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Cognitive and Adaptive Skills in Toddlers Who Meet Criteria for Autism in DSM-IV but not DSM-5

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Abstract

The current study compared adaptive and cognitive skills, and autism severity of toddlers with an autism spectrum disorder (ASD) diagnosis under DSM-IV but not DSM-5 criteria (DSM-IV only group) to those who met autism criteria under both diagnostic systems (DSM-5 group) and to those without ASD (non-ASD group). The toddlers in the DSM-IV only group were less delayed on various domains of adaptive (Communication, Socialization) and cognitive (Expressive and Receptive language, Fine Motor, Visual Reception) skills, and had less severe symptoms of ASD than the DSM-5 group. Thus, they might have the best potential for successful intervention. The DSM-IV only group did not differ from the non-ASD group in any adaptive or cognitive skills except for socialization skills, the hallmark of ASD.

Keywords

Autism spectrum disorder; DSM-5; Cognitive skills; Adaptive skills; Toddlers; Diagnosis

Introduction

The following substantial revisions were made to the autism spectrum disorder (ASD) diagnosis criteria in the Diagnostic and Statistical Manual of Mental Disorders [5th edn.; DSM-5; American Psychiatric Association (APA) 2013]:

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Author Contributions

Author DTJ was part of study design development, data collection, data analysis, and writing. Author LAB was part of study design development, data collection, and writing. Author MLB was part of study design development and data collection. Author DF was part of study design development, data collection, and data analysis.

Compliance with Ethical Standards

Conflict of Interest

Authors DF and MLB are part owners of the Modified Checklist for Autism in Toddlers. This is provided free of charge to physicians. Royalties are charged when it is incorporated into a commercial system. Research into the MCHAT is currently supported by NICHD (Robins, PI). Authors DTJ and LAB declare that they have no conflict of interest.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from individual participants included in the study.

1. The subcategories [Autistic Disorder, Asperger's Disorder, Pervasive Developmental Disorder-Not Otherwise Specified (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 restricted and repetitive behaviors (RRBs) was changed to an autism symptom dyad consisting of deficits in social communication (i.e., DSM-5 Criterion A) and the presence of restricted and repetitive behaviors (RRBs i.e., DSM-5 Criterion B).
3. Two out of four listed 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 in the RRB domain.

The controversial removal of ASD subcategories was based on the workgroup's conclusion that autism is better understood as a single category; behaviors that define autism are believed to be present across all DSM-IV-TR autism subcategories (4th edn., text rev.; APA 2000; the DSM-IV-TR will be hereafter referred to as the DSM-IV). The DSM-5 allows for differentiation within ASD through "severity specifiers," which include ranges in the severity of social communication impairments and RRBs and level of support required (APA 2013). A diagnosis of ASD under the DSM-5 can also be further specified by the presence or absence of language and intellectual impairment (APA 2013). According to the workgroup, these criteria changes will maintain sensitivity of the DSM-IV while increasing specificity, and will allow a dimensional rather than a categorical conceptualization of ASD (APA 2013).

In addition, the collapsing of subcategories was prompted by findings that researchers and clinicians are able to reliably differentiate individuals with ASD from those without ASD, 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 (APA 2013; Frazier et al. 2012; Happé 2011; Lord et al. 2011; Moore and Goodson 2003). 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 for subcategories (APA 2013; Lord et al. 2011).

Furthermore, a language delay was viewed by the workgroup as a factor affecting the presentation of ASD but not a defining component of ASD (APA 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.

Concerns raised over the proposed DSM-5 ASD diagnostic criteria suggested that sensitivity might be sacrificed in an effort to increase specificity (Barton et al. 2013). Efforts to increase homogeneity within ASD (Grzadzinski et al. 2013) led to more stringent diagnostic criteria

in the DSM-5. As a result, individuals with less severe symptoms who received an ASD diagnosis under the DSM-IV may no longer meet criteria for an ASD under DSM-5. A particularly significant concern was raised about the sensitivity of the DSM-5 criteria for very young children (Barton et al. 2013). 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 in the DSM-5 RRB Criteria.

Some studies examining the sensitivity and specificity of the DSM-5 diagnostic criteria for ASD as previously defined indicated a need to relax the current criteria but there is not a consensus as to which domain [i.e., social communication interaction (SCI) or RRB] should be relaxed. Huerta et al. (2012; age range: 2–17 years, 11 months; mean age = 6.4; $SD = 3.6$) found that DSM-5 criteria captured most of the children, and those that were not captured generally met two of the three social communication criteria. Gibbs et al. (2012; age range: 2–16 years; $M = 6.06$, $SD = 3.38$) suggested relaxing the RRB criteria by requiring one instead of two RRBs. Frazier et al. (2012; age range: 2–18 years) suggested relaxing the diagnostic criteria by requiring one less SCI or one less RRB criterion.

