

# Infants and Toddlers With Autism Spectrum Disorder: Early Identification and Early Intervention

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The increased prevalence of autism spectrum disorder (ASD) and its detection during the first 3 years of life have substantial relevance for early intervention. The purpose of this article is to summarize current scientific and policy information on early identification and early intervention for infants and toddlers with ASD and their families. Following a brief overview that provides basic information about ASD, the authors discuss early warning signs of the disorder and available screening and diagnostic tools. Finally, they highlight focused intervention practices and comprehensive treatment models appropriate for infants and toddlers with ASD, as well as issues affecting the delivery of effective early intervention services to children and families.

**Keywords:** *autism spectrum disorders; early identification; early intervention; evidence-based practices; infants and toddlers*

The greatest change in the diagnostic demographics of developmental disabilities in the last 25 years is the emergence of autism spectrum disorder (ASD) as a primary disability condition. Once considered a low-prevalence disorder, ASD is currently one of the most common forms of developmental disability (Newschaffer et al., 2007). The substantial increase in the number of children with ASD has generated pressures from families and policy makers for information about the disorder and for effective interventions and services. Researchers acknowledge ASD as a neurodevelopmental disorder associated with genetic risk (Dawson, 2008); currently, the best prospects for treatment are behavioral, developmental, or some integration therein (Butter, Wynn, & Mulick, 2003; Kasari, Freeman, & Paparella, 2006). In addition, the earlier that intervention begins in children's lives, the better the outcomes (National Research Council, 2001). With valid diagnostic

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tools and early screening processes, clinicians now have great opportunity for identifying children with ASD in the first 2 years of life (Zwaigenbaum et al., 2009); thus, the potential exists to provide high-quality early intervention. The purpose of our article is to (a) review current knowledge about ASD during this early developmental period, (b) describe screening and diagnostic tools relevant at such an early age, (c) identify potentially effective early intervention practices, and (d) examine the provision of services to infants and toddlers and their families.

## **ASD: Prevalence and Etiology**

In the United States, the source most frequently used to define autism is the *Diagnostic and Statistical Manual of Mental Disorders*, published by the American Psychiatric Association. In the current fourth edition (American Psychiatric Association, 2000), ASD is not an official diagnostic category; rather, autistic disorder is one of several diagnostic categories under the broader category of pervasive developmental disorders. Because of the shared diagnostic criteria among the manual's classifications of autistic disorder, Asperger's disorder and pervasive developmental disorders—not otherwise specified, the disorders are commonly referred to as ASD. The shared features of ASD are (a) impaired social interactions and failure to develop social relationships, (b) impaired and disordered language and communication, and/or (c) occurrence of restricted and repetitive behaviors.

Rice (2007) reported that ASD affects boys 3 to 4 times more often than girls, although girls appear to be more severely affected by the disorder. Nevertheless, Carter and colleagues (2007) noted some discrepancy regarding whether gender differences in developmental functioning are as pronounced in toddlers with ASD. In the past, researchers reported that close to 75% of individuals with ASD also had co-occurring intellectual disabilities; however, Volkmar, Lord, Bailey, Schultz, and Klin (2004) suggested that the proportion might now be closer to 50% of the ASD population. Finally, the prevalence of ASD does not appear to be disproportionally represented across ethnic, racial, or socioeconomic groups. However, Mandell and colleagues' recent work (Mandell, Listerud, Levy, & Pinto-Martin, 2002; Mandell, Novak, & Zubritsky, 2005; Mandell et al., 2009) indicated that race/ethnicity as well as socioeconomic factors affect the age at which children are diagnosed, with children from minority groups and lower income or rural households often diagnosed at later ages.

## **Prevalence of ASDs**

As noted previously, the prevalence of ASD has increased tremendously over the last two decades. For example, from the 1960s to the mid-1980s Zahner and Pauls (1987) found prevalence rates of 0.7 per 10,000 to around 2 per 10,000 (from approximately 1 in 14,000 to 1 in 5,000). In 2005, Fombonne estimated that the prevalence rates for ASD were between 35 and 60 in 10,000 (from approximately 1 in 285 to 1 in 166) in the general population. An epidemiological study sponsored by the Centers for Disease Control and Prevention revealed the prevalence of ASD to be in 1 in 150 (Kuehn, 2007). However, Kogan and colleagues (2009) recently reported the U.S. prevalence of ASD among 3- to 17-year-olds to

be 1 in 91, or 1.1% of the population. Because of the increase in prevalence, scholars frequently raise questions to whether ASD is now an epidemic.

We believe that several factors have contributed to the increased prevalence of ASDs. First, clinicians have diagnosed children with ASD at earlier ages, with diagnoses being reliable and accurate for children as young as 2 years old (Lord et al., 2006; Stone et al., 1999). Second, in recent years, researchers have considered autism a spectrum disorder, meaning that the nature and severity of characteristics differ widely across individuals with the disorder. Hertz-Picciotto and Delwiche (2009) examined reasons for the increased incidence of autism in California. They found that earlier age of diagnosis (between 2 and 3 years of age) accounted for 12% of the increased incidence of autism and that the diagnosis of children with milder symptoms accounted for 56% of the increased incidence in the state. Thus, they concluded that two leading reasons for the increased numbers of children with autism in California were that (a) more children were being diagnosed at a younger age and (b) more children with milder characteristics were being diagnosed. Third, as we mentioned, ASD comprises multiple disorders; consequently, the higher prevalence may be partly attributable to including children diagnosed with pervasive developmental disorders—not otherwise specified or Asperger's disorder as part of the broader ASD category. Fourth, some agencies, such as the U.S. Department of Education, did not have a separate eligibility classification for autism until the 1990s. The appearance of such an educational option for children with autism may be contributing to the increased identification of children with ASD because those children may have been classified in a different disability category (e.g., mental retardation, language disorders) (Newschaffer et al., 2007). Finally, increased public awareness about and knowledge of individuals with ASD may play a role in the number of children being diagnosed, given that members of society have become aware of characteristics of the disorder. Specifically, several movies have highlighted autism; numerous books and magazine articles for lay readers have appeared; and national organizations, including the Centers for Disease Control and Prevention, have launched public awareness campaigns on early indicators of the disorder.

