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Comparing theory of mind and emotion recognition in children and adolescents with autism spectrum disorder and attention deficit hyperactivity disorder

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Abstract

Introduction: Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are always associated with cognitive and social deficits. The main purpose of this study was to compare the theory of mind and emotion recognition in children and adolescents with ASD and ADHD.

Materials and Methods: The research method was causal-comparative. The statistical population included all children and adolescents with ASD and ADHD in schools and clinics of psychosocial services and counseling in Seven Educational Districts in Mashhad from March until June 2017. The sample included 85 children and adolescents (42 with autism spectrum disorders and 43 with ADHD) who were selected through purposeful sampling from the above population. Participants completed reading the mind in the eyes test, Sally–Anne test and emotion recognition test. Data were analyzed using independent t-test and multivariate analysis of variance.

Results: The findings of this study showed that the ADHD group has reported higher rates in cognitive theory of mind ($P< 0.001$), affective theory of mind ($P< 0.001$), and also in positive ($P< 0.001$), negative ($P < 0.04$) and neutral ($P< 0.03$) subscales. Furthermore, group with autism spectrum disorder got significantly higher scores in the fear emotion ($P< 0.007$).

Conclusion: The findings of this study indicate a severe deficit of social cognition in children and adolescents with autism spectrum disorder and highlight the need to train mental state recognition skills to enhance social abilities and improve social interactions in these children and adolescents.

Keywords: Attention Deficit Hyperactivity Disorder, Autism Spectrum Disorder, Emotion, Theory of mind.

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Introduction

The theory of mind is the ability to infer one's mental states and those of others and utilize this ability to interpret and forecast the behavior of others. Theory of mind is the central aspect of social cognition and a prerequisite for social functions (1,2). The deficit in recognition of emotion and mental states of others plays a significant role in the communication and social characteristics of Autism Spectrum Disorder (ASD) (3). Theory of mind begins to develop in healthy children in the first year of life and

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reaches its peak around the ages of 9-11 years (4). On the other hand, emotion recognition can be considered as the basis of social functions. *Emotion recognition* is defined as the ability to distinguish between different affective states in the face, gesture, and verbal expressions, in oneself or others, and to understand their socio-contextual meaning and is closely related to the theory of mind (5). According to some evidence (6), higher emotion recognition ability is associated with a more advanced theory of mind, and the combination of the two abilities gives rise to higher social development. The ability to recognize the emotions of others is one of the primary skills that children need to succeed in social situations and develop empathy (7). Identifying and distinguishing emotional facial expressions is a skill that usually develops at least from 10 weeks old in infants (8). Facial expressions for infants become an essential source for identifying emotional states in others (9). This ability evolves throughout childhood (10). If a child is unable to decode the emotions of others, he/she will encounter problems in friendly relations and show peculiar behaviors during social interactions (11). Autism Spectrum Disorders refer to a range of neurodevelopment disorders in the early developmental period that limits social relationships, communications, and everyday functioning, including autism disorder, Asperger and otherwise not-specified disorder. Autism disorder is the core of this spectrum of disorders, defined by qualitative deficits in social interactions, language problems, communication problems, and stereotypical behavior, including behavioral patterns, interests, and limited activities (12,13). In autism spectrum disorder, there is considerable variability in intelligence abilities, so that they range from the level of mental retardation to the level of high intelligence. Within the autistic group of children and adults, one can distinguish between "high-function autism" (IQ 70 or higher) and "low-function autism" (low IQ 70) (14). On DSM-5, a draft presented by a working group of neurodevelopmental disorders recommends a new class called autism spectrum disorders and can unite several previously separate diagnoses. These disorders include autism disorder, Asperger's disorder, erosive disorders of childhood, and pervasive developmental disorders that are not classified differently (12). In new theories, autism is categorized as a disorder with a neurological and biological underpinning that involves neuroanatomical and neurochemical changes in the brain (15). The result of such dysfunction is functional and behavioral disorders (16). One of the essential characteristics of children with autism disorder is impairment in emotion recognition and social cognition (17). Findings from the previous studies suggest that social impairment in children with autism disorder originates from deficits in emotion recognition (18). People with autism spectrum disorder have a problem in recognizing complicated emotions and mental states. These problems involve difficulty in recognizing mental states through eye images (3,7), judging trustworthiness from face images (19), emotion recognition and mental states via movie, (19), and the recognition of irony, sarcasm, or faux pas in social situations (11). Previous studies suggested that people with autism spectrum disorder have difficulty identifying emotions through facial expressions, vocal intonation, and body language (7,17,20). They also have difficulty in social situations that require the integration of emotional symptoms from different perceptual channels (19,21).

