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Psychometric Assessment of the Eyberg Child Behavior Inventory in Children with Autism in Community Settings

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Abstract

The Eyberg Child Behavior Inventory (ECBI) is a frequently used measure to assess interfering behaviors in children and psychometric properties have recently been examined in children with autism spectrum disorder (ASD). There is a need to confirm the identified factors and examine the factor structure in a racially/ethnically diverse, community-based sample. The current study conducts a psychometric analysis of the ECBI in a sample of children with ASD receiving publicly-funded mental health services. Data were collected from 201 children with ASD ages 5–13 years (60% Hispanic/Latinx) participating in a community effectiveness trial. Confirmatory factor analysis indicated poor model fit using previously identified factors and a new four-factor solution was identified. Clinical and research implications of these findings are discussed.

Keywords

Eyberg Child Behavior Inventory; Autism spectrum disorder; Community mental health services; Interfering behaviors; Assessment

Children with ASD experience high rates of co-occurring psychiatric conditions, with epidemiological estimates ranging from 70 to 95% (de Bruin et al., 2007; Gjevik et al., 2011; Leyfer et al., 2006; Simonoff et al., 2008; Soke et al., 2018). Within community mental health services, up to 92% of clients with ASD meet criteria for at least one

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non-ASD psychiatric diagnosis, and the average number of non-ASD diagnoses has been reported to be between 2–3 (Brookman-Frazee et al., 2018; Stadnick et al., 2020).

The mental health system is a critical system of care to address co-occurring mental health needs in youth with ASD. In fact, data collected from outpatient mental health therapists working in publicly funded settings indicated that children with, or suspected of, an ASD diagnosis represented, on average, 21% of their psychotherapy caseloads (Brookman-Frazee et al., 2012a, 2012b). Because Medicaid is the single largest payer of mental health care in the United States (Mark et al., 2005), it is particularly important to examine publicly-funded mental health services for individuals with ASD (Brookman-Frazee et al., 2009; Brookman-Frazee et al., 2012a, 2012b; Maddox & Gaus, 2019; Mandell et al., 2005). Notably, interfering behaviors are the primary presenting concerns for children with ASD receiving mental health services (Brookman-Frazee et al., 2010; Mandell et al., 2005). In response, intervention protocols have been developed for children with ASD, specifically for delivery by community mental health providers (Brookman-Frazee et al., 2012a, 2012b). Given the prevalence of interfering behaviors in this population, and the increasing opportunities for therapists to deliver ASD-tailored mental health interventions, reliable and valid measurement of interfering behaviors is essential to assess symptoms, set treatment goals, and assess response to treatment.

The Eyberg Child Behavior Inventory (ECBI; Eyberg & Pincus, 1999) is a 36-item parent-rating scale that was designed to assess common behaviors exhibited in children 2–16 years of age and has been used to monitor treatment progress in efficacy and effectiveness studies of interventions to address behaviors, notably Parent Child Interaction Therapy (Eyberg & Matarazzo, 1980; see Lieneman et al., 2017 for a review). While the developers of the ECBI originally conceptualized the ECBI as a unidimensional measure (Eyberg & Robinson, 1983; Robinson et al., 1980), the factor structure of the ECBI has been debated in typically developing populations (Axburg et al. 2008; Burns & Patterson, 1991, 2000; Colvin et al., 1999; Eyberg & Robinson, 1983; Gross et al., 2007; Robinson et al., 1980; Stern, 2008; Weiss et al., 2005).

Although the ECBI was designed for conduct-disorder children more broadly, the ECBI has also been used to assess behaviors, identify treatment goals, and track treatment progress in children with ASD (Brobst et al., 2009; Brookman-Frazee et al., 2019, 2012a, 2012b; Pottie et al., 2009; Whittingham et al., 2009). However, to date, only one study has conducted a *detailed examination* of the psychometric properties of the ECBI in children with ASD in the United States. Jeter et al. (2017) analyzed the ECBI's item characteristics, factor structure, and reliability in a sample of 335 caregivers of children ages 2–12 years old ($M = 6.50$; $SD = 2.59$) with ASD. The sample consisted of 108 cases collected via chart review from a university-based psychology clinic, 97 cases collected via chart review from a university-based developmental behavioral pediatrician, and 130 cases collected through archival data from the Interactive Autism Network, a research registry that matches research studies to families of children with ASD. Children in the sample were predominantly male (83.9%) and White (74%). Primary caregivers who provided ECBI responses were mostly biological mothers (85.4%) and were predominantly White (68.1%). Jeter et al. utilized exploratory factor analysis (EFA) with maximum likelihood extraction and oblique rotation

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and found evidence for a 29-item, four factor solution, which accounted for approximately 46% of the variance. The four factors were identified as *Emotional Reactivity* (9 items), *Conduct Problems* (9 items), *Defiant Behavior* (7 items), and *Attention Problems* (4 items). The factors demonstrated adequate-to-good internal consistency, with Cronbach alpha values ranging from 0.79 to 0.88. Convergent and divergent validity were demonstrated by correlations between the factors and theoretically related (i.e., Behavior Assessment System for Children, 2nd edition Externalizing Problems Subscale and the Parenting Stress Index-Short Form Difficult Child Subscale) and unrelated constructs (i.e., BASC-2 Adaptive Skills).

While Jeter et al. (2017) provides an initial exploration of ECBI psychometrics in children with ASD, more work is needed. First, because Jeter et al. conducted exploratory factor analyses to identify their factors, there is a need to confirm Jeter's identified factors with a new sample using confirmatory factor analysis. Secondly, it is necessary to confirm the factor structure in a racially/ethnically diverse, community-based sample. A recent effectiveness trial (Brookman-Frazee et al., 2019) provides the opportunity to confirm the factor structure in an ethnically diverse sample of clinically referred children in Southern California receiving publicly-funded outpatient and school-based mental health services. Third, as interfering behaviors are the primary presenting concerns for children with ASD receiving mental health services, it is important to assess the instrument in a sample drawn specifically from these settings. To address these gaps and advance measurement of behaviors for children with ASD receiving publicly-funded mental health services, this study has three objectives: (1) explore the item-level characteristics of the ECBI in an ethnically diverse sample of children with ASD receiving publicly-funded mental health services, (2) test whether the four factors identified by Jeter et al. (2017) were confirmed in the current sample, and (3) conduct further psychometric analysis of the derived factors.

Method

Procedure

Data were drawn from baseline child assessments conducted within a cluster randomized community effectiveness trial of *An Individualized Mental Health Intervention for ASD* (AIM HI; Brookman-Frazee & Drahota, 2010); a parent-mediated and child-focused intervention to address interfering behaviors for school-age children (ages 5–13 years old) with ASD. The community effectiveness trial was conducted in 29 publicly funded outpatient and school-based mental health programs in Southern California randomized to therapist training in AIM HI or a wait-list control training condition (Brookman-Frazee et al., 2019). Therapists were enrolled from participating programs in dyads with an elgible client from their caseload.

