Alpha Psychiatry

ORIGINAL ARTICLE
Alpha Psychiatry 2021;22(1):7-11
DOI: 10.5455/apd.126537

# The Relationship between the Theory of Mind Skills and Disorder Severity among Adolescents with ADHD

## ABSTRACT

**Objective:** This study aimed to examine the sub-dimensions of the theory of mind (ToM) and to investigate the relationship between ToM skills and disorder severity by comparing adolescents with attention-deficit hyperactive disorder (ADHD) with healthy individuals.

**Methods:** The study included 42 adolescents with ADHD and education- and age-matched 41 healthy volunteers. The Smarties test, ice cream truck test, faux pas recognition test, and eyes test were applied to all participants. Turgay Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-IV)-Based Child and Adolescent Disruptive Behavioral Disorders Screening and Rating Scale (T-DSM-IV-S) was applied to the group with ADHD to measure the disorder severity.

**Results:** The group with ADHD was seen to have ToM skills impairment. There was a statistically significant difference between the groups in terms of the ice cream truck test, faux pas recognition test, and eyes test. A significant correlation was observed between the T-DSM-IV-S results and the eyes test results of the patients.

**Conclusion:** This study has shown that advanced ToM skills can be impaired in adolescents with ADHD and that impairment in skills is associated with disorder severity.

**Keywords:** Theory of mind, ADHD, social cognition

## Introduction

Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of lack of attention, hyperactivity, and impulsive behaviors.[1] The symptoms begin at an early age. Although they vary depending on age and developmental period, they also affect the later stages of life. Children with ADHD experience poor academic performance, low self-esteem, and social isolation and are at risk for emotional and social problems, such as anxiety and depression, in addition to ADHD symptoms.[2] Furthermore, these children are generally excluded from games, they have difficulty in participating in games with rules, and their teachers receive more complaints about them.[3]

According to recent studies, behavioral and social problems in ADHD may increase the deterioration in the theory of mind (ToM),[4] which is one of the domains of social cognition. Social cognition is defined as interpreting and analyzing information about the social environment.[5] The ability to understand people's feelings and thoughts and to interpret their behaviors and intentions is essential for a successful social interaction.[6] In contrast, ToM is defined as the capacity to interpret the thoughts underlying other people's behavior and to understand false beliefs, clues, jokes, tricks, metaphors, and irony.[7] The phrase ToM was first used by Premack and Woodruff[8] as a concept in 1978 after they conducted a study on chimpanzees. In 1983, Wimmer and Perner[9] showed that children could distinguish their thoughts from those of other children from the age of 4 years. The concept of ToM is divided into different components and develops with increasing age. First-order and second-order false-belief tasks, metaphor, irony, and faux pass tests are used to evaluate the ToM



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**Received:** August 26, 2020
**Accepted:** September 22, 2020
**Published Online:** January 19, 2021

**Cite this article as:** Kılınçel Ş. The Relationship between the Theory of Mind Skills and Disorder Severity among Adolescents with ADHD. *Alpha Psychiatry* 2021;22(1):7-11.

skills in the social cognition domain.[10] The affective component is the ability of the person to understand the mental state of another person based on the observable information. Reading the mind in the eyes test is often used to test this ability.[11] Children with ADHD show significantly lower performance in false-belief tests and make more mistakes in reading the mind in the eyes than children with normal development.[12]

The most difficult ToM skill is the ability to understand faux pas, which is more complex than others. The ability to recognize faux pas (understanding that they say what they should not have said or do what they should not have done) develops at the age of 9-11 years.[13] The faux pas recognition test evaluates both the affective component (empathically understanding whether another person may feel hurt or sad) and the cognitive component (understanding that the person does not know that he/she should not have said) of ToM. Therefore, it is considered a good measurement tool for evaluating impairments in fine ToM skills.

Past hypotheses have partly supported that family structure, the number of siblings, physical illness, and adverse events in the family (for example, serious disease, financial loss, or divorce) are related to ToM skills, and the number of studies measuring ToM skills, particularly the faux pas, in children with ADHD is limited. Hence, this study aimed to investigate the relationship between ToM skills and disorder severity, controlling for other factors.

