

## **Neuropsychological Assessment of Adolescents with Learning Disabilities**

**Yulia Solovieva<sup>1\*</sup>, Maria del Rosario Bonilla-Sánchez<sup>2</sup>  
and Luis Quintanar Rojas<sup>2</sup>**

<sup>1</sup>*Faculty of Psychology, Puebla Autonomous University, Mexico.*

<sup>2</sup>*Department of Neuropsychological Diagnosis and Rehabilitation, Faculty of Psychology,  
Puebla Autonomous University, Mexico.*

### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author YS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MRBS and LQR managed the analyses of the study. Authors YS, MRBS and LQR managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/JESBS/2018/43737

#### Editor(s):

(1) Dr. Jyotsana Shukla, Assistant Professor, Amity Institute of Behavioral and Allied Sciences, Amity University, Uttar Pradesh, India.

#### Reviewers:

- (1) P. Moodley, University of Pretoria, South Africa.
- (2) Marzanna Farnicka, University of Zielona Góra, Poland.
- (3) Victor Moses, Ahmadu Bello University, Nigeria.
- (4) Faika Şanal Karahan, Uşak university, Turkey.

Complete Peer review History: <http://www.sciencedomain.org/review-history/26140>

**Original Research Article**

**Received 26 June 2018  
Accepted 04 September 2018  
Published 07 September 2018**

### **ABSTRACT**

The background of the article is historical and cultural neuropsychology, which proposes analysis of learning activity from the level of its functional brain organization. Qualitative assessment of difficulties and functional analysis of syndromes permits to determine brain cortical and subcortical factors or mechanisms, which participate in fulfillment of different actions and operations of learning activity at school age. The objective of the present article is to contribute to consideration of ways and methods of neuropsychological assessment in cases of adolescents with learning disabilities and to share the opinion about the advantages of neuropsychological approach for the understanding of neuropsychological nature of learning disabilities in adolescents. Two cases of female adolescents with learning disability were included in the study. The scheme for neuropsychological assessment created for Spanish speaking patients was applied. Such kind of assessment permits to detect unique brain mechanism or factor responsible for pupil's difficulties.

\*Corresponding author: E-mail: [yulia.solovieva@correo.buap.mx](mailto:yulia.solovieva@correo.buap.mx);

The results have pointed out systemic difficulties in factors of motor sequential organization and regulation and control. Identification of concrete functional mechanism responsible for difficulties helps to obtain precise neuropsychological diagnostic of learning disabilities. The functional deficit of motor sequential organization and regulation and control and voluntary activity might be identified as possible reasons of learning disabilities and problems for realisation of intellectual actions in secondary school. We conclude that the methodology of qualitative analysis of neuropsychological syndrome proposed by Luria might serve as an example of usage of systemic approach for cases of learning disabilities in children and adolescents.

*Keywords: Neuropsychological diagnosis; brain mechanisms; sequential organization; regulation and control.*

## 1. INTRODUCTION

The topic of learning disabilities has been studied from different points of view by different disciplines since the year of introduction of this term in 1963 [1]. Child neuropsychology includes, as one of important objects of study, learning disabilities [2,3,4]. Different methods have been created and applied for assessment, diagnosis and correction of cases of learning disabilities in pupils of primary school [5,6,7,8]. Akhutina and Pilayeva [9] have proposed the new term as “school neuropsychology” as the field of application of neuropsychological methods.

Learning disabilities might be detected not only during the period of studies at primary school, but also at secondary school. Our own experience shows that such difficulties are very common and might be due to different neurological, genetic, social and maturation causes [10,11,12,13,14].

The common neuropsychological approaches, such as cognitive approach, physiopathological approach and cultural and historical approach, don't count with numerous publications of cases of adolescents with learning disabilities [15,16,17]. Few studies report concrete cases of adolescents with learning disabilities including strategies and results of assessment or correction [18,19,20].

Historical and cultural neuropsychology proposes an analysis of learning activity from the level of brain functional organization [21]. Qualitative assessment of difficulties and functional analysis of syndrome permits to determine brain cortical and subcortical factors or mechanisms, which participate in fulfillment of different actions and operations of learning activity at school age in primary and secondary school [22]. The concept of brain factor, as specific contribution fulfilled by

brain zone or union of zones for the common work of the whole functional system, was proposed by Luria and his scientific school [23,24]. It is also possible to understand factor as neuropsychological cause of patient's difficulties.

In our opinion, the term “factor” is useful to precise neuropsychological level of analysis of functional brain participation in cognitive or intellectual actions during learning process. The level of factors might be included as the level of elements of functional systems for different actions of learning. The inclusion of specific level of analysis permits to avoid confusions and conceptual difficulties in the usage of term “brain zone” and “cognitive function”. The factor isn't a brain zone nor a cognitive function. Neuropsychological factor is just one or another elements within functional systems of cognitive actions. The optimized level of functional systems depends of cultural activity correspondent to each psychological age. Fulfillment of specific task requires always participation of diverse factors and their distribution changes dynamically during ontogenetic development and according to automatization [23].

As for school age, the topic of our article, the level of functional systems corresponds to cognitive actions of writing, reading or problems solving as significant actions of school learning. The age of adolescence (learning at secondary school) would be the age, during which these actions achieve level of notable automatization as a result of previous years of studying at primary school. The absence of automatization or presence of low level of acquisition of these actions might be related to the presence of some learning disability. Higher level of realization with proper automatization might be expected in secondary school in comparison with primary school. This situation makes it necessary to look

for more complex cognitive tasks for adolescents during neuropsychological assessment and pedagogical assessment of learning activity.

