



Effectiveness of Cognitive Training on Children with Autism Spectrum in Improving their Performance at Theory of Mind levels (Emotion Recognition and Pretension, Primary Myth Recognition, Secondary Myth Recognition or Joke Understanding)

Sayede Zaynab Mirtalebipour^{1*}, Tayebeh Ferdowsi², Hamidreza Pouretamad³ and Maryam Sadeghi Afrakati¹

¹Department of Psychology, Tonekabon Branch, Islamic Azad University, Tonekabon, IRAN

²University of Tehran, Tehran, IRAN

³Shahid Beheshti University, Tehran, IRAN

Available online at: www.isca.in, www.isca.me

Received 4th December 2013, revised 24th February 2014, accepted 6th June 2014

Abstract

Purpose of the study is determining effectiveness of cognitive training on children with autism in improving their performance at theory of mind level. It was an experimental research with pre-test-posttest with one control group. 10 male students with high-functioning autism in 8-12 age range were selected using multi-stage cluster sampling. Research tool included 38-item test of theory of mind by Steerneman. Following being matched based on chronological age and theory of mind scores, subjects were assigned into two groups: test group (5 students) and control group (5 students). Theory of mind was trained within 16 sessions to the students in the test group, while control group received no training in this regard and they participated only in ordinary school programs. Posttest was run for both groups. Data obtained from pretest and posttest was examined using MANCOVA analysis. Results indicated cognitive training has a significant impact on promotion of theory of mind levels ($P < 0.05$). Cognitive training can be effective in promoting theory of mind levels of the 8-12 years old male students with high-functioning autism.

Keywords: Cognitive training, mental levels, autism disorder, theory of mind, students.

Introduction

Cognitive development is development of the skills used in infants and children for understanding and interaction with their surrounding world¹. Nowadays the authors show attention an important aspect of cognitive development, that is, social cognition. Social cognition is considered as encompassing all skills needed by the child so that he is able to understand tendencies, emotions and feelings of other children and adults². Recently some studies have dealt with investigation of constructs of the social cognition including person perception, role-taking skills, and theory of mind³. The latter, theory of mind, is one of the controversial concepts in developmental psychology⁴. Theory of mind was proposed in 1978 by Peremack and Woodruff⁵. Theory of mind is ability for understanding thoughts and feelings of others based on perception of mental states⁶.

Mental states are propositional attitudes which include: desires, emotions, beliefs, intentions, etc.⁷. Most experimental evidence suggests children can perceive others' emotions, beliefs, and tendencies within 3-4 years old⁸. Emotions is defined as a complex set of states beyond good or bad states which include feelings of happiness, sadness, anger, aggression, etc.⁹. Children perception of emotions is often classified as desires and beliefs¹⁰. In fact, desires and beliefs are main elements of the

emotions. Desires which specify one's goals include wanted outcomes and states and distancing from negative outcomes and states¹¹. According to Wellman, concept of desire is acquired in the age 2 and Flavell argues that in the age 3, children are ready to perceive simple causal relationship between desires, outcomes, emotions and actions. Belief is something based on which we predict what one considers as a correct state of the world. It reflects the way the world is or at least we want to be, thus if we know our belief is wrong, we would try to change it according to the truth of external objects. Generally it is accepted that the child for acquiring the concept of belief should perceives what others believe might be incorrect¹². Thus, the ability for predicting and explaining behavior of others requires theory of mind. Theory of mind acts like an umbrella which covers children perception of others' mental states¹³. Flavell, Miller and Miller-Miller advocating developmental perspective on theory of mind, maintain that theory of mind includes three levels: first level, which is formation of preliminary theory of mind, second level in which real theory of mind, but primary one, is formed, and third level, which includes more advanced aspects of theory of mind such as joke perception and complex judgments.

The authors have reported deficiency of theory of mind in the children with autism^{14,15}, deaf children¹⁶, children with Intellectual disability and Syndrome down¹⁷. Also many studies

have been conducted on investigating effect of training theory of mind to this group of children.

Different studies show children with autism suffer from deficiency in the theory of mind and it is all level of the theory of mind. All findings are consistent with the fact that these children have evident deficiency in their social functions and interactions. It means they are not able to perceive mental states of their and their intention in the social interactions. Outcome of such deficiency may lead to development of an inefficient communication pattern in interpersonal relationships and since one fails to perceive mental states of others as well as their experienced feelings, they are impaired in such constructs and empathy and perspective taking in social interactions¹⁸.

Some studies have shown trained children have significantly better performance in the posttest and follow-up test of theory of mind compared to the control group. Works by Appleton, Reddy, Fisher, and Happe¹⁹ are examples of this case.

