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Toddlers With Autism
Developmental Perspectives

Linda R. Watson, EdD; Grace T. Baranek, PhD; Pamela C. DiLavore, PhD

Recent research has greatly expanded our knowledge about the early development of children with autism and related disorders. Familiarity with this literature will improve the ability of professionals to appropriately diagnose and intervene with young children with autism. This article reviews the literature pertaining to the development of children with autism under the age of 3 years. We examine findings on affective development, sensory processing and attention, praxis and imitation, communication, play, and motor features and stereotyped behaviors, and discuss the interrelationships among these different aspects of development. Screening and diagnostic tools with specific applicability to young children with autism are reviewed as well. **Key words:** *affect*, *assessment*, *autism*, *communication*, *play*, *sensory processing*, *toddlers*

RECENT research has greatly expanded our knowledge of the early development of children with autism and related disorders. An increased understanding of how autism is manifested in very young children holds promise for improving our ability to diagnose children at a younger age and to offer appropriate interventions that address the needs of very young children with autism and their families. The purpose of this article is to summarize the current evidence base related to the development of children with autism under the age of 3 years, and to discuss assessment instruments that have particular applicability to screening for and diagnosing autism in young children.

From the Divisions of Speech and Hearing Sciences (Dr Watson) and Occupational Sciences (Dr Baranek), Department of Allied Health Sciences, and the TEACCH Division (Dr DiLavore), Department of Psychiatry, Medical School, University of North Carolina at Chapel Hill.

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Corresponding author: Linda R. Watson, EdD, Department of Allied Health Sciences, CB # 7190, Medical School, Wing D, University of North Carolina at Chapel Hill, NC 27599-7120 (e-mail: Linda_Watson@med.unc.edu).

EVIDENCE REGARDING EARLY DEVELOPMENT

The first attempts to study the early development of children with autism relied on parents' retrospective reports of their children's early development (eg, Hoshino et al., 1982; Ornitz, Guthrie, & Farley, 1977). This approach provided intriguing insights into the early development of children with autism prior to their diagnoses. Concerns about this research methodology, however, include questions about the accuracy of parental recall of early development after a period of several years has elapsed, and the possible influences of the subsequent knowledge of a child's diagnosis on that recall. Over the past decade, newer research using different methodologies has helped to confirm much of the information from parent recollections, and to significantly elaborate upon that information. This research includes prospective studies of children referred to a diagnostic clinic at age 2 because of concerns about possible autism (eg, Gillberg et al., 1990; Lord, 1995), studies related to the development of screening instruments for autism in young children (eg, Baron-Cohen et al., 1996; Stone, Lee, et al., 1999), developmental studies of toddlers with diagnosed or suspected

autism (eg, Charman et al., 1997; Stone, Ousley, Hepburn, Hogan, & Brown, 1999; Swettenham et al., 1998), and retrospective studies of home videotapes made of infants and young children who were later diagnosed with autism (eg, Adrien et al., 1993; Baranek, 1999; Osterling & Dawson, 1994).

We organize our discussion of the development of young children with autism by the developmental domains of affective development, sensory processing and attention, praxis and imitation, communication, play, and motor features and stereotyped behaviors. We recognize, however, that development is integrated in complex ways across domains, and that the concepts of researchers investigating one domain of development overlap with those of researchers investigating other domains. Our discussion addresses some of these interrelationships.

Affective development

Limitations in facial expression are listed as a possible symptom of autism under the category of "nonverbal social behaviors" in the *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (*DSM-IV*, American Psychiatric Association, 1994). In typical development a broad range of facial expressions is in place by 2–3 months of age, and smiling in response to the smiles of others is observed reliably by 6 months. In general, fewer facial expressions are seen in toddlers with autism, and fewer are directed to other people. In addition, these children are more likely to show ambiguous facial expressions. For example, retrospective parent reports have been more likely to describe infants and toddlers with autism as "having an expressionless face" (Hoshino et al., 1982) than to apply this description to children with other developmental disabilities or children who are typically developing. Retrospective video research has indicated a lack of social smiling in infants with autism (Adrien et al., 1993).

