Continuity and change from early childhood to adolescence in autism

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Background: This longitudinal study of 48 children diagnosed with autism at 2–5 years of age was designed to test the hypothesis that diagnosis would remain stable for most of the sample but that there would be improvements in symptom severity, adaptive behavior, and emotional responsiveness in adolescence. **Methods:** A sample of children with autism assessed in both early and middle childhood were observed in late adolescence with the Autism Diagnostic Observation Scale (ADOS) and their parents were administered the Autism Diagnostic Interview-Revised (ADI-R) and the Vineland Adaptive Behavior Scale. **Results:** All but 2 adolescents (46 of 48) met lifetime criteria for autism according to the ADI-R, and all but 4 adolescents (40 of 44) met criteria for autism spectrum disorder on the ADOS. In contrast to the continuity in diagnosis, parents described improvements in social interactions, repetitive/stereotyped behaviors, adaptive behaviors, and emotional responsiveness to others' distress in adolescence compared to middle childhood. High-functioning adolescents with autism showed more improvement in these domains than low-functioning adolescents with autism. The extent to which the adolescents were observed to be socially engaged with their peers in school in middle childhood predicted adaptive behavior skills even when intelligence level was statistically constrained. **Conclusions:** The developmental trajectory of children with autism appears to show both continuity and change. In this sample, most individuals continued to be diagnosed in the autism spectrum but parents reported improvements in adolescence. The results suggest that social involvement with peers improves adaptive behavior skills, and this argues for focusing intervention programs in this area. In addition, it is clear that high-functioning adolescents improve more than low-functioning individuals not only in cognitive abilities but also in social interaction skills. Thus, any early intervention that impacts the cognitive abilities of young children with autism is likely to have a parallel influence on their social skills as they mature into late adolescence and early adulthood. **Keywords:** Autism, developmental continuity, diagnosis, adaptive behavior, emotional responsiveness.

The developmental course from early childhood into adolescence and young adulthood of children with autism has rarely been described. The lack of a clear understanding of the developmental trajectory in autism has several explanations. First, the very few long-term longitudinal studies of children with autism have generally included only one or two measures often administered at only a few time points. In addition, the measures used have tended to be based on parental recollection of general categories of behavior over fairly long time periods. Although parental reports can provide reliable information, this is more likely to be true for reports of current characteristics and behaviors. Finally, it is difficult to generalize findings across studies because of variations in the methods used and sample characteristics since agreement on diagnostic criteria and reliable diagnostic instruments are relatively new.

The current study was formulated to contribute to the understanding of developmental trajectories in autism by following a moderate size sample of children with autism with assessments in early childhood, the mid-school years, and late adolescence/ young adulthood. Although the children were diagnosed with a variety of measures at intake, diagnoses were confirmed with a standardized interview

(the ADI-R) by middle childhood. While there was some reliance on parental recollections, much of the information about the children came from concurrent parental reports, observations of behavior, and assessments of the children. The study was designed to assess continuity and change in a variety of characteristics important for the adjustment of the individuals over the life course. The factors investigated consist of diagnosis, symptoms, adaptive functioning, and emotional responsiveness. The literature on these factors and our hypotheses concerning change and continuity will be reviewed in the following sections.

Diagnosis and symptoms

Stability of diagnosis and symptoms across the lifespan is central to understanding any disorder and yet remains a relatively unexplored area in the study of autism. Mesibov and colleagues (Mesibov, Schopler, Schaffer, & Michal, 1989) reported decreases in autistic symptoms in a group of 89 children prior to 10 years of age and again after 13 years of age using the Childhood Autism Rating Scale (CARS) (Schopler, Reichler, & Renner, 1988). The CARS is a 15-item rating scale of behaviors asso-

ciated with autism that is generally completed after an observation period. All participants were in North Carolina's TEACCH (Treatment and Education of Autistic and Related Communication Handicapped Children) program, a series of educational and skills training programs designed to meet the needs of individuals with autism throughout the lifespan. Analysis revealed a significant decrease in mean CARS scores in adolescence, indicating a significant improvement over time in 9 of 15 areas.