Another neurodevelopmental disorder with joint basics with autism spectrum disorders (especially in social functions) is attention deficit hyperactivity disorder. Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in children and adolescents. The prevalence of this disorder is about 3 to 5 percent among school-age children. This disorder imposes enormous economic, social, and health costs on society. These children are not well-educated and face problems such as attention deficit disorder, academic failure, inability to regulate school-based tasks, poor problem-solving, and not doing homework (15). Recent theories on the etiology of this disorder have gone beyond the mere emphasis on cognitive and educational domains and have noticed the deficiency in social abilities as one of the most critical research domains. Children with ADHD have shown a pattern of dysfunctional social behavior (22) and impaired social cognition (23). Literature review suggests that people with these disorders exhibit a pattern of inefficiency in interpersonal interactions (24). These patients cannot comprehend social situations and have difficulty interpreting interpersonal information such as emotions and

facial expressions (25). Deficiency in social interactions driven by depression has a significant role in the occurrence and persistence of this disorder (25), and to overcome this impaired cycle, social functions and their cognitive underpinnings in depressed individuals need to be considered.In sum, few studies on social cognitive assessment in ADHD have not explicitly focused on various aspects of this psychological construct and noticed deficits in social cognition abilities. Based on the literature, social cognition has different dimensions, and each dimension has different behavioral outcomes. However, the literature review shows that few studies have examined the theory of mind in children with autism spectrum disorders or attention deficit hyperactivity disorder. On the other hand, given the difference between these two disorders, the types of social and emotional problems are different. Therefore, the present study aimed to assess the ability of theory of mind and emotion recognition in children and adolescents with ADHD and peers with an autism spectrum disorder.

Materials and Methods

The statistical population of this causal-comparative study included all children and adolescents with autism spectrum disorder and peers with attention deficit hyperactivity disorder in schools and psychological services and counseling clinics of Mashhad city (the second populous city of Iran).

The sample of this study included 85 children and adolescents with autism spectrum disorder (42 subjects) and ADHD (43 subjects) who were selected through purposive sampling from counseling centers of schools and psychological services and counseling clinics of Seven Educational Districts in Mashhad. The inclusion criteria for the autism group were a total score of 19 on the Autism Spectrum Screening Questionnaire (ASSQ) and confirmation by a clinical psychologist based on the diagnostic interview. The inclusion criteria for the ADHD group were living with both parents, a score of 60 on Conners Comprehensive Behavior Rating Scale, and approval of a clinical psychologist based on the mentioned diagnosis. Exclusion criteria were moderate to severe hearing or a visual impairment, a history of severe brain injury or neurological disorder, and having a experience of a severely stressful event during the study.

Using G Power software and based on previous studies, we estimated a sample size of 80 participants. To select the sample, 72 children and adolescents with autism spectrum disorder were assessed between March until June 2017 using the Autism Spectrum Disorders Questionnaire, 50 of whom scored more than 19. In the ADHD group, 68 children and adolescents were assessed by Conners Comprehensive Behavior Rating Scale, 50 of whom scored more than 60.

To adhere to the research ethics, the subjects had full authority to participate in the research and their information was kept confidential , and written informed consent was obtained from their parents for the children to participate in the study.

Research instrument

A) High-functioning Autism Spectrum Screening Questionnaire: This valuable tool has 23 items and designed by Ehlers and Gillberg (26) for screening children with high-functioning autism spectrum disorders. Each item is scored from 0 to 2, and the total score will identify children with high-functioning autism spectrum disorders. Children who obtain an overall score of 22 (on teacher's form) and 19 (on parent's form) will be diagnosed with high-functioning autism (23).