Swettenham et al. (1998) demonstrated that 20-month-old infants with autism had deficits in social orienting, as noted by shorter durations of looking at people, relative to children with typical development and those with developmental delays. In research with the same sample of children, Charman et al. (1997) demonstrated that children with autism were unlikely to look at and show facial concern for an experimenter expressing distress, but children in the other 2 groups often did so.

Sensory processing, attention, and self-regulation

There is some controversy regarding the extent to which unusual sensory symptoms are manifest in young children with autism, and more controversy with respect to the nature of these difficulties. Phenomenological narratives from persons with autism recalling their childhood experiences (eg, Grandin, 1997), as well as retrospective reports from parents of children with autism and/or reports from their clinical charts (eg, Dahlgren & Gillberg, 1989; Greenspan & Weider, 1997; Hoshino et al., 1982; Ornitz et al., 1977) attest to numerous symptoms reflective of sensory processing and/or attentional disturbances during the first 3 years of life. Among these symptoms are hypersensitivities to sound, aversion to social touch, avoidance of certain food textures, lack of response to pain, poor orientation to visual stimuli, and overfocused attention or preoccupations with various sensory features of objects (eg, watching things spin, licking objects). These unusual behaviors may range from mild to severe, perhaps moderated in part by the child's coping/self-regulatory abilities and environmental supports, and may interfere with participation in a variety of daily activities (eg, picky eater, temper tantrums in noisy environments, sleeping problems).

It is unclear whether or not sensory features described in young children with autism are completely unique to this diagnosis. S. J. Rogers, S. Hepburn, and E. Wehner (unpublished data), using a parent report instrument, reported higher levels of sensory symptoms in 2–4-year-olds with autism as compared to children with Down syndrome, but not

compared to children with fragile X syndrome. Analyses of home movies taken of infants who were later diagnosed with autism (Adrien et al., 1992; Baranek, 1999) document specific patterns of subtle sensory-attentional symptoms that differentiate clinical groups during the first year of life, often prior to the time that parents are cognizant of the child's diagnosis. Interestingly, infants later diagnosed with autism appear to be differentiated from infants with other developmental disabilities more on the basis of their hyporesponsiveness to both social and nonsocial stimuli than by hyperresponsiveness. Some symptoms intensify during the second year while new symptoms also emerge (Adrien et al., 1993), suggesting the importance of a developmental perspective to understanding these unusual behaviors. Some researchers (Baranek, 1999; Gillberg et al., 1990) hypothesize that the integrity of early sensory processing and attention regulation abilities is critical for the development of later-emerging cognitive and social skills (eg, joint attention). Thus, assessment of disruptions in these basic developmental processes during the infancy period may provide a window to earlier identification and interventions.

Praxis and imitation

Imitation skills are very important in early diagnosis and intervention with children with autism. In typical development, children have a range of imitation skills by the age of 12 months, including the ability to imitate unfamiliar movements and sounds, and to imitate actions for interactive play. Imitation deficits are evident in the youngest children with confirmed diagnoses of autism. Charman et al. (1997) have reported that 20-month-old children with autism show less proficiency in procedural imitation of actions on objects than do children who are typically developing or those with other developmental delays. Research by Stone, Ousley, and Littleford (1997) with 2-year-olds with autism suggests that children with autism have the same developmental patterns as other children with respect to the order of difficulty of motor imitation, but that children with autism overall show less proficiency. Rogers and Pennington (1991) hypothesized that infants who later exhibit autism would not have the ability to engage in neonatal imitation because of an innate impairment of this important social ability, but there is no research evidence available related to neonatal imitation in infants who are later diagnosed with autism. In early intervention programs for children with autism derived from a variety of perspectives, imitation is considered a pivotal skill. The literature confirms that the development of skills in other areas, such as play and language, is closely tied to the child's ability to imitate. Stone, Ousley, and Littleford (1997) found that for 2-year-olds with autism, the imitation of actions on objects is more closely tied to the children's concurrent play skills, and imitation of body movements is more closely tied to the children's expressive language development both concurrently and predictively.

