9-2020

ACCURATELY DIAGNOSING AUTISM SPECTRUM DISORDER AMONG A COMORBID POPULATION

Michelle Okolita
ISPP

Accurately Diagnosing Autism Spectrum Disorder Among a Comorbid Population

Michelle H. Okolita

Kristen M. Newberry, PsyD
Chair

Emese Vitalis, PhD, MBA
Member

A Clinical Research Project submitted to the faculty of The Illinois School of Professional Psychology at National Louis University in partial fulfillment of the requirements for the degree of Doctor of Psychology in Clinical Psychology.

Chicago, Illinois
July, 2020

The Doctorate Program in Clinical Psychology

Illinois School of Professional Psychology
at National Louis University

CERTIFICATE OF APPROVAL

Michelle H. Okolita, M.A.

Clinical Research Project

Accurately Diagnosing Autism Spectrum Disorder Among a Comorbid Population

This is to certify that the Clinical Research Project of

Michelle H Okolita, M.A.

has been approved by the CRP
Committee on

July 16, 2020

as satisfactory for the CRP requirement
for the Doctorate of Psychology degree
with a major in Clinical Psychology

Examining Committee:

Kristen M. Newberry, Psy.D.
Digitally signed by Kristen M. Newberry, Psy.D.
Date: 2020.07.16 16:33:19 -05'00'

Committee Chair

Emese Vitalis
Digitally signed by Emese Vitalis
Date: 2020.07.22 11:39:18 -05'00'

Reader

Reader

Table of Contents

Abstract

Two of the most common neurodevelopmental disorders, attention-deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD), are diagnosed in early childhood. The two disorders share similar impairments across domains, are highly comorbid, and have many overlapping symptoms. Studies have shown that among this comorbid population, children receive an ASD diagnosis a few years after their initial ADHD diagnosis, which leads to many negative consequences, including a delay in treatment. The focus in this study was on the early indicators of ASD that are present prior to the age of 3 years in order to educate others on these symptoms. In an effort to help professions better understand ASD symptoms, a checklist was created using information gathered from internet-based databases as well as published questionnaires with a focus on the symptoms of ADHD, ASD, and comorbid ADHD and ASD. The checklist contains early indicators and impairments found across the domains of language functioning, social functioning, emotional functioning, motor functioning, restrictive and repetitive behaviors, and general behaviors. Future studies would benefit from more extensive research regarding early indicators of the comorbid diagnosis of ASD and ADHD.

Introduction

Mental health problems in childhood can have both short- and long-term negative consequences. According to Cuellar (2015), long-term negative consequences can include lower educational attainment, lower wages, a lower likelihood of employment, and an increase in criminal activity. Issues also can arise when children are misdiagnosed or go undiagnosed until later in life. Misdiagnosis prevents individuals from receiving proper treatment, compromises treatment outcomes, and increases dysfunction (Kvarnstrom, 2017). A later diagnosis often negatively affects a child's ability to receive intervention services. Specifically, among individuals with autism spectrum disorder (ASD), a possible consequence of being undiagnosed or misdiagnosed is issues with self-identity (Beardon & Worton, 2011). Thus, it is important to be able to prevent, identify, and treat mental health conditions as early as possible (Cuellar, 2015).

According to Merten et al. (2017), two steps influence the diagnostic process in children. The first step is to assess the behavior and feelings of the patient, which is done using multiple informants. The next step involves the diagnostician's decision of whether the information gathered leads to a diagnosis. This decision is influenced by the characteristics of the diagnostician, the diagnostic criteria, and the health care system (Merten et al., 2017). Characteristics of the diagnostician include their proneness to using heuristics and nationality (Merten et al., 2017). The health care system played a role in the comorbid diagnosis of ASD and attention-deficit/hyperactivity disorder (ADHD). Until recently, the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM–5*; American Psychiatric Association [APA], 2013) did not allow for a dual diagnosis of ASD and ADHD as ADHD symptoms were believed to be part of or the cause of the

ASD symptomatology (Magnúsdóttir et al., 2016). With changes to the *DSM–5* (APA, 2013), a diagnosis of ASD and ADHD can now coexist.

Problem Background

The *DSM–5* (APA, 2013) contains the most recent diagnostic criteria for any mental health disorder and includes a number of changes to childhood onset disorders. One change is the *DSM–5* now allows for a comorbid diagnosis of ADHD and ASD, which share similar impairments in developmental and cognitive domains. Because ADHD and ASD co-occur so frequently, many researchers have indicated autistic symptomatology should be considered during the initial clinical assessment (Thapar & Cooper, 2016; Rommelse et al., 2010).

ADHD is classified as a neurodevelopmental disorder often accompanied by delays or problems in language, motor, and social development (Nigg & Barkley, 2014). There are three types of ADHD: predominately hyperactive-impulsive, predominately inattentive, and combined hyperactive-impulsive and inattentive. One study showed ADHD to be the third most common disorder identified in a community sample of 5- to 17-year-olds (Leitner, 2014). Estimated prevalence rates for ADHD among children and adolescents range from 5% to 7.2% (Bergey et al., 2018). According to Hogea et al. (2017), ADHD is predominately seen in boys and 10% to 15% of individuals are diagnosed with predominately inattentive type, 5% with predominately hyperactive-impulsive type, and 80% with combined type.

Individuals with ADHD experience difficulty within the academic, career, and interpersonal realms and often complain about the difficulty they experience completing everyday chores and tasks. It is common for these individuals to report difficulty

concentrating, staying on task, remaining on task, and communicating, among other activities. Children with ADHD have been found to exhibit defiant or aggressive behavior across the home and school settings, attain lower than expected levels of academic performance, and develop poor peer relationships compared to typically developing children (DePaul & Kern, 2011). According to Nigg and Barkley (2014), children with ADHD may be prone to more accidents, have difficulty learning, and be difficult to parent. In adulthood, these individuals may experience difficulty getting their work done, have car accidents, and aggravate others with their poor communication skills (Nigg & Barkley, 2014).

ASD is another neurodevelopmental disorder characterized by impairments in social and communication behaviors (Klinger et al., 2014). The estimated prevalence of ASD ranges from less than 1% to 2.6% (Atladottir et al., 2015). Autism was originally characterized by three domains of qualitative impairments in social interactions, impairments in communication, and a restricted range of interests and behaviors. The *DSM–5* (APA, 2013) reconceptualized the domains to impairments in social communication and the presence of restricted and repetitive behaviors after identifying difficulty distinguishing impairments in social interaction with impairments in communication (Klinger et al., 2014). Individuals with ASD struggle to recognize social cues and have impairments communicating socially. They are often described as having an atypical way of relating to others and struggle in peer relationships (Ware-Balch & Ray, 2015). Specifically, individuals diagnosed with ASD have lower levels of empathy, struggle with social–emotional reciprocity, and have difficulty with nonverbal communication behaviors (Ware-Balch & Ray, 2015). Children with ASD may not have

the ability to imitate another person, share a focus of attention with another person, recognize and process faces, or engage in pretend play (Klinger et al., 2014). According to Ware-Balch and Ray (2015), children with ASD also have trouble regulating their own emotions and behaviors. Research has shown 70% of children diagnosed with ASD have behavioral problems, including disruptive behavior, hyperactivity, anxiety, depression, disturbances with sleep, feeding difficulties, and difficulty with toileting (Johnson et al., 2019). Furthermore, children with ASD display atypical behaviors with objects and repetitive motor mannerisms as well as sensory hyper-responsiveness (Klinger et al., 2014; Wetherby et al., 2004).

ASD and ADHD share similar impairments in developmental and cognitive domains. Studies have shown individuals with ASD and ADHD have greater social and cognitive deficits, poorer psychosocial outcomes, and higher rates of internalizing and externalizing problems when compared to those who are diagnosed with only ASD (Lyall et al., 2017). According to Martin et al. (2014), there is evidence of ADHD and ASD being at the extreme ends of a continuum rather than being distinct categories. Still other researchers believe, based on the high heritability and high rate of symptom overlap, ADHD and ASD are co-heritable (Martin et al., 2014). According to Marner (2019), approximately two-thirds of children with ADHD have at least one coexisting condition. Specifically, some studies have shown up to 50% of children with ASD are also diagnosed with ADHD. According to Holland (2014), 18% of children diagnosed with ADHD also exhibit symptoms consistent with ASD. Lyall et al. (2017) reported ASD and ADHD have comorbid prevalence rates ranging from 2% to 78%. With comorbidity between ADHD and ASD ranging up to 78% (Gargaro et al., 2011; Klinger et al., 2014),

clinicians sometimes overlook the ASD symptoms and diagnose a child with only ADHD. Among children diagnosed with ADHD before ASD, approximately 20% received the ADHD diagnosis 3 years before their ASD diagnosis (Stevens et al., 2016). According to Thompson (2015), on average, two out of five children with comorbid ADHD and ASD are diagnosed with ADHD first and 81% of the children are diagnosed with autism after the age of 6 years.

Purpose of the Study

Studies in the existing literature failed to address how to properly and accurately diagnose ASD in children who have a comorbid diagnosis of ADHD. This failure leads to long-term negative consequences for these children and their families. The aim of this study was to identify and discuss the early ASD symptoms found among children with comorbid ADHD symptoms. By identifying the symptomology found in both ADHD and ASD among preschool-age children, overlapping symptoms can be analyzed. Additionally, this study was designed to assist with the accurate diagnosis of ASD in children prior to the age of 3 years by proposing a standard checklist for diagnosticians. Once overlapping ADHD and ASD symptoms are combined, the remaining ASD symptoms should be reviewed for an accurate dual diagnosis to help clinicians accurately diagnose ASD in ADHD children, which will allow for the development of a better treatment plan.

Problem Statements

The symptoms associated with ASD and ADHD appear early in a child's development, making proper diagnosis crucial to help children receive proper treatment. Some researchers report the average range for a diagnosis of ASD is typically between

the ages of 3 and 4 years (Wetherby et al., 2004). However, others state many children do not receive an ASD diagnosis until they approach school age (Sheldrick et al., 2017; Stevens et al., 2016). Vargas-Cuentas et al. (2017) stated that although there have been advances in ASD diagnosis and parents suspect problems emerging around 18 to 24 months of age, the median age of diagnosis is 5.5 years. Sheldrick et al. (2017) reported an important factor when identifying ASD in young children is the level of severity. Specifically, milder severity is associated with a later age at first diagnosis.

ASD is a life-long developmental disability that impairs an individual's ability to develop at a normal rate in all areas of development (Moreno, 2012). There are many behavioral indications of the presence of autism; however, a reliable diagnosis is difficult to make. According to Moreno (2012), even professionals, who have diagnosed or treated more severely challenged autistic individuals have difficulty accurately diagnosing advanced individuals with autism. Wetherby et al. (2004) suggested children who fail to meet the following milestones should be evaluated for ASD or other developmental delays: no babbling or gesturing by 12 months, no single word by 16 months, no two-word phrases by 24 months, and any loss of language or social skills at any age.

There are many challenges within the research and treatment of those diagnosed with ASD. According to Siegel et al. (2015), barriers to the study of children diagnosed with ASD include recruitment in outpatient settings and the relative lack of measures validated for use with nonverbal or intellectually disabled individuals. Sheldrick et al. (2017) reported many flaws, including methodological limitations, in the current research when trying to recognize the age at which ASD can be first identified. Sheldrick et al.

noted measures of central tendency omit information about the full distribution or use sampling methods that introduce bias.

According to Ware-Balch and Ray (2015), there is a gap in treatment for children with autism because of the minimization of focus on interpersonal dynamics. Siegel et al. (2015) explained the treatment of individuals with ASD has been slowed by a lack of gold standard research methods for characterizing verbal status or communication ability, great heterogeneity in the use of clinical measures, and the absence of a consistent definition of nonverbal status. Additionally, the primary reason children with ASD are brought into treatment is for externalizing problem behaviors (Siegel et al., 2015). Without a proper diagnosis, there are implications for treatment and the future of the child (Gargaro et al., 2011; Holland, 2014; McCarthy, 2015). The Autism Treatment Network database shows the co-occurrence of ADHD and ASD is associated with a lower quality of life and poorer adaptive functioning (Leitner, 2014). Literature indicates children diagnosed with ASD who receive treatment prior to the age of 3.5 years see a greater impact compared to those who receive treatment after the age of 5 years (Wetherby et al., 2004). Therefore, it is essential a dual diagnosis of ASD and ADHD be made early in the process to help prevent further complications in treatment.

Below are the problem statements used to guide this study:

PS1: Although children who are diagnosed with ASD prior to the age of 3.5 years have a better prognosis than those who begin receiving treatment after 5 years of age, many children with comorbid ADHD and ASD are diagnosed after the age of 6 years.

PS2: With ADHD and ASD symptoms overlapping one another, diagnosticians often overlook the ASD symptoms and only diagnose a child with ADHD. Among these children, 3 years later, 20% will be diagnosed with ASD (Stevens et al., 2016).

Research Question

Children diagnosed with ADHD and ASD most likely received the diagnosis of ADHD approximately 3 years prior to their diagnosis of ASD. This study was designed to help clinicians to accurately diagnose comorbid ADHD and ASD at an earlier age in order for these children to have an optimal prognosis. The guiding research question was: What symptomology do clinicians need to consider when evaluating children who present with symptoms consistent with ADHD and ASD?

Significance of the Study

An inaccurate mental health diagnosis in children can lead to harmful consequences. Children may not be able to receive proper treatment, may be mistreated, may develop self-identity or self-esteem issues, or there can be an increase in the intensity of their symptoms. Furthermore, the risk for substance abuse, suicidality, or behavioral issues increases for children who are not properly diagnosed and treated. These difficulties are faced by many children who have received a diagnosis of ADHD while having their ASD symptoms discounted.

This study involved a focus on a highly comorbid disorder that is often misdiagnosed. As the literature shows, ADHD is often diagnosed and treated at least 3 years prior to the missed ASD diagnosis (Stevens et al., 2016). This oversight often results in a poorer prognosis as well as frustration and concern from family members,

teachers, and the community. By decreasing the chance of missing the ASD diagnosis, these children should experience better treatment outcomes.

With this research, clinicians can gain a better understanding of the specific symptoms and signs that need to be evaluated. Additionally, by having a checklist, clinicians will be less likely to overlook an ASD diagnosis among children who are presenting with predominately ADHD symptoms. This will allow for a better prognosis among those children who have comorbid ADHD and ASD diagnoses.

Literature Review

ASD and ADHD are both neurodevelopmental disorders typically diagnosed in childhood and are more common in boys than girls with a ratio of six to one (Cooper et al., 2014). The core features of ASD are pervasive and impairing, and having a comorbid diagnosis can create additional challenges for the individual and their family. Identifying an ASD and comorbid diagnosis is critical to the individual's prognosis and treatment plan (Mansour et al., 2017). Receiving an accurate diagnosis is crucial given the importance of early intervention services and to improve the prognosis of children (Corsello et al., 2013; Hinnebusch et al., 2017).

Bühler et al. (2011) noted the overlap in ASD and ADHD symptoms hinders the diagnostic process and increases the risk of a false diagnosis, and concluded that because of the overlap in symptoms, a comorbid approach would help capture the complexity of the symptomatology. Matson and Goldin (2014) reported comorbid symptoms, specifically those associated with intellectual disability and cognitive deficits, are related to the poor prognosis of ASD. Research has shown 70% of children with ASD meet the criteria for one comorbid disorder and 40% meet the criteria for two or more comorbid diagnoses (Mansour et al., 2017). Further, Oerbeck et al. (2017) reported that among children with ADHD, 67% to 69% have a comorbid diagnosis. The most common comorbid diagnoses found in children with ASD include ADHD, mood disorders, and anxiety disorders (Mansour et al., 2017; Wilson et al., 2014). Additionally, Wilson et al. (2014) concluded children diagnosed with ASD have higher rates of somatic symptoms when compared to typically developing children. Konst et al. (2014) stated ASD symptom severity is positively correlated with ADHD symptoms. Studies have shown up

to 85% of children with ASD are likely to present with comorbid ADHD symptoms (Berenguer et al., 2018). According to Konst et al. (2014), as a result of the presence of ADHD symptoms within both disorders, an autism diagnosis is often delayed and initially misdiagnosed with ADHD only. The comorbidity between ADHD and ASD ranges up to 78% (Gargaro et al., 2011; Klinger et al., 2014); however, many children are diagnosed with ADHD prior to having the comorbid ASD diagnosed. As previously mentioned, around 20% of children diagnosed with ADHD received the diagnosis 3 years prior to their ASD diagnosis (Stevens et al., 2016). Many parents of children with ASD have noted an awareness of developmental problems by 18 months of age even though the average age of diagnosis is around 5 years (Adachi et al., 2018).

Although research and advancements have helped expand the knowledge about neurodevelopmental and neurocognitive disorders, researchers have found there is an absence of incorporating the knowledge into everyday practice (Carlew & Zartman, 2017). Both ADHD and ASD are severely impairing and highly heritable neurodevelopmental disorders. Miranda-Casas et al. (2013) suggested the two disorders overlap in genetic, neurobiological, and neuropsychological bases, such as executive functioning or theory of mind skills.

Shared Impairments

Individuals with ASD have impairments in social and communication skills and are characterized as having restricted and repetitive behaviors and interests. Furthermore, these ASD impairments hinder the development of normal social interactions and relationships (Christensen et al., 2016; Doris, 2012; Goldin et al., 2013; Hinnebusch et al., 2017; Jones et al., 2014; Konst et al., 2014; Matson & Goldin, 2014; O'Dwyer et al.,

2016; Saunders et al., 2016; Xiao et al., 2014). In addition to social deficits, impairments are found across motor, cognitive, and language functioning (Kuhl et al., 2013). Other indicators of ASD include flat affect, a lack of interest in others, abnormal gaze, evidence of more stereotyped vocalizations, poor attention, inappropriate object use, and odd play habits (Matson & Goldin, 2014). Individuals with ADHD have difficulties with inattention or hyperactivity and impulsivity (O'Dwyer et al., 2016; Oerbeck et al., 2017).

ASD and ADHD share deficits across many domains, including cognitive, developmental, social functioning, executive functioning, motor speed, and reward processing (Mansour et al., 2017; O'Dwyer et al., 2016). Additionally, those who are diagnosed with both ASD and ADHD have an increase in social and cognitive deficits, perception difficulties, attention deficits, overactivity, decreased processing speed, poorer outcomes, experience more irritability and anger, and have higher rates of internalizing and externalizing problems (Jones et al., 2014; Lyall et al., 2017; Mayes et al., 2012). Specifically, children with comorbid ASD and ADHD experience more severe symptoms of depression and anxiety, which supports that the ADHD symptoms contribute to the internalizing symptoms (Wilson et al., 2014). Further studies have shown the presence of ADHD exacerbates difficulties in behavioral and social functioning in children diagnosed with ASD (Berenguer et al., 2018). Wilson et al. (2014) further reported more difficulties in social relationships and activities among those with lower verbal skills, which may be a risk factor for depressive symptoms. Further research indicated the presence of shared endophenotypes, such as behavior concerns, emotional regulation issues, and poor social awareness of behavioral consequences (Mansour et al., 2017).

