Level of Intellectual Functioning Predicts Patterns of Associated Symptoms in School-Age Children With Autism Spectrum Disorder

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Abstract

The relation between level of intellectual functioning and risk for associated symptoms in children with autism spectrum disorder (ASD) was investigated. Cognitive ability and associated symptoms were assessed directly and/or via parent report in 74 children with ASD at 6 and 9 years of age. Participants were classified as lower and higher functioning using Nonverbal and Verbal IQ and Communication scores on the Vineland at age 6. Children with higher functioning at age 6 displayed increased internalizing symptoms by age 9, whereas children with lower functioning displayed higher hyperactivity, attention problems, and irritability by age 9. Results suggest that level of intellectual functioning may be a risk factor for different patterns of associated symptoms by later childhood.

Autism spectrum disorders (ASDs) are characterized by impairments in social interaction, communication, and a restricted repertoire of interests. In addition to these features, many individuals with ASD suffer from associated behavioral and psychiatric conditions and symptoms, which can further impair functioning. Because ASDs alone can be quite debilitating, associated symptoms are often not the primary focus of diagnosis or treatment. However, such symptoms can exacerbate impairments in individuals with ASD and may be treatable with behavioral and pharmacological interventions.

Associated symptoms in children and adolescents with ASD include psychiatric disturbances and aberrant behaviors, with 10% to over 80% of individuals in this population estimated to suffer from such symptoms (de Bruin, Ferdinand, Meester, de Nijs, & Verjeij, 2007; Lecavalier, 2006; Leyfer et al., 2006). Symptoms most commonly reported include attention problems and hyperactivity, aggression and self-injury, anxiety, fears, obsessive-compulsive behaviors, mood disturbance, and tics (e.g., Baron-Cohen, Scahill, Izaguirre, Homsey, & Robertson, 1999; Gadow, DeVincent, & Pomeroy, 2006; Ghaziuddin, Weidmer-Mikhail, & Ghaziuddin, 1998; Gillot, Furniss, & Walter, 2001; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; King, 2000; Lainhart & Folstein, 1994; Leyfer et al., 2006; Rutter, Greenfield, & Lockyer, 1967). Among adolescents with ASD, depressive and anxiety symptoms may be particularly common (Brereton, Tonge, & Einfeld, 2006; Ghaziuddin et al., 1998; Kim et al., 2000). Researchers have reported exacerbation of associated symptoms and *behavioral deterioration* (defined as hyperactivity, regression, aggressiveness, and/or destructiveness assessed through nonstandard clinical examination and interview) in one third to one half of children with ASD around the time of puberty and early adolescence (Gillbert & Steffenburg, 1987; Kobayashi, Murata, & Yoshinaga, 1992; Rutter et al., 1967).

Less is known about associated symptoms in younger children with ASD. Gadow, DeVincent, Pomeroy, and Azizian (2004) investigated a wide range of associated symptoms in a large group of 3 to 5 year olds. They found more frequent and severe associated symptoms across a range of symptom domains (e.g., ADHD, anxiety, obsessive compulsive disorder, tics, depression, atypical behaviors) in preschoolers with ASD compared

with non-ASD psychiatric referrals and children in regular and special education early childhood programs. Nearly 50% of the preschoolers with ASD showed signs of ADHD. Associated symptoms have also been reported in studies of school-age children. Green, O'Reilly, Itchon, and Sigafoos (2005) studied a group of 13 preschool-age children with a variety of developmental disabilities, including 4 children with autism, and assessed associated symptoms using the Aberrant Behavior Checklist–ABC (Aman & Singh, 1986). The ABC is composed of five subscales that measure behavior such as aggression, self-injury, stereotyped movements, and tantrums. Green et al. documented high total scores on the ABC at first assessment (*M* age 47 months) that remained high in most of the children for the 3 years of the study. Ghaziuddin and colleagues (1998) studied twenty 6- to 12-year-olds with Asperger syndrome and found 10 with ADHD, 4 with depression, and 1 with both ADHD and depression. Gillot et al. (2001) found increased anxiety symptoms in 8 to 12 year olds with high-functioning autism compared with children who had language impairment and typical development. More research on associated symptoms in preschool and school-age children is needed to understand the developmental course of these symptoms and identify risk and protective factors for increased associated symptoms observed in adolescence and adulthood.

