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DSM-5 Autism Criteria Applied to Toddlers with DSM-IV-TR Autism

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DSM-5 Autism Criteria Applied to Toddlers with DSM-IV-TR Autism

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B.A., The College of New Jersey, 2009

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DSM-5 Autism Criteria Applied to Toddlers with DSM-IV-TR Autism

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Abstract

The DSM-5 diagnostic criteria for autism spectrum disorders (ASD) include substantial revisions, including the combination of the subcategories (Autistic Disorder, Asperger's Disorder, and PDD-NOS) into one dimensional category of ASD, combining the social and communication domains into one, and requiring two rather than one repetitive and restrictive behaviors (RRBs). Concerns have been raised about the DSM-5's sensitivity for very young children, especially since RRBs may not manifest in this age group. In order to address concerns about the sensitivity of the DSM-5 ASD criteria in toddlers, the current study examined if toddlers who received an ASD diagnosis under the DSM-IV-TR criteria would maintain their diagnosis with the DSM-5 criteria. Children (n = 232) between the ages of 16 and 39 months (M = 25.95, SD = 4.49) who were part of a multi-site study examining the sensitivity and specificity of the Modified Checklist for Autism in Toddlers and who received an ASD or Non-ASD diagnosis were included in the study. Results suggested that 29% of toddlers who previously met an ASD diagnosis no longer did so with the new criteria. Relaxing criterion B by requiring one instead of two RRBs increased sensitivity while maintaining specificity. Because of the significant implications of early detection and intervention of ASD on outcome, it is important that the DSM-5 criteria reflect the presentation of ASD in toddlers. Requiring two RRBs may negatively impact the early detection of ASD because these behaviors may not have emerged in toddlers.

DSM-5 Autism Criteria Applied to Toddlers with DSM-IV-TR Autism

Kanner (1943) was the first to formally describe a disorder currently understood by the field as a collection or spectrum of related disorders (Autism Spectrum Disorders; ASD). He did so through the description of 11 cases of children aged two to 10 years (eight boys, three girls) who demonstrated impairment in social interaction and communication domains, and the presence of repetitive and/or restrictive behaviors, interests, and activities (4th ed., text rev.; Diagnostic and Statistical Manual of Mental Disorders-IV-TR; American Psychiatric Association, 2000; Kanner, 1943). Almost four decades later, autism was recognized as its own disorder (i.e., Infantile Autism) under the Pervasive Developmental Disorder (PDD) category in the third edition of the DSM (3rd ed.; DSM-III; American Psychiatric Association, 1980; Holaday, 2012). Over the course of various editions of the DSM, autism and its diagnostic criteria underwent many changes, including the change in terminology from "infantile autism" to "autistic disorder" (3rd ed., rev.; DSM-III-R; American Psychiatric Association, 1987) and the inclusion of Asperger's Disorder and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) under the PDD category (4th ed.; DSM-IV; American Psychiatric Association, 1994; Holaday, 2012).

The most recent wave of significant changes to the ASD diagnostic criteria occurred in May of 2013 when the fifth edition of the DSM (5th ed.; DSM–5; American Psychiatric Association, 2013) was published. Prior to these changes, which will be discussed below, ASD was defined as a group of pervasive developmental disorders that included Autistic Disorder, Asperger's Disorder, PDD-NOS, Childhood Disintegrative

Disorder, and Rett's Disorder, with Autistic Disorder indicating greater impairment than PDD-NOS (DSM-IV-TR; American Psychiatric Association, 2000).

In the DSM-IV-TR (American Psychiatric Association, 2000; the DSM-IV-TR will be referred to as the DSM-IV in the rest of the document), Autistic Disorder was conceptualized as a triad of symptoms including impairment in (1) social interaction and (2) communication, and (3) the presence of repetitive and restrictive behaviors (RRBs)). A total of at least six symptoms within the triad must be observed or reported to receive an Autistic Disorder diagnosis. An individual met diagnostic criteria for Autistic Disorder by meeting at least two items in the social impairment domain, at least one item in the communication impairment *or* RRB domains, and a total of at least six items. Social impairment and the presence of RRBs, with the absence of clinically significant delays in early language and cognitive development, reflected an Asperger's Disorder diagnosis. Within the DSM-IV, a PDD-NOS diagnosis required significant impairment in reciprocal social interaction, with the presence of either impairment in verbal or nonverbal communication, or RRBs; in addition, diagnostic criteria for a specific PDD, Schizophrenia, Schizotypal Personality Disorder, or Avoidant Personality Disorder could not be met (American Psychiatric Association, 2000).

In 1999, the American Psychiatric Association (APA) appointed a Neurodevelopmental Work Group to revise the diagnostic criteria for ASD. The APA reported that the workgroup would strive to maintain sensitivity and increase specificity (Worley & Matson, 2012), which the group hoped to achieve by "clean(ing) up a currently hard-to-implement and contradictory diagnostic schema, and to do away with distinctions that are made idiosyncratically and unreliably across different clinicians

(Happé, 2011).” This aim led to the development and publication of the DSM-5 (American Psychiatric Association, 2013), which includes the following substantial revisions in the diagnosis criteria for ASD:

1. The subcategories (Autistic Disorder, Asperger’s Disorder, PDD-NOS, and Childhood Disintegrative Disorder) were combined into one-dimensional category of ASD, and Rett’s Disorder was removed.
2. The autism symptom triad of social impairments, communication impairments, and RRBs was changed to an autism symptom dyad consisting of deficits in social communication (i.e., DSM-5 Criterion A) and the presence of RRBs (i.e., DSM-5 Criterion B).
3. Two out of four RRBs were required in place of the previous requirement of one RRB.
4. Stereotyped and repetitive use of language was relabeled as a symptom present in the RRB domain, rather than in the communication domain.
5. Hypo- or hyperactivity to sensory stimuli was added as a criterion within the RRB domain.

The controversial removal of ASD subcategories was based on the workgroup’s belief that autism is better understood as a single category; diagnostically defining behaviors are believed to be present across all current DSM-IV autism subcategories. The subcategories are presented as differing only in “clinical specifiers” such as symptom severity and verbal communication skills (American Psychiatric Association, 2013). According to the workgroup, this change will maintain the sensitivity of the current DSM-IV while increasing specificity due to the more stringent diagnostic criteria that

allows for a dimensional rather than a categorical conceptualization of ASD (American Psychiatric Association, 2013).

Additionally, some of the changes seem to have been partially prompted by findings that researchers and clinicians are able to differentiate individuals with ASD from those without ASD reliably and accurately, but are not reliably able to differentiate the groups within ASD (i.e., Autistic Disorder, Asperger Syndrome, and PDD-NOS) as required by DSM-IV (Moore & Goodson, 2003; Happé 2011; Lord et al. 2011; Frazier et al. 2012; American Psychiatric Association, 2013). Diagnostic variability across sites as well as tendencies towards diagnosing according to language ability or intelligence rather than "features of the disorder" were cited as contributing to the lack of reliability (Lord et al. 2011; American Psychiatric Association, 2013).

