The goal of this review of the research literature is to discuss approaches to the early detection of autism in infancy. Early detection would enable diagnoses to be made before 18 months of age rather than at 24–30 months, the age where diagnoses start to be made now. After summarizing the criteria for a deficit to be considered “core” to the disorder, the literature on research strategies used in early detection is examined. In order to guide the design of future studies, the review then turns to an overview of what is known about the processes of early social development in typically developing children that underlie the domains in which core deficits are manifested in young children with autism. The social domains covered in the review are those that show development in typically developing infants below 18 months of age: dyadic interaction and imitation; emotion discrimination; and attachment. The review concludes that all of these areas are worthy of investigation in young children, particularly those at higher risk of showing some of the core deficits of autism such as the infant siblings of children with autism.


Key Words: autism; early detection; dyadic interactions; imitation; emotion discrimination; attachment security

One of the major goals of research concerning autism is to identify the core deficits shown by children and adults who suffer from this disorder. This is a central aim that is critical for the design of both diagnostic practices and interventions. A deficit is considered to be core if it is unique to autism, specific rather than general, and universal [Sigman, 1993; Sigman and Capps, 1997]. The requirement that the deficit be unique leads to studies that compare the functioning of groups with autism to control groups that have different disabilities but are matched on age and level of development. To establish the specificity of the deficit, research is carried out that contrasts different functions and abilities across groups, testing the hypothesis that some functions and not others are deficient in the autism group. Finally, for the criterion of universality to be met, core deficits would be expected to appear during at least one age period in all individuals with the diagnosis, regardless of the severity of autism. The absence of the deficit at some ages may occur because of successful compensation, particularly among individuals who have strong cognitive skills.

Using these criteria, a variety of core deficits have been identified, although there is controversy about many of them. The controversy exists largely because of the need to measure areas of function in different ways when individuals are at different ages or skill levels. For example, communication and language deficits are considered core to autism, but these are manifested in gaze and behavioral patterns in nonverbal individuals and in semantic and pragmatic language abilities in verbal individuals. The other problem is that one cannot be certain of the skills involved in any function. For example, there is considerable argument whether the autistic deficit in joint attention is due to a general attention problem or to a more narrowly confined problem with social attention. Despite these controversies, we have established sufficient consensus on core deficits in individuals above the ages of 2–3 years to be able to agree on diagnostic criteria.

The same cannot be said of the characteristics of children less than 2–3 years of age. Because of the wide variability in the development of skills and characteristics of very young typically developing children, it is impossible to be sure that a lack of function is a deficit rather than a delay. At this point, most clinicians and researchers make diagnoses in very young children cautiously, as many children who are followed grow out of their difficulties. The inability to establish core deficits in very young children has serious consequences. One consequence is that we do not know which children to refer for interventions nor how to structure the interventions; second, there is a large gap in our understanding of autistic development because we do not comprehend its origins.

The early detection of autism would be valuable for a number of reasons. First, early detection would allow interventions aimed at minimizing or even, possibly, preventing some of the handicapping symptoms of the disorder. Based on the hypothesis that the self-imposed social deprivation of children with autism compromises their behavioral and brain development [Mundy and Neal, 2001], early detection and intervention might be able to prevent some of the sequelae of growing up autistic. Second, early detection would enable us to characterize the infancy of children with autism in ways that we currently cannot accomplish. Such characterization of the early life of children with autism would broaden our understanding of autistic development.
There are several research strategies that have been employed in attempting to uncover the earliest manifestation of autism, each of these focused on capturing relevant samples of behavior in infants or toddlers. One strategy is to collect and code the videotapes made by parents of infants who are diagnosed with autism later in life. The videotaped behaviors of other groups of children are also coded and compared to the behaviors of children who are later diagnosed with autism. Henry Massie [1975] first used this strategy with children with ‘signs of psychosis,’ some of whom were diagnosed as having autism.

The early studies using home videos had a number of methodological weaknesses. First, the observers were often aware of the children’s diagnoses. Second, the videotaped events varied from one child to another and matching of groups on age could not always be accomplished because the ages of the children were not always known. To standardize the videotaped material and ages of the children, studies began to concentrate on videotapes of first year birthday parties [Osterling and Dawson, 1994]. Moreover, two studies included not only videotapes of 12-month-olds who later were diagnosed with autism and typically developing 12-month-olds but also videotapes of 12-month-olds who were later diagnosed with mental retardation without autism [Baranek, 1999; Osterling et al., 2002]. The inclusion of a mentally retarded group was an important advance in that these studies controlled for the mental retardation that frequently accompanies autism. These studies have identified differences between the 12-month-olds who were later diagnosed with autism and the other two groups. In one study, 9 of 12 behaviors differentiated the three groups, and the infants with autism differed from the other infants according to a discriminant analysis in that they mouthing objects more, showed more aversion to social touch and less orientation to visual stimuli, and were less likely to respond to their own name [Baranek, 1999]. In the other study [Osterling et al., 2002], the two variables that differentiated the autistic and mentally retarded groups most accurately were looking at other people and response to one’s name.

Another approach to defining the early manifestation of autism is by screening large numbers of children for deficits that children with autism often show at later ages. One such study screened 16,235 infants at 18 months of age with a combined observation carried out by visiting nurses and interview of the children’s mothers [Baird et al., 2000]. The items selected for the screening devices were behaviors known to differentiate 3- to 6-year-old children with autism from control children matched on mental age. Children who were initially screen-positive received a second administration of the screen 1 month later by the research team. The high-risk for autism group consisted of 12 children who failed all key items on the check for autism in toddler (CHAT) measuring proto-declarative pointing, gaze monitoring, and pretend play on both administrations. The medium risk for autism group consisted of 22 children who missed the proto-declarative pointing items.

Surveillance and screening of the entire sample continued through the time that the children reached 7 years of age. Only 1 of 12 high-risk children based on the double administration of the CHAT at 18–19 months was later seen as clinically normal, 9 were diagnosed with autism, 1 was diagnosed with PDD, and 1 had a severe language disorder. Only 2 of the children in the medium-risk group were later found to be clinically normal. One was diagnosed with autism, 9 were diagnosed with PDD, 7 had language disorders, 2 had general developmental delay, and 1 had cerebral palsy (CP). Thus, the double screening was accurate in identifying children at high risk of autism, but the classification of medium risk was predictive of problems but not necessarily of autism specifically.

Although the positive predictive value of the screen was high, the sensitivity was very low. Fifty cases of child- hood autism were identified in the screened population and only 10 of these children were identified as either medium- or high-risk by the two administrations of the CHAT. Forty-four children were later diagnosed with PDD but only 10 children were identified as medium or high risk. Thus, when parents, health professionals, and experienced researchers reported a lack of proto-declarative pointing, gaze monitoring, and pretend play in infants at 18–19 months, these reports were predictive of autism, but the failure to report such deficiencies did not put children in the clear. In line with these findings, some recent studies have reported that the CHAT is useful when assessing children who have raised the concern of clinicians or teachers as showing some of the symptoms of autism [Charman et al., 2001; Robins et al., 2001].