## Methods

The study included patients meeting the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) diagnostic criteria for ADHD among the patients who were admitted to Sakarya Child and Adolescent Psychiatry Institute between May 2020 and August 2020. The inclusion criterion was determined as being aged 12-16 years. The exclusion criteria were determined as having a known neurological disorder; additional comorbid psychiatric disorder; intellectual disability; the presence of alcohol and substance use; and using methylphenidate, antidepressant, benzodiazepine, and antipsychotics within the past 3 months. The sampling selection is shown in Figure 1.

The healthy control group was recruited from Sakarya Child Psychiatry Institute and Dr. Şenay Doğan Pediatrics Clinic with similar characteristics in terms of age and gender averages; having no history of psychiatric or medical illness; having no diagnosis of ADHD; not having learning disorders, autism spectrum disorders, schizophrenia, intellectual disability, and bipolar disorder in a parent or sibling.

### MAIN POINTS

- *We examined social cognition abilities in Turkish adolescents with ADHD.*
- *Adolescents with ADHD have no difficulties in first-order social cognition skills.*
- *Adolescents with ADHD display impaired second-order social cognition skills, irony, and reading emotions from eyes.*
- *The presence of a history of adverse events in the family may affect adolescents' second-order social cognition skills.*

The psychiatric examination of the patients was performed by a child and adolescent psychiatrist. The ToM tests were performed by a clinical psychologist and a child and adolescent psychiatrist.

## Materials

The sociodemographic data form created for this study was completed by the parents of all the children included in the study. This form included the following information: patient's age, sex, family structure (1: nuclear family, 2: extended family, 3: single parent), number of siblings, physical diseases, previous adverse events in the family (death of a family member, migration, accident, serious disease, financial loss, or divorce), and events experienced during pregnancy.

The eyes test was developed by Baron-Cohen et al[14] to measure the social skills of children with an autism spectrum disorder. There are 28 items in the pediatric version of this test and 4 options in each item; 1 of the 4 options is considered correct. It measures the ability to make accurate inferences about the mental or emotional state of the person by looking at the eye photos. The Turkish translation and reliability study has been conducted by Girli.[15]

**Faux Pas Recognition Test:** Faux pas recognition test was created by Baron-Cohen et al[13] In the original study, the 10 stories (faux pas stories) were randomly interleaved with the 10 control stories. The researcher introduces the story groups to the child and asks 4 questions for each faux pas story. The Turkish validation and reliabilities of this test were made by Şahin et al.[16, 17]

**Smarties Test:** This test, which is used to evaluate the first-order false-belief tasks, was developed by Perner et al.[18] In this study, we used to pass and fail rates for group comparisons. The Turkish translation and reliability study of this test was conducted by Girli and Tekin.[19]

**Ice Cream Truck Test:** The ice cream truck test, originally named as ice-cream van, was developed by Perner et al.[18] It is also called the second-order false-belief test. In this study, we used to pass and fail rates for group comparisons. The Turkish translation and reliability study of this test was performed by Girli and Tekin.[19]

**Turgay's DSM-IV-Based Child and Adolescent Behavior Disorders Screening and Rating Scale:** Ercan et al[20] conducted the Turkish validity and reliability study of the scale developed by Turgay to screen disruptive behavior disorders based on the DSM-IV diagnostic criteria. The scale includes items assessing inattention, hyperactivity, impulsivity, opposition/defiance, and conduct disorder.[21] The scale was used to evaluate the individuals included in this study in terms of ADHD and disruptive behavioral disorders and was filled out by parents or teachers.

### Statistical Analysis

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences version 22.0 software (IBM Corp.; Armonk, NY, USA). Descriptive statistics were expressed as mean (SD), median (minimum-maximum), frequency distribution, and percentage. Visual (histogram and probability graphs) and analytical (the Kolmogorov-Smirnov and Shapiro-Wilk tests) methods were used to determine whether the variables followed a normal distribution.