Studies have shown the comorbidity of ADHD presents an added risk to behavioral functioning. Particularly, those with a comorbid diagnosis have increased rates of externalizing behavior problems, such as aggression, delinquent behaviors, conduct problems, and oppositional behaviors (Berenguer et al., 2018; Craig et al., 2015). Additionally, children with both ASD and ADHD have higher rates of other comorbid symptoms as well as a higher risk for psychiatric hospitalization, more difficulties with general life functioning, an increase of externalizing behaviors, and more facial affect recognition deficits (Mansour et al., 2017). Mansour et al. (2017) further noted individuals with comorbid ADHD and ASD struggle with inhibitory control and regulating impulsivity, which increases difficulties within social interactions. Mayes et al. (2012) noted individuals with the comorbid diagnoses often have language delays and are likely to have a learning disability in written expression, and dysgraphia.

Accurate Diagnosis

According to Corsello et al. (2013), ASD can be accurately diagnosed in children under the age of 3 years by experienced and trained clinicians using standardized parent interview and observational measures. Hinnebusch et al. (2017) further reported an ASD diagnosis at 18 to 24 months of age is reliable and stable. Research has shown roughly 79% of children who received a diagnosis of ASD at the age of 2 years retained their diagnosis at the age of 4.5 years (Matson & Goldin, 2014). Although Jo et al. (2015) reported ASD is recognized early in life and can be diagnosed as early as 2 years old, others have argued that even though parents suspect something to be wrong, they often struggle to identify the problem and therefore do not seek the necessary treatment (Matson & Goldin, 2014). Larsen et al. (2018) noted the diagnostic age for children with

ASD is approximately 40 months or later despite parents raising concerns earlier. Yates and Le Couteur (2016) noted parents have expressed concerns as early as 15 to 18 months of age. Matson and Goldin (2014) stated ASD symptoms are present by the time the child is a year old; however, a subset of children develop normally until the age of 2 years, after which they begin to regress.

Researchers have noted the subtype of ASD, race, income, awareness of health care, clinical presentations, and physician behaviors in screening practices often affect the age of diagnosis (Jo et al., 2015). According to Yates and Le Couteur (2016), inconsistency of assessment pathways, demand on services, lack of acknowledgement of difficulties at a young age, and the presence of additional diagnoses may be contributing to the later age of diagnosis. Furthermore, health care providers play a critical role in the diagnostic process of ASD (Barnard-Brak et al., 2017). Health care providers are a source of referral for assessment and intervention services; however, they may be reluctant to diagnose ASD at an early age, ignore the initial response to symptoms, or suggest waiting to see whether the child outgrows the symptoms (Barnard-Brak et al., 2017). Barnard-Brak et al. (2017) found parents, on average, visited four to five health care providers before receiving a diagnosis.

According to Christensen et al. (2016), the American Academy of Pediatrics recommends pediatric health care providers administer two ASD screenings, at ages 18 and 24 months, and those with concerning results should receive a comprehensive developmental evaluation from a specialist. According to Barnard-Brak et al. (2017), even though the American Academy of Pediatrics recommends screenings to be performed, most health care providers do not systematically screen for ASD at 18 and 24

months. Larsen et al. (2018) argued the screening that is performed for ASD in the early years does not meet the standards for universal screening based on the limited time frame of the appointment. Barnard-Brak et al. (2017) found less than half of the 59% of children presenting with behavioral symptoms of ASD were referred for follow-up. However, Corsello et al. (2013) argued that as the awareness of the early indicators of ASD increases, more physicians are beginning to routinely screen and refer children to specialists. According to Doris (2012), diagnosing ASD requires two steps. First, children need to have developmental screenings and surveillance at 9, 18, 24, and 30 months of age, which is further recommended by the American Academy of Pediatrics (Doris, 2012; Wan et al., 2019). Second, there needs to be a comprehensive evaluation, which includes observations by pediatricians and interviews with parents to gather information regarding the child's developmental history. Additionally, the comprehensive evaluation should include language and speech functioning and a standardized rating scale (Doris, 2012).

As research continues to grow and contribute to the knowledge about disorders, it is important to understand how to accurately diagnose them. The original guidelines for diagnosing autism came from Kanner's definition of autism in 1943 and in 1987 Asperger began influencing the way autism was defined (Chown & Hughes, 2016). Changing the way disorders are conceptualized played an important role. In 1911, autism was first named to describe a symptom of schizophrenia by German psychiatrist Eugen Bleuler. Bleuler believed autistic thinking was characterized by infantile wishes to avoid unsatisfying realities and replace them with fantasies and hallucinations (Evans, 2013). In the 1960s, psychologists in Britain challenged the infantile thought assumed by Bleuler and used the term autism to describe the exact opposite of what it had meant.

Specifically, in the 1950s, autism was referred to as excessive hallucinations and fantasy in infants and in the 1970s it was referred to as a complete lack of an unconscious symbolic life (Evans, 2013). Researchers Simon Baron-Cohen, Alan Leslie, and Uta Frith concluded children with ASD had difficulties with theory of mind in 1985 (Evans, 2013). Chown and Hughes (2016) stated it took many years to abandon and discredit Kanner's belief that mothers who displayed little emotional reactions to their children (i.e., the refrigerator mother) were a contributing factor to the disorder. Asperger had reported family patterns of autism and helped conceptualize autism as a disorder that affects a person throughout the lifespan. Additionally, Asperger reported individuals are born with ASD and although there is not a cure, there are ways to improve behaviors (Chown & Hughes, 2016).

The first documented example of a disorder that presented similarly to ADHD was noted by Sir Alexander Crichton in 1798 (Lange et al., 2010). At that time, Crichton defined attention as "any object of external sense, or of thought, occupies the mind in such a degree that a person does not receive a clear perception from any other one" (p. 242) and noted the disorder diminishes with age (Lange et al., 2010). In 1932, German physicians, Franz Kramer and Hans Pollnow, reported on a hyperkinetic disease of infancy that depicted children with noticeable motor restlessness (Lange et al., 2010). In the 1990s, researchers discovered genetic components of ADHD and recognized that ADHD is a chronic, lifelong disorder in which 50% of children continue to experience the symptoms as adults (Lange et al., 2010).

As previously mentioned, the *DSM–5* (APA, 2013) contains diagnostic criteria for any mental health disorder and the APA has made many changes throughout the editions.

The changes made in the *DSM–5* (APA, 2013) to ASD and ADHD are discussed next in detail.

History of the DSM

The original *DSM* was published in 1952 and stated the manual was divided into two sections: diagnoses thought to have biological etiology or those that were psychogenic in nature (Carlew & Zartman, 2017). The APA first introduced ADHD in the second edition of the *DSM*, emphasizing the behavioral aspects of the disorder and neglecting information regarding the cognitive symptoms as well as specific diagnostic criteria, cutoffs, and age of onset (Carlew & Zartman, 2017). Additionally, the concept of hyperactivity was incorporated and labeled as hyperkinetic reaction of childhood and defined as overactivity, restlessness, distractibility, and a short attention span in young children, typically diminishing by adolescence (APA, 1968; Lange et al., 2010).

In 1980, the *DSM-III* was published and introduced the aspect of the multi-axial system (APA, 1980; Carlew & Zartman, 2017). The *DSM-III* departed from the International Classification of Diseases (ICD-9) and introduced numerical cutoff scores for symptoms, specific guidelines for age of onset and duration of symptoms, and the requirement of the exclusion of other childhood psychiatric conditions (Lange et al., 2010). Autism was first included in the *DSM-III*; however, severity specifiers were not part of the diagnosis (Mehling & Tassé, 2016). The *DSM-III* no longer had the category of childhood schizophrenia and it was removed as a diagnostic feature for adult schizophrenia and introduced the category pervasive developmental disorders (Evans, 2013). The *DSM-III* pervasive developmental disorders included four subcategories of infantile autism, childhood onset pervasive developmental disorder, residual autism, and

an atypical form (Evans, 2013). The *DSM-III* also included changes to ADHD. The APA renamed the disorder as attention deficit disorder and included specifiers of with or without hyperactivity (Lange et al., 2010). Additionally, the *DSM-III* established three separate symptom lists for inattention, impulsivity, and hyperactivity (Lange et al., 2010). The *DSM-III-R* changed how clinicians conceptualized ASD (APA, 1987). Specifically, ASD was previously viewed as a pervasive lack of responsiveness to other people and was changed to qualitative impairment in reciprocal social interaction (Chown & Hughes, 2016). Furthermore, the *DSM-III-R* made changes to the way clinicians conceptualized ADHD. The *DSM-III-R* renamed the disorder as attention deficit-hyperactivity disorder and removed the concept of two subtypes (APA, 1987; Lange et al., 2010). Additionally, the symptoms of inattention, impulsivity, and hyperactivity were combined into a single list of symptoms with a single cutoff score (Lange et al., 2010). The subtype of ADD without hyperactivity was changed to "undifferentiated ADD" (Lange et al., 2010).

The *DSM-IV* introduced the diagnosis of Asperger's syndrome (APA, 1994; Evans, 2013). The *DSM-IV* added three subtypes of ADHD, including predominantly inattentive type, a predominantly hyperactive-impulsive type, and a combined type (APA, 1994; Lange et al., 2010). Furthermore, the *DSM-IV* recognized ADHD can present in adulthood and included workplace difficulties in the depiction of symptoms (Lange et al., 2010). The *DSM-IV-TR*'s main goal was to correct any errors identified in the *DSM-IV* and maintain the currency of the disorders (APA, 2000; Lange et al., 2010).

The *DSM–5*'s conceptualizations of psychological disorders are more closely understood, identify the contributing factors and underlying etiology, and reflect the current understanding of dimensionality of various developmental, psychological, and

neurological disorders (APA, 2013; Carlew & Zartman, 2017). The changes made in the *DSM–5* have affected the way ADHD and ASD are diagnosed, especially because the new edition allows for a comorbid diagnosis. Additionally, the way subsets of children with ASD are distinguished has changed by now assigning severity ratings based on the severity of support needed (Mehling & Tassé, 2016). Furthermore, even though Asperger's disorder was removed from the *DSM–5*, Asperger's contribution of autism being a spectrum was adopted into the manual (Chown & Hughes, 2016).

Risk Factors

Bornstein et al. (2016) reported early intervention services have been found to improve the life conditions, autonomy, and cognitive skills of children with ASD. Studies have shown parents will monitor their child's development and look for early risk factors for neurodevelopmental disorders (Bornstein et al., 2016). Understanding the early indicators that are present in the first year of life could help with earlier diagnoses and treatment. As ADHD and ASD frequently co-occur, researchers suggest the two disorders should be studied simultaneously (Bröring et al., 2018). Tye et al. (2014) stated a significant amount of overlap between ADHD and ASD is attributable to shared genetic influences. Although there is no clear etiology of ASD, there is evidence that indicates a complex genetic basis with strong heritability (Yates & Le Couteur, 2012). Yates and Le Couteur (2016) noted recurrence rates for siblings with ASD ranging up to 18.7%. Further, Yates and Le Couteur (2012) reported when taking into account twin studies and the population base rate for ASD, the genetic heritability of autism is about 90%. Van Steijn et al. (2013) argued children with ASD or comorbid ASD and ADHD may have one or both parents with a diagnosis or subthreshold symptoms of ASD or ADHD.

Bröring et al. (2018) concluded attention problems are the linking factor between ADHD and ASD. Polderman et al. (2013) noted biological pathways related to attentional control might be involved in specific comorbidity patterns of ADHD and ASD. Attention problems are believed not only to reinforce socialization difficulties as they may limit adaptive social participation, lead to social rejection, and contribute to missed social cues, they may also serve as a risk factor for socialization difficulties (Bröring et al., 2018). Previous research on the genetic overlap and familial transmission of ADHD and ASD has shown mothers with ADHD are more likely to have a child with ASD (Green et al., 2015).

Bornstein et al. (2016) found children with ASD often present with poor response to name, atypical eye contact, atypical cries, and reduced social smiling before 12 months of age. Jones et al. (2014) argued ASD develops from a complex interaction between preexisting vulnerabilities and the environment that alters the development of the brain structure and function. Preexisting protective factors and compensatory skills further play a role (Jones et al., 2014).

Risk factors associated with neurodevelopmental disorders include maternal lifestyle during pregnancy, endocrine-disrupting chemicals, pesticides and other toxins, increasing parental age, vitamin D status, and neonatal morbidities (Atladottir et al., 2015). Yates and Le Couteur (2016) argued risk factors for ASD include having a sibling with autism; parental schizophrenia-like psychosis or affective disorder; maternal sodium valproate use during pregnancy; intellectual disability; Down syndrome; fragile X syndrome; tuberous sclerosis; birth defects associated with the central nervous system, including cerebral palsy; and being born at less than 35 weeks' gestation. Furthermore,

ASD is often associated with medical conditions, such as tuberous sclerosis and fragile X, between 1% and 3% of the time (Yates & Le Couteur, 2012).

Studies have revealed very preterm children often struggle with neurodevelopmental problems and behavioral impairments, including symptoms of ADHD and ASD (Bröring et al., 2018). Very preterm children, born at less than 28 weeks' gestation, show a two- to three-fold risk of developing ADHD and show higher rates of ADHD symptoms compared to full-term children. Children born very preterm also show rates between 5% to 9% of developing ASD (Bröring et al., 2018). Studies have shown preterm children experience early brain damage in both white and grey matter (Bröring et al., 2018).

Brain Patterns

Many researchers have studied the brain structures of children who have been diagnosed with neurodevelopmental disorders and provided insight into how the brain structures are different among disorders and when compared to typical developing children. O'Dwyer et al. (2016) reported brain volume is reduced among individuals diagnosed with ADHD, specifically in the globus pallidus, putamen, caudate nucleus, lentiform gyrus, and cerebellum. Children with ADHD have also been found to have decreased frontal and temporal grey matter volumes (O'Dwyer et al., 2016). Saunders et al. (2016) reported the presence of altered connectivity of the brain regions associated with frontostriatal circuitry among individuals with ADHD. Specifically, there seems to be a distinct underconnectivity between the anterior and posterior regions and reduced connectivity in the frontostriatal connections (Saunders et al., 2016). Further studies have shown at shorter interelectrode distances, children with ADHD have elevated

intrahemispheric coherences in the theta band and reduced lateral differences in the theta and alpha bands. Furthermore, children with ADHD have interhemispheric coherences that are elevated in the delta and theta bands and reduced in the alpha band (Saunders et al., 2016). The authors explained patterns of higher coherence indicate the processes are less flexible, which is why these individuals struggle with visual attention.

O'Dwyer et al. (2016) reported individuals with ASD have reduced volumes of the cerebellum, amygdala-hippocampal complex, frontotemporal regions, caudate nucleus, and nucleus accumbens and increased volume of the superior temporal gyrus. The frontotemporal regions and the amygdala are associated with difficulties in social–emotional processing; the frontostriatal system with repetitive and stereotyped behaviors; the caudate nucleus with repetitive and stereotyped behavior, reward processing, and executive function; and the frontal lobe with executive function, complex tasks that require working memory, motor planning, and logical and emotional attention (O'Dwyer et al., 2016; Saunders et al., 2016). O'Dwyer et al. (2016) noted the left hemisphere is abnormal among individuals with ASD and suggested a lateralized dysfunction in ASD. Altered patterns of connectivity are also found among those with ASD. Specifically, individuals with ASD have functional underconnectivity between the anterior and posterior regions (Saunders et al., 2016). Saunders et al. (2016) reported the severity of the ASD symptoms to be correlated with deviations in connectivity patterns; the greater the symptoms, the more deviations in connectivity. Additionally, individuals with ASD have higher coherence in the primary motor cortex and lower coherence in the frontal lobe networks (Saunders et al., 2016). Sensory hyperactivity to stimuli may be reflected in increased alpha power across the primary somatosensory cortex.

Yates and Le Couteur (2012) noted head growth may be a useful clinical indicator in children with ASD. Macrocephaly, or an overly large head, occurs in 20% to 30% of children with ASD (Yates & Le Couteur, 2012). Xiao et al. (2014) stated children with ASD often have early brain overgrowth and an overall increase in brain volume compared to typically developing children.

There are also impairments in the white matter of the brain among those diagnosed with ASD and ADHD. Xiao et al. (2014) argued impairments in both grey and white matter can be found in individuals with ASD. Specifically, elevated grey matter volumes are most commonly seen in the right superior temporal gyrus of the temporal lobe and higher white matter volumes are commonly seen in the right superior temporal gyrus, left middle temporal gyrus, right insular cortex, and right Heschl's gyrus. Xiao et al. (2014) concluded over 90% of toddlers diagnosed with autism exhibited abnormally larger total brains by the age of 2 or 3 years. The researchers further explained toddlers with autism had more cerebral and cerebellar white matter and more cerebral cortical grey matter compared to typically developing children. Xiao et al. (2014) noted the temporal regions, which play a role in social perception, language, and theory of mind tasks, are commonly affected in children with ASD.

Van Belle et al. (2015) reported high intra-individual variability among individuals with ADHD and with ASD, defined as the temporal variability within performance on a cognitive task. In typically developing children, intra-individual variability decreases between the ages of 6 and 20 years old and is linked to increases in white matter integrity (van Belle et al., 2015). Developmental changes are different among those with ADHD and ASD. Specifically, within ADHD there appears to be a

delay in neural development, whereas ASD is associated with early brain overgrowth followed by a low rate of change later in development (van Belle et al., 2015). Table 1 summarizes the brain structure and functioning found among individuals with ASD and ADHD.

Table 1

Brain Structure/Functioning in ASD and ADHD

Structure	ASD	ADHD
Brain volume	Reduced in cerebellum, amygdala-hippocampal complex, frontotemporal regions, caudate nucleus, and nucleus accumbens (O'Dwyer et al., 2016)	Reduced in globus pallidus, putamen, caudate nucleus, lentiform gyrus, and cerebellum (O'Dwyer et al., 2016)
	Increased in superior temporal gyrus (O'Dwyer et al., 2016)	
Head growth	20% to 30% have macrocephaly (Yates & Le Couteur, 2012)	Studies/findings not found in this review
	Experience early brain overgrowth (Xiao et al., 2014)	
White matter	Higher volumes seen in the right superior temporal gyrus, left middle temporal gyrus, right insular cortex, and right Heschl's gyrus (Xiao et al., 2014)	Studies/findings not found in this review
	Toddlers have more cerebral and cerebellar white matter (Xiao et al., 2014)	
Grey matter	Elevated in the right superior temporal gyrus of the temporal lobe (Xiao et al., 2014	Decreased frontal and temporal grey matter (O'Dwyer et al., 2016)
	Toddlers have more cerebral cortical grey matter (Xiao et al., 2014)	

Structure	ASD	ADHD
Connectivity of the brain regions	Underconnectivity between anterior and posterior regions (Saunders et al., 2016)	Appears to be altered specifically with frontostriatal circuitry (Saunders et al., 2016) Underconnectivity between anterior and posterior regions (Saunders et al., 2016)
Interhemispheric coherences	Higher coherence in primary motor cortex (Saunders et al., 2016) Lower coherence in the frontal lobe networks (Saunders et al., 2016)	Elevated delta and theta bands (Saunders et al., 2016) Reduced alpha bands (Saunders et al., 2016) Shorter interelectrode distances (Saunders et al., 2016)
Lateralized dysfunction	Abnormal left hemisphere (O'Dwyer et al., 2016)	Studies/findings not found in this review

Key Features of ASD

As previously mentioned, ASD is often characterized by impairments in social and communication difficulties as well as restricted and repetitive behaviors. Although impairments in these domains are important, other key features have been identified. In the following sections, key features of ASD, including restrictive and repetitive behaviors, motor development, speech and language development, social skills, theory of mind, executive functioning, sensory sensitivities, attachments, adaptive functioning, and tantrum behaviors, are discussed in depth.

