

Syndromic analysis in child neuropsychology: A case study

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Background. Neuropsychology is a science with its own specific concepts, terms, and methods of analysis of disturbances in psychological development. One of the essential concepts of neuropsychological methodology, according to A.R. Luria, is that of a neuropsychological syndrome, which takes into account both the functional organization of the brain and the behavioral system. However, this concept isn't mentioned in the majority of his publications, and thus is not well known by neuropsychologists. There is no clear understanding of this concept within the works of modern neuropsychologists. This omission has a strong influence on the way analysis and interpretation of developmental difficulties is carried out today.

Objective. The objective of this study is to present an example of the successful application of qualitative syndromic analysis to the case of a Mexican preschool child with developmental problems and learning disabilities.

Design. The clinical analysis was applied to the case of a 6 year old girl with learning disabilities, whose difficulties had been attributed primarily to a low level of general brain activation.

Results. The authors assert that the advantages of A.R. Luria's syndromic approach to clinical cases of difficulties in development and learning disabilities, are that it opens up the potential for finding the general causes on different levels: neuronal maturation, brain mechanisms, activity and personality.

Conclusion. The authors conclude that the topic of syndromic analysis in child neuropsychology requires further scientific discussion. The necessity for revising levels of analysis of clinical cases should be taken in account.

Keywords: neuropsychological syndrome, child neuropsychology, assessment of development, qualitative assessment, Luria's approach, developmental problems, subcortical levels

Introduction

One of the essential concepts of neuropsychological methodology, according to A.R. Luria, is that of a neuropsychological syndrome, which takes into account the functional organization of brain (functional brain units) and the behavioral sys-

tem as a whole. However, this concept is not mentioned in the majority of Luria's publications in languages other than Russian (Luria, 1970, 1973). Tsvetkova (2004) wrote that a neuropsychological syndrome represents "selective deficits of groups of psychological functions, which structure includes the same damaged factor along with the conservation of other functions, which do not include this factor." Clinical application of the concept of neuropsychological syndrome means to consider the common reason (cause), or common base, of all the difficulties observed in each case. This base or level should be considered a link between the level of material brain structures and the level of psychological actions.

According to Luria, such a reason (cause), base, or "factor" could be understood as the psychophysiological mechanism responsible for all the observed symptoms, developmental difficulties, and problems in school, intellectual tasks at any age, and day-to-day behavior. Such a cause could not be identified solely by quantification or assessment of isolated cognitive functions such as language, memory, attention, and so on.

Another consequence of utilizing Luria's analysis is that the cause or "factor" not be confused with symptoms or diverse expression of patient's behavior. We remind readers that, in all modern classifications of clinical developmental syndromes, each syndrome is understood as the combination of symptoms and features of external behavior.

The difficulty in finding the precise neuropsychological factor or common cause responsible for each child's difficulties, is that usually it is isolated cognitive functions which are measured during neuropsychological assessment (Tsvetkova, 2004). For followers of A.R. Luria, isolated evaluation of cognitive functions is inadequate (Vigotsky, 1991). Qualitative assessment has to provide specific information for the specialist to identify the predominant reason or "factor" causing the difficulties, from the point of view of the functional participation of central nervous system (Quintanar & Solovieva, 2008).

At the same time, the "factor" is not merely the level of development of the child's anatomical brain structure itself, but the result of participation of this structure or structures in the child's psychological actions. We understand psychological actions not as isolated "cognitive functions," but acts driven by goals (Solovieva, 2014; Solovieva & Quintanar, 2016a). In early infancy such actions are types of communication and play activity. At school age they are learning skills, such as writing sentences, repeating words spoken by the instructor, reading, etc. It is important to provide detailed analysis of the level of development of the child's psychological actions relative to his/her specific psychological age (Solovieva & Quintanar, 2016b). Then it's possible to establish the relationship between the child's psychological actions (functional) and the structural levels of participation of the child's central nervous system.

