



Games as a Method of Neuropsychological Correction in Preschool Children with ADHD

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Authors' contributions

This work was carried out in collaboration between both authors. Authors YS and LQ have created the methods of neuropsychological qualitative assessment and the program of correction for preschool children based on games. The text was written by author YS and revised by author LQ. Both authors read and approved the final manuscript.

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ABSTRACT

According to psychological and neuropsychological research of pre-school age is the age of significant changes and transformations. Attention deficit disorder is one of developmental syndromes frequently detected at pre-school age. The present study shows the results of neuropsychological correction based on the method of game activity designed for individual therapeutic sessions. The method of qualitative neuropsychological clinical analysis is applied. The subjects of the study were Mexican pre-school children with diagnostic of ADHD. The previous neuropsychological assessment showed the necessity of inclusion of specific methods of correction for formation not only of strategies of regulation and control but also of spatial functions in population of children with ADHD at pre-school age. The assessment accomplished after program application showed significant positive differences in psychological activity of the children. We discuss the possibility of the usage of game paradigm as an alternative method instead of common medication in cases of ADHD.

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1. INTRODUCTION

According to psychological, neuropsychological and physiological research, the pre-school age is the age of significant changes and transformations [1-5]. Attention deficit disorder is one of developmental syndromes frequently detected at pre-school age. Different approaches to assessment and detection of problems in children with attention deficit disorder exist. Medical, genetic, sociological, cognitive, psychoanalytic, pedagogical, psychiatric and neuropsychological are among them. Specific feature of neuropsychological analysis of developmental difficulties is the discovery of relation between psychological level of child's activity's manifestation and functional level of central nervous system, precisely of cortical and subcortical mechanisms. From this point of view, neuropsychological assessment and intervention do not copy methods of neurologists or psychiatrists, but achieve own objectives by using original proper methods.

According to modern neuropsychology [6] and following Luria's proposals [7], neuropsychological assessment pretends to establish weak and strong functional brain mechanisms of children's activity. The knowledge of such aspects offers a new perspective for election of methods for correction. In this case, the goals of such correction will not be "correction of attention", but gradual work with weak brain mechanisms according to results of previous assessment. From such a perspective, neuropsychological correction is not considered as a list of receipts or norms for cognitive tasks, same for all ages and for all children and directed to attention as an isolated cognitive function [8]. Neuropsychological correction becomes heuristic and holistic process, in which flexible strategies should be created according to psychological age, type of difficulties and external orientation provided by an adult. Such strategies should be necessarily based on conception of the zone of proximal development [2] and include not only function of attention, but general activity and personality of children [9].

The main principles of neuropsychological correction within historic and cultural approach and activity theory are:

- 1) Gradual formation of weak brain mechanisms on the bases of strong mechanisms;
- 2) Inclusion of weak mechanism in orientated actions with goal and motive;
- 3) Consideration of psychological age and of rector activity instead of chronological age;
- 4) Gradual interiorization of actions starting with external level;
- 5) Constant orientation and mutual dialogical cooperation within the process of correction.

Speaking about preschool age, we may say that in case of diagnosis of attention deficit disorder weak brain mechanisms often include aspects of voluntary regulation of child's activity [10-12]. Nevertheless, voluntary regulation is not the only one weak mechanism found in this clinic picture. In different studies, the authors have mentioned serious difficulties with spatial analysis and synthesis manifested in typical deficits with graphic tasks, comprehension of complex grammar constructions and all kinds of orientation [13,14,4]. In other studies, lack of general brain activation manifested as lack of stability in all evaluated modalities: motor tasks, verbal and visual reproduction, problems with organization of elements and lines in writing and perceptive non verbal tasks [15,16]. Taking in to account this contributions, it seems to be important modify traditional opinion of the only deficit of executive functions or function of attention in cases of attention deficit disorder [17,18].

