



## RESEARCH ARTICLE

# Comparison of social cognition in adolescents diagnosed with attention deficit hyperactivity disorder and autism spectrum disorder

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### ABSTRACT

**Objective:** The aim of this study was to analyze social cognition deficits in children with autism spectrum disorder (ASD) and attention deficit-hyperactivity disorder (ADHD) regarding their performance in explicit and applied measures of theory of mind (ToM) skills.

**Method:** This study comprised 60 patients with ADHD and 60 patients with ASD according to DSM-5 between the ages of 12 and 16 years and 60 adolescents without any psychiatric diagnosis. The Turkish version of the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and lifetime version (K-SADS-PL) was administered in order to assess their psychopathology. Participants' intelligence levels were assessed with the Wechsler Intelligence Scale for Children-Revised. Reading the Mind in the Eyes Test, Faux Pas Recognition Test, and the Hinting Task were used in patients to evaluate ToM skills.

**Results:** Adolescent patients with ADHD or ASD have difficulties in ToM skills. Adolescents diagnosed with ASD had more difficulties in ToM skills than adolescents with ADHD.

**Conclusion:** This study supports the idea that ADHD or ASD are related to deficits in social cognition skills. Therefore, interventions to improve social cognition skills may help improve compliance with treatment and increase treatment effectiveness in ADHD and ASD cases.

**Keywords:** Autism spectrum disorder, attention deficit-hyperactivity disorder, social cognition, theory of mind

## INTRODUCTION

Social cognition is the ability to understand and explain mental states such as belief, intention, emotion, and imagination of the individuals themselves and others (1). A subfield of social cognition is theory of mind (ToM), which is defined as the mentalizing capacity to interpret, infer and explain mental states underlying the behavior of other people, containing the understanding of false beliefs, hints, purpose,

humor, and metaphor (2). ToM skills are essential for a person to understand that his or her own mental state is different from the mental state of other people and to be able to interpret the mental states of others. The ToM concept consists of different components. First-order false belief, second-order false belief, metaphor, irony and faux pas concepts have been identified as components related to the cognitive system (3). The ability to read the mind in the eyes suggests understanding the mental state beyond simple

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emotions by looking at the expressions in the eye of an individual, and this ability reflects one of the processes that determine ToM (4,5). Cognitive social cognition abilities are necessary when asked about someone's belief and affective social cognition abilities are necessary when asked how someone feels (6).

Baron-Cohen et al. (7) first showed that ToM skills in autism and other common developmental disorders were an important social skill in interpersonal communication. Following ToM studies in autistic children, further studies were conducted examining the ToM skills in groups with different diagnoses.

During the last decade, various ToM studies have been conducted in groups diagnosed with neurodevelopmental disorders, especially attention deficit hyperactivity disorder (ADHD) (8). Prior studies reported that children with ADHD have a reduced capacity for social reciprocity and understanding social cues and that these social weaknesses look like social interaction problems in autism spectrum disorder (ASD). Many social cognition studies emphasized that children diagnosed with ADHD displayed inappropriate social behavior problems, including a deficiency in giving appropriate social responses and in the perception of the behavior of others. The inappropriate social behavior of children diagnosed with ADHD could be etiologically related to ASD (9). Although the former group has been seen to have better ToM skills than ASD groups, it is thought that the low level of ToM skills could contribute to the interpersonal and behavioral problems seen in ADHD (10).

In the light of this knowledge, both ASD and ADHD are neurodevelopmental disorders characterized by social impairments. We hypothesized that (1) ASD and ADHD groups have lower ToM skills than the typical development (TD) group and (2) the ASD group has lower ToM skills than the ADHD group. The first objective of this study was to analyze social cognition deficits in children with ADHD, ASD, and TD in their performance in explicit and applied measures of ToM skills. The second objective was to compare these skills between groups and with adolescents showing TD.

## METHOD

### Participants and Procedure

This cross-sectional case-control study was conducted at Tekirdag State Hospital Child and Adolescent Psychiatry Department. Before initiating the study,

participants' parents provided written informed consent. Ethics approval was obtained from the local ethics committee of Namik Kemal University Faculty of Medicine.

