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ORIGINAL CONTRIBUTION

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Do autism spectrum disorders differ from each other and from non-spectrum disorders on emotion recognition tests?

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Abstract We tested whether dimensional measures of empathic ability, theory of mind, and intelligence would differentiate autism spectrum disorders from each other and from non-spectrum disorders. Tests were administered to children with a diagnosis of Autistic Disorder (AutD; n = 20), Asperger's Disorder (AspD; n = 28), Attention Deficit/Hyperactivity Disorder (Inattentive Type) (ADHD; n = 35), Mental Retardation (Mild) (MR; n = 34), Anxiety Disorder (AnxD; n = 14), or No Psychological Disorder (NPD; n = 36). Results showed that empathic ability discriminated among groups on the autism spectrum (AutD < AspD < NPD). Because empathic ability is not independent of intelligence (AutD < AspD < NPD on intelligence; MR < ADHD < NPD on empathic ability), both dimensions are necessary to discriminate autism spectrum from non-spectrum disorders. When intelligence is covaried, empathic ability discriminated AutD, but not AspD, from other disorders (AutD < MR < ADHD < NPD = AnxD = AspD).

Key words Autism spectrum – empathic ability – emotion recognition – theory of mind – developmental disorder

Introduction

Autism is associated with deficits in theory of mind (ToM) abilities (34, 35, 54) that are both stable (25, 32) and treatment resistant (29; cf. 44). Observations that ToM deficits are relatively specific to Autistic Disorder (AutD; 51, 53) have bolstered a view that ToM deficits are a defining characteristic of AutD (4). There has also been support for the hypothesis that ToM deficits mediate problems of social communication (17) and behavioral development (38) in autistic children. Nonetheless, there is a growing body of evidence indicating that the relationship between ToM ability and autism can only be understood if relationships between other abilities (e.g., emotion recognition ability, verbal ability, reasoning ability) and other developmental disorders (e.g., intellectual disability) are taken into account.

The first line of evidence consists of studies demonstrating that ToM deficits are not specific to autism. Deaf children have social problems similar to those of autistic children (47) and do not differ from autistic children in ToM ability (33, 34). Although some social problems of deaf children may be mediated by ToM deficits, and although hearing loss is overrepresented among children with autism (43), research clearly implicates other mediational mechanisms. For example, deaf children have greater difficulty recognizing emotions than do hearing children and the ability to recognize emotions is related to the onset of deafness: congenitally and prelingually deaf adolescents are less able to recognize emotions than are postlingually deaf adolescents (3). Similarly, there is substantial overlap between the clinical presentation of blind children and autistic children (8) and blind children have been shown to

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perform worse on ToM tests than do sighted children (30). Whatever mechanisms are responsible for a child failing to acquire a ToM (5), ToM deficits are not specific to autism.

The second line of evidence indicates that profound ToM deficits do not necessarily accompany autism. The proportion of autistic subjects who pass ToM tests ranges from 20% (7) to 60% (36). These results not only disconfirm the hypothesis that a failure to acquire a ToM is a necessary component of autism, the substantial variability in ToM ability suggests that the ToM construct needs to be viewed as a continuous rather than a categorical variable. If ToM ability varies among individuals with autism, then it is important to consider with what other constructs ToM ability may covary. For example, if ToM ability covaries with verbal ability, it would be appropriate to ask whether apparent ToM deficits in autism are a function of deficits in verbal ability.

Although research on ToM deficits in autism has frequently used mentally handicapped subjects as controls, the third line of evidence suggests that variability in ToM ability is closely related to variability in intelligence generally, and to language ability specifically. One of the first studies (16) linking ToM ability and general intelligence assessed the relationship between ToM abilities and performance on social cognitive tasks in autistic subjects. Although there was a clear association between ToM ability and social cognitive ability, when verbal intelligence was covaried, people with a diagnosis of AutD who passed social cognitive tasks did not differ from those who failed social cognitive tasks in ToM ability. In other words, within a group of autistics, variability in ToM ability was a function of verbal intelligence (see also 41). Tager-Flusberg and Sullivan (45) report no differences between children with a diagnosis of AutD or Pervasive Developmental Disorder Not Otherwise Specified and children with a diagnosis of Mental Retardation (MR) on tasks including knowledge of mental state terms when language ability was controlled by matching. Dahlgren and Trillingsgaard (11) found no differences between non-retarded autistics, subjects with Asperger's Disorder (AspD), and normals on ToM tasks; Yirmiya and Shulman (50) found that although autistics performed less well than MR subjects on conservation and false belief tasks, the differences were not significant when verbal intelligence was covaried. Yirmiya, Solomonica-Levi, Shulman, and Pilowski (52) further report that among autistics, ToM abilities are correlated with verbal abilities, and among MR subjects, nonverbal abilities are correlated with deception and false belief scores.

Finding that ToM abilities are related to other cognitive abilities is important because autism is comorbid with MR in approximately 75% of cases (2). If ToM ability is not independent of general intelligence, and if autism is typically comorbid with pervasive delays in cognitive development, then the observation that a child is slow to develop ToM ability will be about as likely to indicate a general delay in cognitive development as to indicate a specific delay in acquisition of a ToM. If deficits in ToM ability have a specific relationship to autism, those deficits will only be evident when they are demonstrably greater than deficits in other cognitive abilities.

Individual differences in theory of mind, empathic ability, and the autism spectrum

Because ToM ability is variable among subjects with autism and is not specific to AutD, the ToM construct should be construed as a disability dimension affected by multiple etiological factors, and not as a marker for a specific disorder. A close analogy would be the general intelligence dimension that is useful, among other things, for quantifying disability along a continuum. MR, like autism and the spectrum of autistic-like conditions, ranges in severity from "profound" to "mild." Unlike autism and related conditions, the classification of MR is based on the severity of general cognitive disability as measured by standardized psychological tests rather than on a set of symptoms of general cognitive disability.

In general, autism and related conditions are distinguished from other disorders on the basis of social dysfunction; it is for this reason that Gillberg (18, 19) proposed that they be classed as "Empathy Disorders." Gillberg (18) suggests that many individuals with a diagnosis of autism, AspD, disorders of attention, motor control, and perception, Tourette's Disorder, Obsessive-Compulsive Personality Disorder, and even Anorexia Nervosa share an inability to "conceptualize other people's inner worlds and to reflect on their thoughts and feelings." The choice of the term "empathy disorders" for the class reflects Gillberg's belief that empathy skills require a well-developed ToM.