Successful imitation is dependent upon both comprehension of the social-communicative interaction as well as the sensorimotor demands of the task. Several researchers have suggested that young children with autism may have difficulty forming internal (somatosensory) representations of visually modeled actions (eg, Hughes & Russell, 1993; Smith & Bryson, 1998; Stone, Lee, et al., 1999). Thus, it is possible that aspects of sensory processing and integration impede the successful performance of some imitated as well as nonimitated motor acts by these children.

Communication

Comprehension

Although language and communication impairments are one of the criterial areas for the diagnosis of autism, comprehension is not specifically mentioned in the diagnostic criteria. Nevertheless, relative to their nonverbal cognitive abilities, the comprehension abilities of children with autism are significantly worse than those of their counterparts with

specific language impairment or low intelligence (Fein et al., 1996). Comprehension is a key concern for toddlers with autism. Comprehension problems not only impede the child's progress in social interaction and expressive communication, but also often are implicated in the development of challenging behaviors.

Chapman (1978), in seminal work, proposed that nonverbal "comprehension strategies" are used by typical 9–12-month old infants to decode and respond appropriately to language input, and also constitute the foundation on which more sophisticated language comprehension skills are built. Important strategies include looking at what adults look at, acting on objects noticed, and imitating ongoing activities. Subsequent research has at least partially supported Chapman's model for early comprehension development. For example, individual differences in gaze-following proficiency at 6 and 16 months of age have been found to correlate with receptive vocabulary at 12 and 20 months of age, respectively (Morales, Mundy, & Rojas, 1998; Mundy & Gomes, 1998).

As discussed elsewhere in this article, toddlers with autism are impaired in these key aspects of nonverbal behavior that typically support the mapping of language onto real world objects and relations. In this light, the comprehension deficits of individuals with autism are not surprising. Considering one of the earliest comprehension skills, the reduced responsiveness of children with autism to their own names at the age of 12 months discriminates children with autism from children who are typically developing or developmentally delayed but without autism (Baranek, 1999; Osterling & Dawson, 1994). This continues to be a variable that discriminates between preschoolers with autism who have no or few verbal skills and children with other developmental disabilities (DiLavore, Lord, & Rutter, 1995). Problems comprehending communication extend beyond difficulties in understanding verbal language. Parents of 2-year-olds with autism are less likely to report their children comprehend gestures than are parents of children with other developmental delays (Lord, 1995).

Communicative means

Diagnostic criteria in *DSM-IV* describe the impairment of nonverbal as well as verbal communication skills in autism. Thus, these disorders not only impact communication through verbal language. Eye contact is an important consideration for diagnosis not so much in terms of absolute quantity of eye contact (although that may also be reduced in young children with autism; eg, Swettenham et al., 1998), but more importantly in terms of its use in regulating communication (eg, Stone, Ousley, Yoder, et al., 1997). For example, parents of 2-year-olds with autism are less likely than parents of 2-year-olds with other developmental disabilities to report the coordination of gaze with other behaviors in requesting (Lord, 1995). Related to other precursors of verbal communication, parents retrospectively report less babbling and gesturing during early development in children with autism compared to typically developing children (Ornitz et al., 1977); however, retrospective reports of these behaviors do not discriminate children with autism from children with mental retardation (Hoshino et al., 1982). Another observation regarding communicative means is pertinent to early diagnosis: if a child's primary communicative means entail manipulating another person's body (eg, placing another person's hand on a doorknob to request to go outside), this points to a diagnosis of autism (DiLavore et al., 1995; Stone, Ousley, Yoder, et al., 1997).