Baseline assessments were conducted by the research team with child/caregiver participants. In addition to the ADOS-2 and SRS-2 eligibility assessments, the baseline assessment included a measure of cognitive functioning (the Wechsler Abbreviated Scale of Intelligence-Second Edition or the Differential Ability Scales-II, based on the child's age), parent report of child behaviors (ECBI and the Competing Behavior Scale of the Social Skills Improvement System (SSIS)), assessment for co-occurring, non-ASD psychiatric

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conditions (Mini International Psychiatric Interview for Children and Adolescents, Parent Version (MINI-KID-P)) and parent report of sociodemographic characteristics. Families received a $40 gift card for completing the baseline assessment. The study was approved by the University of California, San Diego Institutional Review Board. Research team members completed an informed consent or assent process with caregiver and child participants prior to participating in the study.

Participants

The current study included 201 children/caregiver dyads who were recruited from the caseloads of participating therapists. Participants were drawn from 29 participating mental health programs; 24 programs were operated by community-based mental health agencies and 5 were school district-operated programs. All programs provided publicly funded mental health services. Children were eligible for the effectiveness trial if they (1) were between 5–13 years of age at the time of study recruitment, (2) spoke English or Spanish as their primary language, (3) presented with at least one interfering behaviors, (4) had an existing ASD diagnosis on record, and (5) demonstrated clinically significant ASD symptoms on a standardized ASD diagnostic measure (i.e., Autism Diagnostic Observation Schedule, 2nd Edition Comparison Score and/or Social Responsiveness Scale, 2nd Edition Total t-score). One child from the effectiveness trial did not have baseline ECBI data available and was not included in the current analyses. See Table 1 for child and caregiver demographics for children included in the current analyses.

Measures

Interfering Behaviors—The ECBI (Eyberg & Pincus, 1999) is a 36-item parent-report measure completed by caregivers about their child's behavior. Each item is rated in two ways: (1) how frequently the behavior occurs, rated on a 7-point Likert scale from (1) "never" to (7) "always", and (2) whether the respondent caregiver perceives the behavior to be a problem, endorsed "yes" or "no". The ECBI yields two scores that are converted into t-scores ($M = 50$; $SD = 10$). The Intensity score represents the frequency of interfering behaviors, while the Problem score represents the total number of behaviors that the respondent caregiver endorsed as problematic. For the current study, only the ECBI Intensity score was used in statistical analyses to be consistent with Jeter et al. (2017).

The Social Skills Improvement System Rating Scales (SSIS; Gresham & Elliott, 2007) is a 79-item measure that assesses social skills, behaviors, and academic competence. For the current study, only the Competing Behavior Scale and its' five subscales (Externalizing, Bullying, Internalizing, Autism Spectrum, and Hyperactivity/Inattention) were used as a measure of convergent validity. Robust psychometric properties for the SSIS have been found, with internal consistency on the various domains ranging from 0.73 to 0.95 for the parent-report version, with the ICC in the current sample being 0.69. Test–retest reliability ranges from 0.73 to 0.87 and convergent and divergent validity are strong (Gresham & Elliott, 2007).

Psychiatric Disorders—An adapted version of the Mini International Neuropsychiatric Interview for Children and Adolescents, Parent Version (MINI-KID-P; Sheehan et al., 1998)

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was completed during the baseline assessment to determine the presence of non-ASD co-occurring psychiatric disorders. The MINI-KID-P is a structured diagnostic interview that assesses symptoms of Axis I disorders recognized in the Diagnostic and Statistical Manual of Mental Disorders (4th ed; DSM-IV) and ICD-10 (World Health Organization, 1993). Robust psychometric properties have been demonstrated, such as strong interrater and test–retest reliability, construct validity, sensitivity, and specificity (Sheehan et al., 1998). A subset of diagnostic models was selected and administered based on the most common psychiatric comorbid disorders for children with ASD in mental health settings according to standardized diagnostic assessment procedures (Brookman-Frazee et al., 2009; Joshi et al., 2010) and therapist report of comorbidities (Brookman-Frazee et al., 2010, 2012a, 2012b). The following modules were administered: ADHD, ODD, Panic Disorder, Agoraphobia, Separation Anxiety Disorder, Social Phobia, Specific Phobia, Obsessive Compulsive Disorder (OCD), Generalized Anxiety Disorder (GAD), Tic Disorders, Major Depressive Episode, Dysthymia, and Manic/Hypomanic episodes. A trained clinical research member administered the MINI-KID to the child's caregiver either in person or on the phone. For the current study, the MINI-KID-P was used to assess discriminant validity (i.e., the factors' ability to discriminate between know diagnostic groups. To be consistent with our approach in the effectiveness study of AIM HI, diagnoses were grouped into four major diagnostic categories to aid analyses: (1) ADHD, (2) ODD, (3) anxiety disorders, and (4) mood disorders.

Cognitive Functioning—Cognitive function was assessed by either the Wechsler Abbreviated Scale of Intelligence-II (WASI-II) or the Differential Abilities Scale-II (DAS-II). Specifically, the WASI-II was administered to children who were 6 years and over (95% of the sample), while the DAS-II was administered to children who were younger than 6 years old at the time of the baseline assessment (5% of the sample). The WASI-II and the DAS-II are both standardized assessments of cognitive ability that are administered in-person by a trained clinical research staff (Wechsler, 2011; Elliott, 2007). The full-scale IQ (FSIQ) score, which is a standard score (M = 100, SD = 15), derived from either the WASI-II or the DAS-II was used for analysis in the current study to assess divergent validity. The same approach of combining FSIQ scores from the WASI-II and DAS-II was utilized in the larger parent trial from which the current study data was pulled (see Brookman-Frazee et al., 2019).

Statistical Analyses

Objective 1: Explore Item-Level Characteristics of the ECBI in an Ethnically Diverse Sample of Children with ASD Receiving Publicly-Funded Mental Health Services—The following were calculated for each of the 36 ECBI Intensity Scale items: means, standard deviations, skewness, kurtosis, and item-total correlations. Independent samples t-tests were conducted to compare the current sample to the Jeter et al. (2017) sample, as well as to the ECBI restandardization sample (Eyberg & Pincus, 1999).

Objective 2: Test Whether the Four Factors Identified by Jeter et al. (2017) are Confirmed in the Current Sample—A confirmatory factor analysis (CFA) with standard maximum likelihood estimation was conducted using *Mplus* version 8

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(Muthén & Muthén, 2017), specifying Jeter et al.'s (2017) 29 item, 4-factors (Emotional Reactivity, Conduct Problems, Defiant Behavior, and Attention Problems) as the model. The comparative fit index (CFI; Bentler, 1990) was used to evaluate model fit, with values > 0.90 indicative of reasonable model fit. Additionally, the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR) were used to evaluate model fit, with an RMSEA and SRMR < 0.08 indicative of reasonable model fit (Bentler, 2007; Steiger, 1990). Due to poor model fit (see Results), exploratory factor analyses (EFAs) using principal axis factoring and direct oblimin rotation were conducted using *SPSS version 26* to further explore the dimensionality of this measure. The variance accounted for by the solution, the variance accounted for by each individual factor, interpretability of the factors (including no cross-loadings, defined as loadings of 0.32 or higher on more than one factor), and parallel analysis were all evaluated to determine the number of factors to retain (Meyer et al., 2006). Loadings of 0.32 and above were interpreted, with loadings > 0.71 considered excellent, 0.63 very good, 0.55 good, 0.45 fair, and 0.32 poor (Tabachnick & Fidell, 2007).