Decreases in CARS scores and DSM-III criteria from early childhood to early adolescence were also noted among a group of 76 subjects with autism spectrum disorder who had not received any special treatment other than standard services such as early identification, special education, and speech therapy (Eaves & Ho, 1996). Despite the lower scores suggesting an amelioration of autistic symptoms with age, the entire sample continued to receive a diagnosis of autism spectrum disorder at follow-up.

In line with these studies, Piven and colleagues (Piven, Harper, Palmer, & Arndt, 1996) compared parental reports of autistic symptom expression in their adolescent and young adult children to retrospective reports when their children were 5 years of age. These comparisons indicated amelioration of social and communicative symptoms but not repetitive behaviors and stereotyped interest. Mapping parental report to DSM-IV criteria, 5 of the 38 participants in their sample no longer met criteria for autism when they reached the adolescent/young adult period. However, all the participants were reported to have persistent autistic characteristics and substantial social impairments in adolescence and young adulthood. Based on the findings from these three studies, we predicted that our sample of adolescents and young adults would show a moderate improvement in autistic symptoms but that the majority would continue to meet diagnostic criteria for autism.

Adaptive behavior

Adaptive behavior is generally defined as the individual's ability to meet the personal and social demands of the environment expected by the culture for someone of his or her age (Nihira, Leland, & Lambert, 1993). Very little information is available about developmental change in the adaptive behavior of individuals with autism or about factors that might predict improvements in adaptive behavior. In one recent study, individuals with autism improved in adaptive behavior with age (Freeman, Del'Homme, Guthrie, & Zhang, 1999). Rates of improvement were related to initial IQ level for two areas of adaptive behavior, communication and daily living skills, but not for socialization skills. Based on the findings of this study, we expected improvements in adaptive behavior from middle childhood to adolescence and young adulthood with rates of improvement posit-

ively associated with intelligence. In addition, we hypothesized that children who were more involved with their peers in the mid-school period would make bigger gains in adaptive behavior than children who were less socially engaged. This hypothesis was based on the observation that, during high-level social play, typically developing children are able to learn to interpret and respond to others' social cues and to acquire skills to initiate and maintain a social interaction (Schuler & Wolfberg, 2000).

Emotional responsiveness

Young children with autism show deficits in responsiveness to the emotions of others (Sigman, Kasari, Kwon, & Yirmiya, 1992). In a study comparing young children with autism to mental age matched controls, children with autism looked less at an adult showing fear, pleasure, distress, or discomfort. In addition, children with autism were rated as less empathic and showed less inhibition of play during the adult's distress (Sigman et al., 1992). In the mid-school follow-up the children with autism continued to show less orienting and attending to an adult's display of distress and appeared less concerned by the adult's distress than did children with Down syndrome and children with other developmental disabilities (Sigman & Ruskin, 1999).

Research suggests that during the period of adolescence and adulthood social interest expands and social skills continue to develop (Ando, Yoshimura, & Wakabayashi, 1980; Mesibov & Handlan, 1997; Mesibov et al., 1989). Given that autistic people tend to become less socially withdrawn as they age, we predicted that there would be more responsiveness to other people's emotions in adolescence and young adulthood than was seen in the mid-school years.

Methods

Participants

The original sample seen in early childhood consisted of 70 children with autism. Because recruitment took place over many years, the location for recruiting subjects varied, although most of the subjects came from either the outpatient or inpatient services of the UCLA Neuropsychiatric Institute or from local elementary or preschools. Fifty-one of the original sample of 70 children (73%) participated in the mid-school follow-up (Sigman & Ruskin, 1999). The children who participated in the mid-school follow-up did not differ from the non-participants in initial age, gender, mental age, DQ/IQ, or socio-economic status, although the mothers of participants were more highly educated than the mothers of non-participants.

At the most recent follow-up, 48 of the original 70 children (68%) were seen. Of the 48 participants from the current follow-up, 45 were also seen during the mid-school follow-up. Six participants from the mid-school follow-up did not participate in the most recent follow-up for the following reasons: one participant had

died; one participant who was living in a group home did not have contact with her parents who were needed to provide consent; one participant had re-entered the foster-care system and his original foster mother was unable to locate him; and two families declined to participate. Three families whom we were unable to locate at the mid-school follow-up were located and participated in the current follow-up.