In our own publications, we preferred to use the word “brain mechanism” as synonymous to Luria’s conception of “factor” or “cause” of difficulties [20,25,26,27]. The term “factor” is more precise in comparison with the term “reason”. The concrete sense of the word “mechanisms” or “factor” also requires referential clarity in order to stress the possibility of functional description on symptoms and their relation of cortical and diverse subcortical levels [26,28]. We propose to use the term “brain functional mechanisms” in order to clarify the content of Luria’s term “factor”. Another reason is that Luria himself, in his works, proposed the relation of neuropsychological analysis with consideration of the level of psychophysiological level of actions [29]. This term was also used by Leontiev [30] and corresponds to one of possible levels of analysis of activity: the level of psychophysiological mechanisms during analysis of cognitive or motor actions.

One of the main tasks of neuropsychological assessment would be finding of precise brain cortical or subcortical mechanism (factor) as responsible for low level of automatization or functioning of the whole system at secondary school. Neuropsychologist should provide a detailed assessment of such factors or mechanisms in order to determine neuropsychological cause of learning disabilities.

### 1.1 Objectives

The objective of the present article is to contribute to consideration of ways and methods of neuropsychological assessment in cases of adolescents with learning disabilities and to share the opinion about the advantages of neuropsychological approach for the understanding of neuropsychological nature of learning disabilities in adolescents.

## 2. MATERIALS AND METHODS

Our study was accomplished with two female cases of adolescents with learning disabilities. The girls were the pupils of private secondary school of the city of Puebla (Mexico) with similar features of social and economic level. Both girls received low school marks and were referred to neuropsychological service. The parents of the girls asked for neuropsychological assessment in

order to understand the reasons for the difficulties.

The Institute of Neuropsychology and Psychopedagogy of Puebla (Mexico) accomplished neuropsychological assessment according to previous agreement of the parents. Clinic interviews and elaboration of history of the development of each patient were applied according to the norms established by the institution.

### 2.1 Patients

**Case 1:** Right handed girl of 13 years old, pupil of the first grade of private secondary school. The girl presented severe difficulties with school matters of Spanish, mathematics, physics and geography. The girl was very slow in her work with school tasks at home and presented distractibility during work. She never communicated interests or necessity in spontaneous manner even to family members or close friends. The parents expressed lack of motivation in general, even for games or entertainment. There was no any kind of pathology or illness reported during the process of early development.

The girl only answered oral questions during assessment and never started communication on her initiative. The answers were laconic with low tone of voice.

**Case 2:** Right handed girl of 13 years old, the pupil of the second grade of private secondary school with notable difficulties in reading. The girl presented impulsivity and destruction, a low level of tolerance for following rules, norms and instructions and aggressive behavior on occasions. The teachers stressed “bad behavior” at school and characterized the girl as too “infantile” for her age. At the same time, they mentioned that she was a “sympathetic girl” with easy communication with people. The parents didn’t report any disturbances or pathology during ontogenetic development. Table 1 presents the general description of two cases.

### 2.2 Materials

Neuropsychological assessment of both patients was accomplished with the help of the Scheme of neuropsychological Brief assessment for Adults [31], created for Spanish speaking patients and might be used starting from 12 year old. The Scheme was applied individually during

**Table 1. General description of cases**

	<b>Motive of neuropsychological consulting</b>	<b>Age</b>	<b>Grade of secondary school</b>	<b>Learning difficulties</b>
Case 1	Distraction, slowness, difficulties in communication, absence of learning motivation, introverted.	13	1	English Spanish Mathematics Geography Physics
Case 2	Distraction, impulsivity absence of tolerance for rules, bad behavior", absence of school motivation.	13	2	English Spanish Mathematics Geography History Reading

1 session of 60 minutes. The Scheme includes tasks, which permit to assess the functional stage of specific brain mechanisms as components of functional systems of learning actions:

- 1) Kinesthetic integration in tactile tasks and tasks for articulation.
- 2) Motor sequential organization of movements in tasks for motor coordination and graphic tasks.
- 3) Phonemic integration in oral tasks at level of phonemes syllables and words according to opposite sounds of Spanish language.
- 4) Involuntary and voluntary audio-verbal retention in conditions of homogeneous and heterogeneous interferent.
- 5) Involuntary and voluntary visual spatial retention in conditions of homogeneous and heterogeneous interferent fulfilled by both hands.
- 6) Spatial simultaneous analysis and synthesis in corporal tasks, understanding of instructions and sentences with specific grammar constructions, drawing and coping tasks.

Afterwards, the Protocol for Assessment of School Success was applied with the tasks for reading, writing and problems solution created for level of secondary school for Mexican adolescents [32]. The Protocol includes different tasks for copy, dictation of words, sentences and texts; tasks for complementation of sentences according to grammar changes and usage of prepositions; operation of changing of grammar times in sentences; usage of proper prepositions; elaboration of new sentences with inclusion of prepositions; reading and understanding of sentences and texts; problems

solving and operations with mathematic concepts.

