Curr Dev Disord Rep (2017) 4:72–77
DOI 10.1007/s40474-017-0114-1

ADHD (C COLOMER DIAGO, SECTION EDITOR)

Executive Functioning, Social Cognition, Pragmatics, and Social Interaction in Attention Deficit Hyperactivity Disorder and Autism Spectrum Disorder

Belén Roselló[1,2] · Carmen Berenguer[1] · Pilar Navío[1] · Inmaculada Baixauli[2] · Ana Miranda[1]

Published online: 5 July 2017

Abstract
Purpose of Review This review synthesizes the most relevant literature on similarities and differences between autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) in four developmental domains.
Recent Findings Regarding executive functioning (EF), children with ASD present greater deficits in planning and flexibility, whereas problems with inhibitory control are more severe in ADHD. With respect to theory of mind (ToM) impairments, the ASD group is more affected, and difficulties occur later in ADHD. In pragmatics, both groups exhibit problems with coherence or inappropriate beginnings, however, children with ADHD have a better performance on stereotyped language and non-verbal communication. Finally, in contrast with children with ASD, participants with ADHD demonstrate knowledge of social skills, but they experience problems in performing social behaviors.
Summary In terms of impairments, children with ADHD are located in an intermediate point between ASD and typical development (TD). Clinical implications are highlighted, and recommendations for future research are discussed.

This article is part of the Topical Collection on *ADHD*

✉ Belén Roselló
m.belen.rosello@uv.es

[1] Universidad de Valencia, Valencia, Spain

[2] Universidad Católica de Valencia, Valencia, Spain

Keywords Autism · ADHD · Executive functions · Theory of mind · Pragmatics · Social adaptation

Introduction

Attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) are two of the most common neurodevelopmental problems, and they share genetic alterations and functional and structural brain characteristics [1]. The prevalence rates are high, reaching about 6.5% in ADHD [2] and one in 68 children in ASD [3]. Although the diagnoses of ASD and ADHD are based on different criteria, the attentional deficits and excessive activity and impulsivity that characterize ADHD are often observed in ASD. In fact, early attention shifting and disengaging impairments may precede the onset of clinical manifestations of ASD, ADHD, or both disorders [4••]. Conversely, the communication difficulties or social interaction deficits typical of ASD are also usually present in ADHD [5•].

However, beyond the overlapping of their diagnostic symptoms, an increasingly solid body of research indicates that these two neurodevelopmental disorders share common deficits with certain differences in cognitive areas that could be considered phenotypes of interest: executive functioning (EF), theory of mind, socialization, and pragmatic language. The present review will analyze the profiles of children with ASD and children with ADHD in different domains, based on findings from studies on similarities and possible divergences. This approach opens up interesting possibilities for the analysis of the underlying physiopathology, and it can help to provide the basis for specific strategies to optimize the efficacy of interventions in these two disorders.

Executive Functioning of Children with ASD and Children with ADHD

The executive functions include a broad range of processes associated with the prefrontal and thalamic-reticular areas of the brain. These processes are responsible for directing and regulating cognitions, emotions, and behavior in order to reach a desired goal [6]. Executive dysfunction has been proposed as a possible cognitive phenotype of ASD and ADHD, helping to explain the main ADHD symptoms [7] and, more specifically, the restrictive interests and repetitive behaviors characteristic of ASD [8].

The possible specificity of the executive functions in ASD and ADHD opens up interesting possibilities for analysis and can provide valuable information about possible antecedents of the behavioral symptoms. The literature suggests that children with ASD present greater difficulties in planning and flexibility, whereas problems with inhibitory impulse control would be more severe in children with ADHD. Response inhibition deficits have also been observed in ASD, although the evidence is less consistent [5•].

Recent findings offer data that help to specify the EF profiles of the two disorders. Children with ASD have more sustained attention failures [9] and make more planning errors than children with ADHD, and these deficits seem to be mediated by processing speed and motor coordination [10]. By contrast, children with ADHD show significant deficits on inhibition tasks compared to neurotypical children [9].

However, some studies do not support the existence of a specific memory function profile of children with ASD compared to children with ADHD. On spatial working memory [11], children with ADHD obtained worse performance than children with typical development (TD) and children with ASD, with no differences found between the two clinical groups. On verbal working memory and delayed recall tasks, only children with ASD and symptoms of attention problems had more deficits than the ADHD and ASD groups without attentional problems [12].