The studies mentioned above (Frazier et al. 2012; Gibbs et al. 2012; Huerta et al. 2012) included samples with wide age ranges. Due to 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. Therefore, the diagnostic sensitivity and specificity in toddlers is of particular importance. Barton et al. (2013) examined the sensitivity and specificity of the DSM-5 ASD diagnostic criteria specifically in toddlers and found that maintaining the current the DSM-5 SCI criteria and relaxing the RRB criteria by requiring one instead of two RRBs would preserve adequate specificity without sacrificing sensitivity in toddlers.

Because of concerns about loss of diagnosis in very young children, we aimed to characterize toddlers who met autism diagnostic criteria for both DSM-IV and DSM-5 (i.e., DSM-5 group) and toddlers who met autism diagnostic criteria for DSM-IV but not DSM-5 (i.e., DSM-IV only group). It would also be important to note how, if at all, the toddlers who meet neither DSM-IV nor DSM-5 diagnostic criteria (i.e., non-ASD group) but had other developmental delays, differed from the DSM-5 and the DSM-IV only group. Therefore, the current study examined differences in adaptive and cognitive functioning and ASD symptom severity among toddlers in DSM-5, DSM-IV only, and non-ASD groups.

Adaptive behavior is defined as the “development and application of the abilities required for the attainment of personal independence and social sufficiency” (Sparrow et al. 1984). In addition to the role they play in diagnostic evaluations, adaptive skills in different domains such as communication, socialization, daily living, and motor development inform treatment planning and allow clinicians to monitor progress (Fenton et al. 2003; Ray-Subramanian et al. 2011).

Previous studies have demonstrated that individuals with ASD present with deficits in the Vineland Socialization domain relative to comparison groups (Loveland and Kelley 1991;

Volkmar et al. 1987). While socialization skills deficits are acknowledged as a hallmark of individuals with ASD, there is less agreement on the existence of a broader adaptive behavior profile in individuals with ASD. Some researchers have found the following pattern: Motor Skills > Daily Living Skills > Communication > Socialization (using age equivalents; Carter et al. 1998; Perry et al. 2009). Yang et al. (2016) suggested that the pattern changes depending on whether age equivalents (exception Stone et al. 1999) or standard scores are used. They replicated the pattern found by Carter et al. (1998) when using age equivalent scores for both verbal and nonverbal individuals with ASD; however, the pattern differed between verbal children (Motor Skills > Daily Living Skills > Socialization > Communication) and nonverbal children (Motor Skills > Socialization Skills > Daily Living Skills > Communication) when using standard scores (Yang et al. 2016). Of note, as acknowledged by Yang et al. (2016), researchers who used standard scores (Ray-Subramanian et al. 2011) and those who used age equivalents (Stone et al. 1999) have found the same Vineland profile when examining adaptive functioning in toddlers with ASD: Motor Skills > Daily Living Skills > Socialization > Communication.

Research also indicates that adaptive functioning may differ based on cognitive functioning in individuals with ASD (Kanne et al. 2010; Perry et al. 2009; Schatz and Hamdan-Allen 1995; Yang et al. 2016). For example, Perry et al. (2009) found that children with ASD and average/borderline cognitive functioning scored significantly higher than children with ASD and intellectual disability (ID) on the Vineland Communication domain.

An examination of the developmental trajectories of adaptive functioning of children with ASD highlighted the importance of cognitive functioning in addition to other characteristics. Two developmental trajectories were found for the Social and Communication domain, with the higher trajectory being quadratic and the lower trajectory being linear and flat (Baghdadli et al. 2011). The lower trajectory was associated with certain early childhood characteristics, including more severe symptoms of ASD, lack of language skills, and lower cognitive functioning. Interestingly, improvement (Socialization, Communication, and Daily Living Skills domains) in this group of children was slower between middle childhood and adolescence when compared to early and middle childhood, which may reflect the effects of the greater number of transitions and demands placed on individuals between middle childhood and adolescence (Baghdadli et al. 2011). These data also further highlight the importance of early intervention since early and middle childhood were the periods of greatest growth within the domains of Socialization, Communication, and Daily Living Skills.

Furthermore, a study that differentiated individuals with ASD by functioning level (low, moderate, high) indicated that the low functioning group was characterized by elevated (more severe) childhood autism rating scale (CARS) scores, and significantly lower scores on standardized tests of cognitive and adaptive functioning (Bitsika et al. 2008). Additionally, Chlebowski et al. (2010) used CARS total scores to develop CARS cut-off scores that differentiated among toddlers who were given Autistic Disorder, PDD-NOS, or Non-ASD (i.e., those not given an ASD diagnosis) diagnoses; toddlers with Autistic Disorder tended to have the highest CARS total scores, followed by toddlers with PDD-NOS, and then toddlers in the Non-ASD group. These findings and studies suggest that

cognitive and adaptive functioning may predict later symptom severity for children with ASD and further highlight their importance in young children (Ben-Itzhak and Zachor 2007; Volkmar et al. 1989; Waterhouse et al. 1996).

