Research in Autism Spectrum Disorders 6 (2012) 378–384

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

Journal homepage: http://ees.elsevier.com/RASD/default.asp

# Development of a critical item algorithm for the Baby and Infant Screen for Children with aUtIsm Traits

Santino V. LoVullo, Johnny L. Matson *

*Louisiana State University, United States*

ARTICLE INFO

*Article history:*
Received 2 May 2011
Accepted 27 June 2011
Available online 23 July 2011

*Keywords:*
Autism spectrum disorders
BISCUIT
Scoring algorithm
Screening
Assessment

ABSTRACT

Autism is defined by impairments in socialization, communication, with the presence of stereotyped behavior. It is also associated with various medical conditions, intellectual disability, comorbid psychopathology, and problem behavior. This is a concerning finding in that there may be a true increase in the disorder's prevalence and that it is associated with poor long-term outcomes. Fortunately, effective treatments exist that can alter the course of the disorder if administered early in a child's life. A method to facilitate early intervention is through the early screening of autism with instruments such as the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT). The primary purpose of the current investigation was to further develop the utility of the BISCUIT by creating an abbreviated scoring algorithm. Participants included 2168 children ages 17–37 with an autism spectrum disorder or atypical development enrolled in an early intervention program. Discriminant function analysis (DFA) and receiver operating characteristic (ROC) analysis were conducted resulting in a 5 item scoring algorithm with comparable diagnostic accuracy to the existing scoring procedure. Implications for these data and directions for further research are discussed.



## 1. Introduction

Autism Spectrum Disorders are characterized by pervasive impairments in socialization, communication, with the presence of stereotypical behavior (Cederlund, Hagberg, & Gillberg, 2010; Dawson, Matson, & Cherry, 1998; Fernell & Gillberg, 2010; Matson, Fodstad, & Dempsey, 2009; Nydén et al., 2010). They are also associated with a myriad of other debilitating features including medical conditions, intellectual disability (La Malfa et al., 2007; Matson & Shoemaker, 2009), comorbid psychopathology (Bellini, 2004; Briegel, Schimek, & Kamp-Becker, 2010; Ghaziuddin, Ghaziuddin, & Greden, 2002; Gillberg, 2010; Schreck, Williams, & Smith, 2004), and severe problem behavior (Matson et al., 2003; Matson, Dixon, & Matson, 2005; Rojahn, Aman, Matson, & Mayville, 2003; Smith & Matson, 2010a, 2010b, 2010c).

It is not surprising then that a diagnosis of ASD is associated with poor social, occupational, and educational outcomes (Gillberg & Steffenburg, 1987; Matson & Sipes, 2010; Matson & Smith, 2008; Matson, Wilkins, Sevin, et al., 2009). For instance, Lockyer and Rutter (1969, 1970), examined 38 individuals ages 16 and over and found that only 8% obtained paid employment and greater than 50% percent lived in residential settings. Gillberg and Steffenburg (1987) examined 23 children until the ages of 16–23. At follow-up, only one individual was classified as independent, half were classified as functioning fairly well, and the other half were classified as functioning poorly. Additionally, 22% had increases in challenging behavior including self-injury and aggression. Howlin et al. (2004) described 69 children with autism and IQs of

* Corresponding author at: Department of Psychology, LSU, Baton Rouge, LA 70803, United States.
*E-mail address:* johnmatson@aol.com (J.L. Matson).

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doi:10.1016/j.rasd.2011.06.011

50 or greater who were followed up as adults (mean age of 29 years). Participants with IQs greater than 70 had better outcomes. However, overall 12% were rated as having very good outcomes, 10% good, 19% fair, 46% poor, and 12% very poor. Only 7% were educated in mainstream schools, 8% worked independently, and more than half lacked friendships.

The prevalence of autism has been steadily rising from 0.41 per 1000 (Lotter, 1966), to more current rates of 6.7 per 1000 in the year 2000 and 9.0 per 1000 in the year 2006 (Rice, 2009). Although it has been proposed that diagnostic artifacts such as a broadened definition of autism and diagnostic substitution explain a large portion of the increase (Coo et al., 2008; Croen, Grether, Hoogstrate, & Selvin, 2002; Shattuck, 2006), others contend that there is a true increase and that these explanations are overstated (Hertz-Picciotto & Delwiche, 2009).

