ADEC 2nd Ed

Autism Detection in Early Childhood

eManual



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ACER

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First published 2022
by ACER Press, an imprint of
Australian Council *for* Educational Research Ltd
19 Prospect Hill Road, Camberwell, Victoria, 3124, Australia

https://shop.acer.org
sales@acer.org

In the spirit of reconciliation, ACER Press acknowledges the Traditional Custodians of Country throughout Australia and their connections to land, sea and community. We pay our respect to their elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today.

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Edited by Shaneen Goodwin
Cover design, text design and typesetting by ACER Creative Services

Autism Detection in Early Childhood (ADEC) 2nd Edition eManual
ISBN 978-1-74286-681-9

A catalogue record for this book is available from the National Library of Australia

Contents



Tables and Figures v

Acknowledgements and About the Authors vii

Overview viii

PART 1

Introduction to Autism Detection in Early Childhood (ADEC) 1

What Does ASD Look Like in Young Children? 1

Early Detection of ASD 2

Preliminary Research 2

PART 2

Core Behavioural Characteristics and Their Operationalisation in the ADEC 5

ADEC Behaviours 5

PART 3

Psychometric Data 10

The Aim of Autism Detection in Early Childhood (ADEC) 10

Samples 10

Reliability and Validity 13

Age at Which Appropriate Behaviour is First Observed 27

Summary of Data 29

PART 4

Adaptations 30

Autism Detection in Early Childhood–Spanish (ADEC-SP) 30

Brief Autism Detection in Early Childhood (BADEC) 32

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PART 5

Administration and Report Interpretation 35

Overview 35

Materials Required 35

Administration 36

Directions for Online Administration 36

The Testing Room 38

Scoring and Reporting 38

What Do I Do if the Child is Unwilling to Cooperate? 38

Suggested Sequence for Testing 39

PART 6

Case Studies 40

References 42

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Tables and Figures



Tables

Table 1: Frequency of Specific Unusual Behaviours and Age When First Observed 4

Table 2: Mean Age in Months of First CARS and ADEC Scores for Each Group in Sample 4 11

Table 3: Summary of Sample Characteristics of Additional Studies Evaluating the ADEC 11

Table 4: Factor Matrix for Principal Axis Factoring (PAF) of Single-Factor Solution of ADEC Items (Nah et al., 2014b) 14

Table 5: Correlations Between ADEC, ADI-R (Total and Subscales), CARS, and CHAT at Time of Diagnosis 16

Table 6: Correlations Between ADEC, CARS, and CHAT at Assessment for Early Intervention Program 16

Table 7: Correlations Between ADEC Total Score and Scores on the ADOS and ADI-R 17

Table 8: Frequency of Responses by Diagnosis and Item–Total Correlations for Each ADEC Item 18

Table 9: Descriptive Statistics and ANOVA Results of ADEC, CHAT, and CARS Scores Comparisons Across Developmental Category for All Children 20

Table 10: Descriptive Statistics and ANOVA Results of ADEC, CHAT, and CARS Scores Comparisons Across Developmental Category for Children Younger than 42 Months of Age 21

Table 11: Differences in Total ADEC Score by ASD Diagnosis 22

Table 12: Pooled Within-Groups Correlations Between Discriminating Variables and Standardised Canonical Discriminant Function Coefficients 22

Table 13: Discriminant Function Analysis Results for Discriminating Developmental Categories Using Three Assessment Tools for ASD 24

Table 14: Values of Sensitivity and Specificity by ADEC Cut-Off Score 27

Table 15: Age (Months) at Which Typical Behaviour is First Observed by Developmental Category for Each ADEC Item 28

Table 16: Correlations Between Scores on the ADEC-SP, CARS, and ADI-R (Hedley et al., 2010) 31

Table 17: Mean ADEC-SP Total Score for Each Diagnostic Group (Hedley et al., 2010) 31

Table 18: Sensitivity and Specificity of ADEC-SP Cut-Off Scores (Hedley et al., 2010) 32

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Figures

Figure 1: Individual Cases as a Function of the Two Discriminant Functions Representing ADEC and CARS Scores in Sample 4 23

Figure 2: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (n = 71) and (b) Those With (or Likely to Have) Another Disability but No Confirmed Diagnosis of Autistic Disorder (n = 16) for Children up to 42 Months of Age 25

Figure 3: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (n = 23) and (b) Those With (or Likely to Have) Another Disability but No Confirmed Diagnosis of Autistic Disorder (n = 8) for Children up to 30 Months of Age 25

Figure 4: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (n = 71) and (b) Typically Developing Children (n = 18) for Children up to 42 Months of Age 26

Figure 5: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (n = 23) and (b) Typically Developing Children (n = 6) for Children up to 30 Months of Age 26

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Acknowledgements and About the Authors



Acknowledgements

The authors would like to acknowledge the contributions of Dr Paul Williamson and Dr Darren Hedley.

About the Authors

Robyn Young, PhD

Robyn Young's interest in autism spectrum disorder (ASD) began while studying for her PhD in Savant Syndrome. This work became the subject of an ABC documentary, *Uncommon Genius*. She went on to develop both the first and second editions of the *Autism Detection in Early Childhood* screener (Young, 2007; Young et al., 2022), which clearly operationalise early behaviours indicative of ASD. Robyn has further collaborated with her colleagues at Flinders University to develop the *Structured Program For Early Childhood Therapists Working With Autism (SPECTRA)* intervention program (Young et al., 2009). She has also published a book on preparing children on the autism spectrum for school, *Ready, Set, Learn!* (Moffat & Young, 2017).

Neil Brewer, PhD

Neil Brewer's PhD and early research career focused on cognitive processing deficits associated with intellectual disability, and he taught predominantly on psychological assessment and cognition and learning in association with intellectual disability. Although in the latter half of his career his main focus has been in the area of forensic psychology, he has maintained an ongoing research program concerned with various aspects of ASD, including early detection in young children and the relationship between social-cognitive difficulties and criminal vulnerability in adults.

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Yong-Hwee Nah is an Educational Psychologist and an Assistant Professor at the National Institute of Education, Nanyang Technological University, Singapore. He has more than two decades of working experience in special educational needs, having worked in special schools as a school psychologist, in a hospital's paediatric clinic as a senior psychologist and as a consultant psychologist in various private clinics. He specialises in the identification of ASD, and both his research and clinical interests lie in the early detection of ASD in young children, as well as understanding and supporting individuals with ASD across their lifespan.

Alliyza Lim, PhD

Alliyza Lim has an interest in applied research that aims to improve the wellbeing of people on the autism spectrum. Her PhD research focused on understanding perceptions of individuals with ASD in the criminal justice system. In addition to investigating the early detection of ASD in young children, she is also involved in research on how ASD may co-occur with other mental health conditions such as PTSD and eating disorders.

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Overview



The behavioural manifestations indicative of a diagnosis of autism spectrum condition (ASD) include social and communication difficulties and ritualistic behaviours. Although some of these behaviours may be directly related to the neurological origins of the condition, others may develop as a result of these earlier deficiencies. Young and Brewer (2002) referred to early symptoms that are considered to be direct manifestations of the underlying neurological differences as "core deficit-linked behaviours". These behaviours are present in very young children on the autism spectrum but may be modified or disappear as the child grows older. As the child develops and becomes affected by environmental factors such as intervention procedures, secondary behaviours may develop, perhaps as a way to compensate for these underlying neurological deficits (Young et al., 2003). The ideal time to make a diagnosis of ASD should therefore be at a young age, preferably before the age of 24 months, when these behaviours considered to be core features of the condition are most conspicuous and in their purest form (Mundy & Sigman, 1989; Sigman et al., 2004; Sigman et al., 2006). The Autism Detection in Early Childhood (ADEC) was designed to recognise these early behavioural features.

Most of the commonly used diagnostic tools require the presence of behaviours (either typical or atypical), the non-appearance of which might not be significant or expected at 18 months. Examples of such behaviours include verbal skills and the development of peer relationships. As a result, many practitioners who are not sensitive to other more significant signs of the condition miss the diagnosis entirely. Practitioners who may have some suspicions but are not aware of other indicators of the condition are inclined to maintain a "wait and see" approach until it is clear that the failure to develop these recognised abilities is atypical. This resulting delay in diagnosis can cause distress for families who are seeking answers, and frustration when the diagnosis finally arrives, and they may reflect on the valuable intervention time lost.

Guided by available literature, existing tests, and our own research, we have identified 16 behaviours we consider best predict the development of ASD in young children. Unlike some of its predecessors, the ADEC has clearly operationalised these behaviours so as to render it suitable for use by allied health professionals with limited experience in the field of ASD. As this test focuses on pre-verbal behaviour, it is suitable for children as young as 12 months. The core behaviours operationalised in the ADEC are believed to reflect the underlying neurological issue(s), rather than secondary manifestations of this condition.

The data presented in this manual show that the ADEC focuses on ASD-related behaviours rather than behaviours common to other developmental disabilities. The result is that, unlike other tools that have high sensitivity but poor specificity (or vice versa), the ADEC provides adequate levels of both. The ADEC thus provides an effective screening tool that can be used with little training to identify children suspected of having or of developing ASD. This capability is important given that significant improvements in ASD symptomology have been shown following early intervention programs (Dawson et al., 2010; Fuller & Kaiser, 2020; Reichow et al., 2012; Zwaigenbaum et al., 2015).

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1 Introduction to Autism Detection in Early Childhood (ADEC)



The Autism Detection in Early Childhood (ADEC) was initially developed to detect autistic disorder in pre-verbal infants. An important limitation of existing assessment instruments is that they do not permit a diagnosis of ASD at this early stage of development. The ADEC focuses on pre-verbal behaviours that can be identified in early infancy and are not dependent on receptive language. Further, it has a behavioural orientation that leads to objective measurement; each characteristic of interest is operationalised in terms of overt behaviours that can be easily observed and objectively measured.

What Does ASD Look Like in Young Children?

ASD is diagnosed by a spectrum of specific behaviours and symptoms rather than by aetiology. Although Kanner's (1943) seminal work suggested a congenital predisposition and ASD is now recognised as a neurological condition (Baron-Cohen, 2004; Muhle et al., 2018) with a probable genetic base (Hashem et al., 2020; Rylaarsdam & Guemez-Gamboa, 2019; Tick et al., 2016), blood tests, genetic tests, or neurological tests that can confirm the diagnosis of ASD are not yet available. Early onset is a diagnostic criterion, and anecdotal reports suggest that children diagnosed with ASD exhibit characteristics from an early age, with the majority of parents noting problems with their child's development before 24 months (Matheis et al., 2017; McDonnell et al., 2020; Zuckerman et al., 2015). In some cases, development may appear typical until about age 1 or 2, when characteristics of those on the autism spectrum begin to emerge or a regression or loss of previously acquired skills is noticed (Ozonoff et al., 2008). Although we recognise that the onset of ASD in children might be expected before words begin to emerge, the most common early cause of concern relates to language and speech problems (Herlihy et al., 2015; Karp et al., 2017; Kozlowski et al., 2011), with social difficulties also causing early concern (Becerra-Culqui et al., 2018). The features of ASD in pre-verbal children are not well documented and little attention has been given to the developmental pathology of the condition. The generic diagnostic criteria often used to facilitate diagnosis, such as the eleventh edition of the *International Classification of Diseases* (ICD-11; World Health Organisation [WHO], 2019) and the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association [APA], 2013), pay little regard to the early manifestations of ASD. Many of these criteria are only appropriate for older children.

Early signs of ASD that have been proposed in the literature include descriptions of children who fail to follow a point, do not respond to their name, do not engage in joint attention behaviour, and whose play may not involve imitation (Baird et al., 2000; Baranek, 1999; Lord, 1995; Mars et al., 1998; Mundy et al., 1986; Osterling & Dawson, 1994; Stone et al., 1999; Tanner & Dounavi, 2020; Vostanis et al., 1998; Werner et al., 2000). It is now understood that the behavioural manifestations of ASD are affected by variables such as age and environment, but little attention has been paid to these variables. The ADEC is an attempt to identify and clearly operationalise the behaviours specific to very young children. The behaviours identified in the ADEC are subject to modification, and possibly amelioration, due to variables such as intervention and age. Thus, the ADEC is targeted at very young children and may not be appropriate for older children or children with low support needs. Nevertheless, our data show that many of the behaviours are still appropriate for older children, particularly for children who may be classified as requiring very substantial support.

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Early Detection of ASD

Arguments have been made against the early diagnosis of ASD, primarily due to the possible negative effects of labelling, as well as the increased possibility of an incorrect diagnosis. Nevertheless, by identifying those on the autism spectrum at a young age, families can understand the diagnosis and gain support at an earlier age. A delay in the diagnosis of ASD can cause significant distress for the parents of the child. Parents are often relieved once they are given an explanation for their child's developmental differences (Abbott et al., 2012; Braiden et al., 2010). Early diagnosis also gives families the chance to learn more about ASD and its effects on their child and allows them more time to adjust and to plan for the future. It also allows them to make decisions about implementing early intervention programs to develop the child's level of adaptive functioning.

Research shows that there is generally a significant delay of approximately 3 years between the average age of the child at which parents first express concern about differences in development and the age at which a diagnosis of ASD is made (Crane et al., 2016; Hofer et al., 2019; Howlin & Moore, 1997; McDonnell et al., 2020). In a survey of over 1,000 parents in the United Kingdom, Crane et al. (2016) found that the mean age of children at the time their families sought medical attention was 3.9 years, yet the children did not receive a formal diagnosis of ASD until they were, on average, 7.5 years of age. This delay remains despite research suggesting that early diagnoses of ASD are reliable and stable over time (Barbaro & Dissanayake, 2017; Lord et al., 2006; Moore & Goodson, 2003; Ozonoff et al., 2015; Pierce et al., 2019).

Difficulty in making a diagnosis at an early age partly stems from the fact that the primary difficulties or core behaviours, arising early in the development of ASD, have not yet been clearly defined or operationalised. Therefore, current diagnostic criteria defined in the *ICD-11* (WHO, 2019) and *DSM-5* (APA, 2013) are based on secondary difficulties that do not typically develop until later in life, certainly beyond the first 18 months. Thus, a diagnosis requires children to demonstrate behaviours not yet developed in the earliest stages of ASD, but that develop as the child becomes older (Young et al., 2003). For example, operationalising difficulties with social interaction in terms of one's ability to engage in reciprocal conversation or develop peer relationships is not appropriate for children under 2 years of age. It can therefore be argued that many of the *DSM-5* (APA, 2013) and *ICD-11* (WHO, 2019) diagnostic criteria do not apply to the diagnosis of infants and children under the age of 2 years and are relevant only to older children (Aitken, 1991; Baranek, 1999; Stone et al., 1994). It can also be argued that the core behavioural characteristics of autism seen in infants are those that reflect the central neuropsychological deficit underlying the condition and may be more likely to appear in their purest form early in development (Ungerer, 1989). These behaviours, however, need to be clearly identified, defined and operationalised if they are to be included and thus facilitate the earlier diagnosis of the condition.