Enrollment criteria included: (a) age 12-16 years; (b) meeting the criteria for either ADHD or ASD according to DSM-5; (c) WISC-R score above 70; (d) physical and cognitive ability to participate in study procedures; and (e) absence of significant physical conditions or developmental delay impairing motility or cognition (e.g., paresis or palsy, intellectual disability). Participants with a history of substance/drug dependence, any neurological or additional medical disease, a history of perinatal complications, and a history of physical head trauma were not included in the study. This study comprised 60 patients with ADHD, 60 patients with ASD and 60 healthy individuals. Sixty-four persons diagnosed with ADHD were interviewed but 3 patients did not agree to participate and 1 patient did not complete the forms. Of 63 patients diagnosed with ASD being interviewed, 1 patient did not agree to join and 2 patients did not fill in the forms.

### Measures

Collection form for sociodemographic and clinical data. This form was developed by the researchers to determine sociodemographic characteristics of patients included in the study. The form for children included data about age, gender, neuromotor development stages, literacy learning time, academic achievement, and medical history, and the form for their first/second-degree relatives included data about education level, residency of parents, and genealogical psychiatric/medical information.

**Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL):** The K-SADS-PL is a semi-structured interview form developed by Kaufman et al. (11) to detect present and life-time psychopathology in children and adolescents. Validity and reliability studies were conducted for a Turkish sample of the scale (12). Data from the child and from at least one parent were combined with a clinician's opinions.

**Reading the Mind in the Eyes Test (RMET):** The RMET was designed by Baron-Cohen et al. (1), aiming to determine participants' ability to sympathize with other persons and to evaluate the extent to which the subject can understand others' mental states solely by recognizing the emotions in their eyes. The RMET has

been frequently used in studies investigating the relationship between psychopathology and social cognition. The pediatric version of this test includes a total of 28 photos in which only eyes are visible. For each test item, a photograph is framed with four words that describe the probable mental state or feeling of the person shown in the photo. Three of these words are distractors and only one term correctly describes the mental state of the person in the image. The test is scored with the sum of the number of items correctly answered by the participant. Girli (13) validated the Turkish translation of the pediatric version of the test and stated that this version can be used in diagnostic and education processes as a valid and reliable instrument.

**The Faux Pas Recognition Test:** The Faux Pas Recognition Test is used to assess high levels of mental cross-referencing (14). It is assumed that developmentally noticing a faux pas is the most complex skill providing a sensitive tool to measure ToM. The meaning of faux pas is that people inadvertently make inappropriate utterances. To realize the occurrence of a faux pas, two mental states need to be represented simultaneously, which demands elements of conceptual skills as well as emotional empathy (15,16). Children are made to listen to a story, and subsequently their comprehension is evaluated by asking four questions. Only if the child gives correct answers to all questions, including the one on understanding, and states the the faux pas resulted from a false belief, it is accepted that the subject has detected the faux pas. In addition, children are expected to find no faux pas in control stories they are given. If any incorrect answer is given, the particular story scores zero points. In this study, the Turkish children's version of the Faux Pas Recognition Test was administered in Turkish, using 5 original faux pas stories and 5 control stories (with a maximum score of 10 points) (14).

**The Hinting Task:** The Hinting Task assesses one of the high-level functions of ToM, the ability to work out the real intention behind spoken words (17). Participants first listen to a story and are then asked about the presumed real intention of the protagonist in the story. The questions contain hints, and if a participant does not answer the first question correctly, he or she is asked another question providing a more direct hint. A correct answer to the first hint receives a score of 2 and a right answer to the second question is scored as 1. If participants could not answer either of the questions correctly, they received

a score of 0. In the present study, we used 4 stories in the Hinting Task (18).

**Wechsler Intelligence Scale for Children-Revised Short Form (WISC-R):** This scale measures the intelligence levels of children between the ages of 6 and 16 years. The instrument was revised in 1974 and standardized as the WISC-R (Revised Version) (19). It was adapted to Turkish culture by Savasir and Sahin (20).

### Statistical Analyses

Data were analyzed using SPSS version 25.0. The findings were given as number, percentage, mean, standard deviation (SD), median, and interquartile range (IQR). The normality of numerical variables was examined by Shapiro-Wilk test. The homogeneity of variances was assessed by Levene's test. While age and total IQ scores of the ADHD, ASD, and control groups were compared with one-way ANOVA test, gender, parents' education, and monthly income were compared using chi-square test. Comparison of test scores between groups was performed by Kruskal-Wallis H test followed by post-hoc Dunn's test with Bonferroni correction. Pearson correlation analysis was used for correlation between numerical data. All hypotheses were bidirectional and the statistical significance level was considered as  $p < 0.05$ .