In child neuropsychology, the relationship between the child's psychological actions and the central nervous system might mean establishing the level of maturation of his/her subcortical or cortical functional relations (or the existence of a lesion on the system). It is important to separate cases where there is a lack of neurophysiological maturation at different subcortical levels, from the kinds of cortical difficulties which appear in adults as a consequence of brain damage. One specific feature of clinical assessment in infancy is that the effects of brain damage or im-

maturity can be expressed in a very generalized and diffuse way, compared to its effects on adults. The whole personality and activity of the child suffers (Slepovich & Poliakova, 2012), and there may even be no progress in psychological development. It is also possible to speak about developmental risk situations at an early age (Katona, 1988) from a global point of view (Muñoz-Ledo, 2003), and the potential for preventing difficulties in development during the first year of life (Pelayo, Solovieva, Marroquín-Andrade, Corona & Quintanar, 2013).

The concept of a neuropsychological syndrome was proposed especially for cases of adults with brain damage (Luria, 1970). Luria's colleagues and followers have also used his concept for developing different clinical pictures for adults and children (Simernitskaya, 1985), (Xomskaya, 1987), (Santana, 1999), (Tsvetkova, 2001), (Solovieva, Lázaro, & Quintanar, 2008), (Tsvetkova, 2004).

The functional or qualitative idea of the existence of a specific neuropsychological syndrome differs from syndromes established in DSM-IV (American Psychiatric Association, 2000). A neuropsychological syndrome should never be reduced only to one "cognitive dysfunction," such as "attention deficit disorder," dyscalculia, dyslexia, or dysgraphia. The syndrome always includes difficulties with diverse kinds of school activity or play, according to the age of the child. Even separate identification of some aspects of cognitive functions, such as language, memory, and attention, could not help identify the common factor of child's difficulties (Glozman & Potanina, 2004).

Instead of the psychometric method of assessment, or the assessment of isolated cognitive functions corresponding to various features of behavior, we propose another scheme for syndromic analysis. In this scheme we include psychological mechanisms as neuropsychological factors, which have to be evaluated functionally during a process of assessment. Assessment is understood as involving interaction with the child, with the possibility of providing help and different tasks which may be more accessible for the child. Such a conception differs from the rigid presentation of tasks to be performed on established tests (Solovieva & Quintanar, 2015). Other levels of analysis are intellectual or through play. Such activities are, for example, classroom learning or, at a preschool age, playing games.

As a consequence of the qualitative analysis and conclusions drawn after the completion of syndromic analysis, we obtain a judgment based on four possible levels:

- 1) the neuroanatomical structure or level of neuronal maturation;
- 2) the neuropsychological "factor" or base of difficulties;
- 3) actions corresponding to the child's psychological age and personality;
- 4) speech production or the neurolinguistic level.

Each level should be characterized according to the positive and negative aspects of development and learning of each child. Such levels could be studied in an interdisciplinary manner, including by specialists in neuroimaging or electrophysiology (Solovieva, Machinskaya, Quintanar, Bonilla & Pelayo, 2013). The authors are aware of the fact that the first level, involving neuroanatomical structures or the level of maturation, might be the hardest level to identify precisely during neuropsychological assessment. The identification of this level requires other meth-

ods and techniques, such as electrophysiological or neuropsychological methods, which are rarely accessible for all clinical cases attended by neuropsychologists. Nevertheless, it is possible to speak of hypotheses on the level of participation of neuroanatomical structures and level of maturation.

The second level, or level of “factor,” is the level of central interest for neuropsychological assessment. Identifying this central factor permits us to determine which activities are well developed and which are disturbed. Such a “factor” might be the “level of general brain activation,” as we show in this article, but other examples are also possible.

The third level, or the level of psychological actions, permits us to develop a detailed analysis of the types of difficulties which have arisen in the child’s school activity, play, overall behavior, and even his/her personality. For example, this level includes identifying specific mistakes in writing and reading as the consequence of a low level of general brain activation.

Finally, the fourth level is the level of verbal interaction, with linguistic analysis of different difficulties in the development, production, and comprehension of speech at different psychological ages, in relation to the identified neuropsychological factor.

Objective

The objective of the study is to present an example of successful qualitative syndromic analysis in the case of a child with developmental problems and learning disabilities.