Although empathy skills may require a well-developed ToM, the ability to conceptualize other people's inner worlds and to reflect on their thoughts and feelings also requires several other abilities; empathy is a broader ability construct of which ToM ability is but one component. Dunn (12) distinguished between a child's need to understand the emotions of other people and the need to understand the minds of other people. Eisenberg (13), following Flavell (15), agreed that in order to understand the origins of perspective-taking, it is necessary to assess how children understand emotion and rudimentary mental constructs. Eisenberg (13) distinguished two components of the ability to understand emotions: the ability

to decode and label emotions based on perceptual cues and the ability to use situational cues to make inferences about others' emotions. When very young children are acquiring a ToM (49), they are also acquiring the ability to decipher perceptual, situational, and verbal cues that will aid their ability to understand the experience of other people.

There is increasing evidence that autism is characterized by deficits in empathic abilities other than, and in addition to, ToM ability. Apart from studies in which the ToM construct is being enlarged to include the ability to make inferences about a target person from photographs of a person's eyes (6), research has shown that emotion recognition abilities are deficient in autistic subjects and in other subjects with pervasive developmental disorders (9), that high-functioning autistics have fewer deficits in emotion recognition abilities than low functioning autistics (26), and that siblings of autistics have emotion-recognition deficits compared with matched controls (40). ToM ability and emotion recognition ability are significantly correlated in subjects with a pervasive developmental disorder (9). The emotion-recognition deficits of autistic subjects may be a function of intelligence; autistic and MR subjects do not differ in emotion-recognition ability when verbal ability is statistically controlled (24; cf. 10, 23).

The finding that autism is characterized by empathic ability deficits other than ToM deficits suggests that it may be practical to measure a higher-order empathic ability dimension; such measurement would permit the quantification of disability within an autism spectrum. Following the example of intelligence tests, a composite measure of empathic ability would be based on a series of distinct, but conceptually related, tests of the ability to conceptualize the experience of another person based on situational cues, emotion recognition cues, and so on (12, 15). The capacity to measure empathic ability would help solve two related problems. First, it would facilitate assessment of covariation between empathic abilities and other cognitive abilities. The ability to control covariation with general intelligence would lessen problems that arise from the comorbidity of autism and MR. Second, it would facilitate investigations of the autism spectrum construct by allowing the direct comparison of the empathic ability profiles of subjects with different diagnoses.

Aims and hypotheses

The general aim of this research is to increase our understanding of how broadly defined empathic ability deficits relate to autism spectrum disorders. This aim is achieved by assessing the utility of both a ToM measure and a composite dimensional measure of empathic ability in: a) discriminating among groups of subjects with different autism spectrum disorders, and b) discriminating between groups of subjects with autism spectrum and non-spectrum disorders. It is expected that autism spectrum disorders will be differentiated from each other on the basis of significant differences in the severity of empathic ability deficits; autism spectrum disorders will be differentiated from non-spectrum disorders on the basis of relatively greater empathic ability deficits than cognitive ability deficits.

Method

Subjects and procedure

Subjects were selected on the basis of a) membership in a diagnostic group with a known or hypothesized position on the autism spectrum, b) membership in a diagnostic group that is frequently comorbid with an autism spectrum group, or c) membership in a diagnostic group that is typically not comorbid with an autism spectrum group. The autism spectrum consisted of three groups: the AutD category defined the more severe end of the spectrum, the AspD category defined a less severe point on the spectrum, and a no psychological disorder (NPD) category defined the "normal" end of the spectrum. Conditions that were frequently comorbid with autistic-like conditions included the MR category (relatively severe disability) (2) and the Attention Deficit Hyperactivity Disorder, Predominantly Inattentive Type (ADHD) category (less severe disability) (10, 20, 39). The Anxiety Disorder (AnxD) category was chosen to represent a clinical condition that is typically not comorbid with autism spectrum disorders (2).

The initial sample consisted of 174 children aged 9–16 years (mean age = 12.09 years, sd = 2.20 years; 129 boys, 45 girls) selected on the basis of a DSM-IV diagnosis of AutD, AspD, ADHD, MR (Mild), AnxD, or on the basis of meeting criteria for No Psychological Disorder. Subjects were recruited from 34 hospitals, clinics, special education units, and schools in the Brisbane metropolitan region where potential subjects were identified by the institutions' staff. Detailed information on the diagnostic status of potential subjects was obtained from the responsible clinician (hospitals and clinics) or from files (school system). For file information, we verified that diagnosis was by a specialist practitioner and that the diagnosis was corroborated by test results, as appropriate. Subjects were excluded from participation if a) for AutD subjects, they met diagnostic criteria for any additional disorder other than MR, b) for MR

subjects, they met diagnostic criteria for any other disorder sampled in this study or the MR was a function of Down's Syndrome, and c) for ADHD, AspD, and AnxD subjects, they met diagnostic criteria for any other disorder sampled in this study (in order to reduce the possibility of complex interactions).

Data from seven subjects were excluded because a) a MR subject had an estimated IQ > 100, b) a NPD subject did not speak English, and c) five subjects had proscribed comorbid disorders. Remaining subjects were distributed across diagnostic categories as follows: NPD = 36 (m = 27), AutD = 20 (m = 17), MR = 34 (m = 18), ADHD = 35, (m = 31), AnxD = 14 (m = 7), and AspD = 28 (m = 24). Of these 167 subjects, 16 (male = 13) had a comorbid condition: AutD and MR in 11 cases; MR and Tourette's Disorder in one case; ADHD and Conduct Disorder in one case; ADHD and Tourette's Disorder in one case; AspD and Oppositional Defiant Disorder in one case; AnxD and Major Depressive Disorder in one case.

Among subjects with AnxD, five had not been given a diagnosis of an anxiety disorder but had an anxiety problem as defined by school counselors and obtained a score on the Children's Anxiety Scale (42) > 1.5 sd above the mean of the standardization sample. No NPD subject reported a history of psychological disorder or obtained a score in the "borderline clinical" range on any parent-rated Child Behavior Checklist scale (1). Thirty-nine subjects were taking psychotropic medication and 37 were "medicated" at the time of testing. Medication use was associated with a diagnosis of ADHD (n = 24), AutD (n = 7), AspD (n = 7), and AnxD (n = 1).

