Social Interaction Behaviors Discriminate Young Children With Autism and Williams Syndrome

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ABSTRACT

Objective: Autistic disorder (AD) and Williams syndrome (WS) are neurodevelopmental disorders characterized by contrasting abnormal social behavior (the former, socially avoidant; the latter, outwardly social); nonetheless, there are individuals with WS who display some behaviors that are characteristic of AD. We quantified the extent to which autism spectrum disorder (ASD) behaviors were present in children with WS. **Method:** Twenty children with WS (27–58 months) and 26 age- and IQ-equivalent children with AD were administered the Autism Diagnostic Observation Schedule (ADOS). ADOS behaviors were compared between groups. **Results:** Two children with WS met *DSM-IV* criteria for AD, one of whom was also classified as having AD by the ADOS algorithm. Discriminant analysis of ADOS behaviors indicated that gesture, showing, and quality of social overtures best discriminated the groups. **Conclusions:** Although some children with WS demonstrated some ASD behaviors, and a minority of children with WS had coexisting AD, the symptom profile in WS was different from AD. Despite some deficits in communication behaviors, showing, and initiating joint attention, children with WS made social overtures and efforts to engage others, whereas children with AD tended not to do so. *J. Am. Acad. Child Adolesc. Psychiatry,* 2007;46(3):323–331. **Key Words:** Williams syndrome, autism, Autism Diagnostic Observation Schedule.

Neurodevelopmental disorders with either independent or interactive genetic bases may be expressed in elements of common neuropathology with both diverging and converging aspects of behavioral phenotypic development. There is a particular advantage in comparing different neurodevelopmental disorders where there is clear evidence of both converging and diverging behavioral, information processing, or other more complex developmental expressions, as is the case in co-occurring autism and fragile X syndrome (Dykens and Rosner, 1999).

Williams syndrome (WS) and autistic disorder (AD) constitute another example of where there is evidence of both converging and diverging phenotypic expression in clearly distinct neurodevelopmental disorders. The typical individual with WS may share some overlapping symptomology with the typical individual with AD (Klein-Tasman et al., 2005), such as abnormal sensitivity to sounds (Levitin et al., 2005; Lincoln et al., 1995), the inability to rapidly shift attention (Lincoln et al., 2002), and early development marked by impaired joint referencing and impaired nonverbal communication skills involving gesture and emotion expression (Laing et al., 2002; Mervis and Klein-Tasman, 2000). In addition, people with WS often demonstrate some of the social deficits and/or unusual problem behaviors seen in autism spectrum disorders (ASDs) including difficulties relating to peers, indiscriminant social behavior, social

Accepted October 12, 2006.

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The project was supported by grants from the National Institutes of Health (PO1 HD33113 and P50 NS22343) and the James S. McDonnell Foundation awarded to Ursula Bellugi, by an National Institute of Mental Health grant to Dr. Lord, and by a seed money grant from Alliant International University to Dr. Lincoln. The authors thank Edward Klima and Ursula Bellugi for their comments and support. Special thanks to the Williams Syndrome Association and the individuals and their families who participated.

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DOI: 10.1097/chi.0b013e31802b9522

isolation, distractibility, obsessive behaviors, inflexibility, ritualism, obsessive worrying, body rocking, verbal perseveration, and pragmatic deficits (Gillberg and Rasmussen, 1994; Mervis and Klein-Tasman, 2000; Pober and Dykens, 1996).

Specific similarities in the behavioral profiles seen in WS and AD may suggest some common underlying brain pathology between the two disorders. Indeed, both individuals with WS and those with AD show abnormalities of the cerebellum (e.g., Courchesne et al., 1988; Gaffney and Tsai, 1987; Hashimoto et al., 1995; Jernigan and Bellugi, 1990; Jernigan et al., 1993; Jones et al., 2000, 2002). In addition, behavioral tasks thought to be sensitive to cerebellar abnormalities show impairments in both disorders (Lincoln et al., 2002). Abnormalities of parietal and/or frontal lobe areas may be another source of similarity between the two syndromes (Courchesne et al., 2001; Reiss et al., 2000). Moreover, each disorder has been associated with chromosome 7q (Badner and Gershon, 2002; International Molecular Genetic Study of Autism Consortium, 2001; Korenberg et al., 2000; Maestrini et al., 2000; Morris and Mervis, 2000a; Osborne and Pober, 2001).