Furthermore, a language delay was viewed by the workgroup as a factor affecting the presentation of ASD but not a defining component of ASD (American Psychiatric Association, 2013). Therefore, a delay in language development in the absence of other methods of communication was removed as a core criterion in the DSM-5.

Upon reflection on the significant changes within the then proposed DSM-5 ASD diagnostic criteria, concerns were raised that sensitivity might be sacrificed in an effort to increase specificity (Worley & Matson, 2012). Efforts to increase homogeneity within ASD (Grzadzinski, Huerta, & Lord, 2013) have led to a more stringent diagnostic criteria in the DSM-5. As a result, individuals with less severe symptoms who had received an ASD diagnosis under the DSM-IV may no longer meet criteria for an ASD under DSM-5. A particularly significant concern had been raised about the DSM-5 criteria's diagnostic sensitivity for very young children (Worley & Matson, 2012). For instance,

children, particularly toddlers, with marked social and communication difficulties and stereotypical behaviors may fail to meet the DSM-5 diagnostic criteria because they may exhibit only one behavior within the DSM-5 RRB Criteria (i.e., DSM-5 Criteria B). Gibbs and colleagues (2012) found that 54% of the children in their sample, who ranged in age from two to 16 years (M = 6.06 years, SD = 3.38 years) and received an ASD diagnosis under the DSM-IV, no longer met criteria for an ASD under the then proposed DSM-5 criteria because they exhibited one rather than the required two RRBs. Relaxing the DSM-5 criteria by requiring one instead of two RRBs was indicated as a solution for significantly increasing sensitivity while maintaining specificity in the detection of ASD cases (Frazier et al. 2011; Gibbs et al. 2012; Huerta et al. 2012).

While the literature provides strong evidence for the presence of various and impairing RRBs in children, adolescents, and adults with ASD (Billstedt, Gillberg, & Gillberg, 2007; Ben-Sasson et. al 2008), their presentation in toddlers and whether the frequency/severity/pattern of RRBs change with age and cognitive ability are not clear. Therefore, the relaxed DSM-5 criteria may hold particular relevance for toddlers because it may detect toddlers with ASD with less severe symptoms, including fewer or no RRBs.

The difference in the presentation of RRBs in toddlers was particularly highlighted and supported by Wiggins and colleagues (2012) who conducted a Ward's cluster analysis on toddlers with ASD and found three clusters (i.e., "ASD, mild impairment," "ASD, moderate impairment," "ASD, severe impairment") that differed on social and communication skills, intellectual abilities, and the rate and intensity of RRBs. Seventy six percent of the variance in differentiating these three clusters were accounted for by social and communication skills, which appropriately reflected the significant

social and communication impairments that constitute an ASD diagnosis. Toddlers within the "ASD, severe impairment" cluster exhibited clinically significant RRBs while toddlers within the other two clusters demonstrated few or subclinical RRBs. While this finding supported the dimensional approach of ASD taken by the DSM-5, it also underscored the possibility of toddlers with ASD not receiving an ASD diagnosis under the DSM-5 because of the absence of clinically significant (i.e., impairing) RRBs (Wiggins et al. 2012).

Stone et al. (1999) also suggested that RRBs might not be consistently present in toddlers with ASD. Though social and communication deficits were reported consistently and with high frequency by independent clinicians in 65 toddlers with ASD (M = 31.4 months; SD = 3.4 months), repetitive interests and activities were endorsed with less consistency and differed from child to child. While preoccupation with stereotyped and restricted patterns of interest was most commonly endorsed, adherence to routines or rituals was rarely endorsed. More recent literature suggests that adherence to routines or rituals occur later in the "developmental course of autism" (Moore & Goodson, 2003; Stone et al. 1999). Additionally, the use of stereotyped language was frequently indicated as "not applicable" for a large number of these toddlers due to their delay in language development. Deficits in nonverbal social-communication skills and in social-emotional reciprocity, and an expressive language delay were indicated as the key diagnostic symptoms of autism in young children (Stone et al. 1999).

In addition to differences in RRB presentation in toddlers, the development and severity of RRBs may be different in toddlers than in other age groups (Cox et al. 1999; Stone et al. 1999; Ben-Sasson et. al 2008). A meta-analysis conducted by Ben-Sasson and

colleagues (2008) found that while sensory seeking behaviors (an RRB in the DSM-5 when it leads to impairment in functioning) are generally present and greater in individuals with ASD regardless of age and spectrum severity compared to non-spectrum individuals, chronological age (CA), severity of ASD, and the comparison group moderated the magnitude of these symptoms. Additionally, sensory seeking behaviors, which are more developmentally appropriate in infants and toddlers, occurred with lower frequency in 0 to 3-year-olds with ASD compared to their typically developing peers (d = -.20); this lower frequency of sensory seeking behaviors in individuals with ASD was not found when comparing them to their typically developing counterparts in other age groups (i.e., 3 to 6-years-old, 6 to 9-years-olds, above 9-years-old). This finding suggested that infants and toddlers with autism may have been less likely than typically developing infants and toddlers to explore their environment and express interest in sensations through different behaviors such as mouthing and seeking physical activity. Because of the motor and cognitive delays usually present in children with autism, it was suggested that they also may not be able to explore their environment and seek sensations like their typically developing peers (Ben-Sasson et al. 2008). Due to the lower frequency of sensory seeking behaviors in 0 to 3-year-olds with ASD and the greater frequency of sensory seeking behaviors in 3 to 6-year-olds, and 6 to 9-year-olds with ASD compared to their typically developing peers, Ben-Sasson and colleagues (2008) suggested that under-seeking of sensations developed into over-seeking of sensations in children with ASD. Sensory seeking behaviors may occur in greater frequencies later (after the age of three) when they are not age appropriate, or manifest as atypical types of sensation seeking. Interestingly, under- and over-responsivity, and sensory seeking symptoms were

all highest for 6 to 9-year-olds with ASD compared to other age groups with ASD (i.e., 0 to 3-year-olds, 3 to 6-year olds, above 9-year-olds) (Ben-Sasson et al. 2008). The increased social and physical demands that go along with increasing demands at school was suggested as a possible reason for the peak in these behaviors.

Consistent with the finding by Ben-Sasson and colleagues (2008) regarding the increase of RRBs with age, Moore and Goodson (2003) found an increase in the number of RRBs reported by parents between the ages of two (Time 1 assessment) and four (Time 2 assessment) while little change was noted in the social and communication domains. However, one particular type of RRB was not indicated as increasing more than another, reflecting the varied presentation of RRBs from child to child.