Subjects were individually assessed (an observer was present in two cases) where they were recruited. Test administration followed a standard order designed to maximize task-engagement. Testing typically required a single two-hour session. In 19 cases, testing was completed in two sessions approximately one week apart.

Materials

Materials included four Emotion Recognition Scales (ERS), a ToM test, and four subscales from the 3rd edition of the Wechsler Intelligence Scale for Children (48). The Children's Anxiety Scale (42) was used to screen for an AnxD and the Child Behavior Checklist (1) was used to screen for psychological disorder in NPD children.

Emotion recognition scales

The ERS are designed to measure the component abilities on which global empathic ability is hypothesized to depend. The present set of ERS includes four scales.

Facial cues test

The FCT measures the ability to recognize facial expressions of emotion. The FCT is a 32-item collection of color slides of Japanese and Caucasian men and women expressing one of seven emotions (anger, contempt, disgust, fear, happiness, sadness, surprise) or a neutral expression. There are four slides for each of the eight emotion categories (28). Slides are presented on a computer monitor and subjects are asked to identify the emotion. Responses are scored against a template of acceptable synonyms for each emotion category and correct responses are summed to yield a total score. In pilot studies of 90 preschool and primary school students, 120 older children and young adolescents, and 160 older adolescents and adults, the FCT was reliable ($\alpha = 0.88$), positively correlated with other ERS and with measures of IQ. The correlation with IQ was very strong in the youngest samples and became weaker as age increased; in adult samples, the correlation was not significant. Emotion recognition ability is established by age four years and has reached asymptote by age 12 years. The sexes do not differ in this emotion-recognition ability at any stage of development.

Comprehension test

The CT is an 11-item ordinal measure of the ability to understand the emotional consequences of exposure to a given emotion-eliciting context (e.g., Susan is given a new bicycle for her birthday. What will Susan feel?; see Appendix 1). CT items sample from the seven emotions represented in the FCT, "social variants" of the emotions (e.g., pride, embarrassment, shame, pity) and variations in the emotion intensity (e.g., terror versus fear). CT items also sample "material" (loss/gain of an object), "social" (interpersonal rejection), and "intrapsychic" (failure to achieve one's goals) causes of emotion. Answers are recorded on the test form and are scored on a three-point scale (based on conceptual scoring criteria and prototypic answers). The test is discontinued if a subject makes three consecutive incorrect (0) answers. In pilot studies of young children, adolescents, and adults, the CT was shown to have acceptable internal consistency ($\alpha = 0.85$), to be convergent with other EAS and with general cognitive ability, to discriminate between male and female adolescent and adult subjects, and to yield an interaction between age and gender across developmental epochs (female superiority beginning in adolescence and increasing with age).

Unexpected outcomes test

The UOT is a 12-item ordinal measure of the ability to apply reasoning skills and knowledge of the causes of emotions to explaining apparent incongruities between emotion-eliciting contexts and the emotions elicited by the contexts. Unlike other emotion recognition or understanding tasks, the UOT measures a developmentally "advanced" rather than a "basic" ability. Like the CT, UOT items describe a situation likely to cause an emotional response in a protagonist ("John finally persuades Susan to go to the movies with him"; see Appendix 2). Unlike the CT, the UOT items indicate the protagonist's emotional response ("On the way to the movies, John can hardly contain his anger"). In each case, the emotion is one not expected to occur in the situation. The test-taker is asked to provide additional situational information to resolve the apparent incongruity. Answers are recorded on the test booklet and are scored on a three-point scale (based on conceptual criteria and prototypic answers). The test is discontinued after three consecutive incorrect answers. Pilot studies of adolescents and adults have shown that the UOT is internally consistent ($\alpha = 0.82$), convergent with other emotion recognition and understanding tasks and with general cognitive ability, and discriminates between male and female adolescent and adult subjects.

Emotion vocabulary test (EVT)

The EVT is a 24-item test of a person's ability to define emotion words (e.g., what does the word "angry" mean? see Appendix 3). Because emotion vocabulary represents a limit to individual performance on other ERS, the words chosen for inclusion in the EVT are taken from the scoring keys of other ERS. The response format of the EVT is open-ended and initial responses may be queried to resolve ambiguities in the initial response. Responses are scored on a three-point scale against conceptual criteria and prototypic answers. Scoring procedures were evaluated and refined in two small-scale pilot studies of adult (n = 15) and adolescent (n = 15) samples; otherwise, no pilot data on the EVT were available.

Weschler intelligence scale for children-III

Cognitive ability was measured with four Wechsler Intelligence Scale for Children, 3rd edition (48) subscales – Vocabulary (WV), Information (WI), Block Design (WBD), and Picture Arrangement (WPA) – selected because they sample both verbal and performance ability, because of their strong relation to the full scale IQ (37), and because they assess strengths and weaknesses associated with autism (21). The tests have acceptable split-half and test-retest reliability and were validated in the context of assessing the validity of the Wechsler battery (48).

Strange stories test

The SST assesses the ability to provide context-appropriate mental state explanations for non-literal (irony, sarcasm, lies) statements (22). Deficits in this ability ostensibly account for interpersonal deficits in children with autism who pass so-called first and second order ToM of mind tests. Happe (22) has used the SST with autistic, mentally retarded, and normal children and adults; results indicate that children with autism perform less well on this task than do mentally retarded and normal children. The test consists of 12 stories (one example of each of 12 different forms of non-literal statement), each accompanied by a picture. Subjects are first asked to indicate whether a statement made by the protagonist of the story ("this banana is a telephone") is true or false as a way of establishing whether the subject has understood the story. Subjects are then asked to explain why the statement was made. Explanations are scored "1" if an adequate explanation is provided; responses are coded to indicate whether the explanation relied on reference to mental states ("the protagonist was pretending") or on physical states ("a banana is shaped like a telephone").

