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THEORY OF MIND OF THE PERSONS WITH VISUAL IMPAIRMENTS: THEORETICAL EXPLANATIONS AND ASSESSMENT PROCEDURES[2]

Theory of mind, as an ability to understand internal states of ourselves and others, was thoroughly assessed in children with autism. Bearing in mind that many blind children manifest autistic-like behavior, scientists made an effort to determine critical stages in theory of mind development of the children with visual impairments.

It was revealed that children with congenital blindness do not achieve high scores on theory of mind tasks before the age of 11. However, innovative assessment procedures, primarily based on tactual or auditory stimuli, indicated that observed delay was not so significant. It is comparable to global delay in other developmental areas.

In addition, it was not until recently that neuroimaging studies determined same cerebral regions that support theory of mind abilities in both, blind and sighted individuals. These findings should be used for creation of specific programs, directed to improvement of theory of mind abilities of blind children, similar to those already established in students with autism spectrum disorders.

Key words: *blindness, autism, false belief*

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INTRODUCTION

Theory of mind (TOM) is an ability to understand, i.e. attribute mental states, such as emotions, desires, beliefs and intentions, to ourselves and to others (Charman, Campbell, Edwards, 1998). This term was first used in the work of two primatologists from the University of Pennsylvania, who tested the abilities of chimpanzees to attribute different mental states to themselves and others (Premack and Woodruff, 1978). Their only incidentally mentioned observations, that it should be necessary to test the natural development of TOM in typically developing children, as well as the possible deficits of TOM in children with intellectual disabilities, initiated numerous research projects in the last decades of the 20th century. Some of this research was related to children with developmental disabilities.

The objective of this article is to present contemporary knowledge on TOM development in persons with visual impairments, as well as innovative techniques for the assessment of the TOM specifically designed for blind children.

DELAYED THEORY OF MIND: SEARCHING FOR THE FRAME OF REFERENCE

TOM was primarily tested in children with autism spectrum disorders. It is well known that many blind children display certain types of autistic-like behavior, such as stereotype and repetitive movements, echolalia and inverse use of personal pronouns (Fraiberg, 1977). Therefore, it is not surprising that exactly Baron-Cohen, one of the foremost authorities in the field of autism research, indicated the possibility of delayed appearance of TOM in blind children (Baron-Cohen, 1995).

Baron-Cohen starts from the assumption that delayed appearance of *joint attention* is the main reason for further delay in the development of TOM in visually impaired children. Joint attention indicates that a child understands that another person has a certain experience with the object of the child's attention. It develops gradually and in sighted

children it appears by the end of the first year of life (Adamson, 1995). In accordance to Baron-Cohen (1995), joint attention derives from the Shared Attention Mechanism, which in sighted children develops primarily on the basis of visual information. In blind children, however, this mechanism can also develop by using other stimulus modalities (primarily audio and tactile-kinesthetic).

Through longitudinal studying of two male babies with congenital blindness, Bigelow (Bigelow, 2003) registered joint attention behavior at the age between 13 and 21 months, i.e. in the period between 23rd and 30th month. Although the follow-up study included only two children, we find the results of this research very significant, since they offer empirical evidence that blind children develop joint attention with a significant delay in comparison with sighted children.

Hobson (1993, 1994) argues that the most important factor in the development of the TOM is child's participation in *affective interactions*. In accordance to Trevarthen (1993), fundamental carriers of information on changes in emotional and motivational state of the partner in communication include "fine and rapid glides and leaps of pitch or volume of voice, eyebrow flashes, pre-beat syllables, suffix morphemes, rhythmic details and embellishments, rapid hand gestures, quick head moves, shifts of gaze", which accompany each spontaneous, casual conversation. A part of this information is received through eyesight. Neither blind nor sighted children could see internal states of others, but sighted children could observe external consequences of internal states such as facial expression or body movements. In order to explain these behaviors sighted children may formulate a causal model of the internal states that drive human actions (Baron-Cohen, 2006). On the other hand, blind persons are, to a high extent, forced to rely on the quality and intensity of voice of other people when assessing their emotions, intentions and desires, and they often lack key information about the psychological state of the other person.

