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Research in Developmental Disabilities 28 (2007) 145–162
Research in Developmental Disabilities

Atypical behaviors in children with autism and children with a history of language impairment

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Received 22 December 2005; received in revised form 1 February 2006; accepted 10 February 2006

Abstract

The frequency, course, and inter-relationships of atypical eating, sleeping, self-injurious behavior, aggression and temper tantrums in children with autism and children with a history of language impairment (HLI), was investigated using a parent interview that was created to examine these problem behaviors. The relationships between these behaviors and language, IQ, severity of autistic symptoms and depression were also assessed. Atypical eating behavior, abnormal sleep patterns, temper tantrums, and self-injurious behavior were significantly more common in the children with autism than those with HLI. Within the autism group, children who exhibited more atypical behaviors tended to have a lower nonverbal IQ, lower levels of expressive language, more severe social deficits and more repetitive behaviors. No relationship between the number of atypical behaviors and measures of cognitive or language ability was noted in the HLI group. However, having more atypical behaviors was related to increased restricted, repetitive behaviors in children with HLI. The atypical behaviors could be divided into two groups: abnormal eating and sleeping, which were independent and tended to begin early in life; and self-injury, tantrums and aggression, which began later and were inter-related. Sleep abnormalities were more common in children (groups combined) diagnosed with major depression.

Keywords: Autism; Language Impairment; Eating; Sleep; Self-injurious behavior; Aggression; Temper; Tantrum

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0891-4222/$ – see front matter
doi:10.1016/j.ridd.2006.02.003

Children with autism display many abnormal behaviors that, while not essential to the diagnosis, cause serious distress for both the child and the family. Unusual eating habits, abnormal sleep patterns, temper tantrums, and aggression to self and to others are among the most common of these abnormal behaviors. In order to achieve a greater understanding of abnormal behaviors in the context of autism, it is important to better characterize their frequency and course as well as to explore their relationship to other aspects of children's functioning including language, intelligence, and severity of autistic symptoms. To achieve this goal, we developed an interview for parents of children participating in two of the Collaborative Programs of Excellence in Autism (CPEA) sites, Boston and Salt Lake City. We begin by reviewing published studies of these behaviors in children with autism.

1. Atypical eating behavior

Atypical eating behavior occurs so frequently in children with autism (Raiten & Massaro, 1986) that at one time it was included among the diagnostic indicators (Ritvo & Freeman, 1978). The most common feeding problem is excessive food selectivity, by type and texture (Ahearn, Castine, Nault, & Green, 2001; Field, Garland, & Williams, 2003; Williams, Dalrymple, & Neal, 2000). Other abnormalities are rituals surrounding eating and food refusal (Schreck, Williams, & Smith, 2004; Williams et al., 2000). Some children with autism may have inadequate nutrition as a result of their limited diets (Raiten & Massaro, 1986; Williams et al., 2000).

Although it has been described, complete food refusal appears to be relatively rare in autism compared to other developmental disabilities. When it does occur, it may be due to gastrointestinal problems. In one study of factors predisposing children to feeding problems, 3 of the 26 children with autism showed complete food refusal, all of whom suffered from gastroesophageal reflux (Field et al., 2003).

A number of hypotheses have been proposed to explain feeding difficulties in children with autism. One hypothesis is that feeding difficulty may be a learned aversion to food secondary to gastrointestinal problems (Field et al., 2003). Others propose that feeding problems result from sensory aversions (Williams et al., 2000). Another hypothesis is that these feeding difficulties are examples of one of the hallmark features of autism: restricted repetitive interests and behaviors and insistence on sameness (Ahearn et al., 2001; Williams et al., 2000). These hypotheses are not mutually exclusive.

2. Abnormal sleep patterns

Sleep problems are more common in children with developmental disabilities than in typically developing children (Richdale, Francis, Gavidia-Payne, & Cotton, 2000). Among developmentally disabled children, sleep problems tend to be more common in younger children and are associated with self-injury, aggression, screaming, tantrums, noncompliance, and impulsivity (Clements, Wing, & Dunn, 1986; Wiggs & Stores, 1996). It is unknown whether these associations occur in children with autism as well.

Research based upon parental report suggests that children with autism are more likely to have sleep difficulties than children with other developmental disabilities and children with no developmental diagnosis (Polimeni, Richdale, & Francis, 2005; Schreck & Mulick, 2000). Among the most commonly reported problems are difficulty falling asleep, frequent awakenings throughout the night and early morning awakenings (Hering, Epstein, Elroy, Iancu, & Zelnik, 1999; Honomichl, Goodlin-Jones, Burnham, Gaylor, & Anders, 2002; Hoshino, Watanabe,

Yashima, Kaneko, & Kumashiro, 1984; Limoges, Mottron, Bolduc, Berthiaume, & Godbout, 2005; Taira, Takase, & Sasaki, 1998; Williams, Sears, & Allard, 2004). Recent polysomnographic studies of sleep characteristics in autism have shown a difference in the overall amount of sleep as well as the quality of sleep as compared to children with Down Syndrome or Fragile X (Harvey & Kennedy, 2002). It has been hypothesized that the sleep difficulties seen in autism are the result of the aberrant activation of neural circuitry involved in the control of both REM and non-REM sleep (Daoust, Limoges, Bolduc, Mottron, & Godbout, 2004; Limoges et al., 2005).

