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Comprehensive Psychometric Analysis of the Eyberg Child Behavior Inventory in Children with Autism Spectrum Disorder

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Abstract Many assessment measures have only been validated for one specific diagnostic population, which is costly and reduces the clinical utility of assessments. The Eyberg Child Behavior Inventory (ECBI) is one popular measure designed to assess disruptive behavior problems in youth. The ECBI has sound psychometric properties in typically developing youth, but the factor structure has never been examined in children with autism spectrum disorder (ASD). Therefore, the current study conducted a comprehensive psychometric analysis of the ECBI in children with ASD. Retrospective data from a nationally representative sample was collected from 335 children with ASD ages 2–12 years old. A four factor solution was identified for this sample. Implications of these findings and directions for future research are discussed.

Keywords Autism spectrum disorder · Disruptive behavior · Assessment · Psychometrics

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Introduction

Autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by extensive impairment in reciprocal social communication and social interaction that occurs along with patterns of repetitive, restricted behaviors, interests, or activities (American Psychiatric Association 2013). In addition to these core deficits, many individuals with ASD exhibit behavioral difficulties, including hyperactivity/impulsivity, attention problems, aggressive behavior, self-injurious behavior, and disruptive/destructive behaviors (Huete et al. 2014; Kaat et al. 2013; Kaat and Lecavalier 2013; Schopler and Mesibov 1994; Simonoff et al. 2008; Storch et al. 2012). Research by Mandell et al. (2005) examined characteristics of children with and without ASD in community mental health settings and found that regardless of diagnosis, children are most often referred to service for disruptive behaviors (Mandell et al. 2005). In fact the majority of children with ASD present with at least one comorbid psychiatric disorder such as attention deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), conduct disorder (CD), obsessive–compulsive disorder (OCD), and generalized anxiety disorder (GAD). Without intervention, disruptive behaviors associated with ASD in early childhood often persist into adolescence and later adulthood (Murphy et al. 2005) creating a myriad of negative outcomes, including increased risk of comorbid psychiatric disorders (Myrbakk and von Tetzchner 2008), reduced social interactions (Matson et al. 2010), and marked interference with learning and skill development (Machalicek et al. 2008). Additionally, emotional and behavioral difficulties negatively impact family stress, school/residential placement, and use of antipsychotic medications (Lauderdale-Littin et al. 2013; McGill and Poynter 2012; Storch et al. 2012). Given

the deleterious effects associated with early childhood disruptive behaviors and ASD, it is imperative that evidence-based assessments are developed to evaluate and monitor early intervention progress.

Assessment of Disruptive Behavior in Children with ASD

Children with ASD frequently exhibit high levels of disruptive behaviors and are most commonly referred for mental health services to address these disruptive behaviors (Huete et al. 2014; Mandell et al. 2005; Schopler and Mesibov 1994). Although diagnosis-specific assessment measures are important for identifying the core symptoms of ASD, these measures are less informative when assessing secondary symptoms in children with ASD, such as disruptive behavior problems. Additionally, the use of diagnosis-specific measures to assess secondary symptoms increases mental health costs because it requires providers to purchase redundant measures for specific populations.

In the last decade, traditional behavioral therapies and parent training programs are increasingly being adapted to address disruptive behavior problems in young children with ASD. (Agazzi et al. 2013; Armstrong et al. 2014; Armstrong and Kimonis 2013; Hatamzadeh et al. 2010; Lesack et al. 2014; Mohajeri et al. 2012; Whittingham et al. 2009). As part of this process, behavior rating scales that were developed and standardized on non-ASD samples are being utilized to assess disruptive behaviors in children with ASD. One such measure, the Eyberg Child Behavior Inventory (ECBI), is a widely used parent rating scale designed to assess disruptive behavior problems in children and adolescents (Eyberg and Pincus 1999; Eyberg and Ross 1978).

Although the ECBI has demonstrated good psychometric properties, the factor structure of the ECBI is highly debated. Eyberg and colleagues originally conceptualized the ECBI as a unidimensional measure of disruptive behavior problems (Eyberg and Robinson 1983; Robinson et al. 1980), and early research supported the univariate factor structure for both children and adolescents. Burns and Patterson (1991) initially proposed that the ECBI may be better conceptualized as a multidimensional measure since a number of ECBI items are characteristically symptoms related to ODD, CD, and ADHD. Currently, research examining the factor structure of the ECBI has revealed inconsistent findings. Four studies found evidence supporting a univariate factor structure (Colvin et al. 1999; Eyberg and Robinson 1983; Gross et al. 2007; Robinson et al. 1980); however, only one of those studies found evidence of a univariate factor structure using a confirmatory factor analysis (CFA; Gross et al. 2007). In comparison, five studies found evidence supporting a three factor model using

both exploratory factor analysis (EFA) and CFA (Axberg et al. 2008; Burns and Patterson 1991, 2000; Stern 2007; Weis et al. 2005). Burns and Patterson (2000) found evidence that the best model fit resulted from a three factor model based on 22 items. Two independent research groups also found evidence supporting the 22-item three factor model using CFA (Axberg et al. 2008; Weis et al. 2005), while one research group found evidence of a 25-item three factor model using CFA (Stern 2007). Overall, a growing body of research suggests that the ECBI may be best represented by a three factor model in typically developing children. Once more, these findings are limited by the inclusion of only typically developing children and therefore may not generalize to children with developmental delays and other neurodevelopmental disorders.

ECBI in ASD

Originally created for typically developing children, the ECBI is a relatively short, behaviorally specific measure, with a simple scoring system. This makes the ECBI an efficient method for measuring the intensity and frequency of disruptive behaviors in children with ASD. Additionally, since the ECBI identifies specific disruptive behaviors, the ECBI also has a high degree of clinical utility and can be used to identify treatment goals and monitor progress (Eyberg and Robinson 1982; Webster-Stratton 1984). Although the ECBI has not formally been investigated within an ASD population, a growing body of research is already using the ECBI to measure disruptive behaviors in children with ASD.

The ECBI has been used to measure the preliminary effectiveness of the Incredible Years parenting program (Roberts and Pickering 2010; Schultz 2011) for parents of children with ASD and the Stepping Stones Triple P (Positive Parenting Program) for parents of children with ASD (Whittingham et al. 2009). In addition, multiple case studies have examined the preliminary effectiveness of parent child interaction therapy (PCIT) for children with ASD using the ECBI for treatment monitoring and as a primary outcome measure (Agazzi et al. 2013; Armstrong et al. 2014; Armstrong and Kimonis 2013; Hatamzadeh et al. 2010; Lesack et al. 2014; Mohajeri et al. 2012). Although the psychometric properties of the ECBI have not been thoroughly examined for children with ASD, it is evident from this growing body of literature that the ECBI is currently being utilized within this population in a variety of clinical and research settings (Solomon et al. 2008; Ginn et al. 2015; Zlomke et al. in press).