Intellectual and adaptive functioning may influence the manifestation of associated symptoms and act as a risk or protective factor for their development. However, the relation between intellectual functioning and associated conditions is complex and not well-understood in people with ASD. One pattern that emerges from the available literature is that lower intellectual ability may be differentially associated with externalizing symptoms, whereas higher intellectual ability may be related to risk for internalizing symptoms. Within a sample of individuals who had severe intellectual disability, including some with ASD, initially described by Wing and Gould (1978), lower IQ was associated with higher levels of *challenging behavior* (defined as sensory, repetitive motor, aggression, hyperactivity, destructive behavior, resistance to change, and sleep problems) both at initial assessment (*M* age 8.9 years) and follow-up (*M* age 20.9 years) (Murphy et al., 2005). Lecavalier (2006) reported that level of adaptive functioning was the most important predictor of associated symptoms in 487 individuals with ASD, ranging in age from 3 years to 21 years. In this sample, lower adaptive functioning was associated with increased hyperactivity and self-injury, whereas higher adaptive functioning was associated with increased anxiety. Szatmari, Bryson, Boyle, Streiner, and Duke (2003), however, found that language and IQ at age 4 to 6 were not adequate predictors of the severity of associated symptoms as measured by the ABC (see previous description) at ages 10 to 13, even though early language and IQ did predict later communication and socialization outcomes. Thus, the evidence is still inconclusive regarding the relation between intellectual functioning and associated symptoms.

Investigators studying internalizing symptoms in autism do not typically focus exclusively on school-age children. However, studies including adolescents and adults with ASD suggest that higher intellectual function may confer risk for internalizing symptoms (Brereton, Tonge, & Einfeld, 2006; Ghaziuddin, Ghaziuddin, & Greden, 2002). Sterling, Dawson, Greenson, and Estes (2006) conducted a systematic investigation in a sample of 45 adults with ASD and found that individuals with ASD who exhibited less social impairment on an autism diagnostic measure and higher intellectual ability were more likely to endorse symptoms related to depression, generalized anxiety, and obsessive compulsive disorder. Because all adults in this sample had relatively strong verbal ability, this finding was not likely an artifact of differential reporting skills. Kanai, Koyama, Kato, Miyamoto, Osada, and Kurita (2004) reported a similar finding with respect to anxiety symptoms measured by the Childhood Autism Rating Scale-Tokyo version (CARS-TV). They conducted a comparison study of higher functioning children, adolescents, and adults with atypical autism (IQ $\geq$ 70; *M* age 6.0 $\pm$ .5 years, range = 2.7 to 22.9) and higher functioning children, adolescents, and adults who met full criteria for autism (*M* age 8.2 $\pm$ 1.1 years, range 3.2 to 18.2). They found that the atypical autism group demonstrated more impaired scores on the anxiety reaction scale than did the full-criteria autism group, despite less impaired or equivalent functioning on other scales. Thus, preliminary evidence suggests that higher functioning individuals with ASD may be at higher risk for developing internalizing symptoms, whereas lower functioning individuals may be at greater risk for externalizing symptoms.