Restrictive and Repetitive Behaviors

One of the signature ASD symptoms is restrictive and repetitive behaviors or interests. Part of the diagnostic features include that preoccupation and restricted interests are abnormal in intensity or focus (Jones et al., 2014). Children with ASD may have a preoccupation with part of objects (Jones et al., 2014). Yates and Le Couteur (2012) stated the preoccupation with an object or interest is abnormal in intensity, content, or both. Additionally, children with ASD demonstrate stereotyped and repetitive motor

mannerisms (Jones et al., 2014). Stereotyped or repetitive movements commonly seen in those with autism include hand flapping, finger flicking, head banging, and twirling. Additionally, children may be repetitive in speech and when using objects (e.g., lining up toys; Yates & Le Couteur, 2016). Although research has shown repetitive behaviors to be common and part of normal development in young children, they generally decrease through the first few years of life (Jones et al., 2014; Schertz et al., 2016). Studies of the association between restrictive and repetitive behaviors and social functioning have consistently uncovered concurrent and predictive negative associations between the behaviors and social indicators (Schertz et al., 2016). Furthermore, Yates and Le Couteur (2016) found the repetitive behaviors can cause significant social impairment, decrease the ability to learn new skills, and contribute to increased levels of parental stress for children with ASD.

Many children may also lack creativity and imagination in play behaviors. Furthermore, sensitivity to environmental stimuli is often seen. Specifically, children may have sensitivities to sounds, smells, textures, or colors, or an insensitivity to pain (Yates & Le Couteur, 2016). Jones et al. (2014) found parents report infants with a 24-month diagnosis of autism had more frequent and intense reactions to a variety of stimuli beginning at 12 months of age.

Motor Development

Motor symptoms are one of the earliest identifiable impairments observed in infants and toddlers who go on to develop ASD. Delays in motor functioning are often present prior to social functioning deficits (Bo et al., 2016). According to Turygin et al. (2013), motor development delays have been detected between 12 and 24 months of age

in children with ASD. Bo et al. (2016) suggested difficulties with motor skills should be considered a primary symptom of ASD. Although motor deficits are not considered to be one of the core symptoms of ASD, clumsiness and motor functioning delays are common (Bo et al., 2016). Around 21% to 100% of children with ASD experience various motor deficits (Bo et al., 2016; Kaur et al., 2018). Kaur et al. (2018) reported motor disturbances are present in children with ASD regardless of cognitive status. Children with ASD have been found to have atypical predictive processing, including lacking anticipatory activation during action execution and action observation (Braukmann et al., 2018). Braukmann et al. (2018) reported infants who were later diagnosed with ASD displayed fewer mouth-opening anticipations during feeding between 4 and 6 months of age.

Historically, repetitive and stereotyped movements have been the primary focus of motor dysfunction with children with ASD. Matson and Goldin (2014) reported children with ASD display more motor stereotypies and participate in more gait movements and complex hand and finger stereotypies than other children. Children with ASD experience difficulties with gross and fine motor coordination, movement patterns in locomotion, praxis, dyspraxia, imitation-based tasks, goal-directed motion, bilateral coordination, asymmetries in postures, abnormal muscle tone, gait abnormalities, social-motor coordination, poor posture control, and a general delay in motor milestones (Jones et al., 2014; Kaur et al., 2018; Planche & Lemonnier, 2012). Additionally, researchers have found in clinical practice that children with ASD experience a delay of learned novel motor skills, including peddling a bicycle and pumping legs on a swing (Bo et al., 2016). Fine motor control deficits, including dexterity, handwriting, object control, and

visuo-motor integration skills, have also been observed among children with ASD (Kaur et al., 2018). Although basic gross and fine motor skill impairments are also found in children with ADHD, impairments in praxis appear to be specific to ASD. Studies have shown children with ASD exhibit spatial and temporal errors during imitation/praxis tasks (Kaur et al., 2018).

Typically developing children progress through a series of gross motor skills, including rolling over within 3 to 4 months, sitting independently between 5 and 7 months, crawling between 7 and 9 months, and walking between 10 and 15 months (Jones et al., 2014). Additionally, infants develop the ability to keep their heads in line with their bodies by 4 months and children diagnosed with ASD often exhibit head lag after 6 months of age (Jones et al., 2014). The development of fine motor skills includes pincer grip between 9 and 12 months and the ability to point between 8 and 14 months (Jones et al., 2014). In infants with ASD, delays in supine, prone, and sitting skills have been observed (Bo et al., 2016). Children between 9 and 12 months of age exhibit notable sensorimotor symptoms and display less static and dynamic symmetry supine position (Bo et al., 2016). Jones et al. (2014) reported that in retrospective studies, parents noted a lower activity level at 6 months of age among children who were later diagnosed with ASD. Toddlers experience deficits in reaching, clapping, pointing, crawling, and walking (Bo et al., 2016). School-age children experience difficulties with limb coordination and postural instability (Bo et al., 2016).

Motor skill development has been associated with social communication and cognitive development in children with ASD (Kaur et al., 2018). According to Jones et al. (2014), the attainment of motor milestones precedes changes in aspects of cognitive

function. Motor difficulties have been linked to abnormal functions, including social communication and restricted interests, activities, and behaviors (Bo et al., 2016). Children with ASD have reduced social attention skills, movement control skills, and visuomotor coordination skills that contribute to decreased bilateral coordination and social synchrony (Kaur et al., 2018). Researchers argue akinesia and dyskinesia affect the ability to initiate, switch, efficiently perform, or continue any action involved in communication, social interactions, or functional activities (Bo et al., 2016). Furthermore, impairments in motor functioning often persist into childhood and affect a variety of motor coordination tasks, including drawing, typing, writing, speaking, and playing (Bo et al., 2016).

Some researchers believe abnormal brain connectivity to be responsible for the motor impairments in gait, posture, coordination, and imitation/praxis among children with ASD (Kaur et al., 2018). Studies have shown the presence of excessive short-range connectivity within cortical regions and poor long-range connectivity between cortico-cortical structures or cortico-subcortical structures (Kaur et al., 2018). Other studies indicated the links between social and motor skills in ASD support the presence of impairments in the mirror neuron system. Dysfunction in the mirror neuron system has been associated with dyspraxia and difficulties in social communication and emotional skills (Kaur et al., 2018).

Speech and Language Development

Researchers have argued that language learning begins in the womb (Jones et al., 2014). By 6 to 9 months of age, typically developing infants recognize the meaning of familiar words and by 16 months their comprehensive vocabulary ranges from about 92

to 321 words (Jones et al., 2014). Jones et al. (2014) highlighted the developmental stages of expressive language in typically developing infants, including crying and vegetative sounds beginning from birth, cooing around 6 to 16 weeks, vocal play between 4 and 7 months, reduplicative babbling between 6 and 10 months, nonreduplicated babbling from 10 to 14 months, and first words at the end of the first year.

Research has shown there are similar communication skill and language deficits for those diagnosed with ASD and ADHD. Although communication skill deficits are one of the main diagnostic criteria experienced by children with ASD, language and pragmatic disturbances often occur in children with ADHD (Fortea et al., 2018). Although the deficits experienced by those with ADHD do not appear to be as severe as those with ASD, researchers have seen difficulties among both groups with coherence and inappropriate initiations. Both groups experience difficulties comprehending social situations and mental states (Fortea et al., 2018). Another weakness among both groups is narrative ability. Children with ADHD experience difficulties in speech fluency and elaboration and comprehension of stories (Fortea et al., 2018). Additionally, children with ADHD talk excessively, interrupt others, and do not listen to what is being said (Sokolova et al., 2017). Children with ASD exhibit language dysfunction and struggle to obtain useful speech, defined as expressive language that may be used frequently, communicatively, referentially, and in a semantically diverse manner (McDaniel et al., 2018). Additionally, children with ASD use language in a stereotypic and repetitive manner, and struggle to engage in back and forth conversations (Sokolova et al., 2017).

Individuals with ASD experience language dysfunction ranging from complete lack of speech through language delays, stilted and overly literal language, to poor

comprehension of speech (Xiao et al., 2014). Language development has also been described as “developmentally scattered” in children with ASD (Turygin et al., 2013). Atypical language with the idiosyncratic use of words or phrases including nonsense or jargon words, pronominal reversals, and abnormal prosody including abnormal pitch, speed, volume, or tone is also common (Yates & Le Couteur, 2016). Children with ASD are likely to display deficits in conceptual rather than grammatical understanding (Turygin et al., 2013). Additionally, children diagnosed with ASD have been found to have delays in receptive language (Jones et al., 2014).

Jones et al. (2014) noted diagnostic features of ASD include a lack or delay of spoken language, deficits in initiating or sustaining conversations, stereotyped or repetitive use of language or idiosyncratic language, and a lack of spontaneous pretend or imitative play. Infants with ASD exhibit fewer speech-like vocalizations, consonant types, and canonical syllable shapes. According to McDaniel et al. (2018), children with ASD present with fewer diverse vocalizations, including smaller consonant inventories, and are more inclined to produce vocalizations without a communicative purpose. According to Jones et al. (2014), infants with ASD produce fewer middle consonant types at 6 months, fewer late consonant types at 9 months, and a lower total number of different consonant types at 12 months. Jones et al. (2014) found infants with ASD had fewer consonants in syllables at 14 and 30 to 36 months of age. Furthermore, children with ASD generate more syllables with atypical phonation (Bornstein et al., 2016). Children diagnosed with ASD have been observed to use gestures and experience difficulties with nonverbal communication, misunderstanding the context, and stereotyped language (Fortea et al., 2018). Yates and Le Couteur (2016) argued a distinct

differentiation from children with specific language disorder is children with ASD fail to use gestures or mime. According to Yates and Le Couteur, children with ASD exhibit repetitive use of speech, including delayed echolalia. Delayed echolalia is copied or directly imitated speech repeated well after it is heard. Mutually reciprocal conversations skills are limited among children with ASD, especially if the conversation is not about a topic of interest. Additionally, children with ASD struggle to engage in conversations about someone else's hobby or interest (Yates & Le Couteur, 2016). Kuhl et al. (2013) concluded the synergistic effects of social and linguistic function are disrupted in children with ASD.

Furthermore, those with ASD struggle with coherence and cohesive adequacy, productivity and grammar, pronominal references, syntactic complexity, and internal state language (Fortea et al., 2018). According to Naigles et al. (2016), errors in pronominal reference are common in typically developing children and are predominately common before the age of 2.5 years. Researchers have discovered pronoun reversals in children with ASD may be attributed to their delayed onset of language or deficits in specific grammatical forms (Naigles et al., 2016). Naigles et al. (2016) argued the use of pronoun reversals by children with ASD can be attributed to social impairments as well as their difficulties with perspective-taking, or deixis.

Parents historically have reported language delays, poor social skills, and unusual, unwanted behaviors (Bornstein et al., 2016; Matson & Goldin, 2014). According to Yates and Le Couteur (2016), 20% to 30% of children will experience a period of stasis or regression of language from 18 to 24 months of age. Strong indicators to have a child evaluated include the absence of babble, gesture, or pointing by 12 months; not saying

single words by 18 months; no two-word phrases by 24 months; and any loss of language or social skills at any age (Yates & Le Couteur, 2016).

Bornstein et al. (2016) cited differences in the vocal behavior of children in ASD. Specifically, studies have shown there are differences in communication through cry between infants and typically developing infants. Fundamental frequency, or pitch, in typically developing infant cries falls in the 300 to 600 Hz range (Bornstein et al., 2016). Abnormal cries, characterized by higher fundamental frequencies and shorter pauses, have been witnessed in infants in ASD. According to Jones et al. (2014), infants diagnosed with ASD at 36 months had cries that were poorly phonated.

Kuhl et al. (2013) demonstrated phonetic learning predicts the speed at which children acquire language and native language discrimination predicts growth of language to the age of 30 months. Further, research has indicated cognitive ability, specifically the relationship between verbal and nonverbal cognitive ability, is a significant factor contributing to the heterogeneity in autism (Kuhl et al., 2013). According to Kuhl et al. (2013), brain measures of early language processing are potential predictors of prognosis in children with ASD.

Social Skills

Researchers have noted individuals with ADHD as well as ASD present with poor social skills (Cervantes et al., 2013). Children with ADHD also exhibit difficulties with social behaviors, including interrupting others and interjecting into a conversation (Cervantes et al., 2013). Because of the social deficits exhibited by children with ADHD, they are less socially preferred, more likely to be rejected by their peers, and have difficulty maintaining friendships (Cervantes et al., 2013). Bühler et al. (2011) noted

children with ADHD are often rejected or disliked within a few minutes during social interactions. Cervantes et al. (2013) stated that although children with ADHD experience social difficulties, the difficulties are not a result of a lack of understanding social rules.

Children with ASD experience difficulties in socialization ranging from basic aspects of social interaction to complex social tasks. Basic social interactions include joint attention and emotion perception skills. Complex social skills include the ability to form and maintain meaningful relationships (Cervantes et al., 2013). Yates and Le Couteur (2016) explained children with ASD often have an absence of joint attention, fail to respond to their name, display inadequate facial expressions, lack awareness of how other people are feeling, and lack awareness of how their behaviors affect others. Joint attention is the ability to direct another's attention by using gestures and being able to follow the gestures of others (Klinger et al., 2014). Joint attention includes showing interest, sharing a focus of attention, and following gaze (Yates & Le Couteur, 2016). The poor facial expressions exhibited by children with ASD include a lack of social smiling and limited use of gestures, such as shaking head, nodding, waving, and clapping (Yates & Le Couteur, 2016). Pang et al. (2018) noted children with ASD struggle to seek sympathy or comfort and struggle to show sympathy or offer comfort toward others. Yates and Le Couteur (2016) noted children with ASD can misinterpret the tone of voice or facial expressions of others and fail to develop mutual sharing of interests or activities. Children with ASD often exhibit social attention deficits around the end of the first year of life. Jones et al. (2014) reported children with ASD display less gaze to faces and less directed vocalizations by 12 months of age. Pang et al. (2018) noted children with ASD lack interest in group, social, or imitative games as well as spontaneous or make-believe

play. Toddlers with ASD have also been observed as having difficulties with imitation beginning around 24 months of age (Jones et al., 2014). Jones et al. (2014) reported children at 12 to 18 months of age displayed fewer imitations of sounds or words.

According to Jones et al. (2014), typically developing infants use communicative and emotional cues to interact during the first few months of life. Jones et al. (2014) stated infants age 8 to 10 months begin to use gestures, including pointing, to communicate and begin to display shared attention. By 9 months of age, typically developing infants use gaze by alternating their direction of gaze between an object of interest and a person (Jones et al., 2014). Furthermore, typically developing infants will interact with others through social games, such as peekaboo (Jones et al., 2014). Jones et al. (2014) noted typically developing infants begin to respond to others' emotional cues over the first year of life. Smiling becomes reactive to social cues over around 2 months of age and by 10 months of age the smiling is differentiated in response to the person.

Cervantes et al. (2013) noted children with ASD experience difficulty feeling empathy toward others, understanding social cues, and associating with peers. Furthermore, children with ASD show a reduced level of social smiling (Jones et al., 2014). Children 36 months of age who are diagnosed with ASD are less likely to smile during play and toward their caretakers (Jones et al., 2014). Children with ASD have been found to struggle with saying thank you, starting conversations, engaging in eye contact, and smiling at others (Cervantes et al., 2013). Many researchers attribute the social impairments found in children with ASD to their repetitive behaviors, restricted interests, and poor communication skills (Cervantes et al., 2013). According to Yates and Le Couteur (2016), difficulties in social skills are often the earliest features of ASD;

however, they are easily missed because they are often subtle. Cervantes et al. (2013) reported social problems manifest as early as the first year of life and remain problematic throughout development.

Some researchers have noted internalizing problems are contributing to the increased rates of social and behavioral issues in children with ASD (Wilson et al., 2014). Vento et al. (2017) argued the social impairments experienced by children with ASD may be attributed to reduced attention to emotional facial expressions.

Theory of Mind

Theory of mind is the ability to attribute mental states such as beliefs, desires, feelings, and intentions to others (Berenguer et al., 2018). Although theory of mind deficits are often recognized in children with ASD, they are also seen in children with ADHD. Many researchers have made attempts to differentiate ADHD and ASD and some have even found possible differentiation within the areas of executive control functions and theory of mind. Some research has shown children with ADHD have deficits in affect recognition though at less severe levels when compared to children on the spectrum (Berenguer et al., 2018; Bühler et al., 2011). Studies have shown children with ADHD appear to do well on theory of mind tasks but struggle to implement that knowledge in social situations (Berenguer et al., 2018). Children with ASD show theory of mind deficits beginning from an early age, whereas children with ADHD tend to develop deficits at a later age. Many argue children with ADHD develop deficits because of their poor inhibitory control and attention difficulties (Berenguer et al., 2018; Bühler et al., 2011). ADHD symptoms are believed to exacerbate theory of mind deficits in children with ASD. Berenguer et al. (2018) argued children with comorbid ASD and

ADHD struggle more with empathy. On the other hand, other researchers concluded there is not a difference in theory of mind tasks between children with ASD and ADHD (Bühler et al., 2011).

Executive Functioning

Although ASD and ADHD have distinct symptom presentations, the two disorders share many behavioral and cognitive features (Goldin et al., 2013). Many researchers argue executive dysfunction plays a role in ADHD and ASD (Cooper et al., 2014; Jones et al., 2014; Tye et al., 2014). Executive functioning refers to "higher-level" cognitive tasks that inspire flexible goal-directed behaviors and share the need to disengage from the immediate environment in order to guide action (Jones et al., 2014). Executive functioning is believed to influence behavior and may contribute to the development of secondary problems (Skogan et al., 2014). Executive functioning is necessary for goal-directed behavior and the development of self-regulation skills, response inhibition, mental flexibility, working memory, reasoning, and planning and organization (Neely et al., 2016; Skogan et al., 2015). Additionally, executive functioning is the daily life self-regulation that drives an individual's ability to organize, prioritize, and integrate cognitive functions (Polderman et al., 2013). Executive functioning tasks involve skills that are mediated by the frontal lobe, such as inhibition, rule learning, flexibility, and working memory (Jones et al., 2014). Berenguer et al. (2018) stated executive functioning is theorized as the effectiveness with which individuals go about obtaining information and solving problems in nine areas: attention, emotion regulation, flexibility, inhibitory control, initiation, organization, planning, self-monitoring, and working memory.