Some studies have found differences in the sensory profiles of individuals with ASD and various comparison groups (Rogers et al. 2003; Leekam et. al 2006; Wiggins, Robins, Bakeman, & Adamson, 2009). A study examining the differences in sensory sensitivity profiles of 34 toddlers with ASD or other Developmental Delays (DD) (age range: 17-45 months; *M*=33 months) found that the toddlers with ASD experienced more difficulties in the area of tactile sensitivity (i.e., "difficulty standing close to others, expresses distress during grooming, unusual reaction to touch, and avoids going barefoot"), auditory filtering (i.e., "difficulty paying attention, lack of response to voice, does not respond to name, and cannot work with background noise"), and taste/smell (i.e., "limits self to certain textures or temperatures, avoids certain tastes, is a picky eater, and avoids certain tastes or smells") domains (Wiggins, Robins, Bakeman, & Adamson, 2009). No differences between ASD and DD groups were found in the areas related to movement preoccupation, sensory under-responsiveness, low energy levels, or

visual/auditory sensitivity. Leekam et al. (2006) found that children (34 to 140 months) with high and low functioning autism exhibited difficulties in two or three sensory domains while their counterparts (children with language impairment and developmental delay (DD), respectively) had difficulties in one, if any, domain. When individuals with high functioning autism (HFA) were compared to an IQ-matched language impaired group and individuals with low functioning autism were compared with the DD group, the HFA had significantly more sensory abnormalities than the low functioning children with autism. Children with low functioning autism did not differ from the DD group. While the differences in how they responded to sensory stimuli did not seem to be a result of IQ, Leekam and colleagues (2006) suggested IQ and age differences might have been found in a larger sample. In a follow up study, they found that some sensory sensitivities change with age and IQ (Leekam et. al 2006). While several symptoms (e.g., "interest in bright lights and shiny things, twisting hands and objects near eyes, get(ting) unusually excited at seeing things spin, look(ing) at objects from many different angles, mouthing objects, spinning around in circles") decreased with age and IQ, sensitivity to gentle touch increased with age (Leekam et. al 2006).

On the other hand, Hus and colleagues (2007) did not find a correlation between chronological age (CA) and the RRBs. They found that verbal and nonverbal IQ rather than CA differentiated ASD groups with high and low number of repetitive sensory motor actions, while insistence on sameness was not significantly impacted by CA or nonverbal and verbal IQ. However, it is important to note that this study only included individuals who were four years old or older; correlations might have been found if younger children had been included. Similarly, a study that addressed concerns that

requiring two RRBs may lead to under-identification of children who might have previously been diagnosed with an ASD also included samples with a wide age range (Huerta et. al 2012). Huerta and colleagues (2012) noted that few children in their study (age range: 2 to 17 years, 11 months) failed to meet the RRB domain and instead, those who did not meet criteria for DSM-5 ASD failed to meet the social communication criteria.

Because of strong evidence of the relationship between early diagnosis and intervention and more positive outcomes (Myers & Johnson, 2007), it is important to have diagnostic criteria that have adequate sensitivity for children under the age of three. Speech before the age of five and higher childhood IQ were indicated as the strongest childhood predictors for outcome, specifically social interaction (Billstedt, Gillberg, & Gillberg, 2007). Early intervention that targets speech and language, and greater social and cognitive engagement could improve language and cognitive delays, and therefore, potentially, facilitate better outcomes in children with autism.

In order to further address the diagnostic concerns, particularly early detection, raised by the DSM-5, Barton and colleagues (2013) examined the sensitivity and specificity of the DSM-5 in toddlers (Mean age = 25.76 months, *SD* = 4.44, range 16.79-39.36 months) by mapping the ADOS and different versions of the ADI onto the DSM-5 items and generating ROC curves to determine the best fitting ASD cutoff scores. Relaxing the social communication criterion by requiring two instead of three symptoms and relaxing the RRBs criterion by requiring one instead of two symptoms was indicated as having the highest level of sensitivity while retaining adequate specificity; greater

importance was placed on sensitivity due to importance of early detection of ASD (Barton et al. 2013).

The current study further examined the sensitivity and specificity of the DSM-5 by including an additional measure (i.e., the DSM-IV checklist) in the DSM-5 mapping published by Barton and colleagues (2013). The sample also differed slightly in that the participants recruited through Georgia State University (GSU; $n = 90$), which were included in the Barton et al. (2013) study, were not included in the current study; only participants recruited through the University of Connecticut ($n = 332$) were included in this study. The first hypothesis of the current study was that a clinically significant percent of toddlers who met diagnostic criteria for an ASD under DSM-IV were no longer expected to do so under the DSM-5 diagnostic criteria. The second hypothesis was that most toddlers who no longer met full diagnostic criteria were expected to have significant social and communication deficits that lead to impairments in daily functioning, often meeting all three social communication criteria but failing to meet the RRB criteria. The third hypothesis of the current study was that relaxing the DSM-5 criteria by requiring one RRB symptom instead of two would increase sensitivity while maintaining specificity. A non-ASD comparison group was included to allow examination of sensitivity and specificity of the DSM-5 as compared to the DSM-IV diagnostic criteria.

Method

Participants and Procedure

The current study included participants from a multi-site study examining the sensitivity and specificity of the Modified Checklist for Autism in Toddlers (M-CHAT;

Robins, Fein, Barton, & Green, 2001), which is a two stage 23-item parent-report screening tool used to assess potential symptoms of ASD in toddlers between 16 and 30 months of age. In the first stage, parents completed the M-CHAT during well child visits at their pediatricians' offices. The pediatrician sites then mailed the completed M-CHATs to their collaborating research site. In the second stage, members of the research team contacted parents to complete follow-up phone calls because their responses to the M-CHAT indicated that their children might be at risk for an ASD (i.e., failing two or more critical items, or any three items). A sample of 682 families were offered and accepted a free developmental and diagnostic evaluation because their responses to the follow-up interview questions continued to indicate ASD risk. Concerns raised by the M-CHAT and M-CHAT follow-up interview were described as social and developmental concerns rather than specifically ASD concerns to parents on the phone to prevent further distress and to minimize reporting bias. These evaluations were completed by a trained graduate student in a clinical psychology doctoral program and an experienced clinician (a licensed clinical psychologists or a developmental pediatrician) and lasted about three hours.

Three hundred thirty-two toddlers (256 males; 76 females) between the ages of 16 and 39 months (M=25.95, SD=4.49) were included in the current study. While 599 toddlers had completed M-CHATs, the M-CHAT follow up phone interview and the developmental and diagnostic evaluation, 267 participants were excluded due to missing data that could not be supplemented by another measure. Toddlers who received an ASD or a non-ASD diagnosis through this evaluation were included; an ASD or a non-ASD diagnosis was given based upon clinical judgment by experienced clinicians and scores

on the Autism Diagnostic Observation Schedule (*ADOS*; Lord, Rutter, DiLavore, & Risi, 2002), different versions of the Autism Diagnostic Interview (e.g., *ADI-R*; Rutter et al. 2003), and Childhood Autism Rating Scale (*CARS*; Schopler et al. 1980).