A meta-analysis of 29 studies by Fuller and Kaiser (2020) found that young children with ASD who received early intervention demonstrated significantly better social communication outcomes than those in control groups. Similarly, Dawson et al. (2010) found that preschool children on the autism spectrum who received early behavioural intervention showed an increase in IQ scores by an average of 17 points and significant improvements in language and adaptive functioning after 2 years of intervention.

Preliminary Research

Research linked to the development of the ADEC has focused on the identification of the core diagnostic behaviours identifiable in infants and very young children with ASD. A number of areas of behaviour have been consistently identified in the literature, including (a) qualitative impairment in reciprocal social interactions, (b) qualitative impairment in verbal and non-verbal communication, (c) restricted repertoire of activities or interests and insistence on sameness, and (d) disturbances in response to sensory stimuli. In very young children, the observable behaviours in these categories

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include failure to direct another person's attention, inability to follow eye gaze or pointing, failure to orient to name, aversions to social touch, lower frequency of looking at another's face, lack of attention to visual stimuli and increased mouthing of objects (Adrien et al., 1991; Baranek, 1999; Charman et al., 1998; Osterling & Dawson, 1994; Tanner & Dounavi, 2020).

Young et al. (2003) used retrospective parental reports to further identify early behavioural differences associated with those on the autism spectrum and the ages at which they typically emerged. Parents of 97 children on the autism spectrum completed an open-ended questionnaire designed to elicit information concerning the nature and approximate age of onset of the early signs of atypical development they had observed in their child. Specific questions were then included about the presence and age of onset of a number of specific social, communication, and stereotyped interests in their child, based on behaviours that have been typically associated with ASD in previous literature.

Parents' responses to the open-ended section regarding the early differences observed in their child were grouped into 22 categories of behaviours, with inter-rater reliability on 20% of the questionnaires exceeding 90%. These categories of behaviour are summarised in Table 1, listed in order of when they were typically first observed. Atypical signs were generally noticed, on average, from 11 months. The earliest signs to be noticed were lack of shared enjoyment and lack of eye contact, usually noted around the ages of 10 months and 12 months, respectively. The most commonly reported difference in development noted by 77.8% of parents was delayed language, usually noted at approximately 19 months (Young et al., 2003).

A number of the behaviours reported by parents in Young et al.'s (2003) study are consistent with findings from previous studies. For example, Gilberg (1989) identified the use of a person as an inanimate object, lack of interest in playing with other children, becoming upset at particular sensations, unusual ways of moving the hands, and anomalies in play in a parental report study. In observational studies examining home videos of infants later diagnosed with autistic disorder (Adrien et al., 1991; Baranek, 1999), behaviours such as appearing uncomfortable when held, lack of eye contact, and rarely using gestures were also identified.

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Table 1: Frequency of Specific Unusual Behaviours and Age When First Observed

Behaviour	Age (months)			Frequency
	M	*SD*	Minimum–Maximum	Percentage*
No interest in toys	9.3	6.2	3–18	8.6
Lack of shared enjoyment	10.4	9.9	0–30	17.3
Lack of eye contact	12.0	9.0	0–30	16.0
Dislikes being cuddled, held	12.1	15.9	0–45	8.6
Unusual body posture	13.4	13.0	0–30	6.2
Unusual fears	13.8	11.3	1–24	7.4
Need for routines/rituals	14.0	3.5	12–18	3.7
Social behaviours – other	14.7	10.7	6–36	7.4
Eating problems	11.0	7.7	0–18	7.4
Stereotyped movements	16.1	5.8	5–24	22.2
No attention to caregiver	17.1	10.5	1–36	34.6
Tantrums/crying	18.1	8.4	0–36	28.4
Regression of language	18.4	5.4	10–30	21.0
Delayed language	18.4	6.7	3–36	77.8
Idiosyncratic development	21.0	7.4	12–30	4.9
Lack of imitative play	21.3	4.3	12–24	9.9
Stereotyped behaviours – other	21.5	15.6	0–46	9.9
Stereotyped/restricted interest	21.7	9.5	5–48	21.0
Lack of pointing/gestures	22.0	17.3	12–42	3.7
Poor socialisation	24.8	10.8	9–48	29.6
Stereotyped/repetitive language	27.6	6.8	18–36	6.2

Note. Percentages reflect the number of valid cases, which may vary slightly between behaviours.

To overcome the limitations of retrospective analysis inherent in the parental report method used by Young et al. (2003) and the lack of control groups, Clifford et al. (2007) carried out behavioural observations of home videos of infants who had subsequently been identified as having either ASD, a developmental or language delay or as typically developing infants. Their aim was to identify the early social difficulties that distinguished pre-verbal infants with ASD from the other two groups. Social behaviours, such as eye contact, play behaviours, response to name, and overall clinical impression, were coded in the study from the videos. Clifford et al. found the following five items discriminated the infants on the autism spectrum from the two control groups, with a correct classification rate of 86.7%: clinical impressions, peer interest, gaze aversion, quality of eye contact, and positive affect. The fact that, overall, "clinical impression" was the best predictor of subsequent development supports the idea that ASD behaviours are present at a young age and suggests to trained clinicians that ASD will develop. But, unlike the presence of atypical behaviours, the behaviours are of concern due to their absence, and therefore need to be clearly identified and operationalised.

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2 Core Behavioural Characteristics and Their Operationalisation in the ADEC



Preliminary research has identified three main domains of behaviour in which children on the autism spectrum experience difficulties: (a) disturbances in interacting with others and with objects, (b) stereotyped, repetitive movements, and (c) bizarre responses to environmental stimuli. Within each domain, specific behavioural tendencies have been noted. These include:

a. *disturbances in interacting with others and with objects:* (a) difficulties with social referencing and sharing attention (i.e., pointing, gaze switching between object and adult, and gaze monitoring), (b) poor eye-gaze behaviour, (c) difficulties with functional play (playing with objects according to their function), (d) difficulties with pretend play (playing with objects as though absent properties are present), (e) poor imitation of movements, (f) reciprocity of smiles, (g) lack of orienting to name, (h) lack of anticipation of others' social approaches, (i) lack of nestling behaviour, (j) rare use of gesture

b. *stereotyped, repetitive movements:* (a) arranging objects in a line, (b) hand-flapping, (c) toe-walking, (d) finger-flicking, (d) rocking, (e) several other (specified and unspecified) behaviours

c. *bizarre responses to environmental stimuli:* (a) covering ears in response to sounds, (b) smelling objects or people, (c) mouthing objects

The ADEC consists of 16 items plus an Adaptation Period, each item focusing on a core behavioural characteristic from one of the three behavioural domains. Each behaviour is defined in the following section.

ADEC Behaviours

1. Response to Name

Failing to orient to name is one of the most commonly observed features in children with ASD. Parents often report that their child may be deaf but note that this deafness can be quite selective. This failure to orient has been observed in children later diagnosed with autistic disorder in a study of home videos of their first year (Baranek, 1999). Analyses of home videos have shown that children on the autism spectrum were less likely to orient to their name being called when compared with children with other developmental conditions (Baranek, 1999) or typically developing children (Osterling & Dawson, 1994; Werner et al., 2000). This deficit has also been demonstrated in children in their second year (Clifford et al., 2007; Ettridge, 2001) and older (Dawson et al., 1998; DiLavore et al., 1995; Saint-Georges et al., 2010; Trillingsgaard et al., 2005). Children who consistently failed to respond to their name between the ages of 12 and 24 months have been found to be significantly more likely to be diagnosed with ASD and have poorer receptive language at 36 months than those who did not (Miller et al., 2017).

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2. Imitation of Motor Behaviours

A lack of ability to imitate simple motor movements has been shown to discriminate children on the autism spectrum from developmentally delayed and typically developing children around the ages of 22 and 54 months in behavioural observation studies (Stone et al., 1990; Stone, Ousley, & Littleford, 1997; Vanvuchelen et al., 2011). Young children diagnosed with autistic disorder imitate simple motor actions much less often than children with other developmental conditions (Charman et al., 1997; DiLavore et al., 1995; Lord et al., 1994; Vivanti et al., 2014), children with language delay (Cox et al., 1999, Lord et al., 1994), and typically developing children (Charman et al., 1997; Cox et al., 1999; Vitanti et al., 2014; Young et al., 2011). Ornitz et al. (1977) found that children with autism first imitate sounds much later than typically developing children (median age for imitating sounds was 12 months for typically developing children compared to 24 months for autistic children; median age for imitating words was 15 months for typically developing children compared to 30 months for autistic children). Delays in imitation among young children are also evident from parental reports (Gillberg et al., 1990; Rowberry et al., 2015; Stone & Hogan, 1993).

3. Stereotypical Behaviour

Ritualistic play begins at around 18 months of age in children with autism and involves the obsessive linear alignment of objects (Prizant & Wetherby, 1988). Although this linear aligning of objects was mentioned in Kanner's (1943) original article, it has not been investigated in many studies. However, parental reports of their children's behaviour in early childhood suggest that such stereotypical behaviour is displayed by some children on the autism spectrum (Greaves et al., 2006; McConkey et al., 2009). It has also been found that some children who later received a diagnosis of autistic disorder did show distress after a line of blocks was disturbed (Ettridge, 2001).

4. Gaze Switching

Although it is not possible to identify the motivation of young pre-verbal children for looking at an adult's face, one possible motive could be to share interest in an object or event, termed "joint attention". Joint attention behaviours include attempts to direct the attention of another by eye gaze or pointing behaviours that indicate the child's attention alternates between the object or event and the adult. The two joint attention behaviours of interest in the ADEC are gaze switching and gaze monitoring (i.e., following and initiating a point). When a child is presented with a stimulus with which they are not familiar, they typically check an adult's facial expression as a guide to see how they should react. Studies have shown that children on the autism spectrum between the ages of 12 and 60 months are less likely to switch gaze than typically developing children (Charman et al., 1997; Ettridge, 2001; Mars et al., 1998; Nyström et al., 2019) or children with other types of developmental or language delay (Charman et al., 1997; Franchini et al., 2019; Wetherby et al., 1998).

5. Eye Contact

Kanner (1943) noted that the children he was describing did not look at people's faces. This lack of eye contact is one of the most commonly noted features of ASD and forms one of the diagnostic criteria of the *DSM-5* (APA, 2013). In our preliminary work, lack of eye contact was noted by 90% of parents of children diagnosed with ASD, and began, on average, at 6 months of age (Baron-Cohen et al., 1992; Chawarska et al., 2014; Sigman et al., 1986; Szatmari et al., 2016; Zwaigenbaum et al., 2005). This is in line with findings from a previous parent report study (Gillberg et al., 1990). Studies using videos of children later diagnosed with autistic disorder have noted a significant lack of eye contact between the ages of 12 and 24 months (Clifford et al., 2007; Mars et al., 1998; Osterling & Dawson, 1994). Studies using various diagnostic tools for detecting autistic disorder have found differences in eye contact between children with autism and children with an intellectual disability (Adrien et al., 1987; Adrien, Barthélémy, et al., 1992; Lord et al., 1994), developmental delay (Charman et al., 1997; DiLavore et al., 1995), and typically developing children (Adrien et al., 1987; Charman et al., 1997; Ozonoff et al., 2010). However, a behavioural observation study of children aged 34 to 75 months found that frequencies of eye contact with a quiet or inactive adult, following a pause in a tickling game or in combination

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with a request or reach for an object, did not differentiate children with autism from those with global developmental delay (Mundy et al., 1986), suggesting this behaviour may vary across contexts (Jones et al., 2017) and stages of development.

6. Functional Play

Children on the autism spectrum have been shown to be less likely to use toys according to their function (preferring less sophisticated forms of play, such as mouthing, spinning, or banging) than do children with other developmental conditions or typically developing children (aged from 5 to 80 months) (Baranek et al., 2005; Fanning et al., 2021; Williams et al., 2001; Wilson et al., 2017). However, other studies with slightly older children by Charman et al. (1998; age 20 months) and Thiemann-Bourque et al. (2019; ages 63 to 91 months) did not identify any differences in functional play between children with autistic disorder and children with developmental delay (Charman et al., 1998) or typically developing children (Thiemann et al., 2019). Nah (2015) found that while functional behaviour differentiated ASD from non-ASD samples under 24 months of age, functional play seemed to improve, and he suggested that functional play may no longer be a suitable behaviour marker as the child gets older. This suggests that, once again, this behaviour may only be apparent in very young children with ASD.

7. Pretend Play

Pretend play involves the use of toys or objects as if they possess characteristics that are absent. For example, a wooden block might be used as if it was a toy car, or an empty toy teapot as if it contained tea. In a behaviour observation study of 20-month-old infants, none of the infants with autistic disorder demonstrated pretend play (Charman et al., 1998). In another study of children between the ages of 3 and 6 years, only two of 22 older children with autism (mean age 54 months) demonstrated this ability (Stone et al., 1990). Lack of pretend play has also been noted by parent report (Stone & Hogan, 1993). Pretend play usually begins in typically developing children at about 18 months of age (Gould, 1986). Children on the autism spectrum have been shown to be less likely to engage in pretend play than children with other developmental conditions (Charman et al., 1997; DiLavore et al., 1995; Sigman & Ungerer, 1984), language delays (Cox et al., 1999), and typically developing children (Baird et al., 2000; Baron-Cohen et al., 1996; Campbell et al., 2018; Charman et al., 1997; Cox et al., 1999; Sigman & Ungerer, 1984; Thiemann-Bourque et al., 2019). This item also forms one of the three key items of the CHAT for screening children for autism at 18 months of age (Baron-Cohen et al., 1992). Unlike some of the core behaviours outlined thus far, this difficulty is not simply delayed but persists into adulthood (Berument et al., 1999). It should be noted, however, that a significant proportion of children with other conditions, including developmental delay (Charman et al., 1998; Thiemann-Bourque et al., 2012), learning and hearing impairments, and intellectual disability, also show this deficit (Stone et al., 1990).

8. Reciprocity of Smile

The tendency for children with ASD to fail to reciprocate another's smile has been indicated by behavioural observation and parental report. Dawson et al. (1990) found that although children with autism aged 30 to 70 months did not differ from typically developing children in frequency or duration of smiles, they were less likely to return their mother's smile, and were less likely to combine smiles with eye contact. Ratings of home videos of children under 24 months showed that lack of social smiling differentiated children with autism from typically developing children (Adrien et al., 1991; Adrien, Perrot, et al., 1992; Cox et al., 1999). Parents of autistic children report that their child "does not smile when expected" significantly more than parents of children with global developmental delay (Gillberg et al., 1990). Further, children are much less likely to reciprocate a smile than other children, including children with language delays (Cox et al., 1999), children with other developmental conditions (Adrien et al., 1987; Adrien, Barthélémy, et al., 1992; DiLavore et al., 1995; Lord et al., 1994; Trillingsgaard et al., 2005), and typically developing children (Ozonoff et al., 2010).