Results

Preliminary analyses

Prior to evaluating our hypotheses, we checked the reliability and validity of the emotion recognition and understanding tasks. Table 1 (on the diagonal) shows that the reliability of the emotion recognition tasks,

Table 1 Correlation matrix: all variables

	CT	EVT	FCT	UOT	WVD	WI	WPA	WV	SST
CT	64								
EVT	65	88							
FCT	56	73	74						
UOT	55	70	53	73					
WBD	37	60	45	50	87				
WI	63	79	65	65	67	88			
WPA	52	67	53	62	63	65	84		
WV	66	85	70	67	60	86	62	91	
SST	61	77	66	58	47	71	62	75	85

Note: Decimals have been omitted from the Table
Alpha coefficients appear in the diagonal
All correlation coefficients are statistically significant at the 0.01 level
CT Comprehension Test; *EVT* Emotion Vocabulary Test; *FCT* Facial Cues Test; *UOT* Unexpected Outcomes Test; *WBD* Wechsler Block Design; *WI* Wechsler Information; *WPA* Wechsler Picture Arrangement; *WV* Wechsler Vocabulary; *SST* Strange Stories Test

although lower than observed in pilot studies of non-clinical subjects, remains at an acceptable level. Table 1 also shows that emotion recognition measures are moderately to strongly related to each other, to the ToM task, and to the intelligence tests. Indeed, the pattern of strong correlation between measures of intelligence, ToM, and empathic recognition ability confirms the need to control for this covariation when assessing group differences on measures of any one construct.

In order to obtain an estimate of general cognitive ability (IQ) and an estimate of general empathic ability (EA), we created two composite variables. IQ was estimated by summing the standardized scores (z-scores) on the four Wechsler subscales (Block Design, Picture Arrangement, Information, and Vocabulary). This procedure results in estimates of general cognitive ability relative to other subjects in the sample rather than to standard developmental norms. EA was estimated by summing standardized scores on the four Emotion Recognition Scales. The ToM scale was excluded from the composite variable in order to assess whether ToM and EA make independent contributions to discriminating between clinical groups.

Correlation analyses indicate that the composite variables are strongly related to each other and to the ToM measure. The correlation between EA and IQ is $r = 0.84$, between IQ and ToM is $r = 0.77$, and between EA and ToM is $r = 0.78$, all significant at the 0.001 level. Notwithstanding these strong correlations across the sample as a whole, a plot of diagnosis by mean scores on the IQ, EA, and ToM measures suggests that the relations between the tests vary as a function of diagnostic group (see Fig. 1).

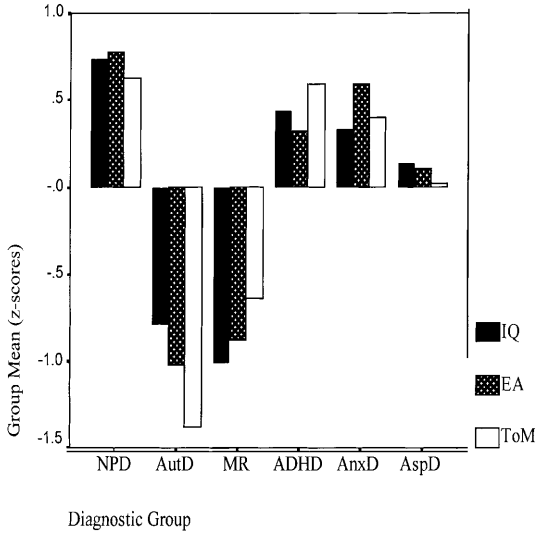

Fig. 1 Performance on Composite Measures of Cognitive Ability (IQ) and Empathic (EA) Ability and on a Theory of Mind (ToM) Test by Diagnosis

Expected group differences in theory of mind, empathic ability, and cognitive ability

Clinical groups were chosen because they were expected to differ significantly from each other along an autism spectrum, along some other severity spectrum, or because they would not show a deficit on the dependent measures used in this study. In order to assess whether our expectations were accurate, we conducted a series of planned comparisons. For each contrast, we first tested for equality of variances. Where variances were unequal, we used Levene's t-test for unequal variances. Means and standard deviations for each of the measures and composite variables by clinical group are reported in Table 2; a summary of statistical analyses of group differences on the composite variables is reported in Table 3.

Autism spectrum disorders were expected to differ on EA and ToM measures as follows: NPD > AspD > AutD. Table 3 shows that the results were consistent with expectation. Children with NPD obtained significantly higher EA scores than children with AspD [$t(62) = 3.49$, $p < 0.001$] and significantly higher ToM scores than children with AspD [$t(62) = 2.70$, $p < 0.001$]. Children with AspD, in turn, obtained significantly higher estimated EA scores than children with AutD [$t(46) = 3.95$, $p < 0.001$] and significantly higher ToM scores than children with AutD [$t(33.39) = 4.39$, $p < 0.001$].

Non-spectrum disorders were expected to differ on IQ measures as follows: NPD > ADHD > MR. Table 3 shows that the results were consistent with expectation. Children with NPD obtained significantly higher IQ scores than children with ADHD [$t(69) = 2.32$, $p < 0.05$] who in turn obtained significantly higher IQ scores than children with MR [$t(67) = 10.93$, $p < 0.001$].

Children with an AnxD were not expected to differ from children with NPD on any measure. Consistent with expectation, Table 3 shows that children with AnxD did not differ from children with NPD on IQ, on EA, or on ToM scores.

Specificity of EA deficits to autism spectrum disorders

Although clinical groups differed from each other as expected, the results presented in Table 3 indicate that deficits in empathic ability are not specific to the autism spectrum. Subjects with MR have EA deficits comparable to subjects with AutD and subjects with ADHD have EA deficits comparable to subjects with AspD (all significantly lower than NPD control subjects). Similarly, subjects with AutD have IQ deficits comparable to subjects with MR and subjects