In one of the initial works on theory of mind training, Gopink and quoted in Kloo and Perner²⁰ showed training belief, perceptions and desire led to improved performance of theory of mind in autistic children. They trained concept of belief to one group of children with autism (belief training) and the second group received training on the prediction and tendency concepts (cohesion training). The training went on for two weeks. Performance of the children in test group was improved in posttest in comparison with the control group.

In Iran, Ansari-Nejad¹¹ investigated effectiveness of training theory of mind to 8-12 years old educable retarded children. Subjects were trained (on emotions, belief, and desire) for 8 sessions. After completion of the training course, total mean score of the theory of mind in the children increased by 10.4 scores from pre-test to posttest.

Acquiring skills related to the theory of mind is an important area in daily communication and social interactions of the children and learning tasks of this area helps them for having a successful life. Autistic children are unable to perceive that fact that mind of others has different thoughts and behavior of the people is determined by these mental states¹⁸.

Accordingly, the efficient and early education is likely an important step in strengthening the cognitive capacity of children with autism, and it seems following this development, some social and emotional areas will be improved too²¹.

General aim of the current work is investigating effectiveness of cognitive training on promotion of theory of mind levels in autistic children so that the major challenge, that is, finding a practical and implementable method for improving levels of theory of mind for this group of children, can be overcome. Research questions include as follows:

Major question: Is cognitive training program effective in improved performance of children high-functioning autism regarding theory of mind levels?

Research Questions Does cognitive training program increase the ability to recognize emotions and pretention (first-level in theory of mind) in children with high-functioning autism?, Does cognitive training program increase the ability to recognize primary myth (second-level in theory of mind) in children with high-functioning autism?, Does cognitive training program increase the ability to recognize secondary myth (third-level in theory of mind) in children with high-functioning autism?

Society, Sample and Sampling Method: Current work was of experimental research type with the pre-test - post-test and control group.

Statistical society included all children with high-functioning autism aged 8-12 who were studying in exceptional schools (specific schools for autistic children) in Tehran during 2012-2013.

Sample was selected by multi-stage cluster sampling method. In the first stage, after referring to Special Education Organization, Tehran city was divided into 5 regions: south, north, west, east and center. Then, one region (Region 2) was selected randomly where Aeen Mehrvarzi School was selected randomly. Finally, a sample in 10 sizes was selected from this school based on the research inclusion criteria. Following implementing and recording theory of mind tests, subjects were matched in terms of chronological age and theory of mind scores (scores below 19) and 5 children were assigned randomly in the test group and 5 children were assigned in the control group.

Research Tool: Data related to theory of mind were collected using 38-item test of theory of mind⁶.

38-item test of theory of mind: Major form of this test by Steerneman was designed for measuring theory of mind in normal children and children with pervasive developmental disorders aged 5-12, and provides information on social perception, child sensitivity and insight as well as the degree by which he is able to accept feelings and thoughts of others.

Ghamarani et al.²² modified this test. They reduced test items to 38 from 72 and used Persian terms instead of the foreign terms. Then they run it on a group of educable mentally retarded students and normal students in Shiraz and measured its validity and reliability.

Similarly, Mansouri et al.¹⁸ measured short form of the test on autistic children through concurrent validity and assessment of the correlation between the subscale scores.

For the short form of the test, such methods as content validity, concurrent validity and correlation of the total and subscale

scores have been used. Concurrent validity is estimated as 0.89 through correlation test with dolls homework which is significant at 0.01 level. Correlation coefficient of subscales with total score of tests was significant in all cases varying between 0.82 and 0.96. Reliability of the test was measured using three methods including retest, Cronbach's alpha, and reliability coefficient passing score. Retest reliability varied between 0.70 and 0.94 and all coefficients were significant at $\alpha = 0.01$. Internal consistency of the test was calculated using Cronbach's alpha for the total test and each of the subscales as 0.86, 0.80 and 0.81. The final factor passing score 98/0 is obtained. The final factor of the passing score was calculated as 0.98²².

This test was designed based on a developmental and multidimensional perspective of the theory of mind and evaluates wider age range and more complex levels of the theory of mind. This test with three subscales is as follows: Subscale 1: Preliminary theory of mind, that is, first-level theory of mind or recognition of emotions and pretention including 20 items. Subscale 2: Primary true theory of mind, that is, second-level theory of mind or recognition of primary myth including 13 items. Subscale 3: more advanced aspects of theory of mind, that is, third-level theory of mind or recognition of secondary myth or joke perception including 5 items.

A total score is obtained for theory of mind from sum of three subscales. The higher is this score, it suggest the child obtains higher levels of theory of mind.