A final approach to early identification is to assess, observe, and follow the infant siblings of children with autism and compare their development to the siblings of typical and developmentally delayed (but not autistic) children. Because the siblings of children with autism are at greater risk than the siblings of children without autism, the assumption behind this methodology is that some of the siblings of children with autism will develop either autism or the broader autism phenotype later in childhood. If that occurs, the early behaviors of the children who develop either autism or the broader phenotype can be contrasted with the behaviors of infants who show typical development. Using this approach, 41 18-month-old siblings of autistic probands and 50 randomly selected 18-month-old infants were screened with the CHAT, administered by health professionals [Baron-Cohen et al., 1992]. None of the randomly selected 18-month-olds and only 4 of 41 siblings of children with autism failed more than one item assessing proto-declarative pointing, social interest, joint attention, and pretend play. The 4 toddlers who failed on two or more of the types of behaviors were diagnosed with autism at 30 months.

Each of these strategies aimed at identifying precursors of autism has strengths and serious shortcomings. The usefulness of the videotaped behavior of the autistic children as infants depends on the selection of events that the parents have chosen to include in their videos. The video session cannot be designed beforehand because the sample is chosen after the diagnosis of autism some years later. The large-scale screening studies require very large samples, which means that only a few measures can be made and that these measures cannot be conducted by expert assessors. One of the reasons why the large screening study described above may have failed to diagnose 18- to 19-month-olds with autism is that the parents may have misunderstood the behaviors to be evaluated. There is some anecdotal evidence that parents did not differentiate between requesting behaviors and joint attention behaviors. In addition, the parents were required to identify behaviors, such as pointing for joint attention, that the child had never shown so that only the most deficient children were considered at risk. The assignment of cases to risk groups was necessary because not all subjects could be followed. Therefore, the experimenters had to rely on criteria for group assignment that were arbitrary because of
the lack of information on these measures in typical children.

Studies of infant siblings may have the most potential for teaching us about early deficiencies in autism because standardized procedures can be administered to children at risk of autism. However, the conceptualization of these studies is particularly critical because these studies are very difficult to conduct. Sibling studies require large samples because the prevalence of autism is still very low in the siblings of autistic children (3–6%) even though much higher than in the siblings of typically developing children. Moreover, sibling studies require extensive long-term follow-ups before the children are old enough to be diagnosable with current tools.

To guide the design of new studies of infant siblings of children with autism, we need to know about the processes of early social development in typically developing children that underlie the developmental domains in which core deficits are manifested in young children with autism. The purpose of this article is to review the literature on typical social and emotional development in the first year and a half of life. We are focusing on the first 18 months, as we would like to identify precursors of later deficiencies as early as possible. The emphasis on social and emotional development is based on the fact that problems in social and communicative function are required for the diagnosis of autism at all ages. We have selected developmental domains based on two factors: (1) much is known about typical development because of extensive research accomplishments and (2) the domain seems particularly important for the development of children with autism. Although we cannot contrast typical and autistic development in the same age periods, the information that is available on children with autism at later age periods is provided with some consideration of what this might mean for earlier development in children with autism.

**DYADIC INTERACTIONS AND IMITATION**

**Dyadic Interaction and Imitation in Typically Developing Infants**

Early social interaction and the temporal coordination of communicative behavior and affect regulation it affords are considered precursors of the development of joint attention and the social understanding of intentions. Because these are known to be some of the most deficient capacities in autism, researchers have proposed that the roots of the autistic disorder may reside in subtle abnormalities in the nonverbal and preverbal interactions of infants born with a genetic predisposition for autism [Porges, 2003; Trevarthen et al., 1998].

**Dyadic interactions**

By 6 months, typically developing infants use complex combinations of vocalization, facial expression, and visual orientation in dyadic interaction with their caregivers. The organization of these expressive behaviors in time seems to convey information to their partners about their states of attention, arousal, and affective engagement. Judging by studies of the behaviors of both partners, infants not only integrate the timing of their own expressive behavior but also coordinate their movements and vocal expressions with those of their interactive partners. This ability comes to depend over time on a well-developed understanding of timing and salience in others’ expressions and on the acquisition of anticipatory control and “social expectancies” [Murray and Trevarthen, 1985; Hains and Muir, 1996; Feldman, 2003].

In the first 6 months of life, smiling is the most prevalent infant social behavior [Jayne and Fogel, 1980; Weinberg and Tronic, 1994; Yal et al., 2003] and there is a strong correlation between smiling and gazing at the mother [van Beek et al., 1994]. Coordinated facial expression, vocalization, and gaze express positive and negative emotions and have been found to be highly patterned and consistent by the age of 3 months [Yal et al., 2003]. Between 9 and 15 months of age infants coordinate smiles, eye contact, and gestures to communicate about objects in episodes of joint attention [Carpenter et al., 1998; Messinger and Fogel, 1998].

Infants’ sensitivity to social cues from their mothers and to sudden disruptions of anticipated interactive patterns are evident from studies of contingency disruption in face-to-face interaction [Tronic et al., 1978; Murray and Trevarthen, 1985]. A sensitive caregiver responds to subtle signals from the infant indexing a motivation to interact and a need for disengagement and modulates her behavior to match and channel the infant’s experiences. The process of reading or sensing another’s state and modulating behavior across sense modalities to match it has been described as affect attunement [Stern, 1985; Stern et al., 1985]. This mutual matching is built on the infant’s early developing perceptual skills [Lewkowicz, 2001]. It is also based on mutually formed dynamic anticipations. By 6 months mothers and infants have well-established patterns for synchrony and attunement; they know each other intimately and are able to predict each other’s expressions in time.

Studies of the vocal expressions of mothers and infants in face-to-face interaction have highlighted the precise temporal and prosodic organization of their utterances and their use of protoconversational rules such as turn-taking, repair, overlap, and collaborative completion [Gratier, 1999, 2003; Malloch, 1999; Trevarthen, 1999]. Between 2 and 6 months infants are particularly expressive in the vocal register; they actively respond to and initiate vocal engagement with interactive partners and they spontaneously imitate or mirror their mothers’ expressions [Kokkinaki and Kugimutzas, 2000]. The timing of vocal interaction is organized around the close matching and monitoring of affect by mother and infant, as expressed through acoustic cues such as pitch, loudness, and timbre. Acoustic analysis of some of these features presents an exciting methodological support for understanding the dynamics of anticipation and repair in preverbal communication [Malloch, 1999; Trevarthen, 1999]. The overall temporal structure of vocal interaction has been found to present a high degree of regularity with clear rhythmic features as well as a certain amount of variability [Crown et al., 2002; Gratier, 2003]. From the first 6 months of life, infants are sensitive to temporal structure in both the auditory and visual modalities [Lewkowicz, 1989] and are particularly attuned to the perception of subtle temporal changes in linguistic and musical stimuli [Trehub, 1999, 2003; Malloch, 1999; Nazzi et al., 1998]. They can discriminate between different visual rhythms [Mendelson, 1986], but the ability to discriminate more complex auditory rhythms improves with age [Moriggiello, 1984].