Despite overlapping behavioral symptoms, brain abnormalities, and possible genetic links, there are different patterns of phenotypic expression in AD and WS. There is clear evidence of divergent patterns of behavior, particularly in the domains of language, social functioning, visuospatial, motor, and cognitive ability (Lincoln et al., 2002). WS is characterized by a unique physical, cognitive, and behavioral phenotype that includes heart defects such as supravalvular aortic stenosis, dysmorphic facial features, mild to moderate mental retardation, and visuospatial and visuomotor integrative impairments (Bellugi et al., 1999; Osborne and Pober, 2001; Pober and Dykens, 1996). Despite early development marked by delay in reaching important language and motor milestones (Bellugi et al., 2000; Morris and Mervis, 2000b), children with WS are often characterized as being "excessively social" and "overly friendly" and showing enhanced social interest in others (Doyle et al., 2004; Jones et al., 2000; Mervis and Klein-Tasman, 2000). In addition, children, adolescents, and adults with WS tend to use high levels of prosody and social engagement devices when telling stories (Jones et al., 2000); Losh et al., 2000). This purportedly "overly social" personality in WS, including indiscriminant social approach behavior, prolonged gazing into the faces of others, and hyperverbal speech, are features that are not at all characteristic of the behavioral, cognitive, social, and language phenotypes of AD. Furthermore, children with AD show none of the typical morphological abnormalities found in children with WS, and they often show relative strengths in visuospatial and visuomotor functions while demonstrating restricted and abnormal language and affective prosody (Lord and Bailey, 2002).

Thus, there is evidence of both behavioral and morphological convergence and divergence in these two syndromes, with some individuals with WS demonstrating ASD behaviors and some individuals with WS meeting standard criteria for autism (Gillberg and Rasmussen, 1994; Reiss et al., 1985). However, there are no studies to date that have quantified the extent to which ASD behaviors are present in children with WS or that have characterized the converging and diverging behaviors of WS with respect to their AD symptoms.

The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) is a behavioral rating measure designed to assess children with ASDs. The ADOS is sensitive and specific in identifying and distinguishing behaviors that relate to core aspects of the behavioral AD phenotype and are at the same time developmentally relevant to a broader spectrum of social, language, and behavioral domains that are important for normal developmental functioning. The ADOS has proven useful in the differential diagnosis of AD and severe specific receptive developmental language disorder (DLD; Noterdaeme et al., 2002), in the diagnostic assessment of communicative and interactive behaviors in children with AD and receptive DLD (Noterdaeme et al., 2000), and in differentiating AD and pragmatic language impairment (Bishop and Norbury, 2002). Thus, the ADOS may be sensitive to converging symptoms and behavioral characteristics of WS and AD, and also being specific enough to detect diverging symptoms and behavioral characteristics essential in characterizing the phenotypic expression of WS and AD (de Bildt et al., 2004; Klein-Tasman et al., 2005).

Using the ADOS, the present study assessed the degree to which phenotypic features commonly associated with autism may be observed in young children with WS. In addition, using discriminant

function analyses, we examined the symptoms that best predict group membership (WS, AD) and that may suggest areas of differentiation, as well as areas of behavioral overlap, between the syndromes.

METHOD

Subjects

Participants included 20 children with WS (9 male, 11 female; mean age 41.6 months, SD = 11.3, range 27–58 months) who were involved in programmatic research conducted by the Laboratory for Cognitive Neuroscience at the Salk Institute. Nineteen of the children had a confirmed deletion of one copy of the elastin gene on chromosome 7q via fluorescence in situ hybridization and met diagnostic criteria for WS based on phenotypic features according to the WS Diagnostic Score Sheet (American Academy of Pediatrics, 2001). The remaining child was diagnosed by a medical geneticist and met the Diagnostic Score Sheet criteria for WS. Pretesting diagnosis of autism-like behaviors in the children with WS were not available to the researchers at the time of testing. All 20 children completed the Bayley Scales of Infant Development (Bayley, 1969) or the Bayley Scales of Infant Development II (Bayley, 1993), from which the Mental Development Index (MDI) was calculated (range <50–86). So as not to inflate the MDI scores of the nine children who were older than the age for which the test norms applied and to calculate scores for the seven children who scored below the Bayley basal of 50 points, a developmental quotient ratio was calculated (Bayley mental age/chronological age x 100) and used in place of the MDI as the best estimate of their intellectual functioning (mean 60.5, SD = 16.0, range 17–85).