The ASD group (n = 234) was composed of toddlers who received a diagnosis of Autistic Disorder (n = 144) or PDD-NOS (n = 90) as defined by DSM-IV diagnostic criteria (see Table 1). The non-ASD group (n = 98) was composed of toddlers who received a diagnosis of Developmental Delay (n = 62) or Developmental Language Disorder (n = 31) as defined by the MCHAT study, or an "other" diagnosis (n = 5; 3 with Motor Delay, 1 = Expressive Language Delay, 1 = Developmental Coordination Disorder and Expressive Language Disorder). The ASD and Non-ASD groups did not differ significantly from each other in terms of ethnicity ($t(320) = -.63$, p = .53), sex ($t(330) = .41$, $p = 68$), or age at evaluation ($t(330) = -1.15$, $p = .25$). Most participants were Caucasian (n = 251; 75.6%) followed by Hispanic or Latino (n = 31; 9.3%) and Black or African American (n = 19; 5.7%). There were an equal number of Asian or Pacific Islander (n = 9; 2.7%) and biracial (n = 9; 2.7%) participants. Three participants (.9%) identified as "other" and ten individuals did not indicate their ethnicity.

In an effort to examine the sensitivity and specificity of the DSM-5, the authors created an algorithm to map the reported and observed symptoms from the diagnostic evaluation onto the DSM-5 diagnostic criteria (see Table 2). The following parent-report and direct observation measures were used to create the current study's DSM-5 algorithm: ADOS (Module1), various editions of the ADI (details of the different editions included below), DSM-IV ASD diagnostic criteria, and additional behavioral observations documented in clinical reports of the diagnostic evaluation. Items in these

measures that reflected the DSM-5 diagnostic criteria were used to create an algorithm and were dichotomously scored as absent or present. A unique algorithm set was created for every listed symptom within each item of the DSM-5 ASD criteria (i.e., A1, A2, A3, B1, B2, B3, and B4) (see Table 2). Algorithm thresholds, "Autism Spectrum Cut Off," for each criterion reflect algorithm thresholds of the ADI-R percentage wise. For example, if the ADI required two out of four items to meet the criterion, the study's algorithm required 50% of the items to be endorsed in order for the criterion to be marked as present. In the case of some missing data, the DSM-IV criteria checklist or the evaluation report was used; this was done only in the case of missing sensory data (B4 from the DSM-5). Criteria C requiring symptoms to be "present in early childhood" and D requiring symptoms to "limit and impair everyday functioning" were met for every participant.

Over the course of the MCHAT study, five different versions of the ADI were used: ADI-Revised (ADI-R); ADI, 3rd edition; ADI-R Short; ADI-R Research, 3rd edition- Toddler Version; and ADI Toddler 2004. Each item on the ADIs that reflected the DSM-5 criteria was matched across all ADI versions. Items that were not in all versions were discarded. The following questions were not in the ADI-R Short version and therefore were not included in the final algorithm: "Midline Hand Movements," "Unusual Attachment to Objects," and "Abnormal, Idiosyncratic, Negative Response to Specific Sensory Stimuli." Similarly, "Undue General Sensitivity to Noise" was not included in the final algorithm because it was not in the ADI-R Research, 3rd edition-Toddler Version.

Measures

The different versions of the Autism Diagnostic Interview (ADI), which are administered by clinicians to parents/caregivers, use a semi-structured interview format to gather past and current developmental information. All five versions cover three function domains (i.e., language and communication, reciprocal social interaction, and RRBs). Average administration time ranged from one to two hours, with ADI-R Short involving the shortest administration time. Each version has an algorithm, which consists of specific items and allows the clinician to determine if the ASD criteria are met. Higher scores indicate more ASD symptoms.

The Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore, & Risi, 2002) is a semi-structured played-based measure used to assess verbal and non-verbal communication skills, social abilities, play, and the presence of RRBs. The standardized format of the activities on the ADOS allows the clinician to observe behaviors that reflect ASD symptoms. Average administration time is about 45 minutes with some variability across modules. Module levels, which are decided by the clinician, are based on chronological age and expressive language abilities. All participants in the current study completed Module 1. Upon the completion of the assessment, the clinician provides ratings (i.e., scores of 0 to 3 and 8; 0 indicating typical development in a particular area, 3 indicating atypical development that reflect symptoms associated with ASD, and 8 indicating that a symptom presentation is not applicable, such as echolalia in a child with no or limited language) for items that reflect different aspects of DSM-IV ASD diagnostic criteria. Specific key items on the ADOS are used for the algorithm to

determine diagnosis, with higher algorithm scores indicating more severe ASD symptom presentation.

DSM-IV checklist is a symptom checklist that directly reflects the DSM-IV ASD diagnostic criteria, used in the larger M-CHAT study. It is filled out by experienced clinicians as part of the evaluation, using all available information, and was used to determine if a participant met ASD diagnostic criteria.

Due to the addition of sensory (hyper- or hyporeactivity) symptoms in the DSM-5 ASD diagnostic criteria, the absence or presence of sensory symptoms could not be determined for all participants from the three measures mentioned above (i.e., ADI, ADOS, DSM-IV checklist) because they were based on the DSM-IV ASD diagnostic criteria, which does not include sensory symptoms. In order to provide the most thorough symptom presentation profile for each participant, evaluation reports were examined for participants who were missing sensory data to determine if they exhibited any sensory sensitivity during the evaluation or as reported by parents.

Data Analysis

The algorithm created for this study was used to determine the new diagnostic breakdown of participants. Percentages of toddlers who met and did not meet each DSM-5 criterion (criterion A or B), as well as the criteria as a whole (criterion A and B), were obtained. In order to determine how a relaxed algorithm (i.e., 2 of 3 Social and Communication symptoms, and/or 1 of 4 RRBs) would affect the new diagnostic breakdown, a relaxed algorithm was applied for the DSM-IV ASD and non-ASD groups. The sensitivity and specificity of the DSM-5 and relaxed DSM-5 was calculated under the assumption that the DSM-IV diagnoses given through the M-CHAT study were true

positives and true negatives. Best estimate clinical judgment, which was considered best practice for assigning an ASD diagnosis and has been shown to have high inter-rater reliability (Klin, Lang, Cicchetti, & Volkmar, 2000), was used to determine the original M-CHAT diagnoses and incorporated clinical observation and interview, ADOS, CARS and ADI results.

It is important to note that for this study, sensitivity and specificity refers to how the DSM-5 ASD diagnoses compare to the DSM-IV ASD diagnoses, and are computed in a sample of toddlers with ASD or another developmental diagnosis, not the general population. Consequently, the results do not bear on the specificity and sensitivity of the new criteria to differentiate ASD from the general population of children.

