

Therapeutic programs aimed at developing the theory of mind in patients with autism spectrum disorders – available methods and their effectiveness

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Summary

Autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by the presence of deficits in social skills and communication as well as repetitive patterns of behavior and interests. Among the theories explaining the mechanisms of the formation of the above cited symptoms, an important role is attributed to the theory of mind, or the ability to draw conclusions about the state of mind of other people, assigning mental states to others and interpreting their behaviors. According to guidelines of the National Institute for Health and Care Excellence on the therapeutic procedures in autism spectrum disorders, the proceedings include various methods, adjusted to the level of functioning and presented difficulties. In the most widely used behavioral social skills trainings, the goal is to practice behaviors using modeling and role-playing techniques. Less attention is devoted to the issue of social understanding, theory of mind or the cognitive aspects of therapeutic interventions. There are studies demonstrating the possibility of developing competence in the theory of mind in people with ASD, as well as generalizing the acquired skills. The article reviews the literature on the use of therapeutic programs aimed at developing the theory of mind in patients with ASD and their effectiveness. As it seems, these are promising interventions, although they require further assessment.

Key words: autism spectrum disorder, social skills training, theory of mind

Introduction

Autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by the presence of deficits in social skills, functional verbal and non-verbal communication, and patterns of behavior and interests [1–3]. It is believed that cognitive theories are the most holistic way to allow the understanding of mechanisms underlying the characteristic symptoms of ASD [3]. The leading significance of irregularities in the theory of mind (ToM), i.e., the inborn ability to draw conclusions about the

state of mind of other people, allowing us to draw conclusions about our own and others' mental states (beliefs, desires, emotions). It covers two processes: detecting and decoding social signals as well as inferring from them, including anticipating someone's behavior. Poor theory of mind implies difficulty or lack of ability to create mental representations, predict and understand emotions and other people's behavior [4], while good ToM has a fundamental influence on establishing satisfying relationships with other people. According to Baron Cohen, the mechanism of shaping the theory of mind is linked to internal and environmental factors. Many studies indicate that diverse, beneficial aspects of the environment can accelerate the development of the theory of mind. The most important being parental sensitivity and having siblings [4]. The process of shaping the theory of mind based on external stimuli consists in verifying and reinterpreting the original hypotheses under the influence of noticing elements that do not match the hypotheses. Noticing incompatibilities causes changes in thinking and final cognitive restructuring. A hypothesis incompatible with the observations and experiences is replaced by more adequate reasoning.

In recent years, among others thanks to the NICE guidelines (The National Institute for Health and Care Excellence) [1], there has been a significant increase of interest in evidence-based therapies for individuals with ASD. The proceedings in relation to the discussed group of patients include various methods, adjusted to the level of functioning as well as the areas of greatest difficulties. The most important interventions are focused on developing social skills. Classic interpersonal skills trainings, addressed to people with deficits in this area, were initiated in the 1960s by Bandura [5]. According to the assumptions, the training was supposed to be structured, performed in a small group and include elements of modeling, role-playing and feedback. Goldstein and McGinnis [6] refined classical intervention by developing training for structured learning of 50 social skills (including listening, conversation, apologizing, giving guidance, sharing, asking for permission, helping others, etc.). These trainings, as well as those most frequently used nowadays (e.g., the PEERS program [7]), do not focus on the cognitive aspect of learned competences. Similarly as in behavioral training, focused on emotional skills (e.g., recognition, expression and understanding of one's own feelings and feelings of others), despite learning the 'action steps' and 'thought steps', the cognitive process itself is not trained. The participant of the training is forced to think of the other person's feelings, paying attention to their tone of voice, posture, facial expressions and spoken content, but it is assumed that he/she has a basic theory of mind [6, 7].

The relationship between social skills and ToM is not thoroughly examined, although it is believed that theory of mind is crucial for understanding social rules [8]. Due to the fact that ToM is a cognitive ability, it is believed that cognitive programs may be more effective in the ToM development than behavioral programs [9]. Unfortunately, there are many indications that interventions developing ToM competences lead to improved results in formal tasks but have an insignificant effect on the social functioning *in vivo* of ASD individuals. Most likely, this is related to the fact that

therapeutic programs put a strong emphasis on the development of the theory of mind as such and not on its use in real-life social situations [10]. Moreover, the interventions are implemented within a limited time. There are also no studies assessing how people with ASD use ToM in social interactions [11]. The aim of the present article is to review literature concerning the possibility of using therapeutic programs aimed at developing the theory of mind in patients with autism spectrum disorders as well as the effectiveness of such programs.