Inconsistent findings regarding the ECBI's internal consistency within the context of experimental and treatment outcome research has become a question within

the literature. Four studies were identified that reported the internal consistency of the ECBI for Australian children with ASD (Lesack et al. 2014; Mohajeri et al. 2012; Pakenham et al. 2005; Sofronoff et al. 2011, 2004), and two studies were identified that reported the internal consistency of the ECBI for children with ASD in the United States (Brobst et al. 2009; Pottie et al. 2009). As previously mentioned, the ECBI has demonstrated good internal consistency in the restandardization sample of typically developing children with Cronbach's alpha values ranging from 0.95 to 0.93 for the Intensity and Problem Scales, respectively (Colvin et al. 1999). In comparison, research using the ECBI within ASD samples has reported lower levels of internal consistency in experimental and treatment studies. Sofronoff et al. (2004) used the ECBI within a sample of Australian children ($n = 51$) with Asperger's Syndrome, ages 6–12 years old. This research study reported a much lower Cronbach's alpha value ($\alpha = 0.82$) compared to the restandardization sample; however, it is unclear from the article whether this value is meant to represent the internal consistency of the Intensity Scale or Problem Scale (Sofronoff et al. 2004). Pakenham et al. (2005) used only the ECBI Intensity Scale in a small sample of 47 Australian children with Asperger's Syndrome, ages 10–12 years old, and found evidence of good internal consistency ($\alpha = 0.94$). Additional research by Whittingham et al. (2009) utilized the ECBI within a sample of children, ages 2–9 years old, who had an ASD diagnosis and found evidence of good internal consistency for the Intensity Scale ($\alpha = 0.92$) and the Problem Scale ($\alpha = 0.88$). Sofronoff et al. (2011) examined a sample of children ($n = 133$), ages 6–16 years old, with a diagnosis of Asperger's Syndrome, and they found evidence of good internal consistency for the Intensity Scale ($\alpha = 0.92$) and the Problem Scale ($\alpha = 0.91$).

Current Study

The ECBI is a widely used parent report measure of childhood disruptive behavior problems that is frequently used by both clinicians and researchers. Due to its brevity and simple scoring system, the ECBI has a high degree of clinical utility and is commonly used to screen children for disruptive behavior problems, monitor treatment progress, and evaluate treatment effectiveness. Although it was originally developed and validated on typically developing children, a growing body of research suggests that the ECBI is frequently being utilized to measure disruptive behavior problems in children with ASD. The psychometric properties of the ECBI for children with ASD are currently unknown. Since the ECBI is frequently used for children with ASD in both clinical and research settings to screen for behavior problems, monitor treatment progress, and evaluate treatment effectiveness, it is imperative that basic psychometric

data be collected on this population. Therefore, the primary objective of the current study is to provide a comprehensive analysis of item characteristics, ECBI factor structure, and reliability.

Method

Participants

Participants in this study included 335 primary caregivers of children with a confirmed diagnosis of ASD. Data for 108 cases was collected via chart review from a university-based psychology clinic where primary caregivers completed measures as part of the standard intake process, representing the treatment-seeking (TS) group. Data from 97 cases was collected via chart review from measures completed during a usual clinic appointment with a university-based developmental behavioral pediatrician (DBP). Additionally, this study examined 130 cases of archival data collected from a nationally-representative sample (36 states) through the Interactive Autism Network (IAN) Research Center at Kennedy Krieger Institute and Johns Hopkins School of Medicine-Baltimore. The IAN Research Center is sponsored by the Autism Speaks Foundation. The IAN is a national online registry with more than 40,000 individuals with ASD and their family members.

Children ranged from 2 to 12 years old, with a mean age of 6.5 years old. Children were predominately male (83.9%) and predominately Caucasian (74%) with other racial groups represented as follows: African American/ Black (15.8%), Hispanic (2.7%), Asian (1%), multiracial (12%), Middle Eastern (3%), and Other (8%). In regards to diagnostic group, 112 children were diagnosed with Autistic Disorder (33.4%), 87 were diagnosed with Asperger's Syndrome (26.0%), 25 were diagnosed with Pervasive Developmental Disorder—Not Otherwise Specified (7.5%), and 111 were diagnosed with Autism Spectrum Disorder (33.1%). See Table 1 for child sample characteristics by group.

Primary caregivers of children in the current study consisted of biological mothers (85.4%), biological fathers (9.3%), and other primary caregivers (5.4%). Caregiver age ranged from 20 to 61 years ($M = 37.21$; $SD = 7.58$). Caregivers were predominately Caucasian (68.1%) with other racial groups represented as follows: African American/Black (14.3%), Hispanic (2.7%), Native American (0.3%), Asian (1.5%), multiracial (1.2%), and other (0.3%). Approximately 65.7% of caregiver participants were married, 16.5% were single, 9.3% were divorced or separated, 5.6% were widowed, and 0.6% reported their marital status as other. Caregivers from 149 families (44.5%) reported their annual household income as less than $60,000, and caregivers from

Table 1 Sample Characteristics of Child

	TS		DBP		IAN		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Child age (years)	4.93	1.58	5.43	1.82	8.57	2.36	6.5	2.59
Parent age (years)	35.9	8.12	35.02	7.32	39.80	6.56	37.2	7.59
	n	*%*	*n*	*%*	*n*	*%*	*N*	*%*
Child sex								
Male	90	83.3	75	77.3	116	89.2	281	83.9
Female	18	16.7	22	22.7	14	10.8	54	16.1
Child ethnicity								
White	68	63.0	67	69.1	113	86.9	248	74.3
Black	24	22.2	25	25.8	4	3.1	53	15.8
Hispanic	3	2.8	1	1	5	3.8	9	2.7
Multiracial/other	12	11.1	4	4.1	8	6.0	24	7.2
Diagnostic group								
Autistic disorder	23	21.3	15	51.5	74	56.9	112	33.4
Asperger's	33	30.6	22	22.7	32	24.6	87	26.0
PDD-NOS	1	0.9	0	0	24	28.0	24	7.5
ASD	51	47.2	60	61.9	0	0	111	33.1

TS treatment seeking, *DBP* developmental behavioral pediatrics, *IAN* interactive autism network

78 families (23.3%) reported their annual household income as greater than $60,000. Caregivers from 108 families (32.2%) did not report their annual household income. See Table 2 for parent sample characteristics by group.