Results

DSM-5 ASD Criteria

ASD Group: Application of DSM-5 ASD Criteria A. Fifteen percent of toddlers in the ASD group did not meet Criterion A, which required meeting all three items within Criterion A (see Table 3). When examining each item under DSM-5 ASD Criterion A, 1% (3 out of 234) of toddlers within the ASD group did not meet A1 (i.e., "deficits in social-emotional reciprocity;" American Psychiatric Association, 2013). On Criterion A2 (i.e., "deficits in nonverbal communicative behaviors used for social interaction;" American Psychiatric Association, 2013), 7% (17 out of 234) of toddlers did not meet. On Criterion A3 (i.e., "deficits in developing, maintaining, and understanding relationships;" American Psychiatric Association, 2013), 8% (19 out of 234) of toddlers did not meet.

ASD Group: Application of DSM-5 ASD Criterion B. Nineteen percent of toddlers

within the ASD group did not meet Criterion B, which required meeting two out of four items in Criterion B (see Table 4). On B1 (i.e., "stereotyped or repetitive motor movements, use of objects, or speech;" American Psychiatric Association, 2013), 16% (38 out of 234) did not meet. On B2 (i.e., "insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior;" American Psychiatric Association, 2013), 79% (184 out of 234) did not meet. On B3 (i.e., "highly restricted, fixated interests that are abnormal in intensity or focus;" American Psychiatric Association, 2013), 62% (145 out of 234) did not meet. On B4 (i.e., "hypo- or hypereactivity to sensory input or unusual interests in sensory aspects of the environment;" American Psychiatric Association, 2013), 16% (38 out of 234) did not meet.

ASD Group: Application of DSM-5 ASD Criteria A and B. Twenty-nine percent (68 out of 234) of toddlers who met DSM-IV criteria for an ASD diagnosis did not meet the DSM-5 diagnostic criteria for an ASD (DSM-IV only group; see Table 5). When considering each DSM-IV diagnostic category, 15% (22 out of 144) of toddlers who were diagnosed with DSM-IV Autistic Disorder did not meet the DSM-5 diagnostic criteria for ASD. A little over half (51%; 46 out of 90) of toddlers who were diagnosed with DSM-IV PDD-NOS did not meet the DSM-5 diagnostic criteria for ASD. Additionally, within the DSM-IV only group (who lost the ASD diagnosis), 50% (34 out of 68) met Criterion A (i.e., all three types of deficits listed under Criterion A, which include social communication and social interaction deficits) but did not meet Criterion B (i.e., two out of the four restricted, repetitive patterns of behavior, interests, or activities listed under Criterion B). Thirty-five percent (24 out of 68) did not meet Criterion A but met Criterion

B, and 15% (10 out of 68) did not meet either Criterion A or Criterion B.

Non-ASD Group: Application of DSM-5 Criterion A. When examining the Non-ASD group, the results will be reported as the percentage of toddlers who met DSM-5 criterion/item to allow for the examination of DSM-5 specificity. For DSM-5 Criterion A, 26% (25 out of 98) of toddlers in the DSM-IV non-ASD group met all three items (see Table 6). 81% (79 out of 98) met A1, 29% (28 out of 98) met A2, and 88% (86 out of 98) met A3.

Non-ASD Group: Application of DSM-5 Criterion B. Over half of the toddlers in the non-ASD group (i.e., 52%; 51 out of 98) met DSM-5 Criterion B by meeting two out of four RRB items (see Table 7). On B1, 53% (52 out of 98) of the toddlers in the Non-ASD group met. On Criterion B2, 15% (15 out of 98) of the toddlers in the Non-ASD group met. On Criterion B3, 26% (25 out of 98) of the toddlers in the Non-ASD group met. On Criterion B4, 44% (43 out of 98) of the toddlers in the Non-ASD group met.

Non-ASD Group: Application of DSM-5 Criteria A and B. Seventeen percent (17 of 98) of toddlers who did not meet DSM-IV criteria for an ASD diagnosis met the DSM-5 diagnostic criteria for an ASD; 76% (13 out of 17) of these toddlers were developmentally delayed (Table 8). In the group of toddlers who continued not to meet an ASD diagnosis, 10% (8 out of 81) toddlers met Criterion A but did not meet Criterion B. Interestingly, 42% (34 out of 81) did not meet Criterion A but met Criterion B, and 48% (39 out of 81) met neither Criterion A nor B.

Sensitivity and Specificity: DSM-5 Criterion A and B: The sensitivity of the DSM-5 ASD diagnostic criteria for the current study's sample is 0.71 and the specificity is 0.83.

Relaxed DSM-5 criteria

Because of some criticism in the literature that the DSM-5 diagnostic criteria may be too stringent, the current study examined the impact of "relaxing" the diagnostic criteria by requiring *two* out of the three items in Criterion A *and/or one* out of the four items in Criterion B.

Relaxed DSM-5 Criterion A Only: Requiring 2 out of 3 items within Criterion A

ASD Group: Relaxed Criterion A. When a "relaxed" set of diagnostic criteria was applied to the DSM-5 diagnostic criteria for ASD by requiring *two of out three* rather than the current three out of three items within Criterion A while still requiring two or more RRBs in Criterion B, 20% (47 out of 234) of toddlers who previously met DSM-IV ASD diagnostic criteria did not meet the relaxed DSM-5 criteria (see Table 9). When examining each DSM-IV diagnostic category, 10% (15 out of 144) of toddlers who were diagnosed with DSM-IV Autistic Disorder did not meet the relaxed DSM-5 diagnostic criteria for ASD. Thirty-five percent (32 out of 90) of toddlers who were diagnosed with DSM-IV PDD-NOS did not meet the relaxed DSM-5 diagnostic criteria for ASD. When further examining the breakdown of the toddlers who continued not to meet the Relaxed DSM-5 diagnostic criteria, 89% (42 out of 47) met the relaxed Criterion A but not Criterion B, 6% (3 out of 47) did not meet the relaxed Criterion A but met Criterion B, and 4% (2 out of 47) did not either the relaxed Criterion A or Criterion B.

Non-ASD Group: Relaxed Criterion A. Forty-one percent (40 out of 98) of toddlers who did not meet diagnostic criteria for an ASD under the DSM-IV criteria met criteria for an ASD when the relaxed DSM-5 diagnostic Criterion A was applied (see Table 10). Out of the 58 toddlers who continued not to meet ASD diagnostic criteria,

53% (31 out of 58) met relaxed Criterion A but not Criterion B, 19% (11 out of 58) did not meet relaxed Criterion A but met Criterion B, and 28% (16 out of 58) did not meet either relaxed Criterion A or B.

Sensitivity and Specificity: Relaxed Criterion A: Sensitivity increased from 0.71 (DSM-5) to 0.80 (Relaxed DSM-5 Criterion A only) and specificity decreased from 0.83 (DSM-5) to 0.59 (Relaxed DSM-5 Criterion A only).

