

Attentional Skills During the First 6 Months of Age in Autism Spectrum Disorder

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ABSTRACT

Objective: To study the quality of early attention in autism spectrum disorder (ASD) through home movies. **Method:** Fifteen home movies from the first 6 months of life of children who later received a diagnosis of ASD were compared with home movies of 15 normal children. The diagnosis was performed after the third year of life of children by two senior child and adolescent psychiatrists using a checklist of symptoms according to the *DSM-IV*. The films of the two groups were mixed and rated by blind observers through a Grid for the Assessment of Attentional Skills in Infants, composed of 13 items grouped into three developmental areas. **Results:** Using multivariate analysis of variance, the authors found significant differences between the two groups for the items in the social attention and the social behavior areas; on the contrary, there were no differences in nonsocial attention. **Conclusions:** The authors pose some hypotheses about a specific early-appearing impairment of attention in ASD in which children shift their spontaneous attention mainly toward nonsocial stimuli rather than toward social stimuli. The importance of this finding for early diagnosis and treatment is underlined. *J. Am. Acad. Child Adolesc. Psychiatry*, 2002, 41(10):1239–1245. **Key Words:** autism, attention, social behaviors, intersubjectivity.

*I was obsessed with certain things and played in my own way.
I make things with Garbage or Junk and Play with them...
I liked things over people and didn't care about people at all.*
—Volkmar and Cohen, 1985, p. 47,
case study of Tony W.

In his original description, Kanner (1943) realized that autism is already evident in infancy with an inability to develop social relationship with people. Nevertheless, formulating a diagnosis before 2 years of life is still extremely awkward even if early diagnosis projects are accomplishing a great deal in this direction (Baron-Cohen et al., 1996; Charman, 1998; Osterling and Dawson, 1994).

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The matter of how early in development the social deficit can be identified is still open, and we need, for both practical and theoretical reasons, to pinpoint the early forms of social difficulty in autism spectrum disorder (ASD).

For many authors, the first sign of social deficit is joint and shared attention. The absence of joint attention and of other typical developmental milestones such as protodeclarative pointing, showing objects, and pretend play has been specifically indicated as a clinical marker of ASD in childhood (Baron-Cohen et al., 1996; Dawson et al., 1990; Lord, 1995; Sigman et al., 1986; Stone et al., 1990), but the predictive validity of these behaviors seems to be questionable before about 18 months of life. The necessity of developing and validating appropriate screening tools with adequate sensitivity and specificity for autism in children before the age of 1 year is the main clinical problem currently confronting the scientific community (Filipek et al., 1999; Senior, 2000). In fact, the early identification of ASD could enhance opportunities for appropriate early intervention, modify prognosis, and, finally, improve the quality of life of these children and their families.

Recent research, based on home-movie analysis, pointed out that diagnosis at 8 to 12 months is feasible (Baranek, 1999; Maestro et al., 2001) and that consideration of

behaviors not previously thought to be diagnostic, such as motor behaviors or basic social skills, may enhance autism identification (Teitelbaum et al., 1998). Retrospective video analysis can be considered a valid and ecological tool for the identification of early ASD signs (Adrien et al., 1991, 1993; Baranek, 1999; Grimes and Walker, 1994; Losche, 1990; Maestro et al., 1999; Massie, 1977; Osterling and Dawson, 1994). Home movies, recorded by parents before the child's problems are diagnosed, provide a good approach in this field even if methodological issues need to be considered. In fact, spontaneous recording by parents may preselect pleasant situations and avoid videotaping children during adverse conditions. This process may obscure certain abnormal behaviors or symptoms. Second, the researchers can explore only those developmental behaviors shown by the movie, in the absence of information about other dimensions of a child's early development (Maestro et al., 2001). However, the originality of this approach is the opportunity to obtain data and information that are not influenced by time or parent's recall. In fact, subtle signs occurring during the first year of life can be forgotten, overlooked, or denied by the parents, because of difficulty in recall, anxiety, or lack of knowledge of normal child development. Given such factors, we may refer, at present, more correctly to age of recognition rather than onset of the ASD; home movies are the only instrument to study the actual course of onset.