Several factors increase the complexity of studying associated symptoms in preschool and

school-age children with ASD. Associated symptoms may be wrongly attributed to features of ASD or intellectual disability in a process called *diagnostic overshadowing* (e.g., Jopp & Keys, 2001). This process may be amplified by diagnostic criteria that exclude some comorbid conditions such as ADHD in the presence of an ASD (American Psychiatric Association, 1994). In addition, children with ASD may manifest symptoms differently from typically developing children. Examples from research on children with fragile X syndrome (Sullivan, Hooper, & Hatton, 2007), intellectual disability (Esbensen, Seltzer, Greenberg, & Benson, 2005), and early reports regarding children with ASD (Lainhart & Folstein, 1994) suggest behavioral equivalents of symptoms of depression and anxiety, such as self-injury, aggression, or repetitive behavior, may need to be considered. Thus, current diagnostic criteria for psychiatric disorders and existing measures of child behavior problems, especially those based on samples of typically developing children, may not adequately characterize associated symptoms in children with ASD (see Antshel, Phillips, Gordon, Barkley, & Faraone, 2006, for discussion of ADHD in ASD). Measuring associated symptoms across a range of ages is complicated because a majority of, but not all, children with ASD have significantly impaired verbal ability. Thus, caregiver report is needed to reduce method variance. However, caregiver report of internalizing symptoms is known to correlate poorly with child self-report. Despite these challenges, the importance of understanding associated symptoms has resulted in continued research in this area and efforts to improve measures of psychopathology in children with autism and other developmental disabilities (e.g., Douma, Dekker, Verhulst, & Koot, 2006; Hodapp & Dykens, 2005; Leyfer et al., 2006).

In the present study we investigated associated conditions in the context of a longitudinal study of development in children with ASD evaluated at ages 3, 6, and 9 years of age. Associated symptoms were assessed via parent report at age 9. The functioning level of children was based on assessments of both intellectual and communication ability at age 6. We hypothesized that (a) children with higher intellectual functioning and communication ability would be more likely to exhibit internalizing behavior (e.g., anxiety and depressive symptoms) by age 9 years, whereas (b) children with lower intellectual functioning and communication ability would be more likely to exhibit externalizing behavior (e.g., attention problems, hyperactivity, and irritability) by age 9.

Method

Participants

Participants were part of an National Institute for Child Health and Human Development (NICHD) multidisciplinary, longitudinal study being conducted at the University of Washington Autism Center. Participants were recruited through local parent advocacy groups, community agencies, clinics, hospitals, and public schools. Children met diagnostic criteria for autistic disorder or pervasive developmental disorder-not otherwise specified based on both the Autism Diagnostic Interview-Revised–ADI-R (Rutter, LeCouteur, & Lord, 2003) and the Autism Diagnostic Observation Schedule–Generic–ADOS-G (Lord, Rutter, DiLavore, & Risi, 2003) when recruited for the study at age 3 to 4. These measures are both standardized instruments used to diagnose ASDs. The ADI-R is a parent interview and the ADOS-G is a semi-structured play observation. In addition, a clinical diagnosis based on *Diagnostic and Statistical Manual of Mental Disorders–DSM-IV* criteria (American Psychiatric Association, 1994) using all available information was made. Potential participants were excluded if they had a history of serious traumatic brain injury, significant sensory or motor impairment, major physical abnormalities, neurological disease or the presence of a genetic disorder of known etiology (e.g., fragile X). The presence or absence of the exclusionary criteria above was established through parent report during a telephone screening interview and examination of medical records conducted at each assessment point of the study. The sample for the present analyses consisted of all children with both intellectual and adaptive functioning data at age 6 and associated conditions data at age 9. The original sample, consisting of 74 children with ASD, is described in greater detail in Dawson et al. (2004). Characteristics of the current sample ($n = 57$) are described in Table 1.