Relaxed DSM-5 Criterion B Only: Requiring 1 out of 4 items within Criterion B

ASD Group: Relaxed Criterion B. Seventeen percent (40 out of 234) of toddlers who met DSM-IV criteria for an ASD diagnosis did not the meet the relaxed DSM-5 criteria (i.e., requiring 1 instead of 2 RRBs (see Table 11). When examining each DSM-IV diagnostic category, 8% (12 out of 144) of toddlers who were diagnosed with DSM-IV Autistic Disorder did not meet the relaxed DSM-5 diagnostic criteria for ASD. Thirty-one percent (28 out of 90) of toddlers who were diagnosed with DSM-IV PDD-NOS did not meet the relaxed DSM-5 diagnostic criteria for ASD. When considering the 40 toddlers who did not meet the relaxed DSM-5 diagnostic criteria, 15% (6 out of 40) met Criterion A but not the relaxed Criterion B, 78% (31 out of 40) did not meet Criterion A but met the relaxed Criterion B, and 8% (3 out of 40) did not meet either Criterion A or relaxed Criterion B.

Non-ASD Group: Relaxed Criterion B*:* Twenty-one percent (21 out of 98) of toddlers who did not meet DSM-IV criteria for an ASD diagnosis met the current study's relaxed DSM-5 criteria; 71% (15 out of 21) of these toddlers were developmentally delayed (see Table 12). Out of the 77 toddlers who continued not to meet relaxed ASD diagnostic criteria, 5% (4 out of 77) met Criterion A but not the relaxed Criterion B, 71%

(55 out of 98) did not meet Criterion A but met the relaxed Criterion B, and 27% (21 out of 77) did not meet either Criterion A or B.

Sensitivity and Specificity: Relaxed Criterion B. Sensitivity increased from 0.71 (DSM-5) to 0.83 (Relaxed DSM-5 Criterion B only) and specificity decreased slightly from 0.83 (DSM-5) to 0.79 (Relaxed DSM-5 Criterion B only).

Relaxed DSM-5 Criterion A and B: Requiring 2 out of 3 items within Criterion A and requiring 1 out of 4 items within Criterion B

ASD Group: Relaxed Criterion A and B. When the DSM-5 ASD diagnostic criteria was relaxed for both Criterion A and B, 6% (13 out of 234) of toddlers who met DSM-IV criteria for an ASD diagnosis did not the meet the relaxed DSM-5 criteria; (see Table 13). When considering each DSM-IV diagnostic category, 3% (4 out of 144) of toddlers who were diagnosed with DSM-IV Autistic Disorder did not meet the relaxed DSM-5 diagnostic criteria for ASD. Ten percent (9 out of 90) of toddlers who were diagnosed with DSM-IV PDD-NOS did not meet the relaxed DSM-5 diagnostic criteria for ASD. When considering the 13 toddlers who did meet not the relaxed DSM-5 diagnostic criteria, about 62% (8 out of 13) met the relaxed Criterion A but not the relaxed Criterion B, 31% (4 out of 13) did not meet the relaxed Criterion A but met the relaxed Criterion B, and 8% (1 out of 13) met neither relaxed Criterion A nor B.

Non-ASD Group: Relaxed Criterion A and B*:* When the DSM-5 ASD diagnostic criteria was relaxed for both Criterion A and B, 58% (57 out of 98) of toddlers who did not meet DSM-IV criteria for an ASD diagnosis met the current study's relaxed DSM-5 criteria; 64% (37 out of 57) of these toddlers were developmentally delayed (see Table 14). Out of the 41 toddlers who continued not to meet ASD diagnostic criteria, 34% (14

out of 41) met the relaxed Criterion A but not the relaxed Criterion B, 46% (19 out of 41) did not meet the relaxed Criterion A but met the relaxed Criterion B, and 20% (8 out of 41) met neither the relaxed Criteria A nor B.

Sensitivity and Specificity: Relaxed Criterion A and B. Sensitivity increased from 0.71 (DSM-5) to 0.97 (Relaxed DSM-5 Criterion A and B) and specificity decreased from 0.83 (DSM-5) to 0.42 (Relaxed DSM-5 Criterion A and B).

Discussion

The current study examined whether toddlers diagnosed with ASD through the DSM-IV diagnostic criteria (i.e., the DSM-IV ASD group) would continue to meet criteria for ASD based on the recently published DSM-5, which includes significant diagnostic changes. A non-ASD comparison group (i.e., the non-ASD group) was established to determine DSM-5's sensitivity and specificity when considering a sample of toddlers with ASD or another developmental diagnosis.

As predicted, a significant percentage of toddlers (29%) within the ASD group no longer met diagnostic criteria for ASD under DSM-5 (the DSM-IV only group). When Criterion A (Social and Communication Domain) and Criterion B (RRB domain) were considered separately within the DSM-IV only group, half of these toddlers met Criterion A but not Criterion B. In comparison, only 35% of toddlers in the DSM-IV only group met Criterion B but not A. Consistent with previous research by Worley and Matson (2012), these results suggested that a large percentage of individuals with ASD who have significant social and communication deficits may present with only one RRB, and therefore, would no longer meet for ASD under the DSM-5. This less severe presentation of ASD in the current study was not captured by the more stringent diagnostic criteria

within the DSM-5. Toddlers within the DSM-IV only group who only meet Criterion A and not Criterion B may represent a group with mild to moderate impairment; those with more severe impairments may be more likely to meet DSM-5 (Wiggins et al. 2012). These results further supported previous findings that indicated lower frequency of RRBs in toddlers with ASD than older children (Moore & Goodson, 2003; Stone et al. 1999). It may also be possible that the toddlers in the DSM-IV only group may go on to meet diagnostic for DSM-5 ASD at a later age due to change in the type and number of RRBs that occur with age (Ben-Sasson et al. 2008).

The newly established DSM-5 Social Communication Disorder (SCD), which is defined by difficulties in the "social use of language and communication" as demonstrated by impairments in verbal and nonverbal use of language, is similar to the conceptualization of the deficits in ASD (particularly PDD-NOS without RRBs in the DSM-IV) with the presence of RRBs being the differentiating feature (American Psychiatric Association, 2013; Tanguay, 2011). The argument for the use of the SCD diagnosis for the toddlers within the DSM-IV only group can be made. However, 12% of the toddlers within this group exhibited one RRB and therefore, would not fit the SCD diagnosis. Additionally, a diagnosis of SCD currently does not warrant the intensive type of services that a diagnosis of ASD does and therefore, may potentially delay or prevent the provision of necessary early intervention to children who might have the best prognosis if they did receive these services.

