estimation of simulation. Relatively to this aspect, it is of crucial relevance the consultation of Purisch (2000, p. 275), Misconceptions about the Luria-Nebraska Neuropsychological Battery, in which the author refers:

"The major criticisms related to the belief that the qualitative and quantitative approaches could not be fused, that the scales were too heterogeneous to produce meaningful scores, that the battery suffered from significant limitations in sampling of neuropsychological skills, and that it had questionable sensitivity to brain dysfunction (...) generally reflected an unawareness of the interpretive process and theory underlying the LNNB, and have been largely negated by a large empirical literature that has evolved over many years".

A last word must be pointed at the thematic of the ecological validity of the test. With our works we tried to include/understand and to have in consideration which is accepted today about this thematic. For example Chaytor and Schmitter-Edgecombe (2003) refer that when we are using a new test, or preceding to the adaptation of a test we must weigh in account a set of questions: "Is the ecological validity of neuropsychological tests adequate?", "What variables are important in ecological validity; research?", "How can this information impact current clinical practice?", "How can this information impact future research?"(p.181).

Makatura, Lam, Leahy, Castillo and Kalpakjian (1999) studied the relation between several classic batteries and its respective sub-scales for evaluation of the memory and results in tests developed to deal with classic criticizes that some batteries of evaluation can not consider ecological aspects of the normal individual functioning. Thus, 111 adults with diagnosis of cerebral injuries were evaluated following traditional methodologies as the LNNB Memory Scale (LNNB-M) and the WMS-R. According to the description of the study, the patients also were evaluated by Rivermead Behavioural Memory Test (RBMT), developed to evaluate daily life issues. Finally, the subjects still were evaluated according to "the subjective" opinion of the clinical technician that accompanied them in a rehabilitation center. What Makatura et al. (1999) refers is that the results suggest that RBMT appears like more effective in the classification of the deficits of the memory, as they are classified by the clinician. At the same time, the LNNB-M and the WMS-R presented relatively adapted results in the identification of subjects without affection of memory or with a level of strong dysfunction. The authors refer that, in this sample of subjects, these two last scales were less effective in the identification of slight deficits. Previously already Ryan and Prifitera (1982) had presented data in the same line of these results, in a study where was studied the validity of criterion of Luria-Nebraska Neuropsychological Battery, Memory Scale (LNNB-M) and Wechsler Memory Scale (WMS). A total of 32 psychiatric patients were evaluated with a positive correlation in both tests [ $r(30) = .65, p < .001$ ]. Levels of agreement between the two scales in the identification of subjects with affection of the memory in the order of 72% have been verified. Finally, the subjects with greater levels of affection of the memory presented significant superior values in the LNNB, concerning with T score (Ryan, Farage, Mittenberg & Kasprisin, 1988; Moses & Johnson, 1983).

In the same sense, the use of neuropsychological tests in subjects without any type of academic formation is another situation in which the use of a unique test proves can lead the evaluator to classify like pathological what is due specifically to differences in the educational level (Ostrosky, Ardilla, Rosselli, Lopez-Arango & Uriel-Mendoza, 1998).

Golden, Golden, Burns & Roth (1997) presented in the 16<sup>o</sup> Annual Congress of the National Academy of Neuropsychology in the EUA a study relative to the existing relation between the data of the neuropsychological evaluation and their capacities for the so called daily life activities, namely, their



independence for financial management of their yields. Golden et al. (1997) administered a sub-test of a battery used in the EJA, named Independent Living Scale (ILS), specifically the sub-tests "Acquiring and Managing Money" (according to the authors this tests presented an ecological clear validated measure, once is directed for the evaluation of daily skills of the subjects) and LNNB-III to a population of old patients with varied psychiatric disturbances. What the authors verified was the significant correlation between the scale "Acquiring and Managing Money" and ten of the scales of the LNN-III, specifically global intelligence, orientation, auditory serial learning, reading, Arithmetic, visual identification, visuo-spatial analysis and visuo-intellectual analysis. According to these, the measures of the LNNB-III with which scale ILS were correlated (Pearson Correlation Coefficient between 0, 42 and 0, 68, with  $p < 0, 03$ ) represents a global tendency so that the skills of daily financial management depend to a great extent on the individual level of multimodal capacities like visual processing of the information, academic skills, integrative cognitive capacities, as well as verbal memory. Golden et al. (1997) suggest that these studies reflect the ecological validity de los items de LNNB-III, as well as the hypothesis that the training in daily skills of financial management could produce an improvement and autonomy in this specific aspect like of the neuropsychological processes that support them.

With our works we have in mind that much is left to do. Many adaptations of items will have to be done in the future. Perhaps, the own methodology of neuropsychological assessment is decentralized of an attempt of presented uniform reference data, or as well, fortifies the initial perspective of Luria, that defended that the neuropsychological evaluation would be turned in a theoretically empty Psychometric from the point of view of the Neurosciences (Luria and Majovski, 1977). Ardilla (1999, p. 68) refers that "(...) Luria's procedures will be combined with some others, including more standardized and psychometrically oriented assessment instruments. Further development of Luria's ideas with regard to neuropsychological assessment is foreseen". Nevertheless, whatever it is the future of our works, we become aware that we are taking the first steps in Portugal about the challenge to the adaptation of which Tupper (1999a,b), called of Neo-Lurian Perspective. In the end, and although what we referred has been in a context not directly related, but also not very far, Pascual-Castroviejo (2003) refers "the patient is the first and only truly important thing" (S170). And for that we will try to continue working hard.

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