The questionnaire assesses autistic problems in three domains of social interaction, a speech and language delay, behavioral problems, and abnormal symbolic games, which are completed by parents or caregivers of the child showing Asperger's symptoms or other autism spectrum disorders. This tool is helpful for children and adults with average intelligence or mild mental retardation. Each item has three options: Score zero for option. *No*, score 1 for the option *to some extent* indicating that the child shows mild symptoms, and score 2 for the option yes (27). In the study by Ii et al. (27), internal consistency and test-retest reliability were 0.67 and 0.61, respectively. Also, the convergent validity of the test has been obtained to be 0.53. In Kasehchi's research (28), the Cronbach's alpha coefficient was estimated 0.77 for parents of typical children, 0.65 for parents of children with autism spectrum, 0.81 for normal children, and 0.70 for teachers of children with autism. Further, the questionnaire had good content validity in the parent's and teachers' groups. Test-retest reliability of ASSQ was

0.467 for parents and 0.614 for teachers of autistic children.

B) Conners Comprehensive Behavior Rating Scale: This questionnaire has been designed by Conners and his colleagues (29) to examine the symptoms of attention deficit hyperactivity disorder in children. In this study, we used parents form (48-item). It is the most frequently and widely used questionnaire for screening and diagnosing ADHD globally and a proper tool for assessing the severity of its symptoms. This questionnaire is scored on a 4-point Likert scale: 0 for never, 1 for low, 2 for high, and 3 for very high (29). Higher scores show more significant ADHD symptoms. Conners et al. (29) considered a cut-off point of 60 as a criterion for diagnosing ADHD. They reported 0.76 for its Cronbach alpha and 0.62 for its construct validity and believed that the desired test could discriminate children with ADHD from normal children.

Khushi et al. (30) conducted a study on 2667 Iranian male and female children aged between 7 and 12 years old and used Pearson correlation and Cronbach's alpha and obtained 0.93 for the correlation of each question with the whole test as well as the reliability.

The high reliability of the questionnaire shows that this tool can measure ADHD symptoms with high accuracy.

C) Benton Facial Recognition Test: This test comprises 28 emotional faces from different people , developed by Benton (31) to measure emotion recognition ability in children. There are seven different images from various people for each emotional state (happiness, sadness, anger, and fear) and, the child should select the option appropriate to the image from among the four options of happiness, sadness, anger , and fear. The test output is to obtain four scores in four emotional states.

Each positive response equals one score in the desired emotion, and higher scores indicate a higher emotion recognition ability.

The application of this test in general and clinical populations suggests its good discriminant validity in detecting patients, and the degree of its sensitivity (as part of validity) has been obtained to be 0.59 (31). Buhlmann et al. (32) reported 0.55 as its convergent validity by examining its correlation with the Ekman emotion recognition test. In the current research, we used the modified version of the above test , which has been developed by Jalili, Bahrami, and Nejati (33). In the study by Nejati and Izadi Najafabadi (34), the internal consistency of this test has been estimated to be 0.71.

D) Reading the Mind in the Eyes Test (Affective Theory of Mind): To measure the affective aspect of Theory of Mind (ToM), the Persian version of reading the mind in the eyes test was employed (7). This mind-reading test includes images from the eye area of actors and actresses in 28 different modes. For each image, four words describing mental states that share a similar emotional capacity are presented. The respondent has to choose an option from among four options only through the visual information in the image; the selected option should best describe the person's mental state in the image. Each participant's total score in these two tasks is calculated based on the sum of his correct answers to each image.

Thus, the highest score a participant can receive in mind-reading and gender recognition is 28. In addition to the overall score, by the model by Harkens et al. (35), three sub-scores were also calculated based on the value of each mental state. According to this model, 28 original images fall into three categories based on positive, negative, and neutral values in each mental state.