Available methods and their effectiveness

The main purpose of the described trainings is to provide people with ASD with tools to understand the mental states of other people. This is supposed to improve the functioning of people with autism in social life and lead to a general increase in their quality of life. The presented research on teaching of the theory of mind, however, differs in the type of interventions. Some of the described interventions are based on the 6-level Mind Reading program, others combine social and cognitive trainings, the next programs are based on animations and refer to the hypersystematic theory of autism, the last ones describe methods using videomodeling and computer technologies.

Table 1. Therapeutic programs aimed at developing ToM in patients with ASD

Study	Reviewed program	Obtained results
Golan et al., 2007	Mind Reading program; 10 children with ASD, 8 sessions, 30 min. each	improvement in acquiring new skills, ability to solve new and cognitively similar tasks, effects lasting until the next examination (after 2 months)
Feng et al., 2008	social skills training and Teaching Mindreading program; case study	improvement in social interactions – more adequate social behaviors, new behaviors observed
Golan et al., 2006	Computer version of the Mind Reading program; 54 participants with ASD aged 17–50	improvement in the ability to recognize emotions based on facial expression and voice intonation, lack of skills generalization
LaCava et al., 2010	Computer version of the Mind Reading program with an assistant; 4 children with ASD aged 7–11	improvement in the ability to recognize emotions, the beneficial influence of an assistant, lack of skills generalization
Adibsereshki et al., 2015	emotion recognition training with direct feedback and correct answers modeling; 24 high- functioning children with ASD, aged 7–12	significant improvement in the area of social competences

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Begeer et al., 2011	social-cognitive training + educational sessions for parents; 40 high functioning children with ASD, aged 8–13	improvement in theory of mind tests, no changes in the field of social understanding in the assessment of parents
Hoddenbach et al., 2012	Mini ToM Intervention; 100 children with ASD aged 7–12; assessment from many informers after the intervention and after 6 months	low effectiveness of therapy
Golan et al., 2010	program using systematization in a series of animated films The Transporters; 20 children aged 4–7	significant improvement in the area of understanding and recognizing emotions
Young et al., 2012	animations and fairy tales The Transporters (13 children with ASD) and Thomas Discovers Emotions (12 children with ASD), children aged 4–8	increased social interest in children in the parents' assessment
Moore et al., 2005	videomodeling; 3 children with ASD	improvement in the perspective-taking ability, increased ability to remember information from presented tasks, generalizing new skills
Hopkins et al., 2011	FaceS program; virtual reality for teaching social competences; 49 children with ASD aged 6–10; assessment before and after training in natural environment	improvement in the area of emotional recognition and social interactions
Zhang et al., 2018	computer game in CVE system; 7 pairs of children with ASD and neurotypical children, and a control group of 7 pairs of neurotypical children	higher level of social cooperation
Russo-Ponsaranet al., 2016	modified version of the commercial MiX program; 12 participants with ASD aged 8–15 and 13 participants from the control group, assessment before the training and 4–6 weeks after the end of the training	improvement in the ability to recognize and imitate emotions skills, generalization (measured after 4–6 weeks, improvement of 40%)
Kandalaf et al., 2013	Social Cognition Training (VR-SCT) program; 8 participants with ASD aged 18–26, assessment before the training, 2 weeks and 6 months after the end of the training	improvement in communication skills in the assessment of the respondents, however, not confirmed by independent measurements

The *Mind Reading* training (or in the original version: *Teaching Mindreading*) is a comprehensive therapeutic program aimed at developing the theory of mind [12], based on the developmental perspective of the theory of mind according to which specific skills appear with child's age and development. The subsequent stages of development, i.e., joint attention, perspective taking, imaginative play, understanding emotions, lead to cognitive restructuring, which later makes understanding of false beliefs possible. The training refers to three levels of cognitive processes: visual perception, knowledge and beliefs, and includes six stages: simple visual perspective taking, complex visual perspective taking, understanding the principle "to see is to know", understanding of real beliefs, understanding of false beliefs, and understanding of second-order beliefs. Studies on the effectiveness of the program have been conducted for many years, and their results indicate improvement in terms of social understanding and the acquisition of skills to solve new, though similar in the cognitive aspect, tasks. However, the generalization of acquired skills for real-life social situations has not been demonstrated yet. Nevertheless, the authors claim that the ToM training is necessary for the better functioning of individuals with ASD.