Executive functioning skills develop in the first few years of life (Jones et al., 2014). Researchers have reported executive functioning deficits, including inhibition and working memory deficits, emerge beginning in preschool-age children (Skogan et al., 2015). Inhibition includes the ability to suppress or withhold unrelated thoughts or behavioral responses in order to complete a task (Skogan et al., 2014). Working memory includes the ability to store, rehearse, and manipulate information (Skogan et al., 2014). Skogan et al. (2014) further noted inhibition and working memory capacities are established by the age of 3 years. According to Jones et al. (2014), working memory can be measured around 6 months of age in an oculomotor delayed response task. Jones et al. discovered infants as young as 9 months old were able to complete a visual attention task to measure inhibitory control. With regard to self-regulation skills, researchers have stated emotional and behavioral regulation skills may reflect the early-emerging executive skills. Specifically, researchers have noted the ability to shift attention between objects could potentially be linked to regulation as infants are required to shift their attention away from over-arousing situations (Jones et al., 2014). Furthermore, Smith et al. (2019) stated infants can maintain mental representation of a hidden object and inhibit the tendency to search for that object in a previously hidden location by the end of the first year of life. By the time children are in preschool, they are able to demonstrate the ability to shift attention between conflicting rules (Smith et al., 2019).

Attempts to distinguish ASD and ADHD have shown differentiation within the areas of theory of mind and executive functioning (Bühler et al., 2011). Berenguer et al. (2018) found the 92% of children in their study with ASD and ADHD showed impairments in executive functioning, whereas children with ASD displayed 47% and

children with ADHD exhibited 63% of executive functioning difficulties. Researchers have found links between executive functioning and early signs of ADHD (Skogan et al., 2014). Deficits in attention orienting and inhibitory processing, behavioral deficits in task performance, and difficulties with sustained attention are common among children with ADHD (Berenguer et al., 2018; Tye et al., 2014). Children with ASD display abnormal response preparation and conflict monitoring, which affects their ability to shift to different cognitive demands and disengage their attention (Tye et al., 2014). Additionally, children with ASD experience more difficulties with cognitive flexibility and planning (Berenguer et al., 2018). Planche and Lemonnier (2012) argued children with ASD struggle with planning, cognitive flexibility or set-shifting, and working memory, which affects their daily life. Arnett et al. (2018) noted individuals with ASD and ADHD inattentive type have been shown to have difficulties with inhibition, planning, and flexibility. Smith et al. (2019) reported those with ASD often become fixated on an idea or action and demonstrate difficulty with perspective-taking and show distress or oppositional behavior when faced with change. Arnett et al. (2018) found variability in reaction time specific to ADHD inattentive type whether it was comorbid with ASD or not. Jones et al. (2014) reported 36-month-old infants with ASD exhibited poorer effortful emotional regulation skills. Jones et al. noted infants 24 months of age diagnosed with ASD display less inhibitory control.

Children with a comorbid diagnosis of ASD and ADHD present with greater executive impairments, including difficulty with inhibitory control, sustained attention tasks, verbal working memory, and cognitive flexibility (Berenguer et al., 2018). Polderman et al. (2013) noted the co-occurrence of ADHD and ASD is driven by shared

impairments on an attentional level not related to behavioral impairments, hyperactivity, social skills, imagination, or routine preferences. Berenguer et al. (2018) found ADHD symptoms had more of an impact on attention shifting problems in children with ASD by negatively affecting their flexibility. Goldin et al. (2013) concluded children with ASD and ADHD have greater deficits in vigilance, working memory, and response inhibition. Bühler et al. (2011) found in their study that children with comorbid ADHD and ASD were more impaired in inhibitory control than were those in the ASD group alone. Goldin et al. (2013) noted children with ASD and ADHD also demonstrate with difficulties in comprehension skills.

Sensory Sensitivities

Children with ASD are often found to have sensory sensitivities. Fluegge (2017) noted individuals with ASD and even those with ADHD may have sensory processing difficulties. Sensory processing is the ability to register, process, and organize sensory information and execute appropriate responses to environmental demands (Chistol et al., 2018). Robertson and Simmons (2013) noted those with ASD have atypical responses to sensory stimuli, including visual, auditory, touch, smell, taste, and within the vestibular system. Maskey et al. (2013) reported adverse sensory reactions occur in approximately 90% of individuals with ASD. Children diagnosed with ASD often have tactile sensory seeking behavior (Planche & Lemonnier, 2012). Planche and Lemonnier (2012) further reported children with Asperger's disorder often display more tactile discrimination and sensory perception capabilities when compared to children with ASD. Robertson and Simmons (2013) noted the sensory disturbances experienced are described as hyper-sensitivity and hypo-sensitivity. Hyper-sensitivity is an overload of stimuli and is

remarkably sensitive to sensory input, whereas hypo-sensitivity occurs when an individual under reacts, appears unaware, or is slow to respond to a stimulus (Neil et al., 2016; Robertson & Simmons, 2013). An individual may exhibit unusual behavior, including intense interest or craving for a specific sensory experience, which is known as sensory seeking (Neil et al., 2016).

Sensory reactions among individuals with ASD may contribute to aggressive behaviors and anxiety (Maskey et al., 2013). Researchers have argued there is a causal relationship between sensory sensitivities and anxiety. Specifically, that sensory over-responsivity gives rise to anxiety (Neil et al., 2016). Further studies have shown difficulties in dealing with uncertainty may give rise to beliefs that uncertainty is negative and should be avoided (Neil et al., 2016). Neil et al. (2016) further noted sensory sensitivities not only cause distress to individuals but have a negative impact on family life and social relationships.

Researchers have argued sensory sensitivities may cause children with ASD to restrict their intake to foods that are preferred, tolerable, and have manageable textures (Chistol et al., 2018). Nearly 80% of children with ASD are described as picky eaters (Odar Stough et al., 2015). Many caretakers report children with ASD to be overly selective in their eating patterns and to consume less varied diets (Chistol et al., 2018; Odar Stough et al., 2015). Furthermore, these children require food to be a particular texture, color, shape, or commercial brand (Odar Stough et al., 2015). One study showed children with ASD have a five-fold risk of feeding problems (Chistol et al., 2018) and the lack of food variety puts these children at risk for nutritional inadequacies (Chistol et al.,

2018). Odar Stough et al. (2015) noted children with ASD consume about half of the number of foods compared to typically developing children.

Attachments

Attachment is a set of an innate behaviors that underlie the development of relationships between children and caregivers. Attachment systems help children establish a sense of security and comfort from a caregiver and adapt as children grow (Teague et al., 2017). Bowlby (1969, as cited in Teague et al., 2017) noted the quality of attachment is affected by the quality of the caregiving experienced. It is believed that when a child is distressed, they will display proximity-seeking behaviors and when a child feels secure, they will exhibit exploratory behaviors. Behaviors displayed by infants include crying and clinging to a caregiver, preference for caregivers, and suspicion of strangers. As the child grows, the attachment behavior is less dependent on physical proximity. Toddlers are seen to use caregivers as a safe-base to which to return when they are exploring new environments (Teague et al., 2017).

Solomon (2015) believed children with ASD have a decreased ability to experience attachment, care, and understanding of others. Children with ASD struggle to form notable attachment relationships with caregivers (APA, 1980). According to researchers, difficulties with interpersonal relationship skills pose a challenge to children and caregivers to be able to understand each other's needs and intentions (Teague et al., 2017). It is believed children with ASD struggle to form attachments as a result of their deficits in making eye contact, turn-taking, conversation, joint attention, and other aspects of interpersonal relatedness (Teague et al., 2017). Teague et al. (2017) concluded the severity of autism symptoms and the presence of an intellectual disability contribute

to insecure attachments to caregivers and are associated with lower attachment security, poorer parent–child interactions, attachment disturbances, and lower cortisol reactions to separation from caregivers.

Adaptive Functioning

Adaptive functioning refers to behaviors that are critical in day-to-day life in the areas of communication, socialization, self-help, and life skills and independence (Ashwood et al., 2015). Adaptive behavioral skills are essential for independent functioning within society and include practical, conceptual, social, and linguistic skills (Nevill et al., 2017). Children with ASD experience greater rates of deficits in adaptive functioning than cognitive functioning (Nevill et al., 2017). Historically, the adaptive functioning of those with ASD has shown significant deficits in socialization, communication skills, and daily living skills (Ashwood et al., 2015).

Adaptive skills are believed to be learned though social interactions within the environment (Nevill et al., 2017). Because children with ASD struggle to acquire adaptive skills as they become older, the deficits are only greater over time, which further supports the importance of diagnosing under the age of 3 years and beginning proper interventions (Nevill et al., 2017). Nevill et al. (2017) further argued adaptive functioning profiles are necessary to consider and aid in the development of the treatment plan.

Nevill et al. (2017) reported individuals with ASD generally present with an adaptive behavior profile with relative strengths in motor functioning, followed by daily living skills, communication, and a relative weakness in socialization; however, other profiles have also been found. Researchers argue inconsistencies in the profiles may be

attributed to symptom severity, age, IQ, language, and socio-cultural variables (Nevill et al., 2017).

The comorbidity between ASD and ADHD can be accounted for by shared genetic influences and studies typically have focused on the cognitive features of the disorders. Ashwood et al. (2015) compared the profiles of adaptive functioning in ASD, ADHD, and a comorbid group. The researchers found the comorbid group had significantly greater impairments across all domains of adaptive functioning. Additionally, high functioning individuals with ASD exhibited a discrepancy between socialization, communication, and increased daily living skills as a function of age. Low functioning individuals with ASD displayed adaptive abilities that were similar to their cognitive abilities (Ashwood et al., 2015). Furthermore, the ADHD group exhibited the lowest scores in communication (Ashwood et al., 2015).

Tantrum Behaviors

Externalizing and tantrum behaviors are commonly observed in children with ADHD and ASD (Tureck, Matson, May, & Turygin, 2013). Tantrums are defined as a cluster of externalizing behaviors such as crying, becoming upset, displaying anger, destroying property, noncompliance or oppositional behavior, and aggression toward others (Goldin et al., 2013). Matson and Goldin (2014) noted some common challenging behaviors include aggression, tantrums, eating disorders, and stereotypic and self-injurious behavior. Children with ASD are known to have inflexible adherence to routines (Jones et al., 2014), which may cause resistance and result in distress or temper tantrums when routines or the environment change (Yates & Le Couteur, 2012). Tureck, Matson, May, and Turygin (2013) argued the reason children with ASD have an increase

in externalizing behaviors is communication deficits. Maskey et al. (2013) argued children with expressive language difficulties display more frequent problematic behaviors.

Goldin et al. (2013) observed tantrum behaviors among children diagnosed with ADHD, ASD, and comorbid ASD and ADHD. The researchers found children diagnosed with comorbid ASD and ADHD scored the highest followed by the ASD group, which supported previous research that showed comorbid ADHD exacerbates the symptoms of ASD (Goldin et al., 2013; Tureck, Matson, May, & Turygin, 2013). Specifically, children with ASD and comorbid ASD and ADHD are significantly more likely to have tantrums, easily become angry and upset, and have difficulties finishing assigned tasks (Goldin et al., 2013). Furthermore, the comorbid diagnosis may exacerbate impairments in social interaction, increase difficulties in daily functioning, and lead to the development of positive adaptive behaviors (Tureck, Matson, May, & Turygin, 2013).

Summary

This chapter discussed two common neurodevelopmental disorders, ASD and ADHD, that are commonly diagnosed in childhood. Although ASD and ADHD are highly comorbid, the overlap of symptoms hinders the diagnostic process and increases the risk of a false diagnosis (Bühler et al., 2011). ASD and ADHD have similar deficits across many areas, including motor speed, reward processing, developmental, language, cognitive, social, and executive functioning (Mansour et al., 2017; O'Dwyer et al., 2016). Furthermore, individuals who are diagnosed with a comorbid diagnosis are found to experience more irritability and anger, and have higher rates of internalizing and externalizing problems (Jones et al., 2014; Lyall et al., 2017; Mayes et al., 2012).

Knowing the early signs of ASD could help children receive an earlier diagnosis and proper treatment. Researchers have noted a diagnosis of ASD at 18 to 24 months of age is reliable and stable (Hinnebusch et al., 2017). Additionally, this chapter discussed in depth the key features of ASD, including restrictive and repetitive behaviors, motor development, speech and language development, social skills, theory of mind, executive functioning, sensory sensitivities, attachments, adaptive functioning, and tantrum behaviors.

Methods

The purpose of this chapter is to introduce the research methodology used to identify the ASD symptomology that needs to be considered when evaluating a child with presenting comorbid ASD and ADHD symptoms. The research plan, approach, and analysis method for this study are discussed in this chapter.

Research Plan

This researcher studied books, journal articles, and published questionnaires to gather an understanding of ASD and ADHD symptoms to help educate clinicians during the diagnostic process. With the appropriate knowledge and understanding of the symptoms, clinicians should be able to make accurate diagnoses. This researcher compiled a list of symptomology for ASD and ADHD with an emphasis on the symptoms found among children with ASD and ADHD and the symptoms found only among children with ASD.

Approach

The researcher conducted a search of internet-based databases using EBSCOhost and Google and the following keywords to obtain the relevant studies for this review: autism, ASD, autism comorbid attention deficit hyperactivity disorder, ADHD, autism in preschool, ADHD in preschool, young children with ADHD, young children with autism, children with autism, early signs of ASD, ASD diagnostic tools, ASD + executive functioning, ASD + social functioning, ASD + language, ASD + sensory sensitivities, ASD + motor functioning, ASD + tantrums, ASD + theory of mind, early indicators of ASD, Ages and Stages Questionnaire, Autism Diagnostic Interview, Autism Diagnostic Observation Schedule, Checklist for Autism Spectrum Disorder, Child Autism Rating

Scale, Children's Social Behavior Questionnaire, Gilliam Autism Rating Scale, Modified Checklist for Autism in Toddlers, Mullen Scales of Early Learning, Repetitive Behavior Scale-Revised, Screening Tool for Autism in Toddlers and Young Children, Short Sensory Profile, Social Communication Questionnaire, Social Responsiveness Scale, and Vineland Adaptive Behavior Scales. Abstracts of documents were reviewed and any relevant documents were retrieved. Resources were omitted if they were conducted prior to 20 years ago, unless an updated study or research was not conducted. Reference lists of the obtained articles were reviewed for further relevant studies. Additionally, published questionnaires were studied and reviewed to gain a better understanding of the symptomology currently being considered when making a diagnosis of ASD.

Analysis

After compiling a list of symptomology of ASD and ADHD, the researcher conducted a comparison of the symptoms. The symptoms found only among children with ASD were emphasized and placed on a checklist.

Results

The difficulty with accurately diagnosing children with ASD can affect their ability to receive early intervention services. As previously discussed, the overlap of symptomology between ASD and ADHD delays a proper diagnosis (Bühler et al., 2011), which often means children receive a diagnosis of ADHD approximately 3 years prior to an ASD diagnosis (Stevens et al., 2016). With studies showing up to 85% of children present with comorbid ADHD symptoms (Berenguer et al., 2018), it is essential for clinicians to understand how to accurately diagnose. To do this, clinicians need to understand the symptomology, early indicators, and diagnostic screens and tools. As previously mentioned, the purpose of this study was to identify and discuss the early ASD symptoms found among children with comorbid ADHD symptoms. This study was intended to help decrease the incidence of the misdiagnosis of ASD in children prior to the age of 3 years by proposing a standard checklist for diagnosticians to use.

Corsello et al. (2013) stated there are few standardized diagnostic tools that have established strong discriminative ability in young children and predictive validity over time. Hinnebusch et al. (2017) argued ASD can not only be detected accurately, but that the diagnosis is highly stable across time.

Although many clinicians rely on intelligence test scores during diagnostic decision-making and treatment planning, questions arise regarding the reliability of the scores based on the social, communication, and behavior difficulties experienced by children with ASD (Baum et al., 2015). Researchers have reported children with ASD obtain lower scores on the vocabulary and coding subtest and children with ADHD obtain lower scores on block design and arithmetic (Hidding et al., 2015). Additionally,

children with ASD as well as ADHD obtain lower scores on the coding subtest compared to the symbol search subtest on intelligence tests (Hidding et al., 2015). Planche and Lemonnier (2012) noted children with ASD have difficulty on the coding subtest of the IQ tests because of their graphomotor deficit. There is research to support the use of nonverbal IQ scores as they are likely to be the most stable over time (Baum et al., 2015). Planche and Lemonnier noted children with high functioning autism have significantly lower verbal IQ scores than performance IQ scores.

Carlew and Zartman (2017) argued neuropsychological research would benefit from developing more functionally based tests that would enable clinicians to answer the referral question more precisely. Additionally, research is needed with a focus on the development of multivariate normative datasets that will improve sensitivity and specificity as well as prevent confusion of symptom presentations (Carlew & Zartman, 2017).

Diagnostic Tools and Screeners

Diagnosing autism involves interviews, observations, and evaluations performed by developmental pediatricians, child psychiatrists, or pediatric neurologists as there are no biological markers or medical tests for diagnosing ASD. Therefore, the diagnosis of ASD is based on behavioral symptoms and developmental history (Costello, 2019; Klinger et al., 2014). DePaul and Kern (2011) stated the screening process is critical because many of the behaviors consistent with ADHD could be symptomatic of another disorder such as autism or a result of a disorganized environment.

The following sections contain a discussion of the various diagnostic tools and screeners that are currently published and widely used when assessing ASD. To note, the

diagnostic measures listed do not encompass all of the measures available, but those that are widely used and discussed in research and clinical practice.

Ages and Stages Questionnaire (ASQ)

The ASQ is a 30-item questionnaire completed by caregivers to assess ASD symptomology (Dumont-Mathieu & Fein, 2005). The ASQ may be given to children between the ages of 4 and 60 months old (Dumont-Mathieu & Fein, 2005). The ASQ yields five domain areas, including communication, gross motor, fine motor, problem solving, and personal-social (Dumont-Mathieu & Fein, 2005).