Procedure

Evaluations of diagnostic status and intellectual ability were conducted at the University of Washington Autism Center by clinical psychologists or advanced doctoral students in child clin-

Table 1. Sample Characteristics at Age 6

Child	
Mean age in months (*SD*)	73.1 (2.8)
Gender (male:female)	61:13
Race (% Caucasian)	70.30
Parent	
Mean mothers' age (*SD*)	38.1 (4.1)
Maternal education (%)	
No college	16
Some college	33
Completed college	51

ical psychology. Diagnostic assessment (ADOS-G, ADI-R) and intellectual functioning measures were administered at three longitudinal time points: ages 3, 6, and 9. Intellectual and adaptive functioning was assessed at age 6 by the Differential Ability Scales and Vineland Adaptive Behavior Scales (Vineland) Communication scale. These instruments were both used because they provide measures of different aspects of function; the DAS, a standardized measure given one-on-one with a trained examiner, and the Vineland, a parent interview yielding information about a child's abilities at home and in the community. Associated symptom measures (Child Behavior Checklist—CBCL; Aberrant Behavior Checklist—ABC; and Conners Rating Scale) were administered at age 9. The ABC, ADI-R, CBCL, Conners, and Vineland scores were reported by the primary caregiver, usually the mother.

Intellectual Ability Assessments

The Differential Abilities Scales (Elliott, 1990) is a battery of cognitive tests for children and adolescents from ages 2 years, 6 months to 17 years, 11 months that takes 25 to 65 minutes to administer. The School Age Level was administered and included six core subtests. The Differential Abilities Scales yields a composite score reflecting conceptual and reasoning abilities (the General Cognitive Ability score), cluster scores measuring verbal and nonverbal skill areas, and individual subtest scores representing a range of diverse abilities.

The Vineland (Sparrow, Balla, & Cicchetti, 1984) is a widely used, standardized, caregiver interview designed to measure adaptive behavior in children from birth to 18 years, 11 months. This instrument consists of 297 items falling in four general domains of functioning: Communication, Daily Living Skills, Socialization, and Motor. The Vineland has been used to assist in the diagnosis of developmental delay, mental retardation, and autism (de Bildt, Kraijer, Sytema, & Minderaa, 2005; Paul et al., 2004). In this study, we report on the Communication subdomain, which has adequate psychometric properties (de Bildt et al., 2005).

Associated Symptom Measures

The ABC is a reliable and valid 58-item measure of problem behaviors known to occur in individuals with moderate to profound developmental disability. The following scales were empirically derived by factor analysis: (a) Irritability, Agitation, Crying, (b) Lethargy, Social Withdrawal, (c) Stereotypic Behavior, (d) Hyperactivity, Noncompliance, and (e) Inappropriate Speech. The ABC was completed by the primary caregiver, usually the mother.

The CBCL (Achenbach & Rescorla, 2001) is a factor-analytically derived behavior checklist completed by parents or guardians. Narrow-band behavior problems (Anxious/Depressed, Withdrawn/Depressed, Somatic Complaints, Social Problems, Thought Problems, Attention Problems, Rule-Breaking Behavior, Aggressive Behavior) are reported.

For the Conners Parent Rating Scales–Revised Short Version—Conners (Conners et al., 1997), parent ratings are used to assess symptoms of attention deficit/hyperactivity disorder and related problem behavior in children and adolescents ages 3 to 17. The 27-item short version takes 5 to 10 minutes to complete. Normative data for the revised scales come from the ratings of more than 2,000 parents. Scores on the Conners differentiate ADHD individuals from nonclinical individuals and other clinical groups.

Results

Level of Functioning at Age 6 as a Predictor of Associated Symptoms at Age 9

We used a MANOVA to assess whether group differences in associated symptoms at age 9 was predicted by IQ and communicative functioning at age 6. Subscales from the each of the three associated symptom measures (CBCL, Conners, and ABC) were used as dependent measures in each analysis. Three dichotomous grouping

