



ARAŞTIRMA / RESEARCH

Comparison of theory of mind abilities in adolescents with attention deficit-hyperactivity disorders and obsessive compulsive disorder

Dikkat eksikliği-hiperaktivite bozukluğu ve obsesif kompulsif bozukluğu olan ergenlerde zihin kuramı yeteneklerinin karşılaştırılması

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Abstract

Purpose: The aim of this study is to compare the theory of mind skills among children and adolescents diagnosed with attention deficit-hyperactivity disorder and obsessive compulsive disorder.

Materials and Methods: Two groups of patients aged between 12-16 years who were diagnosed with obsessive compulsive disorder and attention deficit-hyperactivity disorder diagnostic criteria were included in the study. A detailed form was used for evaluating sociodemographic characteristics and the Wechsler Intelligence Scale (WISC-R) for assessing cognitive functions of patients. In order to evaluate psychopathologies, Schedule For Affective Disorders and Schizophrenia For School-Age Children-present and lifetime version was applied. Theory of mind skills were examined with false belief tests, reading the mind in the eyes task and hinting task.

Results: Adolescents with attention deficit-hyperactivity disorder group showed poorer performance than adolescents with obsessive compulsive disorder in the first and second level theory of mind tests adolescents with attention deficit-hyperactivity disorder group had significantly lower scores of reading the mind in the eyes task than adolescents with obsessive compulsive disorder.

Conclusion: Attention deficit-hyperactivity disorder and obsessive compulsive disorder had differences in theory of mind skills and that theory of mind skills should be reviewed with new methods in addition to the existing methods for diagnosis and treatment.

Keywords: Adolescents, attention deficit and hyperactivity disorder, obsessive compulsive disorder, theory of mind

Öz

Amaç: Çalışmanın amacı dikkat eksikliği-hiperaktivite bozukluğu ve obsesif kompulsif bozukluğu tanısı olan çocuk ve ergenlerde zihin kuramı yeteneklerini karşılaştırmaktır.

Gereç ve Yöntem: Dikkat eksikliği-hiperaktivite bozukluğu ve obsesif kompulsif bozukluk tanısı alan 12-16 yaş arası iki hasta grubu çalışmaya dahil edildi. Sosyodemografik özellikleri değerlendirmek için ayrıntılı bir form ve hastaların zeka seviyelerini değerlendirmek için Wechsler Zeka Ölçeği (WISC-R) kullanılmıştır. Okul Çağı Çocukları için Duygulanım Bozuklukları ve Şizofreni Görüşme Çizelgesi-Şimdi ve Yaşam Boyu Şekli-DSM-5 psikopatolojileri değerlendirmek için kullanılmıştır. Zihin kuramı yetenekleri yanlış inanç testleri, Gözlerden zihin okuma testi ve İma testi ile değerlendirildi.

Bulgular: Dikkat eksikliği-hiperaktivite bozukluğu olan ergenler, birinci ve ikinci seviye zihin kuramı testlerinde obsesif kompulsif bozukluğu olan ergenlere göre daha düşük performans göstermiştir. Dikkat eksikliği-hiperaktivite bozukluğu olan ergenler gözlerden zihin okuma testlerinde obsesif kompulsif bozukluğu olan ergenlere göre anlamlı olarak daha düşük skorlar elde etmiştir.

Sonuç: Dikkat eksikliği-hiperaktivite bozukluğu ve obsesif kompulsif bozukluğunun zihin kuramı becerileri üzerinde farklılıklara neden olduğu sonucuna varılmıştır ve zihin kuramı yeteneklerinin mevcut teşhis ve tedavi yöntemlerine ek olarak yeni yöntemlerle gözden geçirilmesi gerekmektedir.

Anahtar kelimeler: Ergenler, dikkat eksikliği ve hiperaktivite bozukluğu, obsesif kompulsif bozukluk, zihin kuramı

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INTRODUCTION

Social cognition is the ability to understand and explain the mental states such as belief, intention, emotion and imagination of the individuals themselves and others¹. The sub-field 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, metaphor². ToM abilities were first used to explain the symptoms in children with autism by Baron-Cohen³. ToM theory has different components. First-order false belief, Second-order false belief have been identified as components related to the cognitive system⁴. The ability to read the mind in the eyes suggests perceiving the mental situation that goes beyond emotions by affective system in the eye of a person, and this skill reflects one of the processes that determine the ToM^{1,5}. Cognitive component of social cognition (SC) is essential for understanding others' beliefs, and emotional component of SC is important for perceiving what other people are feeling⁶. In psychopathological terms, behavioral symptoms in children with autistic spectrum disorders have been the first area of research for an interest to examine impaired ToM³.

