Journal of Autism and Developmental Disorders, Vol. 12, No. 4, 1982

Sex Differences in Autism[1]

Catherine Lord[2]
Glenrose Hospital, University of Alberta School of Medicine, Edmonton

Eric Schopler
University of North Carolina, Chapel Hill

Dennis Revicki
Eastern Carolina University School of Medicine

Comparisons were made between male and female children with autism, 384 boys and 91 girls, aged 3 years to 8 years, on nonverbal measures of intelligence, adaptive functioning, receptive vocabulary, perception, and eye-hand integration, and on ratings of affect, play, and relating and human interest. Males showed more advanced performances on eye-hand integration and perception skills on the Psychoeducational Profile (PEP) and had higher nonverbal IQs social quotients, and Peabody Picture Vocabulary Test (PPVT) IQs than females. When nonverbal IQ was controlled, the main effect of sex remained; however, sex differences on PPVT scores and on eye-hand integration and perception scale disappeared. Males showed more unusual visual responses and less appropriate, more stereotypic play than females. These results are discussed in terms of hypotheses concerning sex differences in genetic thresholds and in hemispheric lateralization.

A sex difference in the incidence of autism as large as four males to one female has been reported for many years (Coleman, 1978; Wing, 1976), yet relatively little is known about whether the pattern of autistic symptoms is also different in the two sexes. Females account for a relatively

[1]Our thanks are extended to the parents and children who participated in the initial TEACCH diagnostics, and to Robert DeVellis and Barbara Renner for help with computer programming and statistical advice.

[2]Address all correspondence to Catherine Lord, Department of Psychology, Glenrose Hospital, 10230-111 Avenue, Edmonton, Alberta, Canada T5G OB7.

0162-3257/82/1200-0317$03.00/0

small proportion of individuals with autism, which is itself a relatively rare disorder. Autistic girls and women have seldom been observed or studied separately from autistic boys and men. Since they are few in number, females with autism are often combined with three or four times as many males or even excluded from research. When possible sex differences in autistic characteristics have been studied directly, as by Prior and Bradshaw (1979), small sample sizes and large individual variation make it difficult to rule out important group differences on the basis of failures to find statistically significant results. Similarly, most papers that *have* found sex differences have also been based on relatively small numbers of subjects (Coleman, 1978; Symmes, 1976).

Some investigators have observed a greater proportion of autistic males than females in higher (IQ > 70) ranges of intelligence (Brask, cited in Wing, 1981; Lotter, 1974). However, only recently have two papers, one by Lorna Wing (1981) and another by Tsai, Stewart, and August (1981), directly addressed the question of sex differences in autism and related conditions. In a study of 102 autistic children, of which 24 were girls, Tsai et al. (1981) found that females were significantly lower in intelligence, were more likely to show evidence of brain damage (e.g., an abnormal EEG), and had more first-degree relatives affected with autism than did males. The authors used these findings to propose that if autism is inherited, the specific mechanism of inheritance may involve multifactorial transmission.

Wing (1981) also compared the measured intelligence of boys and girls with autism. However, Wing's primary concern was to determine the *sex ratios* of autistic children, children with other social and language impairments, and children with severe retardation without specific impairments in communication or social ability. In recent years, Wing has treated autism as a subgroup within a more general condition that she terms the "triad of language and social impairments" (Wing, Gould, Yeates, & Brierley, 1977), which includes social impairments, language deficits, and the substitution of repetitive, stereotypic activities for imaginative play. Classical autism is differentiated by Wing from the more general triad by a history of extreme aloofness, as opposed to less severe social impairment, and by elaborate and obsessive repetitive routines, as opposed to simpler stereotypic behaviors. In her 1981 paper Wing indicated that male:female sex ratios were much greater for children with autism, across intellectual levels, and for children with other social and language impairments who showed only moderate retardation or less (IQ > 50) than for severely retarded children (IQ < 50) with or without social and language impairments. Wing's study is particularly important since it provides geographically based epidemiological data rather than working from clinic or referral populations and so is less