The current sample of 48 was composed of 6 females and 42 males. The ethnic composition of the group was as follows: 31 Caucasian, 7 African-American, 7 Asian, 2 Hispanic, and 1 other. The majority of participants (42 of 48) continued to live at home with their family; six lived in residential facilities. Of the 48 participants seen at the most recent follow-up, the mean age of the participants during early childhood, middle childhood/ early adolescence, and later adolescence/young adulthood, respectively, was as follows: 3 years, 11 months of age (SD = 1 year), 12 years, 8 months of age (SD = 3 years, 9 months), and 19 years of age (SD = 3 years, 10 months). The degree to which the group seen in later adolescence/young adulthood was representative of the original sample was analyzed. Repeated measures ANOVA revealed that the current participant group did not differ significantly from the original sample in terms of chronological age, mental age, developmental or intelligence quotient, nor language age at intake. Descriptive information about the sample at intake is provided in Table 1.

Procedures

Parents were interviewed about their child's past and current autistic symptoms and adaptive behavior using standardized assessments at two time points: when their children were around 12–13 years of age and approximately seven years later when their children were about 19–20 years of age. During the adolescent/ young adult follow-up, participants' autistic symptoms were assessed directly using a standardized observation and participants' cognitive ability was evaluated using standardized assessments. Approximately half the families came to UCLA for testing and the other half of the sample was assessed in their residence based on parental request and/or distance from UCLA. Testing did not begin until parents signed a consent form and participants who had sufficient capacity signed an assent form. Families were paid for their participation. Testing of all participants was conducted by experimenters who were naive as to the scores of any participant on previous testing.

At the time when this study was initiated in the late 1970s, there were few specialized intervention programs available to most children with autism. For this reason, no assessment of intervention experiences was carried out at recruitment or at the mid-school followup. However, parents were asked in the current follow-up whether their children had participated in intervention programs other than their school experiences. Fourteen parents stated that their children had been involved in behavioral interventions with a mean duration of 54 months. Seven individuals were involved in speech therapy and two were involved in occupational therapy. Given that these descriptive data were based on parental recollection of their children's intervention programs over a long period of time, no evaluation of the impact of these interventions was carried out.

Diagnostic measures

Initial diagnoses. Initial diagnoses of the sample during early childhood changed over time as diagnostic tools and standards evolved. The first half of the 70 children with autism recruited for this study were diagnosed by a team of clinicians based on the standards of the *Diagnostic and Statistical Manual of Mental Disorders*, third edition (APA, 1980) and third editionrevised (APA, 1987). The team of clinicians who made the diagnoses all had extensive experience with childhood psychopathology. For the second half of the sample, clinical judgment was supplemented by two other diagnostic methods: the Childhood Autism Rating Scale (CARS) (Schopler et al., 1988), a structured observation, and the Autism Behavior Checklist (ABC) (Krug, Arick, & Almond, 1980), used as a parent interview. To be classified as autistic, participants were required to meet diagnostic criteria on two of the three methods. Thus, all participants had a well-established diagnosis of autism during early childhood.

Follow-up diagnoses. Parents were interviewed regarding their children's past and current autistic symptoms using the Autism Diagnostic InterviewRevised (ADI-R) (Lord, Rutter, & Le Couteur, 1994) during the middle childhood and adolescent/young adult follow-ups. The examiners who administered the ADI-R had all attended training workshops and were trained to administer and score the ADI-R reliably. Diagnosis of autism on the ADI-R is primarily based on the child's history of behaviors associated with autism. To establish a current diagnosis in the adolescent and young adult years, parental report was supplemented with the Autism Diagnostic Observation Schedule-Generic (ADOS-G) (Lord et al., 2000), a diagnostic instrument based on current expressed autistic symptoms displayed during a structured observation. The ADOS-G had not been used at the middle childhood follow-up because it was still under development at the time.

Table 1 Descriptive information of sample at intake

	Early childhood			Adolescent/Young adult		
	n	*M*	*SD*	*n*	*M*	*SD*
Chronological age (mos.)	70	47.21	12.14	48	47.27	12.12
Language age (mos.)	69	16.49	7.62	47	17.43	8.62
Mental age (mos.)	70	23.71	9.81	48	25.04	11.00
IQ	70	49.31	13.27	48	51.13	12.77

Adaptive behavior measures

Adaptive behavior during the middle childhood/early adolescent follow-up and the adolescent/young adult follow-up was assessed using the Vineland Adaptive Behavior Scales (VABS) (Sparrow, Balla, & Cicchetti, 1984). The validity and usefulness of the VABS has been well established with autistic samples (Perry & Factor, 1989). The VABS raw scores were converted to age equivalents using standardized norms. Percentile rankings were computed using the supplementary norms for individuals with autism (Carter et al., 1998).