During the last decade, various ToM studies have been conducted on groups diagnosed with the neurodevelopmental disorders especially attention deficit hyperactivity disorder (ADHD). Prior studies reported that children with ADHD have a reduced capacity for social reciprocity and understanding social clues and this social weakness looks like social interaction problems in Autism Spectrum Disorder (ASD). Many social cognition studies emphasized that children diagnosed with ADHD have been inappropriate social behavior problems in the deficiency of giving appropriate social responses and the perception of the behavior of others. The inappropriate social behavior of children diagnosed with ADHD could be etiologically related to ASD⁷.

Following ToM studies were found to be related to other psychopathologies such as schizophrenia, depressive disorder, obsessive-compulsive disorder (OCD) and eating disorders^{8,9}. In addition; the cognitive deficits observed in OCD may be related to ToM skills¹⁰. Neurobiological studies of ToM skills have determined that neural connections between amygdala, anterior cingulate gyrus, superior temporal gyrus and prefrontal area called "frontostriatal

system" are important^{11,12}. Frontostriatal system is believed to also be dysfunctional in OCD and ADHD^{13,14}.

It is known that ToM skills in children and adolescents with ADHD are comparative evaluations to healthy control groups¹⁵. However, there is a lack of research comparing the common psychopathologies of childhood and adolescence to the extent to which they affect ToM skills. It is aimed to compare whether adolescents diagnosed with ADHD and OCD differ in terms of ToM skills.

MATERIALS AND METHODS

This cross-sectional case-control study was conducted at the Tekirdağ State Hospital Department of Child and Adolescent Psychiatry Department. Before initiating the study, participants' parents provided written informed consent. Ethical committee approval of the study was obtained from the local ethics committee of Namık Kemal University Medical School on the date of 30.05.2019 with the decision number 2019.60.04.07.

Enrollment criteria included: (a) age 12-16 years; (b) meet criteria ADHD and OCD 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 included 30 patients with ADHD and 30 patients with OCD. 33 participants diagnosed with ADHD were interviewed but 2 patients did not agree to join and 1 patient did not fill the forms. 33 participants diagnosed with OCD were interviewed but 1 patient did not agree to join and 2 patients did not fill the forms. All participants examined by same child and adolescent psychiatrist

Measures

Sociodemographic form

This form was developed by the researchers to determine the sociodemographic characteristics of the patients included in the study. The form for children included data about age, sex, neuromotordevelopment stages, literacy learning

time, academic achievement, medical history, and the form for their first/second-degree relatives included data about the education level, living place of the parents, and psychiatric/medical genealogical information.

Affective Disorders and Schizophrenia Interview Schedule for School Age Children - Now and Lifelong Form (K-SADS-PL-DSM-5)

(K-SADS-PL-DSM-5) is a semi-structured interview form to identify current and lifelong psychopathology in children and adolescents. The validity and reliability study of the scale was conducted for Turkish sample¹⁶.

Wechsler Intelligence Scale for Children-Revised form (WISC-R)

This scale measures the intelligence levels of children between the ages of 6 and 16 years. It was adapted for the Turkish culture by Savasir and Sahin¹⁷.

First Level False Belief Tests

In these tests, the subject should understand that a change in the state of an object knows that a character in the story knows, but the other person does not know it, and foresees the action of the other person based on this separation¹⁸. One of the first level false belief tests, Sally-Anne test and Smarties test were used in the study. Sally-Anne test was developed in 1983 by Wimmer and Perner¹⁹, Baron-Cohen et al. has been modified by²⁰. Smarties test was developed by Hogrefe, Wimmer and Perner²¹. Both tests were translated into Turkish and reliability studies were conducted by Girli and Tekin²².

Second Level False Belief Tests

In these tests require the subject to predict the person in the story by considering the knowledge of another character about a third person¹⁸. Chocolate bar task and Ice-cream truck task were used in the study. Chocolate test was developed by Flobbe et al.²³. The Ice-Cream Van test was developed by Perner and Wimmer in 1985²⁴. Both tests were translated into Turkish was conducted by Girli and Tekin²².

Reading The Mind in the Eyes Task-Child Version

It is one of the advanced mind theory tests and was developed by Baron-Cohen et al.²⁵. The eyes test requires inferences about a person's mental state by just looking at people's eye photographs. In addition, it includes functions such as face detection and

emotion recognition²⁶. In this study, the Turkish version of the mind reading test by Alev Girli was used²⁷.

