PART I

Assessment and Diagnosis

This section highlights the critical role of understanding typical and atypical development of early social-communicative behaviors in the assessment and diagnosis of young children with autism spectrum disorder (ASD). Instruments to assess skills such as imitation, play, social responsiveness, and other prelinguistic nonverbal behaviors are reviewed, and issues pertinent to the diagnosis of ASD in young preschool children, including stability of diagnosis and ability to indicate prognosis at an early age, are considered.

Wetherby (Chapter 1) contrasts the development of joint attention and symbol use in typical children with the distinctive profile of social-communicative behaviors observed in children with ASD. She highlights several important issues in the measurement of social-communicative behaviors, such as the assessment context and the type of scale employed. Examples of approaches and instruments that can be used to assess and describe social-communicative behaviors in young children (e.g., Early Social Communication Scales, Communication and Symbolic Behavior Scales) are presented, and findings from recent prospective studies of the development of early social-communication skills are described. The importance of measuring change in early social-communicative behaviors in response to treatment is addressed, and examples of recent early intervention studies are summarized.

Lord and Richler (Chapter 2) address issues related to the early diagnosis of young children with ASD, including the application of the standard

classification systems to toddlers and preschoolers. Diagnostic instruments that measure social-communication behaviors, as well as repetitive behaviors, are described, with attention to issues of interobserver reliability and the stability of early diagnoses. The authors consider the impact of individual differences in language skills on the diagnostic process and interpretation of results. A framework for understanding the developmental trajectories seen in young children with ASD, including the phenomenon of regression, is employed to inform the diagnostic process and potential interventions, as well as to help us understand emerging evidence at a neurodevelopmental level. Limitations of current diagnostic methods for young children and the need to develop measures to quantify symptom severity are discussed.

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Understanding and Measuring Social Communication in Children with Autism Spectrum Disorders

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Major advances have been made over the past two decades in understanding the social-communication difficulties of children with autism spectrum disorders (ASD), resulting in a greater emphasis on early social-communication features in the diagnostic criteria (American Psychiatric Association, 1994). Research has identified social-communication deficits in children with ASD that can be organized into two major areas: (1) the capacity for joint attention, which reflects difficulty coordinating attention between people and objects; and (2) the capacity for symbol use, which reflects difficulty learning conventional or shared meanings for symbols and is evident in acquiring gestures, words, imitation, and play. This chapter provides an overview of the emergence of social-communication skills in typical development and explores research that characterizes the capacity for joint attention and symbol use in children with ASD. Issues in measurement and approaches to assessment of social communication in children with ASD are described. Implications for early identification of ASD and meaningful outcome measures are underscored.

OVERVIEW OF TYPICAL DEVELOPMENT OF SOCIAL COMMUNICATION

By the end of the first year, most children are not yet producing true words, but they are able to coordinate attention between people and objects, engage in social exchanges, and communicate intentionally or deliberately with caregivers using conventional gestures and sounds that have shared meanings (Bates, O'Connell, & Shore, 1987). The skills that contribute to social-communication competence in typical development are delineated in this section for the capacities of joint attention and symbol use.

The Emergence of Joint Attention

Children acquire three developmental achievements that contribute to the capacity for joint attention and enable them to be active social partners in learning to talk: (1) sharing attention, (2) sharing affect, and (3) sharing intentions (Stern, 1985). Longitudinal and cross-sectional research on typically developing children has documented a developmental sequence of emergence of these skills over the first year of life (Carpenter, Nagell, & Tomasello, 1998; Wetherby & Prizant, 1993, 2002).

The ability to *share attention* typically begins at birth and continues to develop over the first year of life. It begins in the first few months, with an infant and caregiver sharing attention in dyadic interaction and with the caregiver monitoring what the child is looking at. By 9 months of age, the child actively observes others and has learned to shift gaze between people and objects in order to check and see if the caregiver is attending to the child's focus of interest (Bakeman & Adamson, 1984). This process is also referred to as *coordinated joint engagement* or *social referencing*. Gaze shifts play an important role in regulating social interactions in that they signal attention and social interest to the partner. By the end of the first year of life, the child follows the caregiver's attentional focus when looking at and/or pointing to something of interest (Butterworth, 1995), a process referred to as *gaze/point following* or *responding to joint attention*; this is the basis for the ability to figure out another's visual perspective and intentions.

The ability to *share affect* in expressing emotional states to others is evident when a child displays pleasure and directs gaze to the caregiver to share this positive experience or when the child directs signals of discomfort or distress to a caregiver in order to seek comfort. By sharing affect with caregivers, children also learn to interpret emotional states of others as they experience caregivers responding to their emotional expressions.

Stern (1985) refers to this process of caregivers mirroring their child's emotional tone and pace as *affect attunement*.

The ability to *share intentions* refers to being able to signal or direct behaviors to others in order to achieve specific goals. At about 9–10 months of age, a child begins to use sounds, gestures, and other behaviors to communicate intentionally—that is, the child deliberately uses a particular signal to seek a goal (Bates, 1979). In this early period of development, sharing intentions involves coordinating shared attention and/or affect with the use of gestures and sounds to express intentions to another person. Children communicate to express three major intentions by the end of the first year, and these are expressed later through language as words emerge (Bruner, 1981; Wetherby & Prizant, 1993):

1. *Behavioral regulation*, which uses signals to regulate another person's behavior for purposes of requesting objects or actions or protesting objects or another person's behavior (e.g., pointing to request food; pushing object away to protest it).
2. *Social interaction*, which uses signals to draw another's attention to oneself for affiliative purposes, such as greeting, calling, requesting social routines, and requesting comfort (e.g., waving "bye-bye"; reaching to be comforted).
3. *Joint attention*, which uses signals to direct another's attention to interesting objects and events for the purpose of sharing them with others (e.g., showing interesting objects to others, pointing at an object to bring it to someone's attention).

It is the combination of achievements in sharing attention, affect, and intentions that culminates in the broader developing capacity to share experiences (Stern, 1985). The child begins to understand that other people have their own distinct and unique minds and that thoughts and feelings, the "subject matter" of a person's mind, can be shared with others through communication. This understanding has been referred to as *intersubjectivity*, or the sharing of subjective experience, which underlies a child's deliberate and spontaneous attempts to share experiences with caregivers (Stern, 1985; Trevarthen & Hubley, 1978). Intersubjectivity requires a framework of shared meanings for gestures, facial expressions, intonation, and, ultimately, language. The capacity to share experiences underlies reciprocal social interaction in that the child's behavior becomes more finely contingent on the behavior and goals of others. The caregiver and child coconstruct social "dialogues" by taking turns initiating and responding to communicative bids, grounded in a shared focus of attention in reciprocal exchanges.