The current study examines cognitive level and adaptive behavior in three groups: the DSM-5, DSM-IV only, and non-ASD group. We predicted that the lowest functioning group would be the DSM-5 group followed by the DSM-IV only group and then the non-ASD group, as measured by adaptive scores on the domains of the Vineland Adaptive Behavior Scales and the cognitive subscales of the Mullen Scales of Early Learning scores (i.e., DSM-5 < DSM-IV only < non-ASD). Autism symptom severity was also examined and was predicted to follow the same pattern (i.e., DSM-5 > DSM-IV only > non-ASD).

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 et al. 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. 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. Members of the research team then contacted parents of children with high scores (i.e., those failing two or more critical items, or any three items) to complete follow-up phone calls. Families whose responses to the follow-up interview questions continued to indicate ASD risk were offered a free developmental and diagnostic evaluation. Concerns raised by the M-CHAT and M-CHAT follow-up interview were described to parents as social and developmental concerns rather than mentioning ASD to minimize reporting bias. The in-person evaluations were completed by a trained graduate student in a clinical psychology doctoral program and an experienced clinician (a licensed clinical psychologist or a developmental-behavioral pediatrician) and lasted about 3 h.

The current study used a subsample of participants ($n = 281$; 219 males, 62 females) from a sample of 332 toddlers between the ages of 16 and 39 months (51 toddlers were excluded due to incomplete data). Toddlers who received an Autistic Disorder (ASD or PDD-NOS) or a non-ASD [e.g., global developmental delay (DD), developmental language delay (DLD), motor delay] diagnosis were included. An ASD or a non-ASD diagnosis was given based upon best estimate clinical judgment and scores on the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2002), several versions of the autism diagnostic interview (e.g., ADI-R; Lord et al. 1994; Rutter et al. 2003), and the CARS (Schopler et al. 1980).

Participants in the current study consisted of toddlers with ASD and non-ASD diagnoses with complete Vineland Adaptive Behavior Scales and Mullen Scales of Early Learning data. An algorithm, which mapped quantitative data from the ADOS, ADI, and a DSM-IV-TR symptom checklist onto the DSM-5 ASD symptom criteria, was used to categorize these toddlers into the DSM-5, DSM-IV only, and non-ASD groups. The current authors (two licensed clinical psychologists and two clinical psychology graduate students) created the

algorithm (available upon request from the first author), after extensive discussion, considering minimum symptoms needed to meet DSM-5 criteria. Individuals who met ASD diagnostic criteria for both DSM-IV and DSM-5 were categorized as the DSM-5 group ($n = 146$; $Mean\ age = 26.43$, $SD = 4.65$). One hundred sixteen toddlers in the DSM-5 group met criteria for DSM-IV Autistic Disorder and 30 met criteria for PDD-NOS (Table 1). Toddlers who met ASD criteria for DSM-IV but not DSM-5 were categorized as DSM-IV only group ($n = 57$; $Mean\ age = 25.97$, $SD = 3.93$); 18 toddlers in this group had an Autistic Disorder diagnosis and 39 had a PDD-NOS diagnosis (Table 1). Toddlers in the non-ASD group did not meet diagnostic criteria for DSM IV or DSM-5 ($n = 78$; $Mean\ age = 26.70$, $SD = 4.21$); 49 toddlers in the non-ASD group had a GDD diagnosis, 24 had a DLD diagnosis, and 5 had an “other” diagnosis. Of note, 17 toddlers met DSM-5 diagnostic criteria for ASD but not DSM-IV criteria (i.e., DSM-5 only group). Because of the small sample size, they were not included in further analyses; however, Vineland and Mullen domain scores are provided in Table 2 to provide some descriptive information about the DSM-5 only group. The DSM-5, DSM-IV only, and non-ASD groups did not differ significantly from each other in ethnicity [$F(2, 271) = 1.33$, $p = .27$], sex [$F(2, 278) = 0.40$, $p = .67$], or age at evaluation [$F(2, 278) = 0.46$, $p = .63$]. Refer to Table 3 for individual group demographics.

Measures

The Vineland Adaptive Behavior Scales (Sparrow et al. 1984) is a standardized semi-structured caretaker interview that assesses daily adaptive functioning in the following domains: Socialization, Communication, Daily Living, and Motor skills. The current study used the standard score (SS) from each domain to examine differences among groups. The Vineland yields SS with a mean of 100 and a standard deviation of 15. Lower scores in the Vineland indicate greater impairment.