The effectiveness of the program has been evaluated, among others, in the case study [13] where the social skills and ToM trainings were combined as part of the intervention (32 individual sessions and 29 small group sessions). The assessment of patient's social competence and observation of their behavior during lunch breaks were conducted by teachers before and after the training. The obtained results indicated a significant change in the quality of social interactions – social behaviors became more adequate as well as more new behaviors appeared.

In the study of Golan et al. [14], effects of the computerized version of the training were tested (recognition of emotions based on facial expressions and prosodic features, 412 emotions and mental states grouped into 24 categories and 6 developmental levels) in 54 people with high functioning autism or Asperger syndrome, and compared with a control group that did not received any intervention. It was shown that the subjects from the experimental group significantly improved their skills in recognizing emotions through facial expressions and voice intonation, but they did not seem to generalize these skills into real-life situations. In a later project, LaCava [15] used the same software to assess four boys with ASD aged 7–11 years. The aim of the project was to evaluate the effect regarding the ability to recognize emotions as well as social skills presented *in vivo*. An additional element of the intervention was the participation of an adult assistant during the session. Each participant used the software up to two hours a week for a period of 7–10 weeks. Similarly to previous studies, the training showed an increase in the ability to recognize emotions. Furthermore, researchers observed that using the software with an assisting adult improves the test results. However, the improvement was found to have an insignificant effect on social interactions of the subjects.

One of the latest programs aimed at developing the theory of mind is the Iranian program developed by Adibsereshki et al. [16]. Using this program, the authors evalu-

ated the development of the theory of mind in 24 high-functioning children with ASD aged 7–12 years. The program included 15 sessions held 3 times a week. The aim of the program was to teach how to recognize four groups of emotions: presented in pictures, caused by a situation, induced by desire, and induced by beliefs. During the study, the child named the presented emotion, and in the case of an incorrect answer, the researcher gave the child feedback and modeled the correct answer. It was checked whether training in the ToM area affected the quality of interaction with other children. The results were measured using a scale examining cooperation, assertiveness and self-control. In addition, children who completed the training were observed during interaction in the group. The results showed a significant difference between the experimental and the control group in the area of social competences. It was also recognized that the result of the training is permanent.

Some of the interventions focused on social competences and the development of ToM have their origin in studies conducted by Steerneman et al. [17], who developed a test assessing the ToM development and 16-week social-cognitive training. This training is divided into stages: 1. learning the ability to listen to others, making friends, developing visual and auditory perception, verbal and movement imitation; 2. learning how to distinguish fiction from reality, and the assessment of the situation; 3. learning to recognize emotions; 4. learning to assess a problem from different perspectives, developing the ability to recognize the thoughts and feelings of others. This program also has a Polish version [18]. One of the studies in which this type of training was used, was carried out by Beeger et al. [11] in a group of 40 high-functioning children with ASD aged 8–13 years. Five psychoeducational sessions for parents were added to the intervention. The obtained results indicated an improvement in tests assessing the theory of mind. According to parents, there were no changes in the understanding of social situations.

In turn, Hoddenbach et al. [19] developed a training, on the basis of the one created by Steernemann [17], consisting of eight ToM Teaching Session, which they called *Mini ToM Intervention* (understanding of the differences between people, reading intentions to predict the behavior of others, recognizing simple and complex emotions, taking the perspective of other people). The study involved 100 children with ASD aged 7–12 years, divided into three groups due to the level and quality of social contacts (a group of withdrawn, passive and inadequately active individuals). It was expected that children with inadequately active interaction style would benefit most from interventions focused on conceptual understanding, while interventions that strengthen the motivation for social interactions would be most suitable for passive or withdrawn children. It was also recognized that the occurrence of difficult behaviors prevents full use of interventions. Feedback used to evaluate the effect immediately after the intervention and after 6 months was obtained from a wide group of informants (assessed children, parents and teachers). The obtained results, however, indicated low effectiveness of the implemented measures.