The above-mentioned findings in the current study echo concerns that the DSM-5 may be sacrificing sensitivity in order to increase specificity (Warley & Matson, 2012). Previous literature suggested the possible solution of relaxing the DSM-5 diagnostic

criteria (Frazier et al. 2011; Gibbs et al. 2012; Huerta et al. 2012). This method may allow for the increase in sensitivity while maintaining specificity. When both Criterion A and B were relaxed by requiring one less symptom in the current study, 6% of toddlers diagnosed with DSM-IV ASD did not meet the relaxed DSM-5 diagnostic criteria. However, 58% of toddlers who did not receive a DSM-IV ASD diagnosis met the relaxed DSM-5 diagnostic criteria, resulting in a high sensitivity (0.97) but an inadequate specificity level (0.42). The difference in this finding and the conclusion drawn by Barton and colleagues (2013) may reflect the additional measure included in the current DSM-5 mapping, which may have increased the likelihood of a symptom threshold being met and therefore decreasing specificity. Additionally, the samples in the two studies differed slightly, with the Barton et al. (2013) study including participants recruited through GSU. These participants were more likely to be recruited through primary care settings as opposed to Early Intervention sites. Therefore, the GSU participants may have been more mildly impaired due to their recruitment from primary care settings, which may have made it less likely for them to meet the more stringent DSM-5 diagnostic criteria. This possible difference in impairment level between the two samples may have resulted in the need to relax both Criteria A and B in the Barton et al. (2013) study.

When only DSM-5 Criterion B was relaxed by requiring one instead of two RRBs, 17% of toddlers diagnosed with DSM-IV ASD did not meet the relaxed DSM-5 diagnostic criteria, compared to the 29% who did not meet full DSM-5 criteria. Additionally, as hypothesized, DSM-5 sensitivity increased (0.83) and specificity (0.79) was maintained when one instead of two RRBs was required. The greater inclusion of toddlers with significant social and communication impairments (DSM-5 Criterion A)

and one RRB (relaxed DSM-5 Criterion B) would allow toddlers with less severe symptomatology to receive the ASD diagnosis and therefore, the specific and intensive intervention services they need at an early age. This potential for diagnosis and intervention is particularly important in toddlers because of the association of early diagnosis and intervention to more positive outcomes (Myers & Johnson, 2007).

When examining the non-ASD comparison group, 17% of the toddlers met diagnostic criteria for DSM-5. A little over three fourths of the toddlers in this group were diagnosed with DD. This finding may reflect experienced clinicians' use of clinical judgment in addition to testing measures to make an informed diagnosis. Additionally, the global delays in expressive and receptive language, fine motor, visual spatial, and/or daily living skills present in child with a DD diagnosis may result in significant social and communication impairments. Also, while individuals with ASD typically present with more RRBs than those with DD, individuals with developmental delays sometimes do have RRBs (Wiggins et al. 2009). The finding that close to half of the toddlers in the non-ASD group, who continued not to meet criteria for an ASD diagnosis under the DSM-5, exhibited two or more RRBs further highlights the presence of RRBs in individuals with developmental delays not specific to ASD. The presence or absence of two or more RRBs should not have such a significant role in determining whether or not a toddler receives an ASD diagnosis because RRBs do not appear to consistently distinguish ASD cases from non-ASD cases in toddlers.

Strengths and Limitations of the Study

The retrospective nature of the current study limits the generalizability of the results to how the DSM-5 may work in the field when applied at the time of the

diagnostic evaluation. While a significant effort was made to create an algorithm to map the available measures onto the DSM-5 to allow for the greatest possibility of toddlers with DSM-IV ASD meeting the DSM-5 diagnostic criteria, these efforts can not truly reflect how those toddlers may have been diagnosed if the DSM-5 ASD criteria was used at the time of the evaluation. Clinicians may not have elicited the data they needed to make an accurate retrospective DSM-5 diagnosis, especially regarding sensory issues. However, it is important to note that the current study's retrospective methodology has been used by various studies examining the DSM-5 (Gibbs et al. 2012; Frazier et al. 2011; Worley & Matson, 2012).

Additionally, while the study has a comparison group (the non-ASD group), it does not have a non-clinical comparison group. Therefore, the sensitivity and specificity of the DSM-5 calculated in the present paper should be interpreted with caution since the comparison group is not the general population. However, it may be that most patients referred for a developmental and diagnostic evaluation do not represent the general population. Clinicians may be more likely to encounter the need to differentiate ASD from another developmental disorder diagnosis rather than ASD from a typically developing diagnosis. Therefore, the use of a clinical comparison group rather than a typically developing group may be more helpful for diagnostic purposes.

The current study has various strengths. A significant strength is the extensive use of different measures in the creation of the DSM-5 algorithm used for the purposes of this study. The measures included parent report, clinical judgment, and a direct observation measure (ADOS) that is considered a gold standard in the diagnosis of ASD. Additionally, due to the addition of sensory symptoms in the DSM-5, the extra and

cautionary step of examining comprehensive evaluation reports for indications of sensory symptom presence was taken when the other three measures did not allow for the determination of its absence or presence. Furthermore, the comparatively large sample of toddlers allowed for the retrospective exploration of how the DSM-5 may function in a particularly significant age range due to the importance of early detection and intervention.

The current results have strong clinical implications. Due to great importance of early diagnosis and intervention, the possibility of more than one fourth of toddlers with significant social and communication impairment no longer meeting the appropriate diagnosis of ASD has strong and negative implications for their development. They may not receive the appropriate and necessary interventions at the age when they are most effective, if at all. In addition to the impact that this may have on the children, parents and family members will be greatly impacted as well. Early intervention that can potentially lead to more independent functioning at a later age also has economic implications. Therefore, this study further highlights the need to revise the current DSM-5 to better include toddlers with less severe, but still significant, impairments. The results of the current study indicated that this could best achieved by relaxing the DSM-5 Criterion B. In conclusion, maintaining the current the DSM-5 Criterion A and relaxing Criterion B by requiring one instead of two RRBs is indicated as a way of transitioning from a categorical to a dimensional conceptualization of ASD without sacrificing sensitivity in toddlers.

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Table 1

Demographic Characteristic of Sample by Diagnostic Group

	Diagnostic Groups	
	ASD (*n*=234)	Non-ASD (*n*=98)
Age, in months		
Mean (SD)	25.77 (4.58)	26.39 (4.29)
Range	17-39	18-35
Gender (Male: Female)	179:55	77:21
Ethnicity*, %		
Caucasian	78.2%	69.4%
Black/African American	4.3%	9.2%
Asian/Pacific Islander	2.6%	3.2
Hispanic/Latino	8.5%	11.2%
Biracial	3.4%	1%
Other	.4%	2%

*Data available for 322 out of 332 participants.