## **Etiology of ASD**

The etiology of ASD is considered idiopathic (i.e., of uncertain cause) in approximately 90% to 95% of the cases (Caronna, Milunsky, & Tager-Flusberg, 2008). In the remaining 5% to 10%, the characteristics of ASD are thought to be secondary to children's primary impairment. Some common secondary causes of autism include environmental factors (e.g., early exposure to rubella), chromosomal abnormalities, and genetic disorders. One of the most common genetic disorders associated with autism is fragile X syndrome with 15% to 25% of individuals with the syndrome exhibiting characteristics of ASD (Bailey, Mesibov, Hatton, Clark, & Roberts, 2004; Rogers, Wehner, & Hagerman, 2001).

Scientists have continued to better understand the etiology of ASDs, and many investigators have emphasized the role of genetics. For example, Dawson (2008) reported that the concordance rates in ASD for twins (i.e., the occurrence of the disorder in both twins) are 69% to 95% for monozygotic twins, in comparison to 3% to 8% for dizygotic twins. Other researchers have found that the recurrence risk of ASD in a younger sibling, if one or more older siblings has the disorder, ranges from 2% to 35% (Landa & Garrett-Mayer, 2006;

Zwaigenbaum et al., 2007). These wide ranges may reflect methodological differences in the studies as well as a reported elevated recurrence risk when two or more older siblings have ASD in comparison to one older sibling (Ritvo et al., 1989; Zwaigenbaum et al., 2007). Environmental factors—most notably, the role of vaccinations—have also been implicated in the etiology of ASD. At present, the compilation of evidence has indicated that vaccinations are neither a contributing factor to the cause of ASD nor the reason behind the increase in the number of children being diagnosed (Kaye, Melero-Montes, & Jick, 2001; Taylor et al., 1999).

The phenomenon of autistic regression has been one of the reasons why environmental and behavioral risk factors of ASD have been of interest to researchers. Autistic regression is a period of relatively normative development with a subsequent loss of language skills around the second year of a child's life. Occurrence rates of this phenomenon in ASD range from 15% to 30% (Baird et al., 2008). The questions that many researchers are addressing include (a) whether children were developing as expected or early warning signs simply went unnoticed and (b) whether children began to regress developmentally or the development of skills simply slowed (e.g., Landa, 2008; Werner & Dawson, 2005). There have been mixed findings on whether children who regressed in their early years have poorer developmental outcomes than those who did not (e.g., lower IQ, poorer adaptive and language skills; Baird et al., 2008; Werner, Dawson, Munson, & Osterling, 2005).

## **Early Identification**

The prospects for identifying children with ASD during the first 2 years of life have become more promising than in past years. Scientific knowledge about early warning signs of ASD has increased; researchers have developed effective screening and diagnostic instruments; and evidence has accumulated about the stability of diagnoses that occur around 2 years of age. In this section, we selectively review early warning signs of ASD and available tools to screen and diagnosis infants and toddlers with the disorder. It is beyond the scope of our article to provide a comprehensive summary of the research base on early identification of ASD or discuss in detail the psychometric properties of all screening and diagnostic instruments.

## **Early Warning Signs**

In recent years, research and federal funding has emphasized the identification of early warning signs of ASD in infants and toddlers with, or at risk for, the disorder. The goal has been to identify behavioral or physiological indicators occurring early in children's development that reliably predict the onset of the disorder. Earlier identification will allow children to receive an earlier diagnosis and more timely access to early intervention services. Researchers have employed two types of study methods to identify early warning signs of ASD—retrospective studies and prospective studies. Investigators using retrospective studies primarily viewed early home videotapes of children who subsequently received a diagnosis of ASD, to identify atypical behaviors that occurred early in development along with the absence or infrequent exhibition of adaptive behaviors (e.g., coordinated eye contact,

appropriate toy play) that should have occurred (Baranek et al., 2005). Although a useful technique, retrospective video analysis has some methodological limitations, such as variability in the types of settings and contexts in which parents videotape their children, as well as the quality of home videotapes (Baranek et al., 2005). Researchers employing prospective study designs tracked the development of the infant siblings of children with ASD because of their greater genetic risk of developing the disorder. Achieving an adequate sample size has often been a limitation of prospective studies because the majority of the infant siblings will not develop ASD.

To date, researchers have identified a number of early behavioral warning signs for ASD, primarily through retrospective studies. Table 1 provides a list of 29 retrospective and prospective studies of infants and toddlers with ASD and the early warning signs identified therein. We excluded findings from literature reviews on early warning signs of ASD, as well as studies that involved infant siblings if identified symptoms during the infant and toddler years did not lead to the diagnosis of ASD. Some of the identified behavioral warning signs include delays or disorders in (a) early social behaviors, such as social smiling, looking at faces, and responding to one's name (e.g., Baranek, 1999; Osterling & Dawson, 1994; Werner & Dawson, 2005), and (b) early communication behaviors, such as producing vocalizations (e.g., Maestro et al., 2002; Wetherby et al., 2004), using a variety of gestures (e.g., Colgan et al., 2006; Landa, Holman, & Garrett-Mayer, 2007), and coordinating verbal and nonverbal behaviors, such as pairing eye contact with vocalizations (Wetherby et al., 2004; Yoder, Stone, Walden, & Malesa, 2009). Whereas some display of repetitive or stereotypic motor behavior is common for infants and toddlers (cf. Thelen, 1981), repetitive or limited use of toys or objects in manipulative play (Bryson et al., 2007; Morgan, Wetherby, & Barber, 2008), engagement in high rates of stereotypic motor behaviors, or an intense focus on narrow interests (e.g., fascination with letters and numbers) has been associated with ASD as early as the second year of life (Mooney, Gray, & Tonge, 2006).