Twenty-six age- and IQ-equivalent children with AD (14 males, 12 females) served as a comparison group. This group consisted of children meeting *DSM-IV* (American Psychiatric Association, 1994) diagnostic criteria for autism from a larger, more heterogeneous clinical sample who had completed Module 1 ADOS within a set time frame while participating in programmatic research conducted by Dr. Lord. All 26 children (mean age 39.8 months, SD = 11.0, range 27–57 months) were diagnosed as having AD using informal observations by a child and adolescent psychiatrist and psychologist and using structured clinical interviews (Autism Diagnostic Interview-Revised; Lord et al., 1994) and ADOS (Lord et al., 2000). None of the children were suspected of having WS based on these comprehensive evaluations. All 26 children completed the Mullen Scales of Early Learning (Mullen, 1995), from which the Early Learning Composite score was calculated (mean 54.2, SD = 20.3, range 18–92.5). As described for the WS group, ratio IQs were estimated for children whose IQs fell outside the norms for the Mullen scales.

Although two different measures were used to assess intellectual functioning in the two groups, these two tests yield comparable global scores, with a correlation of 0.70 between the Bayley Developmental Index and the Mullen Early Learning Composite (Mullen, 1995).

Materials

Participants were assessed with the ADOS, a semistructured assessment of play, interaction, and social communication skills in young children. Because of their limited speech (less than phrase speech), all of the children were administered the ADOS Module 1. The ADOS consists of a set of semistandard activities that allow the examiner to observe the occurrence or nonoccurrence of behaviors that have been identified as being diagnostic of AD in young children. Each observation focuses on an activity or situation that is tailored to elicit specific social behaviors that are found in typically developing children but often absent or clinically unusual in children with AD. The measure is flexible in that the examiner can use various toys and multiple attempts to engage the child for any given activity. The activities focus on the use of toys that are age appropriate to each child, and each task is presented in a playful game-like manner. The parent or caregiver is present and works with the examiner to create each situation and to engage the child in predetermined tasks. Testing sessions last 30–45 minutes, and the child's response to each activity is videotaped, observed, and coded.

Individual item ratings on the ADOS are scored on the basis of item-specific descriptions of severity. An algorithm is then applied to specific diagnostic domains that include social, communication, and stereotyped and restricted behaviors. A sum of total individual item ratings is derived for each clinical domain, and if the total summed score for each domain exceeds an empirically derived cutpoint, then it is suggested that the individual meets autism criteria for that individual domain (Lord et al., 2000).

Procedures

All of the children were administered the ADOS Module 1 individually while a parent remained in the room. The assessments were performed by clinical psychologists (the first and fourth authors) having reliability in the administration of the ADOS or by a psychometrist trained and supervised by the above approved trainers.

ADOS Algorithm Cut Score Classification. Each participant's behavior was coded for the presence of behaviors identified by the ADOS algorithm. For each individual, a sum score for communication, qualitative impairments in reciprocal social interactions, and total (communication + social) were calculated. The ADOS standardized algorithm cut scores were applied to each individual's communication, social, and total sum scores, and participants were given an ADOS classification of AD, pervasive developmental disorder not otherwise specified (PDD-NOS), or nonspectrum (not having an ASD).

DSM-IV. The presence of restricted and repetitive behaviors during ADOS testing was evaluated for each participant, and participants were then secondarily classified based on *DSM-IV* criteria for AD (requiring at least a single symptom involving restricted and repetitive behavior). *DSM-IV* diagnostic criteria for AD requires the presence of at least six symptoms across three domains: (1) social (at least two criteria must be met), (2) communication (at least one criterion met), and (3) restricted and repetitive behaviors (at least one criterion met). In contrast, the ADOS algorithm cut scores include only items that evaluate social and communication behavior and not restricted and repetitive behaviors or play (an area that falls under social symptoms in *DSM-IV*). The final assessment of *DSM-IV* criteria was made by a licensed clinical psychologist and used all historical and assessment information.