Objective 3: Conduct Further Psychometric Analysis of the Derived Factors— Cronbach's alpha values were computed to assess the internal consistency of each newly identified factor from the EFA, with alpha values between 0.7–0.8 deemed acceptable, 0.8–0.9 good, and > 0.9 excellent (Cronbach, 1951). Convergent and divergent validity were assessed by examining the correlations between each factor and theoretically related (SSIS Competing Behavior Scale) and unrelated variables (Full-Scale IQ), with *r* values between 0.1–0.3 considered weak, 0.4–0.6 moderate, and 0.7–0.9 strong (Akoglu, 2018). Discriminant function analyses (DFA) were used to assess discriminative validity by examining the four new factors' ability to discriminate between known diagnostic groups on the MINI-KID-P (ODD, ADHD, mood disorders, and anxiety disorders).

Results

Objective 1: Explore Item-Level Characteristics of the ECBI in an Ethnically Diverse Sample of Children with ASD Receiving Publicly Funded Mental Health Services

A summary of the descriptive analyses for the current study can be found in Table 2. Skewness ranged from 1.91 ("wets the bed") to −1.75 ("easily distracted"), while kurtosis ranged from 4.31 ("steals") to −1.49 ("verbally fights with siblings"). Only two of the thirty-six items violated kurtosis (i.e., "steals" and "physically fights with friends"). The three items with the highest average frequency ratings were: "easily distracted" ($M = 5.67$, $SD = 1.48$), "short attention span" ($M = 5.45$, $SD = 1.54$), and "gets angry" ($M = 5.45$, $SD = 1.75$). The three items with the lowest mean ratings were: "steals" ($M = 1.65$, $SD = 1.31$), "physically fights with friends" ($M = 1.87$, $SD = 1.41$), and "wets bed" ($M = 1.97$, $SD = 1.83$). Parents of children in our sample reported a significantly higher total average frequency of interfering behaviors ($M = 143.17$, $SD = 36.80$, $N = 166$) compared to the Jeter sample ($M = 134.53$, $SD = 34.60$, $N = 335$; $t(499) = 2.58$, $p = 0.01$), and the restandardization sample ($M = 96.60$, $SD = 36.20$, $N = 798$; $t(962) = 15.04$, $p < 0.001$). See Table 3 for item-level descriptive statistics for the current study, Jeter et al. (2017), and the ECBI restandardization study (Colvin et al., 1999).

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Objective 2: Test Whether the Four Factors Identified by Jeter et al. *Are Confirmed in Current Sample*

CFA model fit was poor using the 29-item, 4-factor solution proposed by Jeter et al. (2017) (χ^2 (371, N = 201) = 991.43, $p < 0.001$, RMSEA = 0.091, SRMR = 0.083, CFI = 0.769). Furthermore, Emotional Reactivity and Conduct Problems were highly correlated ($r = 0.81$), as were Interfering Behaviors and Attention Problems ($r = 0.93$), suggesting a redundancy of factors. Because of the poor model fit that resulted from the CFA, an EFA on using principal axis factoring and direct oblimin rotation with all 36 ECBI Intensity items was conducted with *SPSS version 26*. The Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity both indicated that the data were appropriate for factor analysis (KMO = 0.860, χ^2 (630) = 3248.26, $p < 0.001$).

In terms of percentage of variance accounted for by the solution, results showed that a 4- and 5- factor solution accounted for 49.51% and 54.00% of the variance, respectively. Adding a 5th factor only accounted for an additional 4.5% of variance. In the social sciences, a factor solution that explains 50–60% of cumulative variance is deemed acceptable (Meyer et al., 2006; Taherdoost et al., 2014). Parallel analysis suggests retaining factors for which the 95th percentile eigenvalues generated from random data are larger than the eigenvalues from the original data (Horn, 1965), with eigenvalues that exceed a value of 1. Based on these criteria, parallel analysis suggested a five-factor solution, given that the eigenvalues generated from random data were lower than the eigenvalues from the original data for the first five factors. While results from the parallel analysis and the percentage of variance accounted for by the preliminary EFA, suggested that a five-factor solution would fit the data best, it was decided that a more parsimonious 4-factor model made more conceptual sense and would provide better clinical utility. Specifically, factors four and five of the five-factor solution were difficult to clinically conceptualize, with "destroys toys," "careless about toys," "dawdles at mealtime," "refuses to eat," "poor table manners," and "wets the bed" loading onto factor 4 and "ready for bed," "refuses to go to bed," "refuses to do chores," "refuses to obey," and "dawdles dressing" loading onto factor 5.

Next, an EFA was conducted using *SPSS version 26* using the 36 ECBI items, specifying a 4-factor solution. Two items (i.e., difficulty entertaining self, wets the bed) did not load on any factor, while five items cross-loaded (i.e., sasses adults, argues with parents, fails to finish, interrupts, and does not obey) on at least two factors. Because our goal was to develop a relatively pure measure of interfering behaviors in ASD, these seven items were removed. The remaining 29 items were then subjected to further analysis. The four-factor solution with the remaining twenty-nine items accounted for 51.92% of the variance, however, one item (i.e., careless about toys) cross-loaded. This item was removed, and an additional EFA was run using the remaining twenty-eight items. This solution accounted for 52.45% of the variance, but one item (i.e., refuses to eat) did not load. As such, a final EFA was run without this item. The 4-factor solution with 27 items accounted for 53.71% of the variance and each item clearly loaded onto a single factor. The percentage of variance accounted for and the eigenvalues for the rotated factors were the following: Factor 1 (*Emotional Reactivity*, 11 items) accounted for 31.44% of the variance (eigenvalue = 8.49), Factor 2 (*Conduct Problems*, 8 items) accounted for 8.71% of the variance (eigenvalue

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= 2.35), Factor 3 (*Attention & Hyperactivity*, 4 items) accounted for 7.98% of the variance (eigenvalue = 2.15), and Factor 4 (*Difficulty with Daily Routines*, 4 items) accounted for 5.60% of the variance (eigenvalue = 1.51). Emotional Reactivity included items related to emotion-regulation, such as yelling, whining, and crying; Conduct Problems included items that are characteristic of aggressive behaviors and non-compliance with rules and social norms; Attention and Hyperactivity included three items characteristic of poor attention and one hyperactivity item; Difficulty with Daily Routines included items that are characteristic of trouble with daily activities, such as dressing and bedtime routines. Please see Table 4 for details.

