Beyond Parental Report: Findings from the Rapid-ABC, A New 4-Minute Interactive Autism

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Abstract

Objective was to determine whether a 4-minute, interactive assessment of social-communication abilities, is effective in identifying infants and toddlers at-risk for autism spectrum disorder (ASD). Total of 46 infants and toddlers, 18 at-risk for an ASD and 28 not at-risk for an ASD, ages 15 to 24 months, participated. Assessment protocol included the Rapid-ABC, a general developmental questionnaire, two parent-report screening questionnaires, and behavioral observation. At-risk classification was assigned based on an "all-information-available" clinical judgment by expert clinician. Results yielded strong internal consistency (Cronbach's coefficient alpha = .82) and high test-rest validity for the Rapid-ABC total score ($r = .82$, $p < .001$). ROC analysis identified a cut-off score with high sensitivity (.83; 95%CI = .59-.96) and specificity (.96; 95%CI = .82-1.00). Results provide evidence that the Rapid-ABC is effective in identifying infants and toddlers who are at-risk for ASD and discriminating them from not at-risk infants and toddlers. Future research on the Rapid-ABC will utilize a larger, more diverse population of children within a variety of pediatric settings, as well as discriminate between ASD and other developmental disorders.

Keywords: autism, infants, toddlers, screening

Beyond Parental Report: Findings from the Rapid-ABC, A New 4-Minute Interactive Autism Screener

Autism Spectrum Disorders (ASD) are characterized by deficits in reciprocal social interactions, communication, and restricted repetitive behaviors, and delays and deficits must be evident prior to the age of 36 months (American Psychiatric Association [APA], 2000. Although parents often report delays in children's development before their second birthday (Charwarska et al., 2007; Wiggins, Baio, & Rice, 2006), professionals often do not provide a diagnosis until 4 to 5 years of age (Wiggins et al.). Even with these early concerns, pediatricians often do not assess for an ASD on a regular basis, with only about 8% reporting to do so (Dosreis, Weiner, Johnson, & Newschaffer, 2006). Research into early parental concerns shows that language and social delays are the primary reason for concern prior to 24 months (Chawarska et al., Pinto-Martin et al., 2008). Evaluation of affective displays, eye contact, early joint attention skills and other simple communication skills may provide a powerful behavioral screener for the detection of autism risk in infancy, prior to the emergence of language (Bryson, Zwaigenbaum, McDermott, Rombough, & Brian, 2008; Ozonoff, et al., 2010; Zwaigenbaum et al., 2005). Within the first one to two years of life, typically developing infants and toddlers initiate and respond to affective and attentional cues (e.g., pointing, shifting eye gaze, showing an object) which facilitates the coordination of attention between social partners and contributes to dyadic emotion regulation (Butterworth & Jarrett, 1991; Carpenter, Nagell, & Tomasello, 1998). In the case of children with ASD, however, response to and initiation of affective displays, eye contact, and joint attention signals are slow to emerge within the first two to three years of life. Young children with autism often do not consistently follow another person's direction of gaze or point, even when paired with positive emotional facial expressions, and the initiation of affective and

joint attention signals is observed infrequently in children with ASD during the infant, toddler, and preschool years (Bryson et al.; Mundy, 1995; Zwaigenbaum et al.). This observation is so consistent that deviations in the development of these early social communication abilities are considered to be pathognomonic of very young children with ASD (Dawson, Meltsoff, Osterling, Rinaldi, & Brown, 1998; Mundy).