Measures

Eyberg Child Behavior Inventory

The Eyberg Child Behavior Inventory (ECBI; Eyberg and Pincus 1999; Eyberg and Ross 1978) is a parent report measure of disruptive child behavior problems. The ECBI is comprised of 36-items that are rated by the parent on two scales. On the Intensity Scale, parents rate the frequency with which each problem behavior occurs for their child using a 7-point scale ranging from 1 (Never) to 7 (Always) to obtain a measure of problem severity. Scores on the Intensity Scale can range from 36 to 252 with scores over 131 suggesting the presence of clinically significant behavioral problems (Eyberg and Pincus 1999). On the Problem Scale, parents indicate whether or not the occurrence of each given behavior is a problem by circling "yes" or "no." Scores on

Table 2 Sample characteristics of caregivers

	TS		DBP		IAN		Total	
	n	*%*	*n*	*%*	*n*	*%*	*N*	*%*
Caregiver								
Mother	85	78.7	86	88.7	115	88.5	286	85.4
Father	14	13.0	6	6.2	11	8.5	31	9.3
Other	9	8.3	4	5.1	4	3.1	18	5.4
Marital status								
Single	21	19.4	26	26.8	9	6.9	56	16.7
Married	60	55.6	59	60.8	101	77.7	220	65.7
Divorced/separated	16	14.8	11	11.3	4	3.1	31	9.3
Widowed	2	1.9	1	1.0	16	12.23	19	5.7
Other	2	1.9	0	0	0	0	2	0.6
Income								
Below $60,000	42	39.0	41	42.3	43	33.2	149	44.5
Above $60,000	17	15.8	53	16.5	80	61.5	78	23.3

the Problem Scale range from 0 to 36 (Eyberg and Pincus 1999). A large body of research has found that the ECBI possess good psychometric properties, including high internal consistency, adequate test–retest reliability ($r = .80$) and strong convergent and divergent validity (Eyberg and Pincus 1999; Funderburk et al. 2003; Robinson et al. 1980). For the current sample, the ECBI Intensity scale was found to have excellent reliability with Cronbach's Alpha value of 0.92, and the ECBI Problem scale was found to have good reliability with Cronbach's Alpha value of 0.88.

Behavioral Assessment System for Children, 2nd Edition

The Behavioral Assessment System for Children, 2nd edition (BASC-2) is a broadband parent report measure of child functioning (Reynolds and Kamphaus 2004). The BASC-2 is designed to assess both adaptive and maladaptive behaviors that occur in the community and home setting for three age groups—preschool (ages 2–5), child (ages 6–11), and adolescent (ages 12–21). Parents rated the frequency of specific behaviors on a 4-point scale ranging from "Never" to "Almost Always." On the BASC-2, t-scores ranging from 60 to 69 reflect scores in the At-Risk classification with t-scores greater than 70 reflecting elevations in the Clinically Significant range. The BASC-2 manual presents an extensive body of research that has found the BASC-2 to be a reliable and valid measure (Reynolds and Kamphaus 2004). The current study utilized the BASC-2 Parent Report Scale—Preschool (BASC-2 PRS-P) and BASC-2 Parent Report Scale—Child (BASC-2 PRS-C), as appropriate.

Parenting Stress Index—Short Form

The Parenting Stress Index–Short Form (PSI–SF; Abidin 1995) is a 36-item self-report questionnaire designed to measure parenting stress within the parent–child dyad. Using a 5-point Likert scale, parents indicate the degree to which they agree with each item ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Total Stress scores on the PSI–SF range from 36 to 180 with higher scores indicating more parenting stress. Total Stress scores above the 90th percentile (raw score ≥ 90) suggest the presence of clinically significant levels of parenting stress that may benefit from intervention. In addition to the composite Total Stress score, the PSI–SF measures three broad domains of parental stress: Parental distress (PD), parent–child dysfunctional interaction (PCDI), and difficult child (DC). The PSI–SF has been utilized in a variety of parent populations, including parents of children with behavior problems, parents of children with intellectual disability (Hassall et al. 2005), and parents of children with Asperger's Syndrome and Autistic Disorder

(Davis and Carter 2008; Epstein et al. 2008; Lecavalier et al. 2006). The PSI–SF has shown good test–retest reliability as well as good internal consistency (Abidin 1995). More specifically, research on the PSI–SF with parents of children with ASD has found evidence of Cronbach's alphas ranging from 0.84 to 0.90 (Davis and Carter 2008). For the current sample, the following Cronbach's alpha values were found: Parental distress = 0.86, parent–child dysfunctional interaction = .81, difficult child = 0.77, and total stress index = 0.89.

Procedure

Prior to data collection, this study was approved by the university Institutional Review Board. All data was archival in nature. Cases were included for the current study if children were between the ages of 2 and 12 years old with a diagnosis of ASD. Consistent with DSM-5 recommendations, individuals with a well-established DSM-IV-TR diagnosis of autistic disorder, Asperger's disorder, or PDD-NOS were considered to qualify for the diagnosis of ASD. Therefore, participants were included in the current study if they had (1) a documented ASD diagnosis in their medical chart, OR (2) a parent-reported ASD diagnosis with a supporting evidenced-based assessment. In order to confirm a documented diagnosis of ASD, a review of the medical chart was conducted.

An evidenced-based assessment report was defined as an assessment report utilizing a well-validated measure of autism spectrum symptomology, such as the Autism Diagnostic Interview-Revised (ADI-R; Le Couteur et al. 2003), the Autism Diagnostic Observation Schedule—2nd edition (ADOS-2; Lord et al. 2012), the Social Responsiveness Scale—2nd edition (SRS-2; Constantino and Gruber 2012), or Gilliam Autism Rating Scale (GARS; Gilliam 2006). Participants in the IAN database were clinically validated and confirmed through a review of both parent- and professional-provided medical records using DSM-IV criteria (Daniels et al. 2012; Lee and Ousley 2006). Demographic information and archival data was collected from cases in which a parent completed the ECBI as well as one of the following research measures: the Behavior Assessment System for Children, 2nd edition or the Parenting Stress Index—Short Form.

