



## Qualitative Neuropsychological Assessment in Children with Attention Deficit Disorder

Yulia Solovieva<sup>1\*</sup> and Luis Quintanar<sup>1</sup>

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

### *Authors' contributions*

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

### *Article Information*

DOI: 10.9734/BJESBS/2017/32084

#### Editor(s):

- (1) Saramarie Eagleton, Department of Human Anatomy and Physiology, University of Johannesburg, South Africa.
- (2) Shao-I Chiu, Taipei College of Maritime Technology of Center for General Education, Taiwan.
- (3) Oyedunni Arulogun, Department of Health Promotion and Education, University of Ibadan, Nigeria.
- (4) Stan Weeber, Professor of Sociology, McNeese State University in Lake Charles, Louisiana, USA.

#### Reviewers:

- (1) Jera Kruja, University of Medicine, Tirana, Albania.
  - (2) Sergio Luis Schmidt, State University of Rio de Janeiro, Brazil.
  - (3) T. G. Rejani, IBS, Gujarat Forensic Sciences University, Gujarat, India.
  - (4) Michael F. Shaughnessy, Eastern New Mexico University, Portales, New Mexico, USA.
  - (5) Robert Perna, Texas Institute of Rehabilitation Research, Houston, Texas, US State.
- Complete Peer review History: <http://www.sciencedomain.org/review-history/19225>

**Original Research Article**

**Received 7<sup>th</sup> February 2017**  
**Accepted 18<sup>th</sup> May 2017**  
**Published 27<sup>th</sup> May 2017**

### **ABSTRACT**

**Backgrounds:** The syndrome of attention deficit disorder is one of the most frequent types of disabilities in infancy. The present study analyses the results of fulfilment of tasks of qualitative neuropsychological assessment in Mexican children with and without diagnosis of attention deficit disorder.

**Methods:** The sample includes fourteen children with attention deficit disorder. The control group of sixteen normal children of the same age and the same social level took part in the study. All children assisted kinder gardens and their age was between 5 and 6 years old. Neuropsychological qualitative assessment was applied to all children in order to characterise functional features of execution of the tasks.

**Results:** The most significant differences between two groups were obtained for the functions of voluntary regulation of activity and spatial functions. Examples of fulfilment of tasks of neuropsychological assessment are presented together with some criteria for qualification of difficulties. Our results permit to obtain more precise clinical comprehension of syndrome of attention deficit disorder from neuropsychological point of view.

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

**Discussion:** Our discussion establishes the necessity of concrete qualitative interpretation of results of neuropsychological assessment according to the concept of brain mechanisms considered in neuropsychology.

*Keywords: Attention deficit disorder; qualitative assessment; pre-school development; neuropsychological assessment; developmental neuropsychology; attentional disorders.*

## 1. INTRODUCTION

The syndrome of attention deficit disorder is one of the most frequent clinic pictures in infancy [1,2,3,4]. In different countries significant percentage of learning disabilities in primary school is related to this syndrome. Different researchers try to discover the mechanisms and causes of the syndrome of attention deficit disorder from the point of view of different scientific disciplines. Genetic, prenatal and postnatal pathologies, neurobiological, neuromorphological, neurophysiological, alimental and social factors can be mentioned among these causes [5,6,7]. At the present moment it is difficult to find unanimous opinion between specialists in relation with brain mechanisms and causes of this syndrome [7,8].

According to our opinion, one of specific goals of child neuropsychology, in this field, is characterization of functional participation of brain cortical and subcortical mechanisms. Brain cortical and subcortical mechanisms are components of complex functional systems at brain level. Low level of functional development of such mechanisms might be one of possible causes of difficulties in learning disabilities and different developmental syndromes. These mechanisms take part as components in realization of different actions during diverse periods of development in infancy [3,8]. Examples of such actions are verbal and non-verbal communication, actions with concrete objects and images, verbal actions and situations of playing and learning.

This point of view is related to qualitative assessment and description of development difficulties in cultural and historical conception of development. This tradition in psychology and neuropsychology differs radically from psychometric and psychiatric assessment and cognitive interpretation based on direct localization of symptoms [9,10].

New research based on conception of functional brain organization and qualitative assessment of developmental difficulties has established new data about participation possible mechanisms of

attention deficit disorder. For instance, it was found that not only frontal zones are responsible for the syndrome of attention deficit disorder, but also other functional brain systems. Examples of such zones are posterior associative zones and subcortical profound structures [9,10].

Recently, neuropsychological assessment has become a part of analysis of causes of the syndrome of attention deficit disorder together with medical, psychiatric and behavioural assessment. Some authors mention that possible neuropsychological mechanism might be related to insufficient regulation and voluntary control and dynamic alterations in superior psychological functions [11]. Other researchers [6] have established four variants of neuropsychological defects in 28 children with diagnostic of attention deficit disorder and hyperactivity: 1) retardation in the formation of dominance of left hemisphere and of cortical-subcortical regulation (42% of subjects); 2) dysfunction of right hemisphere in right-handed children (20% of subjects); 3) dysfunctions of posterior zones of both hemispheres and of frontal zones (29% of subjects); 4) insufficient selective work of frontal lobes (9% of subjects).