Table 2 Means and standard deviations for all variables, by diagnosis

	NPD		AutD		MR		ADHD		AnxD		AspD	
	M	sd	M	sd	M	sd	M	sd	M	sd	M	sd
CT	12.36	2.15	8.20	3.96	9.17	2.00	11.48	2.44	11.57	3.25	10.35	3.15
EVT	24.33	6.86	8.40	9.20	6.88	4.71	19.85	6.11	21.85	8.72	18.85	8.74
FCT	20.27	3.12	12.15	5.90	13.08	4.12	18.25	3.82	21.42	3.75	18.92	4.12
UOT	7.94	3.75	2.20	3.10	2.70	1.81	6.45	3.25	6.64	4.66	4.96	3.72
WBD	43.11	12.81	28.90	17.79	19.11	9.20	38.37	13.57	34.57	18.44	38.00	14.86
WI	18.50	4.51	11.00	7.33	9.23	2.80	16.74	2.98	16.14	4.07	15.39	4.51
WPA	36.47	11.35	18.25	12.81	17.08	10.85	35.77	12.70	32.35	15.34	28.85	10.98
WV	31.94	7.38	15.90	12.94	15.58	4.37	28.11	6.46	28.64	10.16	25.21	8.68
SST	10.38	1.67	3.85	3.93	6.26	2.46	10.25	1.19	9.64	1.59	8.42	2.93
EstIQ	3.08	3.03	−3.51	5.15	−4.42	2.30	1.77	2.40	1.35	3.90	0.51	3.23
EstEA	2.43	2.15	−3.48	3.68	−3.02	1.43	0.94	1.80	1.83	3.38	0.24	2.85

CT Comprehension Test; *EVT* Emotion Vocabulary Test; *FCT* Facial Cues Test; *UOT* Unexpected Outcomes Test; *WBD* Wechsler Block Design; *WI* Wechsler Information; *WPA* Wechsler Picture Arrangement; *WV* Wechsler Vocabulary; *SST* Strange Stories Test; *EstIQ* Estimated General Cognitive Ability; *EstEA* Estimated General Empathic Ability

with AspD have IQ deficits comparable to subjects with ADHD (all significantly lower than NPD control subjects). These results are consistent with the fact that disorders like AutD and MR are frequently comorbid (as in this study), but they also confirm the need to assess whether the specific disability (empathy) is a function of the general disability (intelligence). In order to determine if group differences on EA (and ToM) are a function of group differences in IQ, we conducted analyses of covariance in which estimated IQ scores were covaried.

Table 4 shows that when cognitive ability is covaried, the contrast between NPD and AutD subjects is unchanged. The AutD group obtains significantly lower scores than the NPD group on both EA [$F(1, 53) = 12.44$, $p < 0.001$] and ToM [$F(1, 53) = 22.73$, $p < 0.001$]. However, subjects with a diagnosis of AspD no longer occupy an intermediate position on the empathic ability dimension; the AspD group does not differ in empathic ability from the NPD or the AutD

Table 3 Differences Between Clinical Groups on Intellectual Ability, Empathic Ability, and Theory of Mind Ability (Strange Stories Test)

	NPD	AutD	MR	ADHD	AnxD	AspD
NPD		IQ+ EA+ ToM+	IQ+ EA+ ToM+	IQ+ EA+ ToM=	IQ= EA= ToM=	IQ+ EA+ ToM+
AutD	IQ− EA− TOM−		IQ= EA= ToM−	IQ− EA− ToM−	IQ− EA− ToM−	IQ− EA− ToM−
MR	IQ− EA− TOM−	IQ= EA= TOM+		IQ− EA− ToM−	IQ− EA− ToM−	IQ− EA− ToM−
ADHD	IQ− EA− TOM=	IQ+ EA+ TOM+	IQ+ EA+ TOM+		IQ= EA= ToM=	IQ= EA= ToM+
AnxD	IQ= EA= TOM=	IQ+ EA+ TOM+	IQ+ EA+ TOM+	IQ= EA= TOM=		IQ= EA= ToM=
AspD	IQ− EA− TOM−	IQ+ EA+ TOM+	IQ+ EA+ TOM+	IQ= EA= TOM−	IQ= EA= TOM=	

Note: In this Table, a plus sign (+) following a variable indicates that the Row group obtained significantly higher scores than the Column group; a minus sign (−) indicates that the Row group obtained significantly lower scores than the Column group; an equal sign (=) indicates no significant between-group differences. All between group differences are statistically significant at the 0.05 level (independent t-test where variances are equal; Levene's test where variances are unequal)

NPD No Psychological Disorder; *AutD* Autistic Disorder; *MR* Mental Retardation; *ADHD* Attention Deficit Hyperactivity Disorder; *AnxD* Anxiety Disorder; *AspD* Asperger's Disorder; *IQ* estimated general cognitive ability; *EA* estimated general empathic ability; *ToM* Theory of Mind ability measured by the Strange Stories Test

Table 4 Differences Between Clinical Groups in Empathic Ability and Theory of Mind Ability When General Cognitive Ability is Covaried

	NPD	AutD	MR	ADHD	AnxD	AspD
NPD		EA+ ToM+	EA+ ToM=	EA+ ToM=	EA= ToM=	EA= ToM=
AutD	EA− TOM−		EA− ToM−	EA− ToM−	EA− ToM−	EA= ToM−
MR	EA− TOM=	EA+ TOM+		EA− ToM−	EA− ToM=	EA= ToM=
ADHD	EA− TOM=	EA+ TOM+	EA+ TOM+		EA− ToM=	EA= ToM+
AnxD	EA= TOM=	EA+ TOM+	EA+ ToM=	EA+ ToM=		EA= ToM=
AspD	EA= ToM=	EA= ToM+	EA= TOM=	EA= ToM−	EA= ToM=	

Note: In this Table, a plus sign (+) following a variable indicates that the Row group obtained significantly higher scores than the Column group; a minus sign (−) indicates that the Row group obtained significantly lower scores than the Column group; an equal sign (=) indicates no significant between-group differences. All between group differences are statistically significant at the .05 level (independent t-test where variances are equal; Levene's test where variances are unequal)

NPD No Psychological Disorder; *AutD* Autistic Disorder; *MR* Mental Retardation; *ADHD* Attention Deficit Hyperactivity Disorder; *AnxD* Anxiety Disorder; *AspD* Asperger's Disorder; *EA* estimated general empathic ability; *ToM* Theory of Mind ability measured by the Strange Stories Test

group. In terms of ToM ability, when cognitive ability is covaried, the AspD group does not differ from the NPD group but does obtain significantly higher scores than the AutD group [$F(1, 45) = 8.17$, $p < 0.01$].