Results

Preliminary Analysis

In order to preserve the original sample size and produce more accurate standard errors, maximum likelihood

Table 3 Bivariate correlations

	10	9	8	7	6	5	4	3	2	1
1. BASC-2 Adaptability	−0.049	−0.067	0.094	−0.437**	−0.141	−0.285**	−0.153	−0.052	−0.393**	
2. BASC-2 BSI	0.651**	0.526**	0.369**	0.406**	0.434**	0.520**	0.780**	0.691**		−0.393**
3. BASC-2 Internalizing	0.568**	0.421**	0.316**	0.165	0.363**	0.365**	0.554**		0.691**	−0.052
4. BASC-2 Externalizing	0.773**	0.604**	0.401**	0.281**	0.427**	0.482**		0.554**	0.780**	−0.153
5. PSI-SF Total	0.305**	0.246**	0.844**	0.817**	0.719**		0.482**	0.365**	0.520**	−0.285**
6. PSI-SF DC	0.326**	0.236**	0.414**	0.361**		0.719**	0.427**	0.363**	0.434**	−0.141
7. PSI-SF PCDI	0.175**	0.132*	0.562**		0.361**	0.817**	0.281**	0.165	0.406**	−0.437**
8. PSI-SF PD	0.237**	0.224**		0.562**	0.414**	0.844**	0.401**	0.316**	0.369**	0.094
9. ECBI Problem	0.727**		0.224**	0.132*	0.236**	0.246**	0.604**	0.421**	0.526**	−0.067
10. ECBI Intensity		0.727**	0.237**	0.175**	0.326**	0.305**	0.773**	0.568**	0.651**	−0.049

**Correlation significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2 tailed)

estimation was utilized to address missing ECBI and PSI-SF data using AMOS. Statistical tests of skewness and kurtosis were conducted on the ECBI Intensity scale for each sample (TS, DBP, and IAN) and for the combined sample. Based on these analyses, the ECBI Intensity scale was found to be normally distributed for all treatment groups and the combined sample, with a total sample skewness of 0.185 (SE = 0.133) and a kurtosis of 0.009 (SE = 0.266). Mahalanobis distance was used to screen for multivariate outliers, and no multivariate outliers were identified. See Table 3 for correlations between study variables.

Analysis of Group Differences

In order to determine if ECBI scales differed based on data collection site, a one-way analysis of variance (ANOVA) was conducted. Results showed a significant group effect on the ECBI Intensity scale, $F(2, 332) = 5.431$, $p = .005$, and on the ECBI Problem scale, $F(2, 332) = 10.243$, $p < .001$. Post-hoc analyses with a Bonferroni correction indicated that parents in the TS group ($M = 143.11$; $SD = 30.15$) endorsed a higher frequency of challenging behaviors than parents in the IAN group ($M = 128.68$; $SD = 36.73$). Additionally, parents in the TS group ($M = 17.12$; $SD = 7.57$) endorsed more behaviors as problematic than parents in the DBP group ($M = 13.95$; $SD = 8.31$) and the IAN group ($M = 12.53$; $SD = 7.83$). See Table 4 for means and standard deviations of the ECBI and PSI-SF by data collection site.

Analysis of Current Sample in Comparison to Restandardization Sample

Item means and standard deviations, item endorsement frequencies, and item-total correlations were calculated for each ECBI Intensity item. Mean intensity ratings and item endorsement frequencies for the current sample of children with ASD and the typically developing restandardization sample are shown in Table 5. Across all ECBI Intensity items, skewness ranged from −0.96 to 2.77, and kurtosis ranged from −1.30 to 7.41. Corrected item-total correlations ranged from 0.26 (wets the bed) to 0.66 (acts defiant when told to do something). Two independent samples t-tests were conducted in order to determine if group differences existed between the ASD sample and the restandardization sample for the ECBI Intensity scale and the ECBI Problem scale. Results revealed that parents of children with ASD endorsed problematic behaviors on the ECBI as occurring at a significantly higher frequency ($M = 134.53$; $SD = 34.60$) than parents of children in the restandardization sample ($M = 96.60$; $SD = 36.20$), $t(1131) = −16.47$, $p < .001$. See Table 5 for item level t-tests. Additionally, parents in the current sample endorsed a higher number of behaviors as problematic ($M = 14.42$; $SD = 8.10$) than parents in the restandardization sample ($M = 7.10$; $SD = 7.70$), $t(1131) = −14.38$, $p < .001$.

In the current sample, the top three behaviors endorsed at the highest intensity were the items "is easily distracted" ($M = 5.29$; $SD = 1.65$), "gets angry when doesn't get own way" ($M = 5.26$; $SD = 1.62$), and "has short attention span" ($M = 5.22$; $SD = 1.68$). The three behaviors endorsed at the lowest intensity were the items "steals" ($M = 1.38$; $SD = 0.96$), "lies" ($M = 1.82$; $SD = 1.39$), and "physically fights with friends" ($M = 1.85$; $SD = 1.41$). The top three behaviors reported as problematic were "gets angry when doesn't get own way" (66.9%), "has temper tantrums" (66.0%), and "yells or screams" (59.4%). The three items least frequently endorsed as problematic were "steals" (7.5%), "physically fights with friends" (15.2%), and "verbally fights with friends" (16.1%).

Table 4 Group differences for ECBI and PSI–SF

	Treatment seeking		Developmental pediatrics		Interactive autism network		Total	
	M	SD	M	SD	M	SD	M	SD
ECBI intensity	143.1	31.15	132.86	34.75	128.68	36.73	134.54	34.60
ECBI intensity (29-item)	114.31	24.73	107.23	28.70	103.54	28.88	108.05	27.85
ECBI problem	17.12	7.57	13.95	8.31	12.53	7.31	14.42	8.11
ECBI problem (29-item)	13.91	6.66	11.20	6.85	10.01	6.16	11.61	6.72
PSI-SF	(n=97)		(n=86)		(n=128)		(n=299)	
PD	31.76	8.96	39.41	10.94	33.35	8.99	34.53	10.02
P-CDI	29.73	9.39	38.95	10.86	31.64	8.02	33.06	9.99
DC	38.49	8.58	36.80	8.90	41.09	9.38	39.12	9.17
Total score	100.94	19.41	115.86	24.90	105.91	22.27	107.26	22.94

ECBI Eyberg Child Behavior Inventory, *PSI-SF* Parenting Stress Index-Short Form, *PD* Parental Distress, *P-CDI* parent–child dysfunctional interaction, *DC* difficult child

Factor Analysis

In order to determine the appropriate number of factors to retain, a preliminary exploratory factor analysis (EFA) was conducted on the 36 ECBI Intensity items using maximum likelihood extraction and oblique (direct oblimin) rotation. The Kaiser–Meyer–Olkin (KMO) measure indicated that the data included a homogenous collection of variables which makes it suitable for factor analysis, KMO=0.887. Bartlett's test of sphericity also suggested that correlations between items were sufficiently large enough for the EFA, $\chi^2 (630) = 6051.10$, $p < .001$.