Fortunately effective treatment are available that, if applied in an intensive manor, may alter the trajectory of the disorder, at least for many children. Substantial gains have been noted in multiple domains including IQ, classroom placement, social skills, and language. Age of intervention appears to be related to outcome, with children who receive services at younger ages making more substantial gains (Fenske, Stanley, Krantz, & McClannahan, 1985; Harris & Handleman, 2000). Furthermore, early intervention is supported by the neurosciences and may be a more cost-effective means of providing services to individuals with ASD over their lifetimes.

The delivery of early intervention services to children with autism is contingent on timely diagnosis. Although psychometrically sound diagnostic instruments are available, early identification can be facilitated by the use of autism screening measures to quickly assess a large number of children at an early age to identify those who would benefit from a more thorough diagnostic evaluation (Coonrod & Stone, 2005). Autism screening measures vary by the population for which they are intended. Level 1 screeners are used to identify children at risk for autism in the general population while level 2 screeners are designed to identify children at risk for autism who were previously identified as having a developmental disability (Coonrod & Stone, 2005).

The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT; Matson, Boisjoli, & Wilkins, 2007) is an informant based measure designed to assess symptoms of autism and associated problems in young children (17–37 months) who present with developmental concerns. The BISCUIT is comprised of three parts: Part 1 is intended to identify children with ASD (PDD-NOS and Autistic Disorder) from a pool of children with general developmental problems. Part 2 assesses symptoms potentially indicative of comorbid psychopathology in the form of tic disorders, ADHD, Obsessive Compulsive Disorder, and Specific Phobia. Part 3 measures problem behaviors that are commonly exhibited in children with ASD such as self-injury, aggression, disruption, and repetitive behaviors (Matson et al., 2007). The focus of the present study, BISCUIT-Part 1, contains 62 items. Factor analytic procedures yielded 3 primary factors: socialization/nonverbal communication, communication, and repetitive behavior/restricted interests (Matson, Boisjoli, Hess, & Wilkins, 2010). Cutoff scores were calculated using profile analyses and a standard deviation approach (Jacobson & Truax, 1991) to derive scores that would maximize differentiation among groups. This was followed by logistical regression procedures and receiver operating characteristic (ROC) analysis to calculate and optimize sensitivity and specificity. Cutoff scores of 17 (sensitivity = 84.7, specificity = 86.4) and 39 (sensitivity = 84.4, specificity = 83.3) were selected to help differentiate atypical development from PDD-NOS, and PDD-NOS from Autistic Disorder, respectively.

As a precursor to the present investigation, Matson, Wilkins, Sharp, et al. (2009) identified items from the BISCUIT-Part 1 that best differentiated ASD from atypical development (study 1), and PDD-NOS from Autistic Disorder (study 2). Using 13 predictor items, the logistic regression model correctly classified 92% of children as having ASD and 98% as having atypical development (no ASD). Likewise, using 11 predictor items, the logistic regression model correctly classified 88.9% of children with Autistic Disorder and 88.2% of children with PDD-NOS. Predictor items from both studies represented the three core areas of autism: socialization, communication, and stereotyped behaviors. However, the predictive weights of items were not listed, which would have provided information about their relative importance in predicting group membership.

The present study was intended to build upon the findings of Matson, Mahan, and Matson (2009) by developing an abbreviated scoring algorithm for the BISCUIT-Part 1 that would maximize sensitivity and specificity. Development of a scoring algorithm is important for several reasons. Scoring algorithms have shown to be useful for similar instruments (Robins, Fein, Barton, & Green, 2001; Wong et al., 2004), and the identification of critical items may add to the increasing body of knowledge regarding the early symptoms of autism and help professionals better understand the nature of autism in young children. An alternative scoring procedure has the potential to minimize assessment time and/or be used as part of a two pronged scoring procedure to maximize true positives, even at the expense of false positives.

## 2. Method

### 2.1. Participants

The sample consisted of 2168 children ages 17–37 months enrolled in Louisiana's EarlyStep's early intervention program, which provides services to families with children who have a developmental delay or a physical condition likely to result in a developmental delay (see Table 1). Diagnostic classifications for participants were assigned by a licensed doctoral level psychologist with over 30 years experience in the field of autism and developmental disabilities, and based upon DSM-IV-TR criteria, Modified Checklist for Autism in Toddlers (M-CHAT; Robins et al., 2001) scores, and Battelle Developmental Inventory-2nd Edition (BDI-2; Newborg, 2005) scores. Similar diagnostic methodology has been described in prior research where ASD diagnoses were established (Fombonne et al., 2004).