Retrospective analysis by means of home movies showed evidence not only of early occurrence of ASD symptoms but also of difficulties in the development of normal competencies. The first studies to use retrospective video analysis have suggested that young children with autism can be distinguished from normal children with respect to interaction and attachment (Rosenthal et al., 1980), sensory-motor intelligence (Losche, 1990), orientation to stimuli, and looking at other persons (Osterling and Dawson, 1994). Recent studies have shifted their focus to the first year of life. Adrien et al. (1993) found behavioral abnormalities between birth and the first year of age, such as poor social attention, lack of social smiling and appropriate facial expression, hypotonia, and unstable attention. Baranek (1999) suggested the importance of evaluating sensory-motor functions in addition to social skills; in her research, infants with autism, before 1 year of age, were found to have poor visual attention, to require more prompts to respond to name, to take objects excessively to the mouth, and to show aversion to social touch. Osterling and Dawson (2000) pointed

out that the lack of normal babbling and of response to name can be observed in 8- to 10-month-old infants who later received a diagnosis of autism.

The research on early detection of ASD has moved from the search for early pathological signs (such as stereotypies) to the individualization of the absence of typically developing behaviors, such as pointing, joint attention, responding to name, or verbal language. The next step needed is to study how competencies, behaviors, and their underlying cortical functions will develop differently in normal and autistic infants. We have considered attention as one of the basic functions for social development and the basis for the development of joint attention, the lack of which to date is considered one of the earlier signs of autism at the end of the first year of life. The present study, based on the hypothesis that autism might be detected in the first year of life, tries to show significant quantitative and qualitative differences between normal and ASD children at this age. We predicted that infants with autism, in the first 6 months of life, exhibit a specific deficit of attention to social stimuli and that the distribution of spontaneous attention between social and nonsocial stimuli would be different compared with normal children, where infants with autism would attend more to nonsocial than to social stimuli.

METHOD

Materials

We studied home movies from the first 6 months of life of two groups of children. The first (experimental group) was composed of 15 children, 10 male and 5 female, who later received a diagnosis of autistic disorder ($n = 7$) or pervasive developmental disorder-not otherwise specified (PDD-NOS) ($n = 8$). The diagnosis was made at the mean age of 4.1 years (range: 3.5–5.6 years). After a multidimensional 5-day assessment inpatient period encompassing direct individual observations, psychological testing, group observation, and biological examinations, the diagnosis was performed independently by two senior child and adolescent psychiatrists through a checklist of symptoms composed of the 12 criteria for autism derived from the three impaired developmental areas according to *DSM-IV* (American Psychiatric Association, 1994). The overall reliability for each item of the checklist was consistently high, with a Cohen κ value ranging between 0.8 and 1; all of the children satisfied the criteria for ASD diagnosis in accordance with *DSM-IV* criteria and the consensus of the two child and adolescent psychiatrists. We used the category PDD-NOS for cases in which the criteria were met in insufficient number, other than merely on the degree or severity of abnormality. In addition, the Childhood Autism Rating Scale (CARS) was administered. On this measure (Schopler et al., 1988), all 15 children received scores above the cutoff of 30 (mean: 36.6; range: 30–48). The protracted assessment period allowed us to keep out expressive, receptive, or mixed language disorders and also mental retardation. The IQ was

evaluated by means of Griffiths, Leiter, or Wechsler scale: six children were cognitively delayed ($IQ < 70$), and seven had borderline cognitive abilities ($70 < IQ < 80$); for two subjects, information was not available. Only one child of the six cognitively delayed children was affected by a moderate intellectual impairment (mental age between 12 and 18 months). We excluded any type of PDD associated with medical disorder or second syndrome previously described and already well established in the medical literature (termed *double syndromes* by Gillberg and Coleman, 2000). Using a semistructured interview derived from the ERC-A-III (Lelord et al., 1987), parents were asked about their child's developmental history and the appearance of autistic symptoms: for all children, they reported some symptoms in the first 18 months of life; for five children the appearance of autistic symptoms happened between 12 and 18 months of age.

