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REHABILITATION OF EXECUTIVE FUNCTIONING IN AN AUTISTIC CHILD: A CASE STUDY

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SUMMARY

Background:

Executive functions disorders in autistic persons have been reported in a number of studies. The most pronounced symptom is an inability to shift the course of action, which leads to a reluctance to allow any changes in the environment. Yet it is possible to teach an autistic person to perform actions in accordance with learned schemata, at least at the elementary level.

Material/ Methods:

The rehabilitation of a patient treated in our clinics is presented in the paper, against the background of a complex project including the examination and therapy of 25 children. The therapeutic procedure was aimed at developing the skills important for executive functioning.

Results:

An approach consisting of three stages of therapy was applied: creating, realizing, and controlling an action schema. In consequence, considerable modification of the boy's behavior was attained, which resulted in better social functioning. He also began cooperating with others, though in a limited range. His drawings suggest improved reasoning abilities.

Conclusions:

The approach presented in this paper shows that it is possible to modify the behavior of an autistic child, and to develop the skills that are important for self-control and for executive functions in general. The development of executive functions results in better ability to interact with significant others, despite the fact that the child's behavior remains rigid and ritualized.

Key words: theory of mind, development, behavior, cognitive approach

INTRODUCTION

Successful functioning of a human being depends to a considerable degree upon the ability to create representations of the world, which take the form of cognitive schemas (Trzebiński, 1985). These are not simple copies of reality, but a selection of significant features. They may either relate to concrete events, or serve as general, simplified models of a given situation. The schemas enable orientation without the necessity to perform a detailed analysis of all stimuli received. They have a complex structure, since they may consist of a set of elementary components, which is at the same time a component of more complex schemas. Each schema is an autonomous cognitive element, i.e. it can function without activating its own components or a more general schema (Trzebiński, 1985).

Cognitive schemas are particularly useful in various social interactions. They enable us to imagine our own behavior in both particular situations and a more general way. Hence they make it possible to activate appropriate “programs” that are in agreement with the needs and aspirations of a particular individual, i.e. with her will. A very significant role in performing these voluntary actions is played by the so-called “central executive” (Pačhalska, 2008; Jodzio, 2008).

Executive functions are important for cognitive representations, thinking, and making decisions, which means controlling the action of the entire cognitive system (Fuster, 2000; Grafman, 1989; Pačhalska, 2003a, 2003b). Executive functions are most evident in the rule of “3 S’s”: starting, stopping, and shifting (Goldberg, 2001). The ability to shift the course of action is important for proper functioning in everyday situations. We have to change our behaviors to adjust to dynamic situations. Thus we behave in one way while shopping in a supermarket, and in another way in a small shop with a clerk behind a counter. Therefore the term “scenarios” can be used to emphasize the flexible nature of our internal “schemas.” Moreover, the studies performed by Pontius and Yudowitz (1980) revealed that young delinquents have problems with shifting their course of action. They often say that they did not plan to murder anybody, but an unexpected intruder arrived at the spot of their planned robbery. The inability to shift action when the context changes is a significant symptom of frontal lobe dysfunction, and finds reflection in their narratives (Kaczmarek, 1984, 1993, Pontius & Yudowitz, 1980).

Salthouse et al. (cited by Pačhalska, 2008) consider executive functions to be a sequence of activities, including starting, shifting, inhibiting, and refreshing information. The procedural aspect of EF is also stressed by Pačhalska (2002). She points out that our knowledge about the way our brain selects information, transforms it, and stores it is still insufficient. Our knowledge of the transition from idea to action is also insufficient, and this is the very essence of executive function. Despite these insufficiencies, the model of executive functions is frequently used to explain behavioral problems, including those of autistic persons.

AUTISM AND EXECUTIVE DYSFUNCTION

Autism is considered one of the best defined disorders (Pisula, 2001). The criteria enumerated in DSM and ICD make it possible to differentiate autism from other disturbances. Still, the term Autistic Spectrum Disorders (ASD) has come into use since the impairment of particular spheres varies from very deep to quite mild. There are also significant differences between particular individuals, as well as among various therapeutic procedures in terms of efficacy. This may be a cause of many diagnostic failures (Markiewicz & Pachalska, 2007).