Microanalytic studies and naturalistic observation have revealed the natural sociability of infants. They engage the interest and affection of their caregivers through prosocial coordinated elicitations [Trevathan and Hubeley, 1978; Trevarthen, 1980; Trevarthen et al., 1981]. The infant’s communicative abilities and the “intuitive parenting” that supports it have been identified with the special human aptitude for “cultural learning,” including language learning [Halliday, 1975; Vygotsky, 1978; Bruner, 1983; Tomasello and Farrar, 1986; Adamson and Bakeman, 1991; Papousek and Bornstein, 1992; Tomasello; Kruger
and Ratner, 1993]. The infant’s need for communication gives rise to self-other awareness and to the emotions and shared experiences that shape social relationships through the course of development [Reddy et al., 1997; Braten, 1998; Rommetveit, 1998]. The earliest meanings are conveyed to the infant or toddler nonverbally or “paralinguistically” by vocal and gestural expression in natural social situations.

**Imitation**

Imitation has been shown to exist from the first moments of life [Maratos, 1973; Meltzoff and Moore, 1977, 1983; Reddy, 1991]. It is above all an act of social intelligence elicited specifically by goal-oriented human action and not by objects [Legerstee, 1991] and has an interpersonal function from birth [Kugiumutzakis, 1993; Nadal, 2002]. Studies suggest that infants are born with a rudimentary representational capacity reflected in young infants’ ability to exhibit deferred imitation of facial and manual gestures [Meltzoff and Moore, 1994]. Some theorists have posited the existence of a “virtual other” or an innate capacity for social engagement or intersubjectivity [Hobson, 1986] that guides and shapes interactive processes as they become more and more complex and contextualized [Braten, 1998; Porges, 2001; Trevarthen, 1999, 2001]. Imitation appears to serve two primary functions, each of which comes online at different points in development. Its earliest function supports a sense of interpersonal connectedness and mutuality [Nadel et al., 1999; Trevarthen et al., 1999], whereas from the second semester of life imitation starts to provide the infant with information about the physical and social world and supports cultural learning [Kugiumutzakis, 1993; Uzgiris, 1999].

Human neonates’ abilities to imitate fellow humans go hand in hand with their basic preference for human faces [Valenza et al., 1996], their preference for their mothers’ voices [DeCasper and Fifer, 1980], and their ability to discriminate the smell of their mothers’ milk from that of a stranger [Marlier et al., 1998]. An interesting study of neonatal imitation shows that newborns are not only able to imitate but also to provoke adults around them to enter into a reciprocal imitative exchange [Nagy and Molnar, 2004]. Imitation then reflects above all a particular sensitivity for reciprocity and a motivation to share experience that is patterned in time.

Most research on spontaneous dyadic interaction among typically developing infants suggests that its fundamental characteristic is a shared patterning of expressive behavior motivated by the sharing of affect and attention. Studies of mother-infant synchrony in dyadic face-to-face interaction at 3 and 9 months have shown that it is related to secure attachment outcomes at 12 months using the Strange Situation paradigm [Isabella and Belsky, 1991]. The quality of vocal temporal coordination in face-to-face interaction at 4 months is strongly correlated with attachment style at 12 months. Beebe et al. [2001] found that vocal interactions characterized by either high or low coordination predicted insecure attachment styles whereas intermediate levels of mother-infant vocal coordination predicted secure attachment. These findings suggest there is a link between parental sensitivity and reciprocity and temporal coordination. Sensitivity is related to a sense of anticipation that is moderately predictable, allowing for the simultaneous coconstruction of shared patterns and structures and the emergent creativity of novel and surprising interactive events [Haine et al., 2003].

**Dyadic Interaction and Imitation in Children with Autism**

*Dyadic interaction*

Dyadic interaction and imitation have not been studied in children with autism between birth and 18 months of age. Studies of older children with autism highlight specific deficits in imitation [Rogers, 1999; Nadal, 2002] and in nonverbal social–emotional interaction [Sigman et al., 1986; Mundy, 1995; Sigman and Ruskin, 1999].

Communication skills of 3- to 5-year-old children with autism are qualitatively different from those of typically developing children or children with developmental delay matched on language abilities. They exhibit clear deficits in social understanding, spontaneous social approach, emotional responsiveness and imitation, and nonverbal social communication [Dawson and Adams, 1984; Mundy et al., 1986; Dilavore et al., 1995; Travis and Sigman, 1998]. They also have moderate difficulty with turn-taking [Loveland and Landry, 1986; Mundy et al., 1986; Mundy, 1995; Sigman and Ruskin, 1999].

Dawson and her colleagues [Dawson et al., 1990] observed autistic children’s social behavior, affect, and use of gaze in interactions with their caregivers. The authors suggested that the affective behavior of autistic children has potential negative effects on the behavior of others. Comparing interactions of children with autism with those of children with mental retardation and those of typically developing children, Sigman and colleagues found that caregivers of autistic children exhibit a higher frequency of control strategies than other caregivers [Sigman et al., 1986; Kasari et al., 1988], that autistic children respond to parental directives but not parental suggestions, and that greater synchrony between caregiver behaviors and the autistic child’s attention focus is associated with better long-term communication development [Siller and Sigman, 2002]. Parents of autistic children tend to use more attention-getting behaviors, increase their physical proximity, and use more nonverbal prompts than parents of handicapped, nonhandicapped, or language-impaired children [Lemanek et al., 1993].

Research has shown that, contrary to the stereotypic portrayal of mothers of children with autism as cold and nonexpressive, [the refrigerator mothers described by Bettleheim, 1967 and Kanner, 1943] these mothers appear to be highly flexible and involved. Doussard-Roosvelt et al. [2003] analyzed sequential maternal approaches and the corresponding child responses to these approaches in mother-infant interaction with a group of autistic children in a free-play situation. They identified specific maternal approach behavior characteristics and found that these characteristics are particularly effective in eliciting prosocial responses from the child. Children with autism showed fewer contingent responses to their mothers than nonautistic children but their contingency was found to be a function of the type of approach behaviors their mothers used. Their responses were more contingent when the intensity of the approach behavior was high and they were more engaged in the interaction when their mothers used nonverbal behaviors such as increased proximity and objects in the interaction.