The ADHD subtype, assessment procedures, and age are factors that must be taken into account due to their influence on modulating the results. Regarding the role played by the ADHD subtypes, the few studies that have addressed this question suggest that children with ASD experience more severe impairments in behavioral regulation [13] and shifting [14] than children with ADHD, regardless of whether the subtype is predominantly inattentive or combined.

The EF impairment is more extensive in children with ADHD when EF rating scales are applied that collect real life information from significant people who know the subject well, rather than neuropsychological tasks. A recent study [15] used ecological ratings of EF to compare children with ADHD and children with ASD. The results reveal that both groups showed differences from the group with TD on all the EF assessed by the BRIEF: inhibition, shift, emotional control, working memory, planning, organizing materials, monitoring, and the behavioral, metacognitive, and general indices. In addition, the children with ADHD showed more significant deficits than the children with ASD on inhibition, working memory, planning, and the metacognitive index.

Regarding the changes in EF associated with age, an exhaustive review concludes that, although more longitudinal studies are needed, the EF impairments of individuals with ADHD continue to be present in adult life. However, the stability of the impairments in the trajectory from childhood to old age is still unclear. Moreover, it is evident that many adolescents and adults with ASD, in spite of the improvements that occur with development, do not achieve scores within the normal range on the application of EF skills in daily life [16].

Finally, a promising research avenue points out that different EF patterns can be identified in various subgroups of children with ADHD. At least one relatively intact group has been identified, as well as a second group with poor inhibitory control and a third group with poor set-shifting/speed and performance. This latter group is more seriously affected, showing lower academic achievement and cognitive development and more ADHD and oppositional defiant disorder (ODD) symptoms [17].

Social Cognition of Children with ASD and Children with ADHD

Social cognition is a multifaceted construct that includes a wide range of processes, with emotion recognition and theory of mind (ToM) being particularly important. ToM is defined as the cognitive capacity to attribute mental states such as beliefs, desires, thoughts, and intentions to other people, thus making it possible to explain, manipulate, and predict behavior.

Results from studies that have explored social cognition in ASD and ADHD are not completely consistent in terms of whether the two syndromes show comparable severity. Along general lines, the findings suggest that there is a continuum of ToM impairments. The ASD group is more affected, and the ADHD performance falls between that of the TD and ASD groups, both on false belief tasks that assess explicit knowledge [18–20] and in the application of ToM skills to everyday contexts [21••, 22]. However, some studies have found similar performance by ADHD and HFA groups on second-order ToM tasks [23]. Moreover, there are two factors whose presence is associated with a risk of more severe ToM and emotion recognition deficits in children

with ADHD, compared to children with ASD: comorbidity with ODD [24] and the presentation of ADHD along with ASD symptoms [25].

The development of ToM skills probably follows different paths in ADHD and ASD, marking a different development of the impairments. Thus, when ToM skills are examined by comparing groups of children and adolescents, a significant difference is observed in facial affect recognition between the youngest ASD and ADHD groups (ASD < ADHD), whereas this difference is not found in the older groups. These results indicate that ToM deficits occur later in ADHD than in ASD, and parental stimulation and experiences with peer groups may influence their course [26].

A meta-analysis [27•] provides detailed information about social cognition in individuals with ADHD, with ASD, and with TD. The main conclusion highlights that social cognition impairments are not specific to ASD. The low performance on ToM tasks is significantly worse in individuals with ASD than in individuals with ADHD. However, on emotion recognition, especially anger and fear, and on ToM tasks, the children with ADHD have worse performance than the groups with TD. Likewise, although overlapping of impairments is observed between ASD and ADHD, different trajectories are found for the socio-cognitive deficits, so that subjects with ASD have more pronounced impairments in all the developmental stages.

The procedure for assessing ToM skills, whether through direct performance on tasks or through ecological information about the application of the skills in real life, introduces nuances into the results on social cognition. The group with ASD has worse performance than the ADHD and TD groups on different types of ToM tasks, both those that evaluate conceptual ToM knowledge (explicit knowledge) and on inventories that collect information about situations in daily life. However, the profile of the ADHD group can vary depending on the evaluation procedure. Specifically, the ADHD group's performance level is equal to that of the TD group on explicit tasks, whereas impairments in the application of ToM skills in daily life contexts are evident. One possible explanation is that these problems involve affect regulation and motivation, "hot" executive functions that are challenging for individuals with ADHD [21••].