Table 2. Associated Symptoms at Age 9 as a Function of Nonverbal IQ at Age 6

Measure/ Symptom	Nonverbal IQ < 70		Nonverbal IQ ≥ 70		Significant univariate *F*, $p < .05$
	Mean	*SD*	Mean	*SD*	
Child Behavior Checklist[a]					
Anxious/Depressed	53.18	4.64	56.59	6.37	
Withdrawn/Depressed	60.94	7.11	61.21	8.77	
Somatic Complaints	55.94	7.08	54.48	6.90	
Social Problems	59.53	5.54	58.31	6.21	
Thought Problems	67.94	7.46	61.31	8.33	Lo > Hi
Attention Problems	67.53	10.41	61.31	9.14	Lo > Hi
Rule-Breaking Behavior	56.29	6.51	54.45	6.03	
Aggressive Behavior	60.24	9.34	56.24	7.93	
Conners[b]					
Oppositional	54.91	11.88	53.00	11.61	
Inattention	62.50	11.91	60.74	10.63	
Hyperactivity	72.77	13.04	59.71	11.77	Lo > Hi
Aberrant Behavior Checklist[c]					
Hyperactivity	.58	.99	−.09	.84	Lo > Hi
Inappropriate Speech	.54	1.21	.19	.84	
Irritability	.74	1.40	−.09	.93	Lo > Hi
Stereotyped Behavior	1.12	1.41	.07	1.02	Lo > Hi
Withdrawal	.50	1.17	.19	.98	

Note: Nonverbal IQ was based on the Differential Abilities Scales.
[a]F (8, 37) = 2.24, $p = .047$. [b]Z scores for age, $F(3, 53) = 7.55$, $p < .001$. [c]$F(5, 48) = 2.98$, $p < .020$.

variables (high versus low functioning) were created from the Differential Ability Scales Verbal IQ and Nonverbal IQ and the Vineland Communication scores. Children who scored below 70 were considered low functioning (Nonverbal IQ: $M = 50.7$, $SD = 9.7$, $n = 22$; Verbal IQ: $M = 55.5$, $SD = 6.9$, $n = 33$; Communication: $M = 52.9$, $SD = 10.8$, $n = 34$), whereas those who scored above 70 were considered high functioning (Nonverbal IQ: $M = 93$, $SD = 11.6$, $n = 35$; Verbal IQ: $M = 95.2$, $SD = 14.9$, $n = 24$; Communication: $M = 86.2$, $SD = 12.8$, $n = 22$). A MANOVA was run for each outcome measure using each grouping variable.

A significant effect of group membership (high versus low functioning) at age 6 on level of associated symptoms at age 9 was found for eight of the nine MANOVAs conducted (see Tables 2, 3, and 4). When the multivariate analysis was significant, we performed univariate ANOVAs to examine the specific subscales within each measure (significant univariate results are displayed in Tables 2, 3, and 4).

When a significant effect of group membership based on functioning level was found, generally, this reflected a pattern in which lower functioning children had higher problem behavior scores. For example, children who were lower functioning in terms of their nonverbal IQ and communication abilities at age 6 exhibited higher levels of hyperactivity, irritability, and stereotyped behavior on the ABC at age 9. Similarly, children who were lower functioning based on Nonverbal IQ, Verbal IQ, and Vineland Communication ability at age 6 had higher CBCL Thought Problems and Conner's Hyperactivity scores. Higher CBCL Attention Problems scores were only reported for children who were in the lower Nonverbal IQ group.

The single exception to the general pattern that lower functioning children were more likely to have a wide range of behavior problems at age 9 was with respect to parent report of anxious/depressed symptoms on the CBCL. Children who were in the higher verbal IQ group at age 6 had significantly higher CBCL Anxious/Depressed