Hinting Task

It is an advanced mind theory test developed by Corcoran et al. It examines the ability to predict the true intent behind indirect verbal expressions. There are 10 short paragraphs describing communication between two people and ending with one implying one to another. The participant is asked what the person actually wants to say. If the participant does not answer correctly to the first implication question, the question with a more explicit implication is passed. If the correct answer is given for the first implication, 2 points will be given; if the correct answer to the implied question is given correctly, 1 point is given; and if both implied questions are not answered correctly, 0 points are given. A total of 20 points can be obtained²⁸.

Statistical analysis

Data were analyzed using SPSS 25.0 software. The findings were given as number, percentage, mean, standard deviation (SD), median and interquartile range (IQR). The suitability of numerical variables to normal distribution was examined by Shapiro - Wilk test. The homogeneity of variances was examined by Levene test. While age, total IQ scores the ADHD and OCD groups were compared with one-way ANOVA test; Gender, mother and father education were compared using chi-square test. Comparison of test scores between groups was performed using Pearson correlation analysis was used for correlation analysis between numerical data. All hypotheses were bidirectional and statistical significance level was considered as $p < 0.05$.

RESULTS

OCD and ADHD groups consisted of 30 individuals. 46.7% ($n = 14$) of the patients were female and 53.3% ($n = 16$) were male, and the patients were between the ages of 12-16. No significant difference was found between WISC-R performance ($t = 0.773$; $p = 0.442$), verbal ($t = 1.757$; $p = 0.084$) and total ($t = 0.685$; $p = 0.496$) scores of OCD and ADHD groups (Table 1).

All children in OCD and ADHD group (100%, $n = 60$) were successful in the Smarties test ($p=1,000$). The rate of those who were successful in the Sally-

Anne test (93.3%, n = 28) in OCD group was higher than ADHD group (73.3%, n = 22). ($\chi^2=4,320$; $p=0,038$). While OCD group and ADHD group were evaluated for false belief tests, 1st level false belief tests and 2nd level false belief tests were evaluated by classification. For the first level tests, the failure rate

of OCD group (6.7%; n = 2) was lower than the failure rate of ADHD group (26.7%; n = 8) ($\chi^2=4,320$; $p=0,038$). For the second level tests, the failure rate of OCD group (13.3%, n = 4) was lower than the failure rate of ADHD group (33.3%, n = 10). ($\chi^2=6,966$; $p=0,018$).

Table 1. Sociodemographic characteristics of OCD and ADHD group

		OCD	ADHD	Test statistics	p
Age (mean \pm sd)		13.73 \pm 1.48	13.37 \pm 1.32	X ² =4.036	0,303
Gender:%;(n)					
	Female	%53.3 (16)	%53.3 (16)	X ² =5.753	>0,99
	Male	%46.7 (14)	%46.7 (14)		
Maternal Education	Elementary	10	10	0.07	0,999
	High School	10	10		
	Univercity	10	10		
Paternal Education	Elementary	10	9	0.07	0,999
	High School	11	11		
	Univercity	9	10		
Wisc-r performance: mean \pm sd		94.60 \pm 12.244	100.17 \pm 12.298	z=1.757	0.084
Wisc-r verbal: mean \pm sd		95.43 \pm 13.801	92.97 \pm 10.708	z=0.773	0.442
Wisc-r total: mean \pm sd		94.57 \pm 10.298	96.40 \pm 10.444	z=0.685	0.496

ADD: attention deficit hyperactivity disorder, OCD: obsessive-compulsive disorder, WISC-R: Wechsler Intelligence Scale

In OCD group, the percentage of those who were successful in the Chocolate Bar test (93.3%, n = 28) was higher than ADHD group (73.3%, n = 22) ($\chi^2=4,320$; $p=0,038$). The percentage of those who were successful in the Ice-Cream Truck test (93.3%, n = 28) was higher in the group of patients with OCD than those of ADHD group (63.3%, n = 19) ($\chi^2=6,273$; $p=0,012$) (Table 2). The mean score of the

Eye-Mind Reading Test-Child Version (20.8 \pm 2.1) in OCD group was higher than the mean score of ADHD group (16.6 \pm 1.4); and this was statistically significant (t=6,102; $p<0,001$). The mean score of Hinting Task (17.8 \pm 1.6) in the OCD group was higher than the mean score of ADHD group (14.1 \pm 1.1), and this was statistically significant (Z=6,255; $p<0,001$) (table 3).