Method

The authors present a case of a child channeled into neuropsychological assessment because of her serious learning disabilities.

Syndromic analysis was carried out by qualitative comparison of all the data obtained from the clinical picture, the child’s school productions (drawings, writings, tasks in mathematics), and the results of the neuropsychological qualitative assessment. Verbal production, kinds of verbal and non-verbal communication, tastes, aspects of personality, and commentaries by parents and teachers were also taken into account. The neuropsychological assessment was carried out during four individual sessions of 50 minutes each.

The patient

A 6 year old girl, a pupil in the last year of a private preschool institution in the city of Puebla (Mexico), was being seen by the Social Services department of Neuropsychological Assessment at Puebla University Hospital, which is run by Master in Neuropsychological Diagnosis and Rehabilitation on the Faculty of Psychology at the Autonomous University of Puebla. The girl is right-handed; her parents are employed professionals with high levels of education (16 years within the formal Mexican educational system). The reason for the Neuropsychological Assessment was the recommendation of the school psychologist, due to the child’s poor school performance and behavioral problems (impulsiveness, problems with attention and concentration).

The clinical history did not reveal any pathological data, no pregnancy complications, and no risk data, as there was an adequate course of postnatal development. The parents mentioned the lack of independence in the girl's behavior; she was not able to fulfill day-to-day tasks of bathing, dressing, eating, and so on, alone. The preschool institution noted her constant difficulties with communication and the learning process. The girl was not able to fulfill school tasks, showed impulsiveness, and got low marks. Neither medical reports nor other clinical studies were available.

Neuropsychological assessment

The neuropsychological assessment was directed to identifying the strong and weak functional areas of neuropsychological functioning, or brain mechanisms, in relation to her cortical (and subcortical) brain levels (*Table 1*).

Table 1. Relation between brain functional mechanisms and cortical-subcortical levels

Neuropsychological level (brain mechanisms)	Neuronal anatomical or level of maturation (cortical and subcortical zones and connections)
Programming and control	Frontal cortex and connections with frontal thalamic regulation system
Sequential organization of movements and actions	Premotor cortex, secondary motor (partially primary motor) zones
Phonematic and phonemic analysis and synthesis	Temporal secondary zones
Kinesthetic tactile analysis and synthesis	Parietal somatic zones, subcortical posterior zones
Audio-verbal retention	Temporal medial zones, subcortical structures including hypothalamic structures
Visual retention	Secondary occipital zones, parietal-occipital zones including subcortical hypothalamic structures
Spatial analysis and synthesis	Posterior complex associative zones (PTO)
General energetic brain activation (Cortical tone)	Subcortical structures, including reticular formation (diencephalon level)
General emotional activation (participation in activity)	Profound structures, including at the level of the limbic system

In order to obtain information about the level of functioning of these mechanisms, specific tasks were used. The tasks were selected according to their potential for identifying the positive or negative functioning of each mechanism. We stress that there is no one task which could “measure” only one mechanism. Clinical evidence was obtained during the whole assessment and was based on identifying various kinds of mistakes (difficulties), external help, and verbal communication.

During assessment, different tasks were used to determine the level of functionality of various factors. The tasks were selected from the Brief Neuropsychological

logical Assessment for Children (Solovieva & Quintanar, 2013). Intellectual activity appropriate to the child’s psychological age was assessed with tasks selected from the Assessment of Voluntary Activity (Quintanar & Solovieva, 2010) and from the Assessment of School Success (Solovieva & Quintanar, 2012). All these instruments are based on a qualitative methodology created for Spanish-speaking children (Table 2).