The Emergence of Symbol Use

Before using words, children acquire a repertoire of conventional sounds and gestures to express intentions, which reflects their growing knowledge of *shared meanings* (Bates, 1979). Conventional communication develops from the ritualization of functional actions, such as reaching, grasping, and pulling the head away, and, later, from the imitation of new behaviors that have either generally agreed-on meanings, such as waving, showing, and pointing, or private meanings in ritualized exchanges with caregivers (Bates, 1979). Early intentional gestures and sounds are presymbolic communication and are the foundation for the emergence of first words and the transition to symbolic communication. Between 1 and 2 years of age, children develop the capacity to symbolize (i.e., make one thing stand for or represent something else), as is evident in the ability to imitate new behaviors (see Nadel & Aouka, Chapter 8, this volume), to pretend with objects in play (see Wolfberg & Schuler, Chapter 7, this volume), and to use and understand words to refer to objects and events.

The capacity to acquire conventional behaviors is triggered by children's use of active learning strategies that involve exploring objects, observing others, listening to others, and learning from others (McLean & Snyder-McLean, 1999). Over the first year of life, children actively manipulate and explore properties of objects and learn to take turns in social interaction. Usually by 6–9 months of age, the child is able to imitate familiar actions or sounds immediately after the caregiver (i.e., *immediate imitation*). By 12–14 months, the child is able to spontaneously imitate a growing repertoire of familiar actions or sounds at a later time than first observed (i.e., *deferred or delayed imitation*; Barnat, Klein, & Meltzoff, 1996). Thus, shortly after their first birthdays, children have a set of active learning strategies that enable them to establish shared meaning through production and comprehension of conventional signals in social exchange (Bates, 1979).

The emerging capacity to actively explore objects and to imitate people leads to the ability to use familiar objects functionally and conventionally, an important precursor to symbolic play. By 6–9 months of age, children are actively exploring a variety of objects using actions such as grasping, banging, mouthing, and dropping. By 12 months, children are able to use a variety of familiar objects conventionally, such as drinking with a bottle, eating with a spoon, and wiping with a washcloth. These acts of deferred imitation reflect a child's underlying cognitive knowledge, as well as social awareness, of events they have experienced and form the foundation for learning conventional symbols (Bates, 1979).

The roots of language comprehension also are apparent from birth and reflect the capacity to symbolize in parallel with growing achievements in

speech perception. Comprehension involves understanding nonverbal and verbal communicative signals used by others and determining meaning based on the context. Early in development, infants orient to sounds and speech in the environment and recognize familiar voices, and, by 4 months, they become proficient at localizing auditory stimuli. There is increasing evidence that the infant's auditory system is specially equipped to perceive acoustic features of speech, especially categorical perception of consonant distinctions and prosody, which aids in recognition of familiar voices and discrimination of speech sounds (Eimas, 1996; Lieberman, 1996). Infants at 4–6 months of age can make fine phonetic discriminations that distinguish consonants and vowels in syllables used in both their native and unfamiliar languages. Experience influences speech perception during the first year of life, as evidenced by infants at 10–12 months who are able to discriminate phonetic variations used only in their native language (Stager & Werker, 1997; Werker & Tees, 1999). Measures of speech perception at 6 months have been found to predict the number of words used at 16 and 24 months (Tsao, Liu, & Kuhl, 2004), highlighting the important role of speech perception in language development.

In spite of relatively sophisticated speech perception skills in infancy, children do not attend to fine phonetic detail when first learning word meanings (Werker & Tees, 1999). By 9–12 months of age, children demonstrate nonverbal comprehension by responding to nonverbal cues such as *gestural cues* (e.g., pointing to the ball and saying "get the ball"; extending the hand and saying "give it to me"), *situational cues* (e.g., standing in front of the sink and saying "wash hands"; saying "put in" after putting several objects in a container to clean up), and *intonation cues* (e.g., saying "stop it" with a firm tone or "I'm gonna get you" with a playful tone). By responding to this rich array of cues, a child may give the appearance of fairly sophisticated language comprehension but yet not understand actual spoken words. Comprehension becomes decontextualized between 12 and 18 months as children recognize the meaning of words outside familiar contexts (Wetherby, Reichle, & Pierce, 1998). However, children do not make fine phonetic discriminations in word learning until 18–24 months (Tsao et al., 2004; Werker & Tees, 1999), which suggests that an organizational shift occurs in processing language, from discriminating syllables in infancy to associating meaning with words over the second year of life.

The discovery that things have names begins to unfold at about 12–13 months of age (Bates, 1979). First-word acquisition has been described as situation specific, tied to the context, or event bound in that, initially, words may be used only with a narrow meaning in a highly specific context or situation (e.g., "up" refers only to being picked up out of a crib; "dog" is only the family pet). Later in development, words are used to refer to generalized concepts of actions or objects (e.g., "up" refers to any action

involving movement upward; "dog" refers to any small four-legged animal that barks). Children learn to "free up" their understanding and use of words from very specific events to a wider variety of contexts by hearing the same word in different events and hearing different words in similar situations (Bloom, 1993). Vocabulary increases slowly and steadily until about 18–21 months, when there is an acceleration in the rate of new word acquisition, known as the *vocabulary burst*.

The vocabulary burst defines a quantitative change in vocabulary growth, with a number of corresponding qualitative changes in language abilities that indicate movement to generative language. Shortly after children go through the vocabulary burst, they begin to combine two or more words in novel combinations, and hence have truly acquired a productive language system (Bates et al., 1987; Bloom, 1993). By their second birthdays, most children can use and understand hundreds of words and can combine words into simple sentences (Bates, 1979; Wetherby, Reichle, & Pierce, 1998). The dramatic growth rate in word learning that follows the vocabulary burst triggers the transition to a language system that is categorical, combinatorial, rule governed, and generative.

The developmental interaction of joint-attention and symbol-use capacities enables children to become active partners in the intricate "dance" of *reciprocal social communication*. These emerging capacities form the developmental underpinnings needed to engage in conversation, as children learn to consider the experience, knowledge, and perspective of the social partner, to connect sentences in a cohesive manner, and to negotiate meaning. These capacities are essential to acquiring conversational competence, which entails knowing what to say, how much to say, how to say it, how to interpret what others say, and how to participate in a reciprocal social exchange, depending on who you are talking to and what you are talking about.

SOCIAL-COMMUNICATION PATTERNS OF CHILDREN WITH ASD

There is great heterogeneity in language abilities of children with ASD, ranging from failure to develop any functional speech to the development of functional but idiosyncratic use of spontaneous speech. It has been estimated that between one-third (Bryson, 1996) and one-half (Lord & Paul, 1997) of children and adults with autism have no speech. However, in more recent literature, the proportion of nonverbal children with ASD is much smaller among those who received very early intervention. For example, Lord, Risi, and Pickles (2004) followed children who were initially diagnosed with ASD at age 2 and who received early intervention and reported

that 14–20% of this sample was nonverbal (i.e., using less than five words on a daily basis) at age 9. Kjelgaard and Tager-Flusberg (2001) identified subgroups of verbal children with ASD based on language measures; some children showed no linguistic deficits, and other children showed language impairments in grammatical skills with relatively spared vocabulary skills similar to those of children with specific language impairment. In spite of the heterogeneity of language abilities in children with ASD, social-communication or pragmatic impairments are universal across all ages and ability levels (Tager-Flusberg, Joseph, & Folstein, 2001) and are defining features of the clinical disorder (Lord & Paul, 1997; Wetherby, Schuler, & Prizant, 1997). A large body of research over the past two decades has characterized the social-communication deficits of children with ASD, with most children studied being of preschool age. This section reviews research exploring the social-communication skills of children with ASD for the capacities of joint attention and symbol use.