Objective 3: Conduct Further Psychometric Analysis of the Derived Factors

Emotional Reactivity, *Conduct Problems*, *Attention & Hyperactivity*, and *Difficulty with Daily Routines* all demonstrated acceptable-to-good internal consistency (α = 0.89, 0.82, 0.77, and 0.79 respectively). Convergent validity was demonstrated with the Problem Scale of the SSIS (r = 0.48 to 0.60, $p < 0.001$), and its five corresponding subscales (r = 0.16 to 0.70 $p < 0.001$), with the exception of the Autism Spectrum Subscale with *Conduct Problems* (r = 0.09, n.s.). Divergent validity was demonstrated with Full Scale IQ such that none of the derived factors were correlated with FSIQ (r = −0.07 to −0.03, n.s.). See Table 5 for details.

Results from the DFA indicated significant differences in scores on the four factors based on diagnostic groups measured by the MINI-KID-P. For children who met criteria for ODD, the Linear Discriminant Function (LDF) was significant and demonstrated a large effect size (χ^2 (4, N = 169) = 84.22, $p < 0.001$, η^2 = 0.40). *Conduct Problems* accounted for most of the variance (β = 0.67), followed by *Emotional Reactivity* (= 0.47). Children who met criteria for ODD had higher scores (more impairment) on all four factors, compared to those who did not meet criteria for ODD. The LDF correctly classified children who met criteria for ODD 80.5% of the time. For children who met criteria for ADHD, the LDF was significant and demonstrated a medium-to-large effect size (χ^2 (4, N = 169) = 31.95, $p < 0.001$, η^2 = 0.18). *Conduct Problems, Attention & Hyperactivity*, and *Difficulty with Daily Routines* accounted for a similar proportion of the variance (β = 0.40, 0.48, 0.42, respectively). Children who met criteria for ADHD had higher scores on all four factors, compared to children who did not meet criteria for ADHD. The LDF correctly classified children who met criteria for ADHD 70.4% of the time. For children who met criteria for a mood disorder, the LDF was significant, with a small effect size (χ^2 (4, N = 169) = 22.34, $p < 0.001$, η^2 = 0.03). *Attention & Hyperactivity* accounted for most of the variance (β = 0.59), followed by *Difficulty with Daily Routines* (β = 0.47). Children who met criteria for mood disorders had higher scores on all four factors, compared to children who did not meet criteria for a mood disorder. The LDF correctly classified children who met criteria for a mood disorder 65.7% of the time. For children who met criteria for an anxiety disorder, the LDF was significant, with a medium effect size (χ^2 (4, N = 170) = 16.59, $p < 0.001$, η^2 = 0.10). However, this discriminatory difference was only demonstrated for *Difficulty with Daily Routines*, such that those who met criteria for an anxiety disorder had a higher *Difficulty with Daily Routines* score, compared to those who did not meet criteria for an anxiety disorder. The

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LDF correctly classified children who met criteria for an anxiety disorder 61.8% of the time. See Tables 6 and 7 for details regarding the LDF analyses.

Discussion

The ECBI is a commonly used measure to assess behaviors in children without ASD, identify treatment goals, and track treatment progress and has also been used in research studies involving children with ASD (Brobst et al., 2009; Brookman-Frazee et al., 2019, 2018, 2012a, 2012b; Pottie et al., 2009; Whittingham et al., 2009), yet, little information is available about the psychometric utility of the ECBI in children with ASD. The current study expanded upon previous psychometric analyses of the ECBI in a sample of children with ASD (Jeter et al., 2017) by investigating the factor structure and psychometric properties of the ECBI in a new sample of diverse children with ASD (5–13 years old) receiving publicly funded outpatient and school-based mental health services. This was important, given that Jeter's sample was primarily White sample, and participants were recruited from a university-based psychology clinic, developmental behavioral pediatrician, and the Interactive Autism Network.

Results addressing the first aim of this study indicated high levels of interfering behaviors as measured by the ECBI in both the Jeter et al. (2017) and current study sample compared to the restandardization sample (Colvin et al., 1999). The three items with the highest mean frequency ratings in the current study and the Jeter et al. study were the same (i.e., "easily distracted," short attention span," and "gets angry). In the current sample, items with the lowest mean frequency ratings were: "steals," "physically fights with friends," and "wets bed," which only differed by one item ("lies" instead of "wets bed") from Jeter et al.'s findings. Caregivers in the current sample reported a significantly higher total average frequency of interfering behaviors compared to the Jeter and restandardization sample. Taken together, results from Jeter et al. (2017) and the current study complement previous findings that caregivers of children with ASD report more interfering behaviors than caregivers of typically developing children (Kanne et al., 2009; Mahan & Matson, 2011; Mayes et al., 2012; Volker et al., 2010).

Results addressing the second aim of the study indicated that our data did not confirm the factor structure of Jeter et al. Findings suggested that the current sample was best characterized by a 27-item four factor solution that accounted for 54% of the variance. The identified factors were: *Emotional Reactivity, Conduct Problems, Attention & Hyperactivity Problems, and Difficulty with Daily Routines*. Nine items were removed because they did not load ("difficulty entertaining self," "wets the bed," and "refuses to eat") or because they cross-loaded ("sasses adults," "argues with parents," "fails to finish," "interrupts," "does not obey," and "careless about toys") with other factors. Four of the nine items removed in the current study were also removed by Jeter et al. ("difficulty entertaining self," "wets the bed," refuses to eat," and "argues with parents."). The item "wets the bed" did not load in either sample, which was not surprising given that this item has consistently failed to load in previous research using typically developing samples (Axeburg et al., 2008; Burns & Patterson, 1991, 2000; Weis et al., 2005).

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Acceptable-to-good internal consistency was demonstrated by *Emotional Reactivity, Conduct Problems, Attention & Hyperactivity*, and *Difficulty with Daily Routines*. Furthermore, convergent validity was demonstrated by the newly identified factors. Specifically, the factors were highly and positively correlated with the Competing Behavior Scale of the SSIS and its five corresponding subscales, with the exception of the Autism Spectrum Subscale and the *Conduct Problems* factor. This is not surprising, given that the Autism Spectrum Subscale includes items that are uniquely characteristic of core symptoms of autism spectrum disorder and do not include prototypical conduct problem behaviors such as aggression or physical fighting. Evidence for divergent validity was found such that none of the identified factors were significantly correlated with Full Scale IQ.

DFAs demonstrated discriminant validity of the four identified factors. Specifically, results indicated that all four factors were able to classify children who did and did not meet criteria on the MINI-KID-P for ODD, ADHD, and mood disorders. With the exception of children who met criteria for an anxiety disorder based on the MINI-KID-P, children who met criteria for ODD, ADHD, and mood disorders had higher scores on each factor compared to those who did not meet criteria for each diagnostic category. The identified factors were best able to differentiate between children who met criteria for ODD versus those that did not (80.5% correctly classified), followed by those who met criteria for ADHD (70.4%), mood disorders (65.7%), and anxiety disorders (61.8%). The finding that children who met criteria for ODD had the highest classification rate is consistent with the content of the ECBI, which was designed to assess the frequency and intensity of interfering behaviors, many of which are hallmark symptoms of ODD.