The relationships between ToM and the executive functions in ASD and ADHD have aroused little interest, but the scant information available so far indicates that the link between ToM and EF is different in each of these disorders. Specifically, behavioral regulation (inhibition and emotional control) shows a stronger association with social cognition in children with ADHD, whereas metacognitive processes such as initiative and planning have a greater association with social cognition skills in ASD [22].

Pragmatic Language of Children with ASD and Children with ADHD

Pragmatic skills are essential for interactions with classmates and for socioemotional development. They are related to social skills and emotion comprehension; thus, contemporary approaches define pragmatic skills as "behavior that includes social, emotional, and communicative aspects of social language" [28]. It is a heterogeneous construct that can be divided into separate domains that include discourse management (skills to start, maintain, and end a conversation, taking turns, prosody), suppositions (assumptions about the speaker and the specific social context, theory of mind), and non-verbal communication behaviors (eye contact, body and facial expressions).

A large percentage of children with ADHD experience problems with pragmatic language and social skills that are qualitatively quite similar to the socio-communicative functioning deficits characteristic of autism [29]. More specifically, in contrast to 3.6% of children with TD, more than 80% of children with ADHD and 90% of children with ASD have communication impairments [30] that present similitudes. Both individuals with ADHD and those with ASD show impairments in *coherence* (a similar lack of clarity in their accounts, alterations in time sequence …) and *inappropriate beginnings* (addressing others too quickly, tendency toward logorrhea…). However, the children with ADHD have better performance on stereotyped language and non-verbal communication, which are typical autism symptoms, such as pedantic language, use of favorite phrases, lack of facial expression, or little eye contact [30, 31].

Research on pragmatic skills has recently focused on the study of narratives. Comparisons of the two neurodevelopmental disorders with TD show that the narratives of children with ASD and children with ADHD are less coherent and shorter than narratives produced by children with TD. In addition, the ASD group, unlike the ADHD group, produces fewer pronominal references and fewer mentalist cognitive terms than the TD group [32]. According to a recent study, the ASD and ADHD impairments affect not only the coherence and cohesion of the narratives, but also the syntactic complexity. Regarding the differences between the two disorders, the children with ADHD, but not those with ASD, show difficulties in the choice of referential expressions and speech fluency. In addition, the majority of the narrative skills have a significant relationship with the ToM and working memory, which suggests their involvement in language production impairments [33••].

Social Interaction of Children with ASD and Children with ADHD

Difficulties in social interaction constitute a diagnostic criterion of ASD, but children with a diagnosis of ADHD also usually have poor social skills, even though they are not a core feature of the disorder. They have fewer and less lasting friendships, they suffer greater social rejection, and they exhibit more social inhibition behaviors than their peers without the diagnosis [34]. The literature generally shows that alterations in the social domain are less severe in children with ADHD than those in children with ASD. The possible qualitative differences between the two neurodevelopmental disorders have been studied less. The DSM-5 recommends basic guidelines to help to distinguish the social interaction impairments in ASD and ADHD: "the social dysfunction and peer rejection seen in individuals with ADHD must be distinguished from the social disengagement, isolation, and indifference to focal and tonal communication cues seen in individuals with ASD" [35].

The findings show that these two neurodevelopmental disorders obtain lower scores than the group with TD on parents' and teachers' ratings of social skills. From early childhood, young children with ASD symptoms are more impaired on the adaptive scales than those with symptoms of ADHD, regardless of whether the subtype is predominantly inattentive or combined [36]. The challenge then is to identify social interaction profiles of children with ASD and children with ADHD. The profile of the sociocognitive deficits of the two disorders is almost identical, although the group with ASD is more affected [19], as they experience more serious impairments, especially related to withdrawal and avoidance of social interaction [37]. Findings from more specific studies [38] report that the specific deficits vary between the groups: children with ASD lack adaptive social skills, whereas children with ADHD demonstrate knowledge of social skills, but they show maladaptive social behaviors.