Frequently, it is suggested in literature that insufficient functioning of frontal lobes of both brain hemispheres might conduce to clinical picture of attention deficit disorder [12]. It is important to mention that this is a predominant point of view, which hasn't been changed in recent literature at all [13]. However, it is possible to find alternative points of view and opposite opinion. Such opinion doesn't agree with traditional relation between attention deficit disorder and frontal orbital lobes only [14]. For instance, some papers have stressed that some children with hyperactivity syndrome present low level of general regulation and level of brain activation without any pathology in frontal lobes [15].

Our own previous studies have pointed out that the most frequently affected brain factors in children with attention deficit disorder are programming and control, kinetic motor organisation of movements and actions and

spatial functions: analysis and synthesis [16,17,18]. It was shown that, in different ages during ontogenetic development, different brain mechanisms might be responsible for children's difficulties. No specific kinds of pathology or dysfunctions at cortical frontal lobes were detected.

Some studies dedicated to qualitative neuropsychological assessment have pointed out that each age of psychological development has its own specific features. For instance, in pre-school age the clinical picture includes a lot of different symptoms, which might not be reduced to only one brain mechanism as frontal lobes functioning. These symptoms include difficulties with programming and control of voluntary activity, kinetic motor organization of movements, complex spatial functions of orientation (analysis and synthesis) and the level of general cortical activation of activity.

Spatial functions were included as one of the mechanisms of the syndrome of attention deficit disorder in children from 5 to 6 years old in our previous study [17]. In this study it was observed that children with diagnosis of attention deficit disorder presented not only low level of voluntary activity and serious difficulties with self-regulation, but also absence of psychological readiness for school. For example, graphic actions (drawing) showed very low level of development. Such kind of clinical constellation of difficulties with self-regulation and spatial organization might be considered as typical for the age between 5 and 6 years old. In other studies such clinical constellations were described in 25 Mexican and 25 Russian pre-schoolers in comparison with same quantity of normal children of same age [8].

During the period of school learning, at the ages between 6 and 12 years, different kinds of combinations of functional deficits were found. For example, during first three years of primary school, at the age between 6 and 9 years, at least four variants of difficulties from neuropsychological point of view were observed: 1) predominant deficit of programming and control, 2) low level of general brain activation; 3) deficit of spatial functions and 4) combination of deficit of programming and control and low level of brain activation [10,19]. The authors don't insist that the mentioned four variants of difficulties are the only possible variants, which might be found in children with diagnosis of attention deficit disorder. The important point for us is that there are definitely

different variants of this syndrome. Attention deficit disorder might not be explained only using the term of executive functions or frontal dysfunction as it states in literature usually [2,4,7].

Another interesting fact is that detailed analysis of data of neuropsychological assessment of Mexican school children, at the age between 6 and 12 years with low level of general brain activation, has shown that some of these children might receive diagnosis of attention deficit disorder by child neurologist [20]. It is obvious that the difficulties of these children were different from those of children with severe problems in self-regulation or in spatial organization. However, all of them received the same diagnosis: attention deficit disorder.

According to the previously expressed, the methods of correction for children should correspond to functional brain mechanisms identified during neuropsychological assessment. The term of "attention deficit disorder" doesn't help to determine any kind of brain mechanisms. In the opinion of some authors, the diagnosis of syndrome of attention deficit disorder or of minimal brain dysfunction does not show true mechanisms of the defects [8]. Such term seems to be too general and doesn't permit to differentiate specific cases of children who present any kind of motor problems or hyperactivity on the bases of brain damage or other kinds of developmental problems.

The objective of the present study is to show the differences in neuropsychological qualitative assessment of Mexican pre-school children, aged from 5 to 6 years, with and without attention deficit disorder.

## 2. METHODS

Our study represents qualitative description of clinical manifestations of functional difficulties of children with diagnosis of attention deficit disorder in comparison with normal children of same age and same social and cultural living conditions in Mexico. No kinds of statistical or psychometric tests were applied for the assessment. The main goal of the assessment was to characterize strong and weak cortical and subcortical mechanisms of brain functioning. Analysis of results considers functional and systemic participation of brain mechanisms in psychological actions of pre-school age. Such kind of analysis is based on Luria's qualitative neuropsychological approach [8,13].

The method of qualitative analysis of syndrome consists of identification of types of errors and difficulties, which might be observed during assessment by specialist. The errors and difficulties appear, when the adult collaborates with the child asking to fulfil different kinds of tasks. Such tasks might be: independent drawing, coping tasks, pronunciation and denomination of words, playing, usage of objects in games, constructions and so on. The neuropsychologist analyses all kinds of difficulties and relates them to functional state of different brain cortical and subcortical levels. Such procedure permits to establish typical kinds of fulfilment of different tasks of neuropsychological assessment and to describe participation of brain functional systems in children's actions [10,18].

## 2.1 Subjects

The total of thirty children of pre-school age were participants of the study. Two groups of pre-schoolers were conformed in the study: children with diagnosis of attention deficit disorder (N=14) and control group with no clinic diagnosis (N=16). Fourteen pre-school children with diagnostic of attention deficit disorder were selected for the study. The age of the children was from 5 to 6 years and the average age in this group was 5.27. Sixteen regular children with no kind of developmental or behavioural difficulties or learning disabilities from the same socio-economic background and of the same age participated as control group. The average age for the control group was 5.61.

