

Intellectual Activity in Patients with Semantic and Motor Afferent Aphasia

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Authors' contributions

This work was carried out in collaboration between both authors. Author YS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LQ managed the analyses of the study. Author LQ managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The goal of the study is to analyse the defects of intellectual activity in patients with aphasia. The Scheme for evaluation of Intellectual Activity was applied to four Spanish speaking patients with vascular accidents: two patients with semantic and two with motor afferent aphasia. The Scheme includes items of work with texts and pictures. The analyses showed the defects of the operation of synthesis in motor afferent aphasia and of planning and organising activity in semantic aphasia. All patients required of the external orientation base of action. The results are discussed in terms of the neuropsychological mechanisms of factor of each form of aphasia and of the structure of activity. The authors conclude that external helping is useful as the method of rehabilitation in these types of aphasia.

Keywords: Aphasia; intellectual activity; aphasia and intelligence; neuropsychology of intellect.

1. INTRODUCTION

According to neuropsychological definition, aphasia is a syndrome of verbal disturbances,

which appear as a consequence of acquired brain injury. Disturbances or conservation of other psychological functions, such as conceptual thinking, problem solutions and

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emotional sphere may stay intact. There are two main points of view about relations between intelligence and language in patients with aphasia. According to the first point of view, only language alters in aphasia. According to another point of view, other psychological processes, including intelligence, may suffer in patients with aphasia.

The first point of view has been defended since 19-th century, when Lordat [1] realised the first self-description of aphasia. The patient was able to combine abstract concepts but not to express them with words.

Many years after, Dejerine [2] continued to separate speech and intellectual disturbances. He insisted that intelligence was preserved in pure forms of aphasia but not in sensory aphasia which included deterioration of inner speech.

The second point of view has its origin in the works of neurologist Jackson. In 1878 [3] Jackson pointed out that aphasia had to be considered not only as speech disturbance, but also as frustration of basic intellectual processes related to logic proposals and conceptual thinking.

Marie [4] insisted on the existence of strong relations between aphasia and intellectual defects, especially in patients with sensory aphasia. This author reported difficulties of the patients during realisation of abstract tasks. Vigotsky [5] expressed the similar statement saying that aphasia patients were directly connected only to concrete situations. In his opinion, the liberty of abstract thinking was inaccessible for them.

Goldstein [6] emphasised disintegration of categorical thinking as consequence of brain damage. In 1964 Bay [7] tried to demonstrate that abstract thinking was fundamental aphasia disturbance.

However, some authors [8,9] claimed that it was impossible to accept description of particular cases as exclusive and global interpretation.

The new position has been developed in Luria neuropsychological school in the second part of the 20-th century. In multiple studies Luria [10,11] and Tsvetkova [12,13] have analysed intellectual processes in cases of frontal and parietal and occipital damages. Their results showed primary disturbance of intellectual activity in patients with frontal lesions. Patients with lesions in temporal parietal and occipital

zones (TPO area) and with neuropsychological clinical picture of semantic aphasia conserved primary intellectual abilities. Their secondary intellectual difficulties depended basically on primary defects in speech processes [14,13,15,16,17].

Primary defects observed in cases of frontal lesions were related to impossibility to fulfil intellectual activity as a complex psychological process [13]. The patients have lost motives, objectives and orientation as essential parts of intellectual activity [18].

Another picture can be observed in patients with TPO lesions. Intellectual activity is preserved as total process. Nevertheless, execution of particular operations, which is based on spatial orientation, suffers severely.

From this perspective, the study of defects of intellectual activity in aphasia could be realised with the help of analyses of different operations, which are necessary for realisation of corresponding intellectual actions. Such analysis is important for each task or problem solution. Among such operation of intellectual activity analyses, synthesis, generalisation, abstraction, differentiation and comparison could be distinguished [19]. It is obvious that many other specific operations could be found out.

According to Luria [20], it becomes possible to find dependence of realisation of specific operations of intellectual activity on the main factor or central mechanism of each type of aphasia. Every neuropsychological syndrome might present different aspects of suffering of these operations on different levels: anatomical, psychophysiological, psychological and linguistic. This perspective permits to establish correlation between neuropsychological aphasia syndromes and psychological structure of human activity [21]. Previous studies have shown examples and detailed analysis of disturbances of intellectual activity in patients with frontal syndrome and with semantic aphasia [10,13,22].

