

LURIA'S APPROACH TO NEUROPSYCHOLOGICAL ASSESSMENT

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A. R. Luria's approach to neuropsychological assessment was examined. Three basic points of departure from Luria are presented: his interpretation of cognitive activity as functional systems, his emphasis on the individualized approach, and the importance of the analysis of the errors. A distinction was introduced between Luria's neuropsychological testing, and Luria's neuropsychological approach; the former refers to the specific set of neuropsychological tests Luria used and developed and the latter, to the specific clinical use of these tests. It is emphasized that Luria's basic contribution to assessment in neuropsychology, refers to the clinical approach he proposed and developed. Problems related to the normalization and validity of neuropsychological tests are analyzed. It is concluded that different approaches in neuropsychological assessment are related to the specific goals for which neuropsychological assessment is performed.

Keywords: Neuropsychological assessment, Luria's neuropsychology, neuropsychology, behavioral neurology.

One of the most critical points in Luria's neuropsychology, has been his approach to assessment. Frequently, his approach has been considered as nonvalid, obscure, subjective, and the like (e.g., Reitan, 1976). Recently, a distinction has been proposed between behavioral neurology and clinical neuropsychology (e.g., Horton & Puente, 1986; Rourke & Brown, 1986). Luria is introduced as the most typical figure of behavioral neurology. It is further proposed that behavioral neurology is different from clinical neuropsychology in the following ways: (1) Clinical neuropsychology is inclined to follow the tradition of empirical psychology, while behavioral neurology is more inclined to emphasize the conceptual or notional dimensions of behavior; (2) clinical neuropsychology emphasizes the measurement of continuously distributed variables within a psychometric tradition; behavioral neurology emphasizes, within the neurological tradition, dichotomous classification through the use of the pathological sign approach; (3) behavioral neurology emphasizes the individual case analysis and the elucidation of syndromes in terms of the presence or absence of the signs and symptoms thought to be associated with the syndrome in question; clinical neuropsychology strongly relies on psychometric measurement of behavior (Rourke & Brown, 1986).

These differences imply differences in their approach to diagnosis and even rehabilitation. Assessment in behavioral neurology is described as the search for pathological signs and symptoms indicating brain dysfunction, while assessment in clinical neuropsychology is described as the application of standardized psychometric procedures composed of items that are well studied and are of known acceptable reliability and validity (Rourke & Brown, 1986).

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Luria extensively displayed his approach to clinical neuropsychological assessment in Part Three of his book *Higher Cortical Functions in Man* (1966). Toward the end of his life, he published a short guide to neuropsychological assessment (Luria, 1973), which apparently has not been translated into English. I shall begin from these two basic writings for Luria's interpretation of neuropsychological assessment. In addition, I have drawn upon the personal experience of the author who worked with Luria for several years.

Part Three of *Higher Cortical Functions in Man* was summarized and systematized by Christensen (1975) and translated into several languages. Golden (1981; Golden Hammeke & Purisch, 1978) went further and developed a psychometric diagnostic known as Luria-Nebraska Neuropsychological Battery, departing from Christensen's manual. This battery has been widely used in neuropsychological assessment, particularly in the USA.

SOME BASIC POINTS IN LURIA'S APPROACH

According to Luria, the basic goal of neuropsychological assessment is to perform a syndromatic analysis. This departs from his interpretation of brain organization for cognitive processes. Psychological processes should be considered complex functional systems.

1. *Psychological Processes as Functional Systems*

Psychological processes represent functional systems. The concept of functional system is derived from Anokhin (1974), and is understood as a group of interconnected biological operations that produces a particular biological effect. The functional system is based on a complex dynamic constellation of stages, situated at different levels of the nervous system, which in performing an adaptative task, may be changed without the task itself being changed. To write, for instance, represents a complex psychological process (functional system) that requires the participation of multiple areas of the brain; each of these areas makes its particular contribution to the whole system. A focal lesion of the brain will disrupt the ability to write at a particular level (the ability to perform the skilled movements required for writing, the spatial organization of writing, the selection of words, the ability to sequencing graphemes, etc.). However, such particular focal damage will also disrupt all the functional systems for which that particular operation is required. For instance, the patient will not only have difficulties for the spatial organization of writing, but also, for the spatial organization of numbers, figures, drawings, etc. In all the functional systems in which such ability is included, the defect will be apparent.