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9. Response to Everyday Sounds

Despite Kanner's (1943) observation that adverse reactions to commonly heard noises are among the earliest characteristics of children with autism, this phenomenon has received little empirical investigation. A study of home videos of children taken between the ages of 6 and 48 months found that extreme responses to sounds differentiated children with autism from children with global developmental delay (Adrien, Barthélémy, et al., 1992), a finding supported by parental reports (Dickie et al., 2009; Gillberg et al., 1990). Response to sound is just one example of a number of behaviours that demonstrate sensitivity to stimuli through one or more of the senses. One might also see joint attention behaviours such as gaze monitoring occurring spontaneously during this task.

10. Gaze Monitoring

This is the second of the two joint attention behaviours included in the ADEC. The gaze monitoring item includes:

(a) *Follow a point*. Most typically developing children will look at where an adult has pointed before they are 12 months old if the target is not at too great an angle from the adult (Morissette et al., 1995; Woodward & Guajardo, 2002), with some studies suggesting that this ability develops from as young as 4 to 6 months of age (Bertenthal et al., 2014). It has been found that children with autistic disorder are significantly less likely to switch their gaze to follow pointing than typically developing children at the age of 0 to 6 months (Maestro et al., 2001) and 6 to 24 months (Clifford et al., 2008). This also forms one of the three key behaviours used to identify those on the autism spectrum in the CHAT (Baron-Cohen et al., 1992).

(b) *Initiate pointing behaviour*. Empirical research involving children as young as 18 months demonstrates that children with autistic disorder rarely use pointing to direct an adult's attention towards an object or event (Baron-Cohen et al., 1996; Charman et al., 1998; McArthur & Adamson, 1996; Mundy et al., 1990; Mundy et al., 1994; Stone, Ousley, Yoder, et al., 1997). Spontaneous use of pointing behaviour is also included in this item.

11. Responds to Verbal Command

Children with autistic disorder are less likely to follow simple verbal directions (e.g., "come here", "clap hands", or "touch your nose") than are children who do not have autistic disorder (Ettridge, 2001; Mars et al., 1998). The mean age at which typically developing children first understand simple commands is 9 months, whereas for children on the autism spectrum it is significantly later. Ornitz et al. (1977) suggest that the behaviour may occur around 12 months, but this has not been supported in the literature.

12. Use of Words

One of the criteria for autistic disorder in the text revision of the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; APA, 2000) was language delay. While a delay in expressive language is no longer a requirement for the diagnosis of ASD under the *DSM-5* criteria, many children on the autism spectrum have a co-occurring language impairment, with such difficulties observed from as young as 12 months of age (Lazenby et al., 2016). This typically presents in infants as a lack in the use of words (Ohta et al., 1987; Young et al., 2003). A significant difference in the use of words has been found in analysis of early videos made of children with autistic disorder and typically developing children (Ettridge, 2001; Maestro et al., 2001; Mars et al., 1998) and with children with global developmental delay (Adrien, Barthélémy, et al., 1992). Typically developing children first use words (other than "mama" or "dada") at a mean age of 12 months. In contrast, there is some evidence that children with autism do not start to use words until a mean age of 24 months (Ornitz et al., 1977), with some never achieving this milestone. Earlier age of first words and higher number of words spoken in early childhood have been found to predict better cognitive ability and adaptive functioning in young children with ASD (Kover et al., 2016; Mayo et al., 2013).

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13. Anticipatory Posture

Key authors in the area of ASD have noted that very young children with autism tend not to assume an anticipatory posture of raising their arms when being picked up, suggesting a lack of ability to anticipate the social advances of others (Kanner, 1943; Rutter, 1978). While more recent research has neglected this behaviour, in our study of parents' reports of the first signs of atypical development in children later diagnosed with autistic disorder, 50% of parents noted this characteristic at a mean age of 15 months (Young, et al., 2003). This deficit has been observed in videos of children (who were later diagnosed with autistic disorder) taken when the children were between 12 and 24 months (Clifford et al., 2007) and below 6 months of age (Maestro et al., 2001). This behaviour may indicate the ability to understand the mental states of others, commonly referred to as "theory of mind". People with ASD have often been found to have difficulties in this area (Brewer et al., 2017).

14. Nestling

In his original description of autism, Kanner (1943) noted that children with autism do not adjust their body to the posture of the person who is holding them. They often remain unusually rigid or flaccid while being held. In one of our earlier surveys, more than half of the parents of children diagnosed with autistic disorder reported that their children were uncomfortable being held and that this behaviour started at about 14 to 15 months of age (Young et al., 2003). Massie (1978) found that infants with autism were rated as being more avoidant while being held than children who were developing typically during the first 6 months of life.

15. Use of Gestures

Spontaneous use of social gestures in young children with ASD has received little attention in the literature. However, in our study of parents' reports, about 80% of parents of children with autistic disorder reported that their children rarely used gestures to communicate (Young et al., 2003). Analysis of early videos has shown that children with autistic disorder use significantly fewer gestures at 6 to 12 months (Maestro et al., 2001) and 12 to 18 months (Maestro et al., 1999) than typically developing children. The use of gestures by children on the autism spectrum has also been found to be significantly less than other groups of children regardless of the type, or absence, of other conditions (Adrien, Barthélémy, et al., 1992; Choi et al., 2020; Lord, 1995; Lord et al., 1994; Veness et al., 2012; Watson et al., 2013; Wetherby et al., 1998). A study by Cox et al. (1999) also found that the percentage of children with autistic disorder who displayed a definite difference in the use of conventional instrumental gestures remained constant between the ages of 20 and 42 months.

16. Ability to Switch Tasks

Children on the autism spectrum display impaired performance in task switching (i.e., attention shifting or attention disengagement; Bush, 2001; Carotenuto et al., 2019). They are less successful in disengaging attention and have difficulty in rapidly shifting attention compared to children with Down syndrome (Landry, 2000) or typically developing children (Sasson et al., 2011).

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3 Psychometric Data



The Aim of Autism Detection in Early Childhood (ADEC)

The aim of the ADEC was to clearly operationalise core behavioural characteristics that may reflect autistic disorder and thus to create a greater awareness of these early signs. The ADEC is a screening tool that is intended to be used by allied health professionals. It allows people involved in working with the child, including the parents, to understand the specific difficulties the child is presenting with, thus allowing these behaviours to be targeted through intervention. Further, the psychometric characteristics presented below suggest that the ADEC has psychometric properties as good as tools that require extensive training and time to administer, and better than some other commonly used tools. (For a comprehensive review of the major tools used for ASD detection in early childhood, see Brewer et al., 2020.)

Samples

To investigate the psychometric properties of the ADEC, data were collected in four samples of young children. In three of these samples (Sample 1: Ettridge, 2001; Sample 2: Matthew, 2003; Sample 4: Young et al., 2006), the ADEC was administered to children with a *DSM-IV-TR* diagnosis of autistic disorder as well as two comparison samples of children with either no disability diagnosis (i.e., typically developing) or a diagnosis of another disability other than autistic disorder (referred to as "other developmental disability"). Sample 1 (Ettridge, 2001) involved younger children, many of whom had not had a diagnosis confirmed. They were considered "at risk" of autistic disorder either through having genetic predisposition to autistic disorder (e.g., a sibling of a child with autistic disorder) or by showing signs consistent with those on the autism spectrum. Children demonstrating signs of autistic disorder became involved in this study following referrals to the first author (Young) from paediatricians and other healthcare professionals throughout South Australia. Typically, these referrals resulted from concern related to the child's development. Siblings of children already diagnosed with autistic disorder also were recruited for the study due to their genetic predisposition to autistic disorder. Sample 2 (Mathew, 2003) involved older participants who had been diagnosed with autistic disorder by healthcare professionals. All children with autistic disorder had this diagnosis confirmed through Autism SA. Children with other disabilities were approached through various government agencies specialising in children with disabilities, predominantly those related to language. Typically developing children were located through local childcare facilities.

Sample 3 (Parker, 2002) was obtained from respondents to an internet survey and used a parental self-report version of the ADEC. Data from this sample were used to evaluate age-related characteristics underlying the behaviours assessed using the ADEC.

Sample 4 (Young et al., 2006) includes data from 269 participants, some of whose data are included in Samples 1 and 2. All participants had been assessed through the Early Intervention Research Program (EIRP) at Flinders University in South Australia. One hundred and forty-nine participants in this study were diagnosed as having autistic disorder (131 male, 18 female) either by two independent practitioners or through a multidisciplinary assessment at Autism SA. Of the remaining participants, 60 were considered to be typically developing (39 male, 21 female), and 60 were diagnosed as having

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a language condition or other condition (42 male, 18 female). In order for a diagnosis to be accepted by Autism SA, thus allowing a child to be eligible for state-funded services, they had to obtain a Childhood Autism Rating Scale (CARS; Schopler et al., 1988) score of more than 30 and meet *DSM-IV-TR* criteria for autistic disorder. In some cases, the Autism Diagnostic Interview–Revised (ADI-R; Le Couteur et al., 2003) and/or Checklist for Autism in Toddlers (CHAT; Baron-Cohen et al., 1992) was also used.

The data for Sample 4 were not all collected at the one time, as CARS scores were collected from trained professionals and the ADEC scores were collected following referral to the EIRP. If the referral was not accompanied by a CARS score, and therefore a diagnosis was required, a CARS, ADEC and Autism Diagnostic Interview–Revised were completed at that time. The ages of the first assessment we have on each child in Sample 4 are presented in Table 2.

Table 2: Mean Age in Months of First CARS and ADEC Scores for Each Group in Sample 4

Group	CARS		ADEC	
	M	*SD*	*M*	*SD*
Autistic disorder	35.78	12.37	41.46	14.78
Other disability	38.04	15.57	38.80	15.41
Typically developing	N/A	N/A	41.30	14.00

To date, a further five published studies have investigated the psychometric properties of the ADEC. A summary of the sample characteristics for each study is presented in Table 3.

Table 3: Summary of Sample Characteristics of Additional Studies Evaluating the ADEC

Study	Sample characteristics				
	Diagnostic criteria used	Comparison groups	Age (Months)		Source
			Range	*M (SD)*	
Nah et al. (2014b)	*DSM-IV-TR* autistic disorder (*n* = 70)	PDD-NOS (*n* = 24) Other developmental conditions (*n* = 57) Typical development (*n* = 64)	12–36	26.11 (6.89)	Community
Nah et al. (2014a)	*DSM-IV-TR* autistic disorder (*n* = 51)*	PDD-NOS (n = 2)	19–42	33.5 (5.6)	Community
Dix et al. (2015)	*DSM-IV-TR* autistic disorder (*n* = 24) *DSM-IV-TR* PDD-NOS (*n* = 8)	Autism diagnosis not given (*n* = 21)	18–47	32.2 (8.4)	Clinically referred sample
Hedley et al. (2015)	*DSM-5* autism spectrum disorder (*n* = 48)	Developmental delay (*n* = 38) No diagnosis (*n* = 10)	14.3–36.9	28.67 (5.41)	Clinically referred sample
Davis et al. (2015)	*DSM-IV-TR* autistic disorder, Asperger's disorder, or PDD-NOS, or *DSM-5* autism spectrum disorder (*n* = 25)	Autism diagnosis not given (*n* = 17)	15–30	25 (3.8)	Clinically referred sample

*37 participants in this study were part of the participant sample in Nah et al. (2014b).

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Nah et al. (2014b) conducted a comprehensive assessment of the validity and reliability of the ADEC as a level 2 screening tool for ASD among a community sample of children aged between 12 and 36 months who were suspected of having communication or developmental delays (*N* = 215). Data were collected over a 10-year period, and participants were recruited from multiple sources, including general media advertising, developmental clinics and childcare centres in South Australia, and a university research centre for those on the autism spectrum in South Australia. A small number of participants (*n* = 14) were also recruited from an early intervention centre in Singapore. All participants were administered the ADEC, which was scored by two examiners to assess inter-rater reliability. Participants were also independently assessed by an independent diagnostician who was blind to the child's ADEC score, using a battery of tests, including the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), the Autism Diagnostic Interview–Revised (ADI-R; Le Couteur et al., 2003), the Mullen Scale of Early Learning (MSEL; Mullen, 1995), and the Vineland Adaptive Behaviour Scales (Sparrow et al., 1984; Sparrow et al., 2005). The clinical utility of the ADEC was examined by comparing the ability of the ADEC to accurately identify children with ASD to that of the ADOS and ADI-R (current gold standard measures for ASD assessment), while controlling for levels of nonverbal IQ (as measured by the MSEL) and adaptive functioning (as measured by the Vineland). Participants were also invited to return for a second ADEC administration between 12 to 138 days later (*M* = 54.5) to assess the test–retest reliability of the ADEC. A subset of the data from Nah et al. (2014b) was further analysed by Nah et al. (2014a).

Dix et al. (2015) conducted a retrospective file audit of an early intervention program based in Western Australia. Children were referred to the service due to developmental concerns and were screened using the ADEC if they were between the ages of 1 to 3 years. Children who scored highly on the ADEC were then triaged for a diagnostic assessment with a paediatrician. The ADEC was administered to 60 children between January 2008 and December 2010, and of these, 53 families provided consent for their medical records to be analysed as part of this study. Scores on the ADEC were compared against the child's documented diagnostic status in 2013 (i.e., when the child was between 4 and 8 years old).

Hedley et al. (2015) investigated the use of the ADEC among a clinical sample of toddlers aged between 14 to 36 months who were referred to a United States paediatric hospital due to developmental concerns (*N* = 96). All children were administered the ADEC as part of an intake screening interview at the paediatric hospital. The ADEC was administered by a member of the research team who was blind to the outcome of the rest of the child's intake interview, and likewise, the clinician conducting the interview was blind to the child's ADEC score. Upon the conclusion of the intake interview, children who were suspected by the interviewing clinician as having ASD were referred for a full diagnostic assessment by a multidisciplinary team, consisting of a psychologist, psychometrician, speech and language pathologist, and developmental paediatrician or paediatric neurologist. This assessment included the administration of additional tools such as the ADOS-2 (Lord et al., 2012), Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2010), Childhood Autism Rating Scale–Second Edition–Standard Version (CARS-2-ST; Schopler et al., 2010), Mullen Scale of Early Learning (MSEL; Mullen, 1995), and Vineland Adaptive Behaviour Scales–Second Edition (Vineland-II; Sparrow et al., 2005). In cases where the intake interview was not indicative of ASD, children were either referred for other services or evaluations, or were discharged if no concerns were detected.

A study by Davis et al. (2015) examined the use of the ADEC as part of a broader investigation of the model of ASD assessment used by the Toddlers at Risk of Autism Clinic (TRAC) in New South Wales, Australia. The TRAC evaluates children under the age of 2.5 years who are suspected of having ASD and aims to reduce the wait times for a diagnostic assessment for toddlers. The TRAC uses the ADEC in conjunction with the Social Attention and Communication Study (SACS) checklist (Barbaro et al., 2011), a semi-structured play-based assessment designed to screen for autistic disorder in children aged 12 to 24 months. During the assessment, a developmental paediatrician conducts a caregiver interview, while an allied health professional administers the SACS and/or ADEC. Information from both clinicians, as well as written reports from educators and other professionals, are then evaluated against the diagnostic criteria. This study by Davis et al. (2015) examined the assessments conducted at the TRAC between August 2010 and April 2014. A total of 42 children were assessed, ranging in age from 15 to 30 months. Of these, 22 children were assessed using both the SACS and ADEC, 15 using

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the ADEC only, and two using the SACS only (the assessment records of the remaining three children could not be located). As the study aimed to evaluate the TRAC model as a whole, no data were available on the properties of the ADEC as a standalone tool.