Other types of aphasia were not considered for such detailed analysis. In linguistic context different from Russian language, comparative studies of assessment of intellectual actions in patients with different kinds of aphasia might be rarely found. It is not usual to find neuropsychologists who follow conceptions of Luria's approach for interpretation and assessment of patients with aphasia and for analysis of complex intellectual actions as well.

The objective of our study was to analyse the defects of operations of intellectual activity in Spanish speaking patients with motor afferent and semantic aphasia from the point of view of the central mechanism of each form of aphasia.

2. METHODS

2.1 Subjects

Four adults with brain damage were selected. Educational level of patients was from medium to high according to Mexican educational system. All patients have suffered vascular cerebral accidents. Computerised axial tomography pointed out lesions in parietal inferior and temporal-parietal-occipital lobes of left hemisphere respectively.

Two of the patients received diagnostic of motor afferent aphasia and the other two of semantic aphasia according to Luria's classification of aphasia [12]. The age range of all patients included in the study was between 40 and 50 years.

2.2 Material

Neuropsychological evaluation was carried out by Scheme of Neuropsychological assessment for adults [23] and Neuropsychological Assessment for Patients with Aphasia [24] using specific neuropsychological procedures adapted to Mexican patients according to proposals of Luria's approach [25,20].

After that the Scheme for assessment of intellectual activity in patients with brain damage were applied to all patients. The tasks for this instrument were selected according to proposals of Luria [20], Zeigarnik [26] and Tsvetkova [13]. All tasks of the Scheme represent the model of intellectual processing according to the principles of activity theory [18,27].

The Scheme is divided in six parts:

- 1) Establishment of relation of intellectual activity and emotional sphere by identification of meaning and sense of artistic pictures.

- 2) Testing of intellectual activity on verbal level during the work with texts (narratives, descriptive and artistic) including identification of central idea, elaboration of plan and title for the texts.
- 3) Testing of intellectual activity on verbal level during elaboration of a plan and composition according to the proposed theme.
- 4) Testing of intellectual activity on verbal level during elaboration of a plan and composition according to free theme.
- 5) Testing of intellectual activity on verbal level during comprehension of proverbs.
- 6) Testing of intellectual activity on verbal level, level of concrete images and level of concrete actions during solving of problems. Adaptation of the Scheme for evaluation of intellectual development in children was used for this task [28].

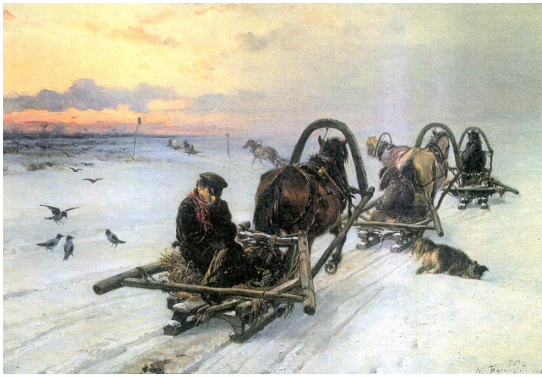
2.3 Structure of the Scheme for Evaluation of Intellectual Activity in Patients with Brain Damage

The Scheme includes 16 artistic pictures organised in pairs according to their meaning and sense [29]:

- two pairs of pictures with the same meaning but different sense;
- two pairs of pictures with the same sense but different meaning;
- two pairs of pictures with the same meaning and same sense but visually different;
- two pairs of pictures with different meaning and sense but visually similar.

The Scheme also includes 36 short texts: 12 narrative, 12 descriptive and 12 artistic; 7 proverbs frequently used in Mexican media and two intellectual tasks (third excluded and logic sequence) applied on verbal, perceptive and materialized levels [28].

Example 1 shows artistic pictures with the same meaning and different sense; Example 2 shows two paintings with the same sense and different meaning; Example 3, pictures with the same sense and meaning, but visually different; and example 4, two paintings with different sense and meaning, but visually similar.