The majority of studies that have analyzed the overlap/differentiation between the ASD and ADHD social symptomatology have used parent or teacher report measures. However, recent studies have applied a standardized observation procedure, such as ADOS (Autism Diagnostic Observation Schedule) [39] to characterize differences in social interaction related to both the ASD and ADHD symptomatology. Differences have been found in communication and social interaction on the ADOS across diagnostic groups, with greater impairment observed for the ASD group and lower scores for the ADHD and no diagnosis groups [40]. Specifically, four social communication symptoms framed in the domain of social-emotional reciprocity and non-verbal communication behaviors from the ADOS effectively discriminate between children with ADHD and children with ASD: quality of social overtures, amount of reciprocal social communication, unusual eye contact, and facial expressions directed to the examiner. These four items described more than 66% of the ASD group and less than 33% of the ADHD group [41].

Discussion

The findings provided by the studies included in this brief review show that impairments in EF, ToM, and pragmatic skills affect children with ADHD and children with ASD. The similarities of the deficits might justify why a large number of children have been alternatively given a diagnosis of one disorder or the other. However, the severity of the symptoms of the children with ADHD in the different domains analyzed lies in an intermediate position between the ASD group and the TD group. This panorama fits the gradient overarching disorder theory, which argues that ADHD is a less severe subtype on the autism spectrum [42], so that individuals who present a more serious form of ADHD are also more likely to present an increase in ASD symptoms.

Considerable progress has been made in recent years, but some questions remain that will have to be clarified by studies that broaden the objectives following rigorous methodological guidelines. A first challenge focuses on the study of the interrelationships among the EF, the ToM, the pragmatic skills, and the complex mediation paths between these three factors and social interaction impairments present in both ASD and ADHD. There are indications that EF and ToM deficits may impair pragmatic communication and, in turn, lead to problems with social and peer relationships. Second, it is necessary to carry out longitudinal studies in order to determine the changes in individuals with ASD versus ADHD throughout the life cycle in different functioning domains. Another challenge consists of extending the focus of analysis to the subgroup with both ASD and ADHD symptomatology, in an attempt to shed more light on the effects of this association on different neurocognitive parameters.