*Imitation*

Some researchers have proposed that imitation in infancy, and the empathetic states of mind that it entails and requires, constitutes a fundamental building block for the development of a Theory of Mind. Imitation and theory of mind are thought of as both being expressions of a more basic ability to form and coordinate representations of self and other [Rogers and Pennington, 1991; Meltzoff and Gopnik, 1993]. Imitation appears to be particularly impaired in autism [Rogers and Pennington, 1991; Smith and Bryson, 1994; Rogers et al., 1995].
soothe the child if he or she becomes 
comment during the procedure but to 
infant. The caregiver is instructed not to 
amount of visual stimuli available to the 
giver's lap across from a screen approxi-
paired preference and infant-controlled 
been used in laboratory assessments of 
emotional aspect of imitation, which might 
underlie its impairment in autism, is the 
ability to perceive and participate in tem-
porally organized stimuli through which 
reciprocity and empathy are cocon-
structed. Supporting this hypothesis is the 
observation that the impairment in imi-
tation is differentially affected depending 
on the types of tasks used. For example, 
both Hobson and Lee [1999] and Stone 
found that children with autism were more adept at imitating 
functional actions than the emotional 
quality of the experimenter's action or 
his body movements without objects.

No studies have investigated dy-
ad interaction and imitation in children 
within autism much below 24–30 months 
of age. In fact, the kind of dyadic inter-
action that is seen in typical development 
in the first 6 months of life is not man-
ifested at later age periods (except, per-
haps, in intimate love relationships). For 
this reason, there really have not been 
studies of this kind of dyadic interaction 
at any age. Until we conduct studies of 
dyadic interactions of 3- to 6-month old 
siblings who later are diagnosed with 
autism, we will not be able to characterize 
the temporal organizations of early dy-
adic interactions of children with autism.

EMOTION DISCRIMINATION

Emotion Discrimination in 
Typically Developing Infants

Besides studies of dyadic inter-
action, another very active area of inquiry 
has focused on evaluating the developing 
capacity of typical infants to differentiate 
affective states, most frequently repre-
sented by static, photographed faces. Emotion discrimination appears to be a 
relevant area of function to evaluate in 
infants at risk of autism because of the 
eccentricities in responsiveness to others' 
feeling states manifested by many indi-
viduals with autism over the life span.

Two paradigms have commonly 
been used in laboratory assessments of 
infant emotion discrimination as tested 
with nonverbal behavioral measures: 
paired preference and infant-controlled 
habitation procedures. In both types of 
studies, the infant is seated on the care-
giver's lap across from a screen approxi-
mately 30 to 60 cm from the infants face 
within a space enclosed on three sides by 
solid-colored panels to reduce the 
amount of visual stimuli available to the 
infant. The caregiver is instructed not to 
comment during the procedure but to 
soothe the child if he or she becomes 
upset. One of three face slide sets are 
generally used: (1) the Ekman and 
Friesen [1976] Pictures of Facial Affect, 
(2) the NimStim–MacBrain Face Stimu-
lus Set (http://www.macbrain.org/ 
faces/index.htm), and (3) color images of 
models taken for specific studies. A static 
image of one emotion is presented on the 
screen and is displayed either by the same 
person across emotions or by different 
persons for each emotion.

In the paired preference procedure, 
infants are familiarized to a pair of iden-
tical facial expressions for an age-depen-
dent familiarization time, such that 
younger infants are given more time to 
become familiar with the facial expres-
sion. The familiarization trial is immedi-
ately followed by two counterbalanced 
(i.e., left and right positions switched) 
test trials in which the familiar emotion is 
paired with a novel emotion posed by the 
same model. Images are presented for a 
fixed amount of time and the infants' 
gaze direction and duration are recorded.

Differential looking times to the familiar 
emotion and the novel emotion suggest 
that the infant is discriminating the emo-
tions displayed.

In the infant-controlled habitua-
tion procedure, introduced by Horowitz 
et al. [1972], the individual infant's per-
formance in terms of gaze direction de-
termines the length of the testing session 
and the number of stimulus presenta-
tions. An observer, who looks at the 
infant through a small peep hole directly 
above or below the center of the screen, 
records the infants' focus on the stimulus 
by depressing a button when the image 
of the stimulus appears as a corneal re-
fection in the infant's eye. A computer 
program calculates looking time based on 
these button presses. Initial looking time 
is computed as the average duration of 
the first two or three trials. Images of one 
emotion are presented until the infant 
reaches a preset habituation criterion. 
The habituation criterion is often com-
puted as a decrement in looking time 
from these first two or three trials, such 
that the infant looks at the screen for less 
than 50% of initial looking time, aver-
aged across any two or three consecutive 
trials following the initial two or three 
trials. A dishabituation set of stimuli 
showing a new emotion follows the ha-
bituation set. The infant's capacity to 
differentiate among emotions is tested by 
the extent to which the infant increases 
looking at a novel emotional expression, 
such as a fearful face, after having been 
habituated to a face showing another 
emotion, such as a happy face.

Previous research suggested that 
typically developing infants visually dis-
criminate a number of different emo-
tions as early as 2 to 4 months of age [La 
Barbara et al., 1976; Young-Browne et 
al., 1977; Barrera and Maurer, 1981; 
Nelson and Horowitz, 1983; Montague 
and Walker-Andrews, 2001]. However, 
more recent studies suggest that this ca-
pability does not fully emerge until 
sometime between 4 and 7 months of age 
and that the order of presentation of 
the emotions influences whether there 
is dishabituation of the new emotion (see Ta-
ble 1). The most well-established se-
quences that infants have been 
demonstrated to differentiate include 
facial expressions of happiness and fear, 
presented in said order [at 5 months, 
Bornstein and Arterberry, 2003; and at 7 
months, Nelson et al., 1979; Nelson and 
Dolgin, 1985; Nelson, 1987; Ludemann 
and Nelson, 1988; Kestenbaum and Nel-
son, 1990; Kotsoni et al., 2001]; and hap-
piness and surprise [at 3 months, Young-
Browne et al., 1977; at 6 months, Caron 
et al., 1982; and at 7 months, Caron et 
al., 1982; Ludemann and Nelson, 1988].

Thus, researchers have found that 
infants can consistently discriminate 
happy from fearful faces, but only if first 
presented with happy and not fearful ex-
pressions. This may be because young 
infants consistently demonstrate a prefer-
ence for fear expressions compared with 
happy expressions, as evidenced by 
longer looking times toward fearful ex-
pressions and failure to dishabituate to fearful expressions [Nelson et al., 1979; 
Nelson and Dolgin, 1985; Kotsoni et al., 
2001]. Happy faces may have less appeal 
as a novel stimulus for young infants, 
who may be accustomed to seeing happy 
adult faces in daily life [Schwartz et al., 
1985].