Table 3. Associated Symptoms at Age 9 as a Function of Verbal IQ at Age 6

Measure/ Symptom	Verbal IQ < 70		Verbal IQ ≥ 70		Significant univariate *F*, $p < .05$
	Mean	*SD*	Mean	*SD*	
Child Behavior Checklist[a]					
Anxious/Depressed	53.12	4.26	58.20	6.72	Hi > Lo
Withdrawn/Depressed	61.04	7.22	61.20	9.34	
Somatic Complaints	54.88	6.05	55.20	8.08	
Social Problems	58.50	5.84	59.10	6.20	
Thought Problems	66.08	7.84	60.75	8.73	Lo > Hi
Attention Problems	63.96	9.96	63.15	10.26	
Rule-Breaking Behavior	55.08	6.48	55.20	6.00	
Aggressive Behavior	57.65	8.97	57.80	8.33	
Conners[b]					
Oppositional	52.85	11.36	54.96	12.16	
Inattention	61.70	11.70	61.04	10.37	
Hyperactivity	68.03	14.57	60.25	11.33	Lo > Hi
Aberrant Behavior Checklist[c]					
Hyperactivity	.32	1.05	−.04	.78	
Inappropriate Speech	.42	1.09	.19	.87	
Irritability	.38	1.30	.01	1.01	
Stereotyped Behavior	.68	1.36	.18	1.13	
Withdrawal	.40	1.18	.19	.89	

Note. Verbal IQ was based on the Differential Abilities Scales.
[a]T scores, $F(8, 37) = 2.69$, $p = .019$. [b]Conners Rating Scale T scores, $F(3, 53) = 3.98$, $p = .012$. [c]*Z* scores, age.

scores by age 9 as compared to children in the lower verbal IQ group.

In summary, lower levels of IQ and communication ability at age 6 were associated with higher level of CBCL Thought Problems, Conners and ABC Hyperactivity, ABC Irritability, and ABC Stereotyped Behaviors by age 9. In contrast, children in the higher verbal IQ group at age 6 were reported to have higher CBCL Anxious/Depressed symptoms by age 9.

Discussion

In the current study we investigated whether level of intellectual functioning at age 6 was associated with specific patterns of associated symptoms in children with ASD at age 9. We predicted that children with higher intellectual functioning at age 6 would demonstrate increased levels of internalizing behavior, such as anxiety and depressive symptoms, at age 9. We also predicted that children with lower intellectual functioning at age 6 would demonstrate increased levels of externalizing behaviors (e.g., hyperactivity, attention problems, irritability) by age 9. To test these predictions, we classified children as having higher versus lower intellectual functioning at age 6 based on their abilities in three domains: Nonverbal IQ, Verbal IQ, and Communication Ability. Omnibus tests indicated significant differences in the expression of associated symptoms at age 9 based on group membership (low vs. high functioning) based on each domain of intellectual functioning.

Partial support was found for the first prediction, namely, that children with higher intellectual functioning at age 6 would show increased levels of internalizing behavior at age 9. Results indicate that children in the higher verbal IQ group at age 6 demonstrated higher scores on the Anxiety/Depression subscale of the CBCL at age 9 years. However, higher nonverbal IQ and com-

Table 4. Associated Symptoms at Age 9 as a Function of Communication (COM) at Age 6

Measure/ Symptom	Vineland COM < 70		Vineland COM ≥ 70		Significant univariate *F*, $p < .05$
	Mean	*SD*	Mean	*SD*	
Child Behavior Checklist[a]					
Anxious/Depressed	54.48	4.94	56.30	7.18	
Withdrawn/Depressed	61.56	7.46	59.90	9.16	
Somatic Complaints	56.36	7.21	53.35	6.46	
Social Problems	59.32	5.45	58.30	6.38	
Thought Problems	67.68	8.38	59.50	6.12	Lo > Hi
Attention Problems	64.84	9.86	62.40	10.24	
Rule-Breaking Behavior	56.12	6.68	54.20	5.57	
Aggressive Behavior	58.80	9.49	56.15	7.42	
Conners[b]					
Oppositional	53.88	9.72	51.86	12.51	
Inattention	62.03	11.55	59.23	10.88	
Hyperactivity	68.79	13.85	57.77	11.02	Lo > Hi
Aberrant Behavior Checklist[c]					
Hyperactivity	.39	.96	−.20	.86	Lo > Hi
Inappropriate Speech	.39	1.12	.14	.84	
Irritability	.49	1.26	−.23	.96	Lo > Hi
Stereotyped Behavior	.87	1.42	−.12	.73	Lo > Hi
Withdrawal	.41	1.16	.05	.91	

Note. Communication ability was based on the Vineland Communication subdomain score.
[a]T scores, $F(8, 36) = 2.92$, $p = .013$. [b]Conners Rating Scale T scores, $F(3, 52) = 4.21$, $p = .010$. [c]*Z* scores, age, $F(5, 47) = 2.47$, $p = .047$.

munication ability at age 6 was not predictive of higher levels of internalizing symptoms at age 9.