The Mullen Scales of Early Learning (Mullen 1995) examines functioning in expressive and receptive language, fine motor, and visual reception domains. Gross motor information was not collected. The current study used the t-score from each domain to examine differences among groups. The Mullen yields t-scores with a mean of 50 and a standard deviation of 10. Lower scores in the Mullen indicate more impairment.

The Childhood Autism Rating Scale (Schopler et al. 1980) is a 15-item clinician rating scale that is based on direct observation as well as parent report. The measure requires clinicians to rate each individual on symptoms related to autism, with higher scores indicating greater autism severity. The current study used total scores to examine differences among groups. Cut-off scores can be applied to the CARS total score to differentiate Autistic Disorder from PDD-NOS (cut off score = 32) and ASD from Non-ASD (cut off score = 25.5; Chlebowski et al. 2010).

The Autism Diagnostic Observation Schedule (Lord et al. 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 and make notes on behaviors that reflect ASD symptoms. Module levels, which are decided by the clinician, are based on chronological age and expressive language abilities.

Different versions of the autism diagnostic interview (*ADI-R Toddler 2004*; Le Couteur et al. 2004; *ADI*; Le Couteur et al. 1989; *ADI-R*; Lord et al. 1994; Rutter et al. 1991, 2003; *ADI-R Toddler 1991*), including a short form of ADI-R under development at the time, were administered by clinicians to parents/caregivers. All five versions of the ADI use a semi-structured interview format to gather past and current developmental information, and cover three function domains (i.e., language and communication, reciprocal social interaction, and RRBs).

The DSM-IV-TR Symptom Checklist, which listed the DSM-IV-TR diagnostic for Autistic Disorder and PDD-NOS, was created for the purposes of the large multi-site study. It required clinicians to indicate the ASD symptom(s) met by each toddler and if s/he met diagnostic criteria for ASD or PDD-NOS.

Data Analysis

Statistical Package for Social Sciences (SPSS) 22 was used for all analyses, except Fisher's exact test (GraphPad software). An ANOVA was conducted to examine group differences in the standard scores for each Vineland domain (i.e., Socialization, Communication, Daily Living, and Motor Skills). Post-hoc comparisons were conducted between pairs of groups and effect sizes were also calculated.

The assumptions of homogeneity of variance and normality were violated for Mullen domains and CARS scores; therefore, the nonparametric Kruskal–Wallis H test, was used to determine group differences, and when significant, the Mann–Whitney *U* test was used to test pair-wise differences. As suggested by Grissom and Kim (2012), effect size was calculated using the following equation for use in nonparametric data analysis by dividing

the Mann–Whitney *U* statistic by the product of the two sample sizes: $\hat{p}_{a,b} = \frac{U}{n_a n_b}$. This effect size estimate ($\hat{p}_{a,b}$) indicates the probability that a randomly drawn score from population *a* will be greater than a randomly drawn score from population *b*.

Results

Initial Diagnosis

More than half of the children (56 %) with a DSM-IV PDD-NOS diagnosis did not meet criteria for ASD on DSM-5, while only 12 % of the children with AD diagnosis lost the diagnosis on DSM-5 (Fisher's exact test $p < .0001$).

Vineland Domain Standard Scores (SS)

With the exception of the Motor Skills domain, each groups' domain means were in the slightly impaired range (70–79) or lower (Table 4).

Vineland Socialization Skills Domain—An ANOVA indicated significant differences among the DSM-5, the DSM-IV only, and the non-ASD groups [$F(3, 289) = 35.88, p < .001, \eta^2 = 0.27$; Table 4]. Posthoc comparisons using the Tukey HSD test indicated that all three groups differed significantly from each other [DSM-5 group ($M = 67.37, SD = 7.62$), DSM-IV ($M = 73.07, SD = 8.37$), non-ASD ($M = 79.22, SD = 8.95$)]. As predicted, the DSM-5

group was the most impaired in socialization skills, followed by the DSM-IV only, and then the non-ASD groups.

Vineland Communication Skills Domain—An ANOVA indicated significant differences among the groups [$F(3, 289) = 20.62, p < .001, \eta^2 = 0.18$; Table 4]. Post-hoc comparisons using the Tukey HSD test indicated that the mean communication SS for the DSM-5 group ($M = 64.80, SD = 6.57$) was significantly lower than the DSM-IV only ($M = 71.21, SD = 9.17$) and the non-ASD ($M = 72.31, SD = 7.95$) groups. The latter two groups were not significantly different from each other. Again, as predicted, the DSM-5 group was the most impaired in communication skills.