Autism Diagnostic Interview, Revised (ADI-R)

The ADI-R is a semi-structured interview that contains 93 items that encompass symptoms of ASD and is given to caregivers (Le Couteur et al., 2003; Mansour et al., 2017). According to Le Couteur et al. (2003), the ADI-R can be given to children and adults, whose mental age is approximately 18 months or older. The ADI-R yields three domains, including abnormalities in reciprocal social interactions; abnormalities in communication; and restricted, repetitive, stereotyped patterns of behavior. Additionally, the ADI-R contains questions regarding early development, signs, and developmental milestones. Researchers have cautioned against only using the ADI-R in young children as it can cause them to overlook a potential diagnosis of ASD based on insignificant evidence of a child displaying restricted or repetitive behaviors; therefore, researchers have encouraged a follow-up assessment or the use of the Autism Diagnostic Observation Schedule (ADOS) or Child Autism Rating Scale (CARS; Akshoomoff, 2006). Other researchers argued the ADI-R and the ADOS display the highest sensitivity and specificity of the various diagnostic tools available (Wan et al., 2019).

Autism Diagnostic Observation Schedule (ADOS)

The ADOS consists of activities, conversations, observations, and codes of behavior to assess ASD severity in individuals from 12 months to adulthood (Frazier et al., 2016; Mansour et al., 2017). The most recent edition, the Autism Diagnostic Observation Schedule, second edition (ADOS-2), consists of five modules depending on an individual's expressive language ability (Zander et al., 2016). Additionally, each module from the ADOS-2 consists of 29 to 34 items (Zander et al., 2016). The ADOS yields scores for specific domains including social behaviors, communication, and restricted and repetitive behaviors (Mansour et al., 2017).

Checklist for Autism Spectrum Disorder (CASD)

The CASD is a 30-item diagnostic tool based on a semi-structured interview, informant information, and observations (Mayes, 2018; Murray et al., 2011). The CASD is given to children from 1 to 17 years of age (Murray et al., 2011).

Child Autism Rating Scale, 2nd edition (CARS-2)

The CARS-2 is a rating scale that contains 15 items completed by professionals gathered from direct observations during the assessment to assess ASD symptomology (Hinnebusch et al., 2017; Mehling & Tassé, 2016). There are parent rating forms also available.

Children's Social Behavior Questionnaire (CSBQ)

The CSBQ is a rating scale that contains 49 items rated by caregivers to assess ASD symptomology (Hartman et al., 2013). The CSBQ can be given to children between the ages of 4 though 18 years. The CSBQ yields scores for six problem areas including not optimally tuned to the social situation; reduced contact and social interest; difficulties

in understanding social information; orientation problems in time, place, or activity; stereotyped behavior; and fear of and resistance to changes (de Bildt et al., 2009).

Gilliam Autism Rating Scale (GARS)

The GARS is a rating scale that contains 56 items rated by caregivers to assess ASD symptomology (Lecavalier, 2005). The GARS yields scores for four subscales, including stereotyped behaviors, communication, social interaction, and developmental disturbance (Lecavalier, 2005).

Modified Checklist for Autism in Toddlers (M-CHAT)

The M-CHAT is a screening tool that contains 23 items used to help assess ASD symptomology in children between 18 and 24 months of age (Corsello et al., 2013; Toh et al., 2018). Corsello et al. (2013) stated that although the M-CHAT can be used to accurately identify children with ASD, there are many children who test false positive.

Mullen Scales of Early Learning (MSEL)

The MSEL is a standardized test of cognitive ability for children between birth and 68 months (Hinnebusch et al., 2017). It is a measure used to assess a child's verbal and nonverbal developmental levels to identify developmental delays (Swineford et al., 2015). The MSEL consists of five scales, including gross motor, visual reception, fine motor, expressive language, and receptive language (Akshoomoff, 2006; Hinnebusch et al., 2017).

Repetitive Behavior Scale-Revised (RBS-R)

The RBS-R is a rating scale consisting of 43 items given to caregivers of children between the ages of 6 and 17 years to measure a variety of restricted and repetitive behaviors and interests observed in ASD (Mehling & Tassé, 2016; Schertz et al., 2016).

The RBS-R yields six subscales, including stereotyped behavior, compulsive behavior, self-injurious behavior, routine behavior, ritualistic/sameness behavior, and restricted interests (Schertz et al., 2016).

Screening Tool for Autism in Toddlers and Young Children (STAT)

The STAT is an interactive play-based session used by professionals to assess ASD symptomology in children ages 2 to 3 years old (Dumont-Mathieu & Fein, 2005). The STAT consists of 12 items; 10 of the items assess behaviors including play, imitation, directing attention, and requesting items (Dumont-Mathieu & Fein, 2005).

Short Sensory Profile (SSP)

The SSP contains 38 items rated by caregivers to assess ASD symptomology (Neil et al., 2016). The SSP is an abbreviated form derived of the Dunn's Sensory Profile, which was originally developed to screen for sensory processing difficulties (Williams et al., 2018). The SSP yields seven domains, including tactile sensitivity, taste/smell sensitivity, movement sensitivity, underresponsivity/seeking sensation, auditory filtering, low energy/weakness, and visual/auditory sensitivity (Neil et al., 2016).

Social Communication Questionnaire (SCQ)

The SCQ contains 40 items rated by caregivers to assess ASD symptomology in children over the age of 4 years (Mansour et al., 2017). According to Barnard-Brak et al. (2017), the SCQ is one of the most widely used screening instruments for identifying individuals at risk for ASD. The SCQ has been reported to be based on the ADI-R (Corsello et al., 2013).

Social Responsiveness Scale, Second Edition (SRS-2)

The SRS-2 contains 65 items rated by caregivers to assess ASD symptomology in children over the age of 2.5 years (Frazier et al., 2016; Mehling & Tassé, 2016). The SRS-2 yields scores for two symptom subscales, including social communication and interaction and restricted interests and repetitive behavior, as well as five treatment subscales, including social motivation, social cognition, social awareness, social communication, and restricted interests and repetitive behavior (Rodgers et al., 2019).

Vineland Adaptive Behavior Scales (VABS)

The VABS is a measure of adaptive functioning and assesses four areas of adaptive behavior, including communication, daily living skills, socialization, and motor skills (Carter et al., 1998; Mehling & Tassé, 2016). The VABS consists of different forms, including a semi-structured interview with the caregiver or a rater form given to a caregiver, and can be given to assess behavior from birth through adulthood (Schertz et al., 2016).

Eye Tracking

Many researchers have been analyzing eye tracking as a way to screen for ASD. Eye tracking is a quantitative, objective evaluation method used to assess the visual patterns in young children with ASD (Muratori et al., 2019). Frazier et al. (2016) argued the lack of an objective measure contributes to parents' denial or delayed acceptance of an autism diagnosis, and there is a strong potential for remote eye tracking as an objective instrument for measuring autism risk as well as estimating symptom severity. Because eye tracking does not require language skills or advanced motor responses, it has the

potential to provide valuable insight when assessing children with ASD (Muratori et al., 2019).

Infants as young as 6 months old demonstrate anticipatory eye movements toward observed action goals (Braukmann et al., 2018). According to Falck-Ytter et al. (2015), anticipatory eye movements of simple goal-directed actions appear typical in children with ASD; however, difficulties are present with more complex actions or when the tasks require understanding social cues or the inference of mental states (Braukmann et al., 2018). Unfortunately, knowledge about early action prediction in young children and infants with ASD is limited (Braukmann et al., 2018).

Indicators and Symptoms of ADHD

The core features of ADHD include persistent difficulties with inattention, impulsivity, hyperactivity, motor coordination, poor regulation of emotion, and low frustration tolerance that is inconsistent with the child's developmental stage (APA, 2000; Daley et al., 2009). Inattentive ADHD symptoms commonly seen in children include forgetfulness, becoming easily distracted, losing materials, disorganization, difficulty sustaining attention, difficulty following directions, not listening when spoken to, and making careless mistakes (Harvey et al., 2015). Researchers have found carelessness, disorganization, task avoidance, losing materials, and being forgetful can be seen as early as 3 years of age, but these specific inattentive symptoms are infrequent in earlier years and increase in frequency as the child develops (Harvey et al., 2015).

Hyperactivity and impulsive ADHD symptoms commonly seen in children include being fidgety, an inability to sit still, restlessness, talking excessively, blurting out answers, difficulty engaging in activities quietly, difficulty awaiting turn, interrupting or

intruding on others, and appearing “on the go” or “driven by a motor” (Harvey et al., 2015). Previous studies have shown children diagnosed with ADHD in preschool continue to manifest difficulties with impulsivity, aggression, and social adjustment in primary school, whereas other studies have shown problems continue in middle childhood (Daley et al., 2009). Other researchers concluded that although symptoms of hyperactivity and impulsivity remain stable beyond the age of 6 years, they appear to decline shortly afterwards (Harvey et al., 2015). Figure 1 outlines the symptoms and signs of ADHD seen in children.

Figure 1

Common Signs of ADHD in Children

Inattentive Type	Hyperactive Type
Careless mistakes	Acts without thinking
Daydreams	Avoids or is reluctant to complete tasks that require sustained mental effort
Difficulty concentrating	Blurting out
Difficulty focusing	Difficulty taking turns
Difficulty following directions	Difficulty with transitions
Difficulty listening when spoken to	Fidgety
Difficulty sustaining attention	Hyperactivity
Difficulty with multistep instructions	Impatient
Distractibility	Impulsivity
Forgetfulness	Inability to play quietly
Getting easily bored with tasks	Inability to remain still
Lack of attention to detail	Inability to sit still
Losing things	Interrupting conversations or activities
Problems organizing	Low frustration tolerance
Trouble completing tasks	Not showing concern for other’s emotions or feelings
	Poor emotion regulation
	Poor motor coordination
	Restlessness
	Talks excessively

Indicators and Symptoms of ASD

Early indicators of ASD often manifest by the time the child is 1 year old. Some researchers have argued signs of ASD, including the chain of smiles and expressions displayed by infants, can be detected as early as 6 months of age (Beuker et al., 2013). Meanwhile, others have argued ASD can be identified as early as 2 to 18 months of age with notable deficits in eye contact, visual orienting, communicative gestures, and the presence of restricted and repetitive behaviors (Jiang et al., 2017). Beuker et al. (2013) further highlighted detections of the level of interest in other people at 12 months of age, use of single words at 16 months, and two-word sentences by 24 months. Some studies have found signs of repetitive behaviors as early as 12 months of age (Beuker et al., 2013). Moreover, researchers have found many parents begin recognizing concerns around 19 months of age, with about 30% of parents raising concerns prior to the first birthday (Chawarska et al., 2007). Other researchers noted parents begin to express concern regarding behavioral abnormalities and differences in skill acquisition by 24 months of age (Horovitz et al., 2011).

Overall early signs of ASD include impaired joint attention; imitation; lack of attention to faces; delayed verbal and nonverbal communication; reduced social engagement, smiling, and eye contact; lack of responding to their own name; and delays in fine or gross motor skills (Klinger et al., 2014; Wetherby et al., 2004). Another symptom of children with ASD is atypical viewing of objects by either excessively staring at simple objects or looking at objects from the corner of the eyes (Turygin et al., 2013).

Researchers believe ASD emerges in three different patterns. The most common involves the manifestation of symptoms in the first year of life (Kanner, 1943, as cited in Kalb et al., 2010). The second onset pattern involves the regression of previously acquired social, communication, or motor skills prior to the age of 36 months (Kalb et al., 2010). The last onset pattern involves milestone achievement followed by a plateau or developmental halt. Kalb et al. (2010) concluded in their study that regression or a plateau in development are associated with ASD as well as an earlier age of diagnosis.

Chawarska et al. (2007), Horovitz et al. (2011), and Özyurt and Dinsever Eliküçük (2018) noted the first recognized concerns reported by parents are delays in speech and language, followed by social responsivity level, medical problems, and nonspecific difficulties related to sleep, eating, and attention. According to Turygin et al. (2013), 74% of the time, communication deficits are the first concerns reported by parents. Additionally, parental concerns may emerge when an infant is not meeting or has a regression of developmental milestones (Chawarska et al., 2007). Regression can involve a loss of words, vocalizations, nonverbal communication skills, social dyadic interaction skills, imitation, or pretend play and is reported in 20% to 33% of ASD cases (Chawarska et al., 2007). Turygin et al. (2013) detected children with ASD have a delay in the development of first words. Specifically, typically developing children will begin saying their first words at 8 to 14 months; whereas children with ASD will do so at 38 months of age (Turygin et al., 2013). Özyurt and Dinsever Eliküçük (2018) found children with ASD have significant difficulties with receptive language, particularly with echolalia and unusual prosody.

Social and communication skills are believed to emerge around 12 months of age (Turygin et al., 2013). Soto et al. (2016) reported children with ASD have impaired social nonverbal behaviors or communicative strategies. Specifically, children with ASD have reduced eye contact, social interest, responding to name, responding to initiations of joint attention, and reduced social smiling (Turygin et al., 2013). Soto et al. (2016) noted that by the first year, many infants with ASD have abnormal social communication skills, including impairments in social nonverbal behaviors, social relationships, and socioemotional reciprocity. Soto et al. (2016) concluded infants diagnosed with ASD at 36 months of age sought social information at a significantly slower pace at 18 months of age when compared to typically developing infants. Furthermore, children diagnosed with ASD do not develop the skill set to respond to their name until the age of 12 to 18 months and the deficit continues through the preschool years, whereas typically developing infants are seen to respond to their name by 4 to 6 months of age (Soto et al., 2016). Additionally, children with ASD show decreased social engagement between 6 and 12 months, reduced attentiveness to their mothers at 12 months, decreased shared positive affect and orienting to a target in response to gaze or point prompts at 14 months, and reduced social referencing at 17 to 20 months (Soto et al., 2016). Özyurt and Dinsever Eliküçük (2018) further noted children with ASD struggle to understand humor and have a difficult time understanding what other people are laughing at when they joke themselves.

Others have reported toddlers diagnosed with ASD show less awareness of sensations compared to typically developing peers (Soto et al., 2016; Wiggins et al., 2009). Toddlers with ASD have been found to have more deficits in tactile sensitivity,

auditory filtering, and taste or smell sensitivity (Wiggins et al., 2009). Soto et al. (2016) found atypical behavior in children with ASD, including unusual visual examination/inspection of objects, looking at objects from unusual angles, and focusing on parts of objects rather than the entire object. Parents have also found infants at 6 months of age have increased sensitivity to sensory input and at 24 months have more frequent and more intense distress reactions to stimuli (Soto et al., 2016). Sensory responses often observed in children with ASD include the covering of ears, repeated rubbing, licking, mouthing of unusual objects, engaging in self-injurious behaviors, and not appearing bothered by loud noises or painful experiences (Soto et al., 2016).

According to Larsen et al. (2018), behavioral concerns in children with ASD often become apparent during the second year of life. Behavioral concerns reported by parents with abnormal frequency and severity compared to typically developing peers include the presence of aggression, tantrum behaviors, and non-compliance (Horovitz et al., 2011).

Restricted and repetitive behaviors include vocal mannerisms (echolalia, repeating syllables, sounds, words, or phrases), motor mannerisms (finger flicking/twisting, hand posturing, arm flapping/waving, toe-walking, jumping, body posturing, or spinning), inflexible adherence to routines or rituals, preoccupations and restricted interests, and sensory behaviors (Soto et al., 2016). Soto et al. (2016) created the Repetitive and Stereotyped Movement Scales to indicate four of the repetitive body movements (i.e., flapping, stiffening, rubbing, patting) and nine object-oriented repetitive behaviors (i.e., spinning, rocking, rolling, collecting, swiping, rubbing, moving, lining, clutching). Figure 2 outlines common symptoms and signs of ASD seen in children.

Figure 2

Common Signs of ASD in Children

Avoiding eye contact	Lacks interest in others
Delayed developmental benchmarks	Not aware of surroundings
Difficulty developing and maintaining friendships	Over/under sensitivity noise
Difficulty following gaze	Parallel play
Difficulty following simple commands	Problems communicating
Difficulty in social-emotional reciprocity	Problems relating to others
Difficulty initiating or responding to social interactions	Rigidity
Difficulty understanding language	Ritualized patterns or routines
Difficulty with transitions	Sensitive to sensory stimuli
Doesn't smile at others	Severe and long temper tantrums
Impaired social interaction	Stereotyped or repetitive movement
In their own world	Unresponsive to common stimuli
Inability to react to other's emotions or feelings	Unresponsive to own name
Inability to use body language or gestures to communicate needs/desires	Unusual finger movements
Intense focus/concentration on a specific topic/item	Vocalizations with gestures
Lack of facial expressions	Withdrawn behaviors
Lacks imaginative play	

Comorbidity

As previously mentioned, ASD and ADHD share deficits across many domains, including cognitive, developmental, social functioning, executive functioning, working memory, response inhibition, socialization skills, motor speed, and reward processing, and engage in higher rates of maladaptive behaviors (Mansour et al., 2017; O'Dwyer et al., 2016; Sokolova et al., 2017; Tureck et al., 2015). A comorbid diagnosis increases the risk of social and cognitive deficits, perception difficulties, attention deficits, overactivity, decreased processing speed, poorer outcomes, language delays, more irritability and anger, hyperactivity, issues with inhibitory control and regulating impulsivity, decreased activation within the prefrontal cortex, and higher rates of

internalizing and externalizing problems (Jones et al., 2014; Klinger et al., 2014; Lyall et al., 2017; Mansour et al., 2017; Mayes et al., 2012). ASD and ADHD also have similar behavioral features, including aggressive and destructive behaviors (Tureck, Matson, May, Davis, et al., 2013). Additionally, those with a comorbid diagnosis exhibit more stereotyped behaviors, exacerbated tantrum behaviors, and more ASD symptomology (Tureck et al., 2015).

Research has shown deficits in executive functioning present differently among children with ADHD and ASD (Neely et al., 2016). Children with only ASD appear to struggle particularly with set-shifting, planning, and self-monitoring and organization (Neely et al., 2016). Children with only ADHD are observed to have significant deficits in verbal working memory (Neely et al., 2016). Neely et al. (2016) found children with comorbid ADHD and ASD demonstrate impairments in executive functioning consistent with children only diagnosed with ADHD.

Burcu-Ayaz et al. (2014) noted 65% to 80% of children diagnosed with ADHD have impaired social interaction and communication skills. Burcu-Ayaz et al. reported the inattention and hyperactivity/impulsivity problems seen in children with ADHD have an inverse relationship with social reciprocity. Attentional difficulties may include deficits in shifting attention and difficulties in disengaging from a task (Sokolova et al., 2017). According to Kröger et al. (2011), hyperactive behavior is a predictor of poor self-control and inappropriate behavior, which further contributes to social difficulties, including peer rejection. It is important to note that although children with ADHD struggle socially, they have shown intact early markers of social development (Marner, 2019). A distinguishing marker is children with only ADHD do not show impairments in facial affect, humor, and

empathy and are able to understand turn-taking, are socially engaged, and recognize their names. When these specific traits are lacking, it indicates there is a co-existing diagnosis of ASD (Marner, 2019). Table 2 presents a brief overview of ASD and ADHD.