We compared the movies of this experimental group with the movies of a second group (control group) composed of 15 normal children, 9 male and 6 female, who were attending a kindergarten (mean age: 4.7 years). Based on the same retrospective parental interview, and on the teacher's description, the intellectual and language development of each child in the control group was normal. The control group was matched with the experimental group for sex and months of age in home videos. We did not include the cognitive level as a variable for matching the two groups because of the low reliability of this parameter when inferred from the naturalistic observation of the home videos.

The whole sample was composed of Italian children belonging mostly to middle/upper-middle-class families, according to the Hollingshead and Redlich (1958) criteria. For both groups, we included only videos without any editing by the parents, without any selection by the researchers, and running for a minimum of 10 minutes (range: 10–62 minutes; mean: 21 minutes 25 seconds). The total number of home videos was 30, all from the first 6 months of life (owing to the brief period of life, we considered only the first 6 months; each subject has one movie). After a complete description of the study to the families, written informed consent was obtained.

Procedure and Measures

To analyze the videos, we chose recordings from the first 6 months of life. The tapes were reviewed in detail and logged according to the child's chronological age during each scenario and according to specific content. Chronological ages were calculated by full months, based on the child's birth date and corresponding dates appearing on the tapes themselves.

The various scenes of the first 6 months of life were analyzed and divided, by labeling every scene in which the infant was visible and involved in human and object interaction. We coded only the scenes that lasted more than 40 seconds. All available footage was coded to prevent selection bias. Scenes included three type of events: (1) familiar routines (feeding, bathing, and toileting); (2) special events (sibling's birthdays, infant's baptism, Christmas, Easter, and other holidays); and (3) play situations (with objects or people). No significant differences were found in the two groups with respect to the type of events (familiar routines: $t_{28} = -0.530, p > .05$; special events: $t_{28} = -0.088, p > .05$; play situations: $t_{28} = 1.142, p > .05$) and to the length of the analyzed video recordings ($t_{28} = 0.331, p > .05$).

We used an interval scoring method and computed the frequencies for each item. Because the length of each video was different, we calculated the frequencies of each behavior for 1 minute (unit-time). Then these frequencies were converted to ratio number of behaviors per time. Proportion scores have been similarly used in other video studies (Baranek, 1999; Grimes and Walker, 1994; Osterling and Dawson, 1994).

The films of the two groups were mixed and rated by blind observers through the Grid for the Assessment of Attention in Infants Through Home Videos (Table 1), composed of items referring to behaviors of everyday life situations that can be taped by films. It is an adaptation of the Grid for the Study of Normal Behaviors in Infants and Toddlers (Maestro et al., 2001) to the range of age 0–6 months. We chose behaviors that seem to be more representative of the growing infant's competencies, and we grouped the first 12 items into three developmental areas: social attention (items 1, 3, 7, and 10); nonsocial attention (items 2, 4, 8, and 11); and social behavior (items 5, 6, 9, and 12). The first version of the grid was revised after a study on a preliminary small group of normal and pathological children. The grid was specifically designed for this study, and it has no validation beyond test-retest. Nevertheless, it seems to have a high degree of face validity both for single items and for the three areas. The results of our research are a preliminary report about its use; in particular, we cannot be sure of the validity of each area subscores, due to the lack of a cluster analysis in a large number of children.

Interrater Reliability

Each rater had a master's degree in clinical or developmental psychology. They were trained by an experienced clinician (S.M.) and a research consultant (D.S.), using video samples of children not being used in the study. The aims of the training were (1) to familiarize with

TABLE 1
Grid for the Assessment of Attention in Infants Through Home Videos

1. Looking at people	The child looks at the mother or other persons
2. Looking at objects	The child looks at objects, camera, or other things
3. Orienting toward people	The child has a spontaneous gaze direction to persons or human voice
4. Orienting toward objects	The child has a spontaneous gaze direction to objects or nonhuman sounds
5. Postural attunement	The child shows a tonic aptness to other person's body
6. Seeking contact	The child has spontaneous movements to reach contact with a person
7. Smiling at people	The child smiles at someone
8. Smiling at object	The child smiles at objects
9. Attuning behaviors	The child has movements or facial expression attuned to other's behaviors
10. Vocalizing to people	The child produces vocalizations, sounds, or babbling toward another person
11. Vocalizing to objects	The child produces vocalizations, sounds, or babbling toward objects
12. Anticipating the other's aim	The child shows anticipatory gestures in response to adult actions; the child waits a specific action of another person
13. Explorative activity with an object	The child explores an object with mouth or hands