Vineland Daily Living Skills Domain—An ANOVA indicated significant differences among the three groups [$F(3, 289) = 8.97, p < .001, \eta^2 = 0.09$; Table 4]. Post-hoc comparisons using the Tukey HSD test indicated that the mean daily living SS for the DSM-5 group ($M = 68.90, SD = 7.31$) was significantly different from the non-ASD ($M = 74.45, SD = 7.93$) group but not the DSM-IV only group ($M = 71.34, SD = 7.79$). The DSM-IV only and the non-ASD groups were also not significantly different on daily living skills. Again, the DSM-5 group was most impaired but the difference between DSM-5 and DSM-IV only groups did not reach significance.

Vineland Motor Skills Domain—An ANOVA indicated significant differences among the groups [$F(3, 289) = 3.18, p = .03, \eta^2 = 0.03$; Table 4]. Posthoc comparisons using the Tukey HSD test indicated that the only significant pair-wise difference was between the DSM-5 group ($M = 80.64, SD = 10.93$) and the non-ASD ($M = 85.84, SD = 13.43$) group; the DSM-IV group did not differ from either of the other groups ($M = 83.05, SD = 12.87$). Again, the DSM-5 group was the most impaired, and had significantly lower scores than the Non-ASD group.

Mullen Scales of Early Learning T-Scores

Each group's Mullen domain means were in the slightly impaired range or below (see Table 4).

Mullen Expressive Language Skills—Independent samples Kruskal–Wallis test, a nonparametric test, suggested the rejection of the null hypothesis ($p = .001$) that the distribution of the expressive language skills t-scores was the same across the three groups. A Mann–Whitney U test indicated that the DSM-5 group's ($M = 23.70, SD = 7.04$) expressive language skills were significantly lower than the DSM-IV only group ($M =$

$29.20, SD = 9.34; U = 2090.00, p < .001, \hat{p}_{a.b} = \frac{U}{n_a n_b}$) and the non-ASD group ($M = 29.42, SD = 7.94; U = 2582.50, p < .001, \hat{p}_{a.b} = .26$; Table 4). The DSM-IV only group and the non-ASD groups did not differ in expressive language skills ($U = 1836.00, p = .59$).

Mullen Receptive Language Skills—Independent samples Kruskal–Wallis test, suggested the rejection of the null hypothesis ($p = .001$) that the distribution of the receptive language skills t-scores was the same across the three groups. A Mann–Whitney U test

indicated that the DSM-5 group's ($M = 22.05$, $SD = 6.07$) receptive language skills were significantly lower than the DSM-IV only group ($M = 27.85$, $SD = 10.59$; $U = 2345.50$, $p < .001$, $\hat{p}_{a,b} = .31$) and the non-ASD group ($M = 29.97$, $SD = 11.87$; $U = 2945.50$, $p < .001$, $\hat{p}_{a,b} = .29$; Table 4). The DSM-IV only group and the non-ASD groups did not differ in receptive language skills ($U = 1843.50$, $p = .49$).

Mullen Visual Reception Skills—Independent samples Kruskal–Wallis test suggested the rejection of the null hypothesis ($p = .001$) that the distribution of the visual reception skills t-scores was the same across the three groups. A Mann–Whitney U test indicated that the DSM-5 group's ($M = 26.73$, $SD = 2.38$) visual reception skills were significantly lower than the DSM-IV only group ($M = 35.02$, $SD = 10.95$; $U = 2094.50$, $p < .001$, $\hat{p}_{a,b} = .27$) and the non-ASD group ($M = 33.86$, $SD = 11.51$; $U = 3220.00$, $p < .001$, $\hat{p}_{a,b} = .32$; Table 4). The DSM-IV only group and the non-ASD groups did not differ in visual reception skills ($U = 1856.50$, $p = .47$).

Mullen Fine Motor Skills—Independent samples Kruskal–Wallis test suggested the rejection of the null hypothesis ($p = .001$) that the distribution of the fine motor skills t-scores was the same across the three groups. A Mann–Whitney U test indicated that the DSM-5 group's ($M = 27.39$, $SD = 9.77$) fine motor skills were significantly lower than the DSM-IV only group ($M = 32.22$, $SD = 10.84$; $U = 2856.00$, $p = .004$, $\hat{p}_{a,b} = .37$) and the non-ASD group ($M = 34.63$, $SD = 13.52$; $U = 3511.00$, $p < .001$, $\hat{p}_{a,b} = .35$; Table 4). The DSM-IV only group and the non-ASD groups did not differ in motor skills ($U = 1874.50$, $p = .52$).