In accordance with the diagnostic criteria of ICD-10 (WHO, 1992) childhood autism is described as a complex disturbance including all three areas of psychopathology: social interactions, communication, and restricted stereotyped behavior. The symptoms of disturbances in social interaction include:

- Significant inability to evaluate socio-emotional signals
- Lack of reaction to others and lack of modulation of behavior in reaction to a given social context
- Significant difficulty in the use of social signals
- Significant disturbances of reciprocal social interactions

The communication disorders include:

- Lack of social use of language
- Weak synchronization and lack of reciprocation in dialogue
- Lack of emotional reactions to both verbal and nonverbal attempts to make contact

The characteristic behavioral disorders include:

- Restricted, stereotyped, and repetitive behaviors and activities
- Inflexibility
- Attachment to uncommon objects
- Concentration on details, dates or time tables
- Occurrence of fear, fits of anger, aggression, and self-aggression

Among symptoms pointing to executive dysfunction are inability to control attention and motor reactions, as well as distractibility. Autistic persons also exhibit difficulties in controlling their actions, especially those aimed at a specific goal. They do not adapt their actions to new situations, and are not able to control their behavior in general (Minschew, Goldstein, Siegel, 1997; Pierce, Glad & Schreibman, 1997). They are very reluctant to accept any changes, since this requires the ability to plan and control one's actions, as well as good working memory (Prior & Hoffman, 1990; Ozonoff, Pennington & Rogers, 1991; Ozonoff & McEnvoy, 1994).

As pointed out above, these abilities are related to executive functions, and the role of language in controlling behavior (Luria, 1976; Kaczmarek, 1986, 2003). A number of recent studies have shown that it is possible to train an autistic child to overcome these difficulties (Baron-Cohen, 2008; Jordan, 2008). Yet this requires the fulfillment of the conditions that are essential for the activation of executive function. The most important of these are:

- a. making a specific situation as concrete as possible. Hence pictures or arrows pointing to specific situations or objects are used alongside verbal instructions (Carlson, Moses & Hix, 1998; Hala & Russel, 2001)
- b. Training by repetition of a given experience and providing explanations, which improves the child's orientation and helps to control inhibition (Kloo & Perner, 2003).

THERAPY DIRECTED AT RESTORATION OF EXECUTIVE FUNCTIONS

According to Pachalska (2008), therapy to restore executive functions should take into account three general approaches:

Modification of environment and/or behavior

This means introducing gradual changes in the environment, since autistic persons tend to stick to established schemas. Thus a small change is made in the presence of the autistic child, e.g. moving a single piece of furniture or a flower to another place. It is important to provoke a positive reaction to this change. Such modification techniques are criticized, but this seems to be due mainly to their form. It has been stated that positive reinforcements are more efficient than negative, but traditional behavioral training is inclined to use punishment of undesired behaviors. This may be due to difficulty in finding an action that would replace the undesired one. If positive reinforcements are used, the method described proves to be useful in teaching goal setting when the child cannot cope with an excess of incoming stimuli.

Cognitive intervention techniques

These involve establishing a specific task by repeating it a considerable number of times. The individual sessions are structured in a very formal way. This may be useful as a tool leading to structuralization of experience, and thus to creating a cognitive schema of a given situation. As pointed out by Burgess (2003), it is difficult – if not impossible – to transfer the results of cognitive therapy into real-life situations. In the case of autistic persons, however, acquiring new behavioral schemas has proven to be very important. Moreover, the schemas may be transformed by using a sequence of repetitions. This does not mean that the autistic person becomes flexible and creative. On the contrary, each change may provoke disorganization of behavior. Yet the established schemas may be successfully used by them in everyday life, provided they are not forced or unexpected. This means that autistic children are able to acquire stiff schemas through the above-mentioned scenarios. We can introduce some alternations in their schemas, but this must be done in a slow and gradual manner.

Training of specific skills

This approach uses a number of methods developed by both cognitive and behavioral psychologists to teach their clients to perform everyday activities. The methods are applied in connection with the modification of the environment as presented above. It should be pointed out that most therapeutic procedures for autistic children are aimed at eliminating undesired behaviors and introducing desirable behaviors in their place. However, according to the systemizing theory of autism, it is possible to transform undesired behaviors into desirable ones without the necessity to eliminate the undesired (Baron-Cohen, 2008). The systemizing approach takes into account the penchant of autistic persons for analyzing, which becomes a basis for creating ordered, and at the same time useful systems. A system may be anything that is regular and can be ordered in accordance with an accepted rule. There are mechanical systems (relating to the components of a machine), abstract (e.g. patterns of numbers) and natural (concerning collections of things). Autistic persons show a tendency to systemize, but do so in a stereotyped, impractical way, while the approach described aims at transforming this systemizing into a directed behavior. Thus, if an autistic person exhibits a tendency to count things, this should be used for a practical purpose, e.g. making inventories of things (Baron-Cohen, 2008).