The brain damage produces not the loss of a specific cognitive process (functional system), but its disturbance at a specific level. This implies that neuropsychological assessment will be aimed at disclosing the fundamental defects underlying the apparent deficits. For this purpose, it will be necessary to administer different types of tasks to the patients and to analyze how the particular difficulties in performing each one of them are manifested.

2. *Individualized Analysis*

Case analysis has been and continues to be the basic method in clinical research. The vast majority of the neurological, psychological and neuropsychological syn-

dromes appearing in the scientific literature have been initially reported as single case analyses. Luria's extraordinary ability and penchant for single case analysis is clearly revealed in several of his books reporting single cases (Luria, 1968, 1974). In fact, in all his writings, this propensity towards the in-depth analysis of every individual case, is clearly reflected. In a certain sense, every patient should be considered as an individual case analysis in Luria's view.

This has two implications: (1) neuropsychological assessment is flexible and should be adapted to each patient; and (2) the examiner has to possess a vast amount of knowledge about brain organization of cognitive activity in order to be able to re-orient the evaluation permanently. It is not enough to know how to apply some more or less standardized tests. Rather, the fundamental knowledge the examiner must have is the knowledge about brain organization of psychological processes. In other words, for Luria the neuropsychologist has to command a solid background not only in psychological measurement, but also in neurology, neurophysiology, neuroanatomy and general psychology.

3. Analysis of Errors

For Luria, the most important observation when testing a patient refers to the nature of deviations or errors, and how such mistakes could be explained. This implies that the pass/fail criterion is not enough, or at best, it is simply an initial gross approximation to the characteristics of the deficit. The qualitative analysis of errors will be particularly informative as concerns the underlying deficit of the patient. It is not enough to know that a patient cannot understand language, or cannot write. For Luria, the most important information is the precise nature of the patient's inability to understand language or to write and the specification of the level in the functional system that is disrupted. What are the actual mistakes the patient presents when trying to understand language or trying to write? The errors produced by patients with frontal, parietal or temporal lesions when performing calculation tasks are quite different, although all of them may present a certain degree of acalculia (Ardila & Rosselli, 1990; Rosselli & Ardila, 1989). All can fail in exactly the same tasks, but for totally different reasons; their errors will be the key clues for understanding the underlying deficit.

NEUROPSYCHOLOGICAL TESTING AND NEUROPSYCHOLOGICAL APPROACH

There are two different aspects in Luria's neuropsychological assessment: (1) the specific tests he used for pinpointing the cognitive deficits, and (2) his particular clinical approach.

In general, a great deal of interest has been focused on the specific tests Luria used; this is reflected, for instance, in the popularity of the above mentioned Luria-Nebraska Neuropsychological Battery. Accordingly, in his *Higher Cortical Functions in Man*, as in his *Neuropsychological Research* monograph, Luria presents an extensive series of tests, which are potentially useful in neuropsychological assessment. In this latter monograph Luria includes the following areas and topics in neuropsychological evaluation (Table 1). For each of them, a complete series of potentially useful tests is listed.

Some of these tests are traditionally used in clinical practice. For instance, several tests constructed to evaluate perceptual integrity. Others were developed by Luria

TABLE 1
Areas Included in Neuropsychological Evaluation According to Luria (1973).

SPATIAL AND VISUOSPATIAL KNOWLEDGE

1. subjective evaluation of visual function
2. recognition of objects
3. volume of visual perception
4. recognition of faces
5. recognition of colors
6. optic-spatial knowledge
7. split of a line
8. examination of grouped and complex figures
9. recognition of letters
10. recognition of numbers

SOMATOSENSORY KNOWLEDGE

1. localization of tactual stimuli
2. discrimination of the number of stimuli
3. kinesthetic sensitivity
4. transference of positions between both hands
5. right-left discrimination
6. finger naming
7. tactual recognition of objects

AUDITORY KNOWLEDGE AND AUDITORY-MOTOR COORDINATION

1. recognition of pitch
2. melodies
3. localization of sounds
4. dichotic listening
5. evaluation and repetition of rhythms

ASSESSMENT OF MOVEMENTS

1. performance of simple movements
2. position praxis
3. spatial praxis
4. Head's test
5. coordinated movements with both hands
6. asymmetric tapping
7. performance of motor programs
8. constructive praxis
9. drawing
10. performance of actions with objects
11. symbolic praxis
12. visual movements
13. oral praxis
14. conditioned reactions