Despite few physiological warning signs of ASD, some researchers have reported evidence that head circumference in infancy may be a diagnostic predictor. For example, Courchesne, Carper, and Akshoomoff (2003) noted a pattern among children later diagnosed with ASD; namely, they had a head circumference that was not enlarged at birth, but a rapid acceleration occurred during the first 2 years of life. This growth in head size is not fully understood, although it may reflect an early neurological warning sign. Note that we include information on head circumference in Table 1 because it is an outwardly visible physiological sign; however, we do not include studies with identified differences in internal brain structures (e.g., enlarged amygdala in toddlers with ASD; Mosconi et al., 2009; Schumann, Barnes, Lord, & Courchesne, 2009).

Researchers have already linked some of the early behavioral warning signs identified in prospective studies of ASD to later developmental outcomes. For example, the presence of atypical object exploration and play at 12 months (Ozonoff et al., 2008) and between 18 and 24 months of age (Morgan et al., 2008)—for example, object spinning or rotating, unusual visual exploration, preoccupation with certain objects—has been associated with lower-than-age-expected scores on the Mullen Scales of Early Learning (Mullen, 1995) and increased autism severity at 3 and 4 years of age. Furthermore, researchers have associated (a) poor social-communication skills (e.g., inability to follow gaze or point), (b) limited use of vocalizations or gestures to regulate the behavior of others, and (c) minimal gains in the

Table 1  
Early Warning Signs of Autism Spectrum Disorder as Identified in Retrospective and Prospective Studies

	Studies <sup>a</sup>																													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	BB	CC	
Core features																														
Communication												I	I	T							T				T					I
Less vocalizing / unusual prosody																														
Lack of coordination of verbal and nonverbal communication										T															T					
Less pointing to request														T								T								
Produce fewer gestures				B													I													
Joint attention <sup>b</sup>																														
Lack of initiating																														
Less sharing of objects, experiences, interests, or attention																														
Lack of responding																														
Lack of showing																														
Social																														
Atypical affect																														
Fewer initiations and responses	B		B	B					T																					
Less interest in social interactions / seeks less physical contact																														
Lack of imitation																														
Lack of social smile	B		B									I																		
Less looking at faces	B		B	B								I		T																
Fewer responses to name being called																														

(continued)

Table 1 (continued)

	Studies <sup>a</sup>																			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Restricted and repetitive behavior																				
More stereotyped/ repetitive play with objects	I															T		I	T	
More repetitive movements or posturing																				
Associated features																				
Head size increase																				
Temperament																				
More passive																				
More irritable / easily distressed																				
Visual attention																				
Atypical eye gaze																				
Latency to disengage / visual fixation on non-social stimuli																				

Note: I = infant (0-12 months); T = toddler (12-24 months); B = both (0-24 months).  
a. R = retrospective study; P = prospective study. *Studies*: A = R-Adrien et al. (1993); B = R-Baranek (1999); C = P-Bryson et al. (2007); D = R-Clifford & Dissanayake (2008); E = R-Colgan et al. (2006); F = R-Courchesne et al. (2003); G = P-Elder et al. (2008); H = R-Fukumoto et al. (2008); I = P-Garon et al. (2009); J = R-Hazlett et al. (2005); K = P-Landa et al. (2007); L = R-Maestro et al. (2002); M = R-Maestro et al. (2005); N = R-Mars et al. (1998); O = P-Mitchell et al. (2006); P = P-Morgan et al. (2008); Q = R-Osterling & Dawson (1994); R = R-Osterling et al. (2002); S = P-Ozonoff et al. (2008); T = P-Sullivan et al. (2007); U = P-Watt et al. (2008); V = R-Werner & Dawson (2005); W = R-Werner et al. (2000); X = R-Werner et al. (2000); Y = P-Wetherby et al. (2004); Z = P-Wetherby et al. (2007); AA = R-Wimpory et al. (2000); BB = P-Yoder et al. (2009); CC = P-Zwaigenbaum et al. (2005).  
b. Joint attention is included as a separate core feature of autism spectrum disorder given the wealth of research on this class of behaviors in the infant/toddler years.



development of response to joint attention bids between 14 and 24 months with poorer receptive and expressive language skills at 30 or 36 months of age (Sullivan et al., 2007).

Several organizations have translated this and other research-based information about early warning signs and development into useful tools for family members, caregivers, and professionals. For example, the Centers for Disease Control and Prevention established a user-friendly and valuable Web site called “Learn the Signs, Act Early,” which contains descriptions of typical development and early warning signs associated with ASD (see <http://www.cdc.gov/ncbddd/actearly/>). In addition, the American Academy of Pediatrics identified behavioral red flags to alert pediatricians about warning signs and the need for early screening (Johnson & Myers, 2007). Also, Autism Speaks created an informative video glossary that provides an excellent introduction to early signs of autism (<http://www.autismspeaks.org/video/glossary.php>). These and other public awareness resources have become available to parents who have concerns about their children’s development.

## **Early Surveillance and Screening**

Developmental surveillance and screening assessments do not provide a diagnosis; rather, they determine if further assessment of children is needed. The American Academy of Pediatrics recommended that surveillance (i.e., a short set of indicators designed as a prescreening measure) be conducted for all children starting at 9 months of age. At a minimum, the academy advised that screening for ASD with an autism-specific screening tool be conducted for toddlers at the 18- and 24-month physical checkups (Johnson & Myers, 2007). Given the active research in this area, scholars have developed and validated a range of autism-screening instruments with supporting psychometric evidence. Two types of screening tools have been developed for practitioners working with infants and toddlers with ASD—broadband screeners (used to identify general developmental concerns) and autism-specific screeners (employed to identify specific behaviors associated with ASD).