Compliance with Ethical Standards

Conflict of Interest Belén Roselló, Carmen Berenguer, Inmaculada Baixauli, Pilar Navio and Ana Miranda declare that they have no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Gargaro BA, Rinehart NJ, Bradshaw JL, Tonge BJ, Sheppart DM. Autism and ADHD: how far have we come in the comorbidity debate? Neurosci Biobehav Rev. 2011;35:1081–8.
2. Willcutt EG. The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a met-analytic review. Neurotherapeutics. 2012;9:490–9.
3. Christensen L, Baio J, Van Naarden K, Bilder D, Charles J, Constantino MD, et al. Prevalence and characteristics of autism spectrum disorders among children aged 8 years. Autism and developmental disabilities monitoring network, 11 sites, United States, 2012. Surveill Summ. 2016;65:1–23.
4. •• Visser JC, Rommelse N, Greeven CU, Buitelaar J. Autism spectrum disorder and attention-deficit/hyperactivity disorder in early childhood: A review of unique and shared characteristics and developmental antecedents. Neurosci Biobehav Rev. 2016;65:229–63. **The review is focused on the temperament (approach/surgency, negative affect, and effortful control) and executive function (working memory, inhibition, and cognitive flexibility) in ASD and ADHD from infancy to preschool years. It concludes that ASD and ADHD share negative affect, although with different motivational and behavioral dispositions. They also share deficits in control and flexibility, but with the implication of divergent behaviors**.
5. • Miranda-Casas A, Baixauli-Fortea I, Colomer-Diago C, Roselló-Miranda B. Autism and attention deficit hyperactivity disorder: similarities and differences in executive functioning and theory of mind. Rev Neurol. 2013;57:177–84. **The review suggests some different patterns of executive functioning in ASD and ADHD. Children with ADHD show failures in inhibitory control, while children with ASD have problems with cognitive flexibility and planning. Furthermore, younger children with ASD have greater deficiencies in the ToM compared to children with ADHD. The use of longitudinal designs might clarify how ToM evolvement affects poor executive functions development in both neurodevelopmental disorders**.
6. Diamond A. Executive functions. Ann Rev Psychol. 2013;64:135–68.
7. Barkley RA. ADHD and the nature of self-control. New York: Guilford; 2005.
8. Lopez BR, Lincon AJ, Ozonoff S, Lai Z. Examining the relationship between executive functions and restrictive, repetitive symptoms of autistic disorder. J Autism Dev Disord. 2005;35:445–60.
9. Sinzig J, Vinzelberg I, Evers D, Lehmkuhl G. Executive function and attention profiles in preschool and elementary school children with autism spectrum disorders or ADHD. Int J Dev Disabil. 2014;60:144–54.
10. Salcedo MD, Moreno JM, Ruiz M, Ferrín M. Evaluation of planning dysfunction in attention deficit hyperactivity disorder and autistic spectrum disorder using the zoo map task. Child Psychiatry Hum Dev. 2013;44:166–85.
11. Matsuura N, Ishitobi M, Arai S, Kawamura K, Asano M, Hinohara K. Distinguishing between autism spectrum disorder and attention deficit hyperactivity disorder by using behavioral checklist cognitive assessment and neuropsychological test battery. Asian J Psychiatr. 2014;12:50–7.
12. Andersen PN, Hovik KT, Skogli EW, Egeland J, Ole M. Symptoms of ADHD in children with high-functioning autism are related to impaired verbal working memory and verbal delayed recall. PLoS One. 2013;8:e64842.
13. Semrud-Clikerman M, Walkowiak J, Wilkinson A, Butcher B. Executive functioning in children with Asperger syndrome, ADHD combined type, ADHD predominately inattentive type, and controls. J Autism Dev Disord. 2010;40:1017–27.
14. Hovik KT, Egeland J, Isquith PK, Gioia G, Skogli EW, Andersen PN, et al. Distinct patterns of everyday executive function problems distinguish children with Tourette syndrome from children with ADHD or autism spectrum disorders. J Atten Disord. 2014; first Published September 24.
15. Roselló B, Berrenguer C. Components of executive functioning in children with ASD and children with ADHD. Paper presented at VIII international meeting of psychology and education. Spain: Alicante; 2016.
16. Hartman CA, Geurts HM, Franke B, Buitelaar K, Rommelse N. Changing ASD-ADHD symptom co-occurrence across the lifespan with adolescence as crucial time window: illustrating the need to go beyond childhood. Neurosci Biobehav Rev. 2016;71:529–41.
17. Roberts BA, Martel MM, Nigg JT. Are there executive dysfunction subtypes within attention-deficit/hyperactivity disorder? J Atten Disord. 2017;21:284–93.
18. Baribeau DA, Doyle-Thomas KA, Dupuis A, Jaboni A, Crosbi J, Mc Ginn H, et al. Examining and comparing social perception abilities across childhood onset neurodevelopmental disorders. J Am Acad Child Adolesc Psychiatry. 2015;54:479–86.
19. 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.
20. Demurie E, de Core M, Roeyers H. Empathic accuracy in adolescents with autism spectrum disorders and adolescents with attention-deficit/hyperactivity disorder. Res Autism Spect Disord. 2011;5:126–34.
21. •• Hutchins TL, Prelock PA, Morris H, Benner J, Lavigne T, Hoza B. Explicit vs. applied theory of mind competence: A comparison of typically developing males, males with ASD, and males with ADHD. Res Autism Spectr Disord. 2016;21:94–108. **The level of complexity of the tasks was critical for distinguishing ToM skills of ADHD and ASD groups. Although children with ADHD can do well on traditional ToM tasks, they fail to apply this competence in the real world. The ToM difficulties of children with ASD have a generalized nature, suggesting a deeper metarepresentational deficit. These findings have implications for current models of social cognition in developmental disabilities**.
22. Miranda A, Berenguer C, Roselló B, Baixauli I, Colomer C. Social cognition in children with autism spectrum disorder and attention deficit hyperactivity disorder. Connections to executive functions. (under review).
23. Buitelaar JK, Van der Wees 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.
24. Downs A, Smith T. Emotional understanding, cooperation, and social behavior in high-functioning children with autism. J Autism Dev Disord. 2004;34:625–35.
25. 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.
26. Bühler E, Bachmann C, Goyert H, Heinzel-Gutenbrunner M, Kamp-Becker I. Differential diagnosis of autism spectrum disorder and attention deficit hyperactivity disorder by means of inhibitory control and 'theory of mind'. J Autism Dev Disord. 2011;41:1718–26.