Reliability and Validity

Internal Consistency

The ADEC has uniformly demonstrated good internal consistency; Cronbach's α = .90 (Sample 1), .93 (Sample 2), .85 (Sample 4), .91 (Nah et al., 2014b) and .80 (Hedley et al., 2015). Cronbach's α did not differ significantly with the removal of any specific item.

Test–Retest Reliability

Using Sample 1, test–retest reliability was assessed over the space of 12 months. Scores were found to be very consistent, r = .90, n = 14, p < .001. Moreover, although scores decreased over time (indicating a decrease in autistic behaviours), the decrease was not statistically significant, $t(13) = -0.58$, p = .57, with a negligible standardised difference score (d = −.07). Hence, at least over a period of 12 months, the ADEC total score was shown to be highly reliable. A slight decline in scores might be expected due to maturation and intervention. Total scores on the ADEC from Sample 4 also exhibited excellent test–retest reliability. The correlation between ADEC score at diagnosis and the child becoming involved in the EIRP was high (r = .82, p < .01). The interval between these two data points ranged from 3 weeks to 18 months.

Further test–retest reliability and inter-rater reliability analyses focused on each of the ADEC items separately, administered with a 2-week interval by different raters. All items exhibited good reliability (r > .30, p <.001). Reliability coefficients exceeded .5 for the following items: use of words, gaze switching, use of gestures, following a point, and functional play. Coefficients for response to name, upset when blocks were disturbed, and response to sounds were not statistically significant.

In the study by Nah et al. (2014b), participants returned for a second ADEC administration between 12 and 138 days later (M = 54.5). Each administration was conducted by a different examiner to reduce the likelihood of familiarity bias. The test–retest reliability of the ADEC total score was high, $r(62)$ = .72, p < .001.

Inter-rater Reliability

Inter-rater reliability was available from 179 assessments over a 2.5 year period (Sample 4). Twelve raters participated in these assessments. The correlation between the first and second ADEC administered, irrespective of rater, was very high (r =.97, p < .001).

Inter-rater reliability data was also available for 19.5% of participants from Nah et al.'s (2014b) study and 24% of participants from Hedley et al.'s (2015) study. Inter-rater reliability for total ADEC scores was high; $r(42)$ = .98, p < .001 (Nah et al., 2014b) and ICC = .95, 95% CI [.89, .98] (Hedley et al., 2015). Inter-rater reliability for individual items ranged from fair to good, with values of Cohen's kappa between .43 (reciprocity of smile) and .88 (imitation).

Content Validity

As mentioned previously, the ADEC was developed specifically to assess behaviours symptomatic of very young children on the autism spectrum. Research linked to the development of the ADEC has focused on the identification of the core behavioural characteristics identifiable in infants and very young children. These behaviours were identified through literature search and independent research. While the items of the ADEC were developed based on the criteria outlined in the *DSM-IV-TR* (APA, 2000), they remain consistent with the criteria in the *DSM-5* (APA, 2013) and cover the following areas: (a) qualitative impairment in reciprocal social interactions, (b) qualitative impairment in verbal and non-verbal communication, (c) restricted repertoire of activities or interests and insistence on sameness, and (d) disturbances in response to sensory stimuli.

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Construct Validity

Nah et al. (2014b) investigated the construct validity of the ADEC by examining the factor structure of the 16 items of the ADEC using principal axis factoring (PAF) with direct oblimin rotation. The PAF indicated four factors with eigenvalues greater than 1, with each factor explaining 43.6%, 8.3%, 7.9%, and 6.3% of the variance in ADEC scores, respectively. While Factor 1 was dominant, the scree plot showed inflexions at the second and fifth factor, suggesting the presence of either one or four factors. Therefore, a parallel analysis was subsequently conducted using software developed by Watkins (2000) to confirm the number of factors to be retained. The results of the parallel analysis revealed that only one factor had an eigenvalue from PAF that exceeded that of the corresponding random dataset. PAF was thus rerun to extract a single-factor solution of "social communication" (items 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, and 16; see Table 4). Cronbach's α for this factor was .92.

Table 4: Factor Matrix for Principal Axis Factoring (PAF) of Single-Factor Solution of ADEC Items (Nah et al., 2014b)

Item	Factor 1 – social communication	
	Factor pattern coefficients	Communalities
Response to name	**.80**	.64
Imitation	**.57**	.32
Stereotypical behaviour	.35	.12
Gaze switching	**.77**	.59
Eye contact in a game of peek-a-boo	**.66**	.43
Functional play	**.75**	.56
Pretend play	**.66**	.43
Reciprocity of smile	**.70**	.49
Response to everyday sounds	**.48**	.23
Gaze monitoring	**.78**	.60
Responds to a verbal command	**.74**	.54
Demonstrates use of words	**.60**	.36
Anticipatory posture	.33	.11
Nestling into caregiver	.36	.13
Use of gestures	**.68**	.46
Ability to switch from task to task	**.66**	.43

Note. The item names in the above are from the first edition of the ADEC (Young, 2007). Item names have been updated in the current (second) edition of the ADEC (Young et al., 2022). Major loadings above .40 appear in bold type.

Convergent Validity

Convergent validity was assessed by correlating total scores on the ADEC, obtained as the sum of scores on all 16 items, with scores obtained on other autistic disorder diagnostic instruments, such as the Checklist for Autism in Toddlers (CHAT; Baron-Cohen et al., 1992), Childhood Autism Rating Scale (CARS; Schopler et al., 1988), Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), and Autism Diagnostic Interview–Revised (ADI-R; Le Couteur et al., 2003).

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The Checklist for Autism in Toddlers (CHAT; Baron-Cohen et al., 1992) was used as it is one of the few tools designed to identify autistic disorder behaviours in children under the age of 2 years. However, research using 16,235 children showed that the CHAT was able to detect only 19 of 50 cases of children with autistic disorder (Baird et al., 2000). The CHAT has been shown to have a very high specificity (i.e., correctly classifying typical children as typical; around 98–100%). However, the sensitivity (identifying those with autistic disorder as having autistic disorder) of the CHAT is fairly low: Baird et al. (2000) identified only 20–38% of children with autistic disorder using the CHAT, depending on the classification of likelihood of autistic disorder. Screening a month later showed that sensitivity dropped to 19–20% and the specificity rose to around 100% (Baird et al., 2000). Despite these difficulties, the CHAT is commonly used as a screening tool among the age group targeted with the ADEC and it was therefore of interest to compare the CHAT with the ADEC.

Although the Childhood Autism Rating Scale (CARS; Schopler et al., 1988; Schopler et al., 2010) is an assessment tool used for children aged over 2 years, many of the children in the study were in this age group and it was considered a useful tool to use to determine convergent validity. The CARS has been reported to have both good reliability and validity; however, it lacks the ability to discriminate those on the autism spectrum from other developmental delays and thus may overidentify 2 year olds and older non-verbal children with mental ages below 18 months. In addition, the behaviours are poorly operationalised and its successful use relies upon skilled clinicians. The CARS is administered through questions directed towards the primary caregiver to elicit responses concerning areas of the child's life.

The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000; Lord et al., 2012) is a semi-structured assessment tool that measures impairments in social communication and restricted and repetitive behaviours from the age of 12 months through to adulthood. Over an administration period of 40 to 60 minutes, the ADOS uses a variety of tasks and activities to elicit behaviours consistent with those on the autism spectrum, which are then observed and coded by a trained examiner. The ADOS demonstrates good psychometric properties and is currently considered to be the gold standard assessment tool for the diagnosis of ASD.

The ADI-R (Le Couteur et al., 2003) involves an extensive caregiver interview that seeks information about more than 100 specific behaviours exhibited currently and in the past. Substantial training in administration is required. The ADI-R is a thorough and exhaustive, semi-structured, investigator-based interview. Results of psychometric examination indicate that the ADI-R is a reliable and valid instrument for diagnosing preschool children on the autism spectrum. Inter-rater reliability, internal consistency and interclass correlations are very high for children over the age 3 years (e.g., Lord et al., 1994). Research has, as yet, failed to demonstrate the efficacy of this test with children less than 20 months.

The ADEC scores were very highly correlated with CHAT scores (Sample 1, $r = .83$, $N = 25$, $p < .001$; Sample 2, $r = .84$, $N = 69$, $p < .001$) and with CARS scores (Sample 1, $r = .66$, $N = 25$, $p = .001$; Sample 2, $r = .59$, $N = 70$, $p < .001$). Data from Sample 4 also show excellent convergent validity (see Table 5 and 6).

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Table 5: Correlations Between ADEC, ADI-R (Total and Subscales), CARS, and CHAT at Time of Diagnosis

Measure	ADEC	ADI-R Total (*N* = 85)	ADI-R Social	ADI-R Communication	ADI-R Repetitive Behaviours	CARS
ADEC						
ADI-R Total	.48**					
ADI-R Social	.51**	.87**				
ADI-R Communication	.56**	.81**	.69**			
ADI-R Repetitive Behaviours	.08	>50**	.34**	.23*		
CARS	.34**	.33**	.43**	.36*	.27*	
CHAT [a] (*N* = 14)	−.62*	−.46	−.53	−.69*	.33	−.33

* $p < .05$
** $p < .01$

[a] A high CHAT score reflects positive behaviours, whereas high scores on other tests are seen as reflecting more autistic disorder symptomology. Thus, we would expect the correlation to be negative.

Table 6: Correlations Between ADEC, CARS, and CHAT at Assessment for Early Intervention Program

Instrument	ADEC	CARS
ADEC		
CARS	.57**	
CHAT [a]	−.74**	−.40*

* $p < .05$
** $p < .01$

[a] A high CHAT score reflects positive behaviours, whereas high scores on other tests are seen as reflecting symptomology more consistent with those on the autism spectrum. Thus, we would expect the correlation to be negative.

Nah et al. (2014b) found strong correlations between total ADEC scores and scores on the ADOS, ADI-R, and their respective subscales (with the exception of the Restricted and Repetitive Behaviour subscale score of the ADI-R; see Table 7).

Hedley et al. (2015) demonstrated strong correlations between total ADEC scores and scores on the CARS-2-ST ($r = .50$, $n = 50$, $p < .01$) and ADOS-2 Total ($r = .60$, $n = 79$, $p < .001$), ADOS2-SA ($r = .66$, $n = 78$, $p < .001$), ADOS-2 RRB ($r = .69$, $n = 78$, $p < .001$), ADOS-2 Severity ($r = .60$, $n = 39$, $p < .001$). There was no significant correlation between ADEC total scores and scores on the ASRS ($r = .05$, $n = 51$, $p > .05$).

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Table 7: Correlations Between ADEC Total Score and Scores on the ADOS and ADI-R

Measure	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. ADEC Total	–									
2. ADOS Comm	.76**	–								
3. ADOS RSI	.84**	.77**	–							
4. ADOS Play	.47**	.58**	.48**	–						
5. ADOS SBRI	.60**	.52**	.40**	.24	–					
6. ADOS Rev	.86**	.88**	.95**	.50**	.60**	–				
7. ADOS Severity	.77**	.86**	.89**	.45**	.60**	.96**	–			
8. ADI-R RSI	.58**	.39	.59**	.22	.04	.54**	.54*	–		
9. ADI-R Comm	.63**	.53**	.61**	.53**	.10	.60**	.45*	.43	–	
10. ADI-R RRB	.16	−.24	−.11	−.38	−.01	−.17	−.17	.02	−.03	–
11. ADI-R Total	.72**	.42	.64**	.26	.07	.58**	.52*	.88**	.73**	.28

Note. ADEC, Autism Detection in Early Childhood; ADOS-2, Autism Diagnostic Observation Schedule; Comm, Communication; RSI, Reciprocal Social Interaction; SBRI, Stereotyped Behaviours and Restricted Interests; ADI-R, Autism Diagnostic Interview–Revised; RRB, Restricted and Repetitive Behaviours.

* $p < .05$
** $p < .01$ (two-tailed)

From "Autism Detection in Early Childhood (ADEC): Reliability and validity data for a level 2 screening tool for autistic disorder," by Y.H. Nah, R. L. Young, N. Brewer and G. Berlingeri, 2014, Psychological Assessment, 26, pp. 215–226. Copyright 2014 by the American Psychological Association. Reprinted with permission.

Predictive Validity

2-Year Follow-Up

Using a subset of the data from Nah et al. (2014b), Nah et al. (2014a) evaluated the predictive validity of the ADEC by examining whether ADEC scores at initial assessment significantly predicted children's diagnostic status at 2-year and 6-year follow-up, after controlling for their level of adaptive functioning. A binary hierarchical logistic regression indicated that the model was statistically significant in predicting diagnosis of autistic disorder according to *DSM-IV-TR* criteria at 2-year follow-up, χ^2 (2, N = 53) = 22.65, $p < .001$, with the Hosmer–Lemeshow (1980) test indicating a good fit, χ^2 (8) = 4.18, $p = .84$. The model as a whole explained between 35.3% (Cox-Snell R^2) and 58.6% (Nagelkerke R^2) of the variance in diagnostic status and correctly classified 88.5% of cases (compared to 82.7% by chance). The odds of having a diagnosis of autistic disorder (according to *DSM-IV-TR* criteria) at 2-year follow-up increased 1.68 times for every unit increase in ADEC score at initial assessment, 95% CI [1.15, 2.46].

The ADEC also demonstrated good predictive validity when evaluated against the *DSM-5* classification for ASD at 2-year follow-up. The model was statistically significant, χ^2 (2, N = 53) = 19.32, $p < .001$, and correctly classified 88.7% of cases (compared to 84.9% by chance). The odds of having a diagnosis of ASD (according to *DSM-5* criteria) at 2-year follow-up increased 1.54 times for every unit increase in ADEC score at initial assessment, 95% CI [1.10, 2.15].

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6-Year Follow-Up

The full model (containing ADEC score as the predictor) was not statistically significant in predicting *DSM-IV-TR* diagnosis of autistic disorder at 6-year follow-up, χ^2 (2, *N* = 22) = 4.49, *p* = .11, *OR* 1.25, 95% CI [0.99, 1.58]. The model as a whole explained between 18.5% (Cox-Snell R^2) and 25.3% (Nagelkerke R2) of the variance in diagnostic status and correctly classified 68.2% of cases (compared to 63.6% by chance). The full model was also not statistically significant in predicting *DSM-5* classification for ASD at 6-year follow-up, χ^2 (2, *N* = 22) = 3.56, *p* = .17, *OR* 1.22, 95% CI [0.95, 1.55].