Table 2. Distribution of general correct numbers of first and second level tests according to groups.

		ADHD		OCD		χ^2	p
		n	%	n	%		
Sally-anne test	True	28	93.3	22	73.3	4.320	0.038
Smarties test	True	30	100.0	30	100.0		
General evaluation of Level 1 false belief tests	True	28	93.3	22	73.3	4.320	0.038
Chocolate test	True	28	93.3	22	73.3	4.320	0.038
Ice-cream Truck Test	True	28	93.3	19	63.3	7.954	0.005
General evaluation of Level 2 false belief tests	True	26	86.7	17	56.7	6.966	0.018

ADHD: attention deficit hyperactivity disorder, OCD: obsessive-compulsive disorder

Table 3. The distribution of the average scores of Reading the Mind in the Eyes Task and Hinting Task.

mean \pm sd	OCD	ADHD	Test statistics	p
Reading The Mind in the Eyes Task:	20.8 \pm 2.1	16.6 \pm 1.4	z=6.102	P<0.001
Hinting Task	17.8 \pm 1.6	14.1 \pm 1.1	Z=6.255	p<0.001

ADHD: attention deficit hyperactivity disorder, OCD: obsessive-compulsive disorder

DISCUSSION

It is known that there are studies evaluating ToM skills of adolescents and children with ADHD compared to their healthy peers; however, the number of studies evaluating ToM abilities of ADHD adolescents with different psychopathological patient groups is extremely low in the literature. This study aims to contribute to the gap in the literature by comparing ToM skills in adolescents with ADHD and OCD. The most powerful aspect of the study is that it is the first study comparing the ToM effects of ADHD and OCD, which are common psychopathologies among adolescents and children.

ToM tests were applied to all adolescents. The results of our study can be summarized as follows: (1) In the first and second level false belief tests, the patients with ADHD had significantly lower scores than the patients with OCD. When all of the false belief tests were evaluated, ADHD group showed significantly lower performance in basic ToM skills compared to OCD group. (2) In the mind reading and implication tests from the eyes where advanced ToM skills were evaluated, ADHD group showed significantly lower performance than OCD group.

Consistent with our results, the previous ToM studies report that the first level false belief test performance deteriorates in children with ADHD compared to healthy control^{29,30,31}. Today's findings showed that second level false belief test performance in ADHD group is significantly worse than OCD group. There are also studies consistent with the study showing that children with ADHD and high-functional autism spectrum disorder (HFASD) perform poorly in ToM tests, especially in the second-level false belief field, compared to healthy control³². In a study conducted with ADHD, ASD, ADHD + HFASD and healthy control group, ToM performance was lower in the groups with ADHD symptoms³³. Previous ToM studies with children diagnosed with ADHD have shown different results from the study^{34,35}. Miranda et al. previously evaluated ToM and executive functions on ADHD, HFASD and healthy control groups. ADHD, HFASD groups showed low ToM performance than healthy control groups³⁶. Present results are similar to the findings of previous studies, where ADHD group performed poorly. Different studies determined that attention deficit/hyperactivity disorder, oppositional defiant disorder and depression and anxiety rates were higher in children diagnosed with ADHD than in children

with typical development children^{37,38}.

In prior studies, attention has been reported to have a significant effect on the performance of reading the mind in eyes and facial recognition³⁹. In this study, it was found that adolescents diagnosed with ADHD had poorer mind reading performance compared to adolescents with OCD. Sinzig et al.³³ examined ADHD, HFOSB, ADHD + HFOSB, and the control group for mind reading and facial recognition test results. Consistent with the study, it was reported that ADHD group showed significantly lower performance and the presence of ADHD symptoms reduced the ability to reading mind from the eyes in ADHD and HFOSB groups.

The study has some methodological limitations. First of all, we used an inappropriate sampling method for participants due to limited time and resources. As a relatively small sample is studied, ToM studies need to be repeated with larger ADHD and OCD groups. Subtypes of ADHD and should be evaluated in terms of ToM skills. The majority of patients with ADHD and OCD were receiving medical treatment and the life-time tic comorbidity of patients was not controlled. It is an important deficiency that the healthy control group is not included in the study. The other limitation of the study was the lack of assessment of effective functions with ToM tests. Furthermore, the cross-sectional study does not provide information about the progression of ADHD and OCD, treatment resistance or changes in symptomatology and the development of ToM impairment. These restrictions may affect the generalizability of results.