The sum of images showing positive, negative, and neutral mental states is equal to 11, 7, and 7, respectively. Most previous studies have used this neuropsychological test to assess the mind-reading ability of patients and healthy individuals, which represents the validity of this test in the studies of mental state perception (24,36). Wang et al. (24) reported a test-retest reliability coefficient of 0.61 and confirmed the convergent validity of this test by examining its correlation with the Ekman face perception test (r= 0.51). In domestic studies, its internal consistency was 0.72, and its test-retest reliability was 0.61 (36).

E) Sally-Anne False Belief Test (Cognitive Theory of Mind): This test was used to examine the cognitive aspect of the theory of mind. In the designed scenario, Sally and Anne are together in a room with a marble, a basket, and a box. Initially, in Anne's presence, Sally puts the marble inside the basket near her and leaves the scene. Then, Anne removes the marble from the basket and hides it in the box.

Afterward, Sally returns to the room. The examiner asks the child the central question of false belief: Where will Sally look for the ball? If the child points to the previous location

(basket) of the marble, he correctly understands the doll's false belief and has given the correct answer to the question. If he points to the present location of the marble, he has failed in answering the doll's false belief test. To ensure whether or not the child has understood the story, two questions are asked: Where is the marble located? (the reality question) Moreover, where was the marble originally? (the memory question). In the study by Grant, Grayson, and Butcher (37), the reliability of this test was evaluated, and the kappa coefficient was 0.59.

Moreover, in the study above, the Sally-Anne test's convergent validity was reported to be 0.53. Data analyzed through SPSS-24 software, independent t-test, and multivariate analysis of variance (MANOVA).

Results

In the autism group, six people were excluded because of lack of cooperation and non-completion of the test and two people due to too much interference of the invigilator in answering the test. In the ADHD group, seven subjects were excluded from the sample due to lack of cooperation and lack of necessary concentration to complete the tests. As a result, the primary sample of the study included 42 people with autism spectrum disorder and 43 ADHD people, totally amounting to 85 subjects. So, 85 cases with autism spectrum disorder (25 boys and 7 girls, mean age: 12.47 ± 3.51 year) and ADHD (29 boys and 14 girls, mean age: 12.93 ±2.85 years) were evaluated. In Table 1, the mean and standard deviation of the research variables are given.

Table 1. Mean and standard deviation of dimensions of theory of mind and emotion recognition in the ASD and ADHD groups

Variable	Autism		ADHD	
	Mean	SD	Mean	SD
Anger	4.19	1.45	4.76	1.42
Fear	4.09	1.14	3.39	1.19
Happiness	3.42	1.12	3.11	1.53
Sadness	3.64	1.42	3.55	1.82
Total score	15.40	3.31	14.81	3.19
Cognitive ToM	0.92	1.11	1.86	1.24
Affective ToM	8.54	3.55	11.90	3.72
Positive states	4.64	2.29	6.93	2.68
Negative states	2.66	1.47	3.25	1.36
Neutral states	1.23	0.82	1.72	1.20

As can be observed in the above Table, in the total score of emotion recognition and the subscales of fear, happiness, and sadness, the autism spectrum group scores are higher than those of the ADHD group, whereas, in the anger subscale, the scores of the ADHD group are higher. Besides, in cognitive theory of mind and affective theory of mind and its subscales, the ADHD group has higher scores than the autism spectrum group.

To investigate the differences between the two groups in affective theory of mind, multivariate analysis of variance was used. In order to apply this analysis, its main assumptions were first examined. One of these assumptions is the normal distribution of dependent variables. Ineffective theory of mind and its subscales, Kolmogorov–Smirnov test results were not significant (P>0.05). Hence, the assumption of normality of data for these variables was confirmed. Levene's test investigated the assumption of the equality of error variances of the dependent variables in the two groups. The results of Levene's test indicate the equality of variance of dependent variables in the two groups (P>0.05). Given the establishment of the above assumptions, multivariate analysis of variance can test the desired hypothesis. Results of the ANOVA model with measurement of Wilks' lambda index (0.79) generally indicated the difference between two groups of autism spectrum disorder and ADHD in affective theory of mind (F= 5.03, P= 0.001). For a more accurate examination of the difference, the results of each variable are presented in Table (2).