The fact that initial preferences 
may interfere with dishabituation is evi-
dence of a particular weakness of the 
experimental procedures for establishing 
emotion discrimination. This weakness is 
that the failure to demonstrate differen-
tiation between the novel and familiar 
stimuli may not necessarily be due to 
incapacities to differentiate between 
emotions. Preferences for particular 
emotions or faces or a lack of motivation 
to differentiate may interfere with the 
demonstration of emotion distinction 
abilities. For example, the conflicting evi-
dence concerning discrimination of 
happy and sad faces in 3-month-olds [Young-Browne et al., 1977; Barrera and 
Maurer, 1981] may be due to the fact 
that Barrera and Maurer used female 
models and that 3-month-olds may be
more successful at discriminating emotions posed by female models, perhaps reflecting a general tendency for infants to have more experience with female faces in day-to-day life [Barrera and Maurer, 1981]. Infants also seem to be more successful at discriminating emotions when habituating to different models posing the same expression of emotion versus one model posing the same expression of emotion [Caron et al., 1985] found that 4-, 5½-, and 7-month-olds were only able to discriminate expressions of happiness and anger when examples of one emotion were toothy and examples of the other emotion were nontoothy. On the other hand, other researchers have found that 5- and 7-month olds are still able to discriminate emotions when both have examples with teeth showing [Schwartz et al., 1985; Ludemann and Nelson, 1988].

Another problem with the emotion discrimination procedures is that many infants become either too irritable or too sleepy to complete the procedures or fail to habituate. There is wide variability in rate of subject loss, averaging 22.9% of the sample (ranging from 4.4 to 39.3%) for habituation studies and 21.4% of the sample (ranging from 5.9 to 37.5%) for paired preference procedures. Given the difficulty of identifying, recruiting, and following infants at risk of autism, experimenters may be reluctant to include procedures for which there will be substantial amounts of missing data.

### Emotion Discrimination in Children with Autism

There are neither studies investigating emotion discrimination in infants with autism nor, more surprisingly, in young children with autism between 2 and 5 years of age.

Numerous studies of older individuals with autism spectrum disorders have been conducted, and these studies identify difficulties in recognizing, interpreting, and responding to other people’s facial and vocal expressions of emotion, which likely contribute to impaired social interactions [Hobson, 1986, 1993; Weeks and Hobson, 1987; Braverman et al., 1989; Hobson et al., 1989; Travis and Sigman, 1998].

Studies of emotion recognition in individuals with autism have mostly consisted of laboratory-based paradigms examining perception of affect within an experimental context, such as tasks requiring subjects to sort, match, or identify images representing people or situations with emotional content. Due to the nature of this research, studies have mostly included older, relatively able children and adolescents with autism [Dissanayake and Sigman, 2001].

Weeks and Hobson [1987] reported that children with autism tend to use nonemotional cues, such as type of hat worn, when sorting or matching face stimuli. On tasks requiring the matching of schematic facial expressions to videotaped sequences of emotional expressions, including gestures, vocalizations, and emotional contexts, adolescents with autism performed significantly worse than nonverbal mental age-matched typically developing and mentally retarded comparison groups. Interestingly, participants with autism demonstrated greater impairments in these tasks than on a control task of matching inanimate objects, such as a train, to their movements or sounds [Hobson, 1986]. Similarly, a study by Boucher and Lewis [1992] revealed that children with autism were significantly worse at discriminating faces (social stimuli) than buildings (nonsocial stimuli).

### Table 1. Infant Discrimination of Paired Emotions

<table>
<thead>
<tr>
<th>Emotions</th>
<th>Able to Discriminate</th>
<th>Somewhat Able</th>
<th>Not Able</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy/Fear</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fear/Happy</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Happy/Surprise</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Surprise/Happy</td>
<td>1</td>
<td>1 (not able at 4 or 5½ mos., able at 7 mos.)</td>
<td></td>
</tr>
<tr>
<td>Happy/Neutral</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Neutral/Fear</td>
<td>1</td>
<td>1 (able at 2 mos., not able at 5 mos.)</td>
<td></td>
</tr>
<tr>
<td>Toothy Happy/Non-toothy Anger</td>
<td>1</td>
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<tr>
<td>Nontoothy Anger/Toothy Happy</td>
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<tr>
<td>Toothy Anger/Toothy Happy</td>
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<td>Non-toothy Happy/Toothy Happy</td>
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<tr>
<td>Fear/Angr</td>
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<tr>
<td>Anger/Fear</td>
<td>2</td>
<td></td>
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<tr>
<td>Fear/Sad</td>
<td>1</td>
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<tr>
<td>Sad/Fear</td>
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<tr>
<td>Fear/Surprise</td>
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<tr>
<td>Surprise/Fear</td>
<td>1</td>
<td>1 (similar trend, nonsignificant)</td>
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<tr>
<td>Fear/Neutral</td>
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<tr>
<td>Neutral/Fear</td>
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<td>Sad/Angr</td>
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<tr>
<td>Anger/Sad</td>
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<td></td>
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</tr>
<tr>
<td>Sad/Surprise</td>
<td>1 (able if presented before happy)</td>
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<tr>
<td>Surprise/Sad</td>
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<td>Surprise/Angr</td>
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<td>Neutral/Angr</td>
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<tr>
<td>Angr/Neutral</td>
<td>1</td>
<td></td>
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</tr>
</tbody>
</table>

*The number shown indicates how many studies have found that infants are able, somewhat able, or not able to discriminate a given pair of emotions. Emotions are listed in the order presented (e.g., Happy/Fear means that infants first habituated to happy, then were tested for discrimination with fear).*

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**Note:** The text and table contain details about infant discrimination of paired emotions, with a focus on the ability of infants to discriminate between different emotional expressions. The table outlines various pairs of emotions and the number of studies finding infants capable of discriminating between them.

---

**Table 1. Infant Discrimination of Paired Emotions**

<table>
<thead>
<tr>
<th>Emotions</th>
<th>Able to Discriminate</th>
<th>Somewhat Able</th>
<th>Not Able</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy/Fear</td>
<td>8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Fear/Happy</td>
<td>1</td>
<td>5</td>
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<td>3</td>
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<td>Neutral/Fear</td>
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<td>Non-toothy Happy/Toothy Happy</td>
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<tr>
<td>Fear/Angr</td>
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<tr>
<td>Sad/Angr</td>
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<td>Anger/Sad</td>
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<td>Sad/Surprise</td>
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<td>Surprise/Sad</td>
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In contrast, the results of other studies support the hypothesis that the deficit in emotion discrimination ability is general rather than specific. For example, the ability to process both emotional stimuli (e.g., expressions of happiness, sadness, fear, anger, surprise, or disgust) and geometric stimuli (e.g., shapes) was investigated [Davies et al., 1994]. These capacities were compared in a group of 20 children with autism or Asperger’s syndrome (10 high-ability and 10 low-ability), a verbal mental age-matched control group of nonautistic typically developing (10 high-ability) children, and a developmentally delayed (10 low-ability) group. Low-ability children in the autism group did not differ significantly in performance from the low-ability control children. However, the high-ability children with autism or Asperger’s syndrome performed significantly worse than the high-ability controls across all tests. These findings suggest that the ability to discriminate both emotions and shapes may improve in typically developing individuals but not in individuals with autism.