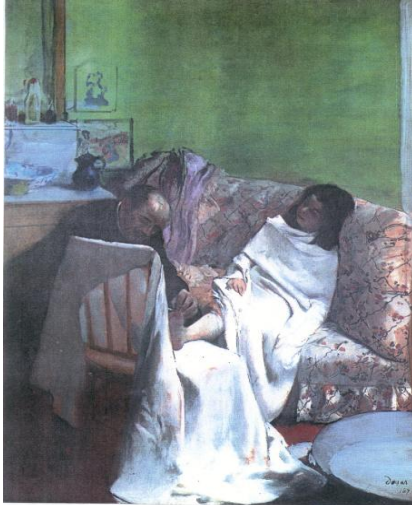
Example 1. Artistic paintings with the same meaning and different sense



Example 2. Artistic paintings with the same sense and different meaning



Example 3. Artistic paintings with the same sense and meaning, but visually different



Example 4. Artistic paintings with different sense and meaning, but visually similar

Among the descriptive texts the following were used: "The Baroque Salon", "Manet", "The teaching of medicine", "Ancient civilizations in Mexico and their historical heritage", "Volcanism and seismicity", "Indian medicine", "Beauty of New York", "Fishing resources" and "The Olmec culture".

Narrative texts include fragments of short stories, tales and proverbs, such as "The lying shepherd", "The crocodile and the hyena", "The oysters", "To give and to receive", "The lightning", "The lion and the mouse", "The Crow and the Fox", "The Fox and the Grapes", "The Stork and the Wolf".

The artistic texts include fragments of stories or novels, for example: "The Odyssey", "The Emperor's New Attire", "The Cemetery", "Inclined in the Evenings", "The Old Lizard", "The Field", "The Veil of Queen Mab", "The Girl of the Match", "The Beauty of New York". Among the artistic texts were emotive texts such as "The hen with throat", "You will eat with me", "The morning", "The rain", "The dawn" and "Act fifth".

The work with proverbs implicated reading (or hearing for psychologist's reading) and showing one of the five options, which explains the meaning of the proverb. The given options were correct, incorrect, distant and similar by structure and similar by sense. Let us show an example of the working with a proverb.

Proverb: *"The devil knows the old man better than the devil".*

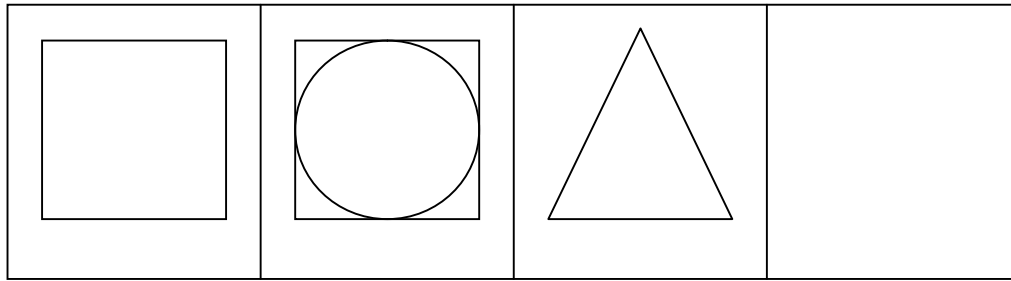
Available Options:

1. The old man is smarter than the devil (incorrect).
2. The devil is dangerous and must be afraid (distant).
3. Experience gives wisdom (correct answer).
4. The devil knows the devil because he is old (close structure).
5. Intelligence does not have much to do with the devil (close meaning).

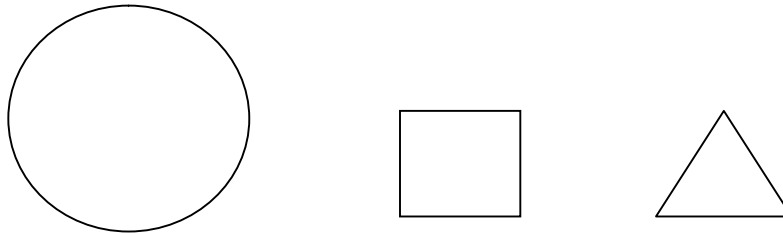
The logic tasks for the Evaluation of Intellectual Development [28] involves the solution of two intellectual problems in three consecutive forms of intellectual actions: the stage of concrete actions, the stage of concrete images and the logical-verbal plane or discursive thinking. In the case of adult patients, the order of presentation of the stages of intellectual development is stating from logical-verbal, stage. If the patient fails, psychologist would present the stage of concrete images and finally, if needed, the stage of concrete actions. If the patient fails at all level, psychologist would pass to the guiding principle of action and give concrete orientation to the patient how to solve the problem. Example 5 shows the first problem, which is to find the figure according to the sequence presented and example 6 shows the second problem: "third excluded".