For broadband screening, Wetherby, Bronson-Maddox, Peace, and Newton (2008) developed the Infant-Toddler Checklist for children 9 to 24 months old; however, they found that this broadband screener was also sensitive to the identification of children with ASD. Baron-Cohen, Allen, and Gillberg (1992) developed the first autism-specific instrument, the Checklist for Autism in Toddlers (CHAT), to screen for ASD during the infant/toddler years. Health care professionals have routinely administered the CHAT to mothers and other familiar caregivers. The Modified Checklist for Autism in Toddlers (MCHAT) includes additional warning signs and a wider age range (16 to 30 months; Robins, Fein, Barton, & Green, 2001; Zwaigenbaum et al., 2009), and researchers have documented its sensitivity (i.e., proportion of children who screen positively and are later diagnosed with the condition) and specificity (i.e., proportion of children who screen negatively and are not later diagnosed with the disorder; Pandey et al., 2008). The MCHAT is available for free download ([http://www2.gsu.edu/~psydlr/Diana\\_L\\_Robins\\_Ph.D..html](http://www2.gsu.edu/~psydlr/Diana_L_Robins_Ph.D..html)).

A revision of the original CHAT, called the Quantitative Checklist for Autism in Toddlers (QCHAT; ages 18 to 24 months), was recently published with evidence of reliability and discriminant validity (i.e., the ability of the instrument to discriminate children who have ASD from children with other developmental disabilities), and Allison et al. (2008a) are currently conducting a fuller examination of its clinical validity. Researchers developed



the QCHAT because of the low sensitivity of the CHAT and MCHAT in the general population. The MCHAT and QCHAT have been completed by caregivers familiar with children's early development.

Reznick, Baranek, Reavis, Watson, and Crais (2007) developed a parent questionnaire measure, the First Year Inventory, which focuses on screening infants at 12 months of age. Watson et al. (2007) provided evidence supporting the construct validity of the measure, and prospective analyses of sensitivity and specificity are currently underway. Informants complete the aforementioned screening tools; Stone, Coonrod, and Ousley (2000), however, developed a clinician-administered screening test, the Screening Tool for Autism in Two-Year Olds, with an administration time of approximately 20 minutes. Stone, McMahon, and Henderson (2008) provided information about the sensitivity and specificity of the tool for use with toddlers.

### **Early Diagnosis: Tools and Stability of Diagnosis**

Zwaigenbaum and colleagues (2009) reported the mean age at which children with ASD receive a diagnosis, around 4 years old, but with active surveillance and screening initiatives comes the prospect of earlier diagnosis. Importantly, when trained clinicians diagnosed children with autistic disorder using valid assessments at 2 years of age, there was evidence for the reliability and stability of the early diagnosis over time (Lord et al., 2006). Until recently, standard diagnostic criteria and assessment procedures for older children were simply adjusted for use with infants and toddlers, which could be problematic because those diagnostic indicators were based on more chronologically or developmentally advanced expressions of autism. Researchers have developed and validated diagnostic tools appropriate for toddlers with ASD. Lord and colleagues developed the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999), a gold standard diagnostic tool, and they have been in the process of validating a version of the ADOS for toddlers. Their research group reported preliminary evidence of specificity and sensitivity (Luyster et al., in press). With the similar intent of diagnosing children with ASD in the first 2 years of life, Bryson, Zwaigenbaum, McDermott, Rombough, and Brian (2008) developed the Autism Observation Scale for Infants, with an administration time of 20 minutes. Zwaigenbaum et al. (2005) provided evidence of reliability for this instrument and discriminant validity.

### **Implications for Early Identification and Diagnosis**

Recent research on the early identification and diagnosis of ASD posits a fundamental implication—namely, that early intervention practitioners and professionals in the medical or allied health communities should be aware of the early warning signs of the disorder. Public awareness resources for professionals and families (e.g., Centers for Disease Control and Prevention Web site) that include warning signs for earlier identification should lead to timely access to effective interventions and services. In the past, many professionals have had a “wait and see” attitude regarding the early screening and diagnosis of ASD, in part, because of the lack of validated measures; however, validated screening and diagnostic tools are available, and clinicians should use them more often in their day-to-day

practice (Johnson & Myers, 2007). Whereas most often licensed professionals (e.g., physicians, psychologists) are involved in diagnosing ASD, practitioners from a variety of disciplines should be involved in early screenings and identification. For example, the use of validated ASD screening tools should be part of standard training for teachers and related practitioners (e.g., speech and language pathologists, occupational therapists) who work in early childhood centers or early intervention/early childhood special education programs; doing so may greatly increase the number of children screened in the infant and toddler years and promote earlier identification of very young children with ASD. However, any increased emphasis on early screening and diagnosis is necessary but not sufficient for high-quality service provision and must be combined with subsequent evidence-based services for infants, toddlers, and preschoolers with ASD and their families.

## **Evidence-Based Practices**

In the field of early intervention for children with ASD, two classifications of practices have appeared in the literature. Focused intervention practices are specific teaching procedures that practitioners or parents use to promote children's learning and development or decrease challenging behaviors. As the name suggests, early intervention service providers select specific focused intervention practices to address individual goals and objectives for infants and toddlers as well as their families. In comparison, comprehensive treatment models (CTMs) are conceptually organized and multicomponent practices that have been integrated in a comprehensive manner (e.g., across developmental domains, across longer periods, across the employment of a variety of focused practices) to promote positive outcomes for children with ASD.