CARS Total Scores

Higher total scores on the CARS indicate more severe symptoms of ASD. Independent samples Kruskal–Wallis test suggested the rejection of the null hypothesis ($p < .001$) that the distribution of the CARS total scores was the same across the three groups. A Mann–Whitney U test indicated that the DSM-5 group's mean CARS total score ($M = 33.75$, $SD = 4.93$) was significantly higher than the DSM-IV only group ($M = 28.73$, $SD = 4.35$; $U = 1607.50$, $p < .001$, $\hat{p}_{a,b} = .21$) and higher than the non-ASD group ($M = 21.94$, $SD = 2.66$; $U = 239.50$, $p < .001$, $\hat{p}_{a,b} = .02$). Additionally, the mean of the CARS total score for the DSM-IV only group was significantly higher than the Non-ASD group ($U = 308.50$, $p < .001$, $\hat{p}_{a,b} = .06$).

Discussion

The purpose of the current study was to compare characteristics of toddlers who met ASD diagnostic criteria under both the DSM-IV and DSM-5 (DSM-5 group) to a group of toddlers with DSM-IV ASD diagnoses who did not continue to meet criteria under the DSM-5 (DSM-IV only group). In addition, these groups were compared to a group of children who did not receive an ASD diagnosis (non-ASD group) under either diagnostic criterion, but did have other developmental delays. There were a number of significant differences in initial diagnoses, adaptive and cognitive abilities, and autism symptom severity levels among the groups.

On the Vineland, results indicated milder impairments in the DSM-IV only group than the DSM-5 group on several subtests, including the Socialization and Communication domains. However, the two groups did not differ significantly in Daily Living or Motor Skills. The DSM-IV only toddlers differed significantly from the non-ASD group on only the Socialization domain. This suggests that the children in the DSM-IV only group exhibited more severe difficulties in negotiating social relationships than the non-ASD group, the hallmark symptom of ASD, but demonstrated comparable skills in their communication, daily living, and motor abilities.

Results from the Mullen indicated a similar pattern in which the DSM-5 group's scores were significantly lower than both the DSM-IV only and non-ASD groups on all four subdomains, indicating greater cognitive impairment. The DSM-IV only and non-ASD groups did not differ significantly on any of the four Mullen subdomains.

When comparing CARS total scores by group, the DSM-5 group scored significantly higher than the DSM-IV only and non-ASD groups, indicating greater autism severity. Furthermore, the DSM-IV only group's mean CARS total score was significantly higher than the non-ASD group's. As indicated by the CARS cut off scores developed by Chlebowski et al. (2010), the DSM-5 group's CARS mean total score reflects those of toddlers diagnosed with Autistic Disorder under the DSM-IV while the DSM-IV only group's CARS mean total score reflects those of toddlers diagnosed with PDD-NOS under the DSM-IV. These results are consistent with the finding that children with DSM-IV diagnoses of PDD-NOS were more than 50 % likely to lose the diagnosis on DSM-5, while only 12 % of those with an AD diagnosis lost the ASD diagnosis on DSM-5 (consistent with findings of Barton et al. 2013).

These results were consistent with our hypothesis that the DSM-5 group would demonstrate greater impairments than the other groups in both adaptive and cognitive skills. Interestingly, the DSM-IV only group of children did not score lower than the non-ASD children on three out of four Vineland domains and on all four of the Mullen subdomains. The only domain on which the DSM-IV only group scored significantly lower than the non-ASD group, Vineland Socialization, confirm the significant social deficits in this group, compared to children with other types of developmental disorders. Taken together, the current findings suggest that children who meet criteria for an ASD diagnosis only under the DSM-IV demonstrate notable social impairments while also presenting less severe adaptive and cognitive profiles than the DSM-5 toddlers. Additionally, the CARS data and initial diagnoses suggest that children with milder symptoms of ASD, diagnosed as PDD-NOS under DSM-IV, are the ones most likely to no longer meet criteria for a diagnosis of ASD under the DSM-5.

This pattern of scores is somewhat consistent with previous findings that show children with ASD typically obtain lower scores on the Vineland Socialization domain when compared to other non-ASD groups, but do not differ in daily living or motor skill scores (Loveland and Kelley 1991; Perry et al. 2009; Volkmar et al. 1987). Toddlers with ASD in our study (both DSM-5 and DSM-IV only groups) had greater socialization impairments than those without an ASD diagnosis. However, only toddlers with more severe symptoms of ASD (DSM-5 group) differed from those without ASD on daily living and fine motor skills. Those with

less severe symptoms of ASD (DSM-IV only group) did not differ from those without ASD on daily living and fine motor skills. It may be that only toddlers with less severe symptoms of ASD fit the pattern of differences in impairment in socialization but not daily living and fine motor skills as described by other studies (Loveland and Kelley 1991; Perry et al. 2009; Volkmar et al. 1987). The current results are also consistent with existing literature indicating that older children who continued to meet DSM-5 criteria for ASD exhibited more adaptive and/or cognitive delays than children who met DSM-IV diagnostic criteria but fail to meet DSM-5 ASD criteria (Mattila et al. 2011; McPartland et al. 2012; Taheri and Perry 2012).