2.4 Procedure

The Scheme was applied to all patients individually in 5 or 6 sessions. The duration of



Example 5. The task “Found the fourth figure according to the sequence”



Example 6. The task “Form a group of two figures excluding the third one” (all figures are red)

each session was of one hour approximately. All patients showed high level of motivation for proposed tasks, especially for the tasks with the content of artistic pictures.

2.5 Control Group

Control group consisted of 10 normal subjects aged from 18 to 50 years with the same educational level (medium – high according to Mexican Educational system). These subjects haven't presented any difficulty during realisation of the tasks of the Scheme. The age range and educational level of the patients included in the study corresponded to those of the control group.

3. RESULTS

In both forms of aphasia the possibility for individual self-orientation in proposed intellectual tasks suffered. The patients needed constant external help and orientation from neuropsychologist in order to accede to better performance. Orientation base of action was not internal and reduced as in normal subjects, but became external and broad. At the same time, the patients showed interest and tried there best during tasks solutions. They were able to accept external help from neuropsychologist and even asked constantly for such help.

The patients with motor afferent aphasia manifested strong difficulties in the following tasks: identification of the sense of artistic

pictures with the same meaning and different sense (75% of errors), elaboration of plans for all types of texts and for given and free themes (50% of errors) and in comprehension of proverbs (35.67% of errors).

The qualitative analyses of mistakes showed that the patients with motor afferent aphasia were able to determine the meaning but not the sense of the pictures. Instead of giving the precise general sense of a picture, they described all its details and isolated elements. During elaboration of plans the patients put down partial details, which were not really meaningful according to the content of the texts. They failed to synthesise the whole information. The plans were too descriptive and extended. Such phenomenon was never observed in normal subjects.

In cases of motor afferent aphasia we have observed detailed description of elements, which were not essential, for interpretation of the main sense of a picture, or for elaboration of a plan. The patients even used their finger to pass from one element to another. They used the operation of precise analyses but failed with the synthesis. The operation of analyses was based on preserved concrete meaning. Nevertheless, the conjunction or synthesis of the elements was inaccessible for the patients.

Patients with motor afferent aphasia made a detailed description of the isolated elements, without being able to unite them in a general

sense (to notice the difference according to the sense of the pictures: the tragedy and the quiet or neutral picture). Let's see an example of such execution of the patients.

To the question "What is represented here?" (Two tables with the same meaning and different sense) (example 1), the patient M.A.S.F. answers:

- A) "It represents a sinking, the ships are three boats but one is sinking and a boat to assist and in the distance a caravel, also aid of the people, the sea, is the high tide."
- B) "They are 7 ships, because they are, a ship is big, three ships of medium size, three of size boys, almost a raft in the sea, also the sky is clean, a blue sky and the sea is blue."

In response to the same question, in relation to the same pictures, the patient F.I.C.J. answers:

- A) "They are boats, they are many, they are three but there are many boys do not know if they are fighting, I imagine how they are several, how close they are together, it is not for them to be together".
- B) "Maybe it would be the same, then when they are together they could kill themselves, because they always go a little bit (signs indicating distance) I guess that's it".

A similar phenomenon was observed during the execution of the task elaboration of the plan for a given topic for written composition. Patients only recorded partial and insignificant details. No attempts were made to generalize or synthesize the information. The plans elaborated were too descriptive and extensive. Let us see some examples elaborated by each one of the patients for the subject "My daily activities".