There have been two basic assumptions about services for children with ASD: first, that early intervention service providers use research as a guide for selecting focused intervention practices or CTMs for infants and children with ASD and their families (cf. Odom, Rogers, McDougle, Hume, & McGee, 2007); second, that practitioners use their professional judgment about context and values (their own and those of the family) in the application of such practices (cf. Buysse & Wesley, 2006). Other authors (e.g., Odom et al., 2003; Odom et al., 2007; Rogers & Vismara, 2008) have extensively reviewed the professional literature on focused intervention practices and CTMs for preschool-age and early elementary-age children with ASD. Efficacy research that includes infants and toddlers with ASD has been relatively limited. In this section, we review research on focused intervention practices and CTMs for young children with ASD and their families and draw implications for practice.

### **Focused Intervention Practices**

Because of the sparse research literature involving infants and toddlers with ASD, practitioners have extrapolated interventions and services from the extant literature on preschool and school-age children with ASD. In a recent review of this literature, investigators from the National Professional Development Center on Autism Spectrum Disorders identified practices that met their explicit criteria for evidence-based practice (Odom, Collet-Klinenberg, Rogers, & Hatton,

in press). Two provisions for the research review were that researchers should have included participants with ASD in their studies and should have employed acceptable methodological features. Odom and colleagues also specified that an evidence-based practice be supported by at least two experimental or quasi-experimental design studies, five single-case design studies, or a combination of at least one group design and three single-case design studies.

Table 2 lists the evidence-based practices and most promising practices for infants and toddlers with ASD. The applicability of these focused practices to this age group of children with ASD is based on (a) the inclusion of the practices in CTMs specifically designed for infants and toddlers with ASD, (b) the presence of children with ASD less than 36 months of age in research studies on these practices, or (c) our best professional judgment.

*Behavioral intervention strategies.* Many of the practices that the National Professional Development Center on Autism Spectrum Disorders identified to increase appropriate behaviors have been adopted from an applied behavior analytic theoretical orientation—including prompting, reinforcement, task analysis, and time delay procedures. Behavioral strategies have been used as individual practices with children, as well as key components of multicomponent interventions. For example, interventionists who use discrete trial training have incorporated prompting, reinforcement, and task analysis in their procedural model. Researchers have also merged these behavioral intervention strategies into an approach known as early intensive behavioral interventions (EIBI; Butter et al., 2003). Investigators who have examined the efficacy of EIBI have included toddlers with ASD as part of larger participant groups of preschool-age children (Howard, Sparkman, Cohen, Green, & Stanislaw, 2005). To date, there are no published studies on the efficacy of EIBI involving only infants and toddlers with ASD. Nevertheless, we believe that some toddlers with ASD will benefit greatly from the behavioral practices discussed above and that providers should use their best professional judgment about how well these practices address the needs and values of very young children with ASD and their families.

*Positive behavior support.* Presently, there has not been sufficient evidence published to support positive behavior support as a single focused intervention strategy for young children with ASD; however, Neitzel (in press) found support for the individual practices that commonly make up the broader positive behavior support approach, and practitioners often use those identified practices to decrease challenging behaviors. These focused intervention practices have included functional behavior assessment, stimulus control, response interruption and redirection, functional communication training, extinction, and differential reinforcement of behavior (i.e., other, alternative, or incompatible behavior). Although limited research on positive behavior support has been specific to infants and toddlers with ASD, there are case studies of positive behavior support being implemented in the homes of young children with ASD (e.g., Buschbacher & Fox, 2003; Marshall & Mirenda, 2002).

*Naturalistic interventions.* Although described with different names, such as incidental teaching (McGee, Krantz, Mason, & McClannahan, 1983; McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992), milieu communication training (e.g., Kaiser, Hancock, & Nietfeld, 2000; Yoder & Stone, 2006a; 2006b), and mediated learning (Schertz & Odom, 2007), several naturalistic interventions have common features. For instance, practitioners using

**Table 2**  
**Focused Intervention Practices as Components of**  
**Comprehensive Treatment Models**

Practices	Models <sup>a</sup>				
	CTS	PDT	ESDM	ESIP	WTP
Behavioral intervention strategies					
Prompting <sup>b</sup>	×	×	×	×	×
Reinforcement <sup>b</sup>	×	×	×	×	×
Task analysis and chaining <sup>b</sup>		×			
Time delay <sup>b</sup>	×	×		×	×
Computer-aided instruction					
Discrete trial training <sup>b</sup>	×	×	×		
Naturalistic interventions <sup>b</sup>	×	×	×	×	×
Parent-implemented intervention <sup>b,c</sup>	×	×	×	×	×
Peer-mediated instruction					×
Picture exchange communication system <sup>b</sup>	×	×			
Pivotal response training <sup>b</sup>	×				
Positive behavior support					
Functional behavioral assessment <sup>b</sup>		×			×
Stimulus control <sup>b</sup>		×			×
Response interruption and redirection <sup>b</sup>		×			×
Functional communication training <sup>b</sup>		×			
Extinction <sup>b</sup>		×			×
Differential reinforcement of other, alternative, or incompatible behavior <sup>b</sup>		×			×
Self-management					
Social narratives					
Social skills training					
Speech generating devices (voice output communication aid)					
Structured work systems <sup>b</sup>	×				
Video modeling					
Visual supports <sup>b</sup>	×	×	×		

Note: The focused practices identified in the table are based on the work of the National Professional Development Center on Autism Spectrum Disorders; thus, the comprehensive treatment models included may use other focused practices or procedures not identified by center's staff.

a. CTS = Children's Toddler School (Stahmer & Ingersoll, 2004); PDT = Project DATA for Toddlers (Boulware et al., 2006); ESDM = Early Start Denver Model (Rogers & Dawson, in press); ESI = Early Social Interaction project (Wetherby & Woods, 2006); WTP = Walden Toddler Program (McGee et al., 1999).

b. The practice may be applicable to infants/toddlers with autism spectrum disorders.

c. *Parent-implemented* has been broadly defined to include comprehensive treatment models with strong parent training or involvement components as part of their treatment model.

naturalistic interventions have created contexts for children to engage in multiple learning opportunities, incorporated child choice into learning situations, and provided additional teacher support for children to perform and practice critical behaviors in common classroom

scenarios (cf. Rule, Losardo, Dinnebeil, Kaiser, & Rowland, 1998). In addition, naturalistic interventions have been implemented across contexts, including children's homes. For example, Schertz and Odom (2007) found that incorporating naturalistic interventions during home routines and play is an effective strategy to increase the joint attention and communication skills of toddler-age children with ASD.