Results support the second prediction that children with lower intellectual functioning at age 6 would demonstrate increased levels of externalizing behavior at age 9. Results indicate that children in the lower nonverbal IQ groups had higher scores on scales measuring behavior problems (CBCL Attention Problems, Conners Hyperactivity, ABC Hyperactivity and Irritability). A similar pattern was evident when functioning level at age 6 was based on lower verbal IQ (which was associated with high levels of Conners Hyperactivity) and lower communication ability (which was associated with high levels of Conners Hyperactivity and ABC Hyperactivity and Irritability).

These are the first findings of which we are aware that intellectual function in early school age may be associated with different patterns of associated conditions by later school-age children with ASD. Our results provide evidence of the presence of associated conditions in 9-year-olds, an age range that had not been a specific focus of study in ASD. Thus, these data have the potential to increase awareness of associated conditions in school-age children. In addition, the use of longitudinal data provides preliminary evidence that intellectual ability may be a useful predictor of the type of associated conditions that may emerge at later ages. This may be particularly important because many professionals believe that some associated conditions become more pronounced in adolescence (e.g., Ghaziuddin et al., 2002). By increasing the understanding of associated conditions in school-age children, we have helped set the stage for elucidating these issues in later years.

Several group differences were found that were not part of our original hypotheses. Children in all three lower functioning groups demonstrated more impairment on the Thought Problems subscale of the CBCL. It is useful to review the items that comprise this subscale to interpret its

meaning in this sample of children with ASD. Notably, several items potentially overlap with the Repetitive and Stereotyped Behavior domain that is part of the diagnosis of ASD (cannot get mind off thoughts, repeats acts, stores things, strange behavior, strange ideas, twitching). However, other items on this scale do not necessarily relate to ASD symptoms (sleep problem, self-harm, inappropriate sexual behavior, psychotic behavior). Thus, interpretation of elevations of the Thought Problems subscale is complex in the ASD population because scores may be influenced by severity of autism symptoms. Similarly, the ABC Stereotyped Behavior subscale that was elevated in the low communication ability group, reflects the Repetitive and Stereotyped Behavior domain that comprises the diagnostic criteria for Autistic Disorder (American Psychiatric Association, 1994). Thus, for the purposes of this study, we chose not to interpret the relative elevations on these scales as representative of increased associated symptoms in ASD because they may be due to increased severity of autism symptoms in the lower functioning ASD group.

The preceding discussion demonstrates the importance of continued research to differentiate ASD-related symptoms from symptoms that occur in addition to, or comorbid with, ASD. This issue is central to improving the lives of individuals with ASD who may experience difficulties over and above those caused by the disorder. It is crucial for effective screening, monitoring, and treatment planning to increase awareness that individuals with ASD may suffer from comorbid psychiatric symptoms. This is particularly important because effective treatments exist for many psychiatric symptoms. Thus, symptoms such as hyperactivity, depression, or anxiety should not be dismissed as part and parcel of ASD but, rather, should be investigated as potentially indicative of a treatable psychiatric condition in addition to ASD. Provision of appropriate treatment for symptoms such as ADHD, anxiety disorders, and depression can spare individuals with ASD and their families from unnecessary stress and suffering. In further intervention-related research, investigators should examine whether appropriate treatment of associated conditions improves response to treatment of core-autism symptoms and educational interventions.