Additionally, the protocol for assessment of intellectual activity was applied [33,34]. The protocol includes tasks for understanding of narrative, artistic and descriptive texts and artistic pictures. The work with texts implies elaboration of plans, selection of a proper title from the series of proposed titles, expression of the short abstract and extraction of the main idea of the texts. The work with pictures implied the identification of emotional expression of the characters and situations represented by artistic means. The tasks for an understanding of proverbs with complex grammar structures and usage of metaphoric expressions were also included.

### 2.3 Procedure

The whole neuropsychological assessment was accomplished in four individual sessions with each girl with approximate duration of 50 minutes for each session.

### 3. RESULTS

The article presents results obtained during neuropsychological assessment by using the tasks, in which each adolescent committed mistakes and showed pronounced difficulties. Functional analysis of syndrome was fulfilled in both cases after procedure of neuropsychological assessment.

**Case 1:** Specific difficulties were found out during realization of the tasks of assessment. The Fig. 1 shows examples of the model of the tasks of coping and continuation of the graphic sequence, while the Fig. 2 shows fulfillment of the task by the girl.



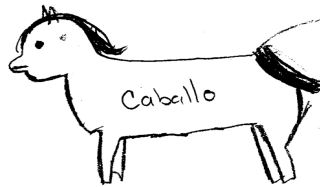
**Fig. 1. Model of graphic sequence**



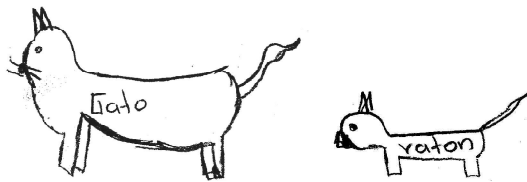
**Fig. 2. Example of execution by the patient girl**

Fig. 2 shows the absence of fluency and interruptions in the process of coping.

The Figs. 3 and 4 show the task of sequential drawing of a series of images by instruction: an animal (Fig. 3), a cat and a mouse (Fig. 4). It is possible to observe that the girl has written the words inside her drawings, while it was never asked by neuropsychologist.



**Fig. 3. "An animal"**



**Fig. 4. "A cat" and "A mouse"**

These examples show impossibility of elaboration of concrete images and the presence of stereotyped drawings. The cat and the mouse are absolutely same and it's not possible to recognize where is the cat and where is the mouse. In other words, the drawing of a mouse repeats the drawing of a cat. It's also possible to note that concrete details in three animals are similar.

Important difficulties were observed also in writing process. The girl wasn't able to use

capital letters at the beginning of the sentences or paragraphs. It's possible to observe severe alteration of space organization in texts and sentences, but not in isolated words. The Fig. 5 shows spontaneous writing in the tasks of narration of activities of the previous day. It's possible to note absence of capital letters, signs of punctuation, proper separation of words in sentences. Motor mistakes were present at the end of the lines together with confusions of motor schemes (models) of the words, among the most typical mistakes. The sentences show severe mistakes of syntactic organization and the whole structure of written expression. There is no coherent beginning of the text; the verbs don't correspond to the nouns; the sentences have no logical conclusion.

The examples show the presence of severe difficulties in syntactic organization of the whole text and it's difficult to read and to understand it.

The girl showed severe difficulties in the tasks of reading and solution of problems. The reading was syllabic with absence of correct intonation. Multiple mistakes of anticipation of words were observed. Anticipations were related to confusion with similar visual structure of combinations of letters in words (for example, "hablaba" instead of "había"). There were also mistakes of substitutions of one letter by another in Spanish words ("pero" instead of "para"). Another error was omission of letters in words ("ergido" instead of "erecido"). The girl was never able to notice her mistakes, so that proper understanding of meaning of texts and sentences wasn't accessible for her. External help provided by neuropsychologist, that consisted in showing mistakes and asking questions in relation to them. Such help was useful to improve the understanding of the meaning of isolated sentences, but not of the whole idea of texts.

---

ayer me levante fui a la escuela hice la tarea vi la tele  
fui a mis clases de ingles me bañe comi jugue me  
peine despues me fui a clases de matematicas Fui  
desde las siete a las ocho y media me puse mi pijama  
me lave la cara los dientes me puse mi locion me  
desenredé el cabello me quite los lentes y me dormí

---

Transcription in Spanish of the text produced by the girl:

---

*"ayer me levanté fui a la escuela hice la tarea vi la tele  
Fui a mis clases de inglés me bañe comí jugué me  
peine después me fui a clases de matemáticas Fui  
desde las siete a las ocho y media me puse mi pijama  
me lave la cara los dientes me puse mi loción me  
desenredé el cabello me quite los lentes y me dormí".*

---

Approximate transcription into English of the text produced by the girl with committed mistakes:

---

*"yesterday i got up went to school i did the homework i watched the tv I went to my  
english class i took a bath eat played i made hair later went to classes of math's Went  
from seven to eight and a half i put my pajama I washed my face my teeth i put lotion i  
made my hair i took of my glasses and i slept"*

---

**Fig. 5. Spontaneous writing by the girl with transcription in Spanish and translation into English**

It's important to stress that the tasks of abstraction of principal idea of the texts were too complex for the girl. The patient wasn't able to extract principal ideas in the texts, neither to identify the meaning of the texts, pictures and proverbs. She couldn't correct her answers and wasn't not aware of her constant mistakes during assessment.

During the whole process of assessment and collaboration, the girl has never expressed any initiative or interest for proposed tasks. She never asked for help or showed the interest in her own results or the meaning of the tasks.