Limitations

These findings should be considered within the context of study limitations. The findings of this study provide a preliminary factor structure of the ECBI in children with ASD receiving publicly funded mental health services. There is a need to confirm the identified factors in another community-based sample and in a wider range of age groups. Given our sample size, we did not have sufficient power to test for measurement invariance, which should be done in future studies to test whether the ECBI assesses behaviors in the same way across different subgroups of children with ASD (e.g., among Spanish vs. English-speaking respondents). Additionally, our sample may have generalizability limits. While the current sample was representative of children receiving publicly funded mental health services in Southern California, it may not be representative of other mental health treatment-seeking samples in other parts of the United States. Finally, the ECBI data were collected via parent report of behaviors. Future studies should extend this work to the Sutter-Eyberg Student Behavior Inventory—Revised (SESBI-R; Burns & Patterson, 2001), which relies on teacher report of behaviors.

Conclusion

The current study extends the psychometric research on the commonly used ECBI measure to assess interfering behaviors in ASD. It is the first to examine the factor structure and psychometric properties of the ECBI in a diverse (~ 60% Latinx) sample of children with ASD with co-occurring mental health conditions. It is also the first to examine the ECBI

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within a sample of children receiving community mental health services. This context is important as there are high rates of co-occurring mental health conditions in ASD. Additionally, understanding the characteristics in usual care settings is important as many children with ASD present to mental health services (Brookman-Frazee et al., 2012a, 2012b) and interfering behaviors are often the primary presenting concerns in children with ASD in this service setting (Mandell et al., 2005).

Researchers have highlighted the need for psychometrically sound treatment outcome tools in ASD to measure outcomes across different treatment modalities, such as behavioral and pharmacological treatments (Mazurek et al., 2020). Results can inform use of the ECBI in a diverse subgroup of children with ASD with co-occurring mental health conditions. The current study did not confirm previously identified factors on the ECBI in a different sample of children with ASD. It is possible that differences between the samples (e.g., older age, higher rates of co-occurring mental health conditions, treatment seeking, more diverse sample), led to poor fit of the originally identified factors in Jeter et al. The present study identified four clinically-relevant ECBI factors *(Emotional Reactivity, Conduct Problems, Attention & Hyperactivity, and Difficulty with Daily Routines)* for this population of children with ASD. The newly identified factors demonstrated good internal consistency, convergent & divergent validity, and discriminant validity. The identified factors can provide a more refined assessment of behaviors that can be used to inform treatment planning and assessment of change over time.

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References

Akoglu H (2018). User's guide to correlation coefficients. Turkish Journal of Emergency Medicine, 18(3), 91–93. [PubMed: 30191186]

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

Axberg ULF, Johansson Hanse JAN, & Broberg AG (2008). Parents' description of conduct problems in their children—A test of the Eyberg Child Behavior Inventory (ECBI) in a Swedish sample aged 3–10. Scandinavian Journal of Psychology, 49, 497–505. 10.1111/j.1467-9450.2008.00670.x [PubMed: 18705675]

Bentler PM (1990). Comparative fit indexes in structural models. Psychological Bulletin, 107(2), 238–246. [PubMed: 2320703]

Bentler PM (2007). On tests and indices for evaluating structural models. Personality and Individual Differences, 42(5), 825–829. 10.1016/j.paid.2006.09.024

Brobst JB, Clopton JR, & Hendrick SS (2009). Parenting children with autism spectrum disorders: The couple's relationship. Focus on Autism and Other Developmental Disabilities, 24, 38–49. 10.1177/1088357608323699

Brookman-Frazee L, Baker-Ericzén M, Stahmer A, Mandell D, Haine RA, & Hough RL (2009). Involvement of youths with autism spectrum disorders or intellectual disabilities in multiple public

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service systems. Journal of Mental Health Research in Intellectual Disabilities, 2(3), 201–219. [PubMed: 19809531]

Brookman-Frazee L, Drahota A, & Stadnick N (2012a). Training community mental health therapists to deliver a package of evidence-based practice strategies for school-age children with autism spectrum disorders: A pilot study. Journal of Autism and Developmental Disorders, 42, 1651–1661. 10.1007/s10803-011-1406-7 [PubMed: 22102293]

Brookman-Frazee L, Drahota A, Stadnick N, & Palinkas LA (2012b). Therapist perspectives on community mental health services for children with autism spectrum disorders. Administration and Policy in Mental Health and Mental Health Services Research, 39(5), 365–373. 10.1007/s10488-011-0355-y [PubMed: 21533846]

Brookman-Frazee L, Roesch S, Chlebowski C, Baker-Ericzen M, & Ganger W (2019). Effectiveness of training therapists to deliver an individualized mental health intervention for children with ASD in publicly funded mental health services: A cluster randomized clinical trial. JAMA Psychiatry, 76(6), 574–583. 10.1001/jamapsychiatry.2019.0011 [PubMed: 30840040]

Brookman-Frazee L, Stadnick N, Chlebowski C, Baker-Ericzén M, & Ganger W (2018). Characterizing psychiatric comorbidity in children with autism spectrum disorder receiving publicly funded mental health services. Autism, 22(8), 938–952. 10.1177/1362361317712650 [PubMed: 28914082]

Brookman-Frazee LI, Taylor R, & Garland AF (2010). Characterizing community-based mental health services for children with autism spectrum disorders and disruptive behavior problems. Journal of Autism and Developmental Disorders, 40(10), 1188–1201. [PubMed: 20204690]

Burns GL, & Patterson DR (1991). Factor structure of the Eyberg Child Behavior Inventory: Unidimensional or multidimensional measure of disruptive behavior? Journal of Clinical Child and Adolescent Psychology, 20, 439–444. 10.1207/s15374424jccp2004_13

Burns GL, & Patterson DR (2000). Factor structure of the Eyberg Child Behavior Inventory: A parent rating scale of oppositional defiant behavior toward adults, inattentive behavior, and conduct problem behavior. Journal of Clinical Child Psychology, 29, 569–577. 10.1207/S15374424JCCP2904_9 [PubMed: 11126634]

Burns GL, & Patterson DR (2001). Normative data on the Eyberg Child Behavior Inventory and Sutter-Eyberg Student Behavior Inventory: Parent and teacher rating scales of disruptive behavior problems in children and adolescents. Child & Family Behavior Therapy, 23(1), 15–28. 10.1300/J019v23n01_02

California Evidence-Based Clearinghouse for Child Welfare. (n.d.). CEBC overview. https://www.cebc4cw.org/leadership/overview/

Colvin A, Eyberg SM., & Adams CD (1999). Restandardization of the Eyberg Child Behavior Inventory. University of Florida. Retrieved from https://www.researchgate.net/publication/239922241_Restandardization_of_the_Eyberg_Child_Behavior_Inventory.

Cronbach LJ (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16(3), 297–334.

de Bruin EI, Ferdinand RF, Meester S, de Nijs PF, & Verheij F (2007). High rates of psychiatric co-morbidity in PDD-NOS. Journal of Autism and Developmental Disorders, 37(5), 877–886. 10.1007/s10803-006-0215-x [PubMed: 17031447]

Elliott CD (2007). Differential Ability Scales-II (DAS-II). San Antonio, TX: Pearson Education.