Deficit in the Capacity for Joint Attention

A deficit in joint attention is a core feature of ASD in the diagnostic criteria of DSM-IV (American Psychiatric Association, 1994) and includes a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people. It is not that children with ASD do not communicate but rather that they do not readily communicate for social goals or purposes. Research has documented that children with ASD communicate predominantly or exclusively to regulate the behavior of others to request or protest something and show a deficit in or absence of communication aimed at drawing another's attention to an object or event to label it or comment about it (Sigman, Mundy, Sherman, & Ungerer, 1986; Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Wetherby, Prizant, & Hutchinson, 1998; Wetherby & Prutting, 1984; Wetherby, Yonclas, & Bryan, 1989). This pattern of deficit in initiating communication for joint attention appears to be a hallmark of ASD and is not characteristic of children with specific language impairments or general developmental delays. Because the ability to communicate for joint attention emerges before words in typical development, a deficit in initiating communication for joint attention may represent a fundamental or core impairment of ASD (Mundy, Sigman, & Kasari, 1990), particularly given that it is evident in very young children with ASD (Charman et al., 1997; Wetherby, Prizant, & Hutchinson, 1998; Wetherby et al., 2004).

Children with ASD also show deficits in joint-attention skills that emerge before initiating joint attention. Compared with children with developmental delays, children with ASD display fewer gaze shifts, spend less time in joint engagement, and have more difficulty following another per-

son's attentional focus by looking where they are looking or pointing (Sigman et al., 1986; Stone, Ousley, Yoder, et al., 1997; Wetherby, Prizant, & Hutchinson, 1998). Preliminary data on a group of 12 preschool children with ASD suggests that the developmental sequence of emergence of joint-attention skills from gaze shifting to gaze/point following to initiating joint attention with gestures is also found in children with ASD (Carpenter, Pennington, & Rogers, 2002). In other words, children with ASD who do not shift gaze also do not follow gaze or point cues or initiate joint attention.

Leekam, Lopez, and Moore (2000) conducted a series of experiments to examine the role of attention in difficulties that preschool children with ASD have in responding to joint attention compared with those of children with developmental delay, matched on nonverbal mental age (MA). They found that children with ASD had more difficulty orienting to attention bids and following a head-turn cue than the control-group children. In contrast, they were as accurate as control-group children in their ability to shift attention to a peripheral target and were faster in responding. These results indicate that children with ASD do not have difficulty shifting attention from a central stimulus and orienting attention to peripheral targets. Rather, children with ASD had difficulty orienting to another person's bid for attention and following another person's gaze and head-turn cue to a peripheral target. Children with ASD were found to show deficits in orienting to social stimuli (their names being called; hands clapping) but not nonsocial stimuli (rattle; musical jack-in-the box) compared with MA-matched controls with Down syndrome and typical development (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Responding to joint attention was correlated with orienting to social stimuli but not to nonsocial stimuli, suggesting a core social orientation deficit.

Research has examined contributions of social-affective mechanisms to the joint-attention deficits in ASD. Clinical descriptions of children with ASD include pronounced deficits in the ability to share affective states (American Psychiatric Association, 1994; Dawson, Hill, Spencer, Galpert, & Watson, 1990). Children with ASD have been found to display less gaze directed to people and positive affect during interactions with unfamiliar adults (Snow, Hertzig, & Shapiro, 1987). Dawson and colleagues (1990) found that children with ASD showed significantly less positive affect coordinated with gaze and were much less likely to respond to their mothers' smiles than typical children. The frequency of gaze directed to their mothers was significantly correlated with receptive and expressive language for the children with ASD. Furthermore, evidence suggests that the deficit in the capacity for sharing positive affect among children with ASD may be associated with the deficit in initiating and responding to joint attention. Deficits in joint attention and shared affect both involve the allocation of

attention between people and objects. Kasari, Sigman, Mundy, and Yirmiya (1990) compared affect displays of children who were communicating for joint attention versus behavior regulation. They found that typically developing children were more likely to share positive affect during episodes of sharing attention on objects or events, whereas children with ASD showed lower levels of shared affect and did not show this integration of shared affect and joint attention.

Deficits in initiating and responding to joint attention would likely have a cascading effect on language development, because language learning occurs within the context of the modeling by the caregiver of words that refer to objects and events that are jointly regarded. McArthur and Adamson (1996) found that when children with ASD interacted with adults who were calling the children's attention to an object or event to establish shared attention, episodes of joint attention were rare. During these adult-initiated episodes of joint attention, the children with ASD displayed significantly less attention directed to the adult partner, as well as to the objects of reference, than did children with developmental language disorders matched on chronological and nonverbal MA. The authors concluded that for children with ASD, the lack of ability to allocate attention between people and objects may contribute to difficulties in acquiring shared meanings of cultural conventions. In a word-learning task, Baron-Cohen, Baldwin, and Crowson (1997) found that, unlike children in developmental-delay and typical control groups, children with ASD rarely used the speaker's direction of gaze to learn the meaning of a novel word for a novel object; instead, children with ASD relied on mapping the novel word to the object that they (the listeners) were looking at, which led to a high rate of mapping errors.

A number of longitudinal studies provide evidence of a relationship between joint attention and language outcomes. Mundy and colleagues (1990) found that measures of gestural joint attention (i.e., responding to joint attention and initiating joint attention with gaze, showing, or pointing) at a mean age of 45 months were a significant predictor of language development 13 months later for children with ASD, whereas none of the other nonverbal measures, initial language scores, MA, chronological age (CA), nor IQ were significant predictors. These findings have been substantiated in a longitudinal study measuring joint attention at 20 months of age and predicting language outcomes at 42 months of age (Charman, Baron-Cohen, et al., 2003). These findings have also been substantiated in a long-term follow-up study examining joint-attention skills of 51 children with autism with a mean age of 3 years, 11 months (Sigman & Ruskin, 1999). Initial joint-attention skills predicted gains in expressive language at a mean age of 12 years, 10 months.

A joint-attentional state during which the child and partner share a site

of interest can be achieved in the following ways, which vary in how active the child's role is in establishing shared attention: (1) the partner looks at the site that the child is looking at; (2) the child looks at the site that the partner is looking at; (3) the child shifts gaze between the site and the partner to check that the partner is looking at the site; (4) the child follows the partner's attentional cue (i.e., gaze, show, or point) to look at the site; and (5) the child uses a communicative gesture or vocalization to draw the partner's attention to the site. This coordination of attention provides a critical moment for language learning when the caregiver models language that interprets and relates the child's experience and focus of attention.