Mandates for Early Screening of ASD

The development of a rapid autism screening instrument for infants and toddlers is an urgent priority, as the Centers for Disease Control and Prevention (CDC) has estimated that approximately 1 child of every 110 children in the United States has an autism spectrum disorder (CDC, 2009). Due to the high prevalence of children with ASD (CDC, 2007a, 2007b, 2009), the Interagency Autism Coordinating Committee (IACC) research recommendation asks for a cost-effective screener or diagnostic measure by 2011 (IACC, 2010). In addition, the American Academy of Pediatrics (AAP) released clinical guidelines recommending that pediatricians screen all infants and toddlers for autism, initially at 18 months then again at 24 months, during well baby checkups (Johnson, Myers, & the Council on Children with Disabilities, 2007). This report states:

> Screen at 18 and 24 months and any other time when parents raise a concern about a possible ASD. Although no screening tool is perfect, choose and become comfortable with at least 1 tool for each age group and use it consistently. Before 18 months of age, screening tools that target social and communication skills may be helpful in systematically looking for early signs of ASDs.

Screening Tools in ASD

Early intervention when children are as young as possible produces verbal language and social changes in children with ASD that cannot be accomplished later (Dawson et al., 2010; McGee, Morrier, & Daly, 1999), and thus in recent years there has been an increase in the development of screening assessments for young children with suspected ASD. Screening tools developed specifically for young children with ASD have been designated into levels in order to identify children with developmental delays using a broad-based approach (Bishop, Luyster, Richler, & Lord, 2008). Screeners that fall under the Level 1 category are aimed at differentiating "children at risk who are at risk of ASDs from the general population, especially those with typical development" (Johnson et al., 2007). These include the CHecklist for Autism in Toddlers (CHAT; Baron-Cohen, Allen, & Gillberg, 1992), the Modified CHecklist for Autism in Toddlers (M-CHAT; Robins, Fein, Barton, & Green, 2001), the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS:ITC; Wetherby & Prizant, 2002), the Social Communication Assessment for Toddlers with Autism (Drew, Baird, Taylor, Milne, & Charman, 2007), and the Quantitative Checklist for Autism in Toddlers (Allison et al., 2008). Level 2 screeners "help to differentiate children who are at-risk of ASDs from those at risk of other developmental disorders" (Johnson et al.), and usually require more time and training to administer and interpret. These include the Screening Tool for Autism in Toddlers (STAT; Stone, Coonrod, & Ousley, 2000) which involves a 15 to 20 minute direct assessment of the child by a clinician.

For children who "fail" a level 1 and a level 2 screener, a comprehensive autism diagnostic assessment and access to early intervention services with parent education are recommended (Johnson et al., 2007; Bishop et al., 2008). A standardized assessment designed

specifically for diagnosing young children with suspected ASD (i.e., children 12-30 months) has been recently developed (Luyster et al., 2009). This assessment, the Autism Diagnostic Observation Schedule-Toddler Module (ADOS-T), which is a downward extension of the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999), has been developed to provide levels of concern for ASD based on a diagnostic algorithm score. These levels of concern are little to no concern, mild to moderate concern, and moderate to severe concern, and the authors recommend a follow-up differential diagnosis evaluation once the child is 36 months (Luyster et al.).

Rationale for a Brief, Interactive ASD Screener

Despite the variety of screeners that are available, the AAP report further indicates that there are no rapid infant screening tools (5 to 10 minutes) that allow interactive assessment by the clinician. Barriers to adequate screening outlined by the report include: (a) absence of direct clinical assessments that can be administered by a general pediatrician or non-specialist; (b) absence of a rapid assessment; and (c) infrequent use of autism specific standardized screening tools by pediatricians (Dosreis et al., 2006).

Best practices for diagnosing young children with ASD involve gathering information from multiple sources, including both parent report and direct observation (Chawarska et al., 2007; Klin et al., 2004; Lord, 1995, Stone et al., 1999). The majority of brief screening tools available for this purpose rely exclusively on parent report (Allison et al., 2008; Robins et al., 2001), however interactive screeners can be used to provide additional data to determine risk status during a clinical visit. This interactive session needs to be comprehensive, but brief since health care providers do not have much time to spend with the young child, especially during the well-baby checkup. In addition, repeated interactive assessments may be especially sensitive to

detecting regression in social-communication skills which occurs in a substantial proportion of infants and toddlers who are eventually diagnosed with autism (Lord, Shulman, & DiLavore, 2004; Werner & Dawson, 2005).