Consistent with previous studies, our study demonstrated strong evidence that ADHD affects negatively ToM skills. ADHD groups performed poorly compared to OCD group in basic and advanced ToM tests. Despite mentioned limitations, It is known that SC and ToM in children and adolescents with ADHD are comparative evaluations to healthy control groups but comparative studies with OCD have not been found. The fact that our sample was kept in a narrow range, such as 12-16 years, only adolescents, adds value to our study. The future studies are needed which healthy control group is also included in the comparisons and whether ToM deficiencies will improve with ADHD's standard treatment. Effective interventions for ToM deficiency may assist ADHD treatment in adolescents.

Yazar Katkıları: Çalışma konsepti/Tasarım: FD; Veri toplama: FD, NÖM; Veri analizi ve yorumlama: FD; Yazı taslağı: FD; İçeriğin eleştirel incelenmesi: FD; Son onay ve sorumluluk: FD; Teknik ve malzeme desteği: FD Süpervizyon: -; Fon sağlama (mevcut ise): yok.

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REFERENCES

- Baron-Cohen S, Wheelwright S, Hill J. The "Reading the Mind in the Eyes"; test revised version: a study with normal adults, and adults with Asperger syndrome or high-functioning autism. *J Child Psychol Psychiatry*. 2001;42:241–51.
- Yıldırım E, Alptekin K. A new featured dimension in schizophrenia: social cognition. *Dusunen Adam. J Psychiatr Neurol Sci*. 2012;25:368-75.
- Baron-Cohen S, Leslie AM, Frith U. Does the autistic child have a "theory of mind"? *Cognition*. 1985;21:37–46.
- Bach LJ, Happe F, Fleming S, Powell J. Theory of mind: independence of executive function and the role of the frontal cortex in acquired brain injury. *Cogn Neuropsychiatry*. 2000;5:175-192.
- Baron-Cohen S, Wheelwright S, Spong A. Are intuitive physics and intuitive psychology independent? A test with children with Asperger syndrome. *J Dev Learn Disord*. 2001;5:47–78.
- Tager-Flusberg H, Sullivan K. A componential view of theory of mind: evidence from Williams syndrome. *Cognition*. 2000;76:59-90.
- Nijmeijer JS, Minderdaa RB, Buitelaar JK, Mulligan A, Hartman CA. Attention-deficit/hyperactivity disorder and social dysfunctioning. *Clin Psychol Rev*. 2008;28:692-708.
- Caillies S, Bertot V, Motte J. Social cognition in ADHD: irony understanding and recursive theory of mind. *Res Dev Disabil*. 2014;35:3191–8.
- Percinel I, Ozbaran B, Kose S. Increased deficits in emotion recognition and regulation in children and adolescents with exogenous obesity. *World J Biol Psychiatry*. 2018;19:112–18.
- Sayin A, Oral N, Utku C. Theory of mind in obsessive-compulsive disorder: comparison with healthy controls. *Eur Psychiatry* 2010;25:116–22.
- Abu-Akel A. A neurobiological mapping of theory of mind. *Brain Res Rev*. 2003;43:29–40.
- Henry JD, Philips LH, Crawford JR, Ietswaart M, Summers F. Theory of mind following traumatic brain injury: the role of emotion recognition and executive dysfunction. *Neuropsychologia*. 2006;44:1623–8.
- Savage CR, Baer L, Keuthen NJ, Brown HD, Rauch SL. Organizational strategies mediate nonverbal memory impairment in obsessive-compulsive disorder. *Biol Psychiatry*. 1999;45:905–16.
- Castellanos F. Neuroimaging of attention deficit hyperactivity disorder. *Child Adolesc Psychiatric Clin N Am*. 1997;6:383-411
- Uekermann J, Kraemer M, Abdel-Hamid M, Schimmelmann BG, Hebebrand J, Kis B. Social cognition in attention-deficit hyperactivity disorder (ADHD). *Neurosci Biobehav Rev*. 2010;34:734–43.
- Ünal F, Öktem F, Çetin Çuhadaroğlu F, Çengel Kültür S, Akdemir D, Foto Özdemir D. Okul Çağı Çocukları için Duygulanım Bozuklukları ve Şizofreni Görüşme Çizelgesi-Şimdi ve Yaşam Boyu Şekli-DSM-5 Kasım 2016-Türkçe geçerlilik ve güvenilirliği. *Türk Psikiyatri Derg*. 2019;30:42-50.
- Savaşır I, Şahin N. Wechsler Intelligence Scale for Children-Revised form (WISC-R) (1995). Turkish Psychological Association Publications, Ankara.
- Bora E. Theory of mind in schizophrenia spectrum disorders. *Türk Psikiyatri Derg*. 2009;20:269- 81.
- Wimmer H, Perner J. Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*. 1983;13:103- 28.
- Baron-Cohen S, Leslie AM, Frith U. Does the autistic child have a 'theory of mind'? *Cognition*. 1985;21:37-46.
- Hogrefe GJ, Wimmer H, Perner J. Ignorance versus false belief: a developmental lag in attribution of epistemic styles. *Child Dev*. 1986;57:567-82.
- Girli A, Tekin D. Investigating false belief levels of typically developed children and children with autism. *Procedia Soc Behav Sci*. 2010;2:1944- 50.
- Flobbe L, Verbrugge R. Children's application of Theory of Mind in reasoning and language. *J Log Lang Inf*. 2008;17:417-42
- Perner J, Wimmer H. 'John thinks that Mary thinks that...'. Attribution of second-order beliefs by 5-10 years old children. *J Exp Child Psychol*. 1985;39:437-71.
- Baron-Cohen S, Jolliffe T, Mortimore C et al advanced test of theory of mind: evidence from very high functioning adults with autism or Asperger Syndrome. *J Child Psychol Psychiatry*. 1997;38:813-22.
- Baron-Cohen S, Wheelwright S, Spong A. Are intuitive physics and intuitive psychology independent? A test with children with Asperger Syndrome. *J Dev Learn Dis* 2001;5:47-78.
- The Autism Research Centre, http://www.autismresearchcentre.com/arc_tests. (accessed 28.10.2012).