Meltzoff and Gopnik (1993) think that imitation is the most important in the development of TOM, which implies that visually perceived movements are represented in one's own movements. Research shows that imitation of facial expressions initiates mechanisms of autonomous changes and a subjective feeling that

is analogue to the feeling and mental state of the imitated person (Ekman, 1990, 1993). Additionally, when a person observes facial expressions of another person, the observer's brain is implicitly adjusting motor elements of the observed person's facial expressions (Dimberg et al, 2000). Motor activity becomes implicitly connected in the observer with autonomous changes, somatic sensations and subjective experience of emotion, which are all connected to facial expressions. In this way, when one person sees emotional expressions of another person, the observer creates, as his/her own inner state, somatic processes of the other person and emotional experience of what the other person is experiencing. This aspect of imitation, important for identification of mental states of others, is completely inaccessible to blind persons.

There are also other factors of challenged affective communication of parents with a visually impaired child. One of the most important aspects of competent parenthood and a predictor of early social and emotional development is parents' sensitivity to signals of the baby, their correct interpretation, timely and adequate reaction (Sroufe, Egeland, Carlson & Collins, 2005). Parents of a visually impaired baby have more difficulties in identifying what their baby needs. They must motivate themselves to make an extra effort when monitoring and stimulating the baby. For this reason, the acceptance of child's disability is a precondition for a sensitive and affectively stimulating parent-child interaction. Research shows that, for the acceptance of parent's role, it is of special importance to overcome the trauma caused by the birth of a disabled child and to cope with negative emotional reactions to the child's disability such as disappointment, anger, guilt and other complex reactions (Howe, 2006).

TRADITIONAL ASSESSMENT PROCEDURES

Relatively rare studies of TOM in visually impaired children have primarily been limited to the assessment of the first and second order TOM, by applying false belief tasks, such as unexpected dislocation and unexpected contents tasks.

The most famous Sally-Anne task is to check whether a child understands beliefs of the protagonist of a story in which one person places an object on location A, and this object is, in absence of that person, moved to location B. The child should recognize that the protagonist of the story still **believes** that the object is on location A, although this is **contrary to the knowledge** of the child (the child knows from the story that the object was moved to a different location). The story usually has the following content:

I will tell you a story about two girlfriends. The story is very short. Pay attention. Their names are Sally and Anne. Imagine this situation in which the two of them found themselves. Sally has a bag next to her, and Anne has a box. Sally puts her ball into the bag, and Anne watches this. After this, Sally leaves the room. Anne takes the ball from the bag and moves it into the box. Sally returns. What do you think, where will Sally look for her ball?

If the participant answers that Sally will look for the ball in the box, the answer is considered unsuccessful, and the answer "in the bag" would be considered successful. A successful answer carries one point.

The second task of the first order TOM is the task of "unexpected content", created as a modification of the so-called Smarties test.

A child is shown a matchbox and then asked what is inside. When the participant answers that the box contains matches, we ask him/her to take the matches out and put coins in their place. Then we ask the question: "When your teacher (we say teacher's name) enters the room and sees this box, what will she think, what is inside the box"?

Children should have an active role in the task (they could replace matches with coins). If the participant answers that his/her teacher will think that there is money in the box, the answer is considered unsuccessful. If the child answers – matches, the answer is considered successful and it carries one point. If the child successfully solves both tasks, it is concluded that he/she has the first order TOM.

For the purpose of **assessing the second order TOM,** the participants solve the false belief task, which is presented to the children in the following way:

Sally has a bag next to her, and Anne has a box. Sally puts her ball into the bag, and Anne watches this. After this, Sally leaves the room, and

Anne takes the ball from the bag and moves it into her box. However Sally is behind the door, watching through the keyhole and sees that Anne has moved the ball, and then she enters the room. What does Anne think, where will Sally look for the ball?"

In order to solve this problem, the participant must be able to represent not only the belief about the location of the object, but also Anne's false belief about Sally's belief (Stone, Baron-Cohen and Knight, 1998). If the participant answers "Anne thinks that Sally will look for the ball in the box", such answer is considered unsuccessful, whereas the answer "Anne thinks that Sally will look for the ball in the bag" is considered successful and it carries one point.

Minter, Hobson and Bishop (1998) assessed the first order TOM in 21 blind children, as well as in sighted children matched by chronological and verbal mental age. All children were above four years of mental age. Children were presented with two first order TOM tasks (visually analogue to unexpected content tasks), as well as the unexpected dislocation task (Wimer & Perner, 1983). Within the unexpected relocation task, a child was presented with three boxes with different textures, and then a pencil was placed in one of these boxes. After one of the researchers has left the room, the child was involved in the game aimed at "fooling" the absent researcher. Namely, the researcher and the child moved the pencil in a different box, and then the child was asked in which box the researcher will look for the pencil when he returns. This unexpected relocation task was solved by as many as 80% of blind children.