Discriminant Function Analysis. Module 1 algorithm items "use of stereotypic/idiosyncratic words or phrases" and "frequency of vocalizations directed to others" were not included in the discriminant function analysis because children who did not express themselves verbally could not be scored on these items. Forward

stepwise discriminant analysis was used to identify the ADOS Module 1 items that contributed to the best separation of the WS and AD groups. ADOS algorithm items (excluding the items mentioned above), as well as the nonalgorithm items play and stereotyped behaviors and restricted interests, were entered into the analysis with the original diagnostic groups (WS, AD) as the grouping measure. The maximum significance of the *F* ratio to enter a variable was set at 0.10; maximum significance of the *F* ratio to remove a variable was set at 0.20.

RESULTS

ADOS Algorithm Cut Score Classification

On the communication problem scale of the ADOS, six (30.0%) children with WS met the cut score for AD, and an additional five (25.0%) met the cut score for PDD-NOS. On the social scale, two (10.0%) children with WS met the cut score for AD, and no additional children met the cut score for PDD-NOS. One child with WS demonstrated cumulative behavior problems that classified him as having AD according to the ADOS algorithm, whereas one met criteria for PDD-NOS.

DSM-IV Classification

Two children with WS met *DSM-IV* criteria for AD, one of whom was also classified by the ADOS algorithm cut scores as having AD. Two additional children with WS met *DSM-IV* criteria for PDD-NOS, one of whom was also classified as PDD-NOS by the ADOS algorithm cut scores. Thus, although the ADOS algorithm placed two (10.0%) children with WS in the ASD range, the *DSM-IV* criteria placed four (20.0 %) of the children with WS in the ASD range.

Discriminant Function Analysis

The ADOS behaviors loaded on to one discriminant function. The three ADOS behaviors with significant Wilks λ ($p < .001$) and their standardized canonical discriminant function coefficients were quality of social overtures (0.89), showing (0.32), and gestures (0.53). The analysis classified 100% of the cases consistent with their original diagnosis (WS, AD).

Clinical Characterization of Autistic Features in Children With WS

During the ADOS, many children with WS demonstrated some problems (a score of 1 or 2 points) in using gestures (45.0%), pointing (55.0%), spontaneously initiating joint attention (50.0%), and showing (the propensity to show an object to another person, 65.0%; Table 1 and Fig. 1). Five (25.0%) children with WS demonstrated some form of restricted or repetitive behavior, and 17 children (85.0%) demonstrated problems with play (functional play, 40%; imaginative play, 85%). In contrast, few children with WS demonstrated symptoms involving the use of another's body to communicate (5.0%), shared enjoyment in interaction (0.0%), facial expressions directed to others (5.0%), unusual eye contact (10.0%), or quality of social overtures (10.0%). There were no statistically significant differences between males ($n = 9$) and females ($n = 11$) with WS on any of the ADOS items, $p > .05$.

Figure 1 illustrates the patterns of scoring by the two groups for each of the ADOS test items. Independent-sample *t* tests indicated that compared with the AD group, the WS group demonstrated significantly fewer problem behaviors on all of the ADOS items, with a Bonferroni correction for multiple comparisons ($p < .0031$; Table 1).

Features of WS Children Meeting *DSM-IV* Criteria for AD

Case 1 was identified by the ADOS algorithm and *DSM-IV* criteria as having AD. This 54-month-old boy with pulmonary and aortic stenosis did not have expressive speech. He achieved a Bayley MDI of <50, with an MDI age equivalent of 8 months (estimated MDI of 29). He was described by parents as being restless, hyperactive, stubborn, sullen, and irritable. He reportedly had several obsessive interests, showed a preoccupation for spinning/rhythmic movements, and often repeated certain acts continually. Parental reports described him as having limited verbal comprehension and a strong attraction to music. During the ADOS assessment, this child was upset for much of test session, but could be quickly appeased with musical toys or his mother's singing. He was observed to engage in self-stimulatory behaviors, hand mannerisms, and hitting objects repeatedly. His eye contact was poor. It was noted that socially he was not overly friendly, would tolerate but not seek out other people, and liked to be alone.