Predictive Accuracy

Receiver operating characteristic (ROC) curves were used to examine the ability of the ADEC to predict *DSM-IV-TR* autistic disorder diagnosis at 2- and 6-year follow-up. The ADEC demonstrated good predictive accuracy at both 2-year follow-up, AUC = .92, 95% CI [.84, .99] and 6-year follow-up, AUC = .85, 95% CI [.69, 1.0].

Diagnostic Discrimination

The diagnostic discrimination of individual items was considered by inspecting the frequency of responses across the three response options (no evidence of poor development, maybe there is evidence of poor development, yes there is evidence of poor development) for children from each developmental category. For the purposes of these analyses, data were combined from both Sample 1 and Sample 2 (previously described on page 10. The patterns of response frequencies for each item of the ADEC are shown in Table 8. In addition, for each item, the mean scores across the three developmental categories are also reported.

Table 8: Frequency of Responses by Diagnosis and Item–Total Correlations for Each ADEC Item

Item	Developmental category	Frequency (% [a])			Item *M*	$r_{i/t}$ [b]
		No	Maybe	Yes		
1. Response to name	Autism spectrum	4 (17)	5 (21)	15 (63)	1.46	0.77
	Typically developing	31 (86)	1 (3)	4 (11)	0.25	
	Other disability [c]	26 (74)	4 (11)	5 (14)	0.40	
2. Imitation	Autism spectrum	2 (8)	2 (8)	20 (83)	1.75	0.64
	Typically developing	21 (58)	3 (8)	12 (33)	0.75	
	Other disability	22 (63)	4 (11)	9 (26)	0.63	
3. Stereotypical behaviour	Autism spectrum	12 (50)	7 (29)	5 (21)	0.71	0.43
	Typically developing	34 (100)	0 (0)	0 (0)	0.00	
	Other disability	34 (97)	0 (0)	1 (3)	0.06	
4. Gaze switching	Autism spectrum	4 (17)	4 (17)	16 (67)	1.50	0.67
	Typically developing	35 (100)	0 (0)	0 (0)	0.00	
	Other disability	23 (66)	3 (9)	9 (26)	0.60	
5. Eye contact in a game of peek-a-boo	Autism spectrum	8 (35)	6 (26)	9 (39)	1.04	0.67
	Typically developing	34 (100)	0 (0)	0 (0)	0.00	
	Other disability	22 (67)	8 (24)	3 (9)	0.42	
6. Functional play	Autism spectrum	7 (29)	12 (50)	5 (21)	0.92	0.65
	Typically developing	25 (69)	9 (25)	2 (6)	0.36	
	Other disability	24 (68)	10 (29)	1 (3)	0.34	

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Item	Developmental category	Frequency (% [a])			Item *M*	$r_{i/t}$ [b]
		No	Maybe	Yes		
7. Pretend play	Autism spectrum	3 (13)	8 (33)	13 (54)	1.42	0.54
	Typically developing	16 (46)	8 (23)	11 (31)	0.86	
	Other disability	13 (37)	7 (20)	15 (43)	1.06	
8. Reciprocity of smile	Autism spectrum	4 (17)	3 (13)	17 (71)	1.54	0.75
	Typically developing	32 (91)	0 (0)	3 (9)	0.17	
	Other disability	22 (65)	8 (24)	4 (12)	0.47	
9. Response to everyday sounds	Autism spectrum	9 (39)	11 (48)	3 (13)	0.74	0.60
	Typically developing	34 (97)	1 (3)	0 (0)	0.03	
	Other disability	30 (86)	5 (15)	0 (0)	0.14	
10. Gaze monitoring	Autism spectrum	7 (30)	3 (13)	13 (56)	1.26	0.71
	Typically developing	30 (86)	0 (0)	5 (14)	0.29	
	Other disability	28 (80)	3 (9)	4 (11)	0.31	
11. Responds to verbal command	Autistic	8 (33)	4 (17)	12 (50)	1.17	0.70
	Typically developing	30 (86)	2 (6)	3 (9)	0.23	
	Other disability	29 (83)	2 (6)	4 (11)	0.29	
12. Demonstrates use of words	Autism spectrum	6 (26)	2 (9)	15 (65)	1.39	0.71
	Typically developing	26 (77)	3 (9)	5 (15)	0.38	
	Other disability	26 (74)	4 (11)	5 (14)	0.40	
13. Anticipatory posture	Autism spectrum	15 (63)	6 (25)	3 (13)	0.50	0.34
	Typically developing	26 (81)	1 (3)	5 (16)	0.34	
	Other disability	25 (71)	5 (14)	5 (14)	0.43	
14. Nestling into caregiver	Autism spectrum	13 (54)	10 (42)	1 (4)	0.50	0.47
	Typically developing	30 (94)	1 (3)	1 (3)	0.09	
	Other disability	30 (86)	2 (6)	3 (9)	0.23	
15. Use of gestures	Autism spectrum	7 (33)	6 (29)	8 (38)	1.05	0.35
	Typically developing	23 (74)	3 (10)	5 (16)	0.42	
	Other disability	6 (19)	18 (57)	8 (25)	1.06	
16. Ability to switch from task to task	Autism spectrum	4 (18)	4 (18)	14 (64)	1.45	0.70
	Typically developing	22 (85)	4 (15)	0 (0)	0.15	
	Other disability	26 (79)	4 (12)	3 (9)	0.30	

Note. The item names in the above are from the first edition of the ADEC (Young, 2007). Item names have been updated in the current (second) edition of the ADEC (Young et al., 2022).

[a] Percentage of responses made within developmental category

[b] Corrected item–total correlation (correlation between item score and total minus item score)

[c] Combined "other disability" groups from Samples 1 (Ettridge, 2001) and 2 (Matthew, 2003)

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From Table 8, it is evident that most of the items do show discriminating power. Two items, namely item 13 (anticipatory posture) and 15 (use of gestures), do not appear to discriminate well. Item 13 does not discriminate well between all three groups, while both autism spectrum and other disability children appear to fail to demonstrate the appropriate use of gestures. Further evidence for the poor quality of these two items is shown by the low corrected item–scale correlations, which are below .40.

Of the items that discriminate quite well, two distinct groupings emerge. Some behavioural difficulties were frequently displayed by children with a diagnosis of autism spectrum. Of these behaviours, item 4 (gaze switching) and 5 (eye contact) are particularly noteworthy. For both of these behaviours, inappropriate behaviour was not observed at all among the typically developing and occurred with much lower frequency among those with a diagnosis of a disability other than autism spectrum.

A few items showed only a low frequency of occurrence but, when inappropriate behaviour was observed, this itself was a good indicator of autism spectrum. The strongest example of this was with item 3 (upset when blocks disturbed): no typically developing child and only one (3%) of the other disability children exhibited inappropriate behaviour, whereas 12 (50%) children on the autism spectrum exhibited an example of inappropriate behaviour. Other items showing a similar, but less striking, pattern were items 10 (response to everyday sounds) and 15 (nestling into caregiver).

Caution in interpreting these results is necessary given the relatively small samples. Nevertheless, the item analysis suggests that all but two of the items from the ADEC appear to be useful in detecting autism spectrum and that some items may reflect low frequency behaviours, the absence of which is suggestive of a diagnosis of autism spectrum. Three developmental categories (autism spectrum diagnosis, typically developing, and other disability diagnosis) were compared for each diagnostic tool using Sample 4 (previously described on pp.10–11). Means, standard deviations and ANOVA statistics are shown in Table 9 for comparisons of ADEC, CHAT and CARS scores across the three developmental categories.

Table 9: Descriptive Statistics and ANOVA Results of ADEC, CHAT, and CARS Scores Comparisons Across Developmental Category for All Children

Measure	Developmental category	*n*	*M*	*SD*	ANOVA statistics
ADEC	Autistic disorder	148	15.32 [a]	6.76	$F(2, 265) = 69.15$ $p < .001$ $\eta^2 = .34$
	Typically developing	60	4.54 [c]	4.27	
	Other disability	60	9.00 [b]	6.68	
CHAT	Autistic disorder	78	2.22 [a]	1.79	$F(2, 151) = 16.43$ $p < .001$ $\eta^2 = .18$
	Typically developing	36	0.49 [b]	0.89	
	Other disability	40	1.17 [b]	1.60	
CARS	Autistic disorder	148	34.12 [a]	5.20	$F(2, 238) = 168.83$ $p < .001$ $\eta^2 = .59$
	Typically developing	34	16.5 [c]	2.08	
	Other disability	59	27.50 [b]	6.24	

Note. Means with different (letters as) superscripts reflect significant post-hoc differences using Tukey's homogeneous subsets post-hoc tests.

As shown in Table 9, all three assessment tools discriminated children on the autism spectrum from children with other disabilities and typically developing children. The ADEC and CARS also differentiated children with other disabilities from typically developing children, suggesting that both instruments not only assess autistic disorder but may also tap into the broader construct of disability. The CHAT did not differentiate children with other disabilities from typically developing children; however, this may be a function of the smaller sample sizes available for this instrument, which resulted in a lack of statistical power.

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This set of analyses was repeated removing all children over 42 months of age. The descriptive statistics are shown in Table 10. For younger children, a similar pattern of results to those from the overall sample was obtained. However, with this younger group, the ADEC appears to offer an advantage over both the CARS and the CHAT, in that it discriminated children with autistic disorder from children with other disabilities. In contrast, there was no statistically significant difference in scores on the CHAT or CARS between children with autistic disorder and children with other disabilities.

Table 10: Descriptive Statistics and ANOVA Results of ADEC, CHAT, and CARS Scores Comparisons Across Developmental Category for Children Younger than 42 Months of Age

Measure	Developmental category	*n*	*M*	*SD*	ANOVA statistics
ADEC	Autistic disorder	71	15.11 [a]	6.44	$F(2, 102) = 19.89$ $p < .001$ $\eta^2 = .28$
	Typically developing	18	5.65 [b]	3.90	
	Other disability	16	9.52 [b]	6.33	
CHAT	Autistic disorder	28	1.75 [a]	1.56	$F(2, 34) = 1.87$ $p = .17$ $\eta^2 = .10$
	Typically developing	4	0.50 [a]	1.00	
	Other disability	5	2.40 [a]	1.34	
CARS	Autistic disorder	71	34.18 [a]	5.18	$F(2, 87) = 26.26$ $p < .001$ $\eta^2 = .38$
	Typically developing	4	15.88 [b]	1.18	
	Other disability	15	29.87 [a]	5.66	

Note. Means with different (letters as) superscripts reflect significant post-hoc differences using Tukey's homogeneous subsets post-hoc tests.

These findings are corroborated by those of Nah et al. (2014b), Hedley et al. (2015) and Dix et al. (2015), who also found that ADEC total scores were significantly higher for children with a diagnosis of ASD than children with other developmental conditions or typically developing children (see Table 11).

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Table 11: Differences in Total ADEC Score by ASD* Diagnosis

Study	Diagnosis	*n*	ADEC total score		Analysis of group differences
			M	*SD*	
Nah et al. (2014b) [a]	ASD	70	19.0	5.4	$F(2, 64) = 24.17$ $p < .001$ $\eta^2 = .43$
	PDD-NOS	24	9.9	6.3	
	Other developmental condition	57	8.5	6.1	
Hedley et al. (2015) [b]	ASD	48	18.4	5.1	$F(2, 95) = 40.82$ $p < .001$ $\omega^2 = .45$
	Developmental delay	38	10.0	4.6	
	No diagnosis	10	8.6	3.5	
Dix et al. (2015) [c]	ASD	32	15.1	5.0	$U = 144.00$ $n = 53$ $p < .001$
	Other developmental condition or no diagnosis	21	10.3	3.4	

* According to the *DSM-5*, individuals with a well-established *DSM-IV* diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder (DSM-5; American Psychiatric Association [APA], 2013). Therefore, hereafter all individuals with a diagnosis will be referred to using the term 'ASD' within tables.

[a] Group differences in ADEC total score were analysed using a one-way ANCOVA with nonverbal IQ as a covariate

[b] Group differences in ADEC total score were analysed using a one-way ANOVA

[c] Group differences in ADEC total score were analysed using a two-tailed Mann-Whitney test

Further investigation of diagnostic discrimination was undertaken using discriminant function analysis (DFA). For each sample, the ADEC, CHAT and CARS total scores were used as dependent variables to discriminate between the three developmental categories. The variables were entered using a stepwise entry procedure to identify the minimum number of instruments required to maximally discriminate between the two groups. The results using Sample 4 (as it had the most power) revealed that only the CARS and the ADEC scores were entered to determine the maximally efficient discriminant functions. This indicated that the CHAT scores provided redundant information. Given there is some overlap in the behaviours included in these tools, this might be expected.

The first discriminant function was represented by the additive combination of the CARS and the ADEC, although CARS scores were the primary determinant underlying the first function. In contrast, the second discriminant function was represented by the difference between ADEC and CARS scores, although the ADEC was the primary determinant underlying the second function. The standardised canonical discriminant function coefficients are shown in Table 12.

Table 12: Pooled Within-Groups Correlations Between Discriminating Variables and Standardised Canonical Discriminant Function Coefficients

Measure	Function 1	Function 2
CARS	.910	−.256
CHAT	.286	.263
ADEC	.508	.841

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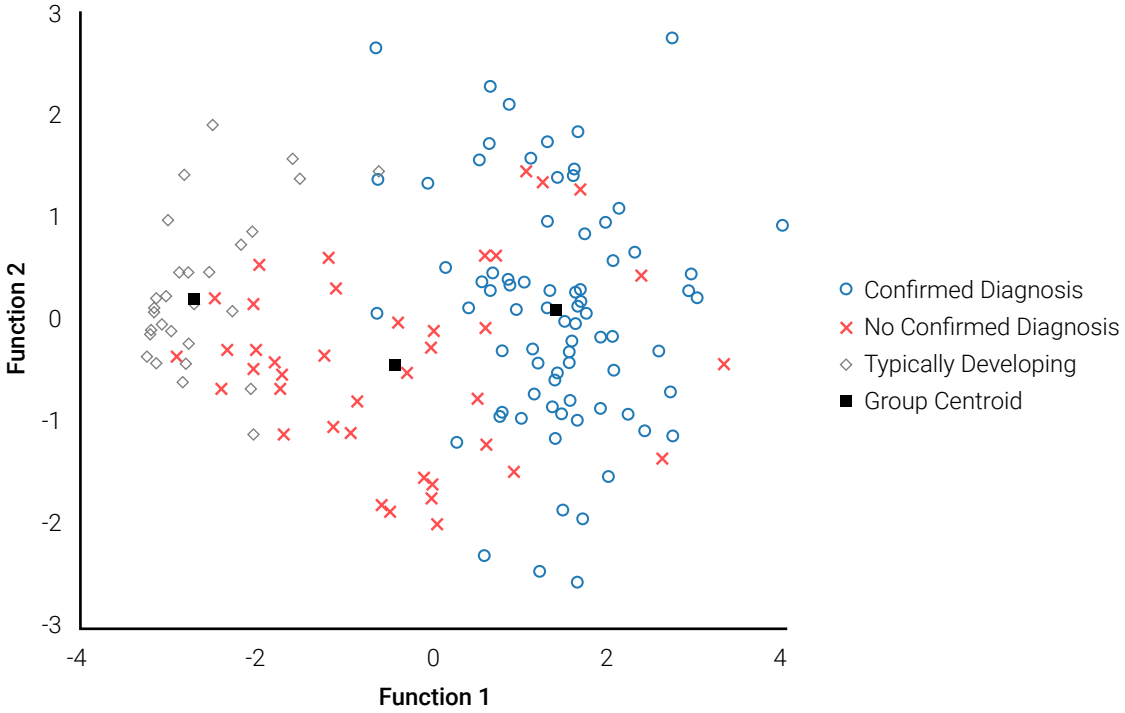
As demonstrated by the statistics showing the functions at the group centroids, the first function discriminated between all three groups, with the second function providing further discrimination between the children with a confirmed diagnosis of autistic disorder and the others. The discriminating power of the two functions is also demonstrated in the plot shown in Figure 1, where cases are plotted on the two-dimensional space formed by the two functions representing combinations of the ADEC and CARS scores.