28. Corcoran R, Mercer G. Schizophrenia, symptomatology and social inference: investigating theory of mind in people with schizophrenia. *Schizophr Res.* 1995;17:5-13.
29. Demurie E, DeCorel M, Roeyers H. Empathic accuracy in adolescents with autism spectrum disorders and adolescents with attention deficit/hyperactivity disorder. *Res Autism Spectr Disord.* 2011;5:126-134.
30. Demopoulos C, Hopkins J, Davis A. A comparison of social cognitive profiles in children with autism spectrum disorders and attention-deficit/hyperactivity disorder: a matter of quantitative but not qualitative difference? *J Autism Dev Disord.* 2013;43:1157-70.
31. Baribeau DA, Doyle-Thomas KA, Dupuis A, Iaboni A, Crosbie J, McGinn H et al. Examining and comparing social perception abilities across childhood-onset neurodevelopmental disorders. *J Am Acad Child Adolesc Psychiatry.* 2015;54:479-86.
32. Buitelaar JK, Van der Wess M, Swaab-Barneveld H, Van der Gaag RJ. Theory of mind and emotion-recognition in autism spectrum disorders and in psychiatric control and normal children. *Dev Psychopathol.* 1999;11:39-58.
33. Sinzig J, Morsch D, Lehmkuhl G. Do hyperactivity, impulsivity and inattention have an impact on the ability of facial affect recognition in children with autism and ADHD? *Eur Child Adolesc Psychiatry.* 2008;17:63-72.
34. Adachi T, Koeda T, Hirabayashi S, Maeoka Y, Shiota M, Wright EC et al. The metaphor and sarcasm scenario test: A new instrument to help differentiate high functioning pervasive developmental disorder from attention deficit/hyperactivity disorder. *Brain Dev.* 2004;26:301-6.
35. Downs A, Smith T. Emotional understanding, cooperation, and social behavior in high-functioning children with autism. *J Autism Dev Disord.* 2004;34:625-35.
36. Miranda A, Berenguer C, Rosell B, Baixauli I, Colomer C. Social cognition in children with high-functioning autism spectrum disorder and attention-deficit/hyperactivity disorder: associations with executive functions. *Front Psychol.* 2017;8:1035.
37. Kim JA, Szatmari P, Bryson SE, Streiner DL, Wilson FJ. The prevalence of anxiety and mood problems among children with autism and Asperger syndrome. *Autism.* 2000;4:117-132.
38. Reiersen AM, Todd RD. Co-occurrence of ADHD and autism spectrum disorders: phenomenology and treatment. *Expert Rev Neurother.* 2008;8:657-69.
39. Berggren S, Engström AC, Bölte S. Facial affect recognition in autism, ADHD and typical development. *Cogn. Neuropsychiatry.* 2016;21:213-27.