The purpose of this study was to examine the reliability and validity of a brief 4-minute interactive screener consists of 5 common adult-child activities (i.e., saying "hello," playing with a ball, reading a picture book, putting on a "hat", and gentle tickling), 18 ratings of nonverbal communication behaviors (e.g., eye contact, smiling, pointing), and 5 summary ratings describing the effort required by the examiner to engage the child. This screener is referred to as the Rapid-ABC, with "rapid" referring to the brief nature of the screener, and "abc" referring to the instruments' focus on assessing social attention, the back-and-forth nature of social interactions, and nonverbal communication.

Methods

Subject Recruitment and Characteristics

The total sample included 46 infants and toddlers between the ages of 15 and 24 months (M = 19.5 months; SD = 3.0), and was recruited from the Emory Autism Center's diagnostic clinic waiting lists and through advertisements distributed to community day care facilities. Characteristics of the research participants can be found in Table 1.

<Insert Table 1 about here>

Protection of human subjects. Research conducted on the Rapid-ABC was reviewed and approved by the Institutional Review Boards of both Emory University and Georgia Institute of Technology. All parents of subjects read and signed an informed consent form and a HIPAA authorization for the use and disclosure of their protected health information prior to

participating in the study. All personnel working with the subjects received training and certification in issues related to HIPAA guidelines (i.e., CITI certification).

Assessment Protocol

For this study, the infants and toddlers' research classification of being "at-risk for ASD" or "not at-risk for ASD" was determined based on an all-information-available judgment. This judgment was made by a Master's or PhD level research clinician, who was highly experienced in the assessment of young children with ASD, and was based on the parent report information gathered as well as all behavioral observations (Chawarska et al., 2007; Klin et al., 2004; Lord, 1995; Stone et al., 1999), and/or the presence of a parent reported language regression. For this pilot study, the research-clinicians completed the whole protocol, including the Rapid-ABC, and used this information in making the all-information-available research risk classification. Risk status was confirmed by a second PhD level clinician based on a chart review of all information available, with a 91% agreement; disagreements were resolved by clinical consensus.

Parent completed checklists. Participation in the study involved administration of the interactive Rapid-ABC screener, a pen-and-paper general development questionnaire that obtained information about early language, social, and motor milestones, two parent report Level 1 screening questionnaires (the CSBS:ITC and the M-CHAT), and behavioral observation (i.e., during the Rapid-ABC administration and throughout the 45-minute research visit). For the CSBS:ITC questionnaire, parents indicated whether their child exhibited behaviors that typically emerge within the first two years of life. The CSBS:ITC is designed for infants and toddlers who are 6 to 24 months of age, and cut-off scores are provided for each month of age. The M-CHAT lists behaviors that parents rated as present or absent. This measure is scored by examining the total number of items "failed" (i.e., more than three items failed indicate autism risk) or the total

number of critical items failed (two or more of six critical items failed indicate autism risk; Robins et al., 2001).

Interactive screening assessment: The Rapid-ABC. The Rapid-ABC is a 4-minute direct assessment of social-communication behaviors that consists of five activities designed to elicit social-communication behaviors, including affect, eye contact, joint attention behaviors, and social reciprocity. The testing format of the Rapid-ABC screener is simple, interactive (versus relying only on parental report), includes common, engaging activities, does not require specialized toys or materials, and can be completed and scored in approximately 4-minutes. The Rapid-ABC was developed at Emory University, and later optimized for ease of use through a collaborative grant between Emory University and the Georgia Tech/Emory Health Systems Institute. The screener has a single page format administration and scoring instructions are depicted by icons. A total score is calculated by counting the number of target behaviors that were not observed and adding that to the overall ratings that record "ease" of engaging the child at five different points during the interaction. Higher scores indicate poorer social-communication abilities overall. An automated scanning software program has been developed for rapid, automated scoring and data collection. This technological solution allows the examiner to obtain a total score automatically, visualization of data across behavioral categories, and comparison of total score to local norms collected within the same clinical setting. A training video and administration/scoring guide, as well as an administration fidelity checklist, have been developed to facilitate clinician education and training.