Eyberg SM, & Matarazzo RG (1980). Training parents as therapists: A comparison between individual parent–child interaction training and parent group didactic training. Journal of Clinical Psychology, 36(2), 492–499. 10.1002/jclp.6120360218 [PubMed: 7372820]

Eyberg SM, & Pincus D (1999). ECBI & SESBI-R: Eyberg child behavior inventory and Sutter-Eyberg student behavior inventory-revised: Professional manual. Psychological Assessment Resources.

Eyberg SM, & Robinson EA (1983). Conduct problem behavior: Standardization of a behavioral rating. Journal of Clinical Child & Adolescent Psychology, 12(3), 347–354.

Gjevik E, Eldevik S, Fjæran-Granum T, & Sponheim E (2011). Kiddie-SADS reveals high rates of DSM-IV disorders in children and adolescents with autism spectrum disorders. Journal of Autism and Developmental Disorders, 41(6), 761–769. 10.1007/s10803-010-1095-7 [PubMed: 20824493]

Author Manuscript Author Manuscript Author Manuscript Author Manuscript

Gresham F, & Elliott SN (2007). Social skills improvement system (SSIS) rating scales. SSIS Rating Scales.

Gross D, Fogg L, Young M, Ridge A, Cowell J, Sivan A, & Richardson R (2007). Reliability and validity of the Eyberg Child Behavior Inventory with African-American and Latino parents of young children. Research in Nursing & Health, 30(2), 213–223. [PubMed: 17380522]

Horn JL (1965). A rationale and test for the number of factors in factor analysis. Psychometrika, 30(2), 179–185. [PubMed: 14306381]

Jeter K, Zlomke K, Shawler P, & Sullivan M (2017). Comprehensive psychometric analysis of the Eyberg Child Behavior Inventory in children with autism spectrum disorder. Journal of Autism and Developmental Disorders, 47, 1354–1368. 10.1007/s10803-017-3048-x [PubMed: 28197750]

Joshi G, Petty C, Wozniak J, Henin A, Fried R, Galdo M, Kotarski M, Walls S, & Biederman J (2010). The heavy burden of psychiatric comorbidity in youth with autism spectrum disorders: A large comparative study of a psychiatrically referred population. Journal of Autism and Developmental Disorders, 40(11), 1361–1370. [PubMed: 20309621]

Kanne SM, Abbacchi AM, & Constantino JN (2009). Multi-informant ratings of psychiatric symptom severity in children with autism spectrum disorders: The importance of environmental context. Journal of Autism and Developmental Disorders, 39, 856–864. 10.1007/s10803-009-0694-7 [PubMed: 19191016]

Leyfer OT, Folstein SE, Bacalman S, Davis NO, Dinh E, Morgan J, Tager-Flusberg H, & Lainhart JE (2006). Comorbid psychiatric disorders in children with autism: Interview development and rates of disorders. Journal of Autism and Developmental Disorders, 36(7), 849–861. 10.1007/s10803-006-0123-0 [PubMed: 16845581]

Lieneman CC, Brabson LA, Highlander A, Wallace NM, & McNeil CB (2017). Parent–child interaction therapy: Current perspectives. Psychology Research and Behavior Management, 10, 239–256. 10.2147/PRBM.S91200 [PubMed: 28790873]

Mahan S, & Matson JL (2011). Children and adolescents with autism spectrum disorders compared to typically developing controls on the Behavioral Assessment System for Children, (BASC-2). Research in Autism Spectrum Disorders, 5, 119–125. 10.1016/j.rasd.2010.02.007

Mandell DS, Walrath CM, Manteuffel B, Sgro G, & Pinto-Martin J (2005). Characteristics of children with autistic spectrum disorders served in comprehensive community-based mental health settings. Journal of Autism and Developmental Disorders, 35(3), 313–321. 10.1007/s10803-005-3296-z [PubMed: 16119472]

Mark TL, Coffey RM, Vandivort-Warren R, Harwood HJ, King EC, & the MHSA Spending Estimates Team. (2005). US spending for mental health and substance abuse treatment, 1991–2001: Public payers bear a growing share of spending for mental illness and substance abuse treatment. Health Affairs, 24(l1), 133–142. 10.1377/hlthaff.W5.133 [PubMed: 15647224]

Mayes SD, Calhoun SL, Aggarwal R, Baker C, Mathapati S, Anderson R, & Petersen C (2012). Explosive, oppositional, and aggressive behavior in children with autism compared to other clinical disorders and typical children. Research in Autism Spectrum Disorders, 6, 1–10. 10.1016/j.rasd.2011.08.001

Mazurek MO, Carlson C, Baker-Ericzén M, Butter E, Norris M, Barr C, & Kanne S (2020). The autism impact measure (AIM): Examination of sensitivity to change. Autism Research: Official Journal of the International Society for Autism Research, 13(11), 1867. [PubMed: 33001561]

Meyer LS, Gamst GC, & Guarino AJ (2006). Principal components and factor analysis. In Meyer LS & Gamst GC (Eds.), & Guarino Applied multivariate research: Design and interpretation (pp. 465–514). Sage Press.

Mutheen LK, & Mutheen BO (2017). Mplus Version 8. Los Angeles, CA: Muthen & Muthen.

Pottie CG, Cohen J, & Ingram KM (2009). Parenting a child with autism: Contextual factors associated with enhanced daily parental mood. Journal of Pediatric Psychology, 34, 419–429. 10.1093/jpepsy/jsn094 [PubMed: 18794189]

Robinson EA, Eyberg SM, & Ross AW (1980). The standardization of an inventory of child conduct problem behaviors. Journal of Clinical Child & Adolescent Psychology, 9(1), 22–28.

Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janvas J, Weiller E, Hergueta T, Baker R, & Dunbar GC (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The

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development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. Journal of Clinical Psychiatry, 59(20), 22–23.

Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, & Baird G (2008). Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. Journal of the American Academy of Child & Adolescent Psychiatry, 47(8), 921–929. [PubMed: 18645422]

Soke GN, Maenner MJ, Christensen D, Kurzius-Spencer M, & Schieve LA (2018). Prevalence of co-occurring medical and behavioral conditions/symptoms among 4-and 8-year-old children with autism spectrum disorder in selected areas of the United States in 2010. Journal of Autism and Developmental Disorders, 48(8), 2663–2676. [PubMed: 29524016]

Stadnick NA, Lau AS, Dickson KS, Pesanti K, Innes-Gomberg D, & Brookman-Frazee L (2020). Service use by youth with autism within a system-driven implementation of evidence-based practices in children's mental health services. Autism, 1362361320934230.

Steiger JH (1990). Structural model evaluation and modification: An interval estimation approach. Multivariate Behavioral Research, 25(2), 173–180. [PubMed: 26794479]

Stern M (2008). Assessing dimensions of disruptive child behavior with the Eyberg Child Behavior Inventory. Unpublished manuscript, Department of Psychology, University of Florida, Gainesville, FL. Retrieved from https://ufdcimages.uflib.ufl.edu/uf/e0/02/01/22/00001/stern_m.pdf

Tabachnick BG, & Fidell LS (2007, 5th edition). Using multivariate statistics (Ch. 13, pp. 612–680). Boston, MA: Pearson Publishing.