Communicative intention

Consideration of communication intention highlights the inseparable nature of social and communicative development. Many communicative behaviors in young children are essentially social in nature. In descriptions of the social-communicative development of typical infants, the period prior to 6 months has sometimes been referred to as a period of "primary intersubjectivity" (Trevarthen, 1979). During this time, infants engage in

mutual imitation, vocal turntaking, and other reciprocal social interactions with caregivers (Meltzoff & Moore, 1998; Reddy, Hay, Murray, & Trevarthan, 1997). By 8–12 months, infants progress to "secondary intersubjectivity," in which there is a focus outside of the face-to-face interactions between infants and their partners (Trevarthan & Hubley, 1978). During this period, infants begin to direct gestures and nonspeech vocalizations to others to communicate a range of intentions, including seeking attention to self or "showing off"; directing attention to objects, events, and other people; requesting objects, actions, and information; greeting; giving; protesting and rejecting; responding and acknowledging; and informing (Bates, 1976). A hallmark of this period is the ability of the infant to coordinate attention to an object or event and to another person within a single communicative act, otherwise known as *joint attention*.

In contrast, children with autism demonstrate a more limited range of preverbal communicative intentions. The *DSM-IV* criteria specifically list a limited range of communicative intents as a possible characteristic of children with autism. Studies indicate that children with autism are especially at risk for lacking communication with more social intent, such as showing off or directing a partner's attention to outside objects, people, or events (Mundy, 1995; Osterling & Dawson, 1994). A lack of protodeclarative pointing is one of the key items for identifying 18-month-old children at risk for autism using the Checklist for Autism in Toddlers (Baron-Cohen et al., 1996). Lord (1995) also reported that parents of 2-year-olds with autism are less likely to report referential pointing by their children than are parents of children with other disabilities. Thus, limitations in the ability of young children with autism to engage in joint attention have proven to be highly reliable in helping to distinguish them not only from children developing typically, but also from children with other types of developmental disabilities. Much of the communication initiated by these children appears to have instrumental purposes (eg, requesting, rejecting, and protesting; eg, Stone, Ousley, Yoder, et al., 1997).

Play

Children with autism often display uneven play skills and demonstrate unique differences as compared to children with other developmental disorders (Stone & Lemanek, 1990; Wing, 1981). Given that play skills are critical to successful social participation for all young children, assessment and intervention practices for young children with autism need to specifically address this important developmental domain.

Social play

Many young children with autism are capable of engaging in some social play; however, the play is often characterized by less proximity to peers, reduced levels of social initiations, fewer responses to social overtures, and more solitary activities than the play of children with other developmental disorders (McGee, Feldman, & Morrier, 1997; Sigman et al., 1999; Stone & Lemanek, 1990). Specifically, Sigman and colleagues found that regardless of the child's level of functioning, children with autism were less socially engaged with peers. Play skills, in addition to nonverbal communication abilities, predicted the number of initiations the child with autism produced, and the extent to which the child with autism engaged with peers.

Some researchers hypothesize that inability to understand complex human interactions, share experiences, and take another's perspective (ie, have a "theory of mind") may contribute to difficulties in the peer engagement process (Baron-Cohen, Leslie, & Frith, 1985; Frith, 1996; Frith & Happe, 1994). Successful play interactions require orienting to salient stimuli, sharing of attention, and coordination of gaze between people and objects—the skills that typical children acquire easily during the first 2 years of life, but young children with autism often lack (eg, Baranek, 1999; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Swettenham et al.,

1998). Difficulties with social orienting and joint attention may significantly reduce levels of engagement in social play; such specific deficits also correlate with measures of functional and symbolic play with objects later in childhood (eg, Stella, 2001).

Object play

In typical development, meaningful interactions with objects begin early in life and progressively become more diverse, complex, and refined throughout development. Several authors describe the importance of infant exploratory play as a means to become familiar with objects or situations that eventually leads to the production of complex play acts (eg, Belsky & Most, 1981; Doctoroff, 1996). Exploratory play emerges by 4 months of age and includes behaviors such as simple repetitive object manipulations. Later evolving types of play include relational play such as putting blocks in a cup (emerging at 10–18 months); functional play such as giving a doll a pacifier (emerging at 12–18 months); and symbolic play such as using a block as a pretend airplane, or feeding a doll using imaginary utensils or food (emerging between 18 and 30 months).