All children from both groups assisted third grade of urban official kinder gardens of the city of Puebla, Mexico. The children had no neurological or psychiatric disturbances. The children presented no other kinds of developmental problems or medical syndromes with the exception of attention deficit disorder established by an external specialist (child neurologist). Traditional procedure by usage of interview was applied. All children presented symptoms of attention deficit disorder. Children from control group didn't present such symptoms or any other kinds of learning disabilities.

## 2.2 Material

The Brief Neuropsychological Scheme for Children created according to linguistic features of Spanish language and psychological features of pre-school age (from 5 to 6 years) has been

applied for assessment [21]. The Scheme is based on Luria's neuropsychological approach for diagnostics and the methods of neuropsychological assessment in children [22,10,18]. The Scheme was designed by the authors of the article and is broadly used for qualitative neuropsychological assessment in countries of Latin America. The tasks of the Scheme are created according to the psychological possibilities of Mexican children of pre-school age (between 5 and 6 years). The Scheme implies qualitative analyses of the process of execution of the tasks. The objective of this analysis is establishment of correlation between mistakes and difficulties and functioning of cortical and subcortical brain systems. The Scheme is of qualitative nature and doesn't give any kind of quantification.

In this study the authors report only results of assessment of brain mechanisms identified as essential for clinical picture of attention deficit disorder. These mechanisms are: programming and self-control of voluntary activity and spatial functions of synthesis and analysis. The tasks for programming and control characterise participation predominantly of frontal cortical and subcortical structures, while the tasks for spatial functions characterise mostly participation of posterior parietal, occipital and temporal zones (TPO structures).

The tasks for assessment of the functioning of neuropsychological brain mechanisms of programming and control included the following items: 1) manual co-ordination; 2) co-ordination of fingers; 3) copy and continuation of graphic sequence; 4) verbal conflictive task presented in form of a game. The tasks for assessment of spatial functions included the following items: 1) copy of a house and 2) free drawing of boy and girl [21]. All tasks were accessible for regular population of pre-school children of the age between 5 to 6 years.

## 2.3 Procedure

The children from the group with diagnosis of attention deficit disorder and from control group were submitted to qualitative neuropsychological assessment. The assessment was individual. The duration of assessment was approximately 50 minutes.

The tasks of manual co-ordination and co-ordination of fingers imply execution of sequence of movements by a child following the motor model of hand movements shown by an adult as

a model. The instruction for the task is: "See how I move my hands (fingers) and do same movements as I do".

The task for copy and continuation of graphic sequence implies the coping of the model on the paper (Example 1).

#### Example 1. Graphic sequence



In the verbal conflictive task, the child has to hit on the table if while hearing the word "red". The child has to hit on the table two times if he or she hears the word "white". The adult pronounces orally the sequence of sentences:

*The hills are covered with white snow.*

*The boy plays with red ball.*

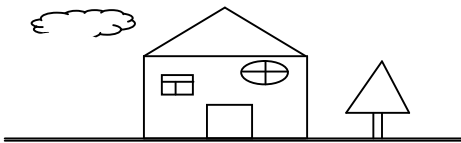
*In the morning the sky is blue.*

*The girl has the red bowl.*

*The flowers in the vase are white and red.*

The task of copy of the house implied the observation of the model and coping of the same model (Example 2). The instruction is: "Look at the house and draw the same exact house" on this paper with the pencil.

#### Example 2. Model of the house



The task of free drawing of "boy" and "girl" consisted of independent drawing by the child without any model. The instruction was: "Draw on the paper a "girl" (and afterwards, a "boy") as you like. Please, explain, where is the "girl" and where is the "boy" and explain "why" do you call them so. Are they different?"

### 2.4 Analysis of Results of Execution of the Tasks

All tasks were marked (qualified) with points from 1 to 4 according to the presence and absence of difficulties and the possibility to notice own mistakes. Point 1 was given for correct execution (absence of difficulties). Point 2 indicated execution with mistakes and posterior correction by child. Point 3 was given in case of severe difficulties with constant mistakes without any

correction. Finally, point 4 was given in cases of total impossibility of execution and absence of intention for correction.

### 3. RESULTS

The results of neuropsychological assessment pointed out the presence of differences in execution of the tasks between two groups of children. The majority of children with attention deficit disorder has shown impossibility for the execution of all the tasks related to the functioning of regulation and control (frontal lobes) with the exception of the item of coordination of fingers, where the difficulties were not so severe. The execution of this task was possible, however, only one child from this group was able to fulfil this task without mistakes. Neuropsychological assessment pointed out severe difficulties in the tasks related to functioning of regulation and self-control in the group of children with attention deficit disorder. This data is similar to our previous studies [18].

The task of copy and continuation of graphic sequence and verbal conflict task (game with instructions) resulted to be the most difficult task for children with attention deficit disorder. Examples 3, 4, 5 and 6 show the execution of the task of copy and continuation of graphic sequence by two subjects with attention deficit disorder and two children from control group.