The patient M.A.S.F. has written:

1. I get up at 8 in the morning,
2. I go to the bathroom to take a shower,
3. I pick up the towel and my clothes,
4. I leave the bathroom and dress and comb my hair,
5. Under the stairs to go to the kitchen, I'm going to have breakfast
7. Prepare breakfast milk, yoghurt fruit and bread,
8. I'm going to see my agenda,

9. I go out to the street at 10 o'clock in the morning,
10. I go to my Doctor...

The patient F.I.C.J., for his own choice for topic "Preparation of food," wrote the following plan:

1. They buy and wash the carrot, squash, they become small,
2. I put the pot and it is put oil,
3. Fry the onion,
4. Put the vegetables to fry and are moving,
5. Since they feel soft,
6. Then you pour chicken broth,
7. Also a bit of spices,
8. Put a sprig of coriander,
9. Is allowed to sew for 10 minutes,
10. If you do it in the pot express less time, because otherwise the vegetable will break down.

The patients with semantic aphasia presented difficulties in the following tasks: elaboration of plans for narrative and artistic texts (64.4% of errors) and comprehension of proverbs (57.1% of errors).

During elaboration of plans for narrative and artistic texts the patients showed lack of ability for organization of material represented in the texts. They didn't know, how to start and how to finish their plans.

At the same time, typical difficulties of this syndrome were observed: impossibility of understanding of complex grammar structures. This fact explains errors in the tasks with proverbs. The version chosen by patients was always the close one of proposed choices (correct, incorrect, close by sense). The same phenomenon was observed during fulfilment of the tasks of the Scheme of intellectual activity. The patients were not able to performance the tasks on verbal level, but could do it on level of concrete images (one patient) or concrete actions (another patient).

Two main difficulties were found out: 1) incomprehension of complex grammar structures and 2) impossibility of organization and planning of material.

In other tasks, the patients were able to analyse and to synthesize the information. They didn't show difficulties with identification of meaning or sense of pictures.

Let us see the examples of elaboration of plans by these patients.

The patient I.L.S., for the subject "The forest", wrote the following plan:

1. There are very beautiful and very green forests,
2. There are many large trees and some very small,
3. There are rivers that pass by,
4. There are cabins that are up well shaped with wood
5. There are people, who start the trees to make wood clandestinely,
6. People go on a hard day there
7. When there is a light on and off immediately.

In the task of developing the plan for a free theme, in all types of texts, patients also presented difficulties. Let's look at two examples of the I.L.S patient:

For the free theme "Painting" wrote:

1. The painting of watercolours,
2. They are composed of different forms (misspelled)
3. There are paintings that are made of paintings
4. I like to draw them (misspelled)
5. There are people who do not like them and do not buy them (misspelled)
6. I see interesting pictures when I go to an exhibition (misspelled)

For the text "The Shepherd Liar," he wrote:

1. a shepherd takes care of his flock (misspelled)
2. and the shout they eat their flock (misspelled)
3. people run scared (word separation) but the shepherd mocks
4. the shepherd cries again (union of words) there comes the wolf
5. and people run down their work to scare the wolf (misspelled)
6. and on the third time he shout but were ignored (misspelled)
7. and the wolf ate the flock (misspelled)
8. how many times a deception loses the people in another deception. (misspelled).

Comparison of the results obtained in two groups of patients pointed out the difficulties in the tasks

with texts and proverbs (table 1). Some differences between groups can be mentioned:

- 1) Patients with motor afferent aphasia had difficulties with all types of texts. Patients with semantic aphasia had less difficulty with descriptive texts. This due to the structure of these types of texts. Such texts have many additional elements, which help to understand them: dates, names, numbers and so on.
- 2) The difficulties in the task with pictures were typical only for patients with motor afferent aphasia.
- 3) Special verbal tasks were inaccessible for patients with semantic aphasia, which were not observed in motor afferent aphasia.

The causes of the defects were different in different forms of aphasia. In motor afferent aphasia the operation of synthesis was altered. In semantic aphasia it was the operation of organisation and planning of sequence of proposed information.

In both forms of aphasia the possibility for successful orientation in the tasks suffers. The patients needed external helping during performance. The orientation base of action became external and broad, instead of being internal and reduced.

Table 1. Percentage of errors in both forms of aphasia

Task	Type of aphasia	
	Afferent motor %	Semantic %
Pictures with same meaning and different sense	75.00	0
Idea of text	0	0
Plan for text	50.00	64.60
Title for text	0	0
Emotion in text	0	0
Plan for given theme	50.00	0
Plan for free theme	50.00	0
Proverbs	50.67	70.1

4. DISCUSION

Since Vigotsky's times, his followers have stressed the stretch relation between all elements of human psyche. Luria's neuropsychological school uses this position of

general psychology [30] and is based on two main principles: social genesis of psychological functions and their dynamic organisation and localisation [31].