Because children with autism are often not diagnosed prior to 2 years of age, very little is known about play development prior to this point except through retrospective research. Baranek (1999) analyzed home movies of infants at 9–12 months of age who were later diagnosed with autism. She found that these infants engaged in more mouthing of objects than did typical children or children with other developmental delays. However, many typical children still mouthed objects to some extent, making it difficult to use this item as a specific behavioral marker for autism. In addition, the level of object play (eg, repetitive/inappropriate vs functional/appropriate play) with objects did not discriminate between groups—perhaps due to the fact that few children in any group had developed object play skills beyond the earlier sensorimotor (eg, exploratory/relational) stages. Thus, using traditional developmental markers of play may have limitations for diagnostic use prior to 12 months of age when higher levels of functional play (presymbolic pretend functions) tend to develop in typical children. By 18 months children with autism demonstrate clear deficits in early pretend skills (ie, functional play such as feeding a doll with a spoon) relative to typical children (Baron-Cohen et al., 1996; Baron-Cohen, Allen, & Gillberg, 1992). By 2–3 years of age, children with autism show significantly fewer functional play acts than do children with other developmental disorders (Stone, Coonrod, & Ousley, 2000), indicating not only a quantitative, but also a qualitative difference in the development of play skills. Preschool and school-aged children with autism often persist in lower developmental levels of play (eg, Libby, Powell, Messer, & Jordan, 1998), demonstrate fewer functional acts with toys, use fewer toys, and engage in more repetitive play (Stone, Lemanek, Fishel, Fernandez, & Altemeier 1990). Some of the lack of creativity with object play has been theoretically linked to executive dysfunction, which makes it harder for children with autism to flexibly switch from familiar routines to alternative, novel play actions (eg, Ozonoff, 1997; Pennington & Ozonoff, 1996; Rogers, Bennetto, McEvoy, & Pennington, 1996).

Motor features and stereotyped/repetitive behaviors

Motor development plays an important role in learning—young children depend upon motoric abilities to explore the environment, play with toys, or engage in social-communicative interactions. Considering strengths and weaknesses within this developmental domain is therefore critical for the purposes of assessment and intervention for young children with autism. The majority of children with autism are often described as (a) achieving basic motor milestones (eg, head control, sitting, crawling, walking) on time (eg, Ohta, Nagai, Hara, & Sasaki, 1987), (b) having relative strengths in motor as compared to social-communicative

skills, and (c) having motor skills that exceed those of children with other developmental disorders with comparable mental ages (Stone, Ousley, Hepburn, Hogan, & Brown, 1999). Nevertheless, up to 28% of children with autism were documented to have lags in gross motor development in one prospective study that screened children during the first 18 months of life (Johnson, Siddons, Frith, & Morton, 1992). Also, parental reports of early motor delays in their young children with autism are noted to increase with the increasing age of their child (Ohta et al., 1987; Ornitz et al., 1977).

Teitelbaum and colleagues (Teitelbaum, Teitelbaum, Nye, Fryman, & Maurer, 1998) conducted a movement analysis of home movies of children with autism as compared to those with typical development and found that postural differences were present in the first months of life. Baranek (1999), using an analysis of home movies at 9–12 months of age, found that posturing was evident in some infants with autism, but appeared symptomatic of neuromaturational delays in general and was not necessarily specific to autism. Children with autism often have concomitant mental retardation; thus, motor delays in this population may be associated more with their level of mental retardation than with their autism. However, there is also accumulating evidence that some children with autism without cognitive delays may exhibit unusual postures, clumsiness, and motor planning problems, particularly as the complexity of tasks increases later in childhood (eg, DeMyer, Barton, & Norton, 1972; Ghaziuddin, Butler, Tsai, & Ghaziuddin, 1994; Jones & Prior, 1985; Smith & Bryson, 1998). It is also important to note that motor performance for children with autism, like that of typical children, appears to be dependent upon the context of purposeful, goal-directed tasks, such that children produce less proficient skills in carrying out decontextualized tasks than contextualized ones (eg, Stone, Ousley, & Littleford, 1997).