In comparison with these results, we can observe that children from control group can manage to complete the tasks correctly, while children with attention deficit disorder present severe difficulties (Tables 1 and 2).

The Tables 1 and 2 show that the children from control group were able to fulfil the task from the first attempt (coordination of fingers) or with self-correction (manual coordination and sequence). The verbal conflictive task was too difficult for 78.57% children with attention deficit disorder and for 12.50% of the children from control group.

The analyses of the results have shown that the average of mistakes during the execution of all the tasks per subject is 6.2 in children with attention deficit disorder and 2.68 in normal children.

The statistical analyses (Mann-Whitney U Test) of the results have shown significant differences between the execution of the children with attention deficit disorder and control group in all tasks related to functioning of the frontal lobes:

manual coordination -  $P = < .000$ ; coordination of fingers –  $P = < .001$ ; sequence -  $P = < .000$ ; verbal conflictive task -  $P = < .000$  (Fig. 1). The most frequent type of such mistakes was mistake of perseveration (constant repetition of the only movement or kind of response).

The results of execution of the tasks related to the functioning of the posterior zones (parietal, occipital and temporal zones) of both hemispheres, responsible for spatial functions,

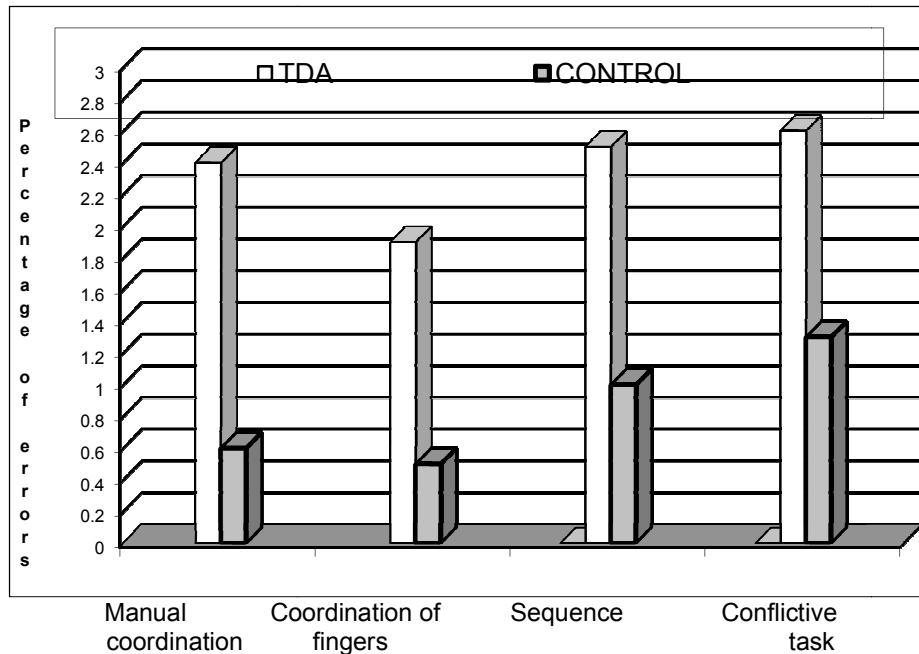
have shown the following. None of the children with attention deficit disorder was able to complete this task appropriately. For the majority of the children, this task was impossible to fulfill (80% of the subjects). The same phenomenon was observed in the task of the free drawing of boy and girl (Table 3). Normal children also have difficulties in these tasks, however the percentage of impossibility is much lower than in children with attention deficit disorder.

**Table 1. Execution of tasks for frontal lobes by children with attention deficit disorder (%)**

Qualification	Manual coordination	Coordination of fingers	Sequence	Conflictive task
Percentage				
1	0.00	7.14	0.00	7.14
2	21.42	35.71	21.42	0.00
3	21.42	21.42	7.14	14.28
4	57.14	35.71	71.42	78.57

**Table 2. Execution of tasks for frontal lobes by control group (%)**

Qualification	Manual Coordination	Coordination of fingers	Sequence	Conflictive Task
Percentage				
1	43.75	62.50	18.75	12.50
2	50.00	31.25	56.25	37.50
3	6.25	0.00	25.00	43.75
4	0.00	6.25	0.00	12.50

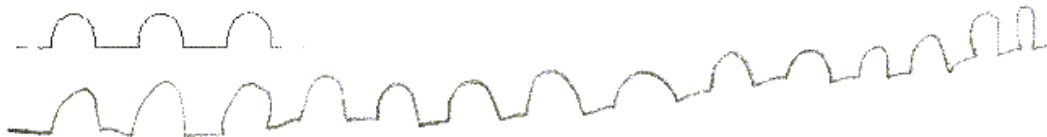


**Fig. 1. Execution of the tasks for frontal lobes of both groups (Average)**

**Example 3. Task of copy and continuation of the sequence.  
Subject C.C. (control group)**



**Example 4. Task of copy and continuation of the sequence.  
Subject J.J. (control group)**



**Example 5. Task of copy and continuation of graphic sequence.  
Subject C.R. (attention deficit disorder)**



**Example 6. Task of copy and continuation of graphic sequence.  
Subject E.F. (attention deficit disorder)**



**Table 3. Execution of tasks for posterior zones by children with attention deficit disorder and children from control group (percentage)**

