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Utility of three N-Item scales of the child behavior checklist 6–18 in autism diagnosis

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ABSTRACT

Background: There is a need for well-validated questionnaire measures as an adjuvant to autism diagnosis. Three past research studies have each delineated a subsample of questions (5-, 9-, and 10-items) from the Child Behavior Checklist 6–18 (CBCL-6-18) that differentiate children with autism from those without (Achenbach & Rescorla, 2001; Duarte, Bordin, Oliveira, & Bird, 2003; Ooi, Rescorla, Ang, Woo, & Fung, 2011; So et al., 2012). Despite the potential of these subscales, no research aside from the initial investigations has been published, and the initial studies had methodological limitations.

Method: This study investigated the criterion validity of the 5-, 9-, and 10-item autism subscales in a well-characterized sample of 483 community-referred children ($\overline{X}_{age}$ = 10.11, SD_{age} = 2.99, Autism n = 127; Not-Autism n = 356). Autism diagnosis was made using the Autism Diagnostic Observation Schedule-2 and children were diagnosed according to DSM-5 criteria.

Results: Receiver Operating Characteristic analyses indicated Area Under the Curve in the poor range (0.633–.684 [95%CIs = 0.578–.734], $ps < 0.001$) for the three subscales. Sensitivity and specificity could not be optimized to acceptable levels with any cutoff value on any subscale.

Conclusion: These n-item subscales are not suitable for identification of autism symptomatology. While the difference between current and past research may be related to sample differences, it is also likely that these differences are the result of methodological improvements. These results underscore the need for use of gold-standard measures, not parent report questionnaires, for autism diagnosis and additional well-designed research into the psychometric properties of autism questionnaires.

1. Introduction

Autism Spectrum Disorder is a neurodevelopmental disorder characterized by limitations in social communication, social interest, and cognitive and/or behavioral flexibility (American Psychiatric Association, 2013). Diagnosis of autism and awareness of autism symptomatology is increasing, as are referrals for autism diagnostic evaluations (Dillenburger, Jordan, McKerr, DeVine, & Keenan, 2013; Gillespie-Lynch et al., 2015; Pizur-Barnekow, Muusz, McKenna, O'Connor, & Cutler, 2013). To diagnose autism accurately, measures with sound psychometrics are necessary. There is a particular need for research regarding autism symptom questionnaires. First, research indicates that between 58 and 93.2% of diagnostic professionals do not utilize gold-standard measures such as the Autism Diagnostic Observation Schedule-2nd Edition (ADOS-2; Lord et al., 2012) and/or the Autism Diagnostic Interview-Revised (ADI-R; Rutter, LeCouteur, & Lord, 2003) in autism diagnosis (Allen, Robins, & Decker, 2008; Cook, Hausman, Jensen-Doss, & Hawley, 2017; Falkmer, Anderson, Falkmer, & Horlin, 2013; Hathorn, Alateeqi, Graham, & O'Hare, 2014). This practice is likely due

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Table 1
Items[1] comprising the CBCL *n*-item scales investigated in the current study.

Item #	Item	5-item[2]	9-item[3]	10-item[4]
1	Acts younger than chronological age		X	X
9	Obsessional; keeps thinking about the same ideas			X
13	Seems confused	X		
17	Becomes engaged in reverie			X
25	Difficulty getting along with peers		X	
29[5]	Afraid of specific things/places/circumstances		X	
42[5]	Prefers to be alone		X	X
46	Engages in nervous habits		X	
62	Uncoordinated			X
66	Repetitive actions	X	X	X
79	Difficulty with speech		X	X
80	Has a blank look			X
84	Engages in unusual behavior	X	X	X
85	Demonstrates unusual ideas	X		
111[5]	Socially withdrawn	X	X	X

[1] Items presented here are similar in content to their respective items on the CBCL-6-18, but are not actual items.
[2] Rescorla (1988) and Duarte et al. (2003).
[3] Ooi et al. (2011).
[4] So et al. (2012).
[5] On Internalizing Problems scale.