The current study is limited by several factors. At the time this study was conducted, there was no single tool to assess psychiatric symptoms that was both psychometrically validated and designed for use with children with ASD (see Borthwick-Duffy, Lane, & Widaman, 1997, for discussion of this issue). Thus, we chose to investigate symptoms using a combination of measures. The CBCL and Conners are psychometrically well-validated, and the ABC is developed for use with individuals who have development disabilities. Although this choice potentially provides the "best of all worlds," it also increases the complexity of interpreting results and conducting analyses. However, Leyfer et al. (2006) recently described a promising new instrument for assessing associated symptoms in autism: the Autism Comorbidity Interview-Present and Lifetime Version (ACI-PL). The availability of a psychometrically sound tool designed for use with children with ASD represents an important development in the study of associated symptoms.

Another limitation of this study is that we assessed associated symptoms through parent report alone rather than including child self-report. This was necessary because the objectives of the current study required inclusion of children with a range of cognitive and communicative abilities, including nonverbal children. However, relying on parent report may have the consequence of underestimating the presence of internalizing symptoms, especially in children with lower intellectual functioning (Masi, Brovedani, Mucci, & Favilla, 2002). Hyperactivity and aggression are observable behaviors and, thus, more accurately reported by parents and caregivers. However, because internalizing symptoms such as anxiety and depressive are more difficult to observe, parent report may be less reliable.

The challenge of accurate reporting is further complicated by the idiosyncratic ways in which some children with ASD manifest anxiety and depression symptoms. Although results of the present study suggest that higher intellectual ability may co-occur with higher levels of depression, the reasons behind this pattern have not yet been established. There may be an actual liability for anxiety and depression related to higher cognitive function. This liability may be related to genetic factors that influence depression and anxiety, differences in autonomic or neuroendocrine responses (Jansen, Gispen-deWied, Van der Gaag, & Van Enggeland, 2003) or the increased insight that less affected individuals have about their disabilities or susceptibility to interpersonal stress (e.g., Hartley, MacLean, Butler, Zarcone, & Thompson, 2005).

The other possibility is that both higher and lower functioning individuals with ASD have equal rates of anxiety and depression, but the manifestation of these difficulties varies to such a degree that they are not detectable in lower functioning children with our current measures. For example, it is possible that anxiety may increase repetitive motor behaviors, sleep disturbance, rigidity, noncompliance, or aggression in lower functioning children with ASD, behaviors that may not be captured by current anxiety and depression scales.

Future research on associated symptoms in ASD should include the development and validation of a comprehensive model to explain the full range of factors that predict and maintain the development of associated symptoms in individuals with ASD. Individual characteristics such as gender, genetic factors, neurobiological factors, and neuroendocrine response may be critical to consider. One finding from this study was that the pattern of results differed when the sample was divided based on Nonverbal IQ versus Verbal IQ. This difference could simply be due to the fact that there are more children in the high Nonverbal IQ group versus the Verbal IQ group. However, future studies should address whether Nonverbal IQ and Verbal IQ is differentially related to the presence of associated symptoms in children with ASD. It is particularly important for future researchers conducting longitudinal studies to include adolescents, the age group in which associated symptoms, especially internalizing symptoms, are thought to increase. Individual coping and cognitive styles should be investigated as potential mediators in higher functioning individuals (e.g., Meyer, Mundy, Van Hecke, & Durocher, 2006). For example, individuals with ASD who have higher cognitive and better social skills may be aware of their own deficits and may experience social anxiety, isolation, and difficulty establishing relationships, which may increase depression and anxiety symptoms. Family, school, and community support and negative life events may also be associated with the development and maintenance of associated symptoms. Better understanding of risk and protective factors is necessary to help identify potential targets for prevention of and intervention in the emergence of associated symptoms in children with ASD. This research should be used to provide mental health professionals with accurate information and training to identify associated symptoms in individuals with ASD across the range of intellectual abilities, thereby improving our ability to provide effective treatment.

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