Qualification	Copy of a house (attention deficit disorder)	Copy of a house (control group)	Free drawing (attention deficit disorder)	Free drawing (control group)
	Percentage			
1	0.00	6.25	0.00	6.25
2	0.00	37.50	0.00	37.50
3	20.00	43.75	20.00	43.75
4	80.00	12.50	80.00	12.50

Some of the typical characteristics of drawings of children with attention deficit disorder were: transparent house (in 57.10% of the cases), absence of necessary details (in 100% of cases), difficulties with the distribution of the picture on the paper (in 93.33% of the cases) and production of images impossible to recognise (in 42.80% of cases). The children were never able to recognize or to explain their own drawings. The mentioned problems can manifest difficulties in functioning of posterior zones of both hemispheres (Stiles & Thal, 1993). This kind of execution could be compared to similar

executions of patients with brain damage in posterior parietal, occipital and temporal (TPO) zones.

Children from control group have also committed diverse mistakes and didn't present perfect pictures. However, their mistakes might be characterised only as moderate mistakes. The drawing of children from control group presented some with essential details of images (68.75% of cases) and difficulties with the distribution of the picture on the paper (in 81.25% of the cases). Transparent images were not found, neither the

difficulties with recognition of their own pictures. It was always possible to recognize their drawing and the children were capable to describe and give explain the drawings. Such moderate difficulties might be related to insufficient training of graphic activity in pre-school institutions.

The examples 7, 8, 9, 10, 11, and 12 show the fulfilment of the tasks of copy of the house and drawing of boy and girl by subjects from group of children with attention deficit disorder and control group.

The analyses (Mann-Whitney U Test) of the results showed significant statistical differences between the execution of the children with attention deficit disorder and control group in the tasks related to the functioning of posterior zones (TPO zones): copy of the house -  $P = < .001$  and free drawing  $P = < .000$  (Fig. 2).

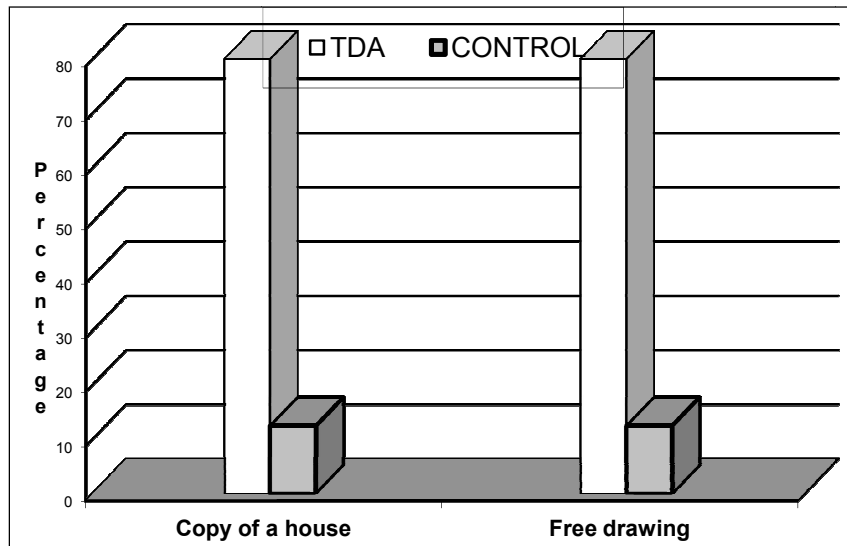
**4. DISCUSSION**

Our results have shown significant differences in execution of the tasks commonly used in qualitative neuropsychology for functioning of frontal cortical and subcortical structures and posterior zones by children with attention deficit disorder and children from control group. According to our results, children with attention deficit disorder showed poor execution in the tasks, which required participation of the factors of serial organisation, control and programming and space factors. It is possible to suppose that the children with

attention deficit disorder might have difficulties in future process of school learning. These results also indicated low level of general brain activation.

According to the literature, frontal lobes and posterior zones represent brain formations of high level of complexity in their structure, functioning and periods of maturation [23,24,25,26,27,28]. These zones are extremely sensible for negative social and organic influences and present complex process of systemic maturation during progressive development through infancy [29].

The functions of frontal lobes are related to aspects of self-control, programming and regulation of voluntary and conscious activity and with personality in general. Some authors have expressed that insufficient functional development of frontal lobes might be related to specific variants of learning disabilities [30,31,32]. For example, such mistakes in writing as perseverations, anticipations and repetitions of letters, words or parts of letter and words are called as regulative dysgraphia or regulative difficulties during acquisition of writing process at school [33]. The absence of orientation, which guarantees the strategy for reading, attention and understanding of complex grammar structures, is one of the main obstacles for normal acquisition of reading [34]. Same type of difficulties might be found in assimilation of mathematics and problem solution [35].