Pearson's correlation coefficient was used to evaluate the correlation between the variables. The Chi-square, Mann-Whitney U, and *t*-tests

**Table 1. Comparison of Sociodemographic Data of ADHD and Control Groups**

| Study parameter | ADHD group median (min-max)/% (n = 42) | Control group median (min-max)/% (n = 41) | Statistics | *P* |
|---|---|---|---|---|
| Age | 12 (12-16) | 13 (12-16) | Z = 1.299 | 0.194 |
| Gender (male) | 52.4% | 56.1% | $\chi^2 = 0.115$ | 0.453 |
| Family structure | | | | |
| Nuclear | 64.3% | 85.4% | $\chi^2 = 5.132$ | 0.077 |
| Extended | 16.7% | 4.9% | | |
| Single parent | 19.0% | 9.8% | | |
| Number of siblings | 2 (1-4) | 2 (1-4) | t = 0.139 | 0.890 |
| Physical illness of the child | 9.5% | 4.9% | $\chi^2 = 0.668$ | 0.413 |
| History of adverse events in the family | 26.2% | 7.1% | $\chi^2 = 5.132$ | 0.011 |
| History of adverse event during pregnancy and birth | 11.9% | 7.1% | $\chi^2 = 0.501$ | 0.478 |

Abbreviations: ADHD, attention-deficit hyperactive disorder; min, minimum; max, maximum.

**Table 2. Comparison of ToM Test Scores**

| Study parameter | ADHD group mean (SD)/% (n = 42) | Control group mean (SD)/% (n = 41) | Statistics | *P* |
|---|---|---|---|---|
| Smarties Test (pass rate) | 100.0% | 97.6% | $\chi^2 = 1.037$ | 0.494 |
| Ice Cream Truck test (pass rate) | 21.4% | 73.2% | $\chi^2 = 22.299$ | 0.001 |
| Faux Pas Recognition Test | 8.60 (3.12) | 18.78 (1.23) | t = 22.517 | 0.001 |
| Child Eyes Tests | 17.79 (3.56) | 21.61 (1.84) | t = 6.160 | 0.001 |

Abbreviations: ToM, Theory of Mind; ADHD, attention-deficit hyperactivity disorder; SD, standard deviation.

**Table 3. Correlation between the Severity of ADHD Symptoms and ToM Test Scores**

| Study parameter | Total Turgay score | Faux Pas Recognition Test |
|---|---|---|
| Total Turgay score | - | - |
| Faux Pas Recognition Test | -0.248 | - |
| Child Eyes Tests | -0.312[a] | 0.356[a] |

Abbreviations: ADHD, attention-deficit hyperactivity disorder; ToM, Theory of Mind.
[a]$P < 0.05$.

**Table 4. ANCOVA Analysis in the Severity of Child Eyes Test Scores with Family Adverse Events as a Covariate**

| Dependent variable | Sum of squares | F | *P* | Eta square |
|---|---|---|---|---|
| Corrected model | 305.224[a] | 18.649 | 0.001 | 0.318 |
| Adverse events | 272.734 | 136.949 | 0.001 | 0.294 |
| ADHD and control group difference | 18.351 | 2.240 | 0.237 | 0.030 |

Abbreviations: ANCOVA, analysis of covariance; ADHD, attention-deficit hyperactivity disorder.
[a]Adjusted R squared = 0.301.

were used for intergroup comparisons. The ToM test scores and sociodemographic variables were entered as confounding variables and compared using the analysis for covariance (ANCOVA) test. Before the analysis, all data were assessed to ensure normal distribution, homogeneity of variance, homogeneity of regression slopes, and sphericity. A *P* value < 0.05 was considered statistically significant.

### Ethical Approval

Approval for the study was granted by the Sakarya University Ethical Committee with approval number 71522473/050.01.04/255 dated May 20, 2020, and verbal informed consent was obtained from the patients, and written informed consent was obtained from the parents or legal guardians of the children.

## Results

There was no significant difference between the group with ADHD and the control group in terms of age, sex, family structure, and the number of siblings. The rate of adverse event history in the family was found to be significantly higher in the group with ADHD (Table 1).

The comparison of the ToM test scores showed a significant difference between the control group and the group with ADHD in terms of the ice cream truck test, faux pas recognition test, and eyes test (Table 2).