The caregiver may be able to compensate for a child's deficits in joint attention by ensuring a common focus of attention when modeling language. In a longitudinal study of 25 children with ASD, Siller and Sigman (2002) investigated whether caregivers followed the child's focus of attention and toy engagement during play and the extent to which this predicted language outcomes. Play samples were initially gathered when the children with ASD were a mean of 50 months of age. The caregivers of children with ASD synchronized their behaviors to their children's attention and activities as much as did caregivers of typically developing children matched on language abilities. However, the children with ASD whose caregivers showed higher levels of synchronization during initial play samples developed better joint-attention skills 1 year later and better language outcomes 10 and 16 years later compared with children of caregivers who showed lower levels of synchronization initially. The strongest predictor of the child's increase in initiating joint attention was the caregiver's initiation of joint attention that is synchronized to the child's attentional focus. The strongest predictor of gain in language was caregiver utterances that follow the child's attentional focus and allow the child to continue the ongoing toy engagement. These findings have important implications for targeting joint-attention skills in intervention by enhancing the child's skills, as well as the partner's ability to support shared attention, and intervening early to establish or enhance synchronization by caregivers as soon as possible.

Deficit in the Capacity for Symbol Use

Many factors may contribute to the language difficulties of children with ASD in addition to joint-attention deficits. Children with ASD may show specific deficits in acquiring conventional communication or more general deficits that affect cognitive and symbolic functioning. This section examines research on deficits in the capacity for symbol use in children with ASD, including language, gestures, imitation, and play.

Children with ASD have varying degrees of difficulty with language production and comprehension, which may be associated with general cog-

nitive impairment. Although a small subgroup of children with ASD have normal aspects of language skills (Kjelgaard & Tager-Flusberg, 2001), preschool children with ASD have been found to have more severe language comprehension and production deficits than nonverbal MA-matched children with developmental delays (Lord & Paul, 1997). The presence of fluent speech, defined as using multiword combinations spontaneously, communicatively, and regularly, before the age of 5 continues to be a good prognostic indicator of IQ, language measures, adaptive skills, and academic achievement in adolescence (Venter, Lord, & Schopler, 1992). Nonverbal IQ has generally been found to be higher than verbal IQ in groups of children with ASD, but there is individual variation in this profile, and the reverse profile has been associated with Asperger syndrome (Joseph, Tager-Flusberg, & Lord, 2002; Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995). Verbal–nonverbal discrepancies have been found to lessen with age because of improvements in language functioning. However, relatively poorer verbal than nonverbal IQ at school age is associated with increased social and communication impairment on the Autism Diagnostic Observation Schedule (ADOS; Joseph et al., 2002).

Children with ASD have difficulty acquiring conventional and symbolic aspects of communication. The quantity and quality of gesture use is limited in children with ASD. Unlike children with language or hearing impairments, children with ASD do not compensate for their lack of speech by using other modalities, such as gestures. Children with ASD predominantly use primitive contact gestures (i.e., leading, pulling, or manipulating another's hand) to communicate and lack the use of many conventional gestures, such as showing, waving, and pointing, as well as symbolic gestures, such as nodding the head and depicting actions (Loveland & Landry, 1986; McHale, Simeonsson, Marcus, & Olley, 1980; Stone & Caro-Martinez, 1990; Wetherby, Prizant, & Hutchinson, 1998; Wetherby et al., 1989). In lieu of conventional means of communicating, children with ASD may develop unconventional or inappropriate behaviors to communicate, such as self-injurious behavior, aggression, or tantrums.

Whereas deficits in gestural communication are characteristic of children with ASD, there is much variability in the use of speech. Some children with ASD have been found to use a limited consonant inventory and less complex syllabic structure, whereas others show adequate complexity of vocalizations (McHale et al., 1980; Stone & Caro-Martinez, 1990; Wetherby et al., 1989; Wetherby, Prizant, & Hutchinson, 1998). In a study of vocal behavior of preschool children who had few or no words, Sheinkopf, Mundy, Oller, and Steffens (2000) found that, compared with children with developmental delays, children with ASD used a comparable proportion of syllables containing consonants but a significantly greater proportion of syllables with atypical phonation, such as squeals, growls,

and yells. The vocal atypicalities were independent of joint-attention deficits in this small sample but were negatively correlated with MA, suggesting that the joint-attention and vocal deficits arise from different pathological processes. Vocal deficits may reflect difficulties in the symbolic capacity and/or motor control of the speech mechanism.

The vast majority of those who do learn to talk go through a period of using echolalia, the imitation of speech of others, either immediately or at some time later (Prizant, Schuler, Wetherby, & Rydell, 1997). An echolalic utterance may be equivalent to a single word or a label for a situation or event. Current understanding of echolalia indicates that it may serve a variety of communicative and cognitive functions (Prizant & Rydell, 1993; Prizant et al., 1997) and may be a productive language-learning strategy for many children with ASD, not unlike imitation for typically developing children. The way echolalic children learn to talk is by imitating phrases associated with situations or emotional states, then learning meanings by trying out these phrases and seeing how they work. Although echolalic children produce phrases or sentences, they may be functioning in the one-word stage if all of their utterances are imitated chunks. Children with ASD may have difficulty making the shift from processing language at the syllable level, in other words as a string of syllables, to associating conventional meaning at the word level. Over time, many verbal children learn to use these chunks purposefully in communicative interactions, and eventually they are able to break down the echolalic chunks into smaller meaningful units as part of the process of transitioning to a rule-governed, generative language system. Pronoun reversals are a by-product of echolalia because the child repeats the pronoun heard, thus reversing the pronouns used in reference to self and other. For example, a child may use the echolalic utterance "Do you want a piece of candy" as a way to request the candy, although it sounds like the child is offering it. Thus echolalia can give the appearance of sophisticated language, but careful examination of how a child uses echolalic chunks or creative combinations of words or phrases can reveal a child's true language level and patterns of language development.

Both the use of echolalia and the reliance on primitive contact gestures may reflect a reenactment strategy in the face of difficulties learning symbolic communication (Schuler & Prizant, 1985; Prizant & Wetherby, 1987; Wetherby, 1986). Reenactment involves repeating an aspect of a situation to make the situation recur, such as putting an adult's hand on the door handle to request to go out, getting the car keys to ask to go for a ride, making sounds or movements used during a tickling game to request to be tickled, or repeating a memorized portion of a song as a request to have someone sing the song. Reenactments occur at early stages of typical communication development and are regarded as *indexical* communication rather than symbolic communication (McLean & Snyder-McLean, 1999).

In symbolic communication, the symbol stands for and is separate from its referent. Repeating an action or phrase that is part of the referent or goal is indexical rather than symbolic because it is an index of, or associated with, the goal (Werner & Kaplan, 1963). Children with ASD may need to acquire a large set of communicative signals at a reenactment level before moving on to become symbol users.

Children with ASD who progress beyond echolalia may acquire a large vocabulary and more advanced aspects of grammar. Most verbal children develop grammatical skills in the same general progression as typically developing children do, but they show persisting problems with conversational rules (Baltaxe, 1977; Tager-Flusberg, 1996), which are pragmatic aspects of language. Some verbal children have difficulties with grammatical aspects of language similar to those of children with specific language impairment (Kjelgaard & Tager-Flusberg, 2001).