Although the AspD group did not occupy an intermediate position on the empathic ability dimension, both the MR and ADHD groups were observed to occupy intermediate positions on the empathic ability dimension when cognitive ability was covaried. Table 4 shows that the EA scores of the ADHD group were significantly lower than those of the NPD group [$F(1, 68) = 3.64$, $p < 0.05$], the EA scores of the MR group were significantly lower than those of the ADHD group [$F(1, 66) = 8.72$, $p < 0.01$], and the EA scores of the AutD group were significantly lower than those of the MR group [$F(1, 51) = 5.46$, $p < 0.05$]. A similar pattern was observed for ToM scores. Although the NPD and ADHD groups did not differ from each other, the MR group obtained significantly lower ToM scores than did the ADHD group [$F(1, 66) = 4.42$, $p < 0.05$] and the AutD group obtained significantly lower ToM scores than did the MR group [$F(1, 51) = 23.79$, $p < 0.001$] when IQ scores were covaried.

Discussion

The general aim of this research was to increase our understanding of how broadly defined empathic ability deficits relate to autism spectrum disorders by assessing the utility of both a ToM measure and a composite dimensional measure of empathic ability in a) discriminating among groups of subjects with different autism spectrum disorders and b) discriminating between groups of subjects with autism spectrum and non-spectrum disorders. The results clearly demonstrate the utility of empathic ability measures in assessing the severity of empathy deficits across both the autism spectrum and other disorders, and suggest their utility – when used in combination with cognitive ability measures – in distinguishing autism spectrum from other disorders. The need for caution about discriminating autism spectrum from non-spectrum disorders arises because a) empathic ability deficits in an autism spectrum group (AspD) appeared to be a function of cognitive ability deficits and b) empathic ability deficits in two non-spectrum groups (ADHD and MR) were disproportionate to their respective cognitive ability deficits.

Discriminating among autism spectrum disorders

A combination of ERS clearly discriminated AutD from AspD, and AspD from NPD groups, which suggests that the ERS are sensitive to the ability deficits that define these disorders. However, the fact that the AspD group did not differ in empathic ability from the AutD, MR or NPD groups when cognitive ability was covaried implies that the AspD group did not, in fact, have a specific empathic ability deficit. Rather, deficits in EA were closely comparable to deficits in both IQ and ToM ability. There are two main alternative explanations for this result.

The rationale for measuring EA in addition to measuring IQ is to determine whether there exists an empathic ability deficit greater than any other deficits that may be present in a given case. Because measures of EA have not been available, clinicians have been ill-placed to judge whether any qualitative impairments in a child's social interaction were greater than, less than, or equivalent to any delays in cognitive development or other skills and abilities. When a child's social interaction is clearly impaired, but the child's cognitive development is not so delayed as to constitute mild MR (e.g., IQ = 75–85), it is understandable that a clinician would decide that the impairment in social interaction occurred in the absence of other clinically significant developmental delays. Our results may mean that when developmental delay in the abilities that are presumably necessary for social interaction is measured, the deficits associated with AspD are no greater than the other deficits of these children. Indeed, it may well be the case that some impairments in social interaction occur (or are remarked upon) only because the broader developmental delay has not been taken into account (cf. 14, 27, 31, 46).

Alternatively, we need to acknowledge that a systematic sampling bias (misdiagnosis) may have resulted in the assignment of children with some other disorder to the AspD group. Because our naturalistic subject selection procedures did not permit us to conduct substantial checks on the reliability of diagnoses, this possibility cannot be ruled out. However, of the 28 children in the AspD group, ten had been diagnosed by one clinician, five by another clinician, and the remaining 13 by other clinicians. When we compared these three subgroups on all of our dependent measures in post hoc tests, no differences were evident (or suggested). If there is a problem in how our AspD subjects were diagnosed, it is a problem that appears to be common to the region (14).

Discriminating between autism spectrum and non-spectrum disorders

Our results are consistent with other studies demonstrating that EA (and ToM) deficits are not specific to AutD or to the autism spectrum. All groups except

AnxD differed from NPD controls on EA, and all groups except AnxD and ADHD differed from NPD controls on ToM ability. Where different disorders can, perhaps, be differentiated from each other is by the patterns of IQ, EA, and ToM deficits. Children with AutD have pronounced ToM deficits that distinguish them from all other groups even when IQ is covaried; conversely, children with ADHD have no ToM deficits (even when IQ is not covaried), but do have EA deficits compared with NPD and AnxD controls (when IQ is covaried). The extent to which EA (and IQ and ToM) deficits are common to different categories of child psychopathology implies that the observation of any given deficit is unlikely to be informative about the class of disorder of which the deficit is symptomatic. Rather, the observation of any given deficit implies the need to assess whether the deficit is greater than, less than, or equivalent to that observed in other ability domains. Although they clearly need to be validated against actual social behavior, measurement tools like the ERS may prove useful in making these assessments.