The difficulty that individuals with autism have in recognizing emotions may be partly due to their verbal limitations. Evidence for this hypothesis is that children with autism resemble the developmentally delayed group in terms of emotion-processing abilities when control groups are matched on language age, rather than on nonverbal mental age [Loveland et al., 1995; Haviland et al., 1996; Ozonoff et al., 1990; Prior et al., 1990]. However, if typically developing infants are able to discriminate emotions in the first year of life, as suggested by studies discussed in the previous section, then normal infants do not require verbal ability to discriminate emotions. This suggests that individuals with autism process emotions in a different way than typically developing individuals, and findings from brain imaging studies support this notion.

Another explanation for the group differences is that emotion discrimination may involve general information processing abilities, including those involved in face processing [Boucher and Lewis, 1992; Davies et al., 1994; Deruelle et al., 2004] and relational information [Davies et al., 1994; Shah and Frith, 1993]. Frith [1989] and Happe [1995] have suggested that children with autism fail to perceive emotions because of an inability to combine all the necessary information into a meaningful whole. Face perception is usually holistic or configural, not piece-meal [Pelphrey et al., 2002].

Some evidence supports the hypothesis that the problem with emotion discrimination extends more broadly to face processing, face recognition, and emotional responsiveness. A recent face-processing study by Deruelle et al. [2004] compared 11 children with autism or Asperger’s syndrome, aged 4 to 13 years, to two groups of typically developing children, matched on verbal mental age and chronological age. Five tasks involved recognizing black-and-white images of faces based on identity (across different emotional expressions or across different perspectives), emotion (expressions of disgust, surprise, or happiness), gaze direction (looking left, right, or straight forward), gender, and lip reading (saying “a,” “o,” or “i”). Compared with the two control groups, the autism group performed significantly worse on all tasks of face recognition except for identity matching.

In the study by Boucher and Lewis [1992] mentioned above, 10 adolescents with autism were less able to recognize recently seen faces, than was true for 10 learning-disabled children matched for age and nonverbal ability and with a group of 10 typically developing children. To ensure a minimal amount of attention to the stimuli, participants were instructed to look carefully at each face and try to remember it, were prompted if they looked away, and were asked to say whether the photograph showed a male or female face.

Research on the visual scanning of faces in autism by Pelphrey et al., [2002] found that participants with autism (5 high-functioning adult males) were qualitatively different in their scanning patterns from control participants (5 normal adult males). In the first study, participants were shown photos from the Eckman and Friesen [1976] face set with one male and one female face for each of the six basic emotions. Compared to control participants, participants with autism spent significantly more time looking at areas of the face without features and significantly less time looking at salient feature areas of the faces, including eyes, nose, and mouth. In a second study, participants were shown images of 24 additional facial expressions and instructed to identify the emotions shown. The autism group performed significantly worse than the control group, but mainly due to poorer performance in identifying portrayals of fear. In both studies, the scanning patterns of the autism group were erratic and disorganized, frequently reflecting attention to only one or two relatively unimportant facial features, such as a cheek, ear, or chin. In contrast, control participants’ scanning patterns seemed strategic and controlled, generally tracing a triangle connecting the eyes, nose, and mouth. Deficits exhibited by individuals with autism in interpreting and responding to facial expressions of emotion may reflect their erratic and disorganized scanning patterns.

In terms of emotional responsiveness, a study by Corona et al. [1998] examined the attention, behavioral reactions, facial affect, and cardiac responses of 22 3- to 5-year-old children with autism in comparison with 22 children with mental retardation matched on mental age in a scenario during which the experimenter pretended to hurt herself and then displayed either strong distress or neutral affect. Both groups looked more at the experimenter’s face and displayed more negative affect and concern in the distress situation than in the neutral situation. However, the children with autism looked much less to the experimenter’s face showing both distress and a neutral emotion than did the children with mental retardation. Moreover, while children with mental retardation showed an orienting response, a decrease in heart rate during the distress condition, the heart rate of children with autism did not change in either condition. Orienting reactions are a measure of interest, so it seems that the mentally retarded children found the distressed adults to be interesting, which was not true for the children with autism. Neither group displayed an arousal reaction as manifested in a heart rate increase, so the group differences in overall attention to faces cannot be attributed to differential arousal reactions of the children with autism.

In summary, the research literature on the typical development of the capacity to differentiate emotions portrays a slowly emerging ability to differentiate between simple facial emotions over the 4- to 15-month age period. There is no comparable literature on the early development of children with autism. The rich literature on emotional discrimination, face processing, face recognition, scanning of faces, and emotional responsiveness carried out almost entirely on older, high-functioning individuals demonstrates that face and emotion discrimination are critical issues to understand in the early lives of children with autism.
SECURITY OF ATTACHMENT

Development of Attachment in Typically Developing Infants

The development of an attachment bond between an infant and the caregiver is one of major tasks of infancy. Aside from rare cases in which there is no stable person with whom the infant can interact, such as those presented by certain institutional rearing conditions, all infants will form an affective tie with a caregiver and will strive to use that caregiver as a source of comfort and reassurance in the face of threats and challenges from the environment [Weinfield et al., 1999]. The study of attachment thus focuses on the quality, rather than presence, of this attachment relationship. Through a history of bids and responses within the caregiver–infant dyad in the first year of life, infants evolve expectations of their caregiver’s likely responsiveness to their signals of distress or need for comfort and contact [Bowlby, 1973; Weinfield et al., 1999]. Individual differences in the quality of attachment are thus best observed in situations that reveal the organization of the infant’s responses in light of these perceptions of availability, particularly in the ability to use the attachment figure as a “secure base” when exploring the environment; and as a “haven of safety” in times of alarm [Bowlby, 1969; Ainsworth et al., 1978].

Ainsworth designed the Strange Situation (SS) procedure to capture this balance of attachment and exploratory behavior under conditions of increasing mild/moderate stress among 12- to 18-month-old infants. The infant is introduced to an unfamiliar laboratory context and an unfamiliar adult and undergoes two brief separations from the mother. Attachment classifications are based on the infant’s behavior toward the attachment figure during the two reunion episodes, placed in the context of the infant’s behavior throughout the session. Infants classified as secure are able to use the caregiver as a secure base from which to explore the novel room and toys. Upon separation, the infant’s play becomes impoverished and the infant may become distressed. Upon reunion, the infant will seek proximity or contact with the caregiver, will be comforted by this proximity and contact, and will eventually return to play. Hence, security in the attachment relationship indicates the infant is able to rely on the caregiver as a source of comfort and protection, and this perception of availability promotes the infant’s exploration of the environment [Weinfield et al., 1999]. Approximately 65% of infants in normative samples fall into this attachment classification.