Table 2

Brief Overview of the Disorders

	ASD	ADHD
Classification	Neurodevelopmental disorder characterized by impairments in social and communication behaviors (Klinger et al., 2014)	Neurodevelopmental disorder accompanied by delays or problems in language, motor, and social development (Nigg & Barkley, 2014)
Restrictive and repetitive behaviors	Preoccupation and restricted interests abnormal in intensity or focus (Jones et al., 2014)	Information unknown
	Stereotyped and repetitive motor mannerisms (Jones et al., 2014)	
Motor development	Delays in motor functioning (Bo et al., 2016)	Basic gross and fine motor skill impairments
	Atypical predictive processing including lacking anticipatory activation during action execution and action observation (Braukmann et al., 2018)	Difficulties with motor coordination (APA, 2000)
	Difficulties with gross and fine motor coordination, movement patterns in locomotion, praxis, dyspraxia, imitation-based tasks, goal-directed motion, bilateral coordination, asymmetries in postures, abnormal muscle tone, gait abnormalities, social-motor coordination, poor posture control, and a general delay in motor milestones (Jones et al., 2014; Kaur et al., 2018; Planche & Lemonnier, 2012)	
	Fine motor control deficits including dexterity, handwriting, object control, and visuo-motor integration skills (Kaur et al., 2018)	

	ASD	ADHD
Speech and language development	Communication skill deficits (Fortea et al., 2018)	Language and pragmatic disturbances (Fortea et al., 2018)
	Difficulties comprehending social situations and mental states (Fortea et al., 2018)	Difficulties comprehending social situations and mental states (Fortea et al., 2018)
	Struggle to obtain useful speech, defined as expressive language that may be used frequently, communicatively, referentially, and in a semantically diverse manner (McDaniel et al., 2018)	Difficulty in speech fluency and elaboration and comprehension of stories (Fortea et al., 2018).
	Use language in a stereotypic and repetitive manner, struggle to engage in back and forth conversations (Sokolova et al., 2017)	Talk excessively, interrupt others, and not listen to what is being said (APA, 2013).
	Atypical language with idiosyncratic use of words or phrases including nonsense or jargon words, pronominal reversals, and abnormal prosody including abnormal pitch, speed, volume, or tone (Yates & Le Couteur, 2016)	
	Display deficits in conceptual rather than grammatical understanding (Turygin et al., 2013)	
	Delays in receptive language (Jones et al., 2014)	
	Use gestures and experience difficulties with non-verbal communication, misunderstanding the context, and stereotyped language (Fortea et al., 2018)	
	Limited mutually reciprocal conversations skills	
	Errors in pronominal reference	

	ASD	ADHD
Social skills	Difficulties in socialization ranging from basic aspects of social interaction to complex social tasks (Cervantes et al., 2013)	Exhibit difficulties with social behaviors including interrupting others and interjecting oneself into a conversation (Cervantes et al., 2013)
	Absence of joint attention, fail to respond to their name, inadequate facial expressions, lack awareness of how other people are feeling, and lack awareness of how their behaviors impact others (Yates & Le Couteur, 2016)	Children are less socially preferred, more likely to be rejected by their peers, and have difficulty maintaining friendships (Cervantes et al., 2013)
		Children are often rejected or disliked within a few minutes during social interactions (Bühler et al., 2011)
	Lack of social smiling and limited use of gestures, such as shaking head, nodding, waving, and clapping (Yates & Le Couteur, 2016)	Talks excessively, blurts out answers, difficulty engaging in activities quietly, and difficulty awaiting turn (Harvey et al., 2015)
	Struggle to seek sympathy or comfort and struggle to show sympathy or offer comfort towards others (Pang et al., 2018)	
	Misinterpret the tone of voice or facial expressions of others and fail to develop mutual sharing of interests or activities (Yates & Le Couteur, 2016)	
	Difficulty with feeling empathy towards others, understanding social cues, and associating with peers (Cervantes et al., 2013)	
	Show a reduced level of social smiling (Jones et al., 2014)	
Theory of mind	Deficits beginning from an early age	Develop the deficits at a later age
	Deficits in affect recognition	Less severe deficits in affect recognition (Berenguer et al., 2018; Bühler et al., 2011)
		Struggle to implement that knowledge in social situations (Berenguer et al., 2018)

	ASD	ADHD
Executive functioning	Abnormal response preparation and conflict monitoring (Tye et al., 2014) Disengage their attention (Tye et al., 2014) Difficulties with cognitive flexibility and planning (Berenguer et al., 2018) Become fixated on an idea or action (Smith et al., 2019) Difficulty with perspective taking (Smith et al., 2019) Show distress or oppositional behavior when faced with change (Smith et al., 2019) Struggle particularly with set-shifting, planning, and self-monitoring and organization (Neely et al., 2016)	Deficits in attention orienting, inhibitory processing, behavioral deficits in task performance, and difficulties with sustained attention (Berenguer et al., 2018; Tye et al., 2014) Significant deficits in verbal working memory (Neely et al., 2016)
Sensory sensitivities	Sensitivities to sounds, smells, textures, colors, insensitivity to pain (Yates & Le Couteur, 2016) Atypical responses to sensory stimuli including visual, auditory, touch, smell, taste, and within the vestibular system (Robertson & Simmons, 2013) Display tactile sensory seeking behavior (Planche & Lemonnier, 2012)	May have sensory processing difficulties (Fluegge, 2017)
Attachments	Decreased ability to experience attachment, care, and understanding of others (Solomon, 2015) Struggle to form notable attachment relationships with caregivers (APA, 1980)	Information unknown
IQ scores	Obtain lower scores on the vocabulary and coding subtest (Hidding et al., 2015) Obtain lower score on coding subtest compared to the symbol search subtest (Hidding et al., 2015)	Obtain lower scores on block design and arithmetic (Hidding et al., 2015) Obtain lower score on coding subtest compared to the symbol search subtest (Hidding et al., 2015)

Proposed Checklist

In an effort to expand professionals' knowledge regarding diagnosing ASD, this study contained discussions of the symptomology, early indicators, and risk factors of ASD as well as ADHD. Although there are various diagnostic tools available, functionally based tests that answer the referral question do not exist (Carlew & Zartman, 2017). As previous literature has established, the lack of training and knowledge on the part of professionals has led to delays in the diagnosis of ASD, especially when ADHD symptoms are also present. The proposed checklist (see Appendix A) consists of early indicators and symptoms of children with ASD, with an emphasis on children prior to preschool age, and should be used as a guide in the effort to determine whether extensive diagnostic testing should be completed. Although there is no cutoff, it is recommended when using this checklist that the diagnosing professional consider a thorough evaluation when there are many items checked off in each domain.

Summary, Discussion, Limitations, and Recommendations

Summary

ASD and ADHD are both neurodevelopmental disorders that are most commonly diagnosed in childhood. Previous research has shown ASD and ADHD are highly comorbid disorders and with the changes made in the *DSM–5*, clinicians are now able to diagnose ASD and ADHD together. However, many children are still being misdiagnosed or go undiagnosed. The overlap in symptomology between ASD and ADHD increases the risk of an inaccurate diagnosis and hinders the diagnostic process (Bühler et al., 2011). Stevens et al. (2016) reported 20% of individuals received an ADHD diagnosis 3 years prior to receiving a diagnosis of ASD; other studies have shown as many as 81% of children with a comorbid ADHD and ASD diagnosis received the ASD diagnosis after the age of 6 years (Thompson, 2015). This delayed diagnosis of ASD prevents children from receiving early intervention services that could greatly increase their prognosis.

Studies have shown an ASD diagnosis, when identified at the age of 3 years, to be accurate and reliable. Hinnebusch et al. (2017) found a diagnosis of ASD to be reliable and stable at 18 to 24 months of age. Though research is expanding the knowledge about these disorders, there remains a misunderstanding regarding how to diagnose ASD within a young population. Barnard-Brak et al. (2017) discussed the role health care providers play, as many are reluctant to diagnose children at an early age, ignore the initial response to symptoms, or suggest parents wait and see whether the child outgrows the symptoms.

This study contained a focus on the symptomology of ADHD, ASD, and comorbid ADHD and ASD. Early indicators of ASD were discussed to better understand how an individual with ASD develops compared to typically developing individuals. Information gathered through this study can help clinicians gain a better understanding of ASD and what symptoms need to be considered when evaluating a child who presents with symptoms consistent with ADHD and ASD.

Information for this project was gathered from books, journal articles, and published questionnaires. A search of internet-based databases using EBSCOhost and Google was conducted to attain relevant studies. Reference lists of the attained articles were reviewed for additional studies. Furthermore, diagnostic tools (i.e., screeners and questionnaires) were reviewed to gain better knowledge of ASD symptomology.

Early indicators and symptoms of ASD were discussed in depth and a list was compiled to create a checklist. The proposed checklist is intended to be used as a guide in efforts to determine whether extensive diagnostic testing is necessary in children up to preschool age. The checklist consists of impairments in language functioning, social functioning, emotional functioning, and motor functioning; restrictive and repetitive behaviors; and general behaviors.

Discussion

This study supports the importance of accurately diagnosing a comorbid diagnosis of ADHD and ASD and highlighted key features of the disorders. As mentioned, ASD and ADHD have overlapping symptoms across many domains, including cognitive, developmental, social functioning, and executive functioning, and having a comorbid

diagnosis increases the rates of maladaptive behaviors (Mansour et al., 2017; O'Dwyer et al., 2016; Sokolova et al., 2017; Tureck et al., 2015).

A distinguishing factor between ASD and ADHD is the impairments found in social and communication skills. Specifically, children with ASD have a skill acquisition deficit in social functioning. This means the child with ASD is unable to successfully perform social skills because they never developed the skill to begin with. Children diagnosed with ADHD have a performance deficit in social skills. For children with ADHD, their inattention and hyperactivity difficulties interfere with their ability to socialize with others. In other words, children with ADHD possess social skills, but struggle to perform those skills. More specifically, children with ADHD understand facial affect, humor, empathy, and social rules (e.g., turn-taking, social boundaries, etc.).

The checklist created for this study provides clinicians and medical health professionals a better understanding of the symptoms and signs that support the need for a thorough evaluation. Additionally, this checklist should help mental health professionals detect an ASD diagnosis among children who are also presenting with ADHD symptoms. The checklist highlights impairments in social, language, emotional, and motor functioning. Additionally, signs of restrictive and repetitive behaviors and other behaviors observed are included in the checklist. These early indicators of ASD are important to be aware of when assessing the presenting problem of a child.

Recommendations for Application in Professional Practice

Clinicians, medical health professionals, and psychologists can greatly benefit from the use of the checklist generated from this study. When parents are raising concerns about a child's behavior, the checklist can be reviewed in an effort to provide

appropriate recommendations. As many medical health professionals are unaware of ASD symptoms, they often neglect to provide the appropriate referral for the child. Additionally, overlapping symptomology across disorders often contributes to ASD being overlooked during the diagnostic process. This checklist provides information regarding early indicators of ASD that have previously been overlooked and can be used as a quick reference. Although this checklist has not been validated, which is discussed next, professionals can use it as a reference to determine whether there is sufficient evidence to warrant further evaluation. Overall, the use of this checklist may help professionals accurately diagnose a child before the age of 6 years because it can provide insight into whether ASD testing measures should be added to the evaluation.

As the checklist contains a focus on early indicators, it can help children receive an accurate diagnosis and receive appropriate treatment. As the study highlighted, early intervention services and receiving treatment prior to the age of 5 years can improve a child's prognosis.

Limitations in Research

Many barriers need to be considered when working with children. According to Siegel et al. (2015), barriers to the study of children diagnosed with ASD include recruitment in outpatient settings and the relative lack of measures that have been validated for use with nonverbal or intellectually disabled individuals. Additionally, there is limited research available on the comorbidity of ASD and ADHD that highlights the early indicators of the comorbid diagnosis, although this may be related to the ASD diagnosis being overshadowed by the ADHD symptoms. In consideration of these

barriers, this review may not be all-inclusive, as it relied on previously conducted research.

This study adds to the existing literature regarding the symptomology and early indicators of ASD. The information gathered regarding the symptoms and early indicators of ASD for this review was drawn from established measures and published research; however, this checklist has not been validated and does not provide diagnostic criteria for ASD. This checklist should not be mistaken as a diagnostic tool, rather as a guide to inform a professional that an ASD evaluation is necessary.

Recommendations for Further Evaluation

Future studies would benefit from validating the proposed checklist. Additionally, future studies regarding the comorbidity of ADHD and ASD should consider whether there are any additional early indicators not discussed in this review.

References

Adachi, M., Takahashi, M., Takayanagi, N., Yoshida, S., Yasuda, S., Tanaka, M., Osato-Kaneda, A., Saito, M., Kuribayashi, M., Kato, S., & Nakamura, K. (2018). Adaptation of the Autism Spectrum Screening Questionnaire (ASSQ) to preschool children. *PLOS ONE*, *13*(7), 1–19. https://doi.org/10.1371/journal.pone.0199590

Akshoomoff, N. (2006). Use of the Mullen Scales of Early Learning for the assessment of young children with autism spectrum disorders. *Child Neuropsychology*, *12*(4/5), 269–277. https://doi.org/10.1080/09297040500473714

American Psychiatric Association. (1968). *Diagnostic and statistical manual of mental disorders* (2nd ed.). Author.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders* (3rd ed.). Author.

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3rd ed., rev.). Author.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.). Author.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Author.

Arnett, A. B., Cairney, B. E., Wallace, A. S., Gerdts, J., Turner, T. N., Eichler, E. E., & Bernier, R. A. (2018). Comorbid symptoms of inattention, autism, and executive

cognition in youth with putative genetic risk. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 59*(3), 268–276. https://doi.org/10.1111/jcpp.12815

Ashwood, K., Tye, C., Azadi, B., Cartwright, S., Asherson, P., & Bolton, P. (2015). Brief report: Adaptive functioning in children with ASD, ADHD and ASD + ADHD. *Journal of Autism & Developmental Disorders*, *45*(7), 2235–2242. https://doi.org/10.1007/s10803-014-2352-y

Atladottir, H., Gyllenberg, D., Langridge, A., Sandin, S., Hansen, S., Leonard, H., Gissler, M., Reichenberg, A., Schendel, D. E., Bourke, J., Hultman, C. M., Grice, D. E., Buxbaum, J. D., & Parner, E. (2015). The increasing prevalence of reported diagnoses of childhood psychiatric disorders: A descriptive multinational comparison. *European Child & Adolescent Psychiatry*, *24*(2), 173–183. https://doi.org/10.1007/s00787-014-0553-8

Barnard-Brak, L., Richman, D., Ellerbeck, K., & Moreno, R. (2017). Health care provider responses to initial parental reports of autism spectrum disorder symptoms: Results from a nationally representative sample. *Child & Adolescent Mental Health*, *22*(1), 30–35. https://doi.org/10.1111/camh.12194

Baum, K. T., Shear, P. K., Howe, S. R., & Bishop, S. L. (2015). A comparison of WISC-IV and SB-5 intelligence scores in adolescents with autism spectrum disorder. *Autism: The International Journal of Research and Practice*, *19*(6), 736–745. https://doi.org/10.1177/1362361314554920

Beardon, L., & Worton, D. (2011). *Aspies on mental health: Speaking for ourselves*. Jessica Kingsley.

Berenguer, C., Roselló, B., Colomer, C., Baixauli, I., & Miranda, A. (2018). Children with autism and attention deficit hyperactivity disorder. Relationships between symptoms and executive function, theory of mind, and behavioral problems. *Research in Developmental Disabilities*, *83*, 260–269. https://doi.org/10.1016/j.ridd.2018.10.001

Bergey, M., Filipe, A., Conrad, P., & Singh, I. (2018). *Global perspectives on ADHD: Social dimensions of diagnosis and treatment in sixteen countries*. Johns Hopkins University Press.

Beuker, K., Schjølberg, S., Lie, K., Donders, R., Lappenschaar, M., Swinkels, S., & Buitelaar, J. (2013). The structure of autism spectrum disorder symptoms in the general population at 18 months. *Journal of Autism & Developmental Disorders*, *43*(1), 45–56. https://doi.org/10.1007/s10803-012-1546-4

Bo, J., Lee, C.-M., Colbert, A., & Shen, B. (2016). Do children with autism spectrum disorders have motor learning difficulties? *Research in Autism Spectrum Disorders*, *23*, 50–62. https://doi.org/10.1016/j.rasd.2015.12.001

Bornstein, M. H., Costlow, K., Truzzi, A., & Esposito, G. (2016). Categorizing the cries of infants with ASD versus typically developing infants: A study of adult accuracy and reaction time. *Research in Autism Spectrum Disorders*, *31*, 66–72. https://doi.org/10.1016/j.rasd.2016.08.001

Braukmann, R., Ward, E., Hessels, R. S., Bekkeringb, H., Buitelaar, J. K., & Hunniusb, S. (2018). Action prediction in 10-month-old infants at high and low familial risk for autism spectrum disorder. *Research in Autism Spectrum Disorders*, *49*, 34–46. https://doi.org/10.1016/j.rasd.2018.02.004

Bröring, T., Oostrom, K. J., van Dijk-Lokkart, E. M., Lafeber, H. N., Brugman, A., & Oosterlaan, J. (2018). Attention deficit hyperactivity disorder and autism spectrum disorder symptoms in school-age children born very preterm. *Research in Developmental Disabilities, 74*, 103–112. https://doi.org/10.1016/j.ridd.2018.01.001

Bühler, E., Bachmann, C., Goyert, H., Heinzel-Gutenbrunner, M., & Kamp-Becker, I. (2011). Differential diagnosis of autism spectrum disorder and attention deficit hyperactivity disorder by means of inhibitory control and "theory of mind." *Journal of Autism & Developmental Disorders, 41*(12), 1718–1726. https://doi.org/10.1007/s10803-011-1205-1

Burcu-Ayaz, A., Gökçe, S., Gümüştaş, F., & Ayaz, M. (2014). Symptoms of autism spectrum disorder in subtypes of attention-deficit/hyperactivity disorder. *Journal of Intellectual & Developmental Disability*, *39*(3), 290–297. https://doi.org/10.3109/13668250.2014.916184

Carlew, A. R., & Zartman, A. L. (2017). DSM nosology changes in neuropsychological diagnoses through the years: A look at ADHD and mild neurocognitive disorder. *Behavioral Sciences, 7*(1), bs7010001. https://doi.org/10.3390/bs7010001

Carter, A. S., Volkmar, F. R., Sparrow, S. S., Wang, J.-J., Lord, C., Dawson, G., Fombonne, E., Loveland, K., Mesibov, G., & Schopler, E. (1998). The Vineland Adaptive Behavior Scales: Supplementary norms for individuals with autism. *Journal of Autism & Developmental Disorders, 28*(4), 287–302. https://doi.org/10.1023/A:1026056518470

Cervantes, P. E., Matson, J. L., Adams, H. L., Williams, L. W., Goldin, R. L., & Jang, J. (2013). Comparing social skill profiles of children with autism spectrum disorders versus children with attention deficit hyperactivity disorder: Where the deficits lie. *Research in Autism Spectrum Disorders*, *7*(9), 1104–1110. https://doi.org/10.1016/j.rasd.2013.05.008

Chawarska, K., Paul, R., Klin, A., Hannigen, S., Dichtel, L., & Volkmar, F. (2007). Parental recognition of developmental problems in toddlers with autism spectrum disorders. *Journal of Autism & Developmental Disorders*, *37*(1), 62–72. https://doi.org/10.1007/s10803-006-0330-8

Chistol, L. T., Bandini, L. G., Must, A., Phillips, S., Cermak, S. A., & Curtin, C. (2018). Sensory sensitivity and food selectivity in children with autism spectrum disorder. *Journal of Autism & Developmental Disorders*, *48*(2), 583–591. https://doi.org/10.1007/s10803-017-3340-9

Chown, N., & Hughes, L. (2016). History and first descriptions of autism: Asperger versus Kanner revisited. *Journal of Autism & Developmental Disorders*, *46*(6), 2270–2272. https://doi.org/10.1007/s10803-016-2746-0

Christensen, D. L., Baio, J., Van Naarden Braun, K., Bilder, D., Charles, J., Constantino, J. N., Daniels, J., Durkin, M. S., Fitzgerald, R. T., Kurzius-Spencer, M., Lee, L.-C., Pettygrove, S., Robinson, C., Schulz, E., Wells, C., Wingate, M. S., Zahorodny, W., & Yeargin-Allsopp, M. (2016). Prevalence and characteristics of autism spectrum disorder among children aged 8 years -- Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2012.