Regarding the first case, conclusion of functional neuropsychological analysis of syndrome has pointed out predominant functional weakness of the mechanisms of motor sequential organization of actions and movements. In the second case, the reason for difficulties was the mechanism of programming and control of voluntary activity. Such functional weakness affected negatively all kinds of intellectual actions such as reading, writing and problems solution, including identification of central ideas of texts and emotional expressions in artistic pictures. Specific difficulties with syntactic production of

written speech were severe and persistent in this case.

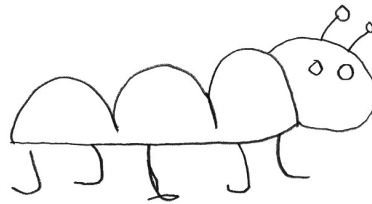
**Case 2:** The second case has presented similar difficulties during assessment. The majority of difficulties were related to the process of planning of complex intellectual actions. The adolescent wasn't aware of her own mistakes committed during assessment. Examples of the difficulties are described below.

The Fig. 6 shows the result of coping and continuation of the graphic sequence by the second patient. It's possible to notice perseverations with rigid execution.

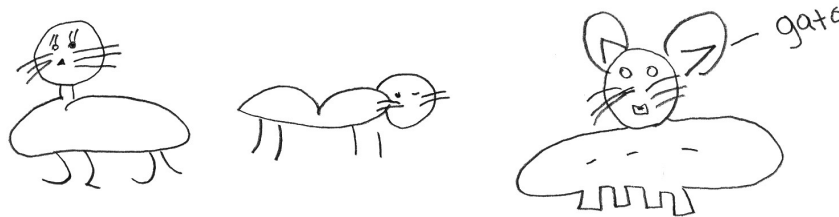
The presence of perseverations was also obvious in the task of drawing of animals. The Figs. 7 and 8 show the execution of the patient, where we might notice repetitions of the same drawing in two occasions. The "worm", drawn for the task "draw an animal", has five legs. The drawing of "a cat" was repeated three times. It's possible to notice the shape of a "worm" (first drawing) in the execution of the cat. The girl refused to draw a mouse. At the end of the task, the girl has written the word "mouse" inside of one of her picture of "a cat".



**Fig. 6. Copy and continuation of graphic sequence**



**Fig. 7. Drawing of an animal**



**Fig. 8. Drawing of a cat**

Sever difficulties with inhibition of the first drawing ("worm") might be noticed in three intentions of drawing of a cat. The girl repeats the body of a worm as stereotype in the text drawings.

Expressed difficulties were observed also in the tasks of reading and understanding of narrations and verbal parts in mathematic problems. Total impossibility to pass from one step of the tasks to another was the main feature of the girl's difficulties.

The task of the copy of sentences shows impulsivity, absence of proper space organization. The patient wasn't aware of her difficulties and never corrects her own mistakes. The Fig. 9 shows the task of the copy of sentences.

All sentences were produced without sings of punctuation. It's difficult to distinguish between capital and common letters and some alterations of spaces are present.

Assessment of reading detected lack of proper intonation and mistakes of anticipation related to

the confusion of initial letter of the words ("carmelo" instead of "gemelo"). Omission of articles, prepositions and conjunctions was one of the common mistakes of the second patient. The girl has never noticed the title of the texts, which was omitted by her. All mentioned mistakes make it impossible to access to the meaning of sentences and texts, especially of artistic and descriptive texts. The girl wasn't able to extract general ideas of the texts. External help by adult, which consisted of directed questions, provided an understanding of some sentences, but not of the main ideas of the texts.

As conclusion of functional analysis of neuropsychological syndrome, we have pointed out predominant functional weakness with the mechanism of programming and control of voluntary activity in the second patient. Such functional weakness affects negatively all kinds of intellectual actions as reading, writing and problems solution, including identification of Central ideas of texts and emotional expressions in artistic pictures.

---

En el parque crecen árboles grandes.  
El cielo de noche se llena de estrellas.  
La maestra explicó una regla nueva.  
Nuestro tío vendrá durante las vacaciones.  
El chofer lavó el carro con agua y jabón.

---

Transcription of the models of sentences in Spanish.

---

*Oraciones modelo:*  
*En el parque crecen árboles grandes.*  
*El cielo de noche se llena de estrellas.*  
*La maestra explicó una regla nueva.*  
*Nuestro tío vendrá durante las vacaciones.*  
*El chofer lavó el carro con agua y jabón.*

---

Approximate transcription in to English of the sentences for copy.

---

*Models of sentences for copy:*  
*There are tall trees in the park.*  
*At night the sky is full of stars.*  
*The teacher has explained the new rule.*  
*Our uncle will arrive during holidays.*  
*The driver washed the car with water and soap.*

---

**Fig. 9. Execution of the task of copy of sentences with transcription in Spanish and translation into English**

#### 4. DISCUSSION

The study of the problems in learning process at primary and secondary is one of an important topic for different specialists, such as pedagogics, pharmacologists, psychologists, psychiatrists and also neuropsychologists. It's possible to suppose that all these specialists propose different ways for an understanding of difficulties.