Authors of activity theory [18,30,19,32] have showed that the realisation of any task implies participation of all psychological processes. Such complex comprehension of human activity is extremely important for modern neuropsychological science, which is making attempts to establish relationship between brain structures and psychophysiological elements of human activity. The analyses of cases of aphasia could help in understanding of relations between the state of psychological processes and the lesion of one or another neuropsychological mechanisms.

This statement permits to suppose that it is not only speech that suffers in cases of aphasia. The result obtained in this study show that speech disturbances are accompanied by specific defects in intellectual processes.

As for motor afferent aphasia, our results are of particular interest. The literature doesn't mention intellectual problems in patients with this form of aphasia [33,13,34,35].

According to our results, intellectual activity doesn't suffer primarily. It is even difficult to notice any difficulties from the first glance. However, the specific tasks permit to discover the absence of operation of synthesis of information on verbal and non-verbal levels. This phenomenon was observed clearly in tasks, where it was necessary to combine and to generalise the elements of information. Such tasks were the comprehension of the sense of pictures and elaboration of plans for given and free topics.

The syndrome of motor afferent aphasia defined by Luria [25] is related to inferior parietal lesion of left hemisphere. The central mechanism or neuropsychological factor of this syndrome is suffering of afferent aspects of fine movements including articulations (oral praxis). In language we find for pronunciation difficulties related to impossibility for finding precise articulations for sounds. On linguistic level expression and impression of sounds and words alter. On psychological level all processes suffer reading, writing, language production and comprehension and, probably, other processes. Our study shows

inclusion of intellectual activity in its operational level in these processes.

As for semantic aphasia, our results are similar to other neuropsychological descriptions of this syndrome. Many authors mention difficulties with simultaneous processes in this form of aphasia. Aysto and Hanninen [36] claim that parietal-occipital lobes of left hemisphere are responsible for simultaneous processing. Swirsky-Saccheetti and co-authors [37] have mentioned that in case of lesions in this area the patrons of complex visual integration, verbal apprehension and complex praxis suffer. Ardila & Ostrosky [38], following Luria [25] has concluded that the difficulties related to semantic aphasia dues to disintegration of spatial relations.

According to Luria [20] the central mechanism of semantic aphasia is the disintegration of perception of complex spatial and quasi-spatial relations. On linguistic level we observe difficulties or impossibility of comprehension and construction of complex grammar and logic structures, which include spatial factor. On psychological level, all processes, which involve spatial and quasi-spatial relations, suffer. Among these processes we also find intellectual activity, where the main defect dues to impossibility for organization of simultaneous information.

We have also observed defects in organisation of the order of elements of information and of planning of different kinds of activities as well. This phenomenon was reflected very clearly in the task with elaboration of plan for texts and for compositions.

Considering the psychological structure of intellectual activity, in both forms of aphasia the orientation base of action was disintegrated and specific intellectual operations were absent. All patients needed external help or orientation during their performance. In motor afferent aphasia this operation is synthesis. In semantic aphasia it is the possibility for organisation and planning of any kind of information.

5. CONCLUSIONS

- Intellectual activity alters in patients with motor afferent and semantic aphasia. In each form of aphasia such defects have their specific nature. Different intellectual tasks can indicate difficulties in different forms of aphasia.

- From the point of view of psychological structure of intellectual activity, intellectual defects found in patients are related to operational level. In the cases of motor afferent aphasia the operation of synthesis is involved. In cases of semantic aphasia the operation of organization and planning of simultaneous information suffer.
- The orientation base of action suffers in both forms of aphasia, which make it impossible to fulfil the proposed task independently.
- External orientation proposed by neuropsychologist is helpful in both forms of aphasia: semantic and motor afferent.
- The results obtained in the present study permit to establish relations between verbal deficits in aphasia and solution of intellectual tasks.
- Intellectual tasks on different levels (verbal, perceptive and materialized) might be helpful and useful for rehabilitation process.

CONSENT

Neuropsychological assessment was consented by all patients and their families.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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