to the time and cost investment required to be trained in these measures, and the comparative ease of administration of questionnaires (Norris & Lecavalier, 2010). Second, questionnaires are a necessary component of any comprehensive diagnostic evaluation, but may be particularly important in evaluation of autism in adolescents and adults, who can demonstrate intact performance on highly structured tasks but demonstrate weaknesses in everyday social interaction (Langmann, Becker, Poustka, Becker, & Kamp-Becker, 2017; Molloy, Murray, Akers, Mitchell, & Manning-Courtney, 2011; Pugliese et al., 2015). Third, particularly regarding questionnaires for children aged 6 and up, there is a lack of information on the majority of autism questionnaires aside from the standardization sample (Norris & Lecavalier, 2010; Hampton & Strand, 2015). Most of what is available has demonstrated weak psychometric properties, including poor inter-rater agreement, low concurrent validity estimates, inability to replicate purported factor structure, and poor sensitivity and specificity (Azad, Reisinger, Xie, & Mandell, 2016; Hampton & Strand, 2015; Hus, Bishop, Gotham, Huerta, & Lord, 2013; Norris & Lecavalier, 2010; Sturm, Kuhfeld, Kasari, & McCracken, 2017). As such, refinement of available questionnaires is necessary.

Three researchers have separately attempted to refine the Child Behavior Checklist, a parent-report, age-normed, internationally-utilized questionnaire, for use in autism diagnosis (Achenbach & Rescorla, 2001). They have each identified items on which children with autism score higher than controls and combined these items to form an autism scale: the 5-item (Rescorla, 1988; later used in Duarte, Bordin, Oliveira, & Bird, 2003), 9-item (Ooi, Rescorla, Ang, Woo, & Fung, 2011), and 10-item (So et al., 2012) (see Table 1 for items).

The 5-item was created by Rescorla (1988) via a cluster analysis of preschool children with and without autism spectrum disorders using a version of the CBCL published in 1979 (Achenbach & Edelbrock, 1979 as cited in Rescorla, 1988). Duarte et al. (2003) tested the utility of Rescorla's scale using a sample of 101 Brazilian children. Using a cut-point of 4, the 5-item had a sensitivity (true positive rate) of 88.6% and specificity (true negative rate) of 80.0% in differentiating children with autism from those with other psychiatric disorders (specific disorders not provided) (Duarte et al., 2003). Logistic regression indicated an OR = 3.0, indicating a child with a high score was three times more likely to be in the autism group than one with a low score (Duarte et al., 2003). The 9-item was created by Ooi et al. (2011) using a sample of 1265 children in Singapore. They reported 71–74% sensitivity and 73–87% specificity in differentiating those with autism from the remainder of the clinical sample, comprised of children with various subtypes of ADHD (Inattentive, Hyperactive/Impulsive, and Combined) (Ooi et al., 2011), with an OR = 1.39–1.46. Sensitivity was 68% and specificity was 80% in differentiating autism children from referred but undiagnosed children, with an OR = 1.44. Cutpoints used were not provided. The 10-item was created by So et al. (2012) using a sample of 2566 children from the Netherlands. In their study, the 10-item had an AUC of 0.73 (fair ability to differentiate those with autism from the remainder of the clinical sample), with an OR of 1.25. However, cutpoints and respective sensitivities/specificities were provided for a combined score only—the 10-item from the Teacher Report Form, a similar scale to the CBCL, plus the 10-item created from the CBCL (So et al., 2012). Sensitivity and specificity at various cutpoints in general would be beneficial for use in clinical practice (Youngstrom, 2014), and particularly regarding the CBCL 10-item scale alone, as teacher reports may not be available.

The above studies suggest that the *n*-item CBCL-6-18 scales have the potential to assist in autism diagnosis, with the added benefit that the CBCL-6-18 is already given in many settings (Warnick, Bracken, & Kasl, 2008). However, the above studies had several limitations. First, none of the studies utilized gold-standard measures in diagnostic procedures, relying on clinical interviews and parent/teacher reports (Duarte et al., 2003; Ooi et al., 2011) or interviews, IQ testing, and clinical observation (So et al., 2012). Second, in all studies, participants were diagnosed according to now outdated criteria—the DSM-IV-TR (Duarte et al., 2003; So et al., 2012) and ICD-9 (Ooi et al., 2011). Given the changes in criteria from the DSM-IV to DSM-5, namely increased requirements for both