Case 2 was identified by *DSM-IV* criteria as having AD; however, he did not meet ADOS algorithm cut scores for ASD. This 56-month-old boy demonstrated

TABLE 1
Mean ADOS Module 1 Algorithm Item Scores for the Original Diagnostic Groups

	AD (n = 26)			WS (n = 20)			t Test	
	%	Mean	SD	%	Mean	SD	t	p *
Communication								
Vocalizations directed to others[a]	100.0	1.77	0.43	40.0	0.50	0.69	7.67	<.001
Use of another's body to communicate[a]	53.8	0.95	1.50	5.0	0.10	0.45	4.27	<.001
Gestures[a]	96.1	1.19	0.77	45.0	0.50	0.61	5.67	<.001
Pointing[a]	100.0	1.60	0.67	55.0	0.95	0.95	4.24	<.001
Social interaction								
Unusual eye contact[a]	100.0	1.76	0.62	10.0	0.20	0.62	12.33	<.001
Facial expressions directed to others[a]	96.2	1.36	0.66	5.0	0.05	0.22	11.17	<.001
Shared enjoyment[a]	88.5	1.09	0.73	0.0	0.00	0.00	9.71	<.001
Showing[a]	100.0	1.67	0.31	65.0	0.75	0.64	7.70	<.001
Initiation of joint attention[a]	100.0	1.50	0.74	50.0	0.60	0.68	7.40	<.001
Response to joint attention[a]	88.5	1.12	0.83	20.0	0.25	0.55	6.17	<.001
Quality of social overtures[a]	100.0	1.48	0.63	10.0	0.10	0.31	15.76	<.001
Restricted and repetitive behaviors								
Unusual sensory interest	80.8	1.07	0.74	15.0	0.20	0.52	5.15	<.001
Hand or finger mannerisms	65.4	1.02	0.90	20.0	0.30	0.66	3.66	<.001
Repetitive/stereotyped behaviors	73.1	1.02	0.81	20.0	0.30	0.66	3.65	<.001
Play								
Functional play	88.5	1.19	0.77	40.0	0.40	0.50	5.90	<.001
Imagination and creativity	92.3	1.55	0.67	80.0	0.90	0.55	4.51	<.001

Note: Possible scores for each ADOS item range from 0 to 2. Higher scores indicate more impairment. ADOS = Autism Diagnostic Observation Schedule; AD = autistic disorder; WS = Williams syndrome; % = the percentage of children earning a score of at least 1 point for the problem behavior.

[a] Indicates ADOS algorithm item.

* p values <.0031 are significant with Bonferroni correction for multiple tests.

well-integrated, communicative eye contact during testing. In fact, it was difficult for him to shift away from eye contact to objects. He banged objects repetitively and rocked spontaneously. Parent report indicated that he used about 40 words and generally single words. He led others by the hand to where he wanted to go. He achieved a Bayley MDI of <50 with an MDI age equivalent of 9.5 months (an estimated MDI of 17). It is possible that the *DSM-IV* classification of AD for this child may have been associated with his severe to profound mental retardation. However, even with a mental age of 9.5 months, he was not classified as AD or ASD by the ADOS algorithm.

DISCUSSION

Although WS and AD are different neurodevelopmental disorders, behaviors associated with ASD are sometimes evident in individuals with WS, and some individuals with WS meet clinical criteria for ASD. Using the ADOS, we quantified the extent to which ASD behaviors were present in 20 children with WS and characterized these behaviors in terms of the extent to which they converged with and diverged from ASD symptomology observed in children with AD.