*Parent-implemented interventions.* Focused interventions have been designed for parents and other family members to use with children with ASD. The process for parent-implemented interventions has consistent steps: identifying intervention approaches, training parents to implement those approaches, and having practitioners provide feedback or ongoing collaborative consultation with parents about intervention implementation. Researchers have found parent-implemented interventions to be effective for young children with ASD. For example, Moes and Frea (2002) found that parents of 3-year-old children with ASD could implement a functional communication training intervention in their homes and that the procedures resulted in children's increased communication skills and decreased problem behaviors. As mentioned above, Schertz and Odom (2007) used a home-based naturalistic intervention strategy with parents of toddlers with ASD, and the procedures increased the joint attention abilities of two of the three children in their single-case design study. Both these teams of investigators employed somewhat different interventions but a similar process, whereby parents or family members learned to implement an intervention that had positive effects on the adaptive behaviors of very young children with ASD. Because most Part C services are delivered in infants' and toddlers' homes and because of the contemporary emphasis on natural environments in early intervention, parent-implemented interventions appear promising for infants and toddlers with ASD and their families.

*Picture exchange communication systems.* Picture exchange communication systems train young children with ASD to communicate thoughts and ideas by exchanging tokens that convey meaning to a communicative partner (Bondy & Frost, 1994). Most of the research on this method was conducted with children older than 3 years of age, but recent studies by Yoder and Stone (2006a, 2006b) involved children with ASD in their second year of life (from 21 to 54 months). The results indicated that this system was superior to a responsive and prelinguistic milieu training intervention for children with certain characteristics (i.e., limited joint attention before treatment and high levels of object exploration). Conversely, responsive and prelinguistic milieu training was more effective for children who showed low object exploration and some initiating joint attention at the start of treatment. These initial treatment-by-aptitude findings hold promise for better targeting interventions to young children with ASD.

*Pivotal response training.* Pivotal response training (PRT) has been classified as a naturalistic intervention; however, we include it as a separate focused intervention practice because of the extant research supporting its use. PRT is based on the proposition that supporting certain pivotal behaviors or features of children's development will have collateral and generative effects on other critical developmental areas (cf. Koegel, Koegel, Fredeen, & Gengoux, 2008). The pivotal behavior sets include motivation, self-initiation, response to multiple cues, and self-management. Consider two examples of the evidence base for

this approach: Stahmer (1998) used PRT to teach symbolic play skills to preschool-age children with ASD, and Jones, Carr, and Feeley (2006) employed PRT to enhance joint attention skills of toddlers with ASD. Thus far, most of the evidence for PRT has been based on older children with ASD; however, the approach appears promising for use with toddlers as well.

*Structured work systems.* Structured work systems involve visually organizing children's work or play areas so that they can learn and practice important skills. For example, work systems could be used with toddler-age children with ASD to visually structure their interactions with toys to promote appropriate play instead of repetitive movements with or idiosyncratic use of objects. Ozonoff and Cathcart (1998), who included children with ASD who were less than 36 months of age in their study, taught parents to implement a structured teaching/work system at home and found positive child outcomes (e.g., improved imitation, fine motor, and gross motor skills).

*Visual supports.* Visual supports have been conceptualized as purposefully placed cues that children see in their environment to assist them in engaging in adaptive behaviors or desired skills. For instance, teachers have routinely used visual schedules in early childhood classrooms to successfully transition children from one location or activity to another. Researchers have examined the use of visual supports for preschoolers with ASD to promote symbolic play (Dauphin, Kinney, & Stromer, 2004) and social-communication skills (Johnston, Nelson, Evans, & Palazolo, 2003). Given early deficits in communication skills for many young children with ASD, we believe that a logical downward extension of visual supports could be to employ them with infants and toddlers with ASD.

## Comprehensive Treatment Models

CTMs differ from focused interventions in scope, intensity, and complexity. CTMs consist of multiple focused intervention practices organized around a conceptual framework; they address multiple developmental areas or core behavioral features of ASD; and they are implemented over extended periods (e.g., a year or more). In a recent review, Odom, Boyd, Hall, and Hume (in press) evaluated 30 CTMs that had been published in the professional literature. These models varied by conceptual and theoretical frameworks as well as by quality of development and empirical support. Model developers who were affiliated with 20 of the 30 models reported their appropriateness for children below the age of 3. However, some CTMs were specifically designed for infants and toddlers with ASD, or those models were explicitly adapted from the original CTM for older children. We briefly describe these models in the following sections.

*Children's Toddler School.* In Children's Toddler School (Stahmer & Ingersoll, 2004), toddlers with ASD and toddlers without developmental delays are enrolled in the same early childhood class for 15 hours per week, and children with ASD receive additional and separate intervention for 2 hours per week. Through this model, a variety of behavioral intervention approaches are used with the children with ASD, and the interventionists provide family education and support through weekly home visits.



*Project DATA for Toddlers.* For Project DATA for Toddlers (Boulware, Schwartz, Sandall, & McBride, 2006), toddlers with ASD and children without developmental delays are enrolled in integrated playgroups for two 1.5-hour sessions per week. Toddlers with ASD receive additional individualized instruction for three 2-hour sessions per week. As with the Children's Toddler School, a variety of behavioral and other evidence-based interventions are used, and project personnel provide family support and education through a weekly 2-hour home visit. In addition, family members implement interventions in their homes or communities for 5 hours per week.