Emotional responsiveness measure

Emotional responsiveness was assessed via parent interview as a question on the ADI-R during the middle school and adolescent/young adult follow-ups. Parents were asked if their child ever tried to comfort them if they were sad, hurt or ill. Parental descriptions of their child's behavior were coded on a 4-point scale from 0 to 3, with lower scores indicating more comforting behavior. Parents were also asked to report retrospectively on their child's offering comfort when he/she was 4–5 years of age.

Direct observation of peer involvement

School assessments were conducted during the middle childhood/early adolescent period to determine the nature of peer interaction of children with autism. Direct observations of the participants were conducted during structured and unstructured periods of two different school days to observe ongoing social interaction. Measures of peer interactions were based on the Peer Play Scale (Howes, 1988) and were coded as non-social play, low-level social play, or high-level social play. Peer interactions were coded continuously every 15 seconds, with the highest level of play recorded during every 15-second block. Each observation period lasted at least 30 minutes, ranging from approximately 30 minutes to approximately 60 minutes with an average observation time of 41 minutes. Frequency counts were transformed to proportion scores for the total observation period to account for differences in observation periods (Sigman & Ruskin, 1999). Proportion of time engaged in high-level play was used as the measure of peer involvement.

Results

Diagnosis and symptoms

At the middle childhood/early adolescent follow-up the ADI-R was administered to the parents of 51 of the children originally diagnosed with autism in early childhood. At the adolescent/young adult follow-up, parents of 48 participants originally diagnosed with autism were interviewed with the ADI-R. Of the 48 parents interviewed at the adolescent/young adult follow-up, 45 had also been interviewed at the middle childhood/early adolescent follow-up.

Diagnosis. Overall, the results support the ADI-R as a valid and reliable instrument for diagnosing autism in middle childhood, adolescence, and young adulthood. Ninety-eight percent (50/51) of participants originally diagnosed with autism in early childhood met ADI-R lifetime criteria for autism in middle childhood and 96% (46/48) of participants met lifetime criteria during adolescence and young adulthood based on parental report.

Of the 48 participants seen at time 3, 44 were administered the ADOS-G to assess current expressed autistic symptoms. Four participants were not administered the ADOS-G because of child non-compliance or parental refusal. Most participants (40 of 44) met ADOS-G criteria for autism spectrum disorder. Thirty-three children met criteria for autism, and seven met criteria for the broader classification of pervasive developmental disorder-not otherwise specified (PDD-NOS). There is little qualitative distinction between autism and PDD-NOS; rather, PDD-NOS is diagnosed as a case of sub-threshold autistic symptomatology.

By adolescence/young adulthood, four individuals showed sufficient diminution of symptoms to no longer meet criteria for autism or the broader autism spectrum on the ADOS-G. These four participants ranged in age from 15 years, 3 months of age to 18 years, 8 months of age (mean age was 16 years, 7.5 months). All four were verbal and during the ADOS-G used language in a largely correct fashion, were able to maintain a back and forth conversation and showed good use of gestures for non-verbal communication. However, on an independent measure of language, the Clinical Evaluation of Language Fundamental-Revised (Semel, Wiig, & Secord, 1987), all four participants continued to show language delays (2 years, 3 months; 2 years, 10 months; 6 years exactly; and 6 years, 11 months delayed). To consider the general level of functioning of these four individuals we also examined IQ scores. Three of the four participants had IQs within the average range of intelligence (IQs of 101, 106, and 110) and one had an IQ in the borderline range of intelligence (IQ = 77) as measured using the *Stanford–Binet Intelligence Scale: Fourth Edition* (Thorndike et al., 1986). In terms of functioning in the school system, all four were mainstreamed in regular classes, two did not receive any supports or services and two had a resource class to monitor their progress.