MMWR Surveillance Summaries, *65*(3), 1–23. https://doi.org/10.15585/mmwr.ss6503a1

Cooper, M., Martin, J., Langley, K., Hamshere, M., & Thapar, A. (2014). Autistic traits in children with ADHD index clinical and cognitive problems. *European Child & Adolescent Psychiatry*, *23*(1), 23–34. https://doi.org/10.1007/s00787-013-0398-6

Corsello, C. M., Akshoomoff, N., & Stahmer, A. C. (2013). Diagnosis of autism spectrum disorders in 2-year-olds: A study of community practice. *Journal of Child Psychology & Psychiatry*, *54*(2), 178–185. https://doi.org/10.1111/j.1469-7610.2012.02607.x

Costello, E. (2019, September 26). *Autism vs. ADHD: A parent's guide to tricky diagnoses*. http://www.additudemag.com/adhd/article/6594.html

Craig, F., Lamanna, A. L., Margari, F., Matera, E., Simone, M., & Margari, L. (2015). Overlap between autism spectrum disorders and attention deficit hyperactivity disorder: Searching for distinctive/common clinical features. *Autism Research*, *8*, 328–337. https://doi.org/10.1002/aur.1449

Cuellar, A. (2015). Preventing and treating child mental health problems. *Future of Children*, *25*(1), 111–134. https://doi.org/10.1353/foc.2015.0005

Daley, D., Jones, K., Hutchings, J., & Thompson, M. (2009). Attention deficit hyperactivity disorder in pre-school children: Current findings, recommended interventions and future directions. *Child: Care, Health & Development*, *35*(6), 754–766. https://doi.org/10.1111/j.1365-2214.2009.00938.x

de Bildt, A., Mulder, E. J., Hoekstra, P. J., van Lang, N. D. J., Minderaa, R. B., & Hartman, C. A. (2009). Validity of the Children's Social Behavior Questionnaire

(CSBQ) in children with intellectual disability: Comparing the CSBQ with ADI-R, ADOS, and clinical DSM-IV-TR classification. *Journal of Autism & Developmental Disorders*, *39*(10), 1464–1470. https://doi.org/10.1007/s10803-009-0764-x

DePaul, G. J., & Kern, L. (2011). *Young children with ADHD: Early identification and intervention*. American Psychological Association. https://doi.org/10.1037/12311-000

Doris, I. (2012). Assessment of autism spectrum disorders. *IFE PsychologIA*, *20*(2), 18–21.

Dumont-Mathieu, T., & Fein, D. (2005). Screening for autism in young children: The Modified Checklist for Autism in Toddlers (M-CHAT) and other measures. *Mental Retardation & Developmental Disabilities Research Reviews*, *11*(3), 253–262. https://doi.org/10.1002/mrdd.20072

Evans, B. (2013). How autism became autism: The radical transformation of a central concept of child development in Britain. *History of the Human Sciences*, *26*(3), 3–31. https://doi.org/10.1177/0952695113484320

Falck-Ytter, T., Thorup, E., & Bölte, S. (2015). Brief report: Lack of processing bias for the objects other people attend to in 3-year-olds with autism. *Journal of Autism & Developmental Disorders*, *45*(6), 1897–1904. https://doi.org/10.1007/s10803-014-2278-4

Fluegge, K. (2017). Abnormal sensory experiences, synaesthesia, and neurodevelopmental disorders. *Journal of Autism & Developmental Disorders*, *47*(9), 2942–2944. https://doi.org/10.1007/s10803-017-3216-z

Fortea, I. B., Forner, C. B., Colomer, C., Casas, A. M., & Miranda, B. R. (2018). Communicative skills in Spanish children with autism spectrum disorder and children with attention deficit hyperactivity disorder. Analysis through parents' perceptions and narrative production. *Research in Autism Spectrum Disorders*, *50*, 22–31. https://doi.org/10.1016/j.rasd.2018.02.006

Frazier, T. W., Klingemier, E. W., Beukemann, M., Speer, L., Markowitz, L., Parikh, S., Wexberg, S., Giuliano, K., Schulte, E., Delahunty, C., Ahuja, V., Eng, C., Manos, M. J., Hardan, A. Y., Youngstrom, E. A., & Strauss, M. S. (2016). Development of an objective autism risk index using remote eye tracking. *Journal of the American Academy of Child & Adolescent Psychiatry*, *55*(4), 301–309. https://doi.org/10.1016/j.jaac.2016.01.011

Gargaro, B. A., Rinehart, N. J., Bradshaw, J. L., Tonge, B. J., & Sheppard, D. M. (2011). Autism and ADHD: How far have we come in the comorbidity debate? *Neuroscience & Biobehavioral Reviews*, *35*(5), 1081–1088. https://doi.org/10.1016/j.neubiorev.2010.11.002

Goldin, R. L., Matson, J. L., Tureck, K., Cervantes, P. E., & Jang, J. (2013). A comparison of tantrum behavior profiles in children with ASD, ADHD and comorbid ASD and ADHD. *Research in Developmental Disabilities*, *34*(9), 2669–2675. https://doi.org/10.1016/j.ridd.2013.04.022

Green, J. L., Rinehart, N., Anderson, V., Nicholson, J. M., Jongeling, B., & Sciberras, E. (2015). Autism spectrum disorder symptoms in children with ADHD: A community-based study. *Research in Developmental Disabilities*, *47*, 175–184. https://doi.org/10.1016/j.ridd.2015.09.016

Hartman, C., de Bildt, A., & Minderaa, R. (2013). CSBQ (Children's Social Behavior Questionnaire). In F. R. Volkmar (Ed.), *Encyclopedia of autism spectrum disorders*. Springer. https://doi.org/10.1007/978-1-4419-1698-3_1917

Harvey, E. A., Lugo-Candelas, C. I., & Breaux, R. P. (2015). Longitudinal changes in individual symptoms across the preschool years in children with ADHD. *Journal of Clinical Child & Adolescent Psychology*, *44*(4), 580–594. https://doi.org/10.1080/15374416.2014.886253

Hidding, E., Swaab, H., de Sonneville, L. M., van Engeland, H., Sijmens-Morcus, M. E., Klaassen, P. W., Duijff, S. N., & Vorstman, J. A. (2015). Intellectual functioning in relation to autism and ADHD symptomatology in children and adolescents with 22q11.2 deletion syndrome. *Journal of Intellectual Disability Research: JIDR*, *59*(9), 803–815. https://doi.org/10.1111/jir.12187

Hinnebusch, A., Miller, L., & Fein, D. (2017). Autism spectrum disorders and low mental age: Diagnostic stability and developmental outcomes in early childhood. *Journal of Autism & Developmental Disorders*, *47*(12), 3967–3982. https://doi.org/10.1007/s10803-017-3278-y

Hogea, L. M., Aungurence, M., & Anghel, T. (2017). ADHD in school children and educators' perceptions. *Romanian Journal of Medical Practice*, *12*(1), 54–57.

Holland, K. (2014). *The relationship between ADHD and autism*. http://www.healthline.com/health/adhd/autism-and-adhd

Horovitz, M., Matson, J. L., & Sipes, M. (2011). The relationship between parents' first concerns and symptoms of autism spectrum disorders. *Developmental*

Neurorehabilitation, *14*(6), 372–377. https://doi.org/10.3109/17518423.2011.617322

Jiang, X., Matson, J., Issarraras, A., & Burns, C. (2017). Stability of autism symptoms in young children. *Journal of Developmental & Physical Disabilities*, *29*(6), 955–967. https://doi.org/10.1007/s10882-017-9567-8

Jo, H., Schieve, L., Rice, C., Yeargin-Allsopp, M., Tian, L., Blumberg, S., Kogan, M. D., & Boyle, C. (2015). Age at autism spectrum disorder (ASD) diagnosis by race, ethnicity, and primary household language among children with special health care needs, United States, 2009-2010. *Maternal & Child Health Journal*, *19*(8), 1687–1697. https://psycnet.apa.org/doi/10.1007/s10995-015-1683-4

Johnson, C. R., Butter, E. M., & Scahill, L. (2019). Introduction. In C. R. Johnson, E. M. Butter, & L. Scahill (Eds.), *Parent training for autism spectrum disorder: Improving the quality of life for children and their families* (pp. 3–9). American Psychological Association. https://doi.org/10.1037/0000111-001

Jones, E. J. H., Gliga, T., Bedford, R., Charman, T., & Johnson, M. H. (2014). Developmental pathways to autism: A review of prospective studies of infants at risk. *Neuroscience & Biobehavioral Reviews*, *39*, 1–33. https://doi.org/10.1016/j.neubiorev.2013.12.001

Kalb, L. G., Law, J. K., Landa, R., & Law, P. A. (2010). Onset patterns prior to 36 months in autism spectrum disorders. *Journal of Autism & Developmental Disorders*, *40*(11), 1389–1402. https://doi.org/10.1007/s10803-010-0998-7

Kaur, M., Srinivasan, S. M., & Bhat, A. N. (2018). Comparing motor performance, praxis, coordination, and interpersonal synchrony between children with and

without autism spectrum disorder (ASD). *Research in Developmental Disabilities*, *72*, 79–95. https://doi.org/10.1016/j.ridd.2017.10.025

Klinger, L. G., Dawson, G., Barnes, K., & Crisler, M. (2014). Autism spectrum disorder. In E. J. Mash & R. A. Barkley (Eds.), *Child psychopathology* (3rd ed., pp. 531–572). The Guilford Press.

Konst, M. J., Matson, J. L., Goldin, R., & Rieske, R. (2014). How does ASD symptomology correlate with ADHD presentations? *Research in Developmental Disabilities*, *35*(9), 2252–2259. https://doi.org/10.1016/j.ridd.2014.05.017

Kröger, A., Hänig, S., Seitz, C., Palmason, H., Meyer, J., & Freitag, C. (2011). Risk factors of autistic symptoms in children with ADHD. *European Child & Adolescent Psychiatry*, *20*(11/12), 561–570. https://doi.org/10.1007/s00787-011-0221-1

Kuhl, P. K., Coffey-Corina, S., Padden, D., Munson, J., Estes, A., & Dawson, G. (2013). Brain responses to words in 2-year-olds with autism predict developmental outcomes at age 6. *PLoS ONE*, *8*(5), 1–13. https://doi.org/10.1371/journal.pone.0064967

Kvarnstrom, E. (2017). *The dangers of mental health misdiagnosis: Why accuracy matters*. https://www.bridgestorecovery.com/blog/the-dangers-of-mental-health-misdiagnosis-why-accuracy-matters/

Lange, K. W., Reichl, S., Lange, K. M., Tucha, L., & Tucha, O. (2010). The history of attention deficit hyperactivity disorder. *Attention Deficit and Hyperactivity Disorders*, *2*(4), 241–255. https://doi.org/10.1007/s12402-010-0045-8

Larsen, K., Aasland, A., & Diseth, T. H. (2018). Identification of symptoms of autism spectrum disorders in the second year of life at day-care centres by day-care staff: Step one in the development of a short observation list. *Journal of Autism & Developmental Disorders*, *48*(7), 2267–2277. https://doi.org/10.1007/s10803-018-3489-x

Lecavalier, L. (2005). An evaluation of the Gilliam Autism Rating Scale. *Journal of Autism & Developmental Disorders*, *35*(6), 795–805. https://doi.org/10.1007/s10803-005-0025-6

Le Couteur, A., Lord, C., & Rutter, M. (2003). *Autism Diagnostic Interview-Revised (ADI-R)*. https://research.agre.org/program/aboutadi.cfm

Leitner, Y. (2014). The co-occurrence of autism and attention deficit hyperactivity disorder in children – What do we know? *Frontiers in Human Neuroscience*, *8*, 268. https://doi.org/10.3389/fnhum.2014.00268

Lyall, K., Schweitzer, J. B., Schmidt, R. J., Hertz-Picciotto, I., & Solomon, M. (2017). Inattention and hyperactivity in association with autism spectrum disorders in the CHARGE Study. *Research in Autism Spectrum Disorders*, *35*, 1–12. https://doi.org/10.1016/j.rasd.2016.11.011

Magnúsdóttir, K., Saemundsen, E., Einarsson, B. L., Magnusson, P., & Njardvik, U. (2016). The impact of attention deficit/hyperactivity disorder on adaptive functioning in children diagnosed late with autism spectrum disorder. A comparative analysis. *Research in Autism Spectrum Disorders*, *23*, 28–35. https://doi.org/10.1016/j.rasd.2015.11.012

Mansour, R., Dovi, A. T., Lane, D. M., Loveland, K. A., & Pearson, D. A. (2017). ADHD severity as it relates to comorbid psychiatric symptomatology in children with autism spectrum disorders (ASD). *Research in Developmental Disabilities, 60*, 52–64. https://doi.org/10.1016/j.ridd.2016.11.009

Marner, K. (2019, December 22). *Is it ADHD or autism? Or both?* http://www.additudemag.com/adhd/article/10236.html

Martin, J., Hamshere, M. L., O'Donovan, M. C., Rutter, M., & Thapar, A. (2014). Factor structure of autistic traits in children with ADHD. *Journal of Autism & Developmental Disorders*, *44*(1), 204–215. https://doi.org/10.1007/s10803-013-1865-0

Maskey, M., Warnell, F., Parr, J. R., Couteur, A. S., & McConachie, H. (2013). Emotional and behavioural problems in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *43*, 851–859. https://doi.org/10.1007/s10803-012-1622-9

Matson, J. L., & Goldin, R. L. (2014). Diagnosing young children with autism. *International Journal of Developmental Neuroscience*, *39*, 44–48. https://doi.org/10.1016/j.ijdevneu.2014.02.003

Mayes, S. D. (2018). Brief report: Checklist for Autism Spectrum Disorder: Most discriminating items for diagnosing autism. *Journal of Autism & Developmental Disorders*, *48*(3), 935–939. https://doi.org/10.1007/s10803-017-3401-0

Mayes, S. D., Calhoun, S. L., Mayes, R. D., & Molitoris, S. (2012). Autism and ADHD: Overlapping and discriminating symptoms. *Research in Autism Spectrum Disorders*, *6*(1), 277–285. https://doi.org/10.1016/j.rasd.2011.05.009

McCarthy, C. (2015, October 27). *Is it ADHD—or autism?* https://www.health.harvard.edu/blog/is-it-adhd-or-autism-201510278462

McDaniel, J., D'Ambrose Slaboch, K., & Yoder, P. (2018). A meta-analysis of the association between vocalizations and expressive language in children with autism spectrum disorder. *Research in Developmental Disabilities*, *72*, 202–213. https://doi.org/10.1016/j.ridd.2017.11.010

Mehling, M., & Tassé, M. (2016). Severity of autism spectrum disorders: Current conceptualization, and transition to DSM-5. *Journal of Autism & Developmental Disorders*, *46*(6), 2000–2016. https://doi.org/10.1007/s10803-016-2731-7

Merten, E. C., Cwik, J. C., Margraf, J., & Schneider, S. (2017). Overdiagnosis of mental disorders in children and adolescents (in developed countries). *Child & Adolescent Psychiatry & Mental Health*, *11*, 1–11. https://doi.org/10.1186/s13034-016-0140-5

Miranda-Casas, A., Baixauli-Fortea, I., Colomer-Diago, C., & Roselló-Miranda, B. (2013). [Autism and attention deficit hyperactivity disorder: Similarities and differences in executive functioning and theory of mind]. *Revista de Neurologia*, Suppl 1, S177–S184.

Moreno, S. (2012). *More cognitively advanced individuals with autism spectrum disorders: Autism, Asperger syndrome and PDD/NOS--The basics*. Jessica Kingsley.

Muratori, F., Billeci, L., Calderoni, S., Boncoddo, M., Lattarulo, C., Costanzo, V., Turi, M., Colombi, C., & Narzisi, A. (2019). How attention to faces and objects changes over time in toddlers with autism spectrum disorders: Preliminary

evidence from an eye tracking study. *Brain Sciences*, *9*(12), 344. https://dx.doi.org/10.3390%2Fbrainsci9120344

Murray, M., Mayes, S., & Smith, L. (2011). Brief report: Excellent agreement between two brief autism scales (Checklist for Autism Spectrum Disorder and Social Responsiveness Scale) completed independently by parents and the Autism Diagnostic Interview-Revised. *Journal of Autism & Developmental Disorders*, *41*(11), 1586–1590. https://doi.org/10.1007/s10803-011-1178-0

Naigles, L. R., Cheng, M., Rattansone, N. X., Tek, S., Khetrapal, N., Fein, D., & Demuth, K. (2016). "You're telling me!" The prevalence and predictors of pronoun reversals in children with autism spectrum disorders and typical development. *Research in Autism Spectrum Disorders*, *27*, 11–20. https://doi.org/10.1016/j.rasd.2016.03.008

Neely, R., Green, J., Sciberras, E., Hazell, P., & Anderson, V. (2016). Relationship between executive functioning and symptoms of attention-deficit/hyperactivity disorder and autism spectrum disorder in 6-8 year old children. *Journal of Autism & Developmental Disorders*, *46*(10), 3270–3280. https://doi.org/10.1007/s10803-016-2874-6

Neil, L., Olsson, N., & Pellicano, E. (2016). The relationship between intolerance of uncertainty, sensory sensitivities, and anxiety in autistic and typically developing children. *Journal of Autism & Developmental Disorders*, *46*(6), 1962–1973. https://doi.org/10.1007/s10803-016-2721-9

Nevill, R. E., Hedley, D., Uljarević, M., Butter, E., & Mulick, J. A. (2017). Adaptive behavior profiles in young children with autism spectrum disorder diagnosed

under DSM-5 criteria. *Research in Autism Spectrum Disorders*, *43-44*, 53–66. https://doi.org/10.1016/j.rasd.2017.09.006

Nigg, J. T., & Barkley, R. A. (2014). Attention-deficit/hyperactivity disorder. In E. J. Mash & R. A. Barkley (Eds.), *Child psychopathology* (3rd ed., pp. 531–572). The Guilford Press.