*Early Start Denver Model.* In Early Start Denver Model (Rogers & Dawson, in press; Vismara & Rogers, 2008), therapists implement intervention with toddlers with ASD in clinic settings. They use a combination of developmental techniques (e.g., shared engagement, positive affect, developmentally sequenced curriculum) and behavioral techniques. Parents also learn to employ the therapeutic techniques in their homes (Dawson et al., in press).

*Early Social Interaction Project.* In the Early Social Interaction Project (Wetherby & Woods, 2006), parents learn to implement interventions in their homes to promote their toddlers' development. Implementers use a developmentally focused and individualized curriculum to guide parent-implemented interventions and visit parents' homes twice per week.

*Walden Toddler Program.* In the Walden Toddler Program (McGee, Morrier, & Daly, 1999), toddlers with ASD are enrolled in an early childhood class with toddlers without developmental delays for 4-hour sessions, 5 days per week. Incidental teaching and a range of other behavioral interventions are used in classrooms, and a developmental curriculum guides individualized instruction. In addition, designated home therapists provide parent education for up to 4 hours per week.

Table 2 indicates the evidence-based focused interventions that have been included in published descriptions of these CTMs. As can be seen, all current infant and toddler CTMs employ naturalistic and parent-mediated interventions as well as some basic behavioral intervention strategies (e.g., prompting, reinforcement), whereas other types of focused intervention practices are unique to some models.

The information presented in this table does not address the efficacy of the reviewed models. The toddler CTMs that we reviewed provided some information about outcomes for children enrolled in their programs, but they generally employed single-case research or group designs that did not compare their model to other intervention programs. The single and important exception was the randomized control trial study recently completed by Dawson and colleagues (in press), who demonstrated significantly more positive developmental outcomes for toddlers participating in the Early Start Denver Model, as compared to generic intervention services provided in the community. In addition, we believe that it is important to note that several efficacy studies are in progress. For example, Autism Speaks is currently funding the Toddler Treatment Network, which is a set of eight projects that focus on models of intervention for infants and toddlers with ASD (see [http://www.autismspeaks.org/science/research/initiatives/toddler\\_treatment\\_network.php](http://www.autismspeaks.org/science/research/initiatives/toddler_treatment_network.php)). Personnel on these projects are examining research questions related to early intervention, and we

believe that they will substantially contribute to the literature on efficacious practices for infants and toddlers with ASD and their families.

## **Implications for Early Intervention**

Practitioners involved in early intervention for infants and toddlers with ASD and their families have been limited by the relative scarcity of information on evidence-based practices. Nevertheless, researchers have been diligently working to establish the research base as a guide for selecting appropriate intervention strategies. In addition, there is scientific evidence from research with preschool children with ASD about the efficacy of many focused intervention practices (cf. Odom et al., 2007; Odom, Collet-Klinenberg et al., in press). Moreover, strategies and tactics employed with older preschool children with ASD may be promising for use with younger children with ASD. We believe that service providers should use their professional wisdom in selecting practices found to be effective for older children with ASD and then determine if those procedures adequately address the needs of infants and toddlers and comport with the values of families (cf. Buysse & Wesley, 2006). As additional intervention practices and models for infants and toddlers with ASD emerge, two fundamental considerations will be (a) the validation and replication of the efficacy of focused intervention practices and CTMs for infants and toddlers with ASD and (b) validation and dissemination of models of professional development that will support the implementation of evidence-based interventions by service providers and families.

## **Service Delivery Systems and Issues**

Over the last decade, research and public policy efforts for children with ASD and their families have focused on early warning signs of the disorder and on the earlier identification of young children with ASD (Johnson & Myers, 2007; Osterling & Dawson, 1994). As policy and practice recommendations to improve early screening and assessment of ASD have been implemented across the country, personnel in early intervention programs have been challenged to provide evidenced-based services for very young children with ASD. Moreover, parents have been confronted with the issue of how best to access the service delivery system for young children with ASD.

Currently, intervention services for infants, toddlers, and preschoolers with ASD and their families have been accessed through different funding streams, including the federal and state government (e.g., Part B and Part C services, Medicaid) and private insurance companies. Nevertheless, critical issues about how best to access local and state service delivery systems remain for many families—especially, families with infants and toddlers with ASD. For children older than 3 years with ASD, families can access a free and appropriate public education through Part B of the Individuals With Disabilities Education Act (2004). With infants and toddlers under 3 years of age, Part C services for young children with developmental delays vary greatly in their type and intensity across states. For example, early intervention services for infants and toddlers with developmental delays and their families have been the responsibility of a state-designated lead agency; however, that lead

agency may not be the state's department of education, and personnel with that agency may or may not have expertise in ASD.

Furthermore, in their National Early Intervention Longitudinal Study, Hebbler et al. (2007) reported the median number of hours of service provided to infants and toddlers with developmental delays and their families per week during the first 6 months of early intervention: 1.5 (with fewer than 9% of the families scheduled to receive more than 6 hours of service per week). This intensity of intervention is far below the recommendation made by the National Academy of Sciences Committee on Educating Children With Autism—namely, that children be engaged in intensive intervention services for 25 hours per week (National Research Council, 2001). Personnel in some states have developed guidelines to address the within-state variability in the content and intensity of services for infants and toddlers with ASD, with most of the states adopting the use of an eclectic model individualized to the needs of children. Nevertheless, researchers have expressed concerns with using such an approach to educating children with ASD given the lack of empirical information to support its efficacy (e.g., Howard et al., 2005; Stahmer & Mandel, 2007).