Taherdoost H, Sahibuddin S & Jalaliyoon N (2014). Exploratory factor analysis; Concepts and theory. Advances in Applied and Pure Mathematics, 375–382.

Volker MA, Lopata C, Smerbeck AM, Knoll VA, Thomeer ML, Toomey JA, & Rodgers JD (2010). BASC-2 PRS profiles for students with high-functioning autism spectrum disorders. Journal of Autism and Developmental Disorders, 40, 188–199. 10.1007/s10803-009-0849-6 [PubMed: 19705267]

Wechsler D (2011). Wechsler Abbreviated Scale of Intelligence (WASI-II). San Antonio, TX: Pearson Education.

Weis R, Lovejoy MC, & Lundahl BW (2005). Factor structure and discriminative validity of the Eyberg Child Behavior Inventory with young children. Journal of Psychopathology and Behavioral Assessment, 27, 269–278. 10.1007/s10862-005-2407-7

Whittingham K, Sofronoff K, Sheffield J, & Sanders MR (2009). Stepping Stones Triple P: An RCT of a parenting program with parents of a child diagnosed with an autism spectrum disorder. Journal of Abnormal Child Psychology, 37(4), 469. [PubMed: 19023654]

World Health Organization (WHO). (1993). The ICD-10 classification of mental and behavioural disorders. World Health Organization.

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Table 1

Demographic characteristics

Child/caregiver characteristics	***n* = 201**
Child age (years) *M*(SD)	9.12 (2.44)
Child Gender (male)	84.1%
Child Hispanic/Latinx	59.7%
Caregiver age (years) *M*(SD)	40.10 (8.24)
Caregiver gender (female)	93.5%
Caregiver race/ethnicity	
Hispanic/Latinx	59.7%
Non-Hispanic White	25.4%
Asian American	4.0%
African American	5.5%
Multiracial	4.5%
Unknown/not reported	0%
Maternal education level	
Less than high school	19.1%
Completed high school	38.2%
Any trade school/college	42.7%
Annual household income	
≤ $25,000	45.3%
$25,001–75,000	37.8%
> $75,000	15.9%

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Table 2

Current study item characteristics

					Skewness		Kurtosis		Item communality	Item-total correlation
		n	*M*	*SD*	γ_1	*SE*	γ_2	*SE*	h^2	*r*
1	Dawdles dressing	200	4.97	1.84	− .57	.172	− .65	.342	.500	.517**
2	Dawdles at mealtime	199	4.15	2.17	− .13	.172	− 1.36	.343	.587	.571**
3	Poor table manners	199	4.14	1.89	− .18	.172	− 1.06	.343	.432	.559**
4	Refuses to eat	200	4.42	1.80	− .32	.172	− .84	.342	.411	.438**
5	Refuses to do chores	201	4.42	1.87	− .38	.172	− .76	.341	.498	.610**
6	Ready for bed	200	4.50	1.91	− .25	.172	− 1.01	.342	.679	.539**
7	Refuses to go to bed	200	4.12	2.06	− .06	.172	− 1.20	.342	.666	.546**
8	Does not obey	200	4.31	1.78	− .14	.172	− .94	.342	.662	.670**
9	Refuses to obey	199	4.57	1.89	− .46	.172	− .90	.343	.683	.715**
10	Acts defiant	199	4.15	1.92	− .20	.172	− 1.03	.343	.754	.718**
11	Argues with parents	201	4.21	2.09	− .21	.172	− 1.22	.341	.602	.627**
12	Gets angry	200	5.45	1.75	− .92	.172	− .25	.342	.740	.703**
13	Temper tantrums	199	4.82	2.00	− .59	.172	− .93	.343	.786	.735**
14	Sasses adults	199	3.86	2.08	− .02	.172	− 1.35	.343	.569	.642**
15	Whines	201	4.53	1.99	− .40	.172	− 1.03	.341	.564	.589**
16	Cries easily	200	4.22	1.96	− .06	.172	− 1.17	.342	.380	.396**
17	Yells	199	4.66	1.92	− .52	.172	− .79	.343	.698	.710**
18	Hits parents	201	2.27	1.74	1.29	.172	.64	.341	.552	.509**
19	Destroys toys	199	2.94	1.85	.60	.172	− .75	.343	.638	.615**
20	Careless about toys	200	3.61	1.89	.12	.172	− 1.10	.342	.624	.605**
21	Steals	200	1.65	1.31	2.22	.172	4.31	.342	.475	.410**
22	Lies	200	2.95	1.80	.58	.172	− .76	.342	.607	.507**
23	Teases other children	200	2.59	1.78	.80	.172	− .64	.344	.462	.489**
24	Verbally fights w friends	198	2.53	1.59	.74	.173	− .47	.346	.577	.467**
25	Verbally fights w siblings	195	3.98	2.24	− .10	.174	− 1.49	.342	.678	.470**
26	Physically fights w friends	200	1.87	1.41	1.81	.172	2.80	.346	.573	.514**
27	Physically fights w siblings	196	3.39	2.19	.38	.174	− 1.30	.342	.675	.501**
28	Seeks attention	200	4.22	2.16	− .13	.172	− 1.39	.342	.544	.549**
29	Interrupts	200	5.19	1.75	− .81	.172	− .37	.341	.601	.582**
30	Easily distracted	201	5.67	1.48	− 1.18	.172	.79	.343	.663	.415**
31	Short attention span	199	5.45	1.54	− .83	.172	.07	.343	.657	.458**
32	Fails to finish	199	4.87	1.82	− .61	.172	− .50	.343	.563	.456**

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					Skewness		Kurtosis		Item communality	Item-total correlation
		n	*M*	*SD*	γ_1	*SE*	γ_2	*SE*	h^2	*r*
33	Difficulty entertaining self	199	3.11	2.06	.62	.172	− .94	.341	.393	.477**
34	Difficulty concentrating	201	4.78	1.86	− .49	.172	− .86	.341	.583	.411**
35	Overactive	199	4.85	2.01	− .64	.172	− .82	.343	.503	.521**
36	Wets bed	201	1.97	1.83	1.91	.172	2.31	.341	.337	.265**