**Fig. 2. Execution of the tasks for posterior zones of both groups in two tasks (average of total impossibility)**



**Example 7. Copy of the house.  
Subject A.L. (control group)**



**Example 8. Copy of the house.  
Subject P.S. (control group)**



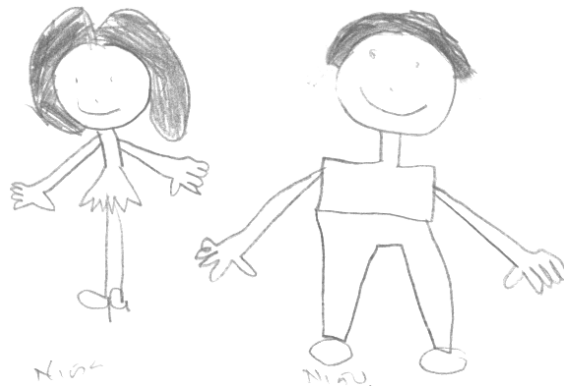
**Example 9. Copy of the house.  
Subject A.K.M. (attention deficit disorder)**



**Example 10. Copy of the house.  
Subject B.S. (attention deficit disorder)**



**Example 11. Free drawing.  
Subject P.S. (control group)**



**Example 12. Free drawing.  
Subject B.S. (attention deficit disorder)**



Such difficulties are related to diverse neuropsychological factors or mechanisms, which depend on level of functioning and maturation of anterior cortical and subcortical structures: 1) serial organisation of actions and movements; 2) programming and control of voluntary activity and sufficient level of general brain activation. Satisfactory functioning of all these factors is necessary for adequate development of each child during pre-scholar infancy. Insufficient serial organisation in speech conducts to reduction of vocabulary, semantic structure and grammar and to difficulties with comprehension of sense of texts and own construction of complex sentences and texts [36]. Insufficient level of activation provides instability in fulfilment of graphic tasks, fluctuation of success in all tasks, difficulties of retention of information of different modalities, impossibility to notice mistakes [20].

Another kind of severe difficulties were problems with spatial analysis and synthesis reflected in impossibility for orientation with objects and images and in strong mistakes in all perceptive tasks. It is broadly known in neuropsychology that the mechanisms of spatial analysis and synthesis, related to posterior brain zones, are necessary not only for space and corporal orientation, but also for such activities as drawing, writing, reading and mathematics [34]. Some studies have shown that the organisation of material on paper depends on appropriate functioning of posterior zones of right hemisphere [37].

We have to stress that the children from the control group didn't show complete development of the mentioned functions according to their results. These data could probably reflect heterogeneous character of development of psychological functions [38,39,13]. However, in comparison with the children with attention deficit disorder, normal children of the same age were able to correct their own mistakes. At the same time, the index of impossibility was significantly lower in this group and children were eagle to ask for help during cooperation with the adult. This fact proves the statement that favourable formation of voluntary activity takes place during initial school age in the conditions of external organisation and planning of child's activity of acquisition of basic scientific concepts guided by teacher [40,41]. We might suppose that this process takes place during the whole period of school education, from the age of 6 to 12 years and even later.

One of the most difficult tasks for children with attention deficit disorder was the verbal conflict task. According to some authors, such tasks are the most sensible for the prediction of the result in learning activity during school age [41].

As for spatial functions, according to our data, it might be concluded that none of the children from both groups has developed the habits of drawing and representation of objects at graphic level. At the same time, children with attention deficit disorder presented particular severe difficulties as complete impossibility of drawing or copying of perceptive models of known simple objects. We suppose that mistakes of normal children were related to poor practice and absence of external organisation and orientation from adults during realization of such types of activity. In their case, we might suppose that the level of development of graphic activity is low. As for the children with attention deficit disorder, the problems are much more severe and show, together with the absence of exercising, functional retardation or immaturity stage of posterior brain zones.

Our study has revealed significant differences in fulfilment of the tasks for frontal lobes between normal children and children with attention deficit disorder. Other studies report that children of the age of 6 years make mistakes in the tasks for serial organisation of movements (coordination of hands and fingers) and this date by itself can't serve for definite prognosis and should be contrasted and compared to other characteristics of execution in other tasks of assessment. According to this consideration, we propose to take into account several indexes or features during qualitative neuropsychological assessment of children of pre-school age as: 1) difficulties with self regulation and control of activity; 2) motor difficulties in the tasks for sequential organization of movements; 3) problems with space organization and distribution of the elements in drawing tasks; 4) evidences of low level of general brain activation.

Low functional level of anterior and posterior cortical and subcortical structures observed in children with attention deficit disorder confirm the necessity of elaboration of special programmes of correction, which has to include development and formation of correspondent neuropsychological factors [18]. Such factors are programming and control and spatial organization of orientation. [23,24,25,26,27,28]. The absence of space orientation is one of the

main obstacles for normal acquisition of reading [34] and mathematics and problem solution [35]. Space factors are necessary not only for space and corporal orientation, but also for such activities as drawing, writing, reading and mathematics [34]. According to previous findings, it is important to prevent learning disabilities in children with attention deficit disorder by elaboration and application of appropriate methods [42,43,44]. The period of pre-school education might be the appropriate period for prevention and application of correspondent methods favourable for psychological development.