Weak brain mechanisms should be included in psychological actions directed to objective and based on internal motivation of child's activity. It is well known that the rector activity of preschool age is playing activity. Games with social roles are the most significant part of such kind of activity [19]. Before starting creation of interventional program for children with attention deficit disorder, it is necessary not only to consider types of games, but also the level of acquisition of playing activity. Cultural and historical approach, based on periodization of psychological development, normally consider level of manipulative games, games with toys and objects, simple symbolic games, complex symbolic games and complex games with social roles [20,21]. Previous qualitative analysis of level of development of playing activity may help

to start with appropriate level and guarantee positive collaboration within the zone of proximal development.

Neuropsychological assessment used in our study is based of Luria's proposals [22,11,16,23]. Additionally, the concept of rector activity of preschool age was considered as main methodological background for elaboration of correction.

The objective of our study is to show the possibility of usage of neuropsychological correction based on games conception. The authors are sharing their experience of assessment and correction applied to Mexican preschool children with diagnosis of attention deficit disorder. The methods of correction used in the study differ from traditional methods and are based on conception of games and playing activity as a rector central activity of preschool age. The study in general is based on historical and cultural paradigm of psychological development [19,24,20].

2. METHODS

2.1 Participants

In this study we report the experience of neuropsychological correction applied during 6 years (with different groups of pre-school children and of individual cases (30 cases in total). All children received traditional diagnosis of attention deficit disorder, which was established by local neurologists according to DSM-IV [25]. The diagnosis of attention deficit disorder was a requisite for inclusion in the study. Local neurologists personally didn't have any interest or participation in the study.

The criterion of inclusion of the children in the study was as follows:

- 1) The age of the children included in the study was between 5 to 6 years.
- 2) All children have shown characteristics of attention deficit disorder according to DSM-IV for more than 6 months, which was established by neurologists.
- 3) The children had no other kinds of problems in their psychological development.
- 4) All children belonged to urban population of the city of Puebla (Mexico).
- 5) All children assisted official preschool urban institutions.

The program of neuropsychological correction followed previous assessment. The program of correction was carried out in correspondent preschool institutions and/or Clinical Center for Attention of Children provided by Master Program of Neuropsychology of Puebla University Hospital. Participation of children in the program of correction was based on previous voluntary agreement with their parents and teachers.

3. ASSESSMENT

Neuropsychological assessment was accomplished according to Luria's theory [26] and its latter development in modern child neuropsychology [27,6,11,23]. This neuropsychological theory is based on fundamental conception of brain functional blocks. Three functional blocks take part in realization of any kind of human activity. Three functional blocks established by A.R. Luria are:

- 1) First functional block: Block of general activation of cortical activity and includes subcortical profound level.
- 2) Second functional block: Block of reception, processing and conservation of information of different modalities and include posterior cortical zones and close subcortical structures.
- 3) Third functional block: Block or regulation and control and includes frontal lobes and close subcortical levels of regulation.

According to conception of functional blocks, neuropsychological assessment should evaluate functional stage of three blocks taking into account specific participation of brain mechanisms within each of them [28, 29]. The Scheme of Neuropsychological Assessment for children includes the tasks, which permits to evaluate positive or negative functioning of following neuropsychological aspects:

- Kinesthetic analysis and synthesis,
- Phonemic analysis and synthesis,
- Motor sequential organization of actions and movements,
- Spatial analyses and synthesis,
- Visuo-verbal retention,
- Audio-verbal retention,
- Regulation, programming and control,
- General brain tonic activation.

Special instruments were developed for Spanish-speaking child population of the age between 5

and 12 years for neuropsychological [28], and psychological assessment of development [29].

Psychological assessment of children has detected poor level of playing activity with following features:

- 1) The role games were inaccessible;
- 2) Actual level was of separate concrete actions;
- 3) Symbolic actions were accessible with the help of the adult;
- 4) The language regulation was not enough and it was necessary to use material orientation and orientation by external actions;
- 5) Absence of initiative for games;
- 6) Incapacity of concluding an action (absence of global activity).