## RESULTS

In the study, the data of 180 individuals (60 ADHD patients, 60 ASD patients, and 60 controls) were analyzed. The groups were similar regarding age, gender, total IQ, maternal education, paternal education, and monthly income ( $p > 0.05$ ). Participants' sociodemographic characteristics are given in Table 1.

RMET, Faux Pas Recognition Test, and Hinting Task scores of at least one group were statistically different from the others ( $p < 0.001$ ) (Table 2).

Post-hoc Dunn's test was used for binary group comparisons. Comparisons between all possible binary groups were statistically significantly different ( $p < 0.05$ , adjusted using Bonferroni correction) (Table 3).

## DISCUSSION

The results obtained in the study can be summarized as follows: 1) ToM skills of adolescents diagnosed with ASD and ADHD are weaker than in the TD group; 2) ToM skills of adolescents diagnosed with ASD are weaker than in the ADHD group. In an earlier study, it

**Table 1: Participants' sociodemographic characteristics**

	Groups						df	F/ $\chi^2$	p
	ADHD		ASD		Control				
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD			
<b>Age (years)</b>	14.00	1.43	14.02	1.44	13.55	1.41	2	2.07	0.129
<b>Gender</b>									
Male	30	50.0	30	50.0	30	50.0	2	0.00	1.000
Female	30	50.0	30	50.0	30	50.0			
<b>Total IQ</b>	95.47	10.31	95.47	10.31	94.45	10.82	2	0.19	0.829
<b>Maternal elementary Education</b>	20	33.3	20	33.3	20	33.3	4	0.07	0.009
High school	20	33.3	20	33.3	19	31.7			
University	20	33.3	20	33.3	21	35.0			
Paternal elementary	20	33.3	19	31.7	20	33.3	4	0.07	0.009
<b>Education</b>									
High school	21	35.0	21	35.0	21	35.0			
University	19	31.7	20	33.3	19	31.7			
<b>Monthly &lt;1000 TL Income</b>	9	15.0	8	13.3	11	18.3	6	3.0	0.800
1000-1999 TL	19	31.7	21	35.0	16	26.7			
2000-2999 TL	22	36.7	22	36.7	19	31.7			
>3000 TL	10	16.7	9	15.0	14	23.3			

SD: Standard deviation, ADHD: Attention deficit-hyperactivity disorder, ASD: Autism spectrum disorder

**Table 2: Comparison of the RMET, Faux Pas Recognition Test, and Hinting Task scores of the groups**

	Groups						df	Kruskal-Wallis H	p
	ADHD		ASD		Controls				
	Median	IQR	Median	IQR	Median	IQR			
<b>RMET</b>	18.0	3.0	16.0	3.0	20.0	4.0	2	77.87	<0.001
<b>Faux Pas Test</b>	4.0	3.0	2.0	1.0	7.0	2.0	2	139.42	<0.001
<b>Hinting Task</b>	15.0	2.0	14.0	2.0	18.0	1.0	2	122.24	<0.001

IQR: Interquartile range, ADHD: Attention deficit-hyperactivity disorder, ASD: High functioning autism spectrum disorder, RMET: Reading the mind in the eyes test

**Table 3: Comparison of the RMET, Faux Pas Recognition Test, and Hinting Task scores between groups**

	RMET		Faux Pas Test		Hinting Task	
	Test statistics	p	Test statistics	p	Test statistics	p
<b>ADHD-ASD</b>	29.55	0.005	56.79	<0.001	22.42	0.052
<b>ASD-controls</b>	81.95	<0.001	111.23	<0.001	99.26	<0.001
<b>ADHD-controls</b>	52.40	<0.001	54.44	<0.001	76.84	<0.001