Although repetitive/stereotyped (eg, arm flapping, toe walking) and ritualistic behaviors (eg, lining up objects) are among the hallmark features of autism, converging evidence (eg, Baranek, 1999; Lord, 1995; Volkmar, Cohen, & Paul, 1986) demonstrates the relatively late-developing nature of these phenomena. That is, repetitive behaviors are so common in typical development that it becomes difficult to discriminate patterns that are specific to children with autism until after the third birthday when these behaviors may persist or perhaps even intensify. Furthermore, stereotyped behaviors may serve numerous functions—some are easily elicited even in typically developing young children under very arousing or stressful conditions (eg, frustration). For young children with autism, difficulties with social skills, communication, or sensory processing may appear to accentuate or maintain these behaviors.

ASSESSMENT INSTRUMENTS FOR EARLY DIAGNOSIS AND SCREENING

Approximately 25% of children show some developmental concerns, but fewer than 30% of primary care practices conduct standardized screening tests (Filipek et al., 1999). Thus, the American Academy of Neurology has developed practice guidelines (Filipek et al., 2000) that emphasize the need for flexible, continual developmental surveillance at every well-child visit. These guidelines are available on the Web site http://www.aan.com/public/practiceguidelines/autism.pdf. Developmental surveillance includes obtaining information from parents regarding any developmental concerns they have about their infant, probing for age-appropriate skills in each developmental domain, and directly observing the child. Since most standardized developmental assessments do not include items that specifically target symptoms associated with autism, a specific screening for autism is also recommended in cases where "red flags" are present. Red flags include items such as no babbling, pointing, or gestures by 12 months of age, no single words by 16 months of age,

no 2-word spontaneous phrases at 24 months of age, or loss of language or social skills at any age. Children who have such concerns should be immediately screened for autism and/or referred for a more specialized evaluation (eg, audiological assessment, diagnostic evaluation) depending on the nature of their difficulties.

Screening for young children at risk for autism spectrum disorders

The purpose of screening is to identify those children who are at risk for autism and will need to undergo more focused diagnostic procedures. There has been much interest in the development of screening tools that can reliably identify young children with autism (eg, Filipek et al., 2000). Good screening tools are those that are age-effective, appropriately inclusive, and easy to use. They also need to reflect good sensitivity (ie, identify all children who are at risk without "false negatives" [missed children]) and specificity (ie, identify only the children at risk for the condition and minimizing "false positives" [misdiagnosing]). Other important psychometric concepts include the positive predictive value of a tool (ie, the percentage of positive test results that are "true positives"), and its negative predictive value (ie, what percentage of negative test results are "true negatives"). A variety of specialized tools are available to screen for and diagnose autism spectrum disorders in young children. These tools vary in terms of the ages for which they are targeted, the format they use, the intended level of screening (population targeted), and content. Table 1 summarizes screening and diagnostic tools for young children with autism. We have included available information about the psychometric properties of each tool; however, in most cases the development and research on these tools are continuing.

Level I tools are those that are targeted for a general population screening and lend themselves to use in primary care settings such as the pediatrician's office. They help to identify children who need to be referred for a more specialized developmental assessment. Level II tools are those that are targeted primarily for early childhood settings or diagnostic settings where children are referred with known developmental delays or concerns. These tools assist the early interventionist, therapist, or health professional in discriminating autism from other developmental delays and suggest the need for further specialized evaluation for autism when needed. Level III tools are specialized instruments that discriminate among different types of autism spectrum disorders. These tools are usually utilized by clinics specializing in diagnosis of children with autism.