The purpose of the present study was to determine if any changes can be noted in autistic children in the development of skills that require the active use of executive functions.

MATERIAL AND METHODS

The study was performed in two ways. First, a statistical analysis was performed on the scores of 25 autistic children (patients of the Specialized Clinic of Diagnosis and Rehabilitation in Lublin, Poland) on tasks evaluating executive function. This was a part of a wider project evaluating various aspects of the development of autistic children. Beside the measurement of executive functions, the theory of mind and the level of central coherence were also assessed (see Markiewicz, 2007). Changes in executive functions were measured with three tasks:

EF 1 – sorting geometrical figures in accordance with a given category. Two categories – shape and color – were applied, and changed in random order. Accomplishing such tasks requires an ability to inhibit one reaction and perform another, which is closely connected with self-regulation of behavior (Russel, 1997; Wimmer & Perner, 1983; Moses, 1993, 2001).

EF 2 – delayed reward, which measures the ability to refrain from expecting immediate gratification.

EF 3 – selecting pictures in accordance with changing principles given in random order by the examiner (Markiewicz, 2007).

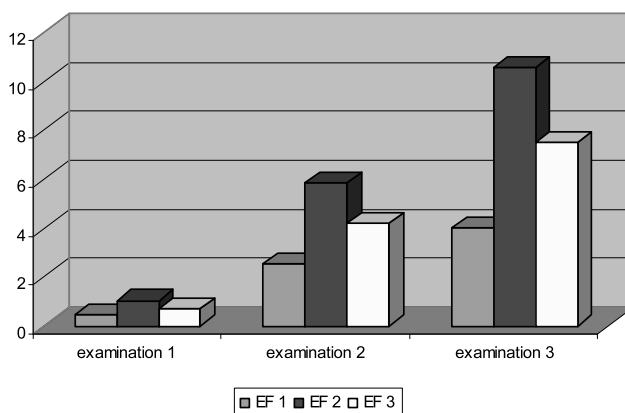


Fig. 1. Changes in performance on EF tasks in consecutive examinations (Markiewicz, 2007)

The results point to progressive changes in all examined skills. They underwent considerable transformations in consecutive examinations, as shown in Fig. 1.

The improvement observed in fulfilling particular tasks was statistically significant. A description of the tasks and the results of the study can be found elsewhere (Markiewicz, 2007; 2009). Therefore, in the present study we decided to describe the rehabilitation and accomplishments of one of our subjects, as an exemplification of how the social skills of autistic children can be improved through the development of executive functions. We believe that this will not only provide a concrete example of the therapeutic procedure, but will also demonstrate that it is actually possible to raise the level of executive functioning in autistic children.

CASE STUDY

Regular developmental therapy with Michael (born in 1992) was started in 1996, when he was four years and three months old. His parents reported that it was impossible to make contact with him, as he did not react to any attempts to enter into emotional attachments. He exhibited self-aggressive reactions, consisting in biting his wrists and persistent scratching the back of his hand. These behaviors occurred when his parents acted contrary to his intentions or expectations.

An assessment performed on the basis of ICD-10 criteria revealed the following:

1. Qualitative impairments of social interactions, which manifested themselves in:
 - (a)Limited social activity: Michael did not react to any attempt to initiate contact by his closest family, nor did he show any interest or rebel against new situations.

- (b) Difficulties in accepting any changes in settled schemas, e.g. signs of frustration in reaction to reordering well known actions.
 - (c) Lack of initiative in establishing social contacts, as well as a tendency to ignore new persons.
 - (d) Severe emotional distance, no sign of spontaneous expression of feelings in speech, gestures or facial expressions.
2. Disorders of communication:
- (a) Lack of willingness to communicate.
 - (b) Weak reactions to visual and/or auditory stimuli.
 - (c) Weak reactions to questions and instructions despite preserved understanding (e.g. he would carry out a command to hand over an object, but only after a considerable delay).
 - (d) A great number of sentence equivalents, consisting mainly of nouns and basic verbs, no application of syntactic rules.
3. Disorders of behavior:
- (a) Prevalence of stereotyped reactions, such as rocking, plucking objects, biting wrists, strong hitting with fingers or hand of objects or table edge.
 - (b) Fits of annoyance caused by petty failures, outbursts of laughter without evident cause.
 - (c) Peculiar treatment of objects, such as touching, tapping, setting objects in motion. He came to sessions with two dice, and taking them away resulted in crying, biting his own wrists, hitting his head.
 - (d) Lack of initiative to start playing with others.