The second task of misleading appearance type was much more difficult. Within this task, the children were given a warm teapot, after which they were asked what was inside. When they answered that there is tea inside, they were able to find out that teapots were actually filled with sand. Then they were asked what the other child would think there is inside the teapot. This task was solved by only 47% of visually impaired participants. All participants in the control group solved both tasks successfully.

Numerous explanations of differences in the achievements of blind children in different tasks have been offered. Some authors think that in the teapot task the blind child manipulated the object for which it believed that contains hot tea, and, therefore, could be dangerous.

Therefore, the children concentrated on the object itself and for this reason they made errors in making conclusions. Additionally, in the pencil relocation task, children actively participated in the deception and that in the one that was the most obvious, which increased their ability to make conclusions (Green et al., 2004). Peterson et al. (2000) differently explain the findings of Minter and associates. First, the misleading appearance, such as the one with the teapot, implies more sophisticated skills of taking a visual perspective, than was the case in the object relocation task, and here the blind children were in less favorable position. The second possibility is that the teapot did not deceive the children because there was no tea aroma, and therefore the false belief ability was not assessed.

In the research of Peterson and associates for the testing of the first order TOM, a modified teapot was used (without warm liquid), the unexpected relocation task with pencils, as well as the famous Sally-Anne task. The results indicate that the success of blind children in this research did not depend on the type of the task. It turned out, however, that children with higher verbal mental age and higher verbal IQ achieved the best results.

Still, the lagging of blind children in the development of TOM cannot be fully attributed to possible global cognitive lagging. The research of Green and associates (Green et al., 2004) analyzed the first order TOM in blind and seeing children, whereby these two groups of participants had equal verbal abilities. Blind children still have significantly lower results on false belief tasks than sighted children.

Delay in the development of TOM can rather be attributed to pragmatic than to semantic-syntactic deficits. It can be discerned from the fact that topics of conversations between a blind child and an adult are typically limited to the child's immediate environment and which is mostly centered on the child. In sighted children, taking of a perspective is based on explicit knowledge on what other people see and perceive. It is difficult for blind children to determine what others see (Andersen, Dunlea, & Kekelis, 1984; Bigelow, 1988; Dunlea, 1984; Farrenkopf & Davidson, 1992). Many blind children think that sighted people can see only what they can touch. Only social interactions with peers, especially conversations about mental states of others, will

contribute to the development of pragmatic elements of speech, and therefore development of TOM.

False belief understanding in blind children is developed only after the age of 11 (McAlpine et al., 1995). Similar results were obtained in an investigation of TOM development in blind children and children with low vision comparing to control group. Research results indicate that at the age of 7-8, blind children have the lowest results on all tested levels of TOM. Unlike blind children, children with low vision at this age show results equal to those of children without visual impairment, but only with respect to the first and second order TOM. On tasks testing the advanced TOM, children with low vision are, at the youngest age, equally unsuccessful as blind children. At the age of 9-10, children with low vision do not achieve progress on the first and second order tasks, but they reach the level of their peers without visual impairment on faux pas tasks. Unlike children with low vision, blind children at the age of 9-10 have much better results than children at a younger age, both on the first and second order tasks, and faux pas tasks. In the highest tested age group (age 11-12), no significant differences were established between blind children, children with low vision and children without visual impairment with respect to TOM (Jablan, Hanak, Glumbić, 2011).

Despite different developmental expiriences, congenitally blind adults eventually develop effective TOM including an understanding of other people's experience of sight (Landau, Gleitman, 1985). Although visual impairment has a strong impact on a trajectory of TOM development, absence of visual experience does not alter the neural development of TOM. In sighted individuals TOM is supported by bilateral temporoparietal junction, medial prefrontal cortex, precuneus and anterior temporal sulci. Neuroimaging analyses revealed that the brain regions, activated in the course of solving TOM tasks, were basically the same for both, sighted and blind participants (Bedny et al., 2009).