This test is conducted individually and is consisted of images and stories. First, tester provides them to the subject and then proposes the questions. This test is composed of 9 individual examples. Each example has some questions, before which the level of theory of mind (first, second, third) is specified.

Methodology

First, theory of mind test was run and all students with the scores lower than mean score (19) were identified.

Following matching students in terms of chronological age and theory of mind scores, they were classified into two groups randomly. The control group received to intervention and just participated in the usual school program, while the test group was daily trained for 1.5 month within 18 sessions in alternative days each for 20 min. following completion of the course, posttest was run for both groups. Training program was offered based on visual stories and role playing.

Results and Discussion

Statistical Method: Research questions were investigated in terms of data distribution normality, homogeneity of variance and covariance and M Box test results and then, data were analyzed based on MANCOVA covariance analysis method.

Findings: Findings related to the mean and SD obtained from 10 subjects is as in tables-1 and 2.

As observed in table-1, total mean of the theory of mind and its levels in the test group subjects before training is 13, 10.60, 2.60, 0.400, respectively and it increased to 29.40, 18.20, 7.20, 3.80, after training in the posttest. However, no significant increase is observed in the mean for control group.

Above table shows results for 4 multivariate tests for significance of the independent variable effect, that is, group agent, in the model. The F obtained for 4 tests suggest difference of both groups in autistic children performance variable in pre-test and posttest levels is significant at error level 0.05.

Table-1
Results for descriptive statistics in test and control groups

Position	Levels of theory of mind	Test		Control	
		Mean	SD	Mean	SD
Pre-test	overall level	13	2.34	13	2.23
	first level	10.60	2.19	8.80	1.64
	second level	2.60	1.67	2.40	1.14
	third level	0.400	0.54	1.80	0.83
Posttest	overall level	29.40	3.6	12.60	2.07
	first level	18.20	1.64	8.40	1.51
	second level	7.20	1.64	2.40	1.14
	third level	3.80	0.83	1.80	0.83

Table-2
Multivariate tests for determination of the significance of independent variable of overall levels of theory of mind

Test type	Value	F	df hypothesis	Distribution error	Sig	Eta
Pillay effect	0.947	62.491	2	7	0.001	0.947
Wilks lambda	0.053	62.491	2	7	0.001	0.947
Hotelling effect	17.855	62.491	2	7	0.001	0.947
Largest root	17.855	62.491	2	7	0.001	0.947

Table-3 indicates difference in the mean of both groups in the children's performance is significant at error level 0.05. In other words, autistic children performance in the test group is better than control group, thus it can be stated cognitive training is effective in improving autistic children performance in theory of mind levels.

Table-4 indicates difference in the mean of both groups in the ability for recognition of emotions is significant at error level 0.05. In other words, the ability for recognition of emotions in the autistic children in the test group is better than control

group, thus it can be stated cognitive training is effective in improving the ability for recognition of emotions and pretention (first-level theory of mind) in the autistic children.

Table-5 indicates difference in the mean of both groups in primary myth recognition is significant at error level below 0.05. In other words, the ability for primary myth recognition in the autistic children in the test group is better than control group, thus it can be stated cognitive training is effective in improving the ability for primary myth recognition (second-level theory of mind) in the autistic children.

Table-3
Covariance analysis (MANCOVA) for overall levels of theory of mind

Source of change	Dependent variable	SS	df	MS	F	Sig.	Eta coefficient
Between-group	Children's performance (pre-test)	0.001	1	0.001	0.001	1	0.001
	Children's performance (posttest)	705.60	1	705.600	90.462	0.001	0.919
Within group	Children's performance (pre-test)	42	8	5.250			
	Children's performance (posttest)	62.400	8	7.800			
Total	Children's performance (pre-test)	42.001	9				
	Children's performance (posttest)	768	9				

Table-4
Covariance analysis (MANCOVA) for recognition of emotions (first-level theory of mind)

Source of change	Dependent variable	SS	df	MS	F	Sig.	Eta coefficient
Between-group	recognition of emotions (pre-test)	8.100	1	8.100	2.160	0.180	0.213
	recognition of emotions (posttest)	240.100	1	240.100	96.040	0.000	0.923
Within group	recognition of emotions (pre-test)	30	8	3.750			
	recognition of emotions (posttest)	20	8	2.500			
Total	recognition of emotions (pre-test)	38.100	9				
	recognition of emotions (posttest)	260.100	9				

Table-5
Covariance analysis (MANCOVA) for primary myth recognition (second-level theory of mind)