The level of involvement and participation of the parents in therapeutic work was very high, despite difficulties in making contact with Michael. During the first visits he was sitting on the chair and spinning his dice. Attempts to get him interested in anything else were fruitless, as he did not pay any attention to his surroundings. The only exception was when his mother left the room. Then he froze, but he did not look for her, and after a while he went back to spinning his dice.

During one of the next visits the therapist let Michael spin his dice at the beginning of the therapeutic session. Then she stopped him, and she spun some other dice she had previously prepared. Michael's first reaction was a cry and an attempt to hit his head. There was a sequence of such actions during the entire session. The therapist would stop him, spin the dice herself, and then let the patient repeat the action. Each time the inhibition of the child's reaction led to crying and self-aggression.

Inhibition of Michael's reaction was attained over time during consecutive therapeutic sessions. He also began to react to the instruction "now me," when the therapist stopped his action and introduced her own. At the same time, he reacted correctly to the instruction "now you" after the therapist let him do a given task himself. These tasks involved the alternate action of the therapist and inhibiting Michael's own action, which required reinforcing the verbal instruction with a gesture (the therapist put her hand on the patient's hand). As

a result of such training, Michael began to wait for the therapist to act. For example, after spinning his dice he waited until the therapist did the same.

As an indication of progress two samples of Michael's drawings are given in Figures 2a and 2b. These were collected during tasks that required drawing an illustration of well known figurative sayings, such as *roller* (in Polish "sea snowman"), *seadog*, *high heels* (in Polish "shoes on needles"), and *traffic jam* (in Polish "traffic cork"). It may be observed that before therapy his drawings are almost illegible, while after therapy the objects depicted there are easy to recognize. Yet Michael is still not capable of grasping the figurative meaning of the sayings, and depicts their literary meaning. An improvement in the ability to pay attention and to arrange elements in the proper order can be noted in Figures 3a and 3b. Before therapy Michael was not able to copy any of the figures from the Bender-Kopitz test, while after therapy he accomplished the task quite well, getting very close to the norm.

The approach described above led to the development of the ability to cooperate, though in a narrow scope. Also other patients, besides Michael, exhibited such forms of activity as handing the therapist their own toy (dice, blocks) and waiting for the sequence "your turn – my turn". Moreover, an ability to transfer the acquired skill to other fields was noted. After some time it was sufficient to say: "Michael, your turn, my turn" to prompt him to cooperate.