ASSESSMENT OF LANGUAGE

1. spontaneous language
2. automatic language
3. repetition
4. naming
5. language comprehension
6. expressive language

ASSESSMENT OF WRITING

1. automatic writing
 2. writing of letters
 3. writing of words
 4. writing of sentences
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TABLE 1 Continued

SPATIAL AND VISUOSPATIAL KNOWLEDGE

ASSESSMENT OF READING

1. reading of letters
2. reading of logotomes
3. reading of ideograms
4. reading of common words
5. reading of complex words
6. reading of words incorrectly written
7. reading of sentences

ASSESSMENT OF MEMORY

1. repetition of series of syllables and words
2. learning of series of syllables or words
3. repetition of two groups of words
4. sentence repetition
5. fable retention

ASSESSMENT OF CALCULATION ABILITIES

1. quantity appreciation
2. reading and writing of simple numbers
3. reading and writing of complex numbers
4. performance of simple calculation tasks
5. performance of three elements calculations
6. successive operations

ASSESSMENT OF INTELLECTUAL PROCESSES

1. fable comprehension
2. comprehension of meaningful pictures
3. problem solution
4. sentence completion
5. verbal association
6. antonyms
7. analogies
8. interpretation of proverbs
9. object classification

himself, such as the tests devised to assess frontal lobe damage. For Luria, the critical factor in neuropsychological assessment does not refer to what tests are specifically used but rather to what type of psychological processes are involved in those particular tests. As a matter of fact, Luria had a more or less standard set of tests, which he used according to the specific dictates. However, this is of minor consequence. Luria's assessment does not call for the use the same tests he incorporated, but rather his assessment stresses the use the particular clinical philosophy he proposed and developed in neuropsychology.

NORMALIZATION AND VALIDITY

In contemporary neuropsychology, much weight has been given to the problem of normalization and validation of tests used in clinical practice. Luria never rejected the normalization of neuropsychological tests; on the contrary, he encouraged normalization. He himself investigated performance of normal populations on neuropsychological tests. He studied the development in normal children of abilities tested in neuropsychologic exams and the like. Furthermore, his tests can be normalized and some of them have, indeed, been so in extensive normal populations. For in-

stance, his ten-word memory test has been administered to normal populations subjects of different age ranges and educational backgrounds. These studies have shown that a 20-year-old person with 12 or more years of formal education requires an average of 3.2 trials for recalling 10 high frequency nouns sequentially presented; a 60-year-old illiterate requires an average of 6.5 trials (Ardila, Rosselli & Rosas, 1989; Ardila, Rosselli & Puente, 1992). But this is secondary. The basic contribution of Luria to neuropsychological assessment was not to develop a series of tests to reveal brain damage, although as a matter of fact, he developed many such measures. The real contribution of Luria to neuropsychological assessment is represented by his individualized clinical approach.

To normalize a test does not mean that the problem of assessment is solved. It is just an additional piece of information for the examiner. Moreover, norms are particularly useful for the beginner, not for the experienced examiner. The latter easily recognizes what could be considered as normal and what should be interpreted as pathological. This holds as well for any type of professional activity. The availability of norms is no substitute for the clinical ability to perform a syndromatic analysis. In addition, norms require very careful interpretation. For instance, current norms used in neuropsychology have a very limited value when assessing Spanish speaking populations (e.g., Rosselli, Ardila, Florez & Castro, 1990; Ardila, Rosselli, & Puente, 1992), and they are totally useless when examining illiterate populations (Ardila, Rosselli & Rosas, 1989; Rosselli, Ardila & Rosas, 1990; Ardila, Rosselli & Ostrosky, 1992). For example, the Luria-Nebraska Battery was used to detect brain damage in a Spanish-speaking population of the neurological service of a hospital institution in Mexico City. Results obtained were practically at chance level, since they only achieved 45% accuracy in discriminating between a normal and a brain-damaged population (Galindo & Ibarra, 1984). Does this mean that it is not possible to perform neuropsychological assessment in Spanish speaking populations or with illiterates just because we do not have norms for these populations?

To speak in terms of norms provides ground for security to the neuropsychologist. But, according to Luria, this cannot replace knowledge of the brain organization of psychological processes. Otherwise, neuropsychological assessment would become a psychometry applied to brain-damaged populations, a psychometry theoretically empty from the point of view of neuroscience. This is precisely what Luria opposed (Luria & Majovski, 1977).