One of the main difficulties on the path of conceptualization of problems in school learning is the absence of the common basis for classification of difficulties [35]. DSM-V [36], for instance, proposes classification by isolated processes or functions. No relation to levels of brain functional or anatomic organization is mentioned in this classification of problems. Nevertheless, the patients of the present article presented complex difficulties in a plenty of school actions such as reading, writing or mathematics and not only as one kind of school action. Traditional diagnosis of dyslexia or dysgraphia wouldn't explain the reason of their

difficulties in the learning process. It's possible to suppose that disabilities in different types of school actions are symptoms as external manifestations and not syndromes of learning disabilities [34,27]. It's obvious that treatments according to isolated symptoms wouldn't be useful for overcoming of pupil's difficulties [37].

Methodology of qualitative analysis of neuropsychological syndrome proposed by Luria [29,38] might serve as an example of usage of systemic approach for cases of learning disabilities in children and adolescents [25,22].

Such kind of neuropsychological qualitative analysis pretends to identify central mechanism (factor) between different possibilities of brain factors by comparison of manifestation of diverse symptoms during realization of different tasks. The tasks at different levels should be contrasted: motor tasks, oral tasks, written production, drawing, understanding and so on. This kind of detailed neuropsychological evaluation permits to establish the cause (central factor) of patient's difficulties with learning



disabilities. On the contrary, quantification as conclusion of application of psychometric tests doesn't provide such a possibility. Same situation might be observed during application of traditional diagnosis by DSM-V [36].

The cases of adolescents with learning disability presented in the article manifest the presence of common brain mechanisms, related to functional stage of anterior cortical and subcortical brain structures. This common mechanism is the mechanism of programming and control of voluntary activity. Such functional weakness conducted to impossibility for automatization and positive acquisition of intellectual actions even in pupils of private secondary school. It's interesting to note that the fact of studying in private schools permits us to reject the possibility of pedagogical neglecting as the only reason of the difficulties and to stress the clinic brain functional nature of learning disabilities in the studied cases.

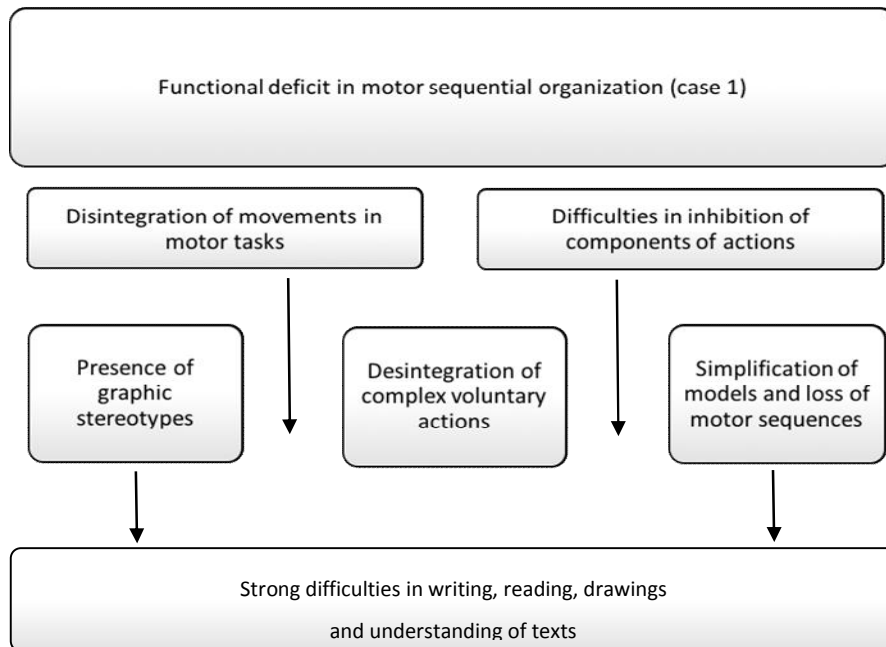
There also some differences between the cases. The first case included functional weakness of motor organization of actions, which was reflected in severe difficulties in written language. Such mechanism wasn't observed with same clarity in the second case, in which severe deficit of regulation and control was predominant factor.

Functional weakness of these mechanisms affects not only one kind of school action, but reflects in a systemic manner in all school actions, related to functional participation of these mechanisms.

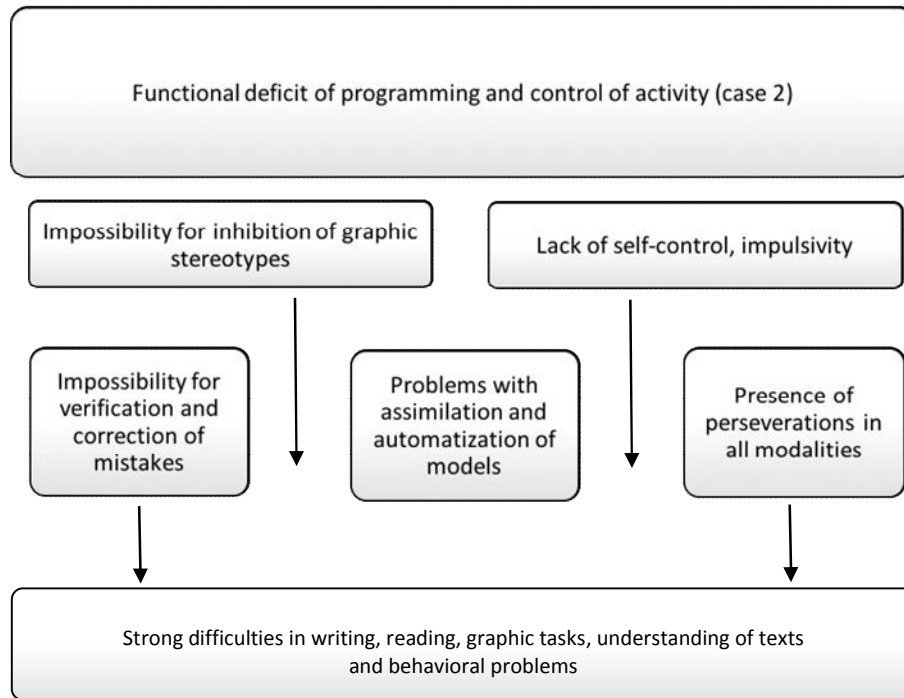
Figs. 10 and 11 represent systemic effect of detected functional mechanisms in both cases.