the grid glossary, (2) to achieve ability on detecting early developmental competencies, and (3) to improve ability in focusing on infant's molecular behaviors from very naturalistic and sometimes overload situations. Because of the small number of items and the method of scoring (frequencies), the training was 3 months long and continued until interrater agreement reached 80%. Interrater reliability (Pearson) was also used for calculating agreement for each behavior scored in the video of children used in this study. The Pearson coefficients were as follows: (a) for the ASD group: looking at people (0.89), looking at objects (0.99), orienting toward people (0.93), orienting toward objects (0.93), postural attunement (1.0), seeking contact (0.92), smiling at people (0.99), smiling at object (0.97), attuning behaviors (not available for the presence of 0), vocalizing to people (0.90), vocalizing to objects (0.94), anticipating the other's aim (0.99), and explorative activity with an object (0.97); (b) for the control group: looking at people (0.99), looking at objects (0.96), orienting toward people (0.85), orienting toward objects (0.97), postural attunement (0.96), seeking contact (0.97), smiling at people (0.96), smiling at object (0.99), attuning behaviors (0.95), vocalizing to people (0.99), vocalizing to objects (0.96), anticipating the other's aim (1.0), and explorative activity with an object (0.96).

Data Analysis

We conducted a multivariate analysis of variance (MANOVA) by using the two groups (control versus experimental) as independent variables and item proportion scores as dependent variables. A MANOVA was also conducted to explore potential differences for the three developmental areas, using group (control versus experimental) as between factor and area (social attention, nonsocial attention, and social behavior) as within-subjects factor. A *t* test was used to explore the group \times area interaction.

RESULTS

MANOVA (Table 2) revealed significant group differences in all items regarding the area of social attention: look-

ing at people ($p < .001$), orienting toward people ($p < .01$), smiling at people ($p < .01$), and vocalizing to people ($p < .001$). Other items characterized the group that later developed ASD: seeking contact ($p < .01$), anticipating the other's aim ($p < .05$), attuning behaviors ($p < .05$), and explorative activity with an object ($p < .05$). Items referring to interest and attention versus nonsocial stimuli (items 2, 4, 8, and 11) had the same score in normal and ASD children. Postural attunement did not differ in the two groups.

For the three areas, MANOVA results showed a significant group \times area interaction ($F_{2,28} = 25,061; p < .001$). Analyses with *t* tests show that the interaction consisted of better performance of the normal group for social attention ($t_{28} = 4,05; p < .05$) and social behaviors ($t_{28} = 2,6; p < .05$), whereas no significant differences was present for nonsocial attention ($t_{28} = 1,1; p > .05$, not significant).

DISCUSSION

This study suggests that developmental differences between ASD and normal children are present during the first 6 months of age. What remains unclear and needs future studies is the specificity of these developmental differences compared with those of infants later who later received a diagnosis of mental retardation.

The significant differences in items regarding interest in other persons confirm that children with ASD reveal a preference for nonsocial stimuli. Attention toward objects does not distinguish autistic from normal infants: object

TABLE 2
Means, Standard Deviations, and Significant Differences in Specific Items

Items	ASD Group		Normal Group		F	p
	Mean	SD	Mean	SD		
1. Looking at people	0.175	0.159	0.936	0.558	25,724	.000***
2. Looking at objects	0.233	0.241	0.263	0.211	0,135	.716
3. Orienting toward people	0.050	0.069	0.333	0.370	8,495	.007**
4. Orienting toward objects	0.045	0.069	0.089	0.088	2,217	.148
5. Postural attunement	0.026	0.090	0.053	0.067	0,824	.372
6. Seeking contact	0.021	0.035	0.092	0.088	8,319	.007**
7. Smiling at people	0.101	0.109	0.402	0.362	9,453	.005**
8. Smiling at object	0.036	0.054	0.023	0.044	0,543	.467
9. Attuning behaviors	0.004	0.01	0.048	0.07	5,587	.025*
10. Vocalizing to people	0.047	0.06	0.872	0.71	19,963	.000***
11. Vocalizing to objects	0.055	0.08	0.125	0.189	1,728	.199
12. Anticipating the other's aim	0.000	0	0.056	0.074	7,104	.013*
13. Explorative activity with an object	0.016	0.032	0.158	0.290	6,748	.015*