Table 2. Types of tasks used for assessment

Neuropsychological mechanisms	Tasks of assessment
Programming and control	Verbal conflictive task, dynamic praxis, copy and continuation of graphic sequence, all drawing tasks, writing by dictation, free writing, copy of complex image “house”, constructive tasks (cubes of Kohs), comprehension of stories and verbal instructions.
Sequential organization of movements and actions	Dynamic praxis, copy and continuation of graphic sequence, all drawing and writing tasks. Quality of speech production and syntactic organization.
Phonematic and phonemic analysis and synthesis	Repetition of words and syllables with opposite sounds, identification of phonemes in words and in series of sounds. Comprehension of oral and written language. All verbal tasks.
Kinesthetic tactile analysis and synthesis	Repetition of words and syllables with proximate consonants according to precise point and mode of articulation. Comprehension of oral and written language. All verbal tasks. Reproduction and retention of tactile stimuli. Tactile recognition of objects, imitation of articulation positions, etc.
Audio-verbal retention	Repetition and retention of two series of 3 words each. Oral comprehension of long sentences. Comprehension of texts.
Visual retention	Free drawing of animal, vegetables, human figures. Reproduction of series of letters and complex figures after copying. Recognition of visual stimuli in series of distractors.
Spatial analysis and synthesis	All kinds of visual and perceptive tasks including drawing and writing. Comprehension of instructions and sentences with complex logic grammar structure (temporal, possessive, cause and consequence effects). Constructive tasks.
General energetic brain activation (Cortical tone)	The overall assessment, especially graphic and written tasks. Tasks for retention in all modalities (visual, tactile, audio-verbal).
General emotional activation (participation in activity)	The overall assessment, especially significant activity according to the age.

Results

The results of the clinical assessment pointed to poor levels of acquisition of voluntary activity, of development of graphic activity, and of preparation for school learning in general. A functional deficit in self-regulation and control, and an insufficient level of tone of general activation were identified. The signs of such deficits were observed in all tasks used for the assessment. A functional immaturity of subcortical profound structures could be the neurophysiological reason for the difficulties observed in this case.