Tasks and behaviors assessed. The Rapid-ABC is comprised of five brief, common activities. Activities included: (a) saying "hello," (b) ball play, (c) turning pages of a book, (d) pretending the book is a hat and putting it on your head, and (e) smiling/tickling. Only a small

ball and a board book are required to administer this assessment. For each activity the examiner observes the child's social-communication and other participatory behaviors. These include: 1) establishing eye contact; 2) shifting attention from the examiner to an object; 3) eye contact after a pause in a game; 4) smiling; 5) taking turns during ball play; 6) turning the pages of the book; and 7) pointing. Behaviors are scored immediately after the completion of each task. In addition, for each task, the effort required by the examiner to engage the child is scored based on a 3-point Likert scale.

Results

Psychometric Properties of the Rapid-ABC Screener

Results show good internal consistency reliability (Cronbach's coefficient alpha = .82). Test-retest validity for the Rapid-ABC total score is high (r = .82; p <.001), and was based on data collected across two visits for 24 infants and toddlers. These infants and toddlers included 9 at-risk for ASD and 15 not at-risk for ASD with an average time between screenings of 5.1 months (SD=2.0).

Receiver Operator Curve Analyses

Using all-information-available judgments from the first visit as the outcome variable, the receiver operator curve (ROC) analysis shows that the Rapid-ABC is effective in discriminating at-risk and not at-risk infants and toddlers, and that a cut-off score of greater than 13 yields a high sensitivity (.83; 95% CI = .59 - .96) and specificity (.96; 95% CI = .82 – 1.00) (see Figure 1).

<Insert Figure 1 about here>

In addition, a cutoff score greater than of 14.3, equivalent to 2 standard deviations above the mean of the Rapid-ABC total score for the not at-risk for ASD infants and toddlers, yielded

correct classification of 93% of the infants and toddlers judged to be at-risk for ASD at initial screening. In addition, 87% of children judged as not at-risk infants and toddlers were correctly identified using this cut-off score. A Rapid-ABC total cut-off score greater than 2 standard deviations above the mean for not at-risk infants and toddlers yielded a sensitivity of .78 and a specificity of .96.

Concurrent Validity

Using the cut-off score of 13 for the Rapid-ABC, a comparison was made between Rapid-ABC risk status outcomes and outcomes on the parental report screeners. The Total Score of the Rapid-ABC screener is correlated with the CSBS:ITC total score ($r = -.68$, $p < .001$), and M-CHAT total number of failed items ($r = .73$, $p < .001$) providing an indication of strong concurrent validity. Percent agreement between risk-status on the CSBS:ITC and the Rapid-ABC was 76.1, and Cohen's kappa was .52, indicating moderate agreement. Percent agreement between risk-status on the M-CHAT and the Rapid-ABC was 84.7, and Cohen's kappa was .68, indicating substantial agreement.

Discussion

Results indicate the Rapid-ABC promises to be a useful interactive screening measure for infants and toddlers judged to be at-risk for an ASD. The Rapid-ABC reliably distinguished between young children that are at-risk for a diagnosis of ASD and those that are not. Test-retest reliability indicates the results are stable across time (Lord, 1995; Luyster et al., 2009), and correlate highly with current screening measures for ASD completed by parents. Interactive screening for ASD may provide reliable information about social behavior that cannot be otherwise obtained from parent report questionnaires alone (Brian et al., 2008; Rogers, 2009; Stone, McMahon, & Henderson, 2008).