Figure 1: Individual Cases as a Function of the Two Discriminant Functions Representing ADEC and CARS Scores in Sample 4



Overall, these data suggest that the best discrimination occurs with using a combination of the ADEC and the CARS and, further, that the ADEC is more discriminating than the CHAT. It appears that the CARS is best for identifying those with a disability but, following a diagnosis of disability, the ADEC is better able to separate out those on the autism spectrum.

Similar analyses were conducted on the smaller samples (Sample 1 and 2). Separate DFAs were carried out for each sample given the differing results obtained using the ANOVAs, particularly in relation to the "other disabilities" category. For each sample, the ADEC, CHAT and CARS total scores were used as dependent variables to discriminate between the three developmental categories. The variables were once again entered using a stepwise entry procedure to identify the minimum number of instruments required to maximally discriminate between the two groups. For both samples, only the CARS and the ADEC scores were entered to determine the maximally efficient discriminant functions. Once again, the CHAT scores provided redundant information.

In both samples, the first discriminant function represents the additive combination of the CARS and the ADEC, although the CARS was the primary determinant underlying the first function. In contrast, the second discriminant function represents the difference between ADEC and CARS scores, although the ADEC was the primary determinant underlying the second function. The standardised canonical discriminant function coefficients are shown in Table 13.

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Table 13: Discriminant Function Analysis Results for Discriminating Developmental Categories Using Three Assessment Tools for ASD

	Sample 1		Sample 2	
	Function 1	Function 2	Function 1	Function 2
Measure	**Standardised canonical discriminant function coefficients**			
ADEC	.159	1.079	.511	.862
CARS	.926	−.577	.826	−.568
CHAT	*ns*	*ns*	*ns*	*ns*
Developmental category	**Functions at group centroids**			
ASD	.907	1.884	2.690	.325
Typically developing	−1.287	−.171	−2.213	.407
Other disability	2.334	−.571	−.160	−.508

Note. The CHAT was not a significant unique discriminator and was not entered into the analysis.

As indicated by the statistics showing the functions at the group centroids, in both samples, the first function discriminated between all three groups with the second function providing further discrimination between one of the developmental categories and the other two categories. In Sample 1, the further discrimination was between the children with autistic disorder and the others whereas, in Sample 2, it was between those with other disabilities and the other children. In addition, 22 out of 24 (90.9%) of the children in Sample 1 were correctly classified by the discriminant functions. Although 1 child with a diagnosis of another disability was classified as having autistic disorder, none of the children with autistic disorder were classified incorrectly. In Sample 2, 58 out of 70 (82.9%) were correctly classified. Of the incorrect classifications, 3 (15%) of the children with autistic disorder were classified as having another disability, while 4 children diagnosed with another disability were classified as having autistic disorder.

Overall, the data are equivocal about the exact way in which the ADEC and the CARS should be used in combination. However, they do suggest that optimal discrimination is gained by using both the ADEC and the CARS rather than one instrument alone and, further, that the ADEC is more discriminating than the CHAT.

Given the ADEC was designed for young children, only data for children aged under 4 years and in Sample 4 were included in the next analyses. Figure 2 shows that, with an ADEC cut-off score of 13, the specificity (correctly identifying people who do not have autistic disorder) is around 80%. The sensitivity (correctly identifying children who are affected) is also high at 70%. These percentages improve to 90% and 88% respectively, when only younger children (less than 30 months) are considered (see Figure 3). These data are even more impressive when the other disability group is removed and the comparison only involves those with a confirmed diagnosis of autistic disorder and typically developing children. Using a cut-off of 13, the sensitivity rises to 100%, while the specificity drops to 70% when all children are included (see Figure 4). For the younger children (< 30 months), the corresponding values are 90% and 100% respectively (see Figure 5).

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Figure 2: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (*n* = 71) and (b) Those With (or Likely to Have) Another Disability but No Confirmed Diagnosis of Autistic Disorder (*n* = 16) for Children up to 42 Months of Age

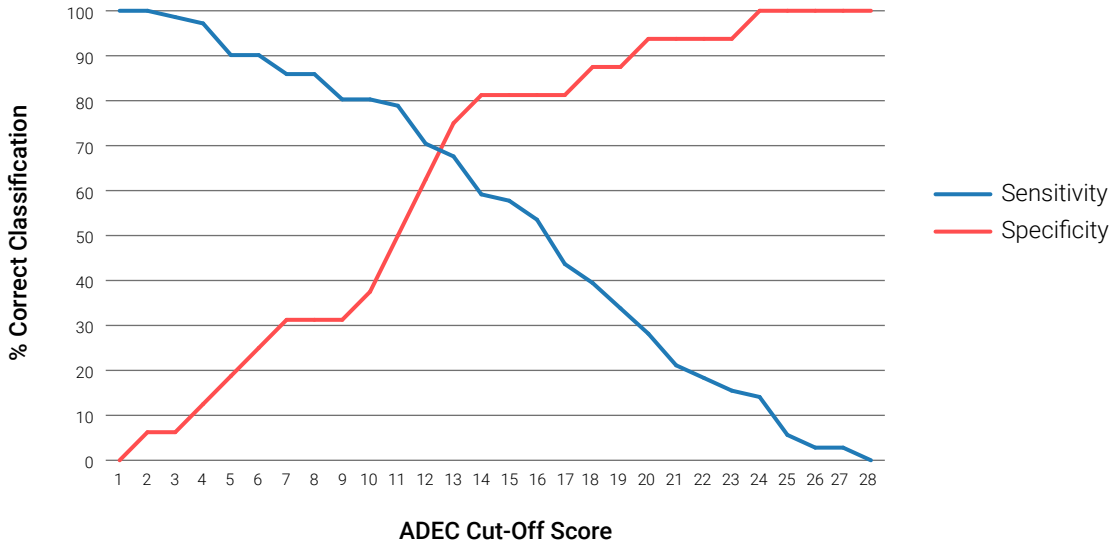

Figure 3: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (*n* = 23) and (b) Those With (or Likely to Have) Another Disability but No Confirmed Diagnosis of Autistic Disorder (*n* = 8) for Children up to 30 Months of Age

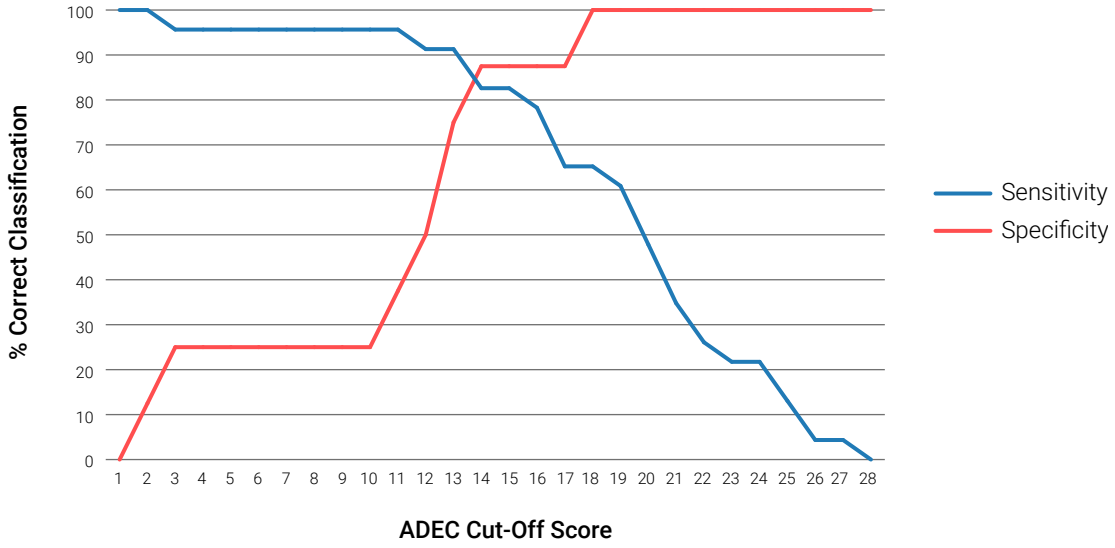

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Figure 4: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (*n* = 71) and (b) Typically Developing Children (*n* = 18) for Children up to 42 Months of Age

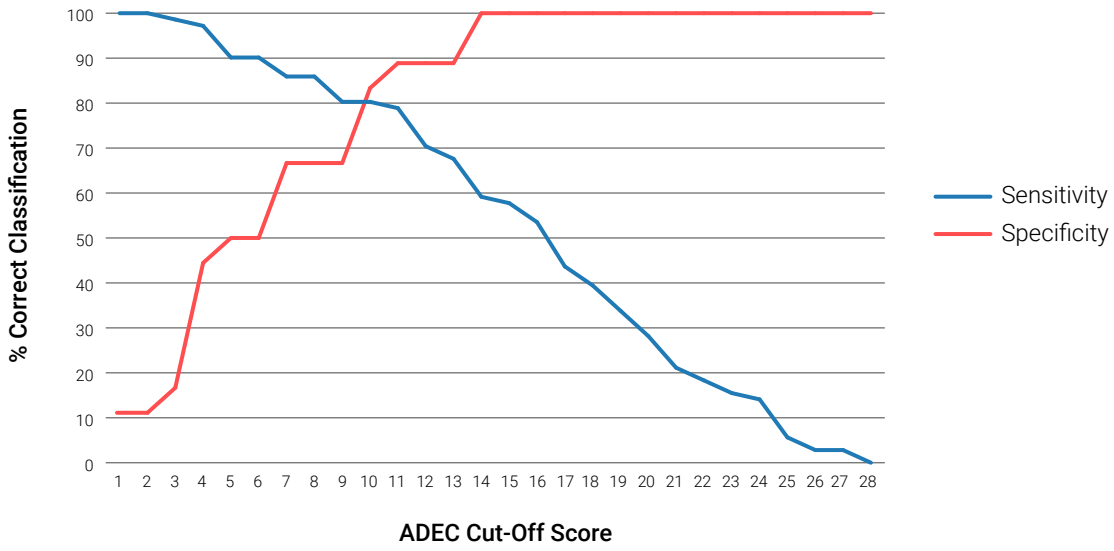
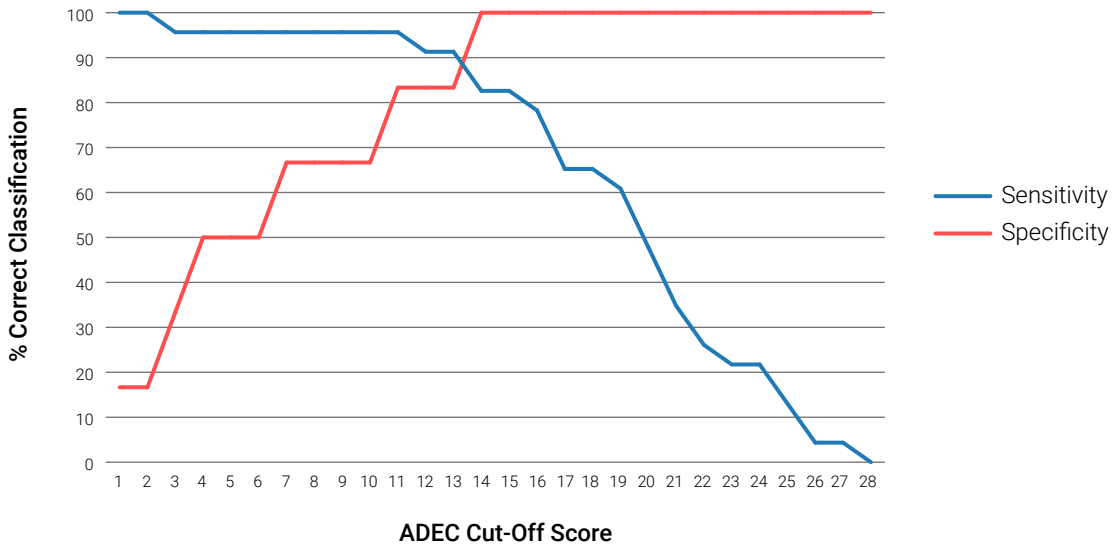


Figure 5: Discrimination Using the ADEC as a Function of Potential Cut-Off Score Between (a) Those With a Confirmed Diagnosis of Autistic Disorder (*n* = 23) and (b) Typically Developing Children (*n* = 6) for Children up to 30 Months of Age



Data from Nah et al. (2014b), Hedley et al. (2015), and Dix et al. (2015) revealed similar values of sensitivity and specificity (see Table 14).

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Table 14: Values of Sensitivity and Specificity by ADEC Cut-Off Score

ADEC Cut-Off Score	Nah et al. (2014b)		Hedley et al. (2015)		Dix et al. (2015)	
	ASD (*n* = 70) vs. Non-ASD (*n* = 121)		ASD (*n* = 48) vs. Non-ASD (*n* = 48)		ASD (*n* = 32) vs. Non-ASD (*n* = 21)	
	Se	Sp	Se	Sp	Se	Sp
3	1.0	.37				
5	1.0	.53				
7	1.0	.66				
9	1.0	.78				
10	1.0	.82	.98	.52		
11	1.0	.89	.94	.63	.88	.62
12	.93	.90				
13	.86	.91				
14			.85	.79		
15	.74	.92				

Note. Se, sensitivity; Sp, specificity.

Age at Which Appropriate Behaviour is First Observed

One weakness in the literature to date is that little attention has been given to the ontogeny of the condition. Many of the behaviours that shape our clinical impression of the condition relate to the secondary behaviours that may have developed to compensate for underlying neurological deficits. For example, operationalising difficulties with social interaction in terms of one's ability to form peer relations is not appropriate for children under 2 years of age. In fact, many of the behaviours that shape our clinical impression of the condition and that are outlined in the *DSM-IV-TR* (APA, 2000) or *DSM-5* (APA, 2013) are rarely observed among young children (i.e., less than 2 years); instead, many of these behaviours develop later in life (Cox et al., 1999; Howlin & Asgharian, 2007; Lord, 1995; Stone et al., 1999). While such behaviours are often considered part of the clinical picture of a person with ASD, they should not be considered the defining characteristics of the condition.