The majority of early screening tools utilize a parent questionnaire format because it is very easy and quick to use. However, it is important to note that supplemental observations are critical in most cases, and that professionals skilled at identifying symptoms of autism may pick up on subtle symptoms that do not evidence on questionnaire data. Likewise, observational assessments have limitations in that they assess the child in only one context, and thus, supplemental parent reports help to identify behaviors that are low in frequency or to obtain information about the occurrence of behaviors across several naturalistic contexts. The content of screening tools varies considerably and is very dependent upon the age for which the tool is targeted, because the specific symptoms of autism are known to change somewhat across development. Some tools (eg, Siegel, 1998) include both "negative" symptoms (absence of language or social behaviors that are expected for the child's age) and "positive" symptoms (presence of unusual behaviors for the child's age). Others (eg, Baron-Cohen et al., 1992, 1996; Berument et al., 1999; Lord et al., 1999; Stone et al., 2000) rely more heavily on the negative symptoms, particularly in areas associated with joint attention that are known to be effective discriminators of young children with autism. One reason why the positive symptoms are often not included in tools aimed at children below 3 years of age is that research has indicated that many repetitive and stereotyped behaviors are not salient

Table 1. Screening tools for autism

Screening tool* and references	Level† of screening	Targeted age	Administration format & time	Content description	Sensitivity & specificity
CHAT Baron-Cohen et al. (1992, 1996)	I	18 mo	Parent Questionnaire and Observational Assessment (15 min)	Nine yes/no questions and 5 child observation items. Measures social interest, social play, joint attention, pretend (functional) play, and protodeclarative pointing	Sensitivity = .38 (low); specificity = .98 (high). Positive predictive value = .29. With second administration, positive predictive value improves (.75). Has been used effectively in large-scale prospective studies in the United Kingdom. Recommend for use by experienced health professionals
M-CHAT Robins, Fein, Barton, & Green (2001)	I (& II)	24 mo	Parent Questionnaire (10 min)	23 yes/no questions that include the 9 items from the CHAT, as well as additional items such as social referencing and comprehension	Preliminary findings (full scale) indicate high sensitivity = .87 and specificity = .99. Positive predictive value = .80. Large-scale prospective study needed; absolute sensitivity and specificity are likely to be lower. Follow-up screening and supplemental observations are warranted
STAT Stone et al. (2000)	II	24 through 35 mo	Observational Assessment (20 min)	Examiner interacts with child in a play context. Items are grouped into 3 categories: play (2 items), imitation (4 items), communication/joint attention (2 items)	Sensitivity = .83 (high) and specificity = .86 (high) for the validation sample. Empirically derived tool; can be used by trained early intervention professionals or health care workers. Replication studies with larger samples are warranted; tool is unpublished
PDD-ST Siegel (1998)	I, II, III	18 mo through 5 y	Parent Questionnaire (5–10 min for each level)	Content includes core autistic features as well as sensory patterns, attention, temperament, and other developmental markers. Divided into 3 stages, each targeting a different level of screening. 71 items tap both *positive* (atypical behaviors present) and *negative* (typical behavior absent) symptoms	Sensitivity = .87 (high); specificity is reported to be moderate. Three-stage approach allows for application to a variety of settings (primary care, developmental clinics, or specialty clinics). Empirical work on this clinically derived tool continues; not yet published

(*continues*)

Table 1. (*Continued*)