For this preliminary EFA, eight factors were identified with eigenvalues greater than Kaiser's criterion of one. These eight factors explained a cumulative 63.04% of variance. Examination of the scree plot showed inflections that would justify retaining four factors. Despite the popularity of using Kaiser's rule and scree test to determine the appropriate number of factors, research has demonstrated that these methods are often unreliable and can overestimate the number of factors to be retained (Cattell and Vogelmann 1977; Cliff 1988; Streiner 1998; Zwick and Velicer 1986). As such, parallel analysis and Velicer's minimum average partial (MAP) test were also conducted since these are considered to be superior methods which are more likely to yield the optimal number of factors to retain (Wood et al. 1996; Zwick and Velicer 1986). Examination of the parallel analysis revealed that the 95th percentile eigenvalues from the random data were lower than the eigenvalues from the original data for the first four factors, suggesting a four-factor solution. The MAP test indicated a minimum average squared correlation of 1.36 was achieved for a five-factor solution.

Primary Exploratory Factor Analyses

Based on these results, solutions for three, four, and five factors were examined using maximum likelihood extraction and oblique rotations (direct oblimin and promax). For all of the following analyses, item loadings less than 0.10 were suppressed to increase interpretability, and only item loadings greater than 0.30 were considered relevant to factor loadings. The four factor solution was preferred for various reasons. The three factor solution had a high number of communalities less than 0.40, suggesting that an additional factor should be explored. When comparing the three factor and four factor solutions simultaneously, it was evident that the factor with the smallest number of items (4 items) remained stable for both solutions. After examination, the four factor solution was chosen over the three factor solution due to greater conceptual clarity. The five factor solution revealed a factor with only two items. Given that factors with fewer than three items are generally considered to be unstable (Costello and Osborne 2005), the five factor solution was rejected.

After determining the appropriate number of factors to retain, a series of EFAs with maximum likelihood extraction were conducted limiting the number of factors to four. There was little difference between the direct oblimin and promax rotations. Following detailed examination, the promax rotation was chosen for the final solution because it enhanced interpretability. The four factor solution with maximum likelihood estimation and oblique (promax) rotation accounted for 43.18% of the cumulative variance. Communalities ranged from 0.84 to 0.11, with sixteen items having communalities less than 0.40. Five items were removed because they did not meet the minimum criteria

Table 5 ECBI item level comparison

Item content	Normative data (N = 798)			ASD data (N = 335)			T-score	p
	M	SD	Percent problem	M	SD	Percent problem		
Dawdles in getting dressed	2.98	1.74	15.3	4.82	1.87	52.8	−15.84	0.000*
Dawdles or lingers at mealtime	2.65	1.75	16.8	4.20	1.94	47.5	−5.18	0.000*
Has poor table manners	2.26	1.37	11.2	3.97	1.86	30.1	−3.91	0.000*
Refuses to eat food presented	2.56	1.66	17.3	4.45	1.80	47.2	−13.62	0.000*
Refuses to do chores when asked	2.79	1.67	22.9	4.40	1.91	48.4	−39.76	0.000*
Slow in getting ready for bed	3.54	1.96	21.6	4.21	1.85	40.3	−20.85	0.000*
Refuses to go to bed on time	3.12	1.98	24.2	4.15	1.95	41.8	−6.32	0.000*
Does not obey house rules on own	2.87	1.59	21.1	4.05	1.81	45.7	−12.17	0.000*
Refuses to obey until threatened with punishment	2.91	1.71	29.2	4.37	1.88	55.8	−9.88	0.000*
Acts defiant when told to do something	2.82	1.63	25.8	4.16	1.89	56.1	−2.12	0.000*
Argues with parents about rules	3.50	1.83	30.7	3.42	2.06	38.8	−2.36	0.034
Gets angry when doesn't get own way	3.90	1.85	36.5	5.26	1.62	66.9	−24.53	0.019
Has temper tantrums	2.26	1.41	20.6	4.70	1.85	66.0	−20.27	0.000*
Sasses adults	2.53	1.67	25.3	3.04	2.05	36.4	−1.81	0.000*
Whines	2.86	1.75	24.7	4.24	1.92	50.7	−19.30	0.070
Cries easily	2.93	1.68	15.4	4.03	1.68	35.8	−31.60	0.000*
Yells or screams	3.14	1.85	25.3	4.59	1.81	59.4	−18.40	0.000*
Hits parents	1.40	1.07	7.6	2.98	2.00	42.1	−3.83	0.000*
Destroys toys and other objects	1.76	1.30	10.3	3.16	1.92	34.6	−2.76	0.006*
Is careless with toys and other objects	2.63	1.70	17.3	3.60	1.99	37.9	−8.51	0.000*
Steals	1.24	0.77	5.8	1.38	0.96	7.5	14.44	0.000*
Lies	2.26	1.41	19.3	1.82	1.39	17.3	9.82	0.000*
Teases or provokes other children	2.53	1.68	20.6	2.01	1.56	17.6	7.66	0.000*
Verbally fights with friends	2.34	1.43	12.9	2.05	1.58	16.1	5.32	0.000*
Verbally fights with siblings	3.11	2.02	30.7	2.72	2.09	26.9	2.93	0.000*
Physically fights with friends	2.04	1.48	10.2	1.85	1.41	15.2	13.50	0.003
Physically fights with siblings	2.52	1.78	23.1	2.69	1.94	33.4	−3.60	0.000*
Constantly seeks attention	3.09	1.77	13.2	4.01	1.97	32.5	−12.68	0.000*
Interrupts	3.29	1.72	30.2	4.55	1.88	44.8	−14.32	0.000*
Is easily distracted	3.38	1.85	22.6	5.29	1.65	56.7	−25.43	0.000*
Has short attention span	2.83	1.81	20.8	5.22	1.68	54.6	−37.32	0.000*
Fails to finish tasks or projects	2.89	1.67	21.7	4.63	1.69	48.7	−23.30	0.000*
Difficulty entertaining self alone	2.28	1.63	10.2	2.59	1.87	21.8	4.22	0.000*
Has difficulty concentrating on one thing	2.61	1.70	19.3	4.26	1.97	42.1	−12.00	0.000*
Is overactive or restless	2.87	1.91	17.8	4.80	1.95	49.3	−15.43	0.000*
Wets the bed	1.68	1.50	8.8	2.83	2.26	23.6	−10.05	0.000*

Normative data obtained from "Restandardization of the Eyberg Child Behavior Inventory" by Colvin et al. 1999, University of Florida

*Denotes a significant p-value after Bonferroni correction at the adjusted level of .0014

of having a primary factor loading of at least 0.30. The following items were removed: "dawdles or lingers at mealtime," "refuses to eat food presented," "argues with parents about rules," "has difficulty entertaining self on own," and "wets the bed." Additionally, the items "is overactive or restless" and "acts defiant when told to do something" were removed due to significant crossloadings of 0.30 on more than one factor.