Another line of research that elucidates the symbolic deficit in ASD is the study of imitation. Numerous studies have documented that children with ASD have difficulty on tasks of body imitation involving simple hand and facial movements, symbolic pantomimes, and actions with objects, compared with CA- and MA-matched control groups (Rogers, Hepburn, Stackhouse, & Wehner, 2003; Stone, Ousley, & Littleford, 1997; Williams, Whiten, & Singh, 2004); however, there is variation in the pattern of imitation deficit. Stone, Ousley, and Littleford (1997) found that in children with ASD, imitation of facial and body movements showed concurrent and predictive associations with expressive language skills, whereas imitation of actions with objects showed concurrent associations with play skills. However, Rogers et al. (2003) did not replicate these relations when controlling for developmental level. Rogers et al. (2003) found that oral–facial imitation and object imitation correlated with dyadic and triadic social responsivity and overall developmental level. Imitation skills were not related to expressive language, play, visual–spatial abilities, or adaptive behavior when controlling for developmental functioning. The children with ASD performed as well as controls on a praxis battery, and imitation was correlated with fine motor skills, not praxis, indicating that general motor dyspraxia did not account for the imitation deficits. They found that developmental functioning accounted for 53% of the variance in imitation, and neither fine-motor skills nor social responsivity added additional predictive value. These findings support the relation between the imitation deficit in children with ASD and both general developmental functioning and a social impairment in dyadic and triadic engagement. However, research on imitation in children with ASD has been restricted to tasks that elicit imitation in a clinical setting. Other than research documenting the use of echolalia, little is known about the spontaneous use of immediate or deferred imitation as an active learning strategy in natural contexts by children with ASD.

Further evidence of a deficit in the symbolic capacity in ASD is the limited ability to develop symbolic or pretend play. It is noteworthy that a lack of varied, spontaneous make-believe play is one of the four diagnostic features of the impairment in communication in DSM-IV (American Psychiatric Association, 1994). Children with ASD show significant deficits in symbolic play (i.e., using pretend actions with objects) and limited abilities in functional play (i.e., using objects functionally; Dawson & Adams, 1984; Sigman & Ungerer, 1984; Wetherby & Prutting, 1984; Williams, Reddy, & Costall, 2001; Wing, Gould, Yeates, & Brierley, 1977). Functional and symbolic play skills have been found to be significantly correlated with receptive and expressive language (Mundy, Sigman, Ungerer, & Sherman, 1987). In their longitudinal study, Sigman and Ruskin (1999) found that the number of different functional play actions predicted expressive language gains, even when controlling for initial language level. When Sigman and Ruskin (1999) compared the predictive value of play and joint attention, a regression analysis revealed that a significant amount of variance in expressive language was accounted for by both functional play and response to joint attention, suggesting that these may reflect separate sources of deficits.

In contrast to deficits in functional object use and symbolic play, children with ASD perform at similar or higher levels on constructive play (e.g., using objects relationally in combination to create a product, such as stacking blocks, nesting cups, or putting puzzles together) compared with typically developing children and children with developmental delays at the same expressive language stage (Wetherby & Prutting, 1984; Wetherby, Prizant, & Hutchinson, 1998). Bates (1979) suggested that symbolic play is acquired through observational learning and that constructive or combinatorial play can be acquired either through observational learning or trial-and-error problem solving. Children with ASD seem to excel at behaviors learned through trial and error. Many of the gestures used by children with ASD (e.g., taking another's hand and leading the person to a goal) are contextually restricted and can emerge naturally from exploration with the child's own body through trial-and-error learning strategies. Similarly, constructive play can be learned through trial and error. The acquisition of conventional gestures, conventional meanings for words, deferred imitation, and conventional use of objects can be learned only through observation. This learning entails observing and imitating the behavior of others from a stream of behaviors and then decontextualizing the behavior to new contexts (Carpenter & Tomasello, 2000). Learning shared meanings, imitating and using conventional behaviors, and being able to decontextualize meaning from the context constitute the symbolic deficits in children with ASD (Wetherby, Prizant, & Schuler, 2000).

It is possible that the joint-attention deficits underlie or contribute to

the symbolic deficits in children with ASD in that difficulties coordinating attention may interfere with learning shared meanings. Wetherby, Prizant, and Hutchinson (1998) examined the social-communication profiles of 22 children with ASD compared with 22 children with developmental delays at the same expressive language level. The children with ASD displayed significantly poorer scores with large effect sizes on the following social-communication measures: gaze shifts, shared positive affect, initiating communication for joint attention, inventory of conventional gestures, use of distal gestures, coordination of gestures and vocalizations, language comprehension, and inventory and complexity of actions in symbolic play. However, they displayed comparable scores in initiating communication for behavior regulation, inventory of consonants, and level of constructive play. These findings support other research that indicates that the profiles of children with ASD are characterized by a distinct constellation of strengths and weaknesses in parameters of social communication. Correlational findings from this study showed that expressive language and language comprehension were not correlated with each other in these children with ASD and that different constellations of social-communication skills were correlated with expressive language versus language comprehension. Expressive language showed large correlations with initiating joint attention and measures of vocal communication, including inventory of consonants. Language comprehension showed moderate correlations with initiating joint attention, inventory of conventional gestures, gaze shifts, and shared positive affect and a large correlation with complexity of actions in symbolic play. These findings support an association between measures of sharing attention and sharing meanings in children with ASD, but further research with larger samples is needed to examine the causal relations among these constructs.

EXPLANATORY HYPOTHESES OF THE SOCIAL-COMMUNICATION DEFICITS OF CHILDREN WITH ASD

Bates (1979) hypothesized that the human symbolic capacity evolved in phylogeny as a "new product" built from the interaction of available "old parts" through the process of "heterochrony," which refers to changes in the developmental timing and rate of maturation of preexisting capacities. Quantitative variations in timing led to a qualitatively new capacity. Bates applied this concept to the ontogenetic development of symbol use. When the relative proportion of available social–cognitive component skills (i.e., communicative intent, tool use, imitation) reaches a certain threshold level in development, new interactions among the components result, creating a new capacity for symbols.

The process of heterochrony may explain the core deficits in social communication, as well as individual variation, in children with ASD (Wetherby & Prutting, 1984; Wetherby, 1991). The relative proportions of component skills available at varying times in development may influence the child's social-communication profile. Slight variations in the developmental timing of individual components may have developmental consequences that are cumulative and pervasive in later stages. The particular combination of skills and experiences available to a child with ASD is not seen at any point in typical development and may lead to distinct profiles of social communication because of the interplay among the available components and interaction with the learning environment. However, the child's skills within specific domains may follow typical developmental progressions. Heterochrony may be the mechanism that operates to produce discrepancies in a child's profile and may be caused by individual variation in or disruption of the precise orchestration of events that unfold during neural maturation.

MEASUREMENT OF SOCIAL COMMUNICATION

Exploring developmental profiles of social-communication skills has contributed to distinguishing children with ASD from children with other developmental delays and to elucidating the core deficits of ASD. Measurement of social communication can address a broad array of skills, including the many facets of joint attention and symbol use reviewed in this chapter. Because of the heterogeneity in children with ASD, it is critical to characterize the nature and extent of deficits in joint attention and symbol use, because these deficits have important implications for language outcomes. This section first discusses psychometric issues that need to be considered in the measurement of social communication and then provides an overview of different approaches to measurement of social communication in children with ASD.