We may suppose that neuropsychological syndromes observed in these cases might be related to immaturity or functional deficit of the mentioned brain mechanisms: programming and control and motor sequential organization. Absence of severity and lack of sufficient data in clinic history (absence of expressed pathologies) makes us suppose the level of neurophysiological immaturity and not brain damage or organic disease in these cases. It's possible to express it as deficit of functional specialization of these brain mechanisms and optimized level of functional of the others.

At the same time, alternative term "attention deficit disorder" [36] introduces nothing special for an understanding of difficulties of adolescents with learning disabilities. The non-specific term "attention" seems to be a kind of umbrella, which includes nearly all kinds of common learning disabilities.



**Fig. 10. Illustration of systemic effect of detected functional mechanisms in the case 1**



**Fig. 11. Illustration of systemic effect of detected functional mechanisms in the case 2**

We might confirm that both pupils described in the article might be compared to adult patients with damage in frontal lobes as the patients with difficulties to organize own behaviour with symptoms of impulsivity and perseveration [39,40,29,23,41]. The literature normally establishes direct relation between these symptoms and attention deficit or deficit of executive functions [42,43,44]. The problem is that children and adolescents with learning disabilities have no evidence of brain injury or organic defects in their clinic history.

Functional immaturity is related more to subcortical level of brain structures or to dynamic relation between cortical and subcortical structures rather than the level of cortex areas properly. Obviously, the diagnosis of the state of subcortical immaturity is much more positive in comparison with information of organic deficit of frontal cortex lobes. The authors believe that this might be one of important considerations to be taken into account during work with adolescents with learning disabilities, their teachers and families. We would like to stress that medication isn't useful in cases of subcortical immaturity, while frequently it's the only recommendation received by the parents of children with learning disabilities.

According to the data obtained in the study and other cases assessed by the authors, our concrete proposal would be to determine learning disabilities not by anatomic level by naming responsible brain zones, difficult to prove during neuropsychological assessment or by naming of only one isolated process as attention or dyslexia. In our opinion, the finding of functional level of neuropsychological mechanisms responsible in each concrete case might be a possible solution and explanation of difficulties in school learning.

Our two cases serve as an example of such a finding. The difficulties were related to the insufficient functional stage of mechanisms of sequential motor organization of movements and programming and control (or both of them as in the first case). Such functional deficit of the mechanisms might be related to lack of neurophysiological maturation of cortical-subcortical regulation, which might be verified by the usage of other methods, such as, for example, the method of electroencephalography [45]. We would agree with the position that the difficulties of the both girls are frontal, but we wouldn't agree that these are always cortical orbital problems, as it might be often found in literature [41,42,43,44].

In the first case, presented in the article, severe difficulties were found in the task of copy and continuation of the graphic sequence. The tendency for fragmental representation was observed. Such difficulty might be related to the problems for denervation of the components of motor series conducted to simplification of the model. Luria [29] has mentioned that voluntary movements consist of chains of motor successive acts, which conform dynamic stereotypes during temporal execution of series of movements. Disintegration of the structure of complex motor series conducts to symptoms of lack of motor fluency and tendency to motor perseverations. Such functional deficit might affect negatively realization of all tasks at school, such as writing, problem solving and reading. The reading process in our patients presented syllabic level, absence of correct intonation and errors of anticipation. All these mistakes conducted to lose of sense of the texts.

The complex process of understanding involves mental comparison of the parts of texts, separation of semantic lines and active process of heuristic searching of the sense [38]. It is obvious that such complex process mightn't be positively achieved in both cases assessed in the study.

Difficulties in writing process, related to functional deficit in motor sequential organization, were mentioned by Akhutina [46]. The difficulties are related to impossibility to pass from one letter to another and inertial repetition of same motor element in the sequence, which might be element of letter, a letter, syllable or word. In our case, it was possible to find such mistakes in the writing of both adolescents. For example, we can find mistakes in the word "desenrede", lack of precision in the letter "m" and the whole word "peine" (Fig. 5).

Functional deficit of regulation and control of voluntary activity is another direct reason or factor of problems in school learning in both cases. Impulsive executions and deficit of critical verification were typical in both cases. Perseverations and production of stereotypes might be found in the tasks of drawing (Figs. 7 and 8). The pupils weren't able to notice mistakes neither to improve the execution in typical school tasks neither in the tasks of drawing.

Akhutina [46] mentions dysorthography as typical sign of mistakes related to deficit of regulation and control of activity. Common mistakes in

these cases are the absence of respect of rules of orthography in writing, substitution of capital letters by common letter and absence of signs of punctuation. Such mistakes might be explained by poor automatization in primary school, but not in secondary school. Another common mistake is omission of letters and syllables and anticipation of letters in writing. The Fig. 9 characterizes precisely these types of mistakes in the case 2.