Limitations

It is important to note that the WS cognitive and behavioral phenotype evolves with development. For example, in WS, early childhood is marked by language delay, whereas adulthood is typically marked by a relative strength in language. We chose to study children with WS within an age range when it is most critical to evaluate the presence of AD in children and at an optimum age to initiate early intervention. It is possible, although there is currently no evidence, that other features or symptoms consistent with ASD could develop in people with WS in later childhood or adulthood. Thus, given the young and narrow age range of the present study, it is not possible to extrapolate the

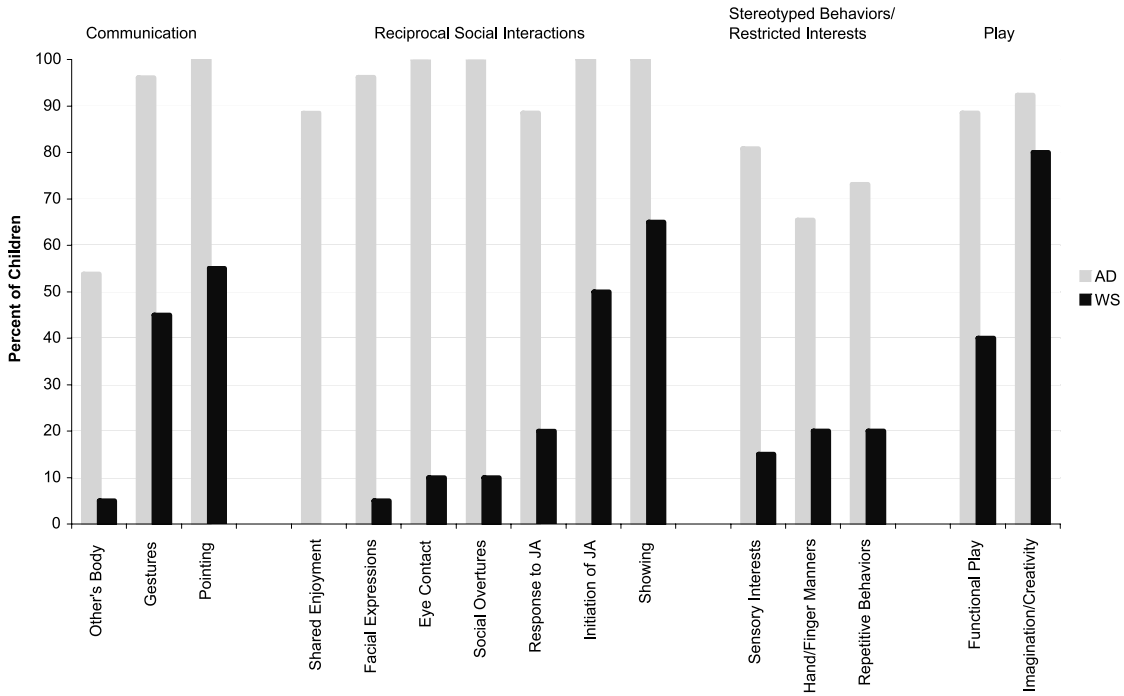

Fig. 1 Percentage of children earning at least 1 point on each ADOS (Autism Diagnostic Observation Schedule) item. AD = autistic disorder; WS = Williams syndrome; JA = joint attention.

current findings to older individuals with WS. It should also be noted that the examiners were not blind to the group membership of the children and that the determination of autism in the children with WS was based solely on their performance on the ADOS and the behavioral observations made during that assessment. Furthermore, in future studies, there would be an advantage to using a single instrument to assess developmental status/IQ as well as one that can cover the age range of the study sample as opposed to needing to use a ratio IQ.

Although there were several participants with WS having low MDI scores, with some being nonverbal, these children are representative of the range of individual variation in the WS population, and it is important to include such children in studies describing the phenotypic profile of WS. Module 1 of the ADOS requires the absence of phrase speech and is appropriate for assessing AD symptoms in totally nonverbal children. This is also the module that would be of most interest in differentiating ASD symptoms in people with neurodevelopmental disorders who lack phrase speech because it would primarily be nonverbal or extremely verbally impaired, developmentally disabled preschool-age children who may need to be differentially diagnosed for autism.

Clinical Implications

Several important clinical implications emerged from this study. First, our findings indicate that although some ASD symptoms are fairly common in children with WS, the behavioral symptom profile in WS tends to be different from that of autism. Although many of the children with WS demonstrated one or more ASD symptoms in communication and social behavior such as restricted use of gesture and pointing, initiating joint attention, and showing, they demonstrated relatively few problems on items related to social interactions such as shared enjoyment, facial expression directed to others, response to joint attention, quality of social overtures, unusual eye contact, and vocalizations directed to others. Thus, despite some problems with communication and in initiating joint attention with a coordinated pointing of the finger and eye gaze, children with WS were still making social overtures and efforts to gain and sustain the attention of others, whereas children with AD tended not to do so.