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References

1. Achenbach T (1991) Manual for the Child Behavior Checklist: 4 – 18 and 1991 Profile. University of Vermont, Department of Psychiatry, Burlington, VT
2. APA (1994) Diagnostic and statistical manual of mental disorders (4th ed) Washington, DC
3. Bachara G, Raphael J, Phelan W (1980) Empathy development in deaf adolescents. American Annals of the Deaf 125:38–41
4. Baron-Cohen S (1995) Mindblindness: an essay on autism and theory of mind. MIT Press, Cambridge, MA
5. Baron-Cohen S (1995b) Theory of Mind and Face Processing: How Do They Interact in Development and Psychopathology? In: Cicchetti D, Cohen DJ (eds) Developmental Psychopathology: Theory and Methods. vol. 1. John Wiley & Sons, New York, pp 343–356
6. Baron-Cohen S, Jolliffe T, Mortimore C, Robertson M (1997) Another advanced test of theory of mind: evidence from very high functioning adults with autism or Asperger Syndrome. Journal of Child Psychology and Psychiatry 38:813–822
7. Baron-Cohen S, Leslie A, Frith U (1985) Does the autistic child have a theory of mind? Cognition 21:37–46
8. Brown R, Hobson R, Lee A, Stevenson J (1997) Are there "autistic-like" features in congenitally blind children? Journal of Child Psychology and Psychiatry 38:693–703
9. Buitelaar J, Van der Wees M (1997) Are deficits in the decoding of affective cues and in mentalizing abilities independent? Journal of Autism and Developmental Disorders 27:539–556
10. Buitelaar J, Van der Wees M, Swabb-Barneveld H, Van der Gaag R (1999) Theory of mind and emotion recognition functioning in autistic spectrum disorders and in psychiatric control and normal children. Development and Psychopathology 11:39–58
11. Dahlgren S, Trillingsgaard A (1996) Theory of mind in non-retarded children with autism and Asperger's syndrome: a research note. Journal of Child Psychology and Psychiatry 37: 759–763
12. Dunn J (1995) Children as psychologists: the later correlates of individual differences in understanding of emotions and other minds. Cognition and Emotion 9:187–201
13. Eisenberg N, Murphy B, Shepard S (1996) The Development of Empathic Accuracy. In: Ickes W (ed) Empathic Accuracy. Guilford Press, New York, pp 73–115
14. Eisenmajer R, Prior M, Leekam S, Wing L, Gould J, Welham M, Ong B (1996) Comparison of clinical symptoms in autism and Asperger's disorder. Journal of the American Academy of Child and Adolescent Psychiatry 35:1523–1531
15. Flavell J (1992) Perspectives on Perspective-taking. In: Beilin H, Pufall P (eds) Piaget's Theory: Prospects and Possibilities. Erlbaum, Hillsdale, NJ, pp 107–139
16. Fombonne E, Siddons F, Achard S, Frith U (1994) Adaptive behaviour and theory of mind in autism. European Child and Adolescent Psychiatry 3:176–186
17. Frith U (1996) Social communication and its disorder in autism and Asperger syndrome. Journal of Psychopharmacology 10:48–53
18. Gillberg C (1992) Autism and autistic-like conditions: subclasses among disorders of empathy. Journal of Child Psychology and Psychiatry 33:813–842
19. Gillberg C (1993) Autism and related behaviours. Journal of Intellectual Disability Research 37:343–372
20. Greene R, Biederman J, Faraone S, Sienna M, Garcia-Jetton J (1997) Adolescent outcome of boys with attention-deficit/hyperactivity disorder and social disability: results from a 4-year follow-up study. Journal of Consulting and Clinical Psychology 65:758–767
21. Happé F (1994a) Wechsler IQ profile and theory of mind in autism: a research note. Journal of Child Psychology and Psychiatry 35:1461–1471
22. Happé F (1994b) An advanced test of theory of mind: understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. Journal of Autism and Developmental Disorders 24:129–154
23. Hobson R, Ouston J, Lee A (1988) Emotion recognition in autism: coordinating faces and voices. Psychological Medicine 18:911–923
24. Hobson R, Ouston J, Lee A (1989) Naming emotion in faces and voices: abilities and disabilities in autism and mental retardation. British Journal of Developmental Psychology 7:237–250
25. Holroyd S, Baron-Cohen S (1993) Brief report: how far can people with autism go in developing a theory of mind? Journal of Autism and Developmental Disorders 23:379–385
26. Loveland K, Tunali-Kotoski B, Chen Y, Ortegon J, Pearson D, Brelsford K, Gibbs M (1997) Emotion recognition in autism: verbal and nonverbal information. Development and Psychopathology 9:579–593
27. Mahoney W, Szatmari P, MacLean J, Bryson S, Bartolucci G, Walter S, Jones M, Zwaigenbaum L (1998) Reliability and accuracy of differentiating pervasive developmental disorder subtypes. Journal of the American Academy of Child and Adolescent Psychiatry 37:278–285
28. Matsumoto D, Ekman P (1995) Japanese And Caucasian Facial Expressions Of Emotion (JACFEE) And Neutral

Faces (JACNeuF). San Francisco State University, San Francisco
29. McGregor E, Whiten A, Blackburn P (1998) Teaching theory of mind by highlighting intention and illustrating thoughts: a comparison of their effectiveness with 3-year olds and autistic individuals. British Journal of Developmental Psychology 16:281–300
30. Minter M, Hobson R, Bishop M (1998) Congenital visual impairment and "theory of mind." British Journal of Developmental Psychology 16:183–196
31. Myrh G (1998) Autism and other pervasive developmental disorders: exploring the dimensional view. Canadian Journal of Psychiatry 43:589–595
32. Ozonoff S, McEvoy R (1994) A longitudinal study of executive function and theory of mind development in autism. Development and Psychopathology 6:415–431
33. Peterson C, Siegal M (1995) Deafness, conversation, and theory of mind. Journal of Child Psychology and Psychiatry 36:459–474
34. Peterson C, Siegal M (1998) Changing focus on the representational mind: deaf, autistic, and normal children's concepts of false photos, false drawings and false beliefs. British Journal of Developmental Psychology 16:301–320
35. Phillips W, Baron-Cohen S, Rutter M (1998) Understanding intention in normal development and in autism. British Journal of Developmental Psychology 16:337–348
36. Prior M, Dahlstrom B, Squires TL (1990) Autistic children's knowledge of thinking and feeling states in other people. Journal of Child Psychology and Psychiatry 31:587–601
37. Sattler J (1974) Assessment of Children's Intelligence (rev. reprint). WB Saunders Company, Toronto
38. Scott F, Baron-Cohen S (1996) Logical, analogical, and psychological reasoning in autism: a test of the Cosmides theory. Development and Psychopathology 8:235–245
39. Seidman L, Biederman J, Faraone S, Weber W (1997) A pilot study of neuropsychological function in girls with ADHD. Journal of the American Academy of Child and Adolescent Psychiatry 36:366–373
40. Smalley S, Asarnow R (1990) Brief report: cognitive subclinical markers in autism. Journal of Autism and Developmental Disorders 20:271–278
41. Sparrevohn R, Howie P (1995) Theory of mind in children with autistic disorder. Evidence of developmental progression and the role of verbal ability. Journal of Child Psychology and Psychiatry 36: 249–263
42. Spence S (1988) A measure of anxiety symptoms among children. Behaviour Research and Therapy 36:545–566
43. Steffenburg S (1991) Neuropsychiatric assessment of children with autism: a population-based study. Developmental Medicine and Child Neurology 33:495–511
44. Swettenham J (1996) Can children be taught to understand false belief using computers? Journal of Child Psychology and Psychiatry 37:157–165
45. Tager-Flusberg H, Sullivan K (1995) Attributing mental states to story characters: a comparison of narratives produced by autistic and mentally retarded individuals. Applied Psycholinguistics 16:241–256
46. Tanguay P, Robertson J, Derrick A (1998) A dimensional classification of autism spectrum disorder by social communication domains. Journal of the American Academy of Child and Adolescent Psychiatry 37:271–277
47. Walter B (1958) On childhood autism, particularly in deaf-and-mute children. Tijdscrift voor Opvoedkunde 3:224–251
48. Wechsler D (1991) Wechsler Intelligence Scale for Children (WISC-III) manual. The Psychological Corporation, San Antonio, TX
49. Wimmer H, Perner J (1983) Beliefs about beliefs: representation and constraining function of wrong beliefs in children's understanding of deception. Cognition 13:103–128
50. Yirmiya N, Shulman C (1996) Seriation, conservation, and theory of mind abilities in individuals with autism, individuals with mental retardation, and normally developing children. Child Development 67:2045–2059
51. Yirmiya N, Solomonica-Levi D, Shulman C (1996) The ability to manipulate behavior and to understand manipulation of beliefs: a comparison of individuals with autism, mental retardation, and normal development. Developmental Psychology 32:62–69
52. Yirmiya N, Solomonica-Levi D, Shulman C, Pilowski T (1996) Theory of mind abilities in individuals with autism, Down syndrome, and mental retardation of unknown etiology: the role of age and intelligence. Journal of Child Psychology and Psychiatry 37:1003–1014
53. Zelazo P, Burack J, Benedetto E, Frye D (1996) Theory of mind and rule use in individuals with Down's Syndrome: a test of the uniqueness and specificity claims. Journal of Child Psychology and Psychiatry 37:479–484
54. Ziatas K, Durkin K, Pratt C (1998) Belief term development in children with Autism, Asperger syndrome, specific language impairment, and normal development: links to theory of mind development. Journal of Child Psychology and Psychiatry 39:755–763