** Correlation is significant at the .01 level; one child was excluded from the full sample because of missing ECBI data

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Table 3

Cross-study item level comparisons

		Study sample					
		Current study (N = 201)		Jeter et al. (2017) (N = 335)		Colvin et al. (1999) (N = 798)	
		M	*SD*	*M*	*SD*	*M*	*SD*
1	Dawdles dressing	4.97	1.84	4.82	1.87	2.98	1.74
2	Dawdles at mealtime	4.15	2.17	4.20	1.94	2.65	1.75
3	Poor table manners	4.14	1.89	3.97	1.86	2.26	1.37
4	Refuses to eat	4.42	1.80	4.45	1.80	2.56	1.66
5	Refuses to do chores	4.42	1.87	4.40	1.91	2.79	1.67
6	Ready for bed	4.50	1.91	4.21	1.85	3.54	1.96
7	Refuses to go to bed	4.12	2.06	4.15	1.95	3.12	1.98
8	Does not obey	4.31	1.78	4.05	1.81	2.87	1.59
9	Refuses to obey	4.57	1.89	4.37	1.88	2.91	1.71
10	Acts defiant	4.15	1.92	4.16	1.89	2.82	1.63
11	Argues with parents	4.21	2.09	3.42	2.06	3.50	1.83
12	Gets angry	5.45	1.75	5.26	1.62	3.90	1.85
13	Temper tantrums	4.82	2.00	4.70	1.85	2.26	1.41
14	Sasses adults	3.86	2.08	3.04	2.05	2.53	1.67
15	Whines	4.53	1.99	4.24	1.92	2.86	1.75
16	Cries easily	4.22	1.96	4.03	1.68	2.93	1.68
17	Yells	4.66	1.92	4.59	1.81	3.14	1.85
18	Hits parents	2.27	1.74	2.98	2.00	1.40	1.07
19	Destroys toys	2.94	1.85	3.16	1.92	1.76	1.30
20	Careless about toys	3.61	1.89	3.60	1.99	2.63	1.70
21	Steals	1.65	1.31	1.38	0.96	1.24	0.77
22	Lies	2.95	1.80	1.82	1.39	2.26	1.41
23	Teases other children	2.59	1.78	2.01	1.56	2.53	1.68
24	Verbally fights w friends	2.53	1.59	2.05	1.58	2.34	1.43
25	Verbally fights w siblings	3.98	2.24	2.72	2.09	3.11	2.02
26	Physically fights w friends	1.87	1.41	1.85	1.41	2.04	1.48
27	Physically fights w siblings	3.39	2.19	2.69	1.94	2.52	1.78
28	Seeks attention	4.22	2.16	4.01	1.97	3.09	1.77
29	Interrupts	5.19	1.75	4.55	1.88	3.29	1.72
30	Easily distracted	5.67	1.48	5.29	1.65	3.38	1.85
31	Short attention span	5.45	1.54	5.22	1.68	2.83	1.81
32	Fails to finish	4.87	1.82	4.63	1.69	2.89	1.67
33	Difficulty entertaining self	3.11	2.06	2.59	1.87	2.28	1.63
34	Difficulty concentrating	4.78	1.86	4.26	1.97	2.61	1.70
35	Overactive	4.85	2.01	4.80	1.95	2.87	1.91
36	Wets bed	1.97	1.83	2.83	2.26	1.69	1.50

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Table 4

Standardized factor loadings for the 27-item, 4-factor solution

#	Item	Factor name			
		Emotional reactivity	**Conduct problems**	**Attention and hyperactivity**	**Diff. w daily routines**
17	Yells	**.794**	.104	− .009	.045
13	Temper tantrums	**.790**	− .035	.050	− .106
15	Whines	**.721**	− .081	− .021	− .038
12	Gets angry	**.651**	.056	− .007	− .162
18	Hits parents	**.613**	.088	− .104	.046
10	Acts defiant	**.604**	.191	− .093	− .184
19	Destroys toys	**.550**	.265	.045	.133
28	Seeks attention	**.538**	.025	.093	.060
16	Cries easily	**.490**	− .168	.064	− .062
2	Dawdles at mealtime	**.381**	− .048	.159	− .250
3	Poor table manners	**.333**	.142	.072	− .125
23	Teases other children	.051	**.654**	− .102	− .057
22	Lies	− .118	**.638**	.073	− .100
24	Verbally fights with friends	− .087	**.612**	.044	− .085
27	Physically fights with siblings	.114	**.602**	.032	.080
25	Verbally fights with siblings	.067	**.594**	− .006	.054
21	Steals	.007	**.554**	.019	.044
26	Physically fights with friends	.085	**.494**	.060	− .052
9	Refuses to obey	.272	**.339**	.045	− .308
31	Short attention span	− .044	.019	**.824**	− .037
30	Easily distracted	− .059	.096	**.790**	.081
34	Difficulty concentrating	.015	− .068	**.766**	− .010
35	Overactive	.227	.053	**.388**	− .083
6	Ready for bed	− .027	− .025	− .018	**−.914**
7	Refuses to go to bed	.010	.054	− .024	**−.789**
1	Dawdles dressing	.122	.042	.174	**−.391**
5	Refuses to do chores	.170	.225	.068	**−.357**

Standardized factor loadings of ≥ 0.30 are indicated above in bold text

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Table 5

Convergent and divergent validity

	Emotional reactivity	Conduct problems	Attention and hyperactivity	Difficulty with daily routines
SSIS				
Competing behavior scale	.598**	.482**	.484**	.582**
Externalizing	.707**	.702**	.471**	.547**
Bullying	.590**	.538**	.335**	.474**
Internalizing	.248**	.155**	.187**	.378**
Autism spectrum	.288**	.088	.264**	.314**
Hyperactivity/inattention	.612**	.445**	.628**	.520**
Cognitive assessment				
FSIQ standard score	− .025	− .018	− .068	.025

** Correlation is significant at .01 level (2-tailed)

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Table 6

Discriminant validity: tests for equality of group means

		Factor names											
		Emotional reactivity			Conduct problems			Attention and hyperactivity			Difficulty with daily routines		
		λ	*F (df)*	*p*	λ	*F (df)*	*p*	λ	*F (df)*	*p*	λ	*F (df)*	*p*
Co-Occurring Symptoms	ODD	.74	60.01 (1, 167)	< .001	.68	60.01 (1, 167)	< .001	.92	60.01 (1, 167)	< .001	.84	60.01 (1, 167)	< .001
	ADHD	.92	14.46 (1, 167)	< .001	.91	17.22 (1, 167)	< .001	.90	18.42 (1, 167)	< .001	.89	20.53 (1, 167)	< .001
	Anxiety	.10	.38 (1. 168)	.54	.10	.43 (1. 168)	.52	.10	.48 (1, 168)	.49	.10	9.01 (1, 168)	< .001
	Mood	.95	8.25 (1, 167)	< .001	.95	8.22 (1, 167)	< .001	.91	15.92 (1, 167)	< .001	.92	14.37 (1, 167)	< .001

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Table 7

Discriminant validity: summaries of linear canonical functions

	Function 1				Function at group centroids		Standardized coefficients			
	λ	χ^2 (*df*)	*p*	η^2	Does not meet criteria	Meets criteria	Emotional reactivity	Conduct problems	Attention and hyperactivity	Difficulty with daily routines
ODD	.60	84.22 (4)	< .001	.40	− .91	.73	.47	.67	.09	.11
ADHD	.82	31.95 (4)	< .001	.16	− .87	.24	.10	.40	.48	.42
Anxiety	.91	16.59 (4)	.002	.10	− .36	.29	− .11	− .50	− .48	1.20
Mood	.97	22.34 (4)	< .001	.03	− .25	.58	.03	.25	.59	.47

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