While trained clinicians can often identify children on the autism spectrum under the age of 2 (Klin et al., 2000), the behaviours that are critical for this early diagnosis have not been consistently recognised or documented. Baron-Cohen and colleagues recognised this need and included two such behaviours ("response to name" and "directing attention") in the Checklist for Autism in Toddlers (CHAT; item Bii; Baron-Cohen et al., 1992). The inability of children on the autism spectrum to switch their gaze to follow a point has also been documented (Baron-Cohen et al., 1996; Maestro et al., 2001). Other research has identified behaviours such as social reciprocity, joint attention, theory of mind, gaze-engagement, social referencing, and hypersensitivity to sound. The significance of these items and the age at which they have the most diagnostic value are yet to be fully determined. What is required is a detailed description of the age at which failure to demonstrate these and other core behaviours is critical for a diagnosis of ASD. Diagnostic tools and criteria should therefore reflect these early difficulties and should not be confused with secondary behaviours demonstrated by many older children with ASD.

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The ADEC represents an attempt to operationalise the behaviours linked to these core difficulties. It is, however, recognised that some of the behaviours characteristic of ASD that are assessed by the ADEC may not be detected in older children because the behaviours are no longer evident. This may arise because the child with ASD learns strategies to reduce these behaviours or develops secondary behaviours to compensate for these core characteristics. In an online survey, Parker (2002) asked parents to indicate the age at which the appropriate behaviours assessed in the ADEC were first observed. The means (and standard deviations) of age at first observation of typical behaviour in relation to each item included in the survey are shown in Table 15.

Table 15: Age (Months) at Which Typical Behaviour is First Observed by Developmental Category for Each ADEC Item

Item	Developmental category	Age at which behaviour was first observed		% of "never" responses
		M	*SD*	
Response to name	ASD (23)	18.2	11.7	12
	Non-ASD (21)	11.7	9.5	0
Imitation	ASD (15)	21.6	13.5	21
	Non-ASD (16)	12.0	7.7	7
Gaze switching	ASD (7)	24.3	13.9	46
	Non-ASD (13)	9.4	5.5	31
Eye contact (in a game)	ASD (17)	15.5	10.7	15
	Non-ASD (16)	9.3	5.6	4
Eye contact (in general)	ASD (15)	14.1	13.6	18
	Non-ASD (17)	9.7	11.4	7
Functional play	ASD (18)	19.2	11.9	21
	Non-ASD (18)	11.6	9.7	3
Pretend play	ASD (12)	37.3	13.0	56
	Non-ASD (11)	26.5	11.0	35
Reciprocity of a smile	ASD (20)	10.6	12.4	9
	Non-ASD (19)	4.8	3.7	0
Response to everyday sounds	ASD (6)	18.3	7.8	56
	Non-ASD (3)	19.3	9.9	54
Gaze monitoring	ASD (9)	23.1	16.3	31
	Non-ASD (16)	18.3	11.6	10
Responds to a verbal command	ASD (21)	25.1	13.3	9
	Non-ASD (15)	14.2	6.5	7
Demonstrates use of words	ASD (18)	27.4	12.9	26
	Non-ASD (16)	19.1	10.8	18
Anticipatory posture	ASD (13)	12.2	8.1	29
	Non-ASD (21)	9.0	7.5	10

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Item	Developmental category	Age at which behaviour was first observed		% of "never" responses
		M	*SD*	
Nestling into caregiver	ASD (16)	8.8	7.6	27
	Non-ASD (16)	3.6	3.1	14
Use of gestures	ASD (15)	22.8	9.3	32
	Non-ASD (13)	18.9	13.5	14

Note. These behaviours merely reflect the skills required to complete the tasks operationalised in the ADEC. Tasks requiring an elicited response to a particular stimulus, such as reactions to certain sounds, reactions to the disturbance of blocks, and ability to switch from task to task could not be included as this survey was drawn from parental report.

The statistics in Table 15 show that most of the behaviours assessed in the ADEC are exhibited appropriately, even by children with ASD, by 2 years of age on average. Some behaviours, such as nestling and reciprocity of a smile, are, on average, first observed before 1 year of age, even among children with ASD. These results suggest that the ADEC is therefore most appropriate in children under 2 years, where the core features of ASD are most salient. Nonetheless, given that differences between the groups were also evident in older children, its use with older children should not be dismissed.

Summary of Data

The data presented above show that the ADEC is an excellent screening tool that can be used to identify ASD among young children. It has high sensitivity and specificity, is reliable, and is valid. The advantages of this tool over existing tools are that it is easy to administer, requiring less than 20 minutes, is based on clearly operationalised behaviours known to be indicative of ASD in the early years, and requires little training or familiarity with typical or atypical development.

Although some of the participants involved in the psychometric evaluation studies of the ADEC were older than the age for which the ADEC was developed, this was unavoidable given diagnoses are typically still delayed. Nevertheless, the data reported here are consistent across all age cohorts and we found no evidence to suggest that the data differed for different cohorts. The possible exception here is that the test was more specific and sensitive among the younger children; this can only be viewed as positive given that the ADEC was designed to support the identification of autistic disorder in very young children.

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4 Adaptations



Autism Detection in Early Childhood–Spanish (ADEC-SP)

Because the ADEC was designed to be quick and easy to administer, it is particularly well-suited to being used to screen for ASD in populations where there is limited access to clinicians with experience in diagnosing ASD. In light of this, Hedley et al. (2010) developed a Spanish version of the ADEC (ADEC-SP) and evaluated its use as a Level 2 screening tool among two samples of Mexican children aged between 15 and 73 months.

Samples

Sample 1 consisted of a total of 61 children, who either had a prior diagnosis of autistic disorder (n = 19), a non-autistic-disorder diagnosis (e.g., developmental delay, language condition, Down syndrome; n = 13), or typical development (n = 29). Sample 2 consisted of 39 children who were referred by a health professional due to developmental concerns and 15 typically developing children recruited from a local childcare centre. The referred children were assessed by two independent clinicians using the ADEC-SP, Childhood Autism Rating Scale (CARS; Schopler et al., 1988), Autism Diagnostic Interview–Revised (ADI-R; Le Couteur et al., 2003), and behavioural observations over a minimum of two occasions. Of these, 34 were found to meet *DSM-IV-TR* (APA, 2000) criteria for autistic disorder (n = 25) or pervasive developmental disorder not otherwise specified (PDD-NOS; n = 9), four were diagnosed with a language condition, and one was diagnosed with a developmental delay.

Validity and Reliability

Internal Consistency

The ADEC-SP demonstrated acceptable internal consistency, with Cronbach's α = .73 (Sample 2).

Inter-Rater Reliability

Inter-rater reliability was available for 62% of assessments in Sample 1, whereby video recordings of the session were scored using the original English ADEC by a second assessor who was blind to the child's ADEC-SP score. There was a strong correlation between the ADEC-SP and ADEC total scores, r = .96, p < .001. There was also high agreement in overall likelihood category for autistic disorder (low likelihood vs. likelihood) between the two raters, with Cohen's κ = .81.

Concurrent Validity

ADEC-SP total scores were significantly correlated with scores on two other measures of autistic disorder: the CARS and ADI-R (see Table 16). There was also acceptable agreement between likelihood category on the ADEC and ADI-R diagnosis, with Cohen's κ = .71.

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Table 16: Correlations Between Scores on the ADEC-SP, CARS, and ADI-R (Hedley et al., 2010)

Measure	CARS	ADI-R Social	ADI-R Comm	ADI-R RRB
ADEC-SP	.82*	.79*	.56*	.60*
CARS		.80*	.53*	.63*
ADI-R Social			.72*	.80*
ADI-R Comm				.52*

Note. ADEC-SP, Autism Detection in Early Childhood–Spanish; CARS, Childhood Autism Rating Scale; ADI-R, Autism Diagnostic Interview–Revised; Comm, Communication; RRB, Restricted and Repetitive Behaviours.

* $p < .002$ (two-tailed)

Diagnostic Validity

ADEC-SP total scores were significantly higher for children with a diagnosis of autistic disorder than children with a non-PDD diagnosis or typically developing children (see Table 17).

Table 17: Mean ADEC-SP Total Score for Each Diagnostic Group (Hedley et al., 2010)

Sample	Diagnosis	*n*	ADEC total score		ANOVA statistics
			M	*SD*	
Sample 1	Autistic disorder	19	15.84	4.98	$F(2, 57) = 48.58$ $p < .001$ $\eta^2 = .22$
	Non-PDD diagnosis	13	7.54	4.81	
	Typically developing	29	4.34	3.22	
Sample 2	Autistic disorder	34	14.35	4.13	$F(2, 50) = 39.55$ $p = .001$ $\eta^2 = .13$
	Non-PDD diagnosis	5	4.2	8.4	
	Typically developing	15	5.53	3.16	

To evaluate the cut-off scores of the ADEC-SP, a subgroup of children aged between 12 and 36 months who either did (n = 18) or did not (n = 13) receive an autistic disorder diagnosis was identified from Sample 2. Estimates of sensitivity and specificity were then calculated for a range of cut-off scores within this subgroup (see Table 18). Consistent with that of the original ADEC, a cut-off score of between 9.5 and 11 provided the optimal balance of sensitivity and specificity for autistic disorder likelihood (see Table 18). Using a cut-off score of 11, the ADEC-SP yielded a positive predictive value (PPV) of 1.00 and a negative predictive value (NPV) of .93 when used among children aged 12 to 36 months.

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Table 18: Sensitivity and Specificity of ADEC-SP Cut-Off Scores (Hedley et al., 2010)

Cut-off score	Sensitivity	Specificity
1.0	1.00	.08
3.0	1.00	.23
4.5	1.00	.39
6.0	1.00	.54
7.5	1.00	.62
8.5	1.00	.69
9.5	.94	.92
11.0	.94	1.00
12.5	.83	1.00
13.5	.67	1.00
14.5	.56	1.00
15.5	.50	1.00
16.5	.39	1.00
17.5	.22	1.00
18.5	.11	1.00
20.5	.06	1.00
23.0	.00	1.00

Summary

The ADEC-SP shows good psychometric properties as a Level 2 screening tool for ASD among young children in Spanish-speaking communities. While additional evaluation of the ADEC-SP is required, the development of further cross-cultural adaptations of the ADEC appear highly promising.

Brief Autism Detection in Early Childhood (BADEC)

One of the barriers to screening children for ASD cited by healthcare professionals is the limited time available in a standard medical consultation (Fenikilé et al., 2015; Keil et al., 2014). This highlights the need for a brief ASD screening tool that can be administered quickly and easily as part of a paediatric check-up, but that is also valid and reliable in detecting cases of ASD. To address this need, Nah et al. (2019) and Nevill et al. (2019) sought to develop and validate a brief version of the Autism Detection in Early Childhood (BADEC).

Samples

Nah et al. (2019) examined archival data from the 197 participants involved in Nah et al.'s (2014b) study, and recruited a further 73 participants specifically for this study. A best estimate clinical (BEC) *DSM-5* ASD diagnosis was made for each participant using all available information (e.g., scores on the Autism Diagnostic Observation Schedule [ADOS], Autism Diagnostic Interview–Revised [ADI-R], and Mullen Scales of Early Learning [MSEL]) excluding ADEC scores, resulting in allocation to one of three groups: ASD (n = 106), non-typical development (n = 86), or typically developing (n = 78).

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Nevill et al. (2019) examined archival data from 110 children aged 14 to 36 months (*M* = 28.78, *SD* = 5.36) who had previously been assessed by a multidisciplinary team at a paediatric hospital (see Hedley et al., 2015). Upon assessment, ASD was diagnosed for 49 children and ruled out for 61 children.

Validity and Reliability

Receiver Operating Characteristic (ROC) Curve Analysis

Using receiver operating characteristic (ROC) curve analysis, Nah et al. (2019) identified that the five items with the highest area under the curve (AUC) values were response to name (item 1), reciprocity of a smile (item 8), gaze switching (item 4), responds to a verbal command (item 11), and use of gestures (item 15). The five items demonstrated good internal consistency, with Cronbach's α = .82, and corrected item–total correlations ranging from .49 to .60.

The five items with the highest AUC values in Nevill et al.'s (2019) dataset were gaze monitoring (item 10), ability to switch from task to task (item 16), response to name (item 1), reciprocity of smile (item 8), and responds to a verbal command (item 11).

Sensitivity and Specificity

Using the five items identified by Nah et al. (2019), a cut-off score of 4 demonstrated the optimal balance of sensitivity (.81) and specificity (.78) in distinguishing ASD from other developmental conditions. This resulted in a positive predictive value (PPV) of .81, negative predictive value (NPV) of .78, and AUC of .80, 95% CI [.73, .86].

Using the five items identified by Nevill et al. (2019), a cut-off score of 5 demonstrated the best balance of sensitivity (.77) and specificity (.86) in identifying children with ASD from children without ASD. This resulted in a positive predictive value (PPV) of .82, negative predictive value (NPV) of .82, and AUC of .82, 95% CI [.73, .90].

Diagnostic Validity

While controlling for non-verbal IQ, children with ASD scored significantly higher than children without ASD on both the BADEC algorithm suggested by Nah et al. (2019), $F(1, 90) = 33.01$, $p < .001$, $\eta^2 = .27$, and that of Nevill et al. (2019), $F(1, 58)$, 20.31, $p < .001$, $\eta^2 = .47$.

Concurrent Validity

Scores on the BADEC algorithm from Nah et al. (2019) were significantly correlated with scores on the original ADEC ($r = .93$, 95% CI [.91, .95]), ADOS revised algorithm ($r = .82$, 95% CI [.69, .89]), ADOS total ($r = .84$, 95% CI [.61, .93]), and ADI-R ($r = .42$, 95% CI [.19, .61]). Likewise, scores on the BADEC algorithm from Nevill et al. (2019) were significantly correlated with ADOS-2 comparison scores ($r = .56$, $p < .01$), ADOS-2 total scores ($r = .69$, $p < .01$), and Childhood Autism Rating Scale–Second Edition (CARS) scores ($r = .63$, $p < .01$), but not with scores on the Autism Spectrum Rating Scales (ASRS; $r = .11$, $p = ns$).

Predictive Validity

To examine its predictive validity, the BADEC algorithm by Nah et al. (2019) was used to predict ASD diagnosis in a binary logistic regression, while controlling for non-verbal IQ and adaptive functioning. The full model was statistically significant, $\chi^2(1, N = 66) = 48.70$, $p < .001$, OR = 2.47, 95% CI [1.47, 4.14], and explained a total of between 52.2% (Cox-Snell R^2) and 69.7% (Nagelkerke R2) of the variance in ASD diagnosis. Similarly, the BADEC algorithm by Nevill et al. (2019) also resulted in a statistically significant binary regression model when controlling for non-verbal IQ, $\chi^2(1) = 30.70$, $p < .001$, B = −0.64, Exp(B) = 0.53, 95% CI [0.36, 0.78], and correctly classified 56% of participants (Nagelkerke R^2).