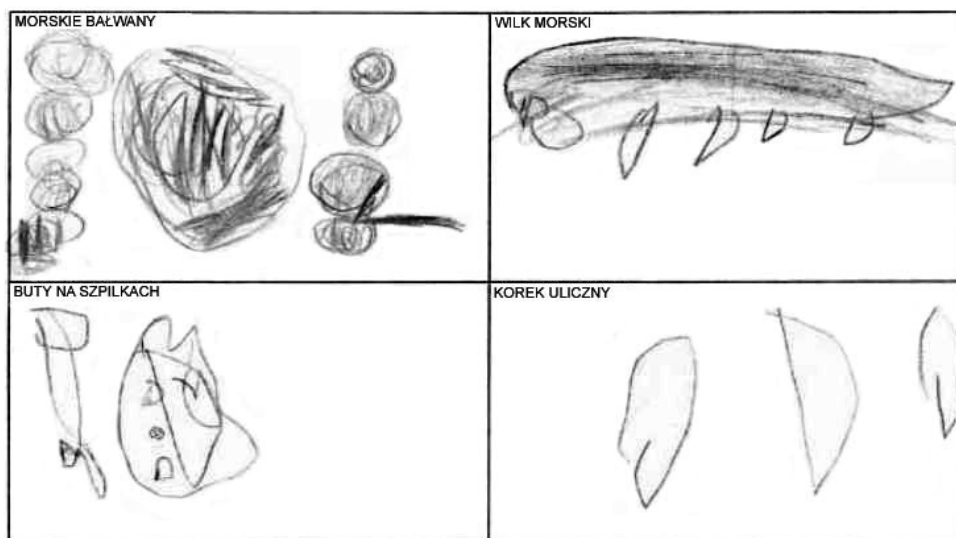


Fig. 2a. Depiction of figurative sayings before therapy

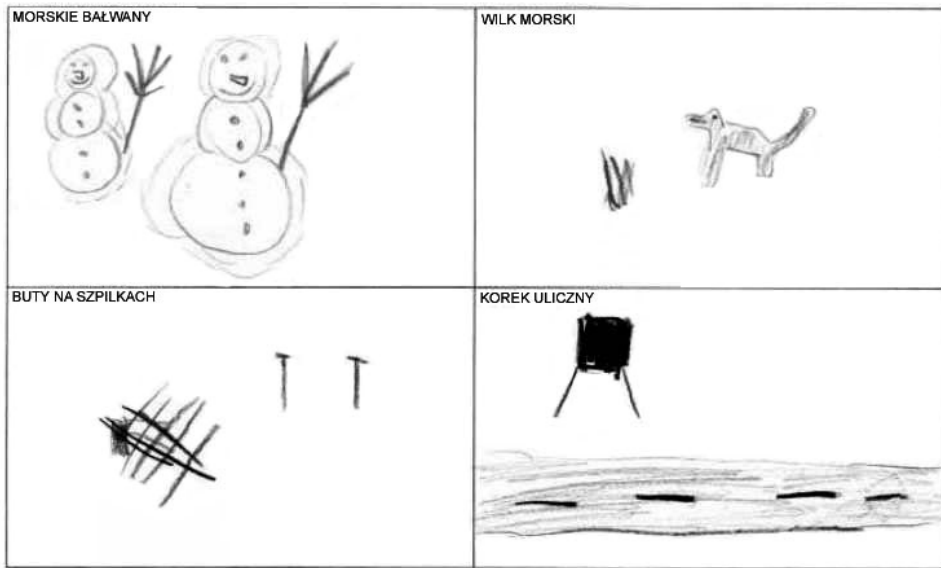


Fig. 2b. Depiction of figurative sayings after three years of therapy



Fig. 3a. Copying Bender-Kopitz figures before therapy. The therapist was sitting opposite the patient, and the figure reflects the child's point of view. The random order of individual drawings can be observed.

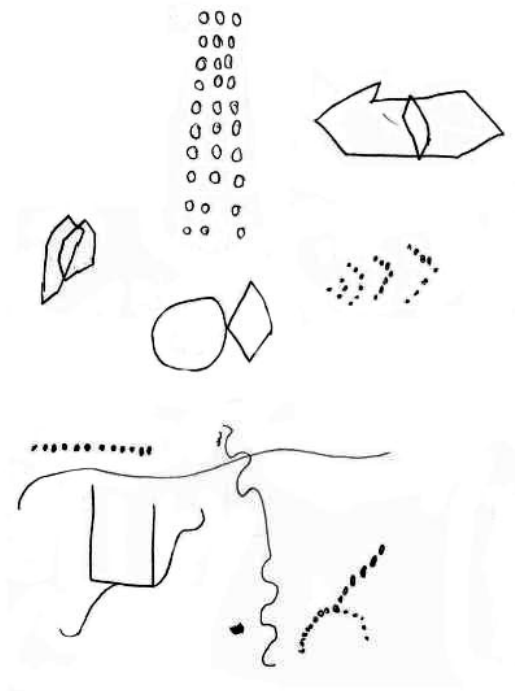


Fig. 3b. Copying Bender-Kopitz figures after three years of therapy. The therapist was sitting opposite to the boy and the figure reflects child's point of view. Rotations as well as random order of individual drawings can be noted here

DISCUSSION

The training presented here enables development of the ability to inhibit one's own reaction and to wait for the actions of another person. The developmental changes also led to the creation of a willingness to stop other reactions, such as crying, biting, etc. It may be concluded that the ability to inhibit one's own behavior is one of the conditions for developing the capability to reason that someone else is aiming at or wants something different from that which one wants oneself. It may therefore be assumed that executive functions are connected to the theory of mind (ToM), as far as understanding other persons' state of mind is concerned. Carlson and Moses (2001) confirmed a relationship between ToM and EF in their study. In another work Carlson and his coauthors found a relationship between the ability of children to adjust their behavior to a given situation and understanding the intentions of others (Carlson, Mandel, Williams, 2004). Baron-Cohen (2008) is of the opinion that the ability to understand the distinctness of others' intentions is a prerequisite for empathy, understood as the capability to see and feel the difference between one's own situation and that of another person.