We may conclude that, in the majority of tasks, both pupil committed constant mistakes related to functional deficit of the third functional unit according to Luria's conception of brain functional organization. Those mistakes are simplifications, stereotypes, perseverations, impulsivity and problems with automatization of rules and processes. According to our analysis, it is possible to observe that the case 1 is related more to functional difficulties with motor sequential organization, while the case 2 is related more to the deficit of regulation and control of activity.

These functional conclusions according to neuropsychological assessment might serve as the basis for differential diagnosis of difficulties in learning process in adolescents and for elaboration of programs of correction and pedagogical help. The strategies of corrections have to take into account mechanisms of motor sequential organization, which should be included in different kinds of external actions. The mechanisms of regulation and control might be improved by gradual joint execution of different intellectual tasks and games on materialized level. No kind of medication would be useful in presented cases [17].

One of limitation of our study, which we might mention, is the absence of the usage of electrophysiological register and analysis of data, which might precise the level of brain compromise in both cases [26,28]. The goal of our future studies would be inclusion of such kind of analysis in cases of adolescents, as it was achieved with younger children [26,28]. Creation and application of programs for neuropsychological correction of adolescents with learning disabilities is also one of our future goals as it was already done in other psychological ages [20,47].

## 5. CONCLUSION

- 1) Qualitative neuropsychological assessment permits to discover systemic

effects of functional deficits of diverse brain mechanisms for the process of learning in adolescents.

- 2) Identification of concrete functional mechanism responsible for difficulties helps to obtain precise neuropsychological diagnostic of learning disabilities.
- 3) Functional deficit of motor sequential organization and regulation and control and voluntary activity might be identified as possible reasons of learning disabilities and problems for realization of intellectual actions in secondary school.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

### REFERENCES

1. Acle G, Olmos A. Dificultades de aprendizaje. Enfoques teóricos. México: UNAM; 1995.
2. Zenoff A. Neuropsicología infantil del aprendizaje. Ensamble entre etiología y fisiopatología básica. En: V. Feld y M. Rodríguez, eds. Neuropsicología del niño. Argentina: Universidad Nacional de Luján; 1998.
3. Santana R. Aspectos neuropsicológicos del aprendizaje escolar. San Juan, Puerto Rico: Innovaciones Psicopedagógicas; 1999.
4. Santana R. La rehabilitación neuropsicológica de los trastornos específicos del aprendizaje. Un modelo teórico global. En: Y. Solovieva y L. Quintanar, eds. Métodos de intervención en la neuropsicología infantil. México: Universidad Autónoma de; 2001.
5. Akhutina TV. Neuropsychological approach towards the diagnosis of learning difficulties. In: Xomskaya ED, editor. Chrestomatía about neuropsychology. Moscow: Russian Psychological Society; 1999.
6. Akhutina TV, Pilayeva NM. The diagnosis of the development of visual-verbal functions. Moscow: Academy; 2003.
7. Mikadze Y. Child neuropsychology. Moscow: Piter; 2008.
8. Glozman J. Seguimiento longitudinal en un caso de retardo en la formación de las funciones psicológicas superiores. Revista Chilena de Neuropsicología. 2014;9(E2):49-53. Akhutina TV. Diagnóstico y corrección de la escritura. Revista Española de Neuropsicología. 2002;4(2-3):236-261.
9. Akhutina TV, Pilayeva NM. Overcoming learning disabilities. A Vigotskian-Lurian neuropsychological approach. Cambridge: Cambridge University Press; 2012.
10. Gearherat B. Incapacidad para el aprendizaje. Estrategias educativas. México: Manual Moderno; 1987.
11. Valdivieso L. Psicología de las dificultades en el aprendizaje escolar. Introducción a la educación especial. Chile: Editorial Universitaria; 1990.
12. Matute E. Un enfoque neuropsicológico para la atención de niños con problemas específicos en el aprendizaje. In: Ostrosky F, Ardilla A. Chayo R, eds. Rehabilitación neuropsicológica. Conceptos y tratamientos básicos para la rehabilitación del daño cerebral. México: Planet; 1996.
13. Manga D, Fournier C. Neuropsicología clínica infantil. Estudio de casos en edad escolar. España: Universitas; 1997.
14. Machinskaya R, Semenova O. Peculiarities of formation of the cognitive functions in junior school children with different maturity of regulatory brain systems. J. Evol. Biochem. Physiol. 2004;40(5):528-538.
15. Azcoaga JE, Derman BE, Iglesias AA. Alteraciones del aprendizaje escolar. Diagnóstico, fisiopatología y tratamiento. España: Paidós; 1997.
16. Eslava-Cobos J, Quintanar L, Mejía L, Solovieva Y. Los trastornos del aprendizaje: perspectivas neuropsicológicas. Bogotá: Neurociencias Magisterio; 2008.
17. Solovieva Y, Quintanar L. Principios y objetivos para la corrección y el desarrollo en la neuropsicología infantil. En: Patiño H. Y López V. eds. Prevención y evaluación en Psicología, México: Manual Moderno; 2014.
18. Semenovich A. Didactic manual for work with left-handed children. Moscow: Center of psychological and medical support for children and adolescents; 1998.
19. Chávez CE. Corrección neuropsicológica en adolescentes con dificultades de aprendizaje. Tesis de maestría en diagnóstico y rehabilitación neuropsicológica. Puebla, México. Benemérita Universidad Autónoma de Puebla; 2003.