Appendix 1

ERS comprehension test: item list

1. Susan is given a new bicycle for her birthday. What will Susan feel?
2. When Mary and her mother came home they found that someone had stolen everything in the house. What does Mary feel?
3. Brett was going to go fishing with this father, but the car broke down and so they had to stay at home. What does Brett feel?
4. Susan looks at the window that she has just broken in her neighbour's house. What does Susan feel?
5. Cathy runs across the street and suddenly hears the screech of skidding car tires. What does Cathy feel?
6. He could have called after her, but Tom just watched her go. She didn't look back. He waited until she was out of sight before he too turned, his feet kicking at the dust in the street as he slowly made his way home. What does Tom feel?
7. Cathy is already late for the game with her friends, but she is not allowed to go until she finds

her jacket, and she can't find her jacket. What does Cathy feel?
8. Tom reads the list of students chosen for the school team. Tom's name is at the top of the list. What does Tom feel?
9. Tom was aware of the people who were watching as he placed the golf ball on the tee, and got ready to hit the ball. Tom thinks about the last time he played golf at this place and about how people laughed when he tried to hit the ball. What does Tom feel?
10. Emma pushed herself out of bed. She was still tired. Even though she was only just awake, she was already thinking about the night before. There was so much to do, and so little time to do it. What does Emma feel?
11. It looked perfect: the settings of bone china and fine crystal, the tall candles with their gentle flames, the soft music in the background, and the tasty food. She sat at one place, and Tom sat at the other, and each one looked as unnatural as a robot in a 50's movie. What does Tom feel?

Appendix 2

ERS unexpected outcomes test: item list

1. Now I'm going to tell you another story. In this story, a little boy called Johnny gets a new bicycle for Christmas. What do you think Johnny would feel? Happy? Well, Johnny didn't feel happy. He started to cry. Why would Johnny cry?
2. Here's another story. In this story, Sean has an ice-cream cone, but he drops it on the ground. How do you think Sean would feel? Sad? Angry? What Sean did was laugh. Why would Sean laugh when he dropped his ice-cream on the ground?
3. This story is about a girl named Lisa. Lisa wants a job very much, and one day she gets a letter telling her that she can have just the job she wants. What does Lisa do? She starts to cry. Why would Lisa be crying?
4. Peter is a man who has been bad, so bad that he has had to go to court. In the court, the judge tells Peter that Peter will have to go to jail for 15 years – a very long time. When Peter hears this, he starts to smile a very big smile. Why would Peter be smiling?
5. Joan is a woman who, one day, has a baby, a very healthy baby. Joan starts to cry and cry and cry. Why would Joan be crying?
6. In this story, John likes a girl called Susan, and he wants her to go to the movies with him. When he asks her, she says yes. At first, he is happy, but when they are on their way to the movies, he is very angry. Why would John be angry?
7. Joyce is sitting with some other people. All these people are looking at Joyce as though they are mad at her. What does Joyce do? She yawns. Why would Joyce yawn?
8. Mary and June were in a meeting together. The meeting was very uncomfortable; everyone was getting very tense. Then Mary said: "Okay June, I was wrong, I'm sorry." What did June do? June burst into tears. Why would June start crying?
9. John went fishing with his father. Together they caught fish, and more fish, and more fish – and all of them very nice fish, too. So what did John do? John bowed his head. Why would John bow his head?
10. Ian wants a girlfriend, and one day, he meets a girl who he likes very very much. In fact, Ian likes this girl far more than he has ever liked a girl before. And this girl seems to like Ian just as much – and maybe more – as he likes her. What does Ian do? Ian laughs and laughs and laughs. Why would Ian laugh?
11. Mary was very tired. All of her muscles were tired. So she took a shower and could feel the lovely feeling of the steaming hot water helping her to relax. What did Mary do then? Mary smashed her fist into the wall. Why would Mary smash her fist into the wall?
12. Mary was bored. She talked and talked and talked about what a boring day she had just had. And while Mary was talking, her friend June started to cry, just a little bit. What did Mary do? Mary just kept talking. Why would Mary just keep talking?

Appendix 3

ERS emotion vocabulary test: item list

1. What does happy mean?
2. What does angry mean?
3. What does fear mean?
4. What does sadness mean?
5. What does surprise mean?
6. What does disgust mean?
7. What does curious mean?
8. What does thrilled mean?
9. What does terror mean?
10. What does joy mean?
11. What does jealous mean?
12. What does proud mean?
13. What does contempt mean?
14. What does guilt mean?
15. What does embarrassed mean?
16. What does panic mean?
17. What does disappointed mean?

18. What does regretful mean?
19. What does envious mean?
20. What does feeling abandoned mean?
21. What does resentment mean?
22. What does feeling violated mean?
23. What does ashamed mean?
24. What does feeling betrayed mean?