Odar Stough, C., Dreyer Gillette, M. L., Roberts, M. C., Jorgensen, T. D., & Patton, S. R. (2015). Mealtime behaviors associated with consumption of unfamiliar foods by young children with autism spectrum disorder. *Appetite*, *95*, 324–333. https://doi.org/10.1016/j.appet.2015.07.019

O'Dwyer, L., Tanner, C., van Dongen, E. V., Greven, C. U., Bralten, J., Zwiers, M. P., Franke, B., Heslenfeld, D., Oosterlaan, J., Hoekstra, P. J., Hartman, C. A., Groen, W., Rommelse, N., & Buitelaar, J. K. (2016). Decreased left caudate volume is associated with increased severity of autistic-like symptoms in a cohort of ADHD patients and their unaffected siblings. *PLoS ONE*, *11*(11), Article e0165620. https://doi.org/10.1371/journal.pone.0165620

Oerbeck, B., Overgaard, K. R., Aspenes, S. T., Pripp, A. H., Mordre, M., Aase, H., Reichborn-Kjennerud, T., & Zeiner, P. (2017). ADHD, comorbid disorders and psychosocial functioning: How representative is a child cohort study? Findings from a national patient registry. *BMC Psychiatry*, *17*, 1–9. https://dx.doi.org/10.1186%2Fs12888-017-1204-7

Özyurt, G., & Dinsever Eliküçük, Ç. (2018). Comparison of language features, autism spectrum symptoms in children diagnosed with autism spectrum disorder,

developmental language delay, and healthy controls. *Archives of Neuropsychiatry / Noropsikiatri Arsivi*, *55*(3), 205–210. https://doi.org/10.29399/npa.19407

Pang, Y. L., Lee, C. M., Wright, M., Shen, J., Shen, B., & Bo, J. (2018). Challenges of case identification and diagnosis of autism spectrum disorders in China: A critical review of procedures, assessment, and diagnostic criteria. *Research in Autism Spectrum Disorders*, *53*, 53–66. https://doi.org/10.1016/j.rasd.2018.06.003

Planche, P., & Lemonnier, E. (2012). Research in autism spectrum disorders children with high-functioning autism and Asperger's syndrome: Can we differentiate their cognitive profiles? *Research in Autism Spectrum Disorders*, *6*(2), 939–948. https://doi.org/10.1016/j.rasd.2011.12.009

Polderman, T. J. C., Hoekstra, R. A., Vinkhuyzen, A. A. E., Sullivan, P. F., van der Sluis, S., & Posthuma, D. (2013). Attentional switching forms a genetic link between attention problems and autistic traits in adults. *Psychological Medicine*, *43*(9), 1985–1996. https://doi.org/10.1017/S0033291712002863

Robertson, A., & Simmons, D. (2013). The relationship between sensory sensitivity and autistic traits in the general population. *Journal of Autism & Developmental Disorders*, *43*(4), 775–784. https://doi.org/10.1007/s10803-012-1608-7

Rodgers, J. D., Lodi-Smith, J., Donnelly, J. P., Lopata, C., McDonald, C. A., Thomeer, M. L., Lipinski, A. M., Nasca, B. C., & Booth, A. J. (2019). Brief report: Examination of sex-based differences in ASD symptom severity among high-functioning children with ASD using the SRS-2. *Journal of Autism & Developmental Disorders*, *49*(2), 781–787. https://doi.org/10.1007/s10803-018-3733-4

Rommelse, N. N., Franke, B., Geurts, H. M., Hartman, C. A., & Buitelaar, J. K. (2010). Shared heritability of attention-deficit/hyperactivity disorder and autism spectrum disorder. *European Child & Adolescent Psychiatry*, *19*(3), 281–295. https://doi.org/10.1007/s00787-010-0092-x

Saunders, A., Kirk, I. J., & Waldie, K. E. (2016). Hemispheric coherence in ASD with and without comorbid ADHD and anxiety. *BioMed Research International*, *2016*, 1–12. https://doi.org/10.1155/2016/4267842

Schertz, H., Odom, S., Baggett, K., & Sideris, J. (2016). Parent-reported repetitive behavior in toddlers on the autism spectrum. *Journal of Autism & Developmental Disorders*, *46*(10), 3308–3316. https://doi.org/10.1007/s10803-016-2870-x

Sheldrick, R. C., Maye, M. P., & Carter, A. S. (2017). Age at first identification of autism spectrum disorder: An analysis of two US surveys. *Journal of the American Academy of Child & Adolescent Psychiatry*, *56*(4), 313–320. https://doi.org/10.1016/j.jaac.2017.01.012

Siegel, M., Smith, K. A., Mazefsky, C., Gabriels, R. L., Erickson, C., Wink, L., Santangelo, S. L., & Autism and Developmental Disorders Inpatient Research Collaborative. (2015). The Autism Inpatient Collection: Methods and preliminary sample description. *Molecular Autism*, *6*(61), 1–10. https://doi.org/10.1186/s13229-015-0054-8

Skogan, A. H., Zeiner, P., Egeland, J., Rohrer-Baumgartner, N., Urnes, A.-G., Reichborn-Kjennerud, T., & Aase, H. (2014). Inhibition and working memory in young preschool children with symptoms of ADHD and/or oppositional-defiant disorder.

Child Neuropsychology, *20*(5/6), 607–624. https://doi.org/10.1080/09297049.2013.838213

Skogan, A. H., Zeiner, P., Egeland, J., Urnes, A.-G., Reichborn-Kjennerud, T., & Aase, H. (2015). Parent ratings of executive function in young preschool children with symptoms of attention-deficit/-hyperactivity disorder. *Behavioral & Brain Functions*, *11*(1), 1–11. https://doi.org/10.1186/s12993-015-0060-1

Smith, H., Carter, A. S., Blaser, E., & Kaldy, Z. (2019). Successful attentional set-shifting in 2-year-olds with and without autism spectrum disorder. *PLoS ONE*, *14*(3), 1–17. https://doi.org/10.1371/journal.pone.0213903

Sokolova, E., Oerlemans, A., Rommelse, N., Groot, P., Hartman, C., Glennon, J., Claassen, T., Heskes, T., & Buitelaar, J. (2017). A causal and mediation analysis of the comorbidity between attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD). *Journal of Autism & Developmental Disorders*, *47*(6), 1595–1604. https://doi.org/10.1007/s10803-017-3083-7

Solomon, O. (2015). "But-he'll fall!": Children with autism, interspecies intersubjectivity, and the problem of "being social." *Culture, Medicine & Psychiatry*, *39*(2), 323–344. https://doi.org/10.1007/s11013-015-9446-7

Soto, T., Giserman Kiss, I., & Carter, A. S. (2016). Symptom presentations and classification of autism spectrum disorder in early childhood: Application to the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (Dc:0-5). *Infant Mental Health Journal*, *37*(5), 486–497. https://doi.org/10.1002/imhj.21589

Stevens, T., Peng, L., & Barnard-Brak, L. (2016). The comorbidity of ADHD in children diagnosed with autism spectrum disorder. *Research in Autism Spectrum Disorders*, *31*, 11–18. https://doi.org/10.1016/j.rasd.2016.07.003

Swineford, L. B., Guthrie, W., & Thurm, A. (2015). Convergent and divergent validity of the Mullen Scales of Early Learning in young children with and without autism spectrum disorder. *Psychological Assessment*, *27*(4), 1364–1378. https://doi.org/10.1037/pas0000116

Teague, S. J., Gray, K. M., Tonge, B. J., & Newman, L. K. (2017). Attachment in children with autism spectrum disorder: A systematic review. *Research in Autism Spectrum Disorders*, *35*, 35–50. https://doi.org/10.1016/j.rasd.2016.12.002

Thapar, A., & Cooper, M. (2016). Attention deficit hyperactivity disorder. *Lancet*, *387*(10024), 1240–1250. https://doi.org/10.1016/S0140-6736(15)00238-X

Thompson, D. (2015). *ADHD may mask autism in young kids*. WebMD. http://www.webmd.com/add-adhd/childhood-adhd/news/20150914/adhd-autism-children

Toh, T.-H., Tan, V. W.-Y., Lau, P. S.-T., & Kiyu, A. (2018). Accuracy of Modified Checklist for Autism in Toddlers (M-CHAT) in detecting autism and other developmental disorders in community clinics. *Journal of Autism & Developmental Disorders*, *48*(1), 28–35. https://doi.org/10.1007/s10803-017-3287-x

Tureck, K., Matson, J. L., Cervantes, P., & Turygin, N. (2015). Autism severity as a predictor of inattention and impulsivity in toddlers. *Developmental*

Neurorehabilitation, *18*(5), 285–289. https://doi.org/10.3109/17518423.2013.807884

Tureck, K., Matson, J., May, A., Davis, T., & Whiting, S. (2013). Investigation of the rates of comorbid symptoms in children with ADHD compared to children with ASD. *Journal of Developmental & Physical Disabilities*, *25*(4), 405–417. https://doi.org/10.1007/s10882-012-9320-2

Tureck, K., Matson, J. L., May, A., & Turygin, N. (2013). Externalizing and tantrum behaviours in children with ASD and ADHD compared to children with ADHD. *Developmental Neurorehabilitation*, *16*(1), 52–57. https://doi.org/10.3109/17518423.2012.719245

Turygin, N., Matson, J. L., Konst, M., & Williams, L. (2013). The relationship of early communication concerns to developmental delay and symptoms of autism spectrum disorders. *Developmental Neurorehabilitation*, *16*(4), 230–236. https://doi.org/10.3109/17518423.2012.756950

Tye, C., Asherson, P., Ashwood, K. L., Azadi, B., Bolton, P., & McLoughlin, G. (2014). Attention and inhibition in children with ASD, ADHD and co-morbid ASD + ADHD: An event-related potential study. *Psychological Medicine*, *44*(5), 1101–1116. https://doi.org/10.1017/S0033291713001049

van Belle, J., van Hulst, B. M., & Durston, S. (2015). Developmental differences in intra-individual variability in children with ADHD and ASD. *Journal of Child Psychology & Psychiatry*, *56*(12), 1316–1326. https://doi.org/10.1111/jcpp.12417

van Steijn, D. J., Oerlemans, A. M., de Ruiter, S. W., van Aken, M. A. G., Buitelaar, J. K., & Rommelse, N. N. J. (2013). Are parental autism spectrum disorder and/or

attention-deficit/hyperactivity disorder symptoms related to parenting styles in families with ASD (+ADHD) affected children? *European Child & Adolescent Psychiatry*, *22*(11), 671–681. https://doi.org/10.1007/s00787-013-0408-8

Vargas-Cuentas, N. I., Roman-Gonzalez, A., Gilman, R. H., Barrientos, F., Ting, J., Hidalgo, D., Jensen, K., & Zimic, M. (2017). Developing an eye-tracking algorithm as a potential tool for early diagnosis of autism spectrum disorder in children. *PLoS ONE*, *12*(11), 1–13. https://doi.org/10.1371/journal.pone.0188826

Vento, M., Gago, B., García-Blanco, A., Perea, M., López-Soler, C., & García-Blanco, M. C. (2017). Communication deficits and avoidance of angry faces in children with autism spectrum disorder. *Research in Developmental Disabilities*, *62*, 218–226. https://doi.org/10.1016/j.ridd.2017.02.002

Wan, G., Kong, X., Sun, B., Yu, S., Tu, Y., Park, J., Lang, C., Koh, M., Wei, Z., Feng, Z., Lin, Y., & Kong, J. (2019). Applying eye tracking to identify autism spectrum disorder in children. *Journal of Autism & Developmental Disorders*, *49*(1), 209–215. https://doi.org/10.1007/s10803-018-3690-y

Ware-Balch, J., & Ray, D. C. (2015). Emotional assets of children with autism spectrum disorder: A single-case therapeutic outcome experiment. *Journal of Counseling & Development*, *93*(4), 429–439. https://doi.org/10.1002/jcad.12041

Wetherby, A. M., Woods, J., Allen, L., Cleary, J., Dickinson, H., & Lord, C. (2004). Early indicators of autism spectrum disorders in the second year of life. *Journal of Autism & Developmental Disorders*, *34*(5), 473–493. https://doi.org/10.1007/s10803-004-2544-y

Wiggins, L. D., Robins, D. L., Bakeman, R., & Adamson, L. B. (2009). Brief report: Sensory abnormalities as distinguishing symptoms of autism spectrum disorders in young children. *Journal of Autism & Developmental Disorders*, *39*(7), 1087–1091. https://doi.org/10.1007/s10803-009-0711-x

Williams, Z. J., Failla, M. D., Gotham, K. O., Woynaroski, T. G., & Cascio, C. (2018). Psychometric evaluation of the Short Sensory Profile in youth with autism spectrum disorder. *Journal of Autism & Developmental Disorders*, *48*(12), 4231–4249. https://doi.org/10.1007/s10803-018-3678-7

Wilson, B., Manangan, C., Dauterman, H., & Davis, H. (2014). ADHD symptoms moderate the relation between ASD status and internalizing symptoms in 3-6-year-old children. *Journal of Autism & Developmental Disorders*, *44*(6), 1347–1356. https://doi.org/10.1007/s10803-013-1995-4

Xiao, Z., Qiu, T., Ke, X., Xiao, X., Xiao, T., Liang, F., Zou, B., Huang, H., Fang, H., Chu, K., Zhang, J., & Liu, Y. (2014). Autism spectrum disorder as early neurodevelopmental disorder: Evidence from the brain imaging abnormalities in 2-3 years old toddlers. *Journal of Autism & Developmental Disorders*, *44*(7), 1633–1640. https://doi.org/10.1007/s10803-014-2033-x

Yates, K., & Le Couteur, A. (2012). Diagnosing autism. *Paediatrics and Child Health*, *23*(1), 5–10. https://doi.org/10.1016/j.paed.2008.10.010

Yates, K., & Le Couteur, A. (2016). Diagnosing autism/autism spectrum disorders. *Paediatrics and Child Health*, *26*(12), 513–518. https://doi:10.1016/j.paed.2016.08.004

Zander, E., Willfors, C., Berggren, S., Choque-Olsson, N., Coco, C., Elmund, A., Morett, A. H., Holm, A., Jifält, I., Kosieradzki, R., Linde, J., Nordin, V., Olafsdottir, K., Poltrago, L., & Bölte, S. (2016). The objectivity of the Autism Diagnostic Observation Schedule (ADOS) in naturalistic clinical settings. *European Child & Adolescent Psychiatry*, *25*(7), 769–780. https://doi.org/10.1007/s00787-015-0793-2

Appendix A: Proposed Checklist

Language Functioning	
Between 6 and 16 weeks of age, exhibited limited cooing	☐
By 9 months of age, struggled to recognize familiar words	☐
By 10 months of age, was not seen to reduplicate babble	☐
By 12 months, struggled to gesture or point to objects	☐
At 12 to 18 months of age, did not imitate sounds or words	☐
By 18 months, was not saying single word sentences	☐
By 24 months, was not saying 2-word sentences	☐
Loss of language or social skills at any age	☐
Abnormal prosody (abnormal pitch, speech, volume, or tone)	☐
Misuse of pronouns (saying he or she instead of I)	☐
Talks in a strange way	☐
Limited range of gestures	☐
Social Functioning	
During feedings between 4 and 6 months of age, did not open mouth in anticipation	☐
By 9 months of age, did not use gaze by alternating direction of gaze between an object of interest and a person	☐
By 6 to 12 months of age, is disengaged socially	☐
By 12 moths of age, appears disinterested in other people	☐
By 12 months of age, appears inattentive to mother	☐
Appears disengaged	☐
As an infant, did not smile socially at others	☐

Does not seek comfort or sympathy	☐
Does not respond to name	☐
Does not turn eyes toward a sound	☐
Has a reduced interest in reciprocal social games	☐
Does not play well with others	☐
Does not engage others in play	☐
Engages in parallel play	☐
Shows limited social initiation	☐
Does not reach for familiar person when person holds out arms	☐
Is not excited when showing an object to someone	☐
Struggles to make eye-contact	☐
Struggles to respond to initiations of joint attention	☐
Struggles to initiate conversations	☐
Struggles to sustain a conversation	☐
Uses someone else's body to communicate	☐
Struggles to understand social rules (stands too close)	☐
Struggles to understand turn-taking	☐
Has difficulty sharing objects	☐
Does not understand humor	☐
Behaves in overly familiar ways with strangers	☐
Behaves in ways that appear strange or bizarre	☐
Appears to be in own world	☐
Does not engage in imaginative or pretend play	☐

Emotional Functioning	
Has poor emotional regulation skills	☐
Becomes easily angry or upset	☐
Has tantrums	☐
Has reduced facial expression	☐
Struggles with facial expressions	☐
Lacks affection	☐
Struggles to empathize with others	☐
Is unaware of other's feelings	☐
Restrictive/Repetitive Behaviors	
Uses objects inappropriately	☐
Lines up toys	☐
Will excessively look at simple objects or look at objects from the corner of eyes	☐
Focuses on a part of an object rather than the entire object	☐
Repeatedly rubs, licks, or puts objects in mouth	☐
Preoccupation with a particular topic	☐
Has repetitive behaviors	☐
Has difficulty transitioning between activities/tasks	☐
Becomes upset when routines are changed	☐
Is unable to adapt to changes in routine	☐
Engages in self-injurious behaviors	☐

Motor Functioning	
Was unable to roll over within 3 to 4 months of age	☐
By 4 months of age, was unable to keep head in line with body	☐
Was unable to sit independently between 5 and 7 months of age	☐
Was unable to crawl by 7 to 9 months of age	☐
By 12 months, was unable to develop pincer grip (the coordination of the index finger and thumb to hold an item)	☐
By 14 months of age, did not point at objects	☐
Was unable to walk by 15 months of age	☐
As a toddler, struggled to reach for objects	☐
As a toddler, struggled to clap	☐
General Behaviors	
Had delayed developmental milestones	☐
Regressed in development at any age	☐
Is a picky eater	☐
Has motor mannerisms (finger flicking/twisting, hand posturing, arm flapping/waving, toe-walking, jumping, body posturing, or spinning)	☐
Has sensitivities to sound (loud and or unexpected noises)	☐
Has sensitivities to smells	☐
Has sensitivities to textures (e.g., tags, jeans, rough)	☐
Is insensitive to pain	☐