During the ADOS-G, all four responded effectively and appropriately to social situations and presses, made clear and appropriate social overtures, and appeared comfortable interacting with the examiner. To obtain a more global sense of social functioning for these four individuals, parental reports of social functioning were considered. According to parental report on the ADI-R and VABS, two of these participants had a group of friends and a best friend and led rather active social lives, showing typical to above average social behavior (70th and 95th percentile on

national percentile ranks), whereas the other two were reported to have just one friend each that they did not socialize with often and showed marked social deficits relative to their age (at or below the 1st percentile on national percentile rankings). Thus, two of the four individuals who did not meet ADOS criteria for autism appear to have relatively good social competence. The other two individuals appear to experience general social difficulties despite not manifesting overt social-communicative impairments during the semi-structured social situations in the ADOS-G.

Symptoms. Domain algorithm scores on the ADI-R for socialization, non-verbal communication, verbal communication, and repetitive interests and stereotyped behaviors for current and past expression of autistic symptoms were compared from middle childhood/early adolescence to adolescence/young adulthood. Verbal communication questions were only asked for those participants with phrase speech. For the purpose of comparing current versus past recollection across both interviews, items that were not applicable through adolescence and young adulthood were dropped from the algorithm (a list of items used is available from the authors).

Parental reports of autistic symptoms were analyzed for each of the sub-domains of the modified algorithm using single factor repeated measures GLM with four levels (mid-school/current, mid-school/past, adolescent/current and adolescent/past). Only the data from subjects with all four data points were included in these analyses. All sub-domains showed significant differences in reported autistic symptoms: social, $F(3, 129) = 39.55$, $p < .001$; non-verbal communication, $F(3, 129) = 21.33$, $p < .001$; verbal communication, $F(3, 45) = 32.18$, $p < .001$; and repetitive behaviors/stereotyped interests, $F(3, 132) = 18.46$, $p < .001$. Tests of within-subjects contrasts revealed that current symptoms in adolescence were reported as less severe than past symptoms: social, $F(1, 43) = 48.83$, $p < .001$; non-verbal communication, $F(1, 43) = 36.53$, $p < .001$; verbal communication, $F(1, 15) = 59.27$, $p < .001$; and repetitive behaviors/stereotyped interests, $F(1, 44) = 49.11$, $p < .001$ (see Table 2).

Current symptoms were reported to improve from mid-school to adolescence for two of the sub-

Table 2 Mean recollected and current domain scores on the ADI-R

Impairments	n	Current		Ever	
		M	SD	M	SD
Social*	44	8.48	4.92	12.93	3.23
Nonverbal communication*	44	3.82	3.17	6.23	2.40
Verbal communication*	16	3.56	2.78	8.06	2.79
Repetitive/stereotyped Behaviors*	45	4.36	2.06	6.02	1.60

*$p < .001$.

Table 3 Current domain scores on the ADI-R

	n	Mid-school		Adolescent	
		M	SD	M	SD
Social*	44	11.75	4.10	8.48	4.92
Repetitive/ stereotyped behaviors*	45	5.42	1.66	4.36	2.06

*$p < .001$.

domains: social, $F(1, 43) = 45.77$, $p < .001$, and repetitive behaviors/stereotyped interests, $F(1, 44) = 14.74$, $p < .001$ (see Table 3). Thus, there was an improvement in the areas of socialization and repetitive behaviors/stereotyped interests based on parents' current judgments of their children's symptoms from mid-school to adolescence/young adulthood. There were no significant differences in reporting of past symptoms across the mid-school and adolescent/young adult follow-ups.

In order to determine whether the change in symptoms differed for high-functioning and low-functioning individuals, participants were grouped into high (IQ $\geqslant$ 70) and low (IQ/DQ < 70). Independent two-tailed t-tests were conducted for high ($n = 12$) and low IQ/DQ ($n = 35$) groups for change in ADI-R current versus past expression of autistic symptoms for each of the modified algorithm domain totals. High IQ participants were reported to show larger reductions in reported social impairments than low IQ/DQ participants, $t(45) = -3.85$, $p < .001$; larger reductions in verbal communicative impairments than low IQ/DQ participants, $t(19) = -2.76$, $p < .05$, and larger reductions in repetitive behaviors and stereotyped interests than low IQ/DQ participants, $t(45) = -4.05$, $p < .001$. Only the nonverbal communication domain did not show a significant difference in reported change in autistic symptoms for high and low IQ/DQ participants (see Table 4). In terms of improvement in current difficulties, there was no significant difference for the high and low samples in the social domain. However, the high-functioning sample was reported to have improved more in repetitive and stereotyped interests than the low-functioning sample, $t(43) = 2.75$, $p < .01$.