All four children with WS that met *DSM-IV* criteria for ASD (AD or PDD-NOS) demonstrated some degree of problem with vocalizations directed to others: pointing, showing, spontaneous initiation of joint attention, and play. In addition, the two children with WS that met *DSM-IV* criteria for AD had at least a 1-point response for items: response to joint attention, repetitive/stereotypic behaviors, hand mannerisms, and unusual sensory interests. Beyond that, the two children with WS/AD had variable profiles and varying degrees of symptoms, suggesting that there is no typical WS/AD profile. Our results are consistent with those of other studies indicating that some children with WS share some symptoms with children with AD, such as early development marked by impaired response to joint referencing and impaired nonverbal communication skills involving gesture (Laing et al., 2002). However, it is unclear whether this is also true for older individuals with WS (Lincoln et al., 2002).

Second, it has been suggested that the overly social personality found in people with WS may provide protection from the development of AD or PDD (Pober and Dykens, 1996); however, it appears that the prevalence of AD in individuals with WS is similar to that reported for other developmental disorders. Although the estimated prevalence of AD in the general population is <1% (American Psychiatric Association, 1994), the prevalence of AD in individuals with mental retardation is estimated at between 8.9% and 11.7% (Nordin and Gillberg, 1996) and at least 7% in individuals with Down syndrome (Kent et al., 1999). Gillberg and Rasmussen (1994) reported that 4 of 60 (6.7%) children with WS registered in their clinic were identified as clearly having AD according to *DSM-III-R* criteria. In our sample of 20 children with WS, 2 (10.0%) met *DSM-IV* criteria for AD, one of whom (5.0%) was also classified as having AD by the ADOS algorithm. Thus, reports of cases of individuals with WS with co-occurring AD range from 5% to 10%.

We speculate that children with these co-occurring conditions are underidentified. For example, none of the children in the WS group in the present study had an official diagnosis of autism before the study, although in one case, it was suggested by parents that their child was different from other children with WS and demonstrated "autism-like" behaviors. Although children with WS may be quite social and friendly, this should not compromise a careful evaluation of their behavior, language, and social skills. It is important that children with WS, especially those who appear different from other children with the same disorder, be fully evaluated for the presence of ASD and that those with coexisting WS and AD are identified as early as possible so they may receive appropriate support and educational intervention.

Third, the ADOS appears to be a valid diagnostic tool in identifying autism in children with WS. The present study showed that the ADOS can differentiate children with a non-ASD developmental disorder (e.g., WS) from children with AD, and also identifying clinical features of ASD in children with WS. Both the ADOS algorithm (which does not require the presence of restricted and stereotyped behaviors) and a discriminant function analysis involving ADOS items (including communication, social, play, and restricted and stereotyped behaviors) differentiated children with WS from children with AD. These results are similar to those reported by Klein-Tasman et al. (2005), in which 2 of 26 (7.8%) children with WS between the ages of 2.5 and 5.5 years met criteria for autism on the ADOS. Thus, the ADOS appears sensitive to both behavioral phenotypic differences as well as similarities between children with WS and children with AD.

A final important implication of this study involves the potential to use the ADOS as a tool to identify phenotypic features of symptoms that may be associated with genotypic variability. It is becoming clear that there is significant individual variation in the WS behavioral profile and that much of this variation may depend, in part, on the size of the deletion around 7q11.23 (Hirota et al., 2003). The region of 7q is believed to include an autism susceptibility locus (Badner and Gershon, 2002; International Molecular Genetic Study of Autism Consortium, 2001). It is not known whether the deletion on 7q that is responsible for the development of WS also includes genes or has an effect on genes that contributes to the development of autism. If this should turn out to be the case, then it would reflect true comorbidity because one condition would be etiologically related to the other condition. If there is comorbidity, then understanding the genotypic effects on symptoms common to both disorders could be quite informative. Alternatively, because the estimated prevalence of AD in young children with WS is within a range that is comparable to that reported for other groups having developmental

disorders and/or mental retardation (7%–14%), it may be the case that there is no component of shared etiology between WS and autism, and it is just a matter of probability or risk factors afforded by mental retardation that a child happens to have both disorders. If there is no common genetic relationship between the two disorders, then common behavioral features must share a distinct etiological basis or common pathways to behavioral disturbance resulting from different etiological mechanisms. A distinct advantage of a tool such as the ADOS is that symptoms that overlap in children with both or either disorder can be identified.