As a result of the variability in what services are covered under Part C, caregivers and personnel have found other means to fund services for children with ASD, such as Medicaid waivers and private insurance (Boyd & Shaw, in press). State officials have applied for federal government waivers of restrictions on funds that they receive for Medicaid services in their states. The waiver program has permitted some states to use discretion in designing their waiver programs to best meet the needs of targeted populations (e.g., families of children with ASD). The Medicaid waivers have been designed to supplement and complement existing state and federal support services that families already have received. The Centers for Medicare and Medicaid Services (see <http://www.cms.hhs.gov/MedicaidStWaivProgDemoPGI/>) list 22 states with Medicaid waivers that have been used for services for individuals with developmental disabilities, which may include infants and toddlers with ASD. Additionally, seven states (e.g., Colorado, Montana, Pennsylvania) have waivers designated specifically for individuals with ASD. The waiver funds have provided valuable services but often only to a restricted number of children in the state, given that some states use a lottery system to decide which families will receive waivers. Families also have sought reimbursement or funds from private insurance companies to cover the expense of intensive behavioral treatments. To date, 15 states have passed legislation that direct insurance companies to cover the expense of some forms of behavioral treatments (e.g., EIBI; see <http://www.ncsl.org/IssuesResearch/Health/AutismPolicyIssuesOverview/tabid/14390/Default.aspx>). In addition, pending federal legislation has a provision that requires insurance companies in all states to provide funds for these services. Professional advocacy organizations, such as Autism Society of America and Autism Speaks (see [http://www.autismspeaks.org/press/insurance\\_legislation\\_campaign.php](http://www.autismspeaks.org/press/insurance_legislation_campaign.php)), have actively supported such a federal policy.

Clearly, there has been social policy momentum and political will to fund early intervention services for infants and toddlers with ASD. However, several challenges to the recent initiatives exist. The costs of some early intervention treatments, such as EIBI, have been relatively expensive when compared to the services received by infants and toddlers with other developmental delays. With the increased prospect of diagnosing ASD at an earlier age, we believe that the pressure for evidence-based interventions will and should be increased, which in turn will strain an already-underfunded service delivery system. An

additional challenge has been the lack of communication and coordination between funding streams and service providers. Ruble, Heflinger, Renfrew, and Saunders (2005) reported that funding from Medicaid might affect collaboration with service providers funded by other sources because of an effort to prevent redundant services and diffuse responsibility for service provision. For example, EIBI providers funded by a Medicaid waiver may not be allowed to receive reimbursement for their time to meet or collaborate with educators in public schools or providers in the Part C program. Such separate streams of intervention may result in disjointed and potentially ineffective services for children and families, and they are certainly counter to the recommended practice of interdisciplinary team collaboration in early intervention.

### **Implications for the Service Delivery System**

There have been inherent challenges with the structure and function of service delivery systems for infants and toddlers with developmental delays, and these challenges may increase as more and more children with ASD receive early diagnoses. As previously stated, first, there has been and continues to be a need to identify scientifically based interventions for young children with developmental delays in general and ASD in particular. However, as these practices are determined, there will be a fundamental need to ensure that families have access to the interventions in a responsive service delivery system. Federal and state policies have been sorely needed to help alleviate costs and make certain that families from different socioeconomic groups and racial and ethnic backgrounds have equal access to effective intervention services and supports. Furthermore, practitioners and policy makers ought to ensure that various service delivery systems can coordinate their services to (a) effectively implement evidence-based practices across providers and (b) significantly reduce the costs of services for families. Well-coordinated service delivery systems should be cost-effective both for the various organizations providing services and for families of children with ASD.

### **Conclusion**

The increasing focus on early identification and effective intervention for infants and toddlers with ASD continues to challenge scientists, policy makers, and families to shift the boundaries of current research, policy, and practice. Researchers are making great strides in understanding the multiple factors that contribute to the increase in ASD prevalence, and they are continuing to unravel the etiology of the disorder. On the biological forefront, researchers have reported that ASD is associated with genetic risk factors based on concordance rates in twins and recurrence risk in younger siblings of children with ASD (e.g., Dawson, 2008; Zwaigenbaum et al., 2007). As Landa (2008) noted, given the heterogeneity associated with ASD, it is highly likely there are multiple causes. On the behavioral forefront, much emphasis is being placed on identifying early warning signs of ASD. Behavioral and even physiological warning signs of ASD have been discovered with retrospective and prospective study designs, and ongoing research is being conducted to link these early warning signs to later developmental outcomes for children. In addition, valid screening

and assessment instruments exist for use with infants and toddlers with ASD, and professionals are advocating for screenings to occur during the first 2 years of children's lives (Johnson & Myers, 2007).

The hope of many professionals and advocates is that earlier identification and assessment of ASD will lead to effective early intervention, which at present includes both behavioral and developmentally based treatments (Landa, 2008). With access to high-quality interventions in the infant and toddler years, the possibility exists for the prevention of autism (Dawson, 2008) or at least a reduction in the severity of children's symptoms over the lifespan because of the malleability of the brain during this critical period of development. At issue is the dearth of focused intervention practices or CTMs with an established evidence base for infants and toddlers with ASD, although research studies are being conducted (e.g., Dawson et al., in press; Odom, Boyd et al., in press; Zwaigenbaum et al., 2009). Many of the promising focused intervention practices and CTMs involve components of naturalistic interventions for teaching pivotal skills in natural environments and parent-implemented approaches where caregivers learn strategies to better support their children's development. For children and families to access effective interventions, the service delivery system for infants and toddlers ought to be improved. Families are beginning to use a variety of means, such as private insurance and Medicaid waivers, in addition to Part C services to get their children access to appropriate early intervention services (Boyd & Shaw, in press). We believe that it is essential for researchers to continue to validate effective and efficient interventions, for practitioners to strive to coordinate and integrate effective day-to-day services, and for policy makers to implement adequate reimbursement of well-coordinated and well-integrated service delivery systems, if optimal outcomes for infants and toddlers with ASD and their families are our ultimate goal.

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Asterisks (\*) denote studies cited in Table 1.

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