The results of the study have shown that difficulties presented by children at the age of 5 and 6 years with diagnosis of attention deficit disorder might not be related to only one brain mechanism and might not be explained only as problems of self-regulation. Regulation problems are definitely present in the children. At the same time, the children show severe problems with spatial organization and orientation. When specialists apply only psychometric tests or interviews from manuals DSM-IV [45] or DSM-V [46], so commonly used in countries of Latin America, specific clinical feature might never be noticed. Psychometric tests don't help for understanding of correlation between kinds of mistakes or difficulties and brain functioning participations as probable factors of such mistakes. Psychometric assessment might normally help only for formal terms of traditional diagnosis. Interviews with parents and teachers don't consider real abilities and disabilities of children with developmental problems.

The methods of qualitative neuropsychological assessment should be known and taken into account as one of the possibilities for clinical study of children with development difficulties. The data of qualitative assessment might help to establish the paths and strategies for elaboration of correction and organization of teaching at school and day-to-day life for each concrete child.

## 5. CONCLUSIONS

1. The children with attention deficit disorder have shown impossibility for fulfilment of the majority of the proposed tasks in comparison with children from control group.
2. The most difficult tasks for children with attention deficit disorder were verbal

conflict task, copy and continuation of the sequence, copy of the house and free drawing of boy and girl.

3. Children from control group make certain mistakes on these tasks with clear tendency for independent correction.
4. Neuropsychological mechanisms of regulation and control, spatial orientation, motor sequential organization and level of activation should be taken into account as possible mechanisms of attention deficit disorder at pre-school age.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Cohen RA. The neuropsychology of attention. New York, Plenum Press; 1993.
2. Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA. The world wide prevalence of ADHD: A systematic review and metaregression analysis. *The American Journal of Psychiatry*. 2007; 164(6):942-948.
3. Quintanar L, Gómez R, Solovieva Y, Bonilla M. Características neuropsicológicas de niños preescolares con trastorno por déficit de atención con hiperactividad. *Revista CES de Psicología*. 2011;4(1):16-31.
4. Barkley RA. Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment. Guilford Publications; 2014.
5. Zavadenko NN. How to understand the child: Children with hiper activity and attention deficit disorder? Moscow. Medical and Psychological Pedagogy; 2000.
6. Osipova EA, Pankratova NV. The dynamic of neuropsychological status in children with different variants of manifestation of the syndrome of attention deficit disorder and hiperactivity. *School of Health*. 1997;4:34-43.
7. Pineda D, Rosselli M. Hiperactivity and attentional deficit. In: Rosselli M, Ardila A, Pineda D, y Lopera F. (eds.) *Child neuropsychology. Advance in research, theory and practice*. Medellín, Prensa Creativa. 1997;253-278.
8. Solovieva Yu, Machinskaya R, Quintanar L, Bonilla R, Pelayo H. Neuropsicología y electrofisiología del TDA en la edad