The results of a recently published study are in accordance to these findings, which identify the left middle temporal gyrus as a brain region that stores visual-motion features relevant to action verbs. The functional profile of this region is identical in sighted and congenitally blind individuals (Bedny et al., 2011).

INNOVATIVE ASSESSMENT PROCEDURES

Meta-analysis, done by Wellman and Liu (2004) shows that sighted children could solve simple false belief tasks by the age of 4-5. Research projects on children with congenital blindness repeatedly indicate a developmental delay of 4 to 7 years in these children.

Brambring and Asbrock (2010) argued that these findings may come from the fact that standard false belief tasks disadvantage blind children, since the presented materials and expected actions have been based rather on visual experience, than tactile or auditory one. They illustrated their assumption with Minter's tea pot task, already mentioned in this article. Blind children do recognize the tea pot itself and they expect that it usually contains some kind of fluid. However, these authors pointed out that this kind of knowledge is not based on their own tactile experience. It rather comes from what other people have told them. When confronted with sand as an unexpected content they may think that nobody has ever told them that tea pot might contain sand.

That is why these authors have created new TOM tasks, with objects and actions more familiar to blind children. In these tasks vision plays none or just a subordinate role in the solution, because the tasks were tactile or auditory. In addition to primarily visually based (or visually and tactually based) false belief tasks, these authors introduced in their research primarily auditory based and primarily tactually based false belief tasks.

The example of the auditory based task of unexpected outcome is as follows: a child was asked to successively press a series of push buttons on a set of ascending steps. When he or she pressed the first button dog barking was emitted. Pressing the second push button was followed by cock crowing. Dog barking was emitted again after pressing of the third button. A child was asked to predict what auditory event would come after the third and all other buttons. Unexpected outcome was baby crying, emitted as soon as one presses the sixth push button.

Primarily tactually based false belief tasks involved various sensory impressions such as changes in temperature, surface or

weight. A child was manipulating with a long box with a series of separate compartments, with lids on each one. He or she was asked to uncover each compartment in the succession. One of the tasks of this type was light can, followed by heavy can and candy as unexpected content. All these tasks were also performed by sighted children who were blindfolded.

The obtained results indicate delay of 19 months in TOM acquisition, which is comparable with delays in other developmental areas.

CONCLUSION

Autistic-like behaviors in congenitally blind children, such as delayed acquisition of TOM, in most cases do not represent underlying pathological processes. Blind children could not rely on visual cues in developing early antecedents of TOM. Hence, they pass through the same stages of the development of TOM as sighted children do, but with significant delay. Innovative procedures for the evaluation of TOM abilities in blind children revealed that the aforementioned delay is not so high and it is comparable to delays in other developmental domains.

Capability of understanding internal mental states is a necessary prerequisite for enhancement of blind children pragmatic abilities. That is why special education teachers and psychologists should master all innovative techniques for the assessment of this important ability. One should also consider implementation of specific curricular contents directed to stimulation of theory of mind development in children and adolescents with visual impairments.

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TEORIJA UMA KOD OSOBA SA OŠTEĆENJEM VIDA: TEORIJSKA OBJAŠNJENJA I NAČINI PROCENE

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Rezime

Teorija uma, kao sposobnost razumevanja unutrašnjeg stanja nas samih i drugih, je detaljno procenjena kod dece sa autizmom. Imajući u vidu da se kod mnoge slepe dece manifestuje ponašanje slično autističnom, naučnici su se potrudili da utvrde ključne faze u razvoju teorije uma kod dece sa oštećenjem vida.

Ustanovljeno je da kongenitalno slepa deca sa ne postižu dobre rezultate na zadacima teorije uma pre jedanaeste godine. Međutim, inovativni načini procene, pre svega oni koji se baziraju na taktilnim i auditivnim stimulansima, su pokazali da ustanovljeno kašnjenje nema veliku važnost. Ono se može uporediti sa opštim kašnjenjem u drugim razvojnim oblastima. Pored toga, tek od skora su neuroimidžing studije utvrdile da isti cerebralni regioni podržavaju sposobnosti teorije uma, kako kod slepih, tako i kod osoba koje vide. Ove rezultate bi trebalo iskoristiti za stvaranje posebnih programa usmerenih ka poboljšanju sposobnosti teorije uma kod slepe dece, slične onima koji su već ustanovljeni za ispitanike sa poremećajima autističkog spektra.

Ključne reči: kongenitalno slepa deca, autizam, lažno verovanje

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