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Summary

Overall, the findings of these studies support the use of a brief version of the ADEC as a valid and reliable screening tool for ASD among young children. However, further research involving prospective evaluation of the BADEC is recommended. Brewer et al. (2020) also caution that the direct comparison of AUC values without the use of any inferential tests (used by both Nah et al., 2019 and Nevill et al., 2019) is unlikely to be adequate in identifying which ADEC items have the best diagnostic value. Given the inconsistency in the items identified for inclusion in the BADEC by Nah et al. (2019) and Nevill et al. (2019), Nevill et al. (2019) recommend the use of all seven items suggested by these two studies: response to name (item 1), gaze switching (item 4), reciprocity of a smile (item 8), gaze monitoring (item 10), responds to a verbal command (item 11), use of gestures (item 15), and ability to switch from task to task (item 16). It is hoped that the availability of a brief but effective screening tool for ASD would encourage more healthcare professionals to include ASD screening as part of their regular practice.

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5 Administration and Report Interpretation



Overview

Details for administration, scoring and reporting of the ADEC can be found in this section, providing easy reference when screening the child.

The ADEC is available online, and administration therefore requires a computer or laptop (or similar device) and internet access. Administrators may access the ADEC via the ACER Psych Testing Platform (APT). For detailed instructions on APT online administration, see pages 36–38.

The screener administrator should read through pages 35 to 39, watch the online videos of the ADEC Introduction Lecture, Screener Demonstration 1, Screener Demonstration 2, log into the APT online platform, and have all the materials prepared before the start of the session.

There are a total of 16 behaviours to be observed. For each behaviour, the administrator selects a rating of 0, 1 or 2, with 0 indicating typical behaviour and 2 reflective of possible ASD behaviour. Specific scoring selection guidelines have been provided for each item in the online screener.

When the screener has been completed, the administrator will receive an online report with the breakdown of all of the behaviour scores, as well as an overall ADEC score. (For further scoring and reporting details, see 38.)

Materials Required

- Device with speakers, camera, and microphone (e.g., desktop/laptop computer, mobile tablet)
- Box in which materials are stored, 50 litres
- Plastic building blocks, 10–12 cm in length
- Bowl, hard plastic, approximately 10 cm in diameter
- Cup, hard plastic, approximately 6 cm in diameter
- Plastic utensils
- Small soft toy
- Toy to elicit excited behaviour (e.g., a toy that moves and talks such as a Bouncing Tigger, or a pop-up toy such as a jack-in-the-box)
- Face flannel/handkerchief, dark and plain
- Toy phone shaped like a car (with wheels), or other multi-use toy phone
- Rectangular object (such as a piece of foam, dish sponge, or block) to use as a pretend phone

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Administration

The ADEC can be administered in one of two ways: (a) in person by an allied health professional (ADEC), or (b) by the child's caregiver as directed by an allied health professional through a live video conference (ADEC-V).

ADEC

The ADEC is administered in person by an allied health professional, in the presence of the child's caregiver(s). If more than one caregiver is present, one is selected as the caregiver who will interact with the child during the administration of the screener. In the event that a child will not participate in the activities when guided by the administrator, the caregiver's assistance may be solicited.

Caregivers are explicitly instructed that it is crucial that they do not prompt the child or comment in any way. This can be done via a standard statement that is read to the caregiver during the "Adaptation Period".

ADEC-V

The ADEC–V is a version of the ADEC that can be administered remotely via Telehealth. In the ADEC-V, a live video conference is set up between the child's caregiver and an allied health professional. The allied health professional then directs the caregiver to administer each of the screener items, while observing and scoring the child's behaviour through the video feed. The ADEC–V provides an ideal solution when there is limited access to local allied health professionals, such as for clients in rural and remote areas. It also allows the child to be observed in a familiar environment and with a familiar adult, which may improve their willingness to cooperate.

Directions for Online Administration

The ACER Psych Testing (APT) platform puts the administrator in control by providing advanced candidate management features along with immediate and advanced reporting functionality for a wide range of assessments.

The below instructions are intended to be a quick-start guide. For more detailed information and support, please refer to the help section on the APT.

Logging in to Your ACER Psych Testing (APT) Platform Account

1. Navigate to your unique account URL, e.g. **https: //psychtesting.acer.edu.au/your-business-name.** If you cannot remember your unique URL, please refer to previous email communications or contact ACER Sales Support at onlinetesting@acer.org.
2. Enter the username and password created during registration. If at any point you cannot remember your login details, click on the **Forgot your password?** link to begin the password reset process.

How to Manage Candidates

Navigate to **Candidates** (via the main navigation bar at the top of the screen), which is circled in green in the following screenshot.

Key:
Green – candidate actions navigation
Blue – export/add candidates
Red – candidate quick selection
Orange – candidate search functions

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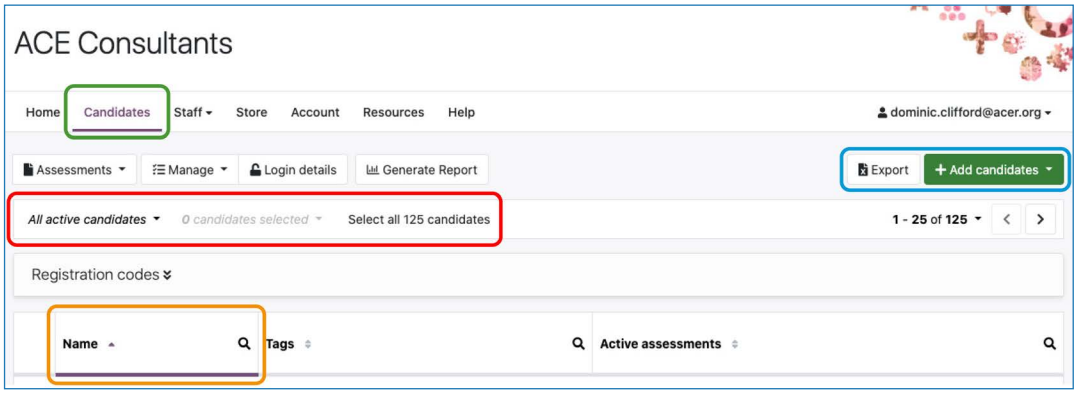

Adding New Candidates

Select the **+ Add candidates** button (circled in blue at the top on the right side of the screen), and then select **New candidate** in the drop-down menu.

Fill in the information fields as required. Double check your information and select **Create candidate** to save your new candidate.

Note. Email addresses, IDs, and usernames cannot be duplicated across candidates – they must be unique to each candidate. For candidates who are minors, and therefore may not have email addresses, it is fine for the administrator to create dummy accounts, including dummy usernames, passwords and email addresses. If creating a dummy email address, note that it needs to include the **@** symbol.

Sitting Assessments on Behalf of Candidates

This process allows administrators to undertake an assessment on behalf of a candidate.

- In the **Candidates** view, select the candidate you wish to complete the assessment for.
- A dialogue box with the candidate's details will appear. Select the Assessments tab at the top of the dialogue box.
- Select the three-vertical-dot icon to the right of the assessment that you wish to sit.
- Select Undertake sittings on behalf of candidates in the drop-down menu that appears, and then follow all of the instructions to complete it.

Managing Assessments

This allows you to manage assessments across several candidates. In the **Candidates** view, select the checkbox next to the candidate(s) you wish to manage assessments for, and select **Assessments** (in the navigation bar at the top). A drop-down menu will appear, from which you can select the following options:

- **Assign:** allocates a candidate to a new assessment for completion.
- **Unassign:** removes an assessment that is already assigned to a candidate.
  – This option only applies to assessments with a **Not Started** status.
  – The credit is also removed from the candidate, and can be reassigned.
- **Close unfinished assessments:** this allows an assessment to be scored in the event that the candidate has not correctly closed off the assessment.
  – This option only applies to assessments with a **Started** status.
  – Any assessments manually closed by an account administrator cannot be reassigned.

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Generating Reports

This process allows you to generate reports for any completed assessments.

- In the **Candidates** view, select the checkbox next to the candidate(s) that have completed assessments, and select **Generate Report** (in the navigation bar at the top).
- Follow the prompts to generate the parameters for the report. Select the **Generate Report** button, and then select **Download Report** to download and view the report.

The Testing Room

The testing room will be prepared prior to the entrance of the child. Ideally, it should:

- be an area that minimises the chance of interruption (e.g., telephone ringing, or other people entering the room)
- be cleared of any distracting items (e.g., TV switched off, toys cleared away)
- contain a table, out of the child's reach, for the materials required and for the laptop/desktop/tablet on which the screener will be administered. The administrator will ideally already have logged into the APT platform
- with younger children, the administration may be done at a highchair.

These conditions should be adhered to as closely as possible, but as the administration of the screener may occur in the child's home, variations may be unavoidable. However, it is important that only the child, the caregiver, and the screener administrator are present during the session.

In addition:

- The toys for the Adaptation Period are placed on the floor.
- The materials required should remain in the box until they are needed, to avoid the child seeing the items.

Scoring and Reporting

Scoring of the items takes place during the online assessment as the items are presented. The screener administrator should read all answer alternatives in full before making their rating selection. When all items are answered and the screener has been completed, the administrator will receive an online report with the breakdown of all items and their ratings from 0–2. An overall ADEC score is also provided, which indicates the likelihood of ASD in the child screened and suggested follow-up.

Interpretations of the overall ADEC score are as follows:

Score	Likelihood of ASD	Possible Follow-up
0–10	Low likelihood	No immediate action required
11–13	Moderate likelihood	Child should be reviewed
14–19	High likelihood	Further testing required
>19	Very high likelihood	A formal ASD assessment is strongly recommended

What Do I Do if the Child is Unwilling to Cooperate?

The Adaptation Period is included to allow the child to relax; if, however, the child is unwilling to play with the toys independently, or is crying or clinging to the caregiver, extend the Adaptation Period and ask the caregiver to interact with the child to help them to relax. Administration of the screener may proceed once the child settles and plays independently.

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If at any time the child is unable to settle or becomes inconsolably distraught or uncooperative, allow the child to play with the Adaptation Period toys and ask the caregiver to try to calm them down. It may be necessary to give the child a "break" by allowing them to leave the room and engage in an activity of their choice for approximately 5 minutes, before resuming the screener. If this is unsuccessful, or is required more than once, the session may be continued on another occasion.

Suggested Sequence for Testing

The following sequence is recommended to improve the efficiency of the session, but is not mandatory. Items can be completed in any order, and if an item is not completed, it may be returned to later. It is recommended that the order of items, and the time allowed between items, be flexible so as to accommodate the child's needs.

1. Response to Name
2. Imitation of Motor Behaviours
3. Stereotypical Behaviour
4. Gaze Switching
5. Eye Contact
6. Functional Play
7. Pretend Play
8. Reciprocity of Smile
9. Response to Everyday Sounds
10. Gaze Monitoring
11. Response to Verbal Command
12. Use of Words
13. Anticipatory Posture
14. Nestling
15. Use of Gestures
16. Ability to Switch Tasks

For younger children, it is important to move quickly through the items before they lose interest. Alternatively, the child may require some time to themself between items, in which case the toys used for the Adaptation Period may be used. However, two items measuring the same behaviour should not be presented consecutively. The ability to switch tasks (item 16) will ideally be observed throughout testing procedure. Further, waving goodbye, measuring use of gestures (item 15), fits conveniently at the end of the session. If behaviours are not elicited when required or prompted but occur spontaneously, then a score of 1 should be given.

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6 Case Studies



Case Study 1

AB was referred to the first author (Young) by a paediatrician, who thought he (AB) might be demonstrating symptomology consistent with ASD. AB was aged 38 months at that time and his score on the ADEC was 17 with a Childhood Autism Rating Scale (CARS) score of 30. On observation, AB showed some joint attention behaviours such as gaze switching, but this was inconsistent. Although he attempted to follow a point, he didn't really know where to look. He responded to a verbal command but only after a delay. He cuddled and showed gestures. Although he would move from one task to another, the assessor found it difficult to engage him. His receptive language was poor, and he had no expressive language. Both tests and behavioural observations supported the diagnosis of ASD. This was supported by two independent practitioners. AB's parents received immediate training in behaviour management. AB commenced intensive behavioural intervention, aged 41 months. At a 20-week follow-up, AB's score on the ADEC was 3 and his CARS score was 22.5. By age 4, AB could express himself using single-word utterances, and his functional and pretend play skills had improved dramatically. He attended full-time kindergarten and, from all reports, was doing well and only presenting with a few behaviours consistent with ASD.

Case Study 2

DT was referred to the first author at 28 months following parental concerns, and an ADEC score of 24 suggested ASD. This was supported using the Autism Diagnostic Interview–Revised and the CARS. DT commenced early intervention 6 weeks after diagnosis, receiving a minimum of 15 hours a week of therapy. At a 20-week follow-up, his ADEC score had improved to 12. At this follow-up, it was noticed that his stereotypical behaviours had reduced significantly, and he had very good receptive language. His play skills were also slowly improving.

Case Study 3

LR was referred to the first author aged 17 months because of concerns she may be demonstrating symptomology consistent with a diagnosis of ASD. Due to difficulties during her mother's pregnancy and a stagnated growth pattern, it was suspected LR had suffered neurological damage. Her paediatrician and mother were concerned about her social and verbal development. Over a 6-week period prior to the assessment, there had been some regression, with a number of unusual behaviours developing. These included stereotypical hand movements, eye gouging, body rocking (even with rhythmic speech), a fascination with patterns, arching her back when cuddled, lining up of toys, unusual vocalisations, aloofness, high-pitched squeals, grunts, moans, and guttural noises. ASD was suspected. On observation, LR consistently responded to her name and to verbal commands. She also demonstrated the use of the phoneme "sh" for shoe. LR did not get upset by a row of blocks that was disturbed. LR was able to use some gestures; for example, she waved goodbye and pointed to an

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object of interest. Her eye contact in a game of peek-a-boo was excellent. LR sought out the source of everyday sounds by responding to noises and looked for other people's interpretations of these sounds. LR consistently gaze switched, looking around to see how others were responding. LR also demonstrated joint attention behaviours. LR played with some toys in a functional manner. LR was able to imitate a simple behaviour such as banging a box. LR was able to switch easily between tasks. Her reciprocating a smile was inconsistent but evident. She did not, however, follow a point, choosing rather to look at my finger extended. Her pretend play was also limited. LR did not really respond to the anticipatory posture of another, although when I went to pick her up, she returned to her mother, suggesting she was aware of my intent. Her score on the ADEC was 9 and a CARS score was 29. LR underwent intensive intervention, targeting behaviours that were of concern. At a 20-week follow-up, her CARS score was 22 and her ADEC was 0. ASD was not suspected in this case.

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