Procedure: All children were submitted to neuropsychological and psychological assessment, which was applied in 2 or 3 individual sessions from 50 to 60 minutes of duration. Later one, qualitative analysis of predominant difficulties and of level of acquisition of playing activity was carried out. Afterwards, the program of neuropsychological correction was applied to all children in individual sessions from starting from 30 continuing with duration of 60 minutes with the total duration for 100 hours during the period of 6 months for each child.

4. RESULTS OF NEUROPSYCHOLOGICAL ASSESSMENT

The general results of neuropsychological assessment with the help of specific tasks permitted to identify about strong difficulties in three aspects of brain functioning: programming and control of child's activity, spatial analyses and synthesis and working functional state of child's activity. Table 1 presents the content of the tasks used for each brain mechanisms included in neuropsychological assessment.

As the data of the assessment have shown, no difficulties were detected with kinesthesia and phonemic analysis and synthesis. Significant difficulties were found in relation of the mechanisms of programming and control, motor organization of actions and movements and spatial functions. Some of the examples such difficulties are presented in the study: The tasks of copy and continuation of graphic sequence for motor organization and the tasks of copy of the house for spatial functions.

The examples below present types of fulfillment of tasks of neuropsychological assessment by pre-school children with attention deficit disorder. Example 1 presents the model, which the children have to copy. Example 2 shows execution of this task by one of the children with diagnosis of attention deficit disorder.

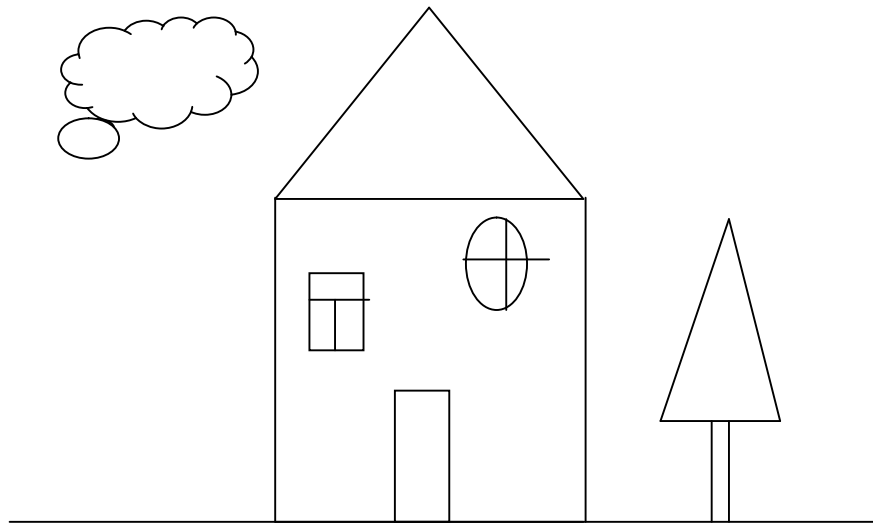
Table 1. Tasks for neuropsychological assessment

Neuropsychological aspects	Tasks
Kinesthetic analysis and synthesis	<ol style="list-style-type: none"> 1. Tactile recognition of known objects. 2. Repetition of syllables, which include consonants with similar articulations. 3. Reproduction of poses of fingers. 4. Reproduction of poses of fingers with closed eyes.
Phonemic analysis and synthesis	<ol style="list-style-type: none"> 1. Repetition of words with opposite consonant phonemes. 2. Repetition of syllables with opposite consonant phonemes. 3. Identification of opposite consonant sounds in series.
Motor organization of actions and movements	<ol style="list-style-type: none"> 1. Tasks for motor coordination of hands. 2. Tasks for motor coordination of fingers. 3. Copy and continuation of a graphic sequence.
Spatial analyses and synthesis	<ol style="list-style-type: none"> 1. Copy of a house. 2. Free drawing of girl and boy. 3. Comprehension of complex grammar structures.

Table 1 continued....