In Ainsworth’s original classification system, two types of insecure attachment were identified [Ainsworth et al., 1969]. Infants classified as insecure avoidant (A) are unlikely to become distressed during the separation and, upon reunion, may show signs of ignoring, looking at or turning away, or moving past the caregiver. If picked up, the infants will do little to maintain the contact. This pattern characterizes one in five infants in normative samples. Infants classified as insecure resistant (C) appear unable to use their caregiver as a secure base to explore the environment—their play may be limited, and they may seek proximity and contact with the caregiver even before a separation is initiated. Insecure resistant infants are likely to become quite distressed during the separation and, upon reunion, may appear to want proximity or contact with the caregiver but are not comforted by it. In normative samples, approximately one in seven infants show this pattern. Infants with insecure attachments thus appear unable to direct attachment behaviors toward their caregivers in times of alarm, and their ability to explore their environment is compromised as well. Indeed, insecure attachments have been linked to histories of unresponsiveness or erratic responsiveness on the part of the caregiver in situations when the environment proved threatening to the infant [Ainsworth et al., 1978; Weinfield et al., 1999].

The attachments of about 15% of children in normative samples, and much higher percentages in high-risk samples, are difficult to classify using Ainsworth’s original A/B/C classification system. Main and Solomon [1986, 1990] devised an additional classification to capture a diverse set of behaviors displayed by some infants in the SS that appear to reflect the absence of a coherent attachment strategy in the face of distress. Infants classified as disorganized/disoriented (D) may display a diverse array of fearful, odd, disorganized, or overtly conflicted behaviors during the SS, including behavioral stilling, conflicting behavioral movements, stereotypes, or direct apprehension and fear regarding the parent.

A large body of work has validated these attachment classifications as representing developmentally meaningful variations. Attachment classifications in the Strange Situation have been linked to maternal behavior in the infants’ first year of life, particularly the extent to which the mother is judged to be responsive and available to her infant’s signals of distress [Ainsworth et al., 1978]. Research in this field also underscores the developmental significance of individual differences in early attachment relationships for subsequent functioning and adaptation—including dependency, self-reliance, and efficacy, empathy, and interpersonal competence [Sroufe and Fleeson, 1986, 1988; for a review, see Thompson, 1999]—well beyond childhood and into adult life.

Attachment Security in Children with Autism

Given that autism is characterized by pervasive deficits in communication, interpersonal relatedness, and emotional responsiveness, it is perhaps not surprising that early clinical accounts and diagnostic systems characterized this disorder by a failure to develop attachment relationships. Nonetheless, research conducted over the past two decades indicates that, contrary to these early postulations, children with autism form attachments to their primary caregivers, and a sizable proportion of these attachments are in fact marked by underlying security.

In the first systematic investigation of attachment behaviors in autism, Sigman and Ungerer [1984] observed 4- to 6-year-old children (mean mental age 24 months) during a free play situation that included one separation and subsequent reunion from the mother. Children with autism directed more social behaviors and physical contact to their caregiver than to a stranger during the reunion episode, thus demonstrating a capacity for discriminative attachment responses. A number of subsequent studies confirmed that 2- to 5-year-old children with autism direct social behaviors such as looks, touches, and vocalizations preferentially toward the caregiver, especially following separation, react to the caregiver’s departure, and increase their proximity seeking toward the caregiver upon reunion [Shapiro et al., 1987; Sigman and Mundy, 1989; Rogers et al., 1991, 1993; Dissanayake and Crossley, 1996, 1997]. Dissanayake and Crossley [1996] elegantly demonstrated that children with autism indeed rely on their caregiver as a secure base for exploring their environment and a haven of safety in times of alarm. The investigators recorded children’s social and proximity behaviors continuously throughout the session and found that children with autism readily played with the toys in the room in the mother’s presence, but upon the stranger’s entrance reduced social and
exploratory behaviors and retreated to their mother, often engaging in physical contact with her. Moreover, while all behaviors were directed preferentially to the mother, the proximity-maintaining behaviors were almost exclusively directed to the mother.

In addition to documenting the presence and patterning of attachment behaviors in children with autism, a number of studies have also examined individual differences in the quality of the attachment relationship in this population. Rogers and colleagues [1991, 1993] used a continuous rating of security based on Ainsworth's original interactive subscales and found no differences between children with autism and a control group of children with developmental and psychiatric disorders on either those subscales or an a five-point global rating of attachment security. Moreover, in one of the first studies to employ Ainsworth's original A/B/C attachment classification, Shapiro et al. [1987] reported that 53% of children with autism were classified as securely attached, while 33% were scored as avoidant and 13% showed resistant attachment patterns. Importantly, no group differences were found in proportions of securely and insecurely attached children among children with autism, children with developmental language disorder, and mentally retarded children.

To date, two studies have included the disorganized/disoriented attachment classification in evaluating autistic children's behavior in the Strange Situation [Capps et al., 1994; Willemsen-Swinkles et al., 2000]. Of the 15 (of 19) children in the Capps et al. study whose attachment security could be classified, all were assigned a primary classification of disorganized/disoriented. However, when children were assigned secondary classifications, 6 (40%) were secondarily subclassified as securely attached, while 9 received insecure subclassifications. Importantly, the 6 securely attached children showed no signs of disorganization apart from repetitive hand and eye movements and odd facial movements typically associated with autism, and these secure attachments were associated with higher concurrent ratings of maternal sensitivity.

In an effort to further differentiate attachment disorganization from autistic stereotypes, Willemsen-Swinkles and colleagues [2000] examined the behavior of children with a diagnosis of pervasive developmental disorder, developmental language disorder, and typically developing children in the Strange Situation while measuring the children's heart rate. Children were classified in two rounds: first, they were assigned one of Ainsworth's original classifications (A/B/C), and, in a second pass, they were classified as disorganized or not, although stereotype behavior was excluded from consideration for the D category. In line with previous findings, there were no group differences in proportions of insecurely attached children, and over 60% of children in the PDD group were classified as securely attached. Importantly, within the group of children with a PDD diagnosis, significant differences were found in the effect of separation and reunion on heart rate between those children who were classified as disorganized compared to children who did not receive a D classification. The heart rate findings hence indicated that, when autistic stereotypes are excluded from the analyses, the disorganized attachment classification can be validly assigned in this population.

Research on attachment in autism this demonstrates that, despite their well-documented deficits in intersubjectivity, children with autism form attachments to their primary caregivers, and individual differences in the quality of these attachments can be illuminated using a methodology that has been developed and widely studied in typically developing infants. However, because a diagnosis of autism is not usually conferred before the age of two, children in the above-referenced studies were necessarily older than the 12- to 18-month-old infants for whom the Strange Situation was designed. This raises the issue of the appropriateness of this methodology for indexing attachment security in 2- to 6-year-old children with autism. One argument put forth in favor of using the Strange Situation is that the majority of children with autism are also mentally retarded. Because the average mental age of most of the children in the attachment studies reviewed hovered around 2 to 2½ years, these children were significantly delayed relative to their chronological agematched peers. Moreover, evidence from the Capps study linking attachment security to maternal sensitivity validates the use of Ainsworth's attachment classifications in this population. Finally, current preschool attachment classification systems typically modify coding criteria to include verbal interactions [Solomon and George, 1999], so it is unclear whether these approaches would be appropriate for children with autism, who by definition experience significant language delays.