- preescolar. Universidad Autónoma de Puebla, México; 2013.
9. Machinskaya R, Semenova O, Absatova K, Subogrova G. Neuropsychological factors associated with cognitive deficits in Children with ADHD symptoms: EEG and neuropsychological analysis. *Psychol & Neurosci.* 2014;7(4):461-473. DOI: 10.3922/j.psns.2014.4.05
  10. Solovieva Y, Quintanar L. Syndromic analysis of ADHD at preschool age according to A. R. Luria concept. *Psychol & Neurosci.* 2014;7(4):443-452.
  11. Lebedinsky VV, Markovskaya IF, Lebedinskaya KS, Fishman MN, Trush VD. Neuropsychological and neurophysiological clinical analyses of anomalies in psychological development of children as phenomenon of minimum brain dysfunction. In: A.R. Luria and contemporary psychology. Moscow, Moscow State University. 1982;62-68.
  12. Maksimenko MYu. Children at pre-school age with insufficient functioning of right hemisphere. *School of Health.* 1997;4:23-26.
  13. Mikadze Y. Neuropsicología infantil. Moscow: Piter Press; 2008.
  14. Castellanos F, Sonuga-Barke E, Milham M, Tannock R. Characterizing cognition in ADHD: beyond executive dysfunction. *Trends in Cognitive Sciences.* 2006;10: 117-123.
  15. Akhutina TV, Korneev AA, Matveeva E Yu, Agris AR. Age-related changes of higher mental functions in 7-9 years old children with different types of state regulation deficits. *Psychology. Journal of the Higher School os Economics.* 2015;12(3): 131-152.
  16. Quintanar L, Bonilla R, Hernández A, Sánchez A, Solovieva Yu. Function of regulation of language in children with attention deficit disorder. *Journal of Thinking and Language of Latin America.* 2001;9:2.
  17. Quintanar L, Solovieva Yu, y Bonilla R. Analysis of visuospatial activity in preschool children with attention deficit disorder. *Human Physiology.* 2006;32(1):43-46.
  18. Solovieva Yu, Quintanar L. Qualitative syndrome analysis by neuropsychological assessment in pre-schoolers with attention deficit disorder with hyperactivity. *Psychology in Russia: State of the Art.* 2015;8(3):1-12.
  19. Solovieva Yu, Pelayo-Gonzales H, Méndez-Balbuena I, Machinskaya R, Morán G. Correlación de análisis neuropsicológico y electroencefalográfico en escolares con diagnóstico de TDA. *Neurobiología.* 2016;7(15)1-15:15816.
  20. Luna B. Síndrome neuropsicológico de déficit de activación cerebral general: Características clínicas en la edad infantil. Master Dissertation. Mexico: Autonomous University of Puebla; 2016.
  21. Solovieva Yu, Quintanar L. Evaluación neuropsicológica infantil breve. México, Ed. Universidad Autónoma de Puebla; 2013.
  22. Akhutina T, Pilayeva N. Overcoming learning disabilities. A Vigotskian-Lurian neuropsychological approach. Cambridge, UK: Cambridge University; 2012.
  23. Luria AR. Language and conscience. Moscow, Moscow State University; 1979.
  24. Luria AR. The role of language in development of behavior. Mexico, Cartago; 1982.
  25. Luria AR, Xomskaya ED. (Eds.) Frontal lobes and regulation of psychic processes. Moscow, Moscow State University; 1979.
  26. Xomskaya ED. Neuropsychology. Moscow, Moscow State University; 1987.
  27. Manelis NG. Neuropsychological regularities in normal development. *School of Health.* 1999;1:8-25.
  28. Korsakova NK, Mikadze YuV, Balashova EYu. Children with problems in learning: Neuropsychological diagnostic of difficulties in minor school children. Moscow, Russian Pedagogical Agency; 1997.
  29. Akhutina T, Neuropsicología de la edad escolar. Una aproximación histórico-cultural. *Acta Neurol Colomb.* 2008;24:17-30.
  30. Pilayeva NM. Neuropsychological help for children in groups for correction and development. In: E.D. Xomskaya y Akhutina T.V. (Eds.). International conference dedicated to the memory of A.R. Luria. Moscow, Moscow State University. 1998;238-243.
  31. Goncharov OA. Express neuropsychological evaluation of children who enter to the first grade of schooling. *School of Health.* 1998;1:36-42.
  32. Yáñez-Téllez G, Romero-Romero H, Rivera-García L, Prieto-Corona B, Bernal-Hernández J, Marosi-Holczberger E, Silva-Pereyra JF. Cognitive and executive

- functions in ADHD. *Actas Españolas De Psiquiatria*. 2011;40(6):293-298.
33. Akhutina TV. Neuropsychological approach for the diagnostic and correction of difficulties in learning of writing. In: Jrakovskaya MG. Contemporary approaches for diagnostic and correction of verbal disorders. San-Petersburg, University of San-Petersburg; 2001.
  34. Luria AR, Tsvetkova LS. Neuropsychology and learning disabilities at normal school. Moscow, Academy of Pedagogical and Social Science; 1997.
  35. Tsvetkova LS. Rehabilitation in cases of brain local damage. Moscow, Moscow State University; 1972.
  36. Akhutina TV, Ignatieva S Yu, Maksimenko MYu, Polonskaya NN, Pilayeva NM, Yablokova LV. The methods for neuropsychological evaluation of children from 5 to 8 years old. *Journal of Moscow State University*. 1996;14(2):51-58.
  37. Akhutina TV, Zolotariova. About visuo-spatial disgraphy: Neuropsychological analysis and methods of correction. In: Yu. Solovieva and L. Quintanar (Eds.), *Methods of intervention in child neuropsychology*. Mexico, Puebla Autonomous University. 2001;17-146.
  38. Akhutina TV. Neuropsychology of individual differences in children as bases for application of neuropsychological methods at school. *School of Health*. 1997;4:9-17.
  39. Lebedinsky VV. Problems in normal and pathological development. In: E.D. Xomskaya y Akhutina T.V. (Eds.). *International conference dedicated to the memory of A.R. Luria*. Moscow, Moscow State University. 1998;193-200.
  40. Talizina NF. *Activity theory applied for teaching*. Mexico, Autonomous University of Puebla; 2009.
  41. Polonskaya NN, Yablokova LV. Functions of programming and control and success in learning during the first school year. In: E.D. Xomskaya y Akhutina T.V. (Eds.). *International conference dedicated to the memory of A.R. Luria*. Moscow, Moscow State University. 1998;231-237.
  42. Quintanar L, Gómez R, Solovieva Y, Bonilla M. Características neuropsicológicas de niños preescolares con trastorno por déficit de atención con hiperactividad. *Revista CES de Psicología*. 2011;4(1):16-31.
  43. Glazman JM. *Developmental neuropsychology*. London: Routledge; 2013.
  44. Solovieva Yu, Quintanar L. Games as a method of correction in preschool Mexican children with ADDH. *British Journal of Education, Society & Behavioural Science*. 2015;11(3):1-14.
  45. American psychiatric association. *Diagnostic and statistical manual of mental disorders (DSM-4)*. Washington; 2000.
  46. American psychiatric association. *Diagnostic and statistical manual of mental disorders (DSM-5)*. Washington; 2003.

© 2017 Solovieva and Quintanar; 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://sciedomain.org/review-history/19225>