Visual-verbal retention	<ol style="list-style-type: none"> 1. Copy and reproduction by memory of 5 letters. 2. Copy and reproduction by memory of 5 complex figures.
Audio-verbal retention	<ol style="list-style-type: none"> 1. Direct repetition of 2 series of 3 words. 2. Involuntary reproduction of 2 series of 3 words. 3. Voluntary reproduction of 2 series of 3 words. 4. Retarded reproduction of 2 series of 3 words.
Programming and control	<ol style="list-style-type: none"> 1. Verbal instructions presented as a game. 2. Free game. 3. Directed game. 4. Marching by instruction. 5. Marching by palming. 6. Schulte table (identification of numbers in disorder). 7. Fulfillment of oral instructions. 8. Identification of smiling faces in series of smiling, indifferent and sad faces.
General brain tonic activation	Procedure of execution of all tasks: presence of fatigue, lack of executive stability, continues pauses, hesitation, problems with distribution of activity and so on.

Example 1. The model for the task of copy of the house:



In the example 2 it is possible to notice severe difficulties, which we can describe in following terms: deficit of global interactive perceptual strategy, total desorganization of coping, motor perseverations of the basic line, spacial inversion of the whole image (the basic line is no the left vertical side of the “house”), spacial difficulteis with representation of details on left and rights

side of the picture, lack of spatial synthesis of the global form (the “tree” and the “cloud” are inside the house”), the whole representation is of macro size, it covers the whole sheet pf paper. All these difficulties indicate unfavorable functioning of programming and control, spacial functions and lack of general tonal activation.

Example 3 shows the task of copy and continuation of graphic sequence, that can be used during neuropsychological assessment for pre-school children.

It is important to mention that similar kinds of difficulties were observed in all assessed children of the age between 5 and 6 years with diagnosis of attention deficit disorder in our group.

Example 4 shows an examples of execution of this task by a child with attention deficit disorder.

Psychological assessment detected impossibility to be included in complex games with social roles, sever difficulties to achieve verbal regulation by adult in all types games. Drawing and other kinds of graphic activity were inaccessible for children. Symbolic substitution was possible as isolated unique actions without any rules only in case the adult impulse this substitution. No initiative was noticed for playing activity. Children could only manipulate toys with no specific goals. Elemental verbal expression and comprehension of directed language were adequate for the age of children.

It is possible to detect severe difficulties in the Example 4. These difficulties can be described by a neuropsychologist as lost of motor model, total disorganization of the task, perseverations of motor program, lack of stability in spaces and intervals between elements of the graphic sequence. The conclusion would be dysfunctional stage of mechanisms of programming and control and of general activation of cortical tone.

Example 2. Copy of the house by a child with ADHD:



Example 3. The model for the task of copy and continuation of the sequence:



Example 4. Execution of the task by a child with attention deficit disorder:



5. PROGRAM OF CORRECTION

The program of neuropsychological correction established the goals of gradual development of poor mechanisms inside the basic activity of pre-school age, which is game activity. The methods chosen during correction come from systemic and structural approach of historic-cultural psychology:

- 1) Activity theory approach for child psychological development [19,2],
- 2) Gradual formation of actions from material to perceptive stage [30,31],
- 3) Neuropsychological principle of development of weak mechanisms on the basis of strong mechanisms [6,11]. The program included methods of gradual introduction of games with rules, verbal and gestural instructions and social roles. Methods of directed material and perceptive actions were used: Elemental classification according to one and two characteristics, analyses of characteristics of concrete objects and situations with objects, comparison of objects and situations, remembering of objects and situations at home, at last session, on the street, in the garden and so on. All actions included the orientation base of action and means of materialization with the help of external objects and actions of an adult.

The program included the following kinds of games:

- 1) Games with concrete actions and toys ("cars in the street");
- 2) Games with symbolic actions (substitution of concrete objects by symbols; "feed the dog" using a pencil as a bone; "guess what a do" and "guess what is it" observing the actions with objects and toys and representation of all actions by an adult;
- 3) Games with instructions for spatial orientation ("put the car behind/ in front of the house; where is the car now?");
- 4) Games with rules introduced by instructions or by presenting of sings and models ("say a word and pass me the ball; in this game the rule is that we can name only red objects");
- 5) Gradual introduction of role games by showing actions, verbal expressions and objects for roles representation (role game such as "hospital", "restaurant", "shopping", "reparation of mobile telephone" and other

games with roles and rules. During the stage of orientation all necessary questions were constantly used: "what do the doctor in the hospital? "What do people do in the restaurant?"). All questions were accompanied by correspondent actions with objects and toys. An adult started to fulfill the actions and tried to include the child and gradually passé him/her the continuation of the action. One of essential elements of all games with social roles was an inclusion of rules of the game with the usage of external symbols/instruments (example 8).