Table 2. Results of multivariate analysis of variance of affective theory of mind in children and adolescents with autism spectrum and ADHD

	Mean square	df 1	df 2	F	Sig.	Effect size
Positive states	111.16	1	83	17.79	0.001	0. 17
Negative states	7.37	1	83	3.65	0. 04	0. 04
Neutral states	4.95	1	83	4.65	0. 03	0. 05
Total score	239.77	1	83	18.09	0.001	0. 17

According to the Table above, the difference between the two groups is significant in the total score of the affective theory of mind test and its subscales. The mean comparison demonstrates that the ADHD group has obtained higher scores than the autism spectrum disorder group in the total score and subscales of the above test.

In the following, the two groups were compared in cognitive theory of mind through a t-test. This test also indicated a significant difference between the two groups (t= 3.62, *P*= 0.001). The mean Comparing the mean scores indicated that ADHD people have higher scores than people with an autism spectrum disorder.

Multivariate analysis of variance (MANOVA) was applied to investigate the differences between the two groups in emotion recognition. Kolmogorov-Smirnov test results were not significant for emotion recognition and its subscales (*P*> 0.05). Thus, the assumption of normality of data for these variables was confirmed. The results of Levene's test also suggest the equality of variance of the dependent variables in the two groups (*P*> 0.05). Considering the establishment of the above assumptions, multivariate analysis of variance was used.

The ANOVA model based on Wilks' lambda (0.81) indicated the difference between the two groups in emotion recognition (F= 3.51, *P*= 0.002). For a more accurate examination of differences, the results of each variable are provided in Table (3).

Table 3. Results of multivariate analysis of variance of emotion recognition in children and adolescents with autism spectrum and ADHD

	Mean square	df 1	df 2	F	Sig.	Effect size
Anger	7.07	1	83	3.41	0.06	0.03
Fear	10.40	1	83	7.58	0.007	0.08
Happiness	2.07	1	83	1.14	0.28	0.01
Sadness	0.152	1	83	0.05	0.81	0.001
Total score	7.41	1	83	0.70	0.40	0.008

Based on the above Table, the difference between the two groups in the total score of the emotion recognition test is not significant. An investigation of the statistical values of the subscales reveals that only in the fear subscale, the difference between the two groups is significant. The mean comparison indicates that the autistic spectrum disorder group has higher scores in this subscale than the ADHD group.

Discussion

This study compared the theory of mind and emotion recognition ability between children and adolescents with ADHD and peers with an autism spectrum disorder. The results showed that ADHD group received higher scores than those of the autism spectrum disorder group in affective and cognitive theory of mind. The findings of this study are partly consistent with the majority of research in the field of autism spectrum disorder (17,18,20,38,39). In one of the first studies in this field (18), the practical theory of mind weakness in people with autism was confirmed. The significant difference between this study and the present research is due to different age groups. The present study evaluated children and adolescents with ADHD compared to peers with ASD. But this study conducted on adult population and compared them with the healthy individuals. In another research (40), researchers concluded that adolescents with autism spectrum disorder have a lower ability in the theory of mind and mentalization. According to this study, promoting emotional abilities and mentalization can improve social skills and make friends in adolescents with autism. Compared to the present study, this research only measured one aspect of the (affective) theory of mind and did not consider other

dimensions of social cognition. The obtained findings are consistent with this behavioral reality observed in autistic children and adolescents. These people have significant deficiencies in their social functions and interactions, meaning that they cannot recognize others' mental states and goals and intentions in social interactions (7,18).

The superiority of the theory of mind in ADHD children and adolescents suggests that impairment in social functions in this group is not as severe as autistic people. However, a growing body of research has confirmed a deficiency in the socio-cognitive abilities of ADHD patients (23). The impairment of this ability appears to manifest itself only when ADHD people are compared with their regular counterparts. The results of previous research indicate that people with attention deficit hyperactivity disorder, compared to peers without this disorder, experience more problems in social relationships with their peers and parents (41), siblings (42), and teachers (43). The failure of these children has been approved in terms of social action based on various assessment techniques such as teacher and parent ratings, peer group assessment methods, behavioral observation in the playground with peers, and controlled observations in various studies (44).