Another type of training aimed at developing the theory of mind is a program that uses a mechanism of systematization (detection of information that is arranged

in repetitive and ordered patterns and sequences) adequate to the cognitive style of people with ASD [20]. The authors referred to the hypersystemizing theory according to which in ASD there is an imbalance between empathy, necessary to understand people, and systematizing, needed to classify objects, facts and concepts. A series of animated films *The Transformers* was created (the main characters of the animation were 8 vehicles with human faces and with specific facial expressions, moving according to specific rules). It was assumed that children with ASD will be more likely to pay attention to human faces and better recognize emotions if the training will use vehicles that are watched with great interest by them due to the predictable nature of movement. The 3D animation series was designed for children aged 3–8 years of age and consisted of 15 5-minute episodes, each of which referred to the selected emotion or mental state (happiness, sadness, anger, fear, disgust, surprise, excitement, fatigue, hostility, pride, jealousy, embarrassment, as well as being polite, funny and worried). In addition to the films, tasks consisting in matching photographs of faces to names of emotions and combining them with a specific situation in which a given emotion could appear were used in the training. In addition, parents and carers were instructed on how to talk with their children about the animation and pay attention to the faces of the characters–vehicles. The study was carried out for 4 weeks (watching min. 3 animations a day) in a group of children aged 4–7 years. It was shown [21] that the intervention significantly influenced the understanding and recognition of emotions in children with ASD.

In another study, Young et al. [22] compared the effect size of *The Transporters* animation and the series of cartoons *Thomas Discovers Emotions* (animations selected from the movie *Thomas The Tank Engine* most expressively presenting the emotions of the main characters and explaining social situations). The study participants watched at least 3 films every day for 3 weeks. In addition, parents discussed the social situations and emotions presented in the cartoons according to the received instructions. The results of the training, regardless of the presented animation (the series *The Transporters* or *Thomas Discovers Emotions*), showed an increase in social interest in children with ASD in the assessment of parents (assessment of: the focus on human faces expressing different emotions, the understanding of social problems and how to solve them, and communication skills). However, no assessment of the durability of the acquired competencies in the long-term was made.

A promising method for developing the theory of mind is videomodeling. Due to the message format being more similar to the real-life situations, it increases the chances of generalization of the learned skills [23]. In the study conducted by Moore et al. [24], video-modeling was used to train the ability to take on the perspective of others. Three children with ASD took part in the study, and the training consisted in displaying a video in which the actors were adults known to children. The actors behaved in a certain way and then explained their way of thinking, solving problems and selected strategies. In order to obtain generalization, the skills were trained based on numerous examples and in accordance with the principle of not going to the next

stages before the specified level is considered as achieved. Each subsequent stage of the exercise was completed with the task assessing generalization. The researchers noted that the training not only improved the ability to take perspective but also increased the ability to memorize information. Moreover, two of the trained children generalized new skills and were able to perform tasks that were not practiced.

Computer-assisted technology (CAT) and virtual reality (VR) create new opportunities to train ToM skills. They allow the construction of a structured, multimodal environment that allows directing real-life situations while the form of the message increases the motivation of the child to participate in the intervention. They also enable frequent and repeatable exposure, which is not possible in classic role-playing trainings, and at the same time the experience of new situations is performed in safe and controlled conditions. Research conducted in this area brought promising results [25], but unfortunately the size effect of the intervention was not assessed and their effectiveness was not compared with traditional methods.

For example, in the study conducted by Hopkins et al. [26] used the *FaceS* program, in which interactive computer games with the participation of realistic avatars were used to teach the competences of social skills. The participants had the opportunity to react to various social situations, recognize facial expressions, determine emotional states of other people, create a common focus. 49 children with ASD aged 6–10 took part in the study, training lasted 6 weeks and included 12 sessions. The program consisted of three games: *Amazing Gazing* (building a common focus and focusing on the direction of the other person's gaze), *Band Aid Clinic* (overall face processing and recognition) and *Follow the Leader* (recognizing facial expressions, especially subtle movements around the eyes). The assessment of social competences before and after the training was carried out in a natural environment (observation conducted by assistants during school breaks and interactions with peers). Children affected by the intervention showed improvement in facial recognition, emotion recognition and social interactions in the natural environment. The intervention was not compared with other therapy model, and the heterogeneity of the assessed group was also the limitation (highly diverse initial level of deficit severity and functioning of the examined children).