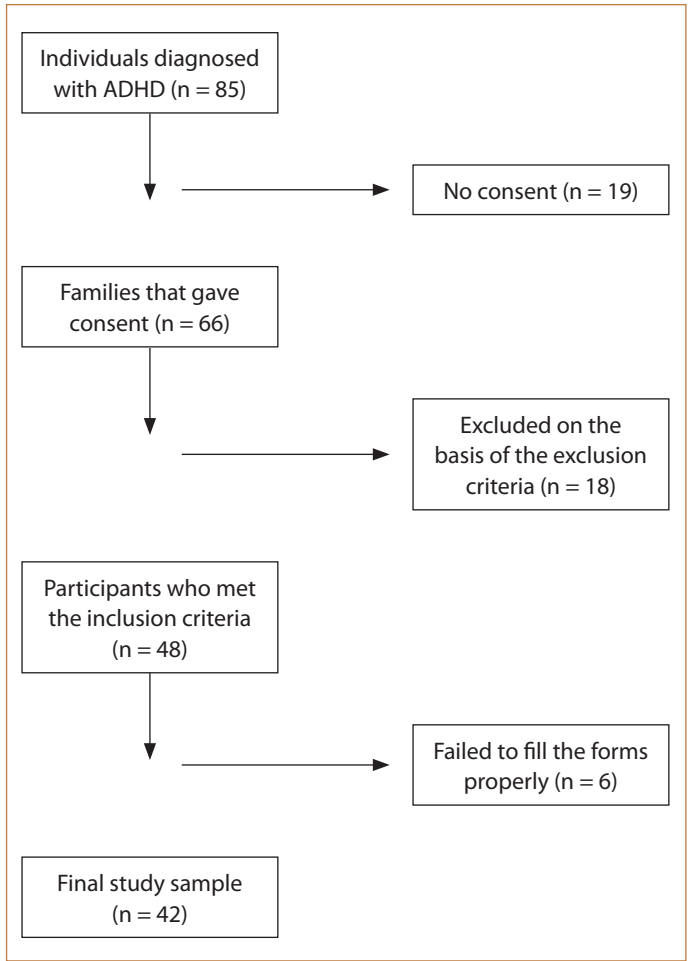


**Figure 1. Sample Selection**
Abbreviation: ADHD, attention-deficit hyperactive disorder.

The relationship between ADHD symptoms and ToM tests was analyzed, and a significant negative correlation was found between the total Turgay scores and the eye test scores (r = -0.312, *P* = 0.030) (Table 3).

The ToM test scores were compared with the ANCOVA test between the group with ADHD and the control group by checking the history of adverse events in the family. The presence of the family history of adverse events was observed to have a significant effect on the eyes test, whereas no significant difference was observed between the 2 groups in terms of the history of adverse events in the family and adjusted child eyes test scores (Table 4).

## Discussion

In this study, the ToM skills of adolescents diagnosed with ADHD were compared with those of the healthy control group. The relationship between the severity of ADHD and these skills was also investigated. A total of 83 individuals aged 12-16 years (42 patients with ADHD and 41 healthy individuals) were included in the study. The groups were observed to have similar characteristics in terms of age, sex, family structure, and the number of siblings.

The results obtained from this study showed that there was no significant difference between the groups in terms of the Smarties Test scores, whereas there was a significant difference in terms of the ice cream truck test, Faux Pas Recognition Test, and eyes test. In the literature, studies are supporting our results. In a study comparing the group with ADHD with the control group with a mean age of 9.8 years, both the groups showed similar results in the first-order false-belief tests, whereas the group with ADHD showed lower scores in the second-order false-belief tests.[22] Similarly, in a study by Perner et al[23] comparing similar groups, no significant difference was found between the groups in terms of first-order false-belief test scores. A study from Turkey compared a group with ADHD with a control group, each including 40 individuals aged 10-16 years. In contrast to our results, the authors have reported no difference between the 2 groups in terms of the ice cream truck test scores. However, a significant difference was reported in the chocolate test, one of the second-order false-belief tests. In the same study, the group with ADHD had lower scores in the eyes test.[24] The eyes test in children has been suggested to be associated with executive functions along with the affective component of ToM and to reflect the contribution of executive functions in understanding facial expressions.[25] It has been shown that children with ADHD fail more in these tests. Therefore, attention and impulsivity problems have been thought to be caused by the weakness of the affective component of ToM.[26] Şahin et al[16] evaluated the ToM performances of children with ADHD, specific learning disabilities, and autism, and also evaluated the ToM performances of healthy individuals aged between 7 and 12 years using the false-belief tests, faux pas test, and child eyes test. The authors observed that the performance of the 3 patient groups was lower than that of the control group, and there was no significant difference between the patient groups in terms of performance. On the contrary, another study found that adolescents with ADHD showed better performance than children with autism and worse performance than the control group in reading the mind in the eyes test. It was further shown in this study that when the effects of attention on the eyes test and the inhibition on the faux pas recognition test were investigated, these 2 factors had no direct effects on ToM performance. These results clarify that poor performance of children with ADHD in reading the mind in the eyes test may be owing to less attention paid to the images and that poor inhibition skills in children with ADHD cause failure in the faux pas recognition test.[12]