Table 2

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

Social-Communication Domain				
DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
A1. Reciprocity	1D. Social Interaction: Lack of social or emotional reciprocity 1c. Social Interaction: Lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects to interest)	B2. Responsive Social Smiling B9. Showing B10. Spontaneous Initiation of Joint Attention B11. Response to Joint Attention B23. Quality of Social Overtures	Offering to share	Autism Spectrum Cut Off: 3

Table 2 Continued

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
A2. Nonverbal Communication	1a. Social interaction: marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction	A6. Use of Other's Body to Communicate A7. Pointing A8. Gestures B1. Unusual Eye Contact B3. Facial Expression Directed to others B4. Integration of Gaze and other behaviors during social overtures B7. Requesting		Autism Spectrum cut off = 4 *Note: If B4 and B7 are missing, the autism spectrum cut off should be lowered to 3; however, if only one item is missing, the autism spectrum cut off should remain at 4.*

Table 2 Continued

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
A3. Relationships	1b. Social interaction: failure to develop peer relationships appropriate to developmental level 2d. Communication: lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level	B5. Shared Enjoyment in Interaction	62. Interest in children 63. Response to approaches of other children	Autism Spectrum cut off = 2 *Note: The autism spectrum cut off will remain at 2. If either ADI item is missing, refer to the DSM IV checklist; if the symptom is indicated as being present on the DSM IV checklist, give a combined score of 2 for both ADI items.*

Table 2 Continued

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

Restrictive and Repetitive Behaviors				
DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
B1. Stereotyped or repetitive speech, motor movements, or use of objects	2c. Communication: stereotyped and repetitive use of language or idiosyncratic language 3c. RRB: Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole body movements	A4. Immediate Echolalia A5. Stereotyped/ Idiosyncratic Use of Words or Phrases D2. Hand and Finger and Other Complex Mannerisms D4. Unusually Repetitive Interests or Stereotyped Behaviors	69. Repetitive use of objects or interest in parts of objects 77. Hand and finger mannerisms 78. Other complex mannerisms or stereotyped body movements	Autism Spectrum cut off: 1 for language items (i.e., A4 and A5) or 2 (i.e., D2, D4, and three ADI items) for motor items. *Note: Autism Spectrum cut off can be met on either the two language items or the 5 motor items. If either speech items (i.e., A4 and/or A5) are listed as being present (i.e., a score of 1), then B1 symptom is present and meets the autism spectrum cut off. If two of the five motor items are missing (i.e., ADOS D2, ADOS D4, and the three ADI items), refer to the DSM IV checklist; if symptom is listed as present is in the DSM IV checklist, a score of 2 is given and symptom B1 is listed as present.*

Table 2 Continued

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
B2. Routines/ Rituals	3b. RRB: Apparently inflexible adherence to specific, nonfunctional routines or rituals		39. Verbal rituals 70. Compulsions/ rituals 74. Difficulties with minor changes in subject's own routines or personal environment 75. Resistance to trivial changes in the environment	Autism Spectrum cut off = 2 *Note: If one item is missing, the autism spectrum cut off remains at 2. If more than one item is missing, refer to the DSM IV checklist; if the symptom is listed as present, a score of 2 is given, which meets the cut off.*
B3. Restricted, fixed interests	3a. RRB: Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus		67. Unusual Preoccupations	Autism Spectrum cut off = 1 *Note: If the one ADI item, which the algorithm consists of, is missing, go to the DSM IV checklist; if the symptom is listed as present, give a score of 2.*

Table 2 Continued

DSM-IV-TR, ADOS (Module 1), and ADI Item Mapping onto DSM-5

DSM-5 Symptom	DSM-IV-TR	ADOS (Module 1)	ADI	Algorithm Scoring
B4. Sensory	3d. RRB: Persistent preoccupation with parts of objects	D1. Unusual Sensory Interest in Play Material/Person	71. Unusual sensory interests	Autism Spectrum cut off = 1 *Note: If either algorithm item (i.e., D1 or ADI item) has a score of 1 and is missing the other item, the autism spectrum cut off will be met. If item D1 on the ADOS has a score of 0 and the ADI item is missing, refer to the evaluation report for that individual and look for any mention of the presence of sensory symptoms. If there is no evidence of sensory issues in the report, then the participant does not meet the autism spectrum cut off.*

Table 3
ASD Group: DSM-5 Criterion A (A1, A2, A3- Must Meet All 3)

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	200	134	66
Do not Meet	34	10	24
Total	234		
Percentages for Do Not Meet	15% (34/234)	7% (10/144)	27% (24/90)

Table 4

ASD Group: DSM-5 Criterion B (B1, B2, B3, B4- Must Meet 2 or More)

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	190	130	60
Do not Meet	44	14	30
Total	234		
Percentages for Do Not Meet	19% (44/234)	10% (14/144)	33% (30/90)

Table 5
ASD Group: DSM-5 Criterion A and B

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	166	122	44
Do not Meet	68	22	46
Total	234		
Percentages for Do Not Meet	29% (68/234)	15% (22/144)	51% (46/90)

Table 6

Non-ASD Group: DSM-5 Criterion A (A1, A2, A3- Must Meet All 3)

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	25	18	7	0
Do not Meet	73	44	24	5
Total	98			
Percentages for Meet	26% (25/98)	29% (18/62)	22% (7/31)	0% (0/5)

Table 7

Non-ASD Group: DSM-5 Criterion B (B1, B2, B3, B4- Must Meet 2 or More)

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	51	35	14	2
Do not Meet	47	27	17	3
Total	98			
Percentages for Meet	52% (51/98)	56% (35/62)	45% (14/31)	40% (2/5)

Table 8
Non-ASD Group: DSM-5 Criterion A and B

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	17	13	4	0
Do not Meet	81	49	27	5
Total	98			
Percentages for Meet	17% (17/98)	21% (13/62)	13% (4/31)	0% (0/5)

Table 9

ASD Group: Relaxed Criterion A (2 out of 3) and DSM-5 Criterion B

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	187	129	58
Do not Meet	47	15	32
Total	234		
Percentages for Do Not Meet	20% (47/234)	10% (15/144)	35% (32/90)

Table 10

Non-ASD Group: Relaxed Criterion A (2 out of 3) and DSM-5 Criterion B

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	40	27	13	0
Do not Meet	58	35	18	5
Total	98			
Percentages for Meet	40% (40/98)	44% (27/62)	42% (13/31)	0% (0/5)

Table 11

ASD Group: DSM-5 Criterion A and Relaxed Criterion B (1 out of 4)

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	194	132	62
Do not Meet	40	12	28
Total	234		
Percentages for Do Not Meet	17% (40/234)	8% (12/144)	31% (28/90)

Table 12

Non-ASD Group: DSM-5 Criterion A and Relaxed Criterion B (1 out of 4)

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	21	15	6	0
Do not Meet	77	47	25	5
Total	98			
Percentages for Meet	21% (21/98)	24% (15/62)	19% (6/31)	0% (0/5)

Table 13
ASD Group: DSM-5 Relaxed Criterion A (2 out of 3) and Relaxed Criterion B (1 out of 4)

		Diagnoses	
Status	Totals	Autistic Disorder	PDD-NOS
Meet	221	140	81
Do not Meet	13	4	9
Total	234		
Percentages for Do Not Meet	6% (13/234)	3% (4/144)	10% (9/90)

Table 14

Non-ASD Group: DSM-5 Relaxed Criterion A (2 out of 3) and Relaxed Criterion B (1 out of 4)

		Diagnoses		
Status	Totals	DD	DLD	Other Diagnosis
Meet	57	37	19	1
Do not Meet	41	25	12	4
Total	98			
Percentages for Meet	58% (57/98)	60% (37/62)	61% (19/31)	20% (1/5)