Final Exploratory Factor Analysis

For the final analyses, an EFA with maximum likelihood extraction and promax rotation was conducted on the remaining 29 items. The Kaiser–Meyer–Olkin measure confirmed the sampling adequacy for the analysis, KMO = 0.869. Bartlett's test of sphericity also established that correlations between items were sufficiently large enough for the EFA, χ^2 (406) = 4781.15, $p < .001$.

Overall, the four factor solution accounted for 46.18% of the cumulative variance. See Table 5 for the factor analysis summary. The final 29 items and their factor loadings are shown in Tables 6 and 7.

Based on the final EFA, the first factor consisted of items related to temper tantrums, whining, crying easily, and yelling or screaming. As such, this factor was labeled Emotional Reactivity. The Emotional Reactivity subscale is comprised of nine items resulting in a maximum possible total score of 63 ($M = 36.59$; $SD = 11.71$; range 10–62). This subscale accounted for 26.89% of variance in the ECBI.

The second factor consisted of items related to conduct behaviors. Overt conduct behaviors were evidenced by verbal and physical aggression towards other children (e.g., "physically fights with friends his/her own age," "verbally fights with friends his/her own age," "physically fights with siblings," "verbally fights with siblings," and "teases or provokes other children"). Covert conduct behaviors also loaded on this factor (e.g., "lies" and "steals"). Two additional items "sasses adults" and "interrupts" loaded on this factor albeit with lower factor loadings. Therefore, this factor was labeled Conduct Problems. The Conduct Problems subscale is comprised of nine items resulting in a maximum possible score of 63 ($M = 22.12$; $SD = 10.19$; range 9–60). This subscale accounted for 7.93% of the variance.

The third factor consisted of items related to oppositional behavior towards adults. This included behaviors like noncompliance to commands, delayed compliance to commands, and failure to follow established rules. As such, this factor was labeled Defiant Behavior. The Defiant Behavior subscale is comprised of seven items resulting in a maximum possible score of 49 ($M = 29.97$; $SD = 8.78$; range = 7–49). This subscale accounted for 6.83% of the variance.

The fourth factor consisted of items related to attention and concentration. Specifically, items on this factor represented difficulties with inattention and task completion. Therefore, this factor was labeled Attention Problems. The Attention Problems subscale is comprised of four items resulting in a maximum possible score of 28 ($M = 19.40$; $SD = 5.97$; range = 4–28). This subscale accounted for 4.53% of the variance.

Table 6 Factor analysis summary

	Total eigenvalue	% of Variance	Cumulative %
Emotional reactivity	7.80	26.89	26.89
Conduct problems	2.30	7.93	34.82
Defiant behavior	1.98	6.83	41.65
Attention problems	1.32	4.53	46.18

Psychometric Examination of 4-Factor Model

The Emotional Reactivity, Conduct Problems, and Attention Problems factors demonstrated good internal consistency with Cronbach's alpha values of 0.87, 0.85, and 0.88, respectively. The Defiant Behavior factor had a Cronbach's alpha value of 0.79, which is considered to be in the adequate range. In order to examine convergent and discriminant validity, the factors were examined in relation to theoretically related and unrelated variables. In relation to the BASC-2 Externalizing Problems composite scale, the following three ECBI subscales demonstrated significant positive correlations with large effect sizes: Emotional Reactivity ($r = .70$, $p < .001$), Conduct Problems ($r = .64$, $p < .001$), and Defiant Behavior ($r = .50$, $p < .001$). The Attention Problems factor also demonstrated a significant positive correlation to the BASC-2 Externalizing Composite scale with a small effect size ($r = .26$, $p = .01$). All four ECBI factors demonstrated the following significant positive correlations with small to moderate effect sizes in relation to the PSI–SF Difficult Child subscale: Emotional Reactivity ($r = .32$, $p < .001$), Conduct Problems ($r = .18$, $p = .001$), Attention Problems ($r = .13$, $p = .01$), and Defiant Behavior ($r = .27$, $p < .001$). Additionally, the Attention Problems factor demonstrated significant positive correlations with the BASC-2 Hyperactivity subscale ($r = .31$, $p < .001$) and the BASC-2 Attention Problems subscale ($r = .43$, $p < .001$). Non-significant correlations were found for all four factors in relation to a number of theoretically unrelated subscales on the BASC-2. See Table 8 for bivariate correlations between factors and other variables.

Discussion

The current study sought to validate the ECBI for use in a population of children with ASD ages two to twelve years old. Although this measure has previously been used clinically and in research to measure disruptive behavior in children with ASD, the psychometric properties of the ECBI for children with ASD have not been established. As such, this study utilized a nationally representative sample to examine how parents of children with ASD responded to the ECBI in comparison to response rates by parents of typically developing children in previously collected research. Additionally, the current study is the first of its kind to explicitly examine the factor structure of the ECBI in a sample of children with ASD.