Another kinds of activities within the program of correction were introduction of graphic activity (drawing) of objects with the help of external orientation. Such orientation consisted in usage of external global form of an object in order to guide the process of graphic execution. After managing with the form, detailed analysis of all features of an object was accomplished together with the child. Such a gradual process permitted to establish orientated perception and representation of concrete objects and to support analytic and synthetic perceptual strategies.

The following examples show some games and tasks used during the work with the children according the program of correction. Example 5 shows the game with instructions used for programming and regulation of self-activity and also for spatial orientation. External helping as external cards for regulation of the children's actions were used as an external form of the action of control. In this game the child had to fulfill correct action and show right (for blue card) or left (for green card). Later on, the colors and the hands changed the order. Such kinds of games were used in different variants (colors, shapes, toys) and actions (sit down and get up, raise the hand, and so on). The children were asked to choose the color or chose a kind of action, which permitted to guarantee major inclusion in the game and progress of initiative and reflection of the rules in the games.

Example 5. Game with instructions: "show correct color (card) as quickly as you can" (2 cards for both hands, choose and tell me: which for right and which for left)

- The birds fly in the nice blue sky.
- The green car of my dad is new.
- My grandmother likes the green soup very much.

- In the blue sea, fishes the fisherman.
- The apple is green.
- My toys are in the green bag.
- The green frog is springing in the garden.
- The blue is my favorite color.

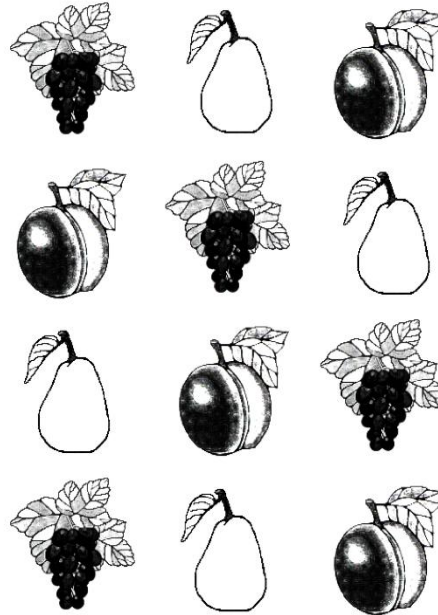
Example 6 presents another kind of game with rules on materialized and perceptive level. In this game, on materialized level, the children had to put the red circle on one fruit, put green circle on the other and let “free” the third object. On perceptive level, the children had to enclose in circle one object, enclose in square another object and leave the third kind of action. As in example 5, the children could change the rules in the game and propose their own instructions. In cases of absence of propositions from the children, the adult presents examples of such changes and the children could chose one options between two proposed options.

Example 7 shows different possibilities for usage of spatial orientation in tasks with instructions and games. There are a variety of objected concrete situations, in which this orientation can be used. The orientation includes always reflection about relations, which exist between different objects. Orientated cards with marks of direction to the left, right, before, after, under, up, down, and so on. Material level refers to concrete situations and perceptive level refers to analysis of illustrations in books, cards, drawing, and photographs.

Example 8 shows a part of correction with procedure of game with social roles and rules “reparation of a telephone”. In this game, a client (therapist) comes to a “master of telephones” for

reparation of a “Brocken telephone”. “The Brocken telephone” has no numbers and needs to be repaired. External scheme for number sequence is placed in front of the child. The adult shows correct sequence of numbers on the phone and orientates the child to follow the order of number in the sequence. The game is useful for social representation and communication of roles (“master and client”) and also for regulation and control of voluntary action in the content of the game (“correct sequence of numbers”).