27.• Bora E, Pantelis C. Meta-analysis of social cognition in attention-deficit/hyperactivity disorder (ADHD): Comparison with healthy controls and autistic spectrum disorder. Psychol Med. 2016;46: 699–716. **This meta-analysis involved 44 studies comparing the performance of individuals with ADHD, ASD and TD in social cognition. The performance on ToM tasks was significantly worse in individuals with ASD than that in individuals with ADHD, but individuals with ADHD showed worse performance in the recognition of emotions and on ToM tasks than group with TD**.

28. Adams C, Baxendale J, Llyod J, Aldredge C. Pragmatic language impairment: case studies of social and pragmatic therapy. Child Lang Teach Ther. 2005;21:227–50.

29. Grzadzinski R, Di Martino A, Brady E, Mairena MA, ONeale M, Petkova E, et al. Examining autistic traits in children with ADHD: does the autism spectrum extend to ADHD? J Autism Dev Disord. 2011;41:1178–91.

30. Helland WA, Biringer E, Helland T, Heimann M. Exploring language profiles for children with ADHD and children with Asperger syndrome. J Atten Disord. 2012;16:34–43.

31. Geurts HM, Embrechts MT. Language profiles in ASD, SLI, and ADHD. J Autism Dev Disord. 2008;38:1931–43.

32. Rumpf AL, Kamp-Becker I, Becker K, Kauschke C. Narrative competence and internal state language of children with Asperger syndrome and ADHD. Res Dev Disabil. 2012;33: 1395–407.

33.•• Kuijper SJM, Hartman CA, Bogaerds-Hazenberg STM, Hendriks P. Narrative production in children with autism spectrum disorder (ASD) and children with attention-deficit/hyperactivity disorder (ADHD): similarities and differences. J Abnorm Psychol. 2017;126:63–75. **This study focused on structural and pragmatic similarities and differences in narratives produced by children with ASD and children with ADHD and on the influence of ToM working memory, and response inhibition in language production. Children of both groups showed impairments on pragmatic measures and on syntactic complexity. ToM and working memory performance but not response inhibition were associated with many narrative skills**.

34. Gardner DM, Gerdes AC. A review of peer relationships and friendships in youth with ADHD. J Atten Disord. 2015;19:844–55.

35. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. Washington DC: American Psychiatric Association; 2013.

36. Turygin N, Matson JL, Tureck K. The relationship of attention-deficit hyperactivity disorder and autism spectrum disorder to adaptive skills in young children. Dev Neurorehabil. 2015;18:317–21.

37. Luteijn EF, Serra M, Jackson S, Steenhuis MP, Althaus M, Volkmar F, et al. How unspecified are disorders of children with a pervasive developmental disorder not otherwise specified? Eur Child Adolesc Psychiatry. 2000;9:168–79.

38. Cervantes PE, Matson J, Adams HL, Williams LW, Goldin RL, Jang J. Comparing social skill profiles of children with autism spectrum disorders versus children with attention deficit hyperactivity disorder: where the deficits lie. Res Autism Spect Disord. 2013;7: 1104–10.

39. Lord C, Rutter M, DiLavore PS, Risi S. Autism diagnostic observation schedule (ADOS). Los Angeles: Western Psychological Services; 1999.

40. Salley B, Gabrielli J, Smitha C, Braun M. Do communication and social interaction skills differ across youth diagnosed with autism spectrum disorder, attention-deficit/hyperactivity disorder, or dual diagnosis? Res Autism Spectr Disord. 2015;20:58–66.

41. Grzadzinski R, Dick C, Lord C, Bishop S. Parent-report and clinician-observed autism spectrum disorder (ASD) symptoms in children with attention deficit/hyperactivity disorder (ADHD): implications for practice under DSM-5. Mol Autism. 2016;7:1–12.

42. Van der Meer JM, Oerlemans AM, van Stejin DJ, Lappenschaar MG, de Sonneville LM, Buitelaar JK, et al. Are autism spectrum disorder and attention-deficit/hyperactivity disorder different manifestations of one overarching disorder? Cognitive and symptom evidence from a clinical and population-based simple. J Am Acad Child Adolesc Psychiatry. 2012;51:1160–72.