Psychometric Issues in the Measurement of Social Communication

Efforts to better understand and enhance social-communication skills of children with ASD hinge on our ability to accurately quantify social communication. Measurement of social communication poses challenges because it is influenced by many variables, including the social partner, the interactive context, the source of information, and psychometric features of the measurement scale. The challenge is how to gather meaningful and accurate measures of social communication efficiently. The following ques-

tions are important to consider in making decisions about measurement of social communication for children with ASD.

- *How is the information gathered?* Measures of social communication can be gathered from observation in the natural environment, from interactive sampling in a laboratory or clinical setting, or from information reported by parents or teachers familiar with the child. Each of these procedures has strengths and limitations. Naturalistic observations of a child interacting with a variety of partners over an extended period of time may capture the child's repertoire of skills and how ecological variables influence the child's social communication, but this outcome is dependent on the child's having adequate natural opportunities to use social communication. Furthermore, quantifying the child's behavior from naturalistic observation is challenging, and sound psychometric methods must be ensured. Measures based on reported information capitalize on the knowledge of a familiar person who interacts with the child on a daily basis. However, parents or teachers may over- or underestimate the child's abilities. It is also challenging to secure accurate measures from children by using interactive sampling procedures. Many factors may influence children's performance, including attention, interest, fatigue, comfort level, and experience in unfamiliar settings. Interactive sampling procedures can range from unstructured play to semistructured opportunities or staged situations designed to encourage or elicit social communication. The person interacting with the child during the sampling may be an unfamiliar experimenter or a familiar person, such as a parent, teacher, sibling, or peer. The accuracy of the information gathered from any of these sources of information needs to be documented.
- *What social communication behaviors will be measured?* Social communication consists of a number of different theoretical constructs, such as shared or coordinated attention, intentionality, and reciprocity, that may be reflected best as latent variables that are not directly observable. Individual items or behaviors to be measured should be selected based on their relationship to a latent variable or underlying construct. In other words, a good measure is an accurate estimate of the magnitude of a latent variable. Because a latent variable cannot be directly measured and observed, the accuracy of the item or behavior measured is inferred by relationships among different items or measures that are assumed to have a causal relationship with the latent variable (DeVellis, 2003). Because the study of social communication is relatively new, the field is in its infancy in determining what the latent variables are and what are good items to measure the latent variables. For example, is joint attention one latent variable, or are initiating and responding to joint attention separate latent variables? Are gaze shifts and drawing attention to objects with a point or show ges-

ture or a word separate skills but correlated measures that reflect a single construct of initiating joint attention? Or are these separate variables that have different developmental trajectories?

- *What measurement scale will be used?* Items or measures can be categorical or continuous variables. Categorical variables measure values that change in steps and may be dichotomous (e.g., gender) or may take on a small or finite number of values (e.g., seasons, days of the week). Categorical variables can represent quantitative attributes in which the categories stand for ranges or degrees of values (e.g., *rarely*, *sometimes*, *often*). Continuous variables measure values that change smoothly, such as age and height. Measures of social communication may be continuous, such as frequency counts and rates of behavior, or categorical, such as the rating scale for the ADOS. Categorical variables may be sufficient to differentiate children with ASD from other populations and thus are useful as screening and diagnostic tools. The advantage of continuous variables is that they provide more precise information to characterize individual variation, allowing for larger variance and greater potential for documenting relationships among variables measured. However, ceiling or floor effects may restrict the range of continuous variables and hence obscure relationships studied.
- *Are the items that constitute the measure homogenous?* The homogeneity or consistency across items or behaviors selected to measure a construct is an important aspect of reliability (DeVellis, 2003). Internal consistency, most commonly measured with Cronbach's coefficient alpha, expresses the degree to which the parts or individual items measure the same underlying construct. High correlations among items suggest that they are all measuring the same thing and hence are presumed to be strongly linked with the latent variable. Thus a good measure of any construct of social communication would be one with multiple items or behaviors that have high internal consistency. Measures with higher internal consistency increase statistical power and the ability to demonstrate relationships among variables.
- *Is a child's performance on the measure judged similarly by different raters?* Because measures of social communication require ongoing judgments about the occurrence or nonoccurrence of behaviors, interrater agreement should be documented by comparing the measures obtained by at least two independent raters.
- *Is the measure stable from test to retest?* Another aspect of reliability is whether the measure is stable from one point in time to another when development or learning has had little or no effect on the child's relative standing in the group. The stability of scores, reflected in high correlations from test to retest, may indicate minimal measurement error.
- *Does the measure capture growth or change in this construct?* Although we want a measure to be stable over time when no learning or de-

velopment has occurred, we also want it to detect change over time when development or learning has occurred. Thus we want to know if a measure of social communication is sensitive to change over time. In research on children with typical development, we want to know the age range over which the measure captures growth and the smallest time interval over which the measure is able to detect change. In research on children with ASD, we want to know whether the measure is able to capture change over time that may reflect development or treatment effects.

- *Does the measure have an empirical association with some criterion measure?* We want to know whether the measure is related to a different measure that has been designated as important or as a "gold standard" for this construct. This is referred to as criterion-related validity, which may be measured at the same point in time (concurrent validity) or at a later point in time (predictive validity). Social-communication measures are often explored in relation to language.
- *Does the measure differentiate children with ASD from other populations?* It is important to know whether a measure of social communication can differentiate children with ASD from other populations. This is referred to as known-groups validation and is accomplished in one of two ways. First, comparisons of the measure in two or more groups of children can reveal whether there are statistical differences. Second, the predictive accuracy of the measure can be examined by classifying the predictor and the criterion measure into dichotomous categories (e.g., pass/fail; low/high) and examining the "hit rate" for correctly classifying children.
- *Does the measure actually measure the construct it purports to measure?* It is important to know that the measure is positively correlated with other measures that are theoretically related and uncorrelated with measures that would not be expected to be related. This is referred to as construct validity, and correlations among constructs should be demonstrated above and beyond the measurement method (e.g., interviewing vs. sampling).

Approaches to Measurement of Social Communication

The most common approach to measuring social communication in research on children with ASD is interactive sampling. This section describes two formal sampling procedures, the Early Social Communication Scales (ESCS) and the Communication and Symbolic Behavior Scales (CSBS), and informal sampling procedures of parent–child interaction that have been used to measure social communication. Additionally, the recent use of parent-report tools to measure social communication is described. Psychometric features of each of these approaches are presented.

Early Social Communication Scales

The ESCS is a structured observation tool designed to measure nonverbal communication skills in a laboratory setting (Seibert, Hogan, & Mundy, 1982; Mundy, Hogan & Doehring, 1996). The ESCS sample takes 15–25 minutes to administer and is videotaped for later scoring. It consists of a set of semistructured eliciting situations designed to encourage specific nonverbal behaviors between the examiner and the child and measures low- and high-level behaviors for both initiating and responding to joint attention, requesting, and social interaction. For example, for initiating joint attention, low-level behavior includes eye contact and alternating gaze, and high-level behavior includes showing and pointing gestures. For responding to joint attention, low-level behavior consists of following a proximal point or touch, and high-level behavior consists of following a line of regard of a distal point.