Best practice standards for diagnosing young children with ASD include gathering information from both parent report and interactive assessment and observations (Chawarska et al., 2007; Klin et al., 2004; Lord, 1995; Stone et al., 1999), and the Rapid-ABC can easily be incorporated into these screening assessments. Combining results from the Rapid-ABC and parent report, along with clinical judgment, can make the decision to refer for a comprehensive evaluation more quickly, leading children into evidence-based treatments in a more timely manner.

Limitations and Future Research

Preliminary results of the Rapid-ABC indicate that it is a reliable measure for distinguishing ASD risk status in young children. Even with these promising results, there are several limitations to be mentioned. The primary limitation of the data presented is that a comprehensive differential ASD evaluation needs to be completed on all infants and toddlers in the study to finalize diagnostic status (to date, five ADOS-T (Luyster et al., 2009) assessments have been completed although more follow-up evaluations are planned), which can be validated with accuracy at 36 months (Lord, 1995; Stone et al., 1999).

A second limitation is the lack of data on children with other developmental disabilities other than ASD (i.e., Down syndrome, intellectual disabilities, etc.). The Rapid-ABC can reliably distinguish if a children is at-risk for ASD or not, but distinguishing between ASD and other disabilities is also needed. The sensitivity and specificity of the Rapid-ABC is encouraging, but future research should expand at-risk populations to determine how reliable it is in making these often times difficult distinctions.

Beside the areas mentioned above, future research on the Rapid-ABC should increase the number of subjects, gather standardized data on the language/cognitive outcomes of the infants

and toddlers, gather longitudinal data to identify whether repeated screenings with the Rapid-ABC may be useful in identifying infants and toddlers who experience an early developmental regression (Lord et al., 2004; Werner & Dawson, 2005), and differentiate between at-risk for ASD and children with general developmental delays.

Conclusions

According to the most recent report by the Health Resources and Services Administration and the CDC, ASD occurs in up to 1% of children (CDC, 2207a, 2007b, 2009; Johnson et al., 2007; Kogan et al., 2009); however, an ASD is often not diagnosed until children are preschool age or older, despite the presence of symptoms during infancy (Chawarska et al., 2007; Shattuck et al., 2009; Wiggins et al., 2006). This project evaluated an interactive ASD screener that provides a rapid, but effective method for large population screening for autism symptoms that can be integrated into pediatric well-baby checkups or during visits with other pediatric specialists, including developmental pediatricians, early intervention specialists, speech-language therapists, or occupational therapists. Early screening and identification of autism-risk during infancy may lead to earlier access to specialized interventions and improved developmental outcomes (Howlin, Magiati, & Charman, 2009; McGee et al., 1999; Reichow & Wolery, 2009).

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Table 1. Characteristics for total sample of infants and toddlers at-risk for ASD and not at-risk for ASD.

Characteristics	**At-Risk for ASD (n = 18)**	**Not At-Risk for ASD (n = 28)**
Male, No. (%)	11 (61)	14 (50)
Age, mean (SD), mon	20.4 (3.1)	19.0 (2.8)
Race/ethnicity, mother %		
White/Caucasian	72.2	89.3
African American/Black	22.2	7.1
Hispanic or Latino	5.6	3.6
% Highest level of education, Mother*		
High school graduate	16.7	0
At least some college	77.7	100
Missing	5.6	0
CSBS:ITC total score**, mean (SD)	22.3 (11.3)	42.2 (6.5)
Number of items failed on M-CHAT**, mean (SD)	9.1 (5.0)	.5 (1.0)
Number of M-CHAT critical items failed**, mean (SD)	3.1 (1.8)	.1 (.4)
Rapid-ABC total score**, mean (SD)	15.9 (5.0)	6.9 (3.7)

* $p < .05$; ** $p < .001$

Figure 1. ROC Curve for the Rapid-ABC and its ability to discriminate infants and toddlers judged to be at-risk for ASD and not at-risk for ASD.