Our ability to demonstrate that 3-to 6-year-old children with autism exhibit attachments that do not differ from typically developing infants does not allow us to conclude that these attachments develop in a normal fashion. The limited state of knowledge regarding the development of autism in the first year of life means that we do not have any information about the formation of attachment relationships in autistic infants, such as early patterns of reciprocity, synchronization, and modulation within the infant–mother dyad [Disnayake and Sigman, 2001]. At least one recent study of older children with autism indicates that caregivers of children with autism do not differ from caregivers of developmentally delayed and typically developing children in the extent to which they synchronize their behaviors to their child's focus of attention [Silzer and Sigman, 2002]. Hence, despite the fact that the autistic children in this study exhibited characteristic impairments in preverbal communication skills, particularly joint attention, relative to the language-matched controls, caregivers successfully adapted their interactive behavior to their children's developmental level. It may well be the case that, despite early-appearing deficits in social orienting in autistic infants [Osterling and Dawson, 1994; Baranek, 1999; Osterling et al., 2002; Dawson et al., 2004; Werner et al., 2000], caregivers are able to accept, accommodate, and be sensitive to their infants' signals and thus to provide experiences consistent with attachment security [Beckwith et al., 2002].

It is difficult to presume, however, that the attachments of children with autism continue to develop in a normal fashion. Given that children with autism experience most difficulty with behaviors that require taking into account other people's intentions, motivations, and feelings, it is likely that, for most children with autism, attachments do not progress into the final stage of developing internal working models of relationships [Rogers et al., 1991; Capps et al., 1994; Yirmiya and Sigman, 2001]. Attachment security in autism has been linked to children's cognitive abilities [Rogers et al., 1991, 1993; Capps et al., 1994; Willemsen-Swinkles et al., 2000] and social-interactive abilities [Capps et al., 1994; Willemsen-Swinkles et al., 2000], suggesting that yet unspecified levels of cognitive and social skill on the part of the child may be prerequisite for the development of secure mother–infant attachment [Beckwith et al., 2002]. It has been argued that children with autism may display attach-
ment at a basic psychobiological level, but these attachments may not progress into the psychological realm [Sigman and Siegel, 1992; Capps et al., 1994; Dis-

sanayake and Sigman, 2001]. It may be at the stage of developing an internal working model of the caregiver that the at-
tachments of children with autism di-
verge from the course of typically developing children [Dis-

sanayake and Sigman, 2001].

**DISCUSSION**

In this article, we have reviewed some of what is known about the social/emotional development that typically oc-
curs in the first year of life. Infants begin life with a preference for social stimuli, and this soon develops into a preference for familiar people. Between 3 and 6 months of life, typically developing in-
fants are involved in intense dyadic inter-
actions with their caregivers that result in their becoming familiar with the interac-
tive styles of their usual social partners. By 4 to 6 months of age, any violation of their expectations of social interactions leads to a change in the infants’ attention and affective responses. At 4 to 7 months of age, infants begin to demonstrate the capacity to distinguish between emo-
tional expressions of static displays of the face, although the means that they use to make these distinctions is not clear. By 8 to 10 months, typical infants show pref-

erences for their familiar caregivers, and strangers are often greeted with trepida-
tion and, by 12 months, infants display a pattern of response to separation and re-
union that demonstrates what they have learned to expect from their experiences with their caregivers.

We have virtually no information as to whether children with autism de-
velop through the same stages in the first year of life. Studies of infants at risk of autism may allow us to determine how early social/emotional development is perturbed in children who eventually are diagnosed with the disorder. Stemming from the information we have reviewed about older children with autism, we might expect variations in developmental trajectories over the course of the first year. If it is true that infants with autism have deficits in social orientation, then one would predict that, in contrast to typically developing infants, their dyadic interactions would be less intense and, possibly, less patterned as a consequence of their lower social involvement. Simi-
larly, less social orientation and involve-
ment would likely lead to less capacity to distinguish between the emotional ex-
pressions of others.

Based on this scenario, one would hypothesize that attachment to caregivers would occur more slowly, although, as outlined above, it is possible that caregivers might find ways to circumvent the social deficits of their young children with autism. We know that, by 3 to 5 years of age, children with autism are capable of forming secure attachments to their caregivers. This information raises the question of whether these secure at-
tachments are based on a similarly estab-
lished history of sensitively coordinated expression between the infant and the caregiver or whether children with au-
tism develop attachments to their care-
givers through a parallel but distinct de-
velopmental trajectory. Alternatively, perhaps the social orientation deficits of children with autism are not so profound as to impede dyadic interactions with fa-
miliar caregivers, so that secure attach-
ments are able to develop as a conse-
quence of coordinated exchanges between infant and mother.

Returning to the discussion of “core deficits” with which we opened this article, it might be informative to examine the question as to whether chil-
dren with autism are likely to have core deficits in early patterns of dyadic interac-
tion, capacity to distinguish facial ex-
pressions, and attachment security. The clearest answer that we can furnish is that attachment security is very unlikely to be a core deficit in autism, as the patterns of security and insecurity are found in the same proportions in samples of children with autism as in samples of typically developing children. The identification of disorganized or insecure attachment in a 1-year-old is unlikely to be a discrimi-
inating predictor of later autism because the rates of insecurity and disorganization are high in nonautistic samples.

Identification of disordered dyadic interactions in 4- to 6-month-olds might possibly be more discriminating. There is some evidence that children whose de-
velopment is at risk because of maternal depression show disordered dyadic inter-
action in early infancy, although the pat-
tern of disorder is different from what might be expected for infants at risk of autism. If social orientation is a problem in autism, then infants with autism would likely show less attention and emotion to their mothers during social interactions and less disturbance in their interactions when their mothers ceased activity and responsiveness. The extent to which this pattern of response might be unique to autism is impossible to know without studies of other clinical or risk groups. Additional research would also be neces-sary to determine the specificity and uni-
versality of disorders of dyadic interac-
tions in autism groups.

Although early failure to show dis-

crimination of emotions might character-
ize autism in infancy, the uniqueness, specificity, and universality of this deficit would have to be established. However, there is a practical problem with the pro-
cedures now used. Because the subject loss rate is quite high and because failure to discriminate emotions may be attrib-
utable to preferences for particular stim-
uli or disinterest in facial portrayal of emotion, the rate of false positives might be very high if this measure was used to predict autism even if difficulties in dif-
ferentiating between emotions was a core deficit in infants with autism.

The identification of core deficits is likely not to be the sole goal of longi-
tudinal studies of infant siblings of chil-
dren with autism. As mentioned above, the other very important goal is to iden-
tify the pathways that some infants at risk of autism and infants with autism take to reach developmental achievements. It is likely that children with autism acquire the capacity to differentiate emotions in others making use of different skills than is true for typically developing children. Similarly, children with autism may de-
velop attachments and, even secure at-
tachments, through different routes than typically developing securely attached children. Studies of siblings of children with autism are likely to provide information about the early life of children with autism that we are completely lack-
ing at the current stage of our knowl-
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