The lower scores on the ADI-R for parental report of current behavior vs. their recollections of past behavior at both middle childhood and adolescence/young adulthood may be interpreted in two ways. First, it may be that parents simply remember their children as more impaired earlier. Because we do not have comparable parent reports in the 3–5-year-old period, this interpretation cannot be ruled out. The second hypothesis is that the characteristics of autism diminish from an early age, particularly for higher-functioning individuals. The strongest evidence for this hypothesis is that parents described fewer current social impairments and less repetitive current behaviors and stereotyped interests in adolescence/young adulthood than in middle childhood.

Table 4 Mean change in ADI-R symptom domain score and VABS composite score

Impairments	Low IQ < 70			High IQ ≥ 70		
	n	M	SD	n	M	SD
Social**	35	−3.85	3.56	12	−8.58	4.19
Nonverbal communication	33	−2.15	2.83	12	−3.50	2.35
Verbal communication*	10	−2.40	2.88	11	−5.36	2.01
Repetitive/stereotyped behaviors**	35	−2.23	1.94	12	−4.83	2.04
VABS composite score**	29	3.66	14.69	12	46.33	45.31

*$p < .05$; **$p < .001$.

Adaptive behavior

Adaptive behavior in adolescence and young adulthood was representative of individuals with autism, with average VABS percentile rankings ranging from 62 to 65% compared to a normative sample of adolescents and adults with autism. Individual rankings ranged from the 1st percentile to the 99th percentile (Carter et al., 1998). Comparison of age-equivalent domain scores on the VABS revealed that our sample did not show a particular weakness in socialization relative to other areas of adaptive functioning as is often cited in the literature (Carter et al., 1998; Kraijer, 2000; Rodrigue, Morgan, & Geffken, 1991).

Paired samples two-tailed t-tests of VABS adaptive behavior composite age equivalent scores revealed that parents reported that their child's adaptive behavior improved from the mid-school years to the adolescent and young adult years, t (40) = 3.07, $p < .01$. Further analysis revealed improvement for 2 of the 3 VABS domain scores: daily living skills improved from the mid-school years to the adolescent and young adult years, t (40) = 3.59, $p < .01$; socialization also improved from the mid-school years to the adolescent and young adult years, t (40) = 2.39, $p < .05$. However, scores for the communication domain were not significantly different from the mid-school years to the adolescent/young adult years (see Table 5).

In order to determine whether the change in symptoms differed for high-functioning and low-functioning individuals, participants were divided into high (IQ ≥ 70) and low (IQ/DQ < 70) groups. Independent samples t-tests revealed that high IQ participants gained significantly more months in adaptive behavior on average than low IQ/DQ participants, t (39) = 4.59, $p < .001$ (see Table 4).

The hypothesis that peer social engagement would contribute to gains in adaptive behaviors was tested with Pearson correlation coefficients. These analyses showed that the percentage of time that the children with autism spent in high-level play with peers in the mid-school years predicted gains in VABS adaptive behavior composite scores, r (32) = .69, $p < .001$, daily living skills scores, r (32) = .51, $p < .01$, communication scores, r (32) = .64, $p < .001$, and socialization scores, r (32) = .70, $p < .001$ from the mid-school years to the adolescent and young adult years. Even after controlling for mid-school IQ/DQ, percentage of time engaged with peers in high-level play in the mid-school years continued to predict gains in VABS adaptive behavior composite scores, r (30) = .51, $p < .01$, communication scores, r (30) = .52, $p < .01$, and socialization scores, r (30) = .56, $p < .01$, from the mid-school years to the adolescent and young adult years. Thus, the hypothesis that peer social engagement would predict later adaptive behavior was confirmed in this study.