Example 6. Game with rules: Enclose in the circle each pear; enclose in a square each peach. Let the grapes be free:



Example 7. Games with spatial orientation on material and perceptive level:

Left / right
Above / below
Up / down
Inside / outside

Analyses of real situations (what do we see in garden)
Analyses of situations by memory (what have we seen)
Analyses of graphic representation of real situations
Drawing of objects and by memory
Games of finding of hidden objects (verbal and material regulation by instructions and objects: 2 steps left, 3 steps straight, 2 steps right, open the box and you will see...guess what?)

Comparison of objects and situations on material and perceptive level:

Yesterday / Tomorrow
Before / After
Quickly / Slow

Verbal analyses of real situations and by memory
Verbal anticipation and planning of situations
Analyses of characteristics of real objects (toys)
Analyses of graphic representations of objects
using
the model of the global form (circle, square) and
location
of all characteristics of an object (donkey, duck)

Example 8. Game of “reparation of the telephone”:



6. RESULTS

After 100 sessions of working with the program of neuropsychological correction final assessment was carried out. Important changes were noticed in children’s activity. Example 9 shows the task of copy of the house fluffed by same child before and after the program of correction (see model en example 1). It is possible notice better orientation on the paper, presence of global form, and absence of motor perseverations, good integration and representation of each precise space for all details of the picture. All these features were absent in the first assessment. During final assessment all children showed better results in the tasks for spatial orientation. Severe mistakes

with global and analytic strategy have disappeared. Spatial and motor organization of drawings was significantly improved. Children were able to act by verbal regulation and never lost the objective of the prosed task.

Example 10 shows execution of the task of copy and continuation of graphic sequence by the same child before and after correction. In the examples before the correction we can observe total impossibility to carry out the task (see the model in example 3). The child loses the goal of the task and starts to draw line and circles. After correction we can steel fin presence of difficulties, but the child tries to follow the instruction and to reproduce the motor sequence in a more organized and proper way. Actually,

the child manages to do it at the beginning, by the task is difficulties and after some corrects movements; the child is not able to continue. Anyway, the qualitative changes between initial and final excecutions are obvious.

Example 9. The task of copy of the house before and after program of correction:

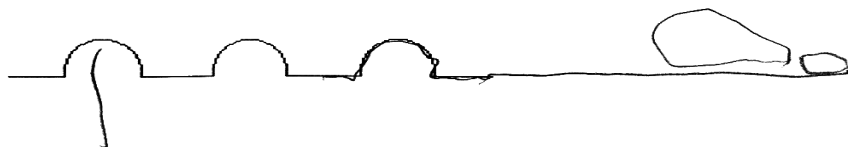


Before correction



After correction

Example 10. Copy and continuation of the sequence:



Before correction



After correction

7. DISCUSSION

Elaboration and usage of effective methods for neuropsychological correction is one of important aspects of child neuropsychology. Frequently, the process of correction is not considered as essential part of assessment. The separation even between specialists who assess and who correct is a frequent situation in many of countries. The therapists, who take part in the process of correction, traditionally chose empirical methods or methods from traditional speech therapy. Such methods do not have clear relation with given diagnostic (attention deficit disorder). Sometimes, therapists use general strategies for correction, for example "mediation strategies", which are believed to be useful for all types of learning disabilities or developmental deficits and even for disturbances in adult patients with brain damage. In Mexico, for instance, correction of children with ADDH is limited only to medication by Methylphenidate (commercial name: "Ritalin"), which leads, in many cases, to personal dependence on peels and not to overcoming of learning disabilities of children.

Another way of correction is based on behavioral cognitive approach. This approach is based on recommendations for organization and planning of time for day-to-day activities at home. The recommendations are mostly given to children's relatives and teachers. In our opinion, the limitation of such approach is that nothing is proposed or done for child's activity and development. In practice, such approach is limited to recommendation given to parents. Such approach may be called an "adaptation" instead of gradual development and overcoming of difficulties. Correction is directed to parents and to reduction or reorganization of effects of social stimuli and not to the concrete activity of the child.