Note: Frequencies of each item are converted to ratio number of behaviors per time. ASD = autism spectrum disorder. *p* Value according to multivariate analysis of variance ($df = 1$): * $p < .05$; ** $p < .01$; *** $p < .001$.

exploration, involving a few activity patterns, such as mouthing, waving, and banging, tended to be the same in both groups. This result probably means that attention is not implicated as a primary function but as an elective function only toward social stimuli. In short, infants with autism exhibited a specific qualitative pattern of attention, highly consistent with theories predicting that ASD children have a specific deficit in attending social stimuli. A confirmation of the idea of an early disconnection in attention directed to objects and to humans has been recently proposed by Schultz et al. (2000). Using functional magnetic resonance imaging to study face and object perception, they found that during face (but not object) discrimination, the autism group had significantly different activation from controls in some cerebral areas and conclude that individuals with ASD have a pattern of brain activity during face discrimination that is consistent with the pattern more typical for object perception.

A number of experimental clinical studies have focused on attention abnormalities in ASD (Courchesne et al., 1994; Plaisted et al., 1998). In particular, Swettenham et al. (1998), in an elegant study of ten 20-month-old autistic children, found that shifting attention between two objects was more frequent in the autistic than in the control children, whereas infants with autism showed less shifting attention between an object and a person, or between a person and another person. Thus they demonstrated that infants with autism spontaneously orient less to social stimuli at 20 months of life. Our findings seem to indicate that this trend is present also in the first 6 months of life.

Our findings are also congruent with the data derived from the research on home movies conducted by Osterling and Dawson (1994, 1999), raising the possibility that children with ASD have a more specific problem orienting to people. These authors (Osterling and Dawson, 2000) recently confirmed that 8-month-old infants with early-onset ASD were much less likely to orient when their name was called than normally developing infants. Our study confirms that children with ASD have attentional problems in their ability to orientate toward human voices and enables us to form the hypothesis that it is a part of a basic dysfunction regarding human stimuli. Indeed, our data may suggest that children with autism, instead of a more general problem with responsiveness to all types of sensory stimuli, have a specific deficit in social attention. In contrast to findings by Baranek (1999), we also suggest that this social deficit appears from the beginning and that it does not depend on maturation to become apparent.

Further investigation is needed to clarify whether the finding of a deficit in attentional skills may serve as a precursor to difficulties in other more socially directed behaviors, such as joint attention, that involve a triadic coordination of attention between the infant, another person, and an object (Bakeman and Adamson, 1984), and that are known to be problematic in children with autism after 12 months of age (Baron-Cohen et al., 1996; Lord, 1995; Sigman et al., 1986). The early selective difficulty in attention toward people could impair attention monitoring and the coordination of attention and affect that is necessary for joint attention. We suggest that the early dissociation between social and nonsocial attention could be a primary manifestation of the initial pathological processes in ASD (Mundy and Crowson, 1997). Mundy and Crowson proposed a cybernetic model in which an initial pathological process feeds back upon itself to give rise to additional and perhaps pernicious components of the neurodevelopmental disturbance associated with ASD. Mundy and Crowson also suggested that a primary manifestation of initial pathological processes is an attenuation of the typical capacity of the child to attend to and process social information and that this attenuation can deprive the developing child with autism of the amount of social information that is needed for normal shaping of neural connections involved in the early neurodevelopmental processes.

Furthermore, four other observations emerge from this research. First, "postural attunement," frequently referred to as one of the first expressions of impairment in reciprocal social interaction, was not found as a significant indicator of autism. It is, in fact, the only item included in the area of social behavior that does not differ in the two groups; this means that there is no difference between normal and autistic children and that postural attunement is not impaired in ASD. Also, in Baranek's research (1999), the similar item "unusual posturing of body parts" is found to be specific to early developmental disabilities but not to autism.