The most severely affected toddlers from our sample qualified for an ASD diagnosis under the new criteria, making them eligible for early intervention services. The importance of utilizing intensive, evidence-based treatments for children with ASD before 4 years of age is well documented in the literature (Ben-Itzhak and Zachor 2011; Berry 2009; Borman and Fletcher 1999; Green 1996; Howard et al. 2005; MacDonald et al. 2014; Matson et al. 1996; Sallows and Graupner 2005). Therefore, it is likely that children with severe ASD presentations will have access to necessary intensive treatments, when available in their region. In contrast, the children from our sample who received an autism diagnosis under the DSM-IV but no longer meet criteria for an ASD diagnosis under the DSM-5 would not be eligible for such autism-specific services. Although this group of toddlers presents with less severe deficits in cognitive and adaptive functioning and less severe symptoms of ASD when compared to the DSM-5 group, they continued to show scores on the Socialization domain of the Vineland characteristic of ASD. These toddlers are of greatest concern because they may be particularly suited, based on their higher cognitive and adaptive capacities, to benefit maximally from intensive early intervention.

The group of children who met criteria on DSM-5 but not on DSM-IV was small enough ($n = 17$) that results are probably not stable enough to interpret. No particular pattern of functioning is obvious in their Vineland and Mullen results.

Studies have shown that a small portion of children with DSM-IV autism spectrum diagnoses have been able to obtain what is termed “optimal outcomes” (Fein et al. 2013; Helt et al. 2008) or “very positive outcome” (Anderson et al. 2014). These terms refer to children who received an ASD diagnosis in early childhood, but no longer met criteria for an ASD diagnosis when re-evaluated later in development. Previous research indicates that both child and intervention characteristics contribute to a child’s achieving optimal outcomes (Berry 2009; Fein et al. 2013; Helt et al. 2008; Orinstein et al. 2015). For example, young children with ASDs who have initially higher Vineland Motor and Mullen Expressive Language scores are more likely to lose their diagnosis over time (Berry 2009; Moulton et al. 2016; Sutura et al. 2007). A recent study examining characteristics of toddlers diagnosed with PDD-NOS indicated that young children with higher scores on all four Mullen domains, particularly Visual Reception, were more likely to no longer meet criteria for an ASD when reevaluated at age 4 (Brennan et al. 2014). These findings suggest that our DSM-IV only group of toddlers may also have the potential to make significant gains in treatment tailored to the children with autism-specific needs.

It has been suggested that toddlers who previously met diagnosis for PDD-NOS, which is a majority of the toddlers in the DSM-IV only group, may be better suited for the diagnosis of Social Communication Disorder (SCD; APA 2013). However, the presence of one or more RRBs prevents the diagnosis of SCD and the presence of fewer than two RRBs prevents the diagnosis of ASD under the DSM-5. Therefore, it is not clear where toddlers with social communication deficits and one RRB should be categorized diagnostically, and whether a diagnosis of social communication disorder will qualify them for the specific services they need.

Strengths and Limitations

All participants in the DSM-IV only and the DSM-5 groups received their ASD diagnosis through the DSM-IV-TR. DSM-5 diagnostic criteria for ASD was applied retrospectively. This process cannot truly reflect how those toddlers may have been diagnosed if the DSM-5 ASD criteria were 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, the methodology used to establish the DSM-IV only and the DSM-5 groups has been used by various studies examining the DSM-5 (Barton et al. 2013; Frazier et al. 2012; Gibbs et al. 2012; Worley and Matson 2012).

While the current study has a comparison group (the non-ASD group), it does not have a non-clinical comparison group. However, clinicians may be more likely to need to differentiate ASD from another developmental disorder rather than ASD from a typical development, in developing treatment recommendations and prognosis. Therefore, the use of a clinical comparison group rather than a typically developing group may be more helpful for diagnostic purposes. Additionally, Yang et al. (2016) suggested that Vineland profiles in individuals with autism differed based on whether standard scores or age equivalents were used. Similar to the study by Ray-Subramanian et al. (2011) examining adaptive functioning, the current study used standard scores and not age equivalents. Examination of if and how the DSM-5, DSM-IV only, and non-ASD groups differ based on Vineland age equivalents should be considered for future research.