Emotional responsiveness

The hypothesis that children with autism would manifest increasing emotional responsiveness to others' distress as they matured was supported by parental report. Paired samples two-tailed t-tests of parental reports of their child's 'current' comforting behavior, assessed during the mid-school years and assessed again in the adolescent and young adult years, revealed significant differences across the two assessment periods, $t(44) = 4.957, p < .001$. Parents reported that their children offered more comfort to them if they were sad, hurt or ill in the adolescent and young adult follow-up than they did in the mid-school follow-up. Pearson correlations revealed that par-

Table 5 Adaptive behavior composite age equivalent score

Impairments	Mid-school			Adolescent/Young adult		
	n	M	SD	n	M	SD
Total score*	41	57.65	42.76	41	73.59	61.76
Daily living*	41	65.95	39.16	41	88.17	62.25
Socialization*	41	46.85	37.31	41	62.93	63.99
Communication	41	60.98	55.96	41	68.83	64.97

*$p < .05$.

ental reports of their child's 'current' comforting behavior in the mid-school assessment was predictive of parental reports of their child's 'current' comforting behavior in the adolescent and young adult assessment, $r(43) = .52$, $p < .001$, even after controlling for participants' IQ/DQ scores in the mid-school years, $r(36) = .37$, $p < .05$.

Discussion

The results of this study provide evidence of both continuity and change in the developmental trajectory of children with autism from early childhood to late adolescence. Diagnosis of autism spectrum disorder shows very strong stability over time in that almost all the children continue to meet diagnostic criteria as adolescents and young adults even when current behavioral observations were used to establish diagnosis. On the other hand, improvement was reported by parents in terms of symptoms, adaptive behavior, and behavioral responsiveness to the emotions of others. Parents mentioned fewer symptoms in adolescence/early adulthood than they remember when the children were 3–5 years of age. Moreover, they reported fewer symptoms in the areas of socialization and repetitive behaviors/stereotyped interests in adolescence than in middle childhood. They also described stronger adaptive behavior in all areas except communication skills and more empathic behavior in adolescence than in childhood. The behavioral observations largely support the findings from parental reports.

It must be pointed out that the improvements in symptoms, adaptive behavior and empathy were mostly confined to the higher-functioning individuals. The parents of the subset of the sample with lower IQs reported much less progress than that reported for children with higher IQs. This finding lends significance to intervention efforts directed toward improving these cognitive and language skills of children with autism in early life. Successful interventions in the cognitive and communicative domains are likely to generalize to improvements in social functioning, even if diagnosis is not altered. Despite the severe limitations of high-functioning adolescents with autism, they still enjoy relatively more adaptive and social skills than low-functioning adolescents with autism.

The findings also point to another possible area where interventions may have important pay-offs and that is on the school playground. In the current study, the social involvement of the children was observed and recorded by non-participant observers who did not intervene in the social environment of the children. Elementary school children who were more socially engaged gained more adaptive skills than less engaged elementary school children. Although it is true that social engagement was partly a function of cognitive skills, social engagement predicted improvements in adaptive behavior even when

the effects of intelligence were statistically constrained. Thus, it appears that engagement with peers improves the social skills of children with autism as is true for typically developing children. To the extent that peer engagement can be increased in schoolchildren with autism, there may be improvements in their adaptive and social skills.

Improvements in social behavior were reported from middle childhood/early adolescence to later adolescence/young adulthood, suggesting the transition from mid-childhood to adolescence may coincide with emerging social interest for individuals with autism. Although it is clear that parents see their children as less symptomatic as the children mature, the interpretation of this finding is not clear. It could be that children actually change in their behavior, as has been suggested by previous research (Eaves & Ho, 1996; Mesibov et al., 1989). Alternatively, parents may habituate to their children's behavior so they see it as less severe than in the past. One way to test these alternative hypotheses is with repeated observations of the same children with the ADI-R and ADOS-G over all time points. This could not be done in the current study because these instruments were not designed at the time that the longitudinal study was begun.

The major limitation of this long-term longitudinal study is the lack of information about the experiences of the children in their families, schools, and intervention programs. We have increasing evidence that the development of at least some children with autism is associated with their experiences (Bono, Daley, & Sigman, in press; National Research Council, 2001; Rogers, 1998; Siller & Sigman, 2002). The next generation of longitudinal studies must examine continuity and change in autism in relation to varying environmental contexts, be these across cultures, families, or educational and treatment contexts. It may be that certain environments foster more optimal development so that the picture drawn in the current study is unduly conservative. Although we can be heartened by the improvements in these children followed over the period from the late 1970s to the early years of the next century, future longitudinal studies will hopefully chart more dramatic gains.

Acknowledgements

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