Second, the low significance of "explorative activity with an object" confirms the conviction that stereotypies are not useful as predictors in the first year of life. They probably become more obvious after the second year of life, and we can hypothesize that they are a long-term consequence of the earlier dysfunctions. In this item is included also what Baranek calls "mouthing objects" (Baranek, 1999), so we have some doubts that this item could be an early behavioral manifestation of stereotypy as suggested by Baranek.

Third, the significance of “research of contact” shows that aloofness is another early marker for autism. With respect to this item, the problem is how to demonstrate it with a screening instrument in the first year of life, avoiding a too-subjective evaluation. We must also consider that this item could be linked to movement disturbances recently signaled as an important research area in the field of early detection of autism (Teitelbaum et al., 1998). Thus it appears premature to use this item in a screening tool until it can be cross-validated in future studies.

Fourth, we underline the significance of “anticipating the other’s aim.” We found these data particularly important because they confirm our previous research (Maestro et al., 2001) in which we concluded that the impairment in anticipating others’ intentions was one of the first detectable signs of the difficulty to comprehend the significance of others’ reactions. Now we can confirm that finding, but the fact that also in normal children the anticipation of another’s aim is extremely low in frequency leads us to think that this item is dependent on developmental changes and its importance grows in the second half of the first year of life. Finally, the early specific deficit in attention toward social stimuli may interfere in the expression of the innate primary intersubjectivity (Trevorthen, 1979; Trevorthen and Aitken, 2001), and in this way the secondary intersubjectivity (Stern, 1985; Trevorthen and Hubley, 1978) does not develop. In short, we propose the deficit of social attention as a basic mechanism for the well-known impairment of intersubjectivity in autistic children who, moreover, seem to be capable of exhibiting the rudiments of intentionality and of subjectivity.

Limitations

According to previous studies, our research confirms retrospective video analysis as an effective tool to study early natural history of autism. The innovation of this research is to focus on attention and social attention, which has assumed an increasingly important place in the developmental psychopathology of autism. Nevertheless, there are several limitations to the current study.

First, the grid was specifically designed for this study. Even if it has face validity, it has no validation beyond test-retest, and the results of our research can be considered a preliminary report about its use. The aim of this issue was not the validation of the grid, and further research will be conducted to validate the instrument in a larger sample. The grid’s validation could also better describe its differ-

ent dimensions and open further research to compare results with other diagnostic groups (e.g., mental retardation).

Another limit is that we did not provide a control group of children affected by mental retardation. Studies of young infants with autism that include a control group of cognitively delayed children without autism are needed to determine the impact of cognitive impairment on the abilities of children with autism and the specificity of autistic processes before 1 year of age. So, up to now, it is hard to claim that the differences in the infants’ attention skills are due to autism *per se* rather than to primary cognitive impairments.

Finally, in this study, we did not take into account the different courses of onset of ASD (DeLong, 1999; Maestro et al., 1999). In fact, a fair number of individuals with autism experience clinical regression, and the characteristics of early development of these subjects are probably different from those of individuals who show symptoms in the first months of life. In our sample, we included five subjects with such history of regression, a too-small sample to detect differences between subjects with and without such history. Further research with two comparable groups will enhance the possibility of understanding whether the specific deficit of attention is a common trait in the two groups or not. Indeed, although it is clear that for some children autistic symptoms have a late onset, the characteristics of normal behaviors and how these children really lose them are still unknown.

Clinical Implications

The specific deficit in ways of responding to social stimuli and the absence of the typical shift of infant’s attention from human beings to objects which happens at about 3 to 4 months of age (Trevorthen, 1979) could in the future be identified as an important item in a checklist for autism in infants. To enhance the capacity of professionals to recognize autism in the first year of life, we are preparing a video showing how children later found to have autism have, unlike normal infants, a preference for looking at objects and do not orient to speech and faces.

We can hypothesize that this early social attention deficit in the infant has increasingly negative effects on early environmental interactions and in this way contributes to a deviant path of development and of biological maturation of the brain (Schore, 1996). If this hypothesis is correct, we can imagine that an early intervention program delivered in the context of a social interaction and providing compelling social input to the child could decrease

the cumulative effects of the primary deficit in social attention. Thus our finding can enhance the capacity for both an early diagnosis and more effective treatment targeted to divert the atypical attention development in ASD.

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