Numerous research studies have documented aspects of reliability and validity of the ESCS in children with ASD, Down syndrome, and typical development (Mundy et al., 1996). High interrater agreement for the ESCS has been well documented. Test–retest stability of initiating and responding to joint attention from 14 to 17 months and concurrent relations with language outcomes were demonstrated with typically developing children (Mundy & Gomes, 1998). Studies using the ESCS have documented the predictive validity of initiating and responding to joint attention and requesting in relation to language outcomes in children with typical development (Morales, Mundy, & Rojas, 1998; Mundy & Gomes, 1998), Down syndrome (Mundy, Kasari, Sigman, & Ruskin, 1995), and ASD (Mundy et al., 1990; Rogers et al., 2003; Sigman & Ruskin, 1999) and significant group differences between children with typical development, Down syndrome (Mundy et al., 1995), and ASD (Mundy et al., 1990).

Measures of internal consistency have not been reported for the ESCS, which limits our ability to interpret correlations or lack of correlations with other measures. For instance, we do not know whether measures of responding to joint attention have higher internal consistency than measures of initiating joint attention. If this were the case, this would be one explanation for measures of responding to joint attention having stronger predictive correlations (e.g., Sigman & Ruskin, 1999). Correlational data among the six social-communication skills measured with the ESCS and receptive and expressive language have been published and support criterion-related validity. However, further research using factor analysis is needed to determine the latent variables that underlie individual items measured on the ESCS (e.g., low vs. high level of initiating and responding to joint attention) and separate or shared constructs measured.

Communication and Symbolic Behavior Scales Developmental Profile

The CSBS Developmental Profile (CSBS-DP; Wetherby & Prizant, 2002) is a standardized tool designed for screening and evaluation of communication and symbolic abilities of children from 6 to 24 months of age. It was recently developed based on the CSBS (Wetherby & Prizant, 1993), which is a more in-depth tool designed for program planning. The CSBS-DP behavior sample is a face-to-face evaluation of the child interacting with a parent and clinician that takes about 25 minutes to administer and that is videotaped for later analysis. The sample consists of systematic procedures designed to entice or tempt the child to communicate and to encourage spontaneous play. It measures the following social-communication skills organized into three composites:

1. *Social:* gaze shifts; shared positive affect; gaze/point following; rate of communication; initiating communication for behavior regulation, social interaction, and joint attention; inventory of conventional gestures; and distal gestures.
2. *Speech:* syllables with consonants, inventory of consonants, inventory of words, and inventory of word combinations.
3. *Symbolic:* comprehension of object names, person names, and body parts, inventory and complexity of actions in symbolic play, and constructive play with blocks.

The CSBS-DP has been nationally field tested, and standard scores and percentiles can be calculated based on a normative sample (Wetherby & Prizant, 2002). Information about the psychometric features of the CSBS-DP has been reported in Wetherby, Allen, Cleary, Kublin, and Goldstein (2002); Wetherby, Goldstein, Cleary, Allen, and Kublin (2003); and Wetherby and Prizant (2002). The behavior sample has a high degree of internal consistency (alpha coefficients ranging from .86 to .92), very good interrater reliability, and good test–retest reliability for standard scores over a 4-month interval, with significant increases in raw scores, providing evidence that it detects growth over short periods but produces relatively stable rankings of children. Construct validity has been supported by the developmental progression of scores from 6 to 24 months of age and by intercorrelations among cluster and composite scores. A principal-component analysis of the items was used to form the seven clusters and three composites of the behavior sample (Wetherby & Prizant, 2002). More variables are measured with the CSBS-DP than with the ESCS, with some overlap, and they are organized differently. For example, on the CSBS-DP, gaze shifts, shared positive affect, and gaze/point following are grouped in the Emotion and Eye Gaze cluster, and initiating joint attention is grouped with social

interaction and behavior regulation in the Communication cluster. The ESCS provides more precise ratings of the six skills measured. Moderate to large correlations were found between the behavior sample gathered between 12 and 21 months and outcomes on standardized language tests at 2 and 3 years of age (Wetherby et al., 2002, 2003), supporting the predictive validity of the CSBS-DP and the value of measuring social-communication skills to predict later language. The CSBS (Wetherby, Prizant, & Hutchinson, 1998) and the CSBS-DP (Wetherby et al., 2004) have been found to show significant group differences in social-communication skills of children with typical development, developmental delays, and ASD.

Parent–Child Interaction Measures of Social Communication

Sampling procedures that gather parent–child interactions to measure social communication have been reported; however, little is known about the psychometric features of these procedures. Unstructured parent–child play samples have yielded limited spontaneous communication, and, therefore, researchers have added structure to the sampling procedures, as done in the ESCS and CSBS. For example, Yoder and Warren (1998) found that child initiations were rare in unstructured play samples of mother–child interaction with 58 prelinguistic children with developmental disabilities, and they added structured requesting opportunities. Virtually no research is available on the psychometric features of measures of social communication gathered from parent–child interactions in natural environments. The ecological validity of measuring social communication from naturalistic parent–child interaction underscores the critical need for research in this area.

Parent-Report Measures of Social Communication

Another method for measuring a child's social communication is to use reported information from significant others familiar with the subtle nuances of the child's social communication in natural environments. Research on parent report of early language skills has demonstrated that parents can be very accurate in reporting about current and emerging behaviors, as opposed to giving retrospective accounts of past milestones (Fenson et al., 1993). Furthermore, accuracy is greater when a recognition format or checklist is used instead of free-form reports or diary methods. Numerous studies indicate that parent report using the MacArthur Communicative Development Inventory (CDI; Dale, Bates, Reznick, & Morisset, 1989; Fenson et al., 1993, 1994; Miller, Sedey, & Miolo, 1995; Thal, O'Hanlon, Clemmons, & Fralin, 1999) and the Language Development Survey (Rescorla & Alley, 2001) are reliable and valid measures of communication development in children with typical development, specific language impairment,

and Down syndrome and sensitive indicators of language delays in young children. The CDI has been used with a small sample of children with ASD, and the number of words produced based on parent report showed a large correlation with standardized measures of language production; in contrast, the number of words comprehended based on parent report were not correlated with standardized measures of language comprehension (Charman, Drew, Baird, & Baird, 2003). These findings are preliminary but suggest that either parent report or standardized language comprehension measures may be inaccurate for children with ASD.