In ADHD patients, there are problems in the areas of inhibition, attention, and impulse control. Therefore, the child or adolescent faces difficulty in applying pre-learned rules and regulations in the current situations. Most of the time, these problems are manifested in all educational, social, and behavioral domains (15). Accordingly, interference in the cognitive-social functions of children with ADHD is not far-fetched. Nevertheless, based on the findings of the present study, these children are better off compared to groups with more complex neurodevelopmental disorders such as autism spectrum. Another point is that in the first approaches to social cognition, autistic children were believed to lack any theory of mind ability (45). This study shows that people with autism do not lack any theory of mind, but they also possess a theory of mind which is very basic. More interestingly, at both levels of theory of mind (affective and cognitive), children and adolescents with autism -even at the cognitive level, which is the more advanced level of theory of mind- have also achieved scores. The main reason for this finding is that the children and adolescents who studied were from the "high-functioning autism" group. This group, because of their higher intelligence and linguistic ability, is always better off cognitively. The theory of mind ability is also reported to be directly related to general intelligence (18).

The results of emotion recognition disclosed that the two groups do not differ significantly in the overall score of emotion recognition, and among the subscales, only in the subscale of fear, the autistic spectrum disorder group scored higher than the ADHD group. Understanding emotions play an essential role in social relationships and social behavior, and this is the same deficiency from which autistic children suffer, as claimed. Castelli (46) observed that people with autism disorder, compared to normal children, state general and inaccurate interpretations of social interactions. Since these children have significant deficiencies in their social functions and interactions, the major causes of this deficiency must be well-identified. Concerning the findings of this research and the studies, it can be concluded that deficiency in social interactions of these children is a result of a defect in the perception of others' mental states (theory of mind) rather than emotional states, meaning that these children cannot distinguish others' mental states and goals and intentions in social interactions.

The consequence of such a defect can lead to a dysfunctional communication pattern in interpersonal relationships. Because the individual is incapable of understanding the mental states of others and their experienced emotions and feelings, he/she fails in constructs such as empathy in social communication. Accordingly, the difference between autistic and ADHD children likely becomes manifest in the theory of mind. Theory of mind is also a higher level function of emotion recognition and is correlated with higher brain functions such as problem-solving and decision-making (47). According to the results of the present study, in the fear emotion, unlike the other three primary emotions, the difference between the two groups was significant, and the group with autism spectrum disorder performed better. According to the results of some previous studies (48,49), people with autism spectrum disorder have difficulty in recognizing emotions such as fear due to avoiding attention to the eye area and poor eyesight. However, in

the present study, the results indicate that ADHD patients are weaker in detecting fear and obtain low scores in this subscale. People with ADHD usually have a history of disobedience and conflict with authorities (50) and high impulsivity and risk-taking (51).

Such behaviors by these children may be their inability to understand the emotion fearfully. The main limitation of this study main was the absence of a regular group with demographic characteristics similar to the other two groups of research. The absence of such a group does not allow for comparing the findings of this study with the average population. Another limitation relates to different subgroups of autism disorder and ADHD. Lack of control over the type and amount of treatment received in the studied children and adolescents was another limitation of this research. Some forms of medication or psychotherapy are likely to affect children and adolescents' cognitive and social abilities and may influence the output of the tests used. In this study, non-probability purposive sampling was employed. This type of sampling may lead to the intervention of nuisance variables and non-representative samples.

Conclusion

The findings of the present study generally demonstrated that children and adolescents with autism spectrum disorder are less able to recognize mental states (theory of mind) relative to ADHD children and adolescents. In contrast, the two groups showed no significant difference in emotional state recognition. At the same time, they are increasing the theoretical knowledge and enriching previous models of emotional and cognitive abilities in children and adolescents with neurodevelopmental disorders, the findings of this research highlight the importance of mental state recognition skills training to promote social abilities and improve social interactions in autistic children and adolescents.

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