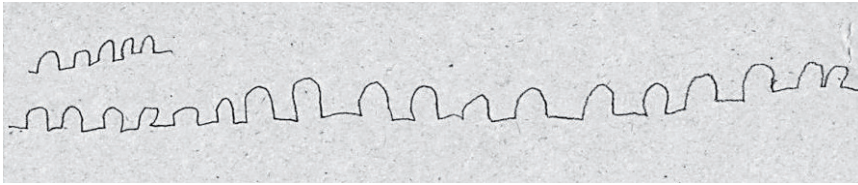


Figure 1. Task of copying and continuing a graphic sequence

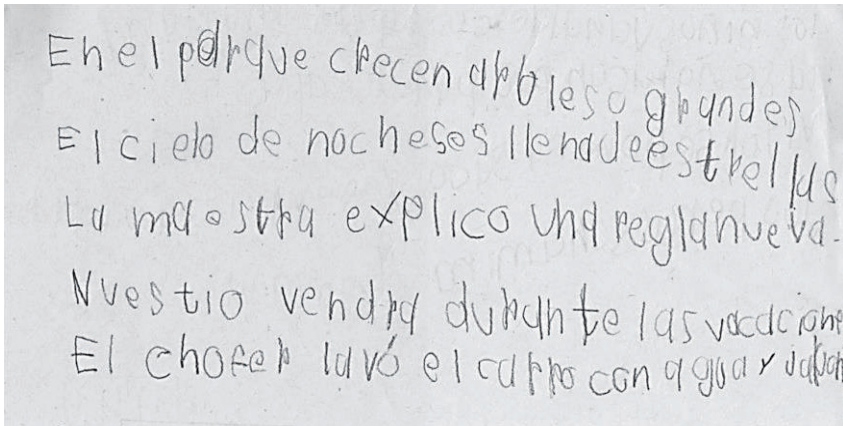


Figure 2. Writing by copying

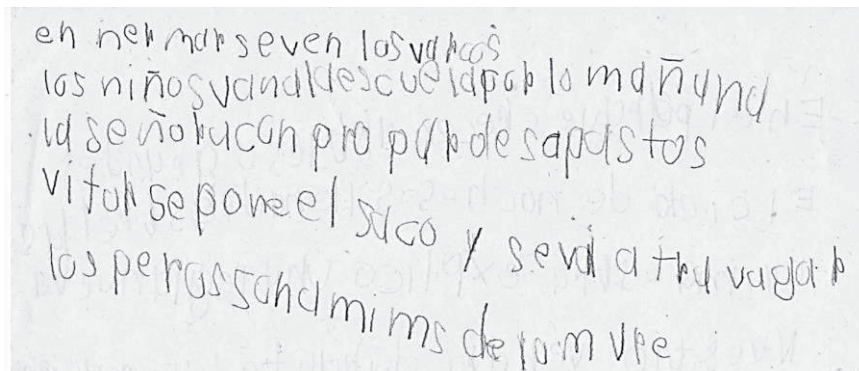


Figure 3. Writing by dictation

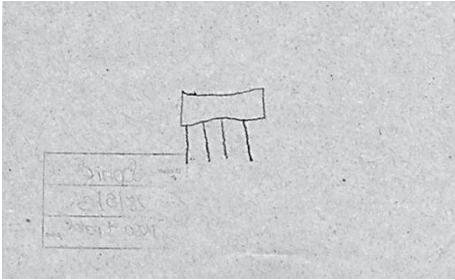


Figure 4. Free drawing of a table



Figure 5. Free drawing of a “round” watch.



Figure 6. Free drawing of a house.

The kinds of errors, difficulties, and lack of executive stability, ability to follow a proposed orientation, and verbal production obtained from all the applied tasks, all of which led to such a conclusion, may be seen in the examples of the girls' performance in various tasks during neuropsychological assessment (Figures 1, 2, 3, 4, 5, 6).

Table 3 reprises all the types of mistakes and difficulties which appeared during the qualitative neuropsychological assessment.

Table 3. Qualitative observations, according to brain mechanisms

Neuropsychological mechanisms	Tasks of assessment
Programming and control	Difficulties in independent execution of verbal conflictive tasks and constructive tasks, absence of perseverations, positive response to external help of an adult, possibility of comprehension of stories with external help of guidance by questions, good understanding of verbal instructions.
Sequential organization of movements and actions	Adequate motor fluency in dynamic motor tasks for hand and for fingers, absence of perseverations. Absence of expressive syntactic problems. Executive difficulties and fluctuation of tone in elements of graphic sequence. Constant repetition of last elements in stage of fatigue, constant changes of size, and some difficulties with precision of elements (<i>Figure 1</i>).
Phonematic and phonemic analysis and synthesis	Perfect identification of phonemes, syllables according to sound oppositions of Spanish phonetics
Kinesthetic tactile analysis and synthesis	Absence of difficulties in articulation; adequate stage of oral and manual praxis
Visual retention	Possibility to reproduce 5 of a series of 5 elements in reproduction of letters; 4 of 5 elements in reproduction of visual figures, noticing the lack of one figure in own execution. In conditions of homogeneous interference, manage to reproduce 3 of 5 elements of letters and figures. In conditions of heterogeneous interference, cannot reproduce stimuli. In memory tasks with usage of external signs (pictograms), manages to fulfill the tasks correctly.
Audio-verbal retention	Possibility to reproduce 1 of 6 elements of the series for involuntary memory. For voluntary memory manages to reproduce 2 of 6 elements. In conditions of heterogeneous interference, cannot reproduce stimuli.
Spatial analysis and synthesis	Some problems with distributions of elements. Fluctuation of executive tone, some tendency to asymmetry, lack of proportionality, losing of the basic line in drawings and in writing. Writing with difficulties in finding right distribution of elements, execution in blocks (figures 2 and 3). Neither rotations nor inversions are observed. Difficulties with precision of lines, unstable lines in all graphic tasks (figures 4 and 5). General lack of development of graphic activity, imprecise images.
General energetic brain activation (Cortical tone)	Reduction of volume of reproduction in memory and retention tasks. Good results in all voluntary and mediated memory tasks. In all tasks during assessment constant fluctuations, disorganized execution, necessity for constant orientation and guidance, usage of external language as orientation. Separation of pencil during drawing and writing, impulsive execution in tasks for identification of phonemes and words, difficulties in verifying executions. Bigger difficulties in a situation of saturation (fatigue) and in long tasks with presence of multiple elements. Frequent changes from wrong to right answer. Better responses in conditions of external verbal and emotional orientation.
General emotional activation (participation in activity)	Positive emotional contact, interest in playing and communication with the adult

Discussion

According to the results of the neuropsychological assessment, it was possible to draw conclusions about four levels of syndromic analysis. We include personality in this analysis in order to specify certain features of behavior (Table 4).