In comparison to the typically developing restandardization sample, parents of children with ASD endorsed a higher frequency of challenging behaviors and reported a higher number of these behaviors as problematic. These findings are consistent with a large body of research

Table 7 Factor loadings

	Emotional reactivity	Conduct problems	Defiant behavior	Attention problems
Has temper tantrums	**1.022**	−0.161	−0.012	−0.066
Yells or screams	**0.848**	0.024	−0.053	−0.063
Gets angry when doesn't get own way	**0.811**	−0.050	0.080	−0.067
Hits parents	**0.682**	0.048	−0.090	−0.022
Destroys toys and other objects	**0.472**	0.153	0.051	0.097
Whines	**0.434**	0.063	0.160	0.052
Cries easily	**0.365**	−0.035	0.185	0.053
Is careless with toys and other objects	**0.347**	0.119	0.141	0.187
Constantly seeks attention	**0.338**	0.116	−0.010	0.168
Verbally fights with friends	0.002	**0.873**	−0.104	−0.025
Verbally fights with siblings	0.013	**0.773**	−0.148	−0.083
Teases or provokes other children	−0.137	**0.749**	0.068	−0.025
Lies	−0.199	**0.687**	0.143	−0.027
Physically fights with siblings	0.224	**0.540**	−0.108	−0.041
Physically fights with friends	0.192	**0.539**	−0.098	0.064
Sasses adults	0.132	**0.511**	0.156	−0.033
Steals	−0.025	**0.414**	0.122	−0.030
Interrupts	0.117	**0.365**	0.095	0.120
Slow in getting ready for bed	−0.118	0.084	**0.675**	−0.011
Refuses to go to bed on time	0.007	−0.027	**0.622**	−0.049
Dawdles in getting dressed	−0.077	−0.001	**0.600**	0.139
Refuses to do chores when asked	0.005	−0.028	**0.596**	−0.100
Does not obey house rules on own	0.181	−0.008	**0.571**	−0.072
Refuses to obey until threatened with punishment	0.172	0.080	**0.500**	0.057
Has poor table manners	0.123	−0.091	**0.431**	−0.018
Has short attention span	0.038	−0.057	−0.126	**0.968**
Is easily distracted	0.011	0.042	−0.105	**0.865**
Has difficulty concentrating on one thing	−0.063	−0.036	0.020	**0.802**
Fails to finish tasks or projects	−0.040	−0.055	0.225	**0.611**

Item loadings greater than 0.30 are bolded

suggesting that parents of children with ASD report higher levels of challenging behaviors than those of typically developing children (Kanne et al. 2009; Mahan and Matson 2011; Mayes et al. 2012; Volker et al. 2010).

Initial research of the ECBI in typically developing children established the clinical cutoffs for the Intensity scale and Problem scale as the convergence of one standard deviation above the mean for the typical developing sample and one standard deviation below the mean for the clinical group (Eyberg and Ross 1978). For the initial ECBI research, this method resulted in cutoff scores of 127 for the Intensity scale and 11 for the Problem scale (Eyberg and Ross 1978). A similar method of one standard deviation above the mean was used for the restandardization sample, resulting in clinical cutoff score of 132 for the Intensity scale and 15 for the Problem scale (Colvin et al. 1999). If the same method were utilized

for the current sample, it would result in clinical cutoff scores of 169 for the Intensity scale and 23 for the Problem scale. Given the high prevalence of challenging behaviors in children with ASD, it is likely that any parents with ECBI scores over the standard clinical cutoff scores of 132 and 15 would likely benefit from intervention. As such, a different clinical cutoff score is not recommended for children with ASD. However, it is clinically useful to know that caregivers who rate their child's behavior above 169/15 are reporting to be experiencing significantly more challenging behaviors than other parents of ASD. It is likely that these families may need more intensive support throughout treatment as well as referrals to additional providers (e.g., individual therapy for caregivers, medication management for child).

Preliminary analyses of group site differences demonstrated that parents reported a wide range of behavior

Table 8 Correlations with theoretically related and unrelated constructs

	Emotional reactivity	Conduct problems	Defiant behavior	Attention problems	Externalizing problems	Difficult child	Adaptive skills
ECBI emotional reactivity		0.547**	0.559**	0.320**	0.704**	0.324**	−0.148
ECBI conduct problems	547**		0.399**	0.228**	0.643**	0.180**	0.080
ECBI defiant behavior	0.559**	0.399**		0.312**	0.502**	0.271**	−0.066
ECBI attention problems	0.320**	0.228**	0.312**		0.263**	0.134*	0.026
BASC-2 externalizing problems	0.704**	0.643**	0.502**	0.263**		0.427**	−0.153
PSI–SF difficult child	0.324**	0.180**	0.271**	0.134*	0.427**		−0.141
Adaptive skills	−.148	0.080	−.066	0.026	−0.153	−0.141	

**Correlation significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2 tailed)

problems. As expected, parents of children with ASD who were actively seeking behavior therapy services reported higher levels of disruptive behavior than parents of children recruited during a regularly scheduled appointment at their developmental behavior pediatrician. Parents who were actively seeking treatment also reported higher levels of disruptive behavior than parents who completed measures online through the IAN. These findings provide support that the current sample is representative of a normative range of disruptive behavior problems in children with ASD.

Results from the current study found evidence of a multidimensional factor solution for the ECBI in a sample of children with ASD. A series of EFAs revealed that a four factor solution was the best fit for the data. This solution accounted for approximately 46% of the variance. The four factors identified through EFA were named Emotional Reactivity, Conduct Problems, Defiant Behavior, and Attention Problems.

In comparison to the existing literature on the ECBI factor structure in typically developing children, the four factors identified in this sample differ from initial research supporting a unidimensional factor solution for the ECBI in a typically developing sample (Colvin et al. 1999; Eyberg and Robinson 1983; Robinson et al. 1980). However, this body of research utilized PCA to determine the factor structure, which can yield inflated estimates of variance accounted for by the components (Bentler and Kano 1990; Osborne and Costello 2009; Floyd and Widaman 1995; Ford et al. 1986; Gorsuch 1990; MacCallum and Tucker 1991; Mulaik 1990; Snook and Gorsuch 1989; Widaman 1990, 1993). As such, PCA is no longer considered to be an ideal primary extraction method and is better

conceptualized as a preliminary step in EFA because it exposes valuable information about the maximum number of factors and the nature of the factors (Tabachnick and Fidell 2013).

The four factor solution identified in the current study corresponds reasonably well to the three factor solutions identified by Burns and Patterson (1991, 2000) in large samples of typically developing children. The preliminary examination of the ECBI by Burns and Patterson (1991) conducted PCAs with varimax rotation on two separate samples and found similar, albeit not exact, results. Their research identified a three factor solution in both the pediatric sample (ODD, ADHD, CD) and the random general population sample (ODD, CD, ADHD), each comprised of 35 items. The item "wets the bed" consistently did not load significantly on any factor. In contrast, the current sample identified a 29-item, four factor solution of Emotional Reactivity, Conduct Problems, Defiant Behavior, and Attention Problems.