The problem of validity is somehow more complex. According to current psychometry, it could be granted that Luria's assessment possesses validity of several types: face validity, construct validity, and content validity. However, the problem rests with the predictive validity in Luria's approach. In contemporary theory of measurement applied to neuropsychology, predictive validity refers to the capability of a particular test (or set of tests) to predict brain pathology (Boll, 1981; Reitan and Davison, 1974). Lezak (1983) has called attention to the fallacy that sometimes underlies the development and cross-validation of neuropsychological tests in terms of how well their "hit rates" differentiate between an unequivocally brain-damaged population and normal controls.

Two observations should be considered.

(1) The primary goal of neuropsychology is *not* to discover brain damage. Brain damage is generally understood as a structural disorder, which consequently has to be discovered through methods geared towards a structural analysis of the brain (CAT, MRI, etc.). The neuropsychological exam is not simply some weak or imprecise procedure to localize possible brain damage, sometimes used before applying a truly powerful procedure to pinpoint the brain pathology. The primary goal of neuropsychy-

chological assessment is to analyze the cognitive status of a patient, usually secondary to a certain pathological condition of the brain. And the only manner of determining cognitive status is through cognitive procedures. Similarly, the only way to determine structural pathology of the brain is through a structural analysis of the brain. A patient with a fluent aphasic disorder of language very likely presents a pathology in his left temporoparietal area. However, even if no structural pathology is demonstrated through CAT or MRI, this does not mean that he no longer presents with an aphasia. It only means that the specific paraclinical procedure used was unable to discover the underlying pathology responsible for his aphasia.

(2) Clinical-anatomical correlations were widely developed by Luria. As a matter of fact, he is a precursor of the method of the superimposition of lesions to disclose critical areas in a particular type of disorder. His study of 800 patients to determine the critical brain area for phonemic discrimination deficits has become classic. This procedure of superimposing lesions to highlight critical areas responsible for clinical syndromes is extensively used in the present day neuropsychological research (e.g., Damasio & Damasio, 1989; Kertesz, 1983). Luria strived to establish correlations between brain pathology and disturbances at specific levels of information processing, not to correlate brain pathology with performance in specific tests. Tests may be changed, but since some specific level of information processing would be still required, impairment will be manifested. Besides, the performance on even apparently very simple tests can require the participation of different brain systems. Hence, even performance on simple tests can be altered as a consequence of very different brain pathology, although the specific errors will be different. Many different types of brain pathology can alter, for instance calculation abilities; however, in each case the difficulty (and the errors) will be the result of a disturbance at a different level. Patients with frontal lobe damage and patients with angular gyrus damage can both present with serious difficulties in performing simple calculation tests. However, the underlying impaired mechanism and the type of errors manifested are quite different (Rosselli & Ardila, 1989). Consequently, the validity derived from correlating the site of the brain pathology with performance on a particular test appears, in Luria's interpretation as a very gross and crude approximation.

For Luria, the information collected from the observation of brain-damaged patients should be helpful for developing an increasingly more accurate picture of brain organization of cognitive processes. If we knew well enough how the brain works we should be able to predict brain pathology accurately when analyzing in detail the performance of a patient on a set of tests. The departure point in the neuropsychological assessment is the knowledge about how the brain works, not the knowledge about how to apply a series of tests in standardized conditions.

THE GOALS OF NEUROPSYCHOLOGICAL ASSESSMENT

For Luria, neuropsychological assessment is performed in order: (1) to describe the general pattern of changes taking place in cognitive ability of a patient; (2) to identify the fundamental defect(s); that is, to find the factor(s) underlying his/her signs and symptoms, and (3) to propose therapeutic procedures.

Several additional purposes could be added. For instance, frequently, neuropsychological assessment is performed to assist in determining the labor capabilities of a patient, or to secure additional information for the differential diagnosis between two apparently similar conditions (e.g., transient global amnesia and dissociative amnesia; dementia and depression; etc). The assessment may also be administered

simply for exploratory and/or research purposes. In the United States apparently a great interest in neuropsychological assessment has been developed for forensic issues, which demand a great deal of effort from North American neuropsychologists. However, this does not mean that basic aims of assessment have changed. Rather, it means only that additional requirements have emerged.