In addition to the behavior sample, the CSBS-DP includes two parent-report tools, a one-page 24-item Infant–Toddler Checklist that is completed quickly at a physician's office or child-care center for screening and a four-page follow-up Caregiver Questionnaire, both of which measure the same social-communication skills as the behavior sample. The psychometric features of these parent-report tools have been reported by Wetherby and colleagues (Wetherby et al., 2002, 2003; Wetherby & Prizant, 2002). The Checklist and Caregiver Questionnaire have large concurrent correlations with each other, moderate correlations with the behavior sample on the Social composite, and large correlations with the behavior sample on the Speech and Symbolic composites (Wetherby & Prizant, 2002). The accuracy of the Checklist has been compared to standardized language measures at 2 years. Sensitivity was 87.4%, and specificity was 75.2% using the bottom 10th percentile, or 1.25 standard deviations below the mean, as criterion for risk. A regression analysis indicated that the Checklist and behavior sample were a significant predictor of receptive and expressive language outcomes at 2 and 3 years of age but that the behavior sample explained a significant amount of unique variance in language outcomes beyond the Checklist (Wetherby et al., 2003). Preliminary findings using the Infant–Toddler Checklist on a general population screen of more than 3,000 children between 12 and 24 months indicate that sensitivity was 89% for children identified with developmental delay and ASD combined and increased to 94% for children later identified with ASD (Wetherby et al., 2004). These findings indicate that parent report is a valuable measure of social communication and suggest that combining it with interactive sampling may improve accuracy. However, further research is needed to examine the accuracy of parent-report tools of social communication for children with ASD. For now, caution is needed, because adding an inaccurate measure to an accurate measure or adding two inaccurate measures together will not improve accuracy.

A number of diagnostic and screening tools also measure social-communication skills, and these are reviewed in detail in other chapters in this volume (Charman & Baron-Cohen, Chapter 3, Lord & Richler, Chapter 2; Zwaigenbaum & Stone, Chapter 4).

Implications for Earlier Identification of ASD

The diagnostic features of ASD should be evident in very young children, because they involve abilities that typically develop in the first few years of life. The literature reviewed suggests that there is a constellation of social-communication parameters that are important early indicators of ASD. The lack of language and limitations in communication development may be among the first symptoms that are evident to parents and professionals.

Wetherby et al. (2004) conducted a prospective longitudinal study to identify red flags for ASD from videotapes collected during the second year of life. Three groups of 18 children were identified: one with ASD, one with developmental delays in which ASD was ruled out (DD), and one with typical development (TD) who were screened under 24 months of age. Significant group differences were found between the ASD and both the DD and TD groups on the following nine red flags observed in the behavior sample: (1) lack of appropriate gaze; (2) lack of warm, joyful expressions with gaze; (3) lack of sharing enjoyment or interest; (4) lack of response to name; (5) lack of coordination of gaze, facial expression, gesture, and sound; (6) lack of showing; (7) unusual prosody; (8) repetitive movements or posturing of body, arms, hands, or fingers; and (9) repetitive movements with objects. Significant differences were found between the ASD and TD groups, but not the ASD and DD groups, on the following four red flags: (1) lack of response to contextual cues; (2) lack of pointing; (3) lack of vocalizations with consonants; and (4) lack of playing with a variety of toys conventionally. These findings indicate that children with ASD can be distinguished from those with DD and TD in the second year of life on a combination of lack of typical behaviors and presence of atypical behaviors, and they underscore the importance of social communication in earlier identification of ASD.

Social-Communication Outcome Measures in Intervention Research

Although a large number of studies delineate the core social-communication deficits associated with ASD, very few studies have documented intervention effects on these core skills. The most widely used outcome measures in group intervention studies with children with ASD are changes in IQ and percentage of children with posttreatment placement in regular classrooms (National Research Council, 2001). Considering the heterogeneity in the social-communication skills of children with ASD, it is important to measure these skills in intervention research in order to adequately describe participants being studied and to document how children with different characteristics respond to different treatments. There have been several studies using single-subject design that have provided systematic evidence of

naturalistic behavioral teaching techniques to improve social-communication skills in children with ASD (e.g., Buffington, Krantz, McClannahan, & Poulson, 1998; Hancock & Kaiser, 2002; Hwang & Hughes, 2000; Whalen & Schriebman, 2003) and a recent randomized group design (Aldred, Green, & Adams, 2004). Although it is beyond the scope of this chapter to review intervention research, two recent studies are discussed in detail, one single-subject and one group design, to examine the social-communication measures utilized.

Whalen and Schreibman (2003) implemented a multiple-baseline design study across participants using pivotal response training to target initiating and responding to joint attention in 5 children with ASD ranging from 49 to 52 months of age. They measured social communication in three contexts: (1) unstructured play sample with an experimenter presenting joint-attention probes (showing objects, pointing, shifting gaze) every 30 seconds; (2) structured joint-attention sample with an experimenter using procedures from the ESCS with an adapted scale (*significantly*, *somewhat*, and *not impaired*); and (3) structured laboratory observations with an untrained experimenter and with the caregiver in a generalization setting. Phase 1 of treatment was response training to teach responding to joint-attention bids of the experimenter, and Phase 2 was initiation training to teach initiating joint attention with gaze shifting and pointing. Four assessments were carried out: at baseline, after Phase 1 of treatment, posttreatment, and 3 months following treatment. Response training was effective for all 5 participants, and initiation training was effective for 4 of the 5 participants. It is noteworthy that all of the participants showed some response to joint attention at baseline but minimal or no initiating of joint attention. Response training did not lead to changes in initiation of joint attention. All participants maintained responding to joint attention but decreased initiating joint attention from posttreatment to follow-up. This study demonstrated that changes in joint-attention skills can be systematically taught and documented in children with ASD using structured sampling procedures.

Aldred et al. (2004) implemented a randomized group design with 14 children each in the treatment and control groups ranging from 29 to 60 months of age. Parents of children in the treatment group attended monthly sessions focused on facilitating the children's communication and were asked to spend 30 minutes daily practicing these strategies with their children. The pre- and posttreatment measures included the ADOS, the Vineland Adaptive Behavior Scales, the CDI, the Parenting Stress Index, and a parent–child interaction sample. The sample was a 30-minute unstructured play sample videotaped to measure child communication acts, asynchronous and synchronous parental communication, and shared attention. They found significantly lower ADOS scores in the treatment group, covarying for baseline ADOS score. The treatment group showed higher

scores on the Vineland, but this was nonsignificant when covaried for baseline score. The treatment group showed significantly greater improvement on expressive language measured on the CDI, but no difference from the controls in language comprehension. The treatment group showed significantly better outcomes in parental positive synchronous communication and in child communicative acts. There was no significant difference between groups in level of shared attention. This study suggests that significant gains in social communication can be documented by teaching parents how to enhance their children's communication in a cost-effective treatment.

Future research should strive to document meaningful changes that reflect the core social-communication deficits in children with ASD. The research reviewed in this chapter suggests that multiple aspects of joint attention and symbol use should be measured, both to describe the participants and to be used as possible treatment outcomes. Even the most effective treatment studies of children with ASD show variable outcomes (National Research Council, 2001), and a child's social-communication skills before treatment may influence the response to treatment. For example, Bono, Daley, and Sigman (2004) found that the relation between amount of intervention and amount of gain in language for children with ASD depended on their ability to respond to joint attention from others, as well as initial language skills. Systematic measurement of social communication will contribute to our understanding of interactions between treatment and child characteristics. For example, treatments that use adult-directed teaching strategies may be more effective with children who have better skills in responding to joint attention or in language comprehension than with children who are deficient in those skills. Treatments in which the adult synchronizes with the child's attentional focus may be more effective than more directive approaches for children who have limited skills in responding to or initiating joint attention. As we work with younger and younger children, targeting and documenting progress in social-communication skills becomes even more essential, because these skills form the underpinnings of later social competence and enable children to participate more actively and successfully in a variety of learning contexts.

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