In this study, a statistical difference was found between the group with ADHD and the control group in terms of the history of adverse events in the family. The comparison of the presence of a history of adverse events in the family with ToM tests showed that this factor had a significant effect on the eyes test. Adverse events are environmental conditions that are experienced during childhood and adolescence and require social, psychological, or neurobiological adaptation in the child. Each of these conditions affects the mental health and development of the child.[27] Neuroscience studies have shown that certain parts of the brain are most susceptible to stress during the developmental periods.[28] Bowlby[29] suggests that the early childhood years are an important period for the development of ToM. The interaction between the attachment figures helps the development of the ToM by interpreting the beliefs, thoughts, and opinions of the child. Adverse events are thought to be particularly affected by 2 skills: emotional processing and executive functions.[30] Living with a single parent and low socioeconomic level have been reported to be associated with cognitive and inhibitory control skills. In this study, children with similar socioeconomic levels but living with a single parent were observed to show poor performance in both cognitive domains.[29] Adverse events can lead to a lack of consistent rules, routines, and parental supportive behaviors, which have important contributions to the child's development, resulting in executive dysfunction in children.[31] Executive dysfunction contributes to the development of ADHD and symptoms becoming permanent.[27] In a study comparing cognitive skills with the type of events experienced, neglected children were shown to be at a greater risk than maltreated children.[32] Moreover, the severity of neglect causes permanent effects on facial emotion recognition and social cognition skills.[33]

The evaluation of the correlation between ToM tests and the severity of ADHD symptoms showed that there was a significant correlation between the scores obtained from the eyes test and the severity of symptoms. The study conducted by Şahin et al[16] on children with ADHD reported a significant negative correlation between the Turgay[21] scores and all ToM tests. Studies are reporting that neuropsychological test performance scores increase with age.[34] The differences in the results of the two studies may be owing to the age group of the patients included in the study. The age group in this study was older than that in other studies. In a study by Maoz et al[35] involving children aged 6-12 years, patients with ADHD were reported to show poorer performance in the faux pas recognition test. The authors have reported a negative correlation between the ADHD scale scores and test scores in the hyperactivity and impulsivity subtypes of ADHD. In the same study, patients were given methylphenidate and no difference was found in terms of performance when they were compared with healthy controls after methylphenidate treatment.[35] These results suggest that stimulants can be effective in improving the ToM skills through dopaminergic pathways.[36]

The fact that ToM skills were not compared by ADHD subtypes can be considered as one of the limitations of this study. Some studies have reported that there is no difference between ADHD subtypes.[16] Despite the limitations, this study is important because it demonstrates the deterioration of social cognition in ADHD and the effect of adverse events on social cognition.

ToM skills are impaired, and childhood experiences are also effective in this deterioration in ADHD. In light of these results, interventions to be made in early childhood can improve ToM skills. Furthermore, ADHD treatment is of great importance in reducing social and behavioral problems, considering its relationship with the severity of symptoms.

*Ethics Committee Approval:* *Ethics committee approval was received for this study from the Ethical Committee of Sakarya University (Approval Date: May 20, 2020; Approval Number: 71522473/050.01.04/255).*

*Informed Consent:* *Verbal informed consent was obtained from the patients and written informed consent was obtained from the parents or legal guardians of the patients who participated in this study.*

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

*Conflict of Interest:* *The author has no conflict of interest to declare.*

*Financial Disclosure:* *The author declared that this study has received no financial support.*

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