Table 4. Levels of neuropsychological syndrome in the studied case

Level of nervous system	Subcortical immaturity, adequate level of functioning of cortical zones.
Neuropsychological level	Insufficient functioning of cortical tone or of general brain activation. Lack of executive stability in all tasks, difficulties with verification and planning of activity. External help of adult is useful and permits to fulfill the tasks correctly. Tendency to perseveration as reaction to tiredness and in complex tasks.
Psychological level	Different types of games are attractive for the girl, which is typical for her age. Symbolic games and complex games with social roles are accessible. Insufficient acquisition of graphic and visual perceptive activities. Forced introduction of writing and reading with poor voluntary activity makes a negative general effect on school success and intellectual activity. Possibility to respond positively to external regulation and helps from an adult.
Linguistic level	No specific particularities were found in speech production or comprehension.
Personality	Impulsivity, extreme dependence on adults and constant emotional approval of all actions. Positive acceptance of all external orientation and help during assessment (zone of proximate development). Pre-school does not use any strategies of external help, which leads to a lack of satisfaction and negative relationship with learning.

The case was analyzed in relation to a variety of aspects of activity and personality appropriate to the girl’s age. Systemic observation of the functional stage of brain mechanisms, which conform to functional systems for all school behavior, permitted us to establish central mechanisms as the cause or “factor” of the learning disabilities. Both strong and weak aspects of the girl’s development were identified. Among the strong aspects we can mention phonemic, tactile and spatial analysis and synthesis; motor sequential organization; and general emotional level. Among the weak aspects is insufficient development of voluntary activity due to a low general activation (subcortical structures, possibly including reticular formation and other levels). As we have mentioned, the presence of characteristics of both strong and weak aspects is a necessary component of the syndromic analysis model proposed by Luria and his followers (Akhutina & Pilayeva, 2012).

We understand that the logic of syndromic analysis is not common in neuropsychological practice, and that the use of the psychometric perspective is much more popular. Nevertheless, we assert that it might be useful and interesting for our colleagues abroad to know about such a methodology and its use in cases of Mexican children with developmental difficulties and learning disabilities. Future studies would allow us to identify other specific syndromes and to improve the whole

qualitative methodology. Such a methodology differs essentially from the quantitative approach, and could be not easily applied in statistical analysis or psychometric assessment of large populations (Plaisted, Gustavson, Wilkening & Golden, 1983), (Teeter, 1986), (Rosselli, Matute, Ardila, Botero, Tangarife, Echevería, Arbelaez, Mejía, Méndez, Villa & Ocampo, 2004).

The usefulness of the qualitative approach lies in its providing the potential for clinical-personalized assessment of unique cases of developmental difficulties, which is helpful for strategies of correction and development. It is also useful for establishing a clear relationship between the level of the individual's central nervous system, neuropsychological mechanism or factor, psychological activity, and personality. Besides the significant advantages of such a complex integrated approximation in clinical cases of children's difficulties in development and learning, we can mention the possibility of discovering their general causes on different levels: neuronal maturation, brain mechanisms, activity, and personality.

Conclusion

1. Syndromic analysis represents a qualitative method in child neuropsychology.
2. Syndromic analysis is the subject of recent qualitative clinical work and includes diverse levels of assessment: neuronal anatomic (level of cortical and subcortical maturation), neuropsychological (brain mechanisms), psychological (dominant activity), and personality (features of behavior).
3. Syndromic analysis helps to establish the relationship between learning activity and personality of a child with difficulties, with the level of maturation of cortical and subcortical functional stage.
4. Syndromic analysis offers a new integrative vision in psychology and neuropsychology, and implies identification of the central reason (factor or cause), which explains or combines different symptoms of difficulty in development and learning.

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