The results of the current study have strong clinical implications. It is concerning that toddlers in the DSM-IV only group, who have the cognitive strengths to potentially make significant gains in autism treatment may not receive those services at the age at which they are the most effective (Macdonald et al. 2014; Rogers et al. 2014). In addition to the impact that this may have on the toddlers, parents and family members will be greatly impacted, and there is the potential for increased educational and public health costs. Early intervention that can potentially lead to more independent functioning at a later age has economic implications. This study further highlights the need to revise the current DSM-5 to include toddlers with less severe, but still significant, impairments.

When examining the sensitivity and specificity of the current DSM-5 across a wide age range (i.e., from toddlers to late adolescence), researchers came to different conclusions as to which criteria (SCI or RRB) should be relaxed (Huerta et al. 2012; Frazier et al. 2012; Gibbs et al. 2012). Barton et al. (2013) examined diagnostic sensitivity and specificity in toddlers only and recommended relaxing the RRB criterion by requiring one in order to

preserve adequate specificity without sacrificing sensitivity in toddlers. Further research is indicated to examine the fit of the DSM-5 ASD diagnostic criteria for toddlers, especially those who were diagnosed as PDD-NOS under the DSM-IV and therefore, demonstrated less severe symptoms of ASD.

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Table 1

DSM-IV diagnoses for DSM-5 and DSM-IV only groups

	DSM-IV diagnoses	
	Autistic disorder	PDD-NOS
Diagnostic groups		
DSM-5 ($n = 146$)	116	30
DSM-IV Only ($n = 57$)	18	39

Table 2

Vineland and Mullen scores for DSM-5 only group

Standard scores (<i>n</i> = 15)^a	SS(<i>SD</i>)
Vineland domain	
Socialization	76.07 (10.98)
Communication	69.00 (7.04)
Daily living	72.23 (9.63)
Motor skills	81.00 (14.27)
T-scores (<i>n</i> = 16) ^b	
Mullen domains	
Expressive language	24.56 (6.04)
Receptive language	26.56 (11.92)
Visual reception	33.31 (14.32)
Fine motor	30.31 (10.53)

^aVineland data available for 15 out of 17 participants^bMullen data available for 16 out of 17 participants

Table 3

Demographic characteristic of sample by diagnostic group

	Diagnostic groups		
	DSM-5 (<i>n</i> = 146) ^a	DSM-IV only (<i>n</i> = 57) ^b	Non-ASD (<i>n</i> = 78) ^c
Age (months)			
Mean (SD)	26.43 (4.65)	25.97 (3.93)	26.70 (4.21)
Range	17–39	18–34	18–35
Gender (male: female)	116:30	42:15	61:17
Ethnicity (%)			
Caucasian	79.5 %	78.9 %	69.2 %
Black/African American	6.8 %	1.8 %	9.0 %
Asian/Pacific Islander	2.1 %	3.5 %	3.8 %
Hispanic/Latino	8.9 %	10.5 %	12.8 %
Biracial	0.7 %	1.8 %	0 %
Other	0 %	0 %	2.6 %

^a Ethnicity data available for 143 out of 146 participants^b Ethnicity data available for 55 out of 57 participants^c Ethnicity data available for 76 out of 78 participants

Table 4

Vineland and Mullen scores by Diagnostic Group

	Diagnostic groups		
	DSM-5 SS(SD)	DSM-IV only SS(SD)	Non-ASD SS(SD)
Vineland domain standard scores	(<i>n</i> = 145)	(<i>n</i> = 56)	(<i>n</i> = 77)
Socialization	67.37 (7.62) ^a	73.07 (8.37) ^a	79.22 (8.95) ^a
Communication	64.80 (6.57) ^{ab}	71.21 (9.17) ^a	72.31 (7.95) ^b
Daily living	68.90 (7.31) ^a	71.34 (7.79)	74.45 (7.93) ^a
Motor skills	80.64 (10.93) ^a	83.05 (12.87)	85.84 (13.43) ^a
Mullen domains t-scores	(<i>n</i> = 139)	(<i>n</i> = 55)	(<i>n</i> = 73)
Expressive language *	23.70 (7.04) ^{ab}	29.20 (9.34) ^a	29.42 (7.94) ^b
Receptive language	22.05 (6.07) ^{ab}	27.85 (10.59) ^a	29.97 (11.87) ^b
Visual reception	26.73 (2.38) ^{ab}	35.02 (10.95) ^a	33.86 (11.51) ^b
Fine motor	27.39 (9.77) ^{ab}	32.22 (10.84) ^a	34.63 (13.52) ^b

Means with the same superscripts within rows are significantly different at the p .05 based on Tukey HSD post hoc paired comparisons for Vineland domains and Mann–Whitney U test for Mullen domains

* The n for expressive language across all diagnostic groups is one less than the other Mullen domains