Disclosure: Dr. Lincoln is the President and CEO of the Center for Autism Research, Evaluation & Services, Inc. Dr. Lord receives royalties from the publication of the ADOS; however, he did not receive royalties from the unpublished protocols at the time of this research. The other authors have no financial relationships to disclose.

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A Delphi Approach to Reach Consensus on Primary Care Guidelines Regarding Youth Violence Prevention Edward De Vos, EdD, Howard Spivak, MD, Elizabeth Hatmaker-Flanigan, MS, Robert D. Sege, MD, PhD

Objective: Anticipatory guidance is a cornerstone of modern pediatric practice. In recognition of its importance for child well being, injury prevention counseling is a standard element of that guidance. Over the last 20 years, there has been growing recognition that intentional injury or violence is one of the leading causes of morbidity and mortality among youth. The US Surgeon General identified youth violence as a major public health issue and a top priority. Yet, only recently has the scope of injury prevention counseling been expanded to include violence. Pediatric health care providers agree that youth violence-prevention counseling should be provided, yet the number of topics available, the already lengthy list of other anticipatory guidance topics to be covered, developmental considerations, and the evidence base make the selection of an agreed-on set a considerable challenge. The purpose of this study was to systematically identify and prioritize specific counseling topics in violence prevention that could be integrated into anticipatory guidance best practice. *Design:* A modified electronic Delphi process was used to gain consensus among 50 national multidisciplinary violence-prevention experts. Participants were unaware of other participants' identities. *Methods:* The process consisted of 4 serial rounds of inquiry beginning with a broad open-ended format for the generation of anticipatory guidance and screening topics across 5 age groups (infant, toddler, school age, adolescent, and all ages). Each subsequent round narrowed the list of topics toward the development of a manageable set of essential topics for screening and counseling about positive youth development and violence prevention. *Purposes:* Forty-seven unique topics were identified, spanning birth to age 21 years. Topics cover 4 broad categories (building blocks): physical safety, parent centered, child centered, and community connection. Participants placed topics into their developmentally appropriate visit-based schedule and made suggestions for an appropriate topic reinforcement schedule. The resulting schedule provides topics for introduction and reinforcement at each visit. *Conclusions:* The Delphi technique proved a useful approach for accessing expert opinion, for analyzing and synthesizing results, for achieving consensus, and for setting priorities among the numerous anticipatory guidance and assessment topics relevant for raising resilient, violence-free youth. **Pediatrics** 2006;118:e1109–e1115.

Maternal Depression and Violence Exposure: Double Jeopardy for Child School Functioning Michael Silverstein, MD, MPH, Marilyn Augustyn, MD, Howard Cabral, PhD, MPH, Barry Zuckerman, MD

Objective: The goal was to determine how violence exposure affects the relationship between maternal depression, cognitive ability, and child behavior. *Methods:* A multivariate regression analysis of data for a nationally representative sample of kindergarten students was performed. Maternal depression and violence exposure were measured with standardized parent interviews. Standardized *T* scores were derived from direct testing of children in reading, mathematics, and general knowledge; child behavior was reported by teachers. *Results:* A total of 9360 children had neither maternal depression nor violence exposure, 779 violence only, 1564 depression only, and 380 both. Maternal depression alone was associated with poorer mean *T* scores for reading, mathematics, and general knowledge. However, this effect was attenuated by nearly 25% for reading and general knowledge with adjustment for violence. Children with concurrent exposure to depression and violence had lower mean *T* scores for reading, mathematics, and general knowledge, as well as more-concerning behaviors, than did those exposed to either factor alone. Across all outcome measures, boys seemed more affected than girls. *Conclusions:* Violence compounds the effect of maternal depression on school functioning and behavior. Research and intervention planning for children affected by maternal depression should consider violence exposure. **Pediatrics** 2006;118:e792–e800.