A different kind of approach in child neuropsychology is based on Luria's and Vigotsky's conception of historical and cultural development [22,11,16,23]. According to this conception, assessment and correction represent inseparable parts of one general process. This process considers child's developmental difficulties and concrete ways for their overcoming according to objectives of psychological preschool age.

The results of the study show effectiveness of combination of neuropsychological and

psychological methods for qualitative analysis of syndrome of developmental difficulties. In our study, weak aspects from neuropsychological and psychological point of view in attention deficit disorder in pre-school age were identified. From neuropsychological point of view, such weak aspects are: programming and control, spatial orientation and general activation of brain cortex. From psychological point of view, weak aspects are: low level of development of playing activity, poor voluntary activity and absence of any kind of graphic activities. According to our results, it is possible to claim about the existence of particular characteristics of this clinical picture in pre-school age [32,14].

This kind of qualitative appreciation of clinical picture permits to elaborate creative program for neuropsychological correction. The main contribution of this program is the fact that not only attention is taken into account as a weak function, but the whole personality and activity of children. We may say that this type of program can be called not only program of correction, but also program for development [33]. The program for development has to take into account all features of psychological age of children and necessity of detailed understanding of the process of gradual interiorization of actions. According to Galperin [30], the function of attention could be understood as internal action of individual control. The origin of this internal control is not the brain or frontal lobes by itself [34], but external action of joint control shared between child and adult. Such actions of joint control were used in our program. Constant orientation of activity, provided by psychologist during the process of correction, is another fundamental basis of organization of the program. All actions of the children were guided and proposed initially by an adult. Later on, the child started to show more and more capacity to take part in playing actions and to organize own activity independently [34].

We may suppose that neuropsychological assessment at preschool age have broad possibilities for detection of variety of problems, which cannot be resumed with the generally known with term of "attention deficit disorder". We consider that traditional denomination of the syndrome of "attention deficit disorder" does not reflect the real nature and brain mechanisms of children's difficulties. The negative effect of this situation is that traditional pharmacological or behavioral methods for overcoming are commonly useless or wrong. Such methods are

frequently limited to medication or conductive formal measures, which only suppose the training of executive functions by constant repetition or simplification of the tasks. No progression or development is considered in such training. Instead of development, these methods chose adaptation to difficulties with future possibility of personal defects (absence of self confidence and profound dependence on medication). Consideration of qualitative perspective based on historical and cultural approach and activity theory can be a useful instrument on the way of overcoming of stretch quantitative methodology for both assessment and correction [35,33].

Our results also show the necessity of inclusion of specific methods of correction for formation not only of strategies of regulation and control, but also of spatial functions in population of children with ADDH at pre-school age [13,36]. Only complex programs of directed activity divided between an adult and a child can guarantee success in psychological and cognitive development of children with syndrome of attention deficit disorder. Such programs are currently created and applied in our day-to-day practice of neuropsychological correction in Mexico and other countries of Latin America [35,37,38].

8. CONCLUSIONS

- Qualitative analyses of data obtained by neuropsychological assessment of syndrome of attention deficit disorder at pre-school age permitted to establish specific complex of difficulties: functional weakness of regulation and control, motor organization and spatial orientation.
- Psychological analyses established poor development of playing activity in these children.
- The necessity of inclusion of specific methods of correction for formation not only of strategies of regulation and control, but also of spatial functions in population of children with ADDH at pre-school age.
- Neuropsychological correction based on organization of child's playing activity has shown positive effect on their psychological activity and it's neuropsychological mechanisms.
- External organization and constant orientation of the child's activity is necessary mean for overcoming of developmental difficulties in cases of attention deficit disorder at pre-school age.

- Alternative proposals of corrections instead of traditional medication are very useful in cases of attention deficit disorder.

9. LIMITATIONS OF THE STUDY

No variants of the syndrome of attention deficit disorder were included in the study. Participants of the study were only preschool children and no other ages were taken into account.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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