A basic level of executive function requires the ability to work out new patterns of behavior and thinking, as well as a capability of being critical towards those patterns (Burgess, 2003). Accordingly, executive functions include a number of adaptation skills, such as abstract and creative thinking and introspection, as well as all those processes which enable a person to analyze her own needs, desires, dreams, and the ways to achieve them (Lezak, 1995).

A considerable improvement of cognitive skills was also noted in our studies. It was found that the increase of the scores attained at tasks measuring executive functions correlated with the results of central coherence (Markiewicz, 2007). The same occurred in Michael's case.

Despite the achievements described above, our study shows that in autistic persons the range of adaptive abilities involving the regulation of one's own behavior is rather narrow. Nevertheless, it is possible to teach an autistic person some adaptive behaviors, and to mold expectations relating to situations the child encounters.

Paçhalska (2007) proposes an approach using three stages of therapy aiming at the development of executive function:

Creating a schema of action. This includes setting a goal, planning a course of action and – depending upon the autistic child's possibilities – formulating the intentions of a given activity, as well as the expectations connected with it.

Realization of the schema of action. This includes initiation of behavior, putting particular actions in a proper sequence, prospective memory (recalling the intention and goal of a given action).

Adjustment of the schema of action. The following skills are trained here: inhibiting (eliminating) undesirable behaviors, concentrating upon the task, formulating opinions and assessing situations, making a decision (to continue or changed the schema of behavior), and finding a solution.

Lindsay and Norman (1977) argue that the most important preconditions for the mental regulation of behavior (self-control) are as follows:

- An internal model of the world, formed as an active cognition, including the past, present, and expectations about the future.
- An ability to determine whether or not everything is going as it should, including a comparison of achieved results to expectations.
- A system of correction of behavior in accordance with the current situation.

The approach described in the present paper puts emphasis on developing the ability to make the patient aware of the necessity for self-control of behavior. This, naturally, requires making an effort to acquire such control (see Vaughn, Kopp, Krakow, 1984; Kochanska, Murray, Harlan, 2000; Kochanska, Coy, Murray, 2001). Acquiring a schema of self-control leads to significant improvement in social functioning of an autistic child. We used very simple repetitive rules to enable the patients to master them. Naturally, the rules occurring in social settings are much more complicated, Yet in the case of autistic children simplification of the tasks given to them is a prerequisite for

their becoming self-reliant, at least to some degree. Hence the schemas used in therapy should correspond to the schemas they actually use. This is the only way to activate the mental regulation of behavior in autistic persons.

CONCLUSIONS

When analyzing the activity of autistic persons from the point of view of their ability to control their behavior, two opposing points of view can be taken: pessimistic (focusing on their limitations) or optimistic (pointing to their potential). The optimistic view provides an incentive to develop and further modify therapeutic programs. To look no farther, we may pity the blind that they are not able to see colors and recognize shapes, but we may also try to reduce the barriers between the world of seeing and blind people. A good example of such an optimistic and helpful approach is making use of Braille.

The process of acquiring knowledge of the world is the result of active synthesis and cognitive comparison, which leads to the development of the ability to predict the probability of certain events and circumstances transpiring. This is supported by the memory system, which also enables the comparison of what is actually occurring with what was expected in this situation. Each decision to react or not to a particular event is a kind of a plan or image of the situation, which undergoes changes due to our intended action. In most cases it is performed consciously, but it may undergo automation to a considerable or partial degree.

The above approach – with alternations due to Michael's limitations – was used in the case described in the present study. Considerable improvement in his social functioning was noted, though this does not mean that he has reached the level of a healthy child in terms of these skills. It should be borne in mind that the tasks used did not require plasticity and active reasoning. They had a repetitive character, and after the patient acquired them only small alternations were gradually introduced. In this way Michael acquired some social skills, but his behavior remained rigid and ritualized. Yet the results of therapy described here allow for the conclusion that it is possible to develop executive functions in autistic children, which at the same time leads to the considerable improvement of their social functioning.

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