20. Solovieva Y, Bonilla R, Quintanar L. Corrección neuropsicológica de problemas de aprendizaje escolar en la adolescencia. En: Martín Pérez Mendoza, Eduardo Alejandro Escotto Córdova, Juan Carlos Arango Lasprilla, y Luis Quintanar Rojas, eds. *Rehabilitación Neuropsicológica. Estrategias en trastornos de la infancia y del adulto*. México: Manual Moderno; 2014.
21. Quintanar L, Solovieva Y. Análisis neuropsicológico de los problemas en el aprendizaje escolar. *Revista Internacional del Magisterio*. 2005;15:26-30.
22. Solovieva Y, Quintanar L. Syndromic analysis in cases of development and learning problems: following to A.R. Luria. In: Da Silva Marques F, Ávila-Toscano J, Góis H, Leonel J, Ferreira N, Solovieva Yu, Quintana L, editors. *Neuroscience to Neuropsychology: The study of the human brain (volumen I)*. Barranquilla, Colombia: Ed. Reformed University Corporation; 2016.
23. Luria AR. *El cerebro en acción*. México: Roca; 1989.
24. Xomskaya E. El problema de los factores en neuropsicología. *Revista Española de Neuropsicología*. 2002;4(2-3):151-167.
25. Solovieva Y, Quintanar L. Qualitative syndrome analysis by neuropsychological assessment in preschoolers with attention deficit disorder with hyperactivity. *Psychology in Russia: State of the Art*. 2015;8(3):112-124.
26. Solovieva Y, Rivas X, Méndez-Balbuena I, Machinskaya R, Pelayo H. Neuropsychology and electroencephalography to study attention deficit hyperactivity disorder. *Rev. Fac. Med*. 2016a;64(3):427-434.
27. Solovieva Y, Quintanar L. Intellectual activity in Patients with semantic and motor afferent aphasia. *International Neuropsychiatric Disease Journal*. 2017; 9(1):1-11.
28. Solovieva Y, Pelayo-González H, Méndez-Balbuena I, Machinskaya R, Moran-Grecia A. Correlation of neuropsychological and electroencephalographic analysis in schoolchildren diagnosed with TDA. *Neurobiology*. 2016b;7(15):150816.
29. Luria AR. *Funciones corticales superiores del hombre*. México: Fontamara; 1986.
30. Leontiev A. *Selected psychological works*. Moscow: Moscow State University; 1983.
31. Quintanar L, Solovieva Y. *Evaluación neuropsicológica breve para adultos*. México: Universidad Autónoma de Puebla; 2013.
32. Solovieva Y, Quintanar L. *Esquema para la evaluación del éxito escolar en adolescentes*. México: Universidad Autónoma de Puebla; en prensa.
33. Solovieva Yu, Chávez M, Quintanar L. Alteraciones de la actividad intelectual en los casos de la afasia semántica. *Revista Española de neuropsicología*. 2001;3(4): 12-33.
34. Solovieva Y, Torrado O, Maravilla L, Rivas X. Análisis neuropsicológico diferencial en dos casos diagnosticados con TDAH. *Informes psicológicos*. 2017;17(1):121-141.
35. Ostrosky F, Ardila A, Chayo R. *Neuropsychological rehabilitation*. México: Planet; 1996.
36. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-V) 5th Ed*. Whashington, DC; 2013.
37. De Quiros J, Schragger O. *Fundamentos neuropsicológicos en las discapacidades de aprendizaje*. Argentina: Panamericana; 1980.
38. Luria AR. *Conciencia y lenguaje*. Madrid: Aprendizaje Visor; 1995.
39. Luria AR, Xomskaya ED. editors, *Frontal lobes and the regulation of the psychic processes*. Moscow: Moscow State University; 1979.
40. Xomskaya E. *Neuropsychology*. Moscow: Moscow State University; 1987.
41. Cohen R. *The Neuropsychology of attention*. New York: Plenum Press; 1993.
42. Flores JC. *Neuropsicología de los lóbulos frontales*. México: Universidad Autónoma de Tabasco; 2006.
43. García K, Rigan E. *Funciones ejecutivas y dificultades de aprendizaje*, en Tirapu U, García A, Ríos M, Ardila A. editores *Neuropsicología de la corteza prefrontal y las funciones ejecutivas*. España: Viguera; 2012.
44. Fuster JM. *Executive frontal functions*. *Experimental Brain Research*. 2000;133: 66-70.
45. Mashinskaya R, Semenova O, Absatova K, Sugrobova G. *Neurophysiological factors associated with cognitive deficits in children with ADHD symptoms: EEG and*

- neuropsychological analysis. Psychol. Neurosci. 2014;7(4):461-473.
46. Akhutina TV. Diagnóstico y corrección de la escritura. Revista Española de Neuropsicología. 2002; 4(2-3):236-261.
47. Solovieva Y, Torrado O, Quintanar L. Orientation for initial introduction of written speech in primary school. Journal of Education, Society and Behavioural Science. 2018;24(4):1-18.

---

© 2018 Solovieva et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*

*The peer review history for this paper can be accessed here:  
<http://www.sciencedomain.org/review-history/26140>*