In summary, the main contribution of Luria to neuropsychological assessment, refers not to the specific set of tests he used, but to the clinical approach employed when using them. Does it mean that his approach should be considered as a different neuropsychology (or perhaps not even neuropsychology)? Should neuropsychology be interpreted as a branch of psychometry? Or should it be included as a branch of neuroscience? Or both? For Luria, the answer is obvious.

REFERENCES

- Anokhin, P. K. (1974). *Biology and neurophysiology of the conditioned reflex and its role in adaptive behavior*. New York: Pergamon Press.
- Ardila, A. & Rosselli, M. (1990). Acalculias. *Behavioral Neurology*, 3, 39–48.
- Ardila, A., Rosselli, M., & Rosas P. (1989). Neuropsychological assessment in illiterates: Visuospatial and memory abilities. *Brain and Cognition*, 11, 147–166.
- Ardila, A., Rosselli, M., & Ostrosky, F. (1992). Socioeducational factors in clinical neuropsychological assessment. In A. Puente & R. McCaffrey (Eds.), *Psychobiological factors in clinical neuropsychological assessment*. New York: Plenum Press.
- Ardila, A., Rosselli, M., & Puente, A. (1992). *Neuropsychological assessment of the Spanish speaker: A practitioner's guide*. New York: Plenum Press.
- Boll, J. T. (1981). The Halstead-Reitan neuropsychology battery. In S. B. Filskov, & T. J. Boll (Eds.) *Handbook of clinical neuropsychology*, vol 1. New York: Wiley
- Christensen, A. L. (1975). *Luria's neuropsychological investigation*. New York: Spectrum.
- Damasio, H., & Damasio, A. R. (1989). *Lesion analysis in neuropsychology*. New York: Oxford University Press.
- Galindo, G. & Ibarra, R. (1984). Bateria neuropsicologica de Luria-Nebraska: un intento de validacion. Unpublished thesis. Mexico: Universidad Anahuac.
- Golden C. J. (1981). A standardized version of Luria's neuropsychological tests: a quantitative and qualitative approach to neuropsychological evaluation. In S.B. Filskov & T. J. Boll (Eds.) *Handbook of Clinical Neuropsychology*, vol. 1, New York: Wiley.
- Golden, C. J., Hammeke, T. & Purisch, A. (1978). Diagnostic validity of the Luria Neuropsychology Battery. *Journal of Consulting and Clinical Psychology*, 46, 1258–1265.
- Horton, A. M. & Puente, A. E. (1986). Human neuropsychology: an overview. In D. Wedding, A. M. Horton & J. Webster (Eds.) *The neuropsychology handbook: behavioral and clinical perspectives*. New York: Springer.
- Kertesz, A. (1983). *Localization in neuropsychology*. New York: Academic Press.
- Lezak, M. D. (1983). *Neuropsychological assessment*. New York: Oxford University Press.
- Luria, A. R. (1966). *Higher cortical functions in man*. New York: Basic Books.
- Luria, A. R. (1968). *The mind of a mnemonist*. New York: Basic Books.
- Luria, A. R. (1973) *Neuropsychological research*. Moscow: Ed. MGU (in Russian).
- Luria, A. R. (1974). *The man with a shattered world*. New York: Basic Books.
- Luria, A. R. & Majovski, L. V. (1977). Basic approaches used in American and Soviet clinical neuropsychology. *American Psychologist*, 32, 959–968.
- Reitan, R. M. (1976). Neuropsychology: the vulgarization that Luria always wanted. *Contemporary Psychology*, 21, 737–738.
- Reitan, R. M. & Davison, L. A. (1974). *Clinical neuropsychology: current status and applications*. Washington, D. C.: Winston and sons.
- Rosselli, M. & Ardila, A. (1989). Calculation deficits in patients with right and left hemisphere damage. *Neuropsychologia*, 27, 607–617.
- Rosselli, M., Ardila, A., Florez, A. & Castro, C. (1990). Normative data on the Boston Diagnostic Aphasia Examination in a Spanish-speaking population. *Journal of Clinical and Experimental Neuropsychology*, 12, 313–322.

- Rosselli, M., Ardila, A., & Rosas, P. (1990). Neuropsychological assessment in illiterates II: Language and praxic abilities. *Brain and Cognition*, *12*, 281–296.
- Rourke, B. P. & Brown, G. G. (1986). Clinical neuropsychology and behavioral neurology: similarities and differences. In S. B. Filskov & T. J. Boll (Eds.) *Handbook of clinical neuropsychology*, vol 2. New York: Wiley.