Given the limitations of PCA, Burns and Patterson (2000) later conducted a preliminary EFA and subsequent CFA on a large sample of typically developing children and found evidence of a 22-item, three factor solution. Comparatively, the Attention Problems factor identified in the current sample consists of the same four items as the Inattentive Behavior scale identified with CFA by Burns & Patterson (2000). Seven of the nine items on the Conduct Problems factor in the current sample also loaded on the Conduct Problem Behavior factor in the typically developing sample. Two items on the Conduct Problems factor in the current sample, "sasses adults" and "interrupts," loaded on the Oppositional Defiant Behavior Towards Adults factor in the research by Burns and Patterson (2000). One

item, "destroys toys and other objects," on the Conduct Problem Behavior factor by Burns and Patterson (2000) loaded on the Emotional Reactivity factor in the current study. Additionally, items from the Oppositional Defiant Behavior Towards Adults factor identified in the typically developing sample loaded on the Emotional Reactivity factor and the Defiant Behavior factor in the current study.

Weis et al. (2005) used a CFA to examine the 22-item, three factor solution proposed by Burns and Patterson (2000). Comparatively, the Attention Problems factor identified in the current sample consisted of the same four items as the Inattentive Behavior scale found by Weis et al. (2005). Seven of the nine items on the Conduct Problems factor in the current study also loaded on the Conduct Behavior Problems factor (Weis et al. 2005). One item from the Conduct Behavior Problems factor, "sasses adults," in the current study loaded on the Oppositional Defiant Behavior Towards Adults scale in their research. Additionally, one item, "interrupts," loaded on the Conduct Problems scale in the current study but did not load on any scale in the CFA by Weis et al. (2005).

More recent research on the ECBI factor structure using CFA in a sample of young Swedish children, Axberg et al. (2008) found a 22-item, three factor solution consisting of Oppositional Defiant Behavior Towards Adults, Inattentive Behavior, and Conduct Problem Behavior. The Attention Problems factor identified in the current sample consisted of the same four items as the Inattentive Behavior scale found by Axberg et al. (2008). Relatedly, seven of the nine items on the Conduct Problems factor in the current study also loaded on the Conduct Behavior Problems factor (Axberg et al. 2008). One item from the Conduct Behavior Problems factor, "destroys toys and other objects," loaded on the Defiant Behavior scale in the current study. One additional item, "interrupts," loaded on the Conduct Problems scale in the current study but did not load on any scale in the CFA by Axberg et al. (2008).

In summary, the current study found evidence of a 29-item, four factor solution for the ECBI in children with ASD. These findings correspond reasonably well to the three factor solutions identified in previous research (Axberg et al. 2008; Burns and Patterson 1991, 2000; Weis et al. 2005). The consistency of items on the Attention Problems factor between the current research study and previous research suggests that this factor is stable throughout typically developing children and children with ASD. Similarly, the Conduct Problems subscale was fairly consistent between findings from the current study and previous research. The greatest amount of discrepancy appeared in the Oppositional Defiant Behavior Towards Adults factor in previous research studies which was separated into two separate factors, Emotional Reactivity and Oppositional

Behavior, in the current study. It is likely that children with ASD engage in a number of problematic behaviors related to emotional reactiveness (e.g., crying, whining, temper tantrums) that are not inherently indicative of defiant behavior and may instead be related to difficulties with communication or sensory concerns. Another consistent finding was that the item "wets the bed" was not found to significantly load on any factor in the current study as well as previous research, suggesting that this item should be eliminated due to psychometric limitations and lack of conceptual relatedness (Axberg et al. 2008; Burns and Patterson 1991, 2000; Weis et al. 2005).

The four factor ECBI structure identified in the current sample of children with ASD has a number of important implications. Conceptually, it would be expected that children with ASD and high intensity scores on only one ECBI factor would exhibit different behavioral profiles. It is possible that discrepancies in ECBI factor endorsements could be used to identify targeted treatments for children with ASD. Clinically, the four ECBI factors may be useful for identifying appropriate treatments. It is possible that children with ASD and high levels of Defiant Behavior may be more likely to benefit from behavioral parent training interventions. It is also likely that children with high levels of Defiant Behavior and Conduct Behavior on the ECBI factors will require more intensive services than those with only high levels on one factor or the other. Additionally, the Attention Problems factor may serve as an important indicator for identifying children with ASD who may benefit from an evaluation for Attention Deficit Hyperactivity Disorder and may also be useful for measuring behavior changes during stimulant medication trials.

In contrast, it is also possible that the 29-item ECBI Total score may be more appropriate for differentiating within the externalizing disorders spectrum for children with ASD. This would be consistent with previous research on the ECBI factors in typically developing children demonstrated that the ECBI Total score was better able to differentiate between the externalizing disorders than the three ECBI components identified (Weis et al. 2005). It is possible that, similar to typically developing children, the externalizing behaviors in children with ASD lack enough behavioral differentiation to distinguish between externalizing disorders. This may be because these problematic behaviors are often comorbid and tend to co-occur in clinic-referred children (Dishion et al. 1995; Loeber and Keenan 1994; Stormshak et al. 2000; Wahler 1997). At this time, further research is needed to determine the predictive power of the ECBI factors in children with ASD.

All four factors that were identified demonstrated adequate to good reliability. Each of the four factors demonstrated convergent validity with the BASC-2 Externalizing Problems composite scale. Additionally, discriminant

validity was established for all four factors as evidenced by non-significant correlations to a number of theoretically unrelated subscales on the BASC-2.

Limitations and Future Directions

Although the current study provides important information about the psychometric properties of the ECBI in a sample of children with ASD, it is not without limitations. The findings from this research study represent a preliminary factor structure of the ECBI in children with ASD. As such these findings need to be replicated using a confirmatory factor analysis. The current study is limited by its relatively homogeneous sample composition in terms of sex and ethnicity (i.e., Caucasian males) although the sample composition does match with epidemiological research on ASD. Additionally, age groups were not equally represented in the sample. Future research should seek to replicate these findings in a larger and more diverse sample. Additionally, future research should examine the reliability of the ECBI across demographic subgroups, such as age, gender, and ethnicity. Given the heterogeneous nature of ASD, future research would also benefit from examining how ASD symptom severity impacts parents responding on the ECBI.

Conclusion

The current study identified four meaningful factors (Emotional Reactivity, Conduct Problems, Defiant Behavior, and Attention Problems) in the ECBI for children with ASD and provided evidence of its psychometric properties in this population. Indices of reliability obtained in the current sample based on the four factor solution ranged from acceptable to good and the ECBI demonstrated good convergent validity. These findings are consistent with previous research on the ECBI in typically developing children (Colvin et al. 1999; Eyberg and Pincus 1999). Overall, the current research findings suggest that the ECBI is a psychometrically sound measure of behavior problems in children with ASD.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

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