Post-hoc Dunn's test, ADHD: Attention deficit-hyperactivity disorder, ASD: High functioning autism spectrum disorder, RMET: Reading the Mind in the Eyes Test

was determined that ToM performances of children diagnosed with ASD were similar to those of the ADHD group, while the same study showed that children diagnosed with ASD and ADHD performed rather more poorly than healthy controls (21). There

are also studies consistent with this research showing that children with ADHD and ASD perform poorly in ToM tests, especially in the second-level false belief tasks, compared to healthy controls (22). In a study conducted with ADHD, ASD, ADHD+ASD, and

healthy controls, ToM performance was lower in the groups with ADHD symptoms (23). Another study contradicts our study in that children diagnosed with ASD and ADHD did not differ with regard to ToM performance (24). In our study, ToM performances of ADHD and ASD groups were quite low compared to the TD group. A meta-analysis by Bora and Pantelis (10) as well as another study consistent with the current results (25) have found that the ToM abilities of individuals with ADHD range somewhere between those of individuals with ASD and those of persons with TD

The present findings support a recent study showing that patients diagnosed with ADHD and ASD had weak facial affect recognition abilities due to ADHD symptoms (23). In a prior study, attention has been reported to have a significant effect on the performance of reading the mind in the eyes and facial recognition (26). In this study, it was found that adolescents diagnosed with ADHD and ASD showed a poorer mind-reading performance compared to adolescents in the TD group.

Miranda et al. (27) previously evaluated ToM and executive functions in ADHD, ASD and TD groups. ADHD and ASD groups showed low ToM performance, while the ASD group performed much lower than the TD group. The present findings are similar to the results of previous studies, where patient groups performed more poorly than TD group and the ASD group had a poorer ToM performance compared to the ADHD group. Similar findings were reported in the chapter by Ozonoff et al. (28) with weak ToM and limited flexibility, which is one of the core symptoms of ASD, consistent with the low performance of ToM in the ASD group in our study. Different studies determined that attention deficit/hyperactivity disorder, oppositional defiant disorder (ODD), and depression and anxiety rates were higher in children diagnosed with ASD and ADHD than in children with TD (29,30).

It has been reported in the literature that executive function problems in the ADHD group with a comorbid ODD caused ToM deficits, and there was a reciprocal relationship between the two skills (15). In the current study, when comparing the ADHD group without ODD comorbidity and TD groups, a significant difference was found in all the ToM tasks. When the TD group and the ADHD groups were compared, it was found that differences in the RMET performances between the control group and the ADHD group without ODD were not significant.

Thus, the results of the current study were not similar to the findings of previous studies that have shown that ADHD with ODD had no significant effect on ToM (31).

Our results are consistent with a prior study in finding poorer performance on the Faux Pas Recognition task in children with ADHD. Another interesting finding of that study was that ToM scores increased to the level of healthy controls upon methylphenidate administration (32). In contrast to the findings of previous studies (33,34), the performance of the ADHD and ASD groups in the Faux Pas Recognition Test was poorer than that of the TD group.

It is necessary to state the limitations that may affect the interpretation of the data. First of all, comorbid presentations of ASD and ADHD diagnoses are common. About 60% of children with ASD are diagnosed with ADHD (35) and 30% of children with ADHD display heightened ASD traits (36). In addition, the use of a relatively small sample in this study is another limiting factor for generalizing the data. Rather than a cross-sectional design, longitudinal studies are needed, considering that at a single point in time, adolescents with ADHD and ASD cannot provide information about the progression of ADHD and ASD, treatment response and/or clinical changes in ADHD and ASD.

In conclusion, the results of this study show that adolescent patients with ADHD and ASD have difficulties in ToM skills, which is consistent with the results reported in prior studies with children and adolescents with ADHD and ASD. Considering other studies, interventions to improve ToM skills may help improve compliance with treatment and increase treatment effectiveness in ADHD and ASD cases. ToM has a potential for affecting social, academic, and behavioral outcomes in children, which are often the target of early intervention.

Contribution Categories		Author Initials
Category 1	Concept/Design	F.D.
	Data acquisition	F.D.
	Data analysis/Interpretation	F.D.
Category 2	Drafting manuscript	F.D.
	Critical revision of manuscript	F.D.
Category 3	Final approval and accountability	F.D.
Other	Technical or material support	F.D.
	Supervision	F.D.



**Ethics Committee Approval:** Ethic approval was obtained from the local ethics committee of Namik Kemal University Faculty of Medicine (Date: 28/07/2020, Number: 2020.179.07.12).

**Informed Consent:** Before initiating the study, participants' parents provided written informed consent.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** No potential conflict of interest was reported by the author.

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