Screening tool* and references	Level† of screening	Targeted age	Administration format & time	Content description	Sensitivity & specificity
ASQ Berument, Rutter, Lord, Pickles, & Bailey (1999)	II	Two versions: 4–6 y; over 6 y	Parent Questionnaire (15 min)	40-items derived from the Autism Diagnostic Interview-Revised. Items include 3 traditional categories used for diagnostic purposes: reciprocal social interaction, language and communication, and repetitive and stereotyped behaviors	Sensitivity = .96 (high). Specificity = .80 (high) for differentiating autism vs other diagnoses (mental retardation excluded), but specificity drops to .67 when discriminating autism from mental retardation. Useful as a brief screener for children above 4 years of age. The ASQ is soon to be published under a new name (Social Communication Questionnaire)
ADOS Lord, Rutter, DiLavore, & Risi (1999)	III	18 mo through adulthood	Observational diagnostic assessment (30–45 min depending on module selected)	Semistructured activities provide presses for communication, play, socialization, and stereotyped behaviors/restricted interests. Autism or autism spectrum disorder are diagnosed on the basis of meeting cut-off scores in communication and social areas	Module 1: Sensitivity = .97; specificity = .94; Module 2: Sensitivity = .95; specificity .87 for discriminating autism/ASD from other nonspectrum diagnoses. This tool does not provide adequate opportunity to observe the full range of stereotyped/restricted behaviors; the addition of these stereotyped behaviors lowered overall sensitivity and specificity in validation studies. Other observational or parent-report measures are suggested to augment assessment of stereotyped behaviors

*CHAT = Checklist for Autism in Toddlers; M-CHAT = Modified Checklist for Autism in Toddlers; STAT = Screening Tool for Autism in Two Year Olds; PDD-ST = Pervasive Developmental Disorders Screening Test; ASQ = Autism Screening Questionnaire; ADOS = Autism Diagnostic Observation Schedule.

†Level I: A general population screening—for use by primary care specialists (eg, health professionals; pediatricians) to screen for children at risk for autism from the general population. Level II: A specialized screening for children known to have developmental concerns and suspected of having autism—for use by early interventionists or health care practitioners working in settings for children with known developmental delays. Level III: An autism specific screening or diagnostic tool—for use by professionals in autism specialty clinics to determine the particular type and/or severity of autism spectrum disorder (eg, autistic disorder vs pervasive developmental disorder, not otherwise specified).

prior to 3 years of age and these may intensify during the preschool years (Lord, 1995).

CONCLUSIONS

Although we have considerably more to learn about the common patterns and individual differences in development of infants and toddlers with autism spectrum disorders, recent research has greatly broadened our knowledge in this area. A number of instruments can be used to assist clinicians in screening or diagnosing young children suspected of having disorders in the autism spectrum. The evidence to date suggests that we can reliably diagnose autism in some children as young as 18 months of age, but that we will fail to recognize the disorder in many toddlers who will later show clear symptoms of autism spectrum disorders. Although we currently have the knowledge and tools to identify many toddlers with autism spectrum disorders who can benefit from early intervention services, the feasibility of diagnosing children below the age of 18 months has not yet been systematically addressed. We also need to continue to advocate for and advance the research needed to develop more sensitive screening and diagnostic instruments for very young children with autism spectrum disorders. Large-scale prospective research studies are needed to address methodological limitations inherent in previous studies, and to provide a more accurate representation of the specificity, sensitivity, and predictive power of these assessments.

Implications for early intervention include recognizing the sequential and transactional dependencies and effects among various domains of development we have discussed. For example, orienting and responsiveness to stimuli in the environment, imitation, and joint attention are likely pivotal skills for more self-regulated and efficient learning of play, language, and other social behaviors, and should be areas for intensive early intervention. Giving early attention to the adaptations and strategies that improve the child's ability to comprehend communication will reduce frustration for both the child and caregivers, and will serve to prevent the development of maladaptive behaviors related to communicative failures. In considering expressive communication skills for this age group, we want to facilitate the development of adaptive verbal *and nonverbal* means of communication rather than focusing solely on the development of verbal communication. In addition, our intervention efforts will put priority on expanding the frequency of intentional communication expressed by the child, followed by expanding the range of functions to include more social communicative functions. Play is also a critical component of the early intervention curriculum for this population, to provide contexts for increased social awareness and interactions with adults and peers, and to promote more consistent levels of engagement with objects in the environment and a symbolic level of processing. Of course, the needs of young children with autism and their families must be addressed on an individualized basis, but applying our current knowledge of development in infants and toddlers with autism will greatly enhance our ability to implement effective early intervention programs.

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