In turn, Zhang et al. [27] developed a computer game in which the participant had the task to establish various interactions with another participant of the game, communicate, ask questions and exchange information, as well as cooperate, adapt, coordinate their activities to achieve a common, intended goal and optimize the effect. The study involved 28 individuals (7 pairs of children with ASD and neurotypical children, and a control group of 7 pairs of typically developing children). The goal was to train the skills during real-life social interactions in dynamically changing situations. The conversations between the players were open, they were not based on a communication tree with a limited number of questions and answers. The results of the study showed a statistically significant, higher level of cooperation in children with ASD after the training.

In another study, Russo-Ponsaran et al. [28] used a modified version of the commercial *MiX* program (a micro-expression analysis tool designed to improve the recognition of emotions in typically developing adults). 12 people with ASD aged 8–15 and 13 people from the control group were examined. The training lasted eight weeks (45–60 min. 2 times a week). The ability to recognize emotions and imitate face expressions was practiced, with classes including instruction, exercises that mimic expression, revision exercises, and skills testing. The assessment of the effect (the ability to recognize and express emotions, self-presentation, change in social functioning in the natural environment) was performed immediately after the training and again after 4–6 weeks. Improvement in the ability to recognize emotions in the evaluation using the training tool and competence generalization were demonstrated (the effect was sustained over time – with an improvement of 40% after 4–6 weeks). There was also an improvement in imitation abilities of four emotions: anger, disgust, contempt, and surprise, but no changes were observed in the area of social behavior or the increase in vocabulary in the area of naming and describing emotions.

Interventions focused on social interactions and flexibility of thinking are also addressed to adults with ASD. One example is the *Social Cognition Training* (VR-SCT) [29], in which, in a virtual setting (office, flat, shops, school, restaurant, park etc.), participants train certain skills (recognizing emotions, reading social signals, initiating, maintaining and ending conversations, negotiating, building concise statements, interviewing, cooperation, relationships with a friend, dating, interaction with other people) using avatars looking similar to the participants and trainers. The pilot study included 8 people aged 18–26. Verbal and non-verbal communication skills and the theory of mind were evaluated before the start of the training, and re-evaluated 2 weeks and 6 months after the end of the intervention. However, the obtained results were ambiguous. People participating in the training claimed that their communication skills improved, which was not confirmed using independent measurements.

Recapitulation

People with autism spectrum disorders, due to the specificity of their symptoms are often given interventions aimed at developing social competences. In behavioral trainings of social skills, the goal is, above all, to practice a certain behavior using modeling and role-playing techniques. Much less attention is devoted to the issue of social understanding, the theory of mind, i.e., the cognitive aspects of therapeutic interventions. However, it seems that the deficits in the area of mentalization are the main reason of difficulties in the understanding of intentions and beliefs of other people and building relationships with them.

The studies cited above demonstrate that there are many opportunities to develop competence within the theory of mind in people with ASD, which in some cases may even result in some generalization of the taught skills. However, their weakness is the applied research methodology. In future research, it is necessary to

improve methodological standards by: (1) increasing the sample size; (2) dividing respondents into subgroups in accordance with the criterion of linguistic competence, cognitive functioning level and presence of co-occurring disorders; (3) comparing the effectiveness of various methods of the ToM development (e.g., computer-assisted technologies vs. traditional methods); (4) extending the duration of interventions due to the long process of social skills development; (5) developing tools to measure changes in ToM in the assessment of real-life social situations; (6) making additional measurements in the field of self-esteem and quality of life of people with ASD, which may be improved even when there is no clear effect in the area of social functioning; (7) developing methods to increase the motivation of people with ASD to implement new skills. An area that also requires further research is the development of such methods, the use of which would involve the generalization of skills learned during the training.

As it seems, ToM trainings are a promising method, but they require further research. In addition to tangible therapeutic benefits, they constitute a significant contribution to the understanding of problems in autism spectrum disorders and the mechanisms responsible for the presence of symptoms. It is very important to strive to create therapeutic programs whose effectiveness is based on reliable evidence.

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