Source of change	Dependent variable	SS	df	MS	F	Sig.	Eta coefficient
Between-group	primary myth recognition (pre-test)	0.100	1	0.100	0.049	0.831	0.006
	primary myth recognition (posttest)	57.600	1	57.600	28.800	0.001	0.783
Within group	primary myth recognition (pre-test)	16.400	8	2.050			
	primary myth recognition (posttest)	16	8	2			
Total	primary myth recognition (pre-test)	16.500	9				
	primary myth recognition (posttest)	73.600	9				

Table-6
Covariance analysis (MANCOVA) for secondary myth recognition (third-level theory of mind)

Source of change	Dependent variable	SS	df	MS	F	Sig.	Eta coefficient
Between-group	Secondary myth recognition (pre-test)	4.900	1	4.900	9.800	0.014	0.551
	Secondary myth recognition (posttest)	10	1	10	14.286	0.005	0.641
Within group	Secondary myth recognition (pre-test)	4	8	0.500			
	Secondary myth recognition (posttest)	5.600	8	0.700			
Total	Secondary myth recognition (pre-test)	8.900	9				
	Secondary myth recognition (posttest)	15.600	9				

Table-6 indicates difference in the mean of both groups in secondary myth recognition is significant at error level below 0.05. In other words, the ability for secondary myth recognition in the autistic children in the test group is better than control group, thus it can be stated cognitive training is effective in improving the ability for secondary myth recognition (third-level theory of mind) in the autistic children.

Discussion: Considering obtained results it is clear training theory of mind increases level of theory of mind, ability for recognition of emotions and pretention (first-level theory of mind), primary myth recognition (second-level theory of mind), and secondary myth recognition (third-level theory of mind) in the children with high-functioning autism.

Findings of the current work are consistent with findings by Begeer and Gevers¹ entitled as theory of mind in autistic children indicating increase in skills of the theory of mind, perceptual skills, subjective level and task of understanding emotions in these children. Similarly, Feng et al.²³ trained an 11-year old autistic girl on the theory of mind and found the subject had increase in scores at three levels of theory of mind and its overall level. In Iran, Ansari-Nejad¹¹ investigated effectiveness of training theory of mind in 8-12 years old educable retarded children and found training has significant effect on all levels of theory of mind which is consistent with findings in the current work.

Results obtained in the previous works suggest that questions alone do not suffice the development of theory of mind²⁴, but the experience can contribute to the development of theory of mind. Previous works showed parental talks with the children on mental states is positively related to the development of the children's theory of mind (primary myth recognition)¹¹. In addition, relationship between paternal nurturing style with the number of siblings have been specified¹¹. These studies denote that the experience is necessary for development of the theory of mind, since the experience provides more opportunities for children for learning about thoughts of others and essentially communication and social learning can be important sources for perceptual development of the children regarding the mind²⁵.

Overall, various studies have been conducted on theory of mind in the exceptional children generally and autistic children especially and most of them have attempted to solve problems of these children. Autism refers to fundamental limitations in the current functions. It is manifested with significantly lower social and cognitive functioning (lower than average) which is simultaneously accompanied by problems in two or more areas of appropriate adaptive skills such as communication, self-help, family life and social skills. In fact, autism is a way of functioning that begins in childhood and it is identified by limitations in cognitive and social skills and adaptive skills.

Considering importance of the theory of mind as a social tool, any harm to the development of theory of mind would lead to an

impediment in interaction with others. Thus, it is necessary to evaluate skills of theory of mind in autistic children as the initial step for providing educational and interventional facilities and its training as facilitating factor for the ability of the theory of mind. Hence, it seems necessary that the parents of children with autisms as well as trainers in the special schools dealing with these children, provide rich environment and required training for development of mental and cognitive abilities in these children as to reduce the severity of injuries on functioning of the theory of mind in patients and to provide an opportunity for students to increase skills related to theory of mind.

Similar to any other research works, the current one had also some limitations. It was conducted on the males with high-functioning autisms (8-12 years old), thus the results cannot be generalized to other autism groups with average or low functioning and other ages. In addition, results of this work cannot be generalized to other exceptional groups such as children with visual impairments, hearing loss, mental retardation, movement disorders, etc.

Conclusion

Considering this work is limited to the autistic children (aged 8-12), thus the authors are recommended to work on other age group and exceptional groups in the future works.

In addition, the current work investigates effectiveness of cognitive training on the levels of the theory of mind in autistic children. Hence, it is recommended to investigate effectiveness of this training on increasing social skills in the autistic children. It should be noted the major aim of the current work was training for modifying one of cognitive deficiencies in the autistic children (deficiency in the theory of mind). Thus, it is recommended future works study cognitive training programs for modifying other cognitive deficiencies in these children such as executive function and central coherence. And finally it is suggested the families and educational experts are informed of the results of the current work for optimal use of the research findings.

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