3. Self-injurious behavior

Self-injurious behavior has been studied extensively in children with mental retardation, but less research has been conducted on children with autism (Oswald, Ellis, Singh, Singh, & Matson, 1994). McClintock, Hall, and Oliver (2003) found that self-injurious behavior was related to both receptive and expressive communication in a meta-analysis of studies on challenging behaviors in individuals with intellectual disabilities. Among people with mental retardation, autistic features may be associated with higher rates or increased severity of self-injury (Bodfish, Symons, Parker, & Lewis, 2000; Collacott, Cooper, Branford, & McGrother, 1998; Schroeder, Schroeder, Smith, & Dalldorf, 1978). Among individuals with autism, prevalence estimates range from 20% to 71% (Ando & Yoshimura, 1979b; Bartak & Rutter, 1976; Janicki & Jacobson, 1983), depending, in part, on the IQ and age range of the samples. A number of studies have reported that individuals with autism who are also mentally retarded have higher levels of self-injury than individuals without mental retardation (Bartak & Rutter, 1976; Poustka & Lisch, 1993). In children with autism, lower levels of expressive functional language and more severe scores on the communication, socialization and daily living skills domains of the Vineland Adaptive Behavior scales are associated with increased self-injury (Baghdadli, Pascal, Grisi, & Aussilloux, 2003).

4. Aggression

In children with mental retardation, aggression is related to gender, age and expressive communication (Ando & Yoshimura, 1978; McClintock et al., 2003). There are numerous anecdotal reports of violence and aggression in people with autism spectrum disorders, particularly Asperger's syndrome, but little systematic research concerning its frequency and character has been published (Kohn, Fahum, Ratzoni, & Apter, 1998; Mawson, Grounds, & Tantam, 1985). The limited studies suggest that among children with mental retardation, a diagnosis of autism is associated with a higher incidence of tantrums, aggression, and destruction of property (Ando & Yoshimura, 1979a; McClintock et al., 2003). Most case studies attribute violence to deficits in theory of mind (a lack of empathy and inability to appreciate the victim's point of view), although this interpretation is controversial (Ghaziuddin, Tsai, & Ghaziuddin, 1991).

5. Temper tantrums

Research on typically developing children has shown that temper tantrums are most common in young children and decrease in frequency with age (Bhatia et al., 1990; for review, see Leung & Fagan, 1991). Few studies have addressed temper tantrums specifically among children with autism, as most of the research on problem behaviors in individuals with autism or mental

retardation has focused on aggression and destruction of property (e.g., Applegate, Matson, & Cherry, 1999; Dawson, Matson, & Cherry, 1998; McClintock et al., 2003). In one study of aggression in individuals with mental retardation, tantrums were highly correlated with the presence of aggression (Bihm, Poindexter, & Warren, 1998). In two studies, Ando and Yoshimura (1978, 1979a) addressed tantrums specifically, along with other maladaptive behaviors, examining the effects of age, IQ and a diagnosis of autism. They found no differences in age or IQ in between children with and without tantrums. Tantrums were significantly more prevalent in children with autism as compared to children with mental retardation. No studies have addressed the root of temper tantrums in autism, but clinical experience suggests that children are more likely to have temper tantrums when a change in their routine occurs or when they are denied a desired object or activity.

The purpose of this study was to further characterize these atypical, maladaptive behaviors in the context of autism. Characterizing the course and interrelationship of these behaviors may offer clues about their etiology and the role that autism symptoms may play in their expression. In addition, this study attempts to determine the specificity of these atypical behaviors to autism spectrum disorders (ASD). In order to address this question, we compared the prevalence of these behaviors in children with ASD and children with HLI. Children with ASD and children with language impairment (HLI) both have communicative impairments which may contribute to these behaviors. Our goal in comparing these two groups was to determine which atypical behaviors are related to these communicative impairments and which are related to other symptoms of autism or other co-morbid psychopathology.

6. Method

6.1. Participants

Participants in this study included 107 children: 39 children with a history of HLI and 67 children with autism spectrum disorder (ASD). All the children were recruited and tested at the Boston CPEA site, as part of a larger program project. Children in both groups ranged in age from 4 years 2 months to 14 years 2 months.

6.1.1. Diagnosis of autism

On entry to the study, autism was diagnosed by expert clinicians using DSM-IV criteria, and confirmed using the Autism Diagnostic Interview—Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) and the Autism Diagnostic Observation Schedule (ADOS-G; Lord et al., 2000). Children with other medical and genetic conditions (e.g., tuberous sclerosis, neurofibromatosis) were excluded.

6.1.2. Diagnosis of language impairment

All the children in the HLI group had histories of language delays and impairments, based on parental report, and participated in professional speech and/or language intervention. The children with HLI scored below the threshold for autism on the ADI-R.

Children for this study were recruited from a variety of community resources, including parent groups, organizations serving children with autism or language impairments, and schools or other educational programs serving these populations. All children in the study had some functional language. Presence of behavioral problems was not a factor in recruiting participants.

6.2. Measures

6.2.1. IQ

Cognitive functioning was assessed using the preschool or school-age differential ability scales (DAS; Elliot, 1990).

6.2.2. Language

Language ability was measured using the Peabody Picture Vocabulary Test-III (PPVT; Dunn & Dunn, 1997) for receptive language, and the Expressive Vocabulary Test (EVT; Williams, 1997) for expressive vocabulary.

6.2.3. Autism symptoms

The severity of social and communicative deficits and restricted, repetitive behaviors were measured using the corresponding algorithm scores on the ADI-R (Lord et al., 1994).

6.2.4. Adaptive behavior

The Interview form of the Vineland Adaptive Behavior Scales (VABS; Sparrow, Balla, & Cichetti, 1984) was administered to one parent. The VABS assesses skills in four domains: communication, daily living skills, socialization and motor skills.

6.2.5. Depression

In order to assess the presence of depression, we used a version of the Kiddie Schedule for Affective Disorders and Schizophrenia, present and lifetime and epidemiologic versions (K-SADS-PL and E) that had been modified for use in autism (Leyfer et al., in press).

6.2.6. Atypical behavior

The Atypical Behavior Patterns Questionnaire (ABPQ) is a parent interview developed for this project. SF and JL jointly developed this instrument based upon clinical experience with these behaviors in children with autism and the available literature. The questionnaire focuses on behaviors that are often problematic for autistic children and adults: sleep problems, eating problems, self-injurious behavior, temper tantrums, and aggression. Behaviors must have been present for at least 3 months to be coded as present. For each behavior that was endorsed, parents also reported the child's age in years when the behavior started, age when it stopped (if the behavior was no longer present), relevant symptoms, the course of the behavior, and any treatment sought. If parents could recall only an age range for age at onset or offset the midpoint was taken and rounded up to the nearest full year. The definitions for each behavior are included in Table 1.

Analyses of the data for this study were based on the 101 questionnaires that were completed (38 HLI, 63 ASD[1]). For the analyses that involved comparisons between the ASD and HLI children, groups matched on age and NVIQ were required. This method led to the exclusion of nine low-functioning children with ASD from the case-control analyses. These comparisons included 54 children with ASD (47 males, 7 females) and 38 children with HLI (27 males, 11

[1] Four children with ASD had incomplete questionnaires. If there was information concerning the presence and age of onset, they were included in the figures of cumulative age of onset. Those with complete data for a behavior were included in the calculation of percent affected and age of onset for that behavior. Their data was excluded from all other statistical analyses.

Table 1
Definition of the atypical behaviors assessed

Behavior	Definition
Atypical eating behavior	Food refusal, selectivity, or unusual behaviors or rituals associated with mealtime
Abnormal sleep patterns	Initial insomnia (difficulty falling asleep), middle insomnia (periods of waking during the night), or terminal insomnia (early-morning waking)
Self-injurious behavior	Head banging, hitting one's self, and biting one's self
Aggression	Hitting, kicking, biting, and pinching others
Tantrums	Crying, flailing and yelling usually in response to some aversive stimulus, such as change in activity

females). These two groups did not differ significantly in age or nonverbal IQ, as shown in Table 2.

6.3. Validation of the ABPQ

The concurrent validity of the ABPQ was assessed by comparing parent report of the presence or absence of the behaviors on the ABPQ to parent report of the same problem behaviors on the ADI-R and VABS interviews. These interviews were conducted at a different visit, at least 1 month from the time of the ABPQ. The number of children in each validity assessment represents the number within the total sample for whom data were available on both measures, and the data are presented in Table 3. Crosstabs were calculated to determine the percent agreement between parent responses on each of the two measures used for validation of the ABPQ. The Kappa statistic was used to determine whether the percent agreement was significantly greater than that predicted by chance. Percent agreement ranged from 70% to 81% and the kappa statistic ranged from 0.385 to 0.599.

6.4. Statistics

Chi-square analyses were used to assess group differences in the frequency of each of the behaviors. A chi-square analysis was also used to assess the difference in the prevalence of depression in children with and without sleep problems. Only those children who had completed an evaluation the KSADS and the ABPQ were included in this analysis. A Mann Whitney U was

Table 2
Comparison of ASD and HLI on age, cognitive functioning and language

	Autism spectrum disorder (ASD)			History of language impairment (HLI)			*t*	*p*
	N	*M*	S.D.	*N*	*M*	S.D.		
Chronological age (months)	54	91.2	29.8	38	95.3	33.1	0.624	0.534
Full scale IQ	54	81.0	18.9	38	89.5	17.3	2.208	0.036
Nonverbal IQ	54	87.4	19.0	38	92.0	17.5	1.180	0.241
Verbal IQ[a]	53	78.6	20.2	35	89.5	16.1	2.806	0.006
EVT (standard score)	54	77.3	21.1	38	91.2	13.9	3.805	<0.001
PPVT (standard score)	54	80.6	21.4	38	99.3	15.8	4.595	<0.001

[a] Subscale IQ scores are available only for children who tested within age-level on the DAS.

Table 3
Validation of the atypical behaviors parent questionnaire

Behavior	Validator	Agreement (%)	Kappa
Atypical eating behavior ($n = 99$)	Vineland maladaptive behaviors item: "exhibits an eating disturbance"[a]	78.8	0.577*
Abnormal sleep patterns ($n = 100$)	Vineland maladaptive behaviors item: "exhibits a sleep disturbance"[a]	81.0	0.599*
Self-Injurious behavior ($n = 103$)	ADI-R item: self-injury	75.7	0.395*
Aggression ($n = 104$)	2 ADI-R items: aggression to family members, aggression to non-family members	70.2	0.385*
Tantrums ($n = 91$)	Vineland maladaptive behaviors item: "has temper tantrums"[a]	73.6	0.494*

[a] The Vineland measures current behavior, therefore validation involved a comparison of positive responses on the Vineland with current behaviors on the ABPQ.
* $p < 0.001$.

used to determine group differences in the total number of atypical behaviors present. These group analyses were completed with the matched groups. Point-biserial correlations were used to assess the relationship of each atypical behavior to cognitive, language and severity measures in children with ASD. In addition, the relationship between the number of atypical behaviors observed and cognitive, language and severity measures was examined in both groups using a Spearman's Rho correlation. The Cramer's V statistic was used to assess the relationships among the five behaviors. This statistic normalizes chi-square and allows the strength of the relationships between different behaviors to be compared.

7. Results

7.1. Prevalence of atypical behaviors

Table 4 presents the frequency of each atypical behavior among the ASD and HLI children. All of the atypical behaviors examined in this study occurred more frequently in children with ASD than in children with HLI. The difference in frequency was significant for atypical eating behavior ($\chi^2 = 32.3$, $p < 0.001$), abnormal sleep patterns ($\chi^2 = 4.9$, $p = 0.03$), temper tantrums ($\chi^2 = 19.5$, $p < 0.001$) and self-injurious behavior ($\chi^2 = 6.4$, $p = 0.01$). The groups were not significantly different in the frequency of aggression ($\chi^2 = 1.7$, $p = 0.2$). Table 5 presents the age at onset of each behavior, proportion of children who had each behavior and proportion of the children in whom the behavior persisted at the time of the study.

Table 4
Comparison of the frequency of each atypical behavior in children with autism and language impairment

Behavior	ASD ($n = 54$)	HLI ($n = 38$)	χ^2	d.f.	Significance
Atypical eating behavior	$n = 41$ (76.4%)	$n = 6$ (15.4%)	32.3	1	<0.001
Abnormal sleep patterns	$n = 34$ (63.6%)	$n = 15$ (41.0%)	4.9	1	0.026
Self-injurious behavior	$n = 18$ (32.7%)	$n = 4$ (12.8%)	6.4	1	0.012
Aggression	$n = 18$ (32.7%)	$n = 8$ (20.5%)	1.7	1	0.198
Temper tantrums	$n = 38$ (70.9%)	$n = 9$ (23.1%)	19.5	1	<0.001

Table 5
Age at onset and percent affected for each behavior: including all children given any portion of the ABPQ

	ASD				HLI			
	n[a]	Age onset[b]	Percent affected		n[a]	Age onset[b]	Percent affected	
			Ever	Current			Ever	Current
Atypical eating behavior	64	1.4, 1, 0–5	76.6	70.3	39	0.8, 0.5, 0–2	15	12.8
Abnormal sleep patterns	65	1.6, 1, 0–7	67.7	43.1	39	1.9, 1, 0–10	41	36
Self-injurious behavior	62	2.8, 2, 0–8	30.6	19.4	38	3, 3, 1–5	13	2.7
Aggression	61	3.5, 3, 0–10	32.8	26.2	39	2.8, 3, 0–5	20.5	12.8
Temper tantrums	56	2.7, 2, 0–11	64.3	46.4	39	2, 2, 0–4	23.1	23.1

Note: Including only those children age 6 years and older did not affect the data.
[a] This number represents the children for whom all relevant data concerning the past and present occurrence of the behavior of interest was collected.
[b] Mean, median, range (in years).

7.1.1. Atypical eating behavior

Atypical eating behavior was reported in over three-quarters of the children with autism, while it was only seen in 16% of the children with HLI. Most eating problems among the children with autism involved the child's preference for particular foods (58%) and a restricted range of foods (63%). In the parents' opinions, over 30% of the children with autism showed a preference for foods based on texture, while 14% were sensitive to color. Only 16% displayed preference based upon taste. Problems often began in the first year of life and nearly all the children who had eating problems began to exhibit these behaviors before age 3 (Table 5 and Fig. 1). Most (88%) of those children continued to have problems at the time of the interview.

7.1.2. Abnormal sleep patterns

Over two-thirds of the children with autism had experienced atypical patterns of sleep. Initial insomnia and middle insomnia each occurred in more than half of the children with ASD who had sleep disturbances. Terminal insomnia was the least frequent problem reported, with 12% of the sleep-disturbed children with ASD having this problem. In 80% of cases, parents reported that

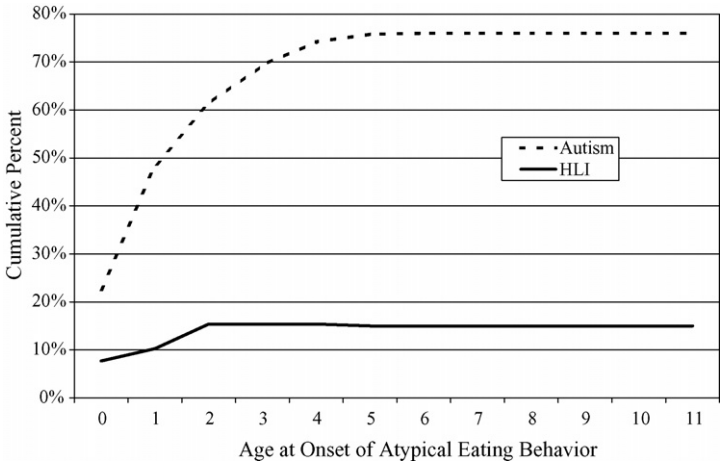

Fig. 1. Cumulative age at onset (in %) of children exhibiting atypical eating behavior.

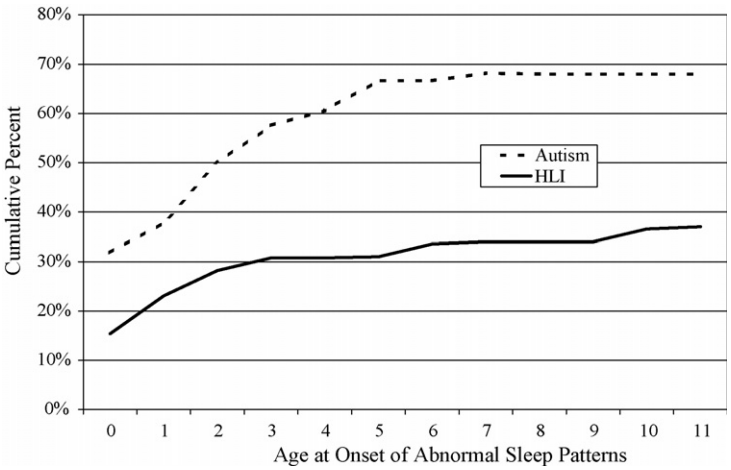

Fig. 2. Cumulative age at onset (in %) of children exhibiting abnormal sleep patterns.

sleep problems were a constant, rather than episodic, problem. Sleep problems typically began in the first or second year of life (see Table 5 and Fig. 2), and continued at the time of the interview in about 60% of the cases. Approximately 40% percent of the children with HLI had abnormal sleep patterns. Initial and middle insomnia each occurred in about half the cases, whereas terminal insomnia was not present in any children in the language-impaired group. The presence of sleep disturbances in children with autism and with HLI combined was significantly related to the presence of depression, diagnosed using the KSADS ($N = 90$, $\chi^2 = 4.54$, $p = 0.03$). Thirty-two percent of the children with abnormal sleep patterns also had depression, compared to 13% of children who did not have abnormal sleep patterns who had depression.

7.1.3. Self-injurious behavior (SIB)

Self-injury was present in almost one-third of the children with ASD. Several types were described: head banging (65%), hitting oneself (50%), and biting oneself (30%). Only five of the 20 children with self-injury displayed more than two different types of this behavior. As indicated in Table 5 and Fig. 3, onset of self-injurious behavior peaked during the toddler years. The behavior continued at the time of the interview in 60% of these cases. In the language-impaired group, four children had a history of self-injurious behavior. It had ended at the time of the interview for all four children.

7.1.4. Aggression

While aggression occurred somewhat more frequently in children with ASD (38%) as compared to children with HLI (21%), this difference was not significant. Of those children with ASD who displayed aggressive behavior, more than three-quarters exhibited those behaviors both at home and outside the home. Parents (88%) and siblings (75%) were the targets of the aggressive behavior most often, although teachers were also targets of aggression in 70% of the cases. In virtually all of the cases (92%), aggression was directed toward more than one person. As with self-injury, over half of the children had the onset of aggressive behavior during the toddler years (Table 5 and Fig. 4). However, onset continued through age 5. Eight children with HLI displayed aggression. Five of those children displayed aggression both at home and at school. The majority of the HLI children were aggressive towards their parents ($N = 6$) and

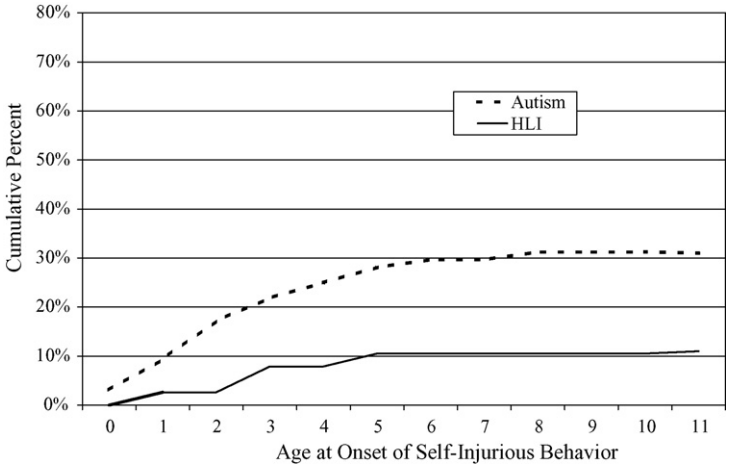

Fig. 3. Cumulative age at onset (in %) of children with self-injurious behavior.

siblings ($N = 5$). One HLI child was aggressive toward other relatives and other caregivers and one child was aggressive toward his teacher.

7.1.5. Temper tantrums

The prevalence of temper tantrums was significantly greater in the ASD group. Approximately 70% of the children with autism had experienced a period of severe tantrums either in the past or in the present. For 60% of these children, tantrums occurred on a daily basis and were a constant (rather than episodic) problem during the period in which they were present. Twenty percent of the ASD children had the onset of tantrums by 1 year of age, 40% by 2 years of age, and half by 3 years of age (Table 5 and Fig. 5). About 8% of ASD children had onset after age 5. Age of offset varied, but more than half of the children still experienced tantrums at the time of the interview. For children in the language-impaired group, tantrums were present in almost one

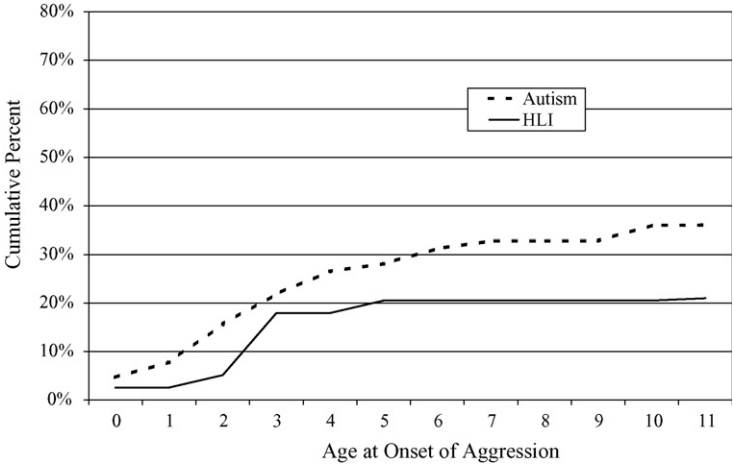

Fig. 4. Cumulative age at onset (in %) of children exhibiting aggressive behavior.

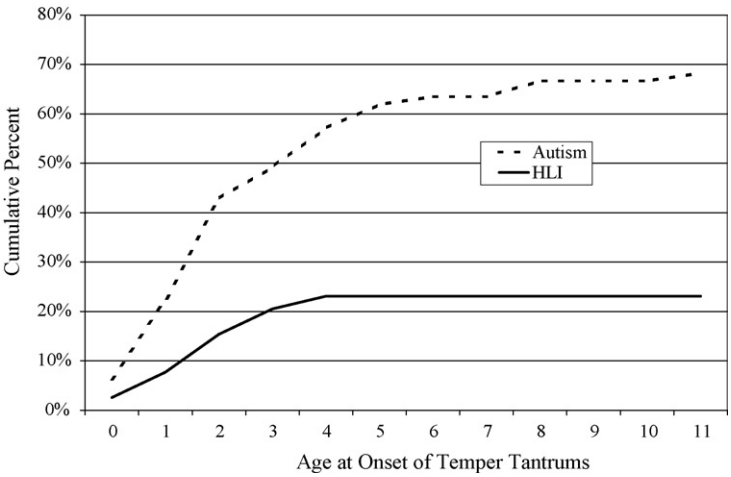

Fig. 5. Cumulative age at onset (in %) of children with temper tantrums.

quarter of the children. In all these cases, the behavior remained problematic at the time of the interview.

7.2. Relationships among atypical behaviors

The calculated relationships between the atypical behaviors are shown in Table 6. These relationships were calculated for the occurrence of behaviors (either past or present) during the lifetime of the child (ASD and HLI groups combined). All of the violent behaviors (SIB, aggression, and temper tantrums) were significantly related to one another. Atypical eating behavior was only related to temper tantrums.

7.3. Relationship of atypical behaviors to cognitive, language and severity measures

Point-biserial correlations were used to assess the relationship between atypical behaviors and cognitive, language and autism severity measures. These analyses were completed for children with ASD only as there were too few children in the HLI group who displayed these behaviors. As shown in Table 7, aggression was the only behavior to show a significant relationship to both cognitive and language measures. SIB was related to expressive language. Aggression was the only behavior to show a significant relationship to any autistic symptoms. There was a significant

Table 6
Relationships among the five behaviors calculated using the Cramer's V statistic

	Atypical eating behavior	Abnormal sleep patterns	Self-injurious behavior	Aggression	Temper tantrums
Atypical eating behavior	–	0.18	0.121	0.091	0.246**
Abnormal sleep patterns	0.18	–	0.18	0.18	0.026
SELF-injurious behavior	0.121	0.18	–	0.330**	0.327**
Aggression	0.091	0.18	0.330**	–	0.284**
Temper tantrums	0.246**	0.026	0.327**	0.284**	–

** $p \leq 0.01$.

Table 7
The relationship of IQ and language measures to the presence of atypical behaviors in autistic children as measured by point-biserial correlations

Behavior	*N*	NVIQ[a]	VIQ[a]	FIQ	PPVTss	EVTss
Atypical eating						
Present	48	−0.224	−0.213	−0.234	−0.103	−0.0897
Absent	15					
Abnormal sleep						
Present	42	−0.198	0.213	−0.049	−0.015	−0.019
Absent	21					
Self-injurious						
Present	21	−0.032	−0.0777	−0.0626	−0.0768	−0.309*
Absent	42					
Aggression						
Present	22	−0.297*	−0.242*	−0.276*	−0.286*	−0.285*
Absent	41					
Temper tantrums						
Present	43	−0.024	−0.087	0.046	0.068	−0.029
Absent	20					

[a] Subscale IQ scores are available only for children who tested within age-level on the DAS. Fifty-nine children tested within age level for NVIQ and 58 for VIQ.
* $p < 0.05$.

relationship between the presence of aggression and the repetitive behavior algorithm score on the ADI.

7.4. Multiple atypical behaviors

The total number of atypical behaviors (between zero and five) was calculated for each child. This total count included any behaviors that the parent reported, either in the past or the present. Fig. 6 shows the pattern of multiple behaviors for the children with ASD and HLI. There was a significant difference between the matched groups in the total number of atypical behaviors ($U = 338.5$, $p < 0.001$, Mann–Whitney *U*-test). Ninety-eight percent of the children with autism had at least one reported atypical behavior. In fact, the majority demonstrated two or three such behaviors and almost 13% had experienced all five problems. In contrast, one-third of the children with language impairments had no atypical behaviors, and the majority had only one or two. No children in this group had all five atypical behaviors.

7.5. Relationship between the number of atypical behaviors and cognitive, language and severity measures

For the 101 children studied (autism and HLI groups combined), the total number of atypical behaviors was inversely related to all of the cognitive and language measures (NVIQ $r_{s(98)} = -0.255$, $p = 0.012$; VIQ $r_{s(94)} = -0.253$, $p = 0.014$; FIQ $r_{s(102)} = -0.299$, $p = 0.002$; PPVT $r_{s(102)} = -0.367$, $p < 0.001$; EVT $r_{s(102)} = -0.377$, $p < 0.001$). In addition, the total number of atypical behaviors seen in a child over their lifetime was related to increased social and communicative deficits as well as increased restricted, repetitive behaviors, as measured by the ADI (ADI social domain $r_{s(102)} = 0.614$, $p < 0.001$; ADI repetitive behavior domain

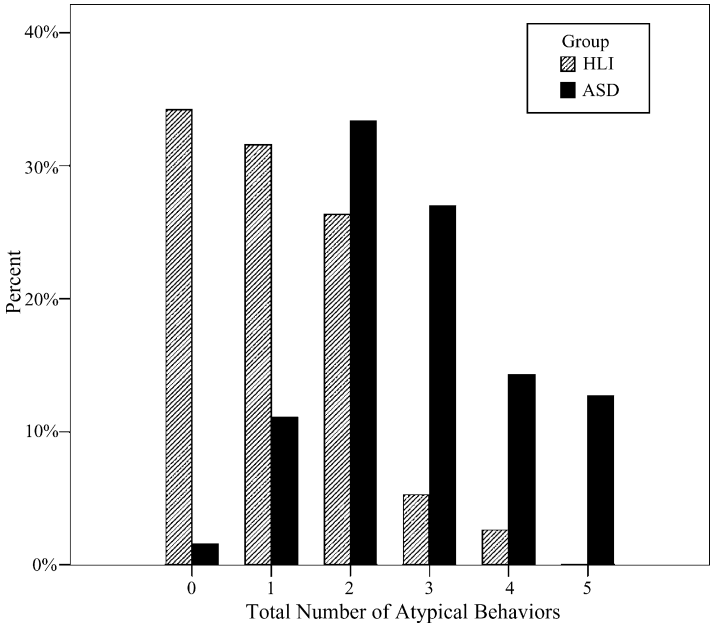

Fig. 6. Total number of atypical behaviors reported for children ASD and children with HLI.

$r_{s(102)} = 0.638$, $p < 0.001$; ADI communication domain $r_{s(98)} = 0.553$, $p < 0.001$). Children with ASD with more atypical behaviors tended to have a lower NVIQ ($r_{s(59)} = -0.258$, $p = 0.05$) and lower levels of expressive language as measured by the EVT ($r_{s(63)} = -0.246$, $p = 0.05$), but not receptive language. In addition, these children displayed increased social deficits ($r_{s(63)} = 0.305$, $p = 0.015$) and more repetitive behaviors ($r_{s(63)} = 0.326$, $p = 0.009$). The relationship between the number of atypical behaviors and communication deficits did not reach significance in children with ASD ($r_{s(63)} = 0.219$, $p = 0.096$). There was no relationship between the number of atypical behaviors and measures of cognitive or language ability in the HLI group. However, there was a relationship between the number of atypical behaviors and repetitive behaviors seen in children with HLI ($r_{s(38)} = 0.354$, $p = 0.029$).

8. Discussion

In this study, we asked parents of children who had either autism or a history of HLI about five abnormal behaviors that are common among children with autism. Four of the five behaviors (i.e., atypical eating behavior, abnormal sleep patterns, temper tantrums, and self-injurious behavior) were significantly more common in the children with autism than those with HLI. Rates of aggression were increased in the ASD children, but group differences did not reach significance. It is possible that differences between groups other than diagnosis, such as verbal IQ and expressive and receptive language functioning, may have contributed to the findings. At least in the ASD group, however, VIQ, PPVT, or EVT scores were not significantly related to the presence of the four behaviors, with the single exception of EVT and self-injurious behavior. The comparison of children with ASD to children with a different developmental disorder involving language suggests specificity of the increased rates of atypical behaviors to autism. In addition to increased rates of the four individual atypical behaviors, children with autism had significantly

more of the atypical behaviors than did the children with HLI. Why atypical behaviors as diverse as those involving eating, sleep, emotion and self-injury occur in association with autism and why they frequently co-occur remains unknown.

The five behaviors can be divided into two groups by considering factors including age of onset, associations with cognition and language, and inter-relationships. The first group constitutes eating and sleeping problems. Abnormalities of eating and sleeping had an early onset, often within the first year of life. However, these two behaviors were not associated with each other (having poor sleep did not increase the likelihood of having abnormal eating) or with the other three behaviors. In addition, neither behavior was related to IQ or language ability in children with ASD.

In contrast to eating and sleeping problems, self-injurious behavior, aggression, and temper tantrums tended to start later, after the second or third birthday, and in a few children they started after age 5. These three behaviors were significantly associated with each other, suggesting the possibility of overlapping etiologies. However, these behaviors did not show the same relationship to cognitive and language measures. Aggressive behavior was associated with lower nonverbal IQ and expressive and receptive language scores. This finding suggests the possibility, often raised by clinicians, that aggression is sometimes related to the child's inability to express his thoughts and wishes. Temper tantrums showed no significant relationship to cognitive or language measures. However, this may relate to the way we asked about the behaviors, and/or parents' tools for managing the behaviors. Self-injurious behavior did not show a relationship to cognitive measures, but did relate significantly to expressive language. These findings are similar to those found by McClintock and colleagues (McClintock et al., 2003), except that they also found a relationship between SIB and receptive language, which may be because their analyses included a broader range of children.

Age at onset of the atypical behaviors in children with ASD was very young. Parents reported that atypical eating and sleeping behaviors had their onset from birth in 20–30% of the children with ASDs. Age at onset of these difficulties is before the reported onset of abnormal head and brain growth (Courchesne, Carper, & Akshoomoff, 2003; Lainhart, 2003) and before the cluster of core symptoms necessary for the diagnosis of ASDs is usually present. The early age at onset of these atypical behaviors suggests that they may be constitutional in nature, i.e., possibly early signs of dysregulation or negative temperament, which may be found in a minority of children with ASD during this early developmental period (Zwaigenbaum et al., 2005). Although atypical eating and sleep behaviors had similar patterns of age at onset, as mentioned above, they were not related to each other. This finding suggests that etiological factors, or perhaps the brain abnormalities that are associated with atypical eating and sleep, may be different and independently contribute to autism. Soon after the very early onset of sleep and eating difficulties in ASD children is the onset of severe temper tantrums. Tantrums occurred in 40% of the ASD children by 2 years of age, as is found among typically developing children. However, tantrums persisted much longer in children with ASD and onset of the behavior continued until age 11 in this sample. Temper tantrums were associated with atypical eating but not sleep behaviors.

The number of atypical behaviors present in a given child was negatively correlated with IQ and language functioning in the combined sample of ASD and HLI children. Children with more atypical behaviors tended to have lower IQs and lower expressive and receptive language functioning. ASD children with more atypical behaviors tended to have a lower NVIQ and less expressive language. It was not possible to determine from our data if low cognitive and language functioning leads to increased numbers of atypical behaviors, if the co-occurrence of multiple atypical behaviors interferes with the development of IQ and language functioning, or if some

third factor increases the number of atypical behaviors and decreases IQ and language functioning.

The number of atypical behaviors was also related to the severity of social and communicative deficits as well as to restricted, repetitive behavior in the combined ASD and HLI children. This is consistent with our finding that these atypical behaviors are more common in children with ASD. In the ASD group, the number of atypical behaviors was related to the severity of social deficits and repetitive behaviors, but why they are related is unclear.

Sleep abnormalities require special mention. Sleep disturbance is regularly linked to depression in the literature (for review see, Tsuno, Besset, & Ritchie, 2005). However, this relationship has not been addressed in the autism literature. The majority of studies examine physiological and behavioral variables without considering the role that depression may play (Schreck & Mulick, 2000; Wiggs and Stores, 2004; Williams et al., 2004). In this study, we found a relationship between sleep abnormalities and a lifetime history of major depression, which was diagnosed several years after the onset of sleep problems, in children and adolescents with ASD. This has potentially important clinical and research implications for children with autism. One possibility is that sleep problems in some very young children with autism and later depression represent continuities in developmental psychopathology. Unlike the literature based on unspecified types of developmental disorders, there was no relationship between sleep abnormalities and self-injury or aggression in our sample of ASD and language disabled children.

The early onset, severity, persistent course, and frequent co-occurrence of the atypical behaviors brings into clearer focus what a difficult and stressful period very early childhood is for children with ASD and their parents. It will be difficult, however, to study the causes and early effects of atypical eating and sleeping behaviors and tantrums because their onset is often before the age when ASDs can be reliably diagnosed. In addition, the atypical behaviors, as currently understood, are nonspecific. By themselves, they may not be helpful in identification of children at risk of developing ASDs. It is possible that when they occur together with early behavioral indicators of qualitative abnormalities of social and communication development and tendency toward stereotyped, repetitive behaviors, they may contribute to the early identification of children with ASD. The ongoing studies of younger siblings of autistic children may shed light on this point.

Our study was intended as an exploratory project and thus has several limitations. This was a retrospective questionnaire that relied heavily on parents' memory. Interviewers were not blind to the participant's diagnosis, and the sample was not chosen at random. Subjects were required to have enough language to participate in some psychological tests and this requirement resulted in restricted ranges of IQ and language. As a result, the relationships of the atypical behaviors and IQ and language measures may not have been as strong as they would be in an unselected sample. Larger samples of subjects who vary more in IQ and language ability will increase the power to detect relationships between atypical behaviors and IQ and language factors. In this study, we focused on onset and occurrence of atypical behaviors in children 14 years of age or younger. It is possible that atypical behaviors onset in some individuals with ASD after 14 years of age. Finally, although the findings of our study appear important, they need replication in independent samples before firm conclusions can be drawn.

Acknowledgements

This research was supported by grants from and the National Institute on Deafness and Other Communication Disorder (U19 DC 03610, Boston University School of Medicine; PO1

HD35476, University of Utah) which are part of the NICHD/NIDCD Collaborative Programs of Excellence in Autism, as well as by the National Institute of Neurological Disorders and Stroke (F30 NS048615). We are grateful to Robert Joseph, Susan Bacalman, Gail Andrick, Anne Lantz Gavin, Shelly Steele, Laura Becker, Margaret Kjelgaard, Jenny Roberts, Courtney Hale, and Echo Meyer for their help in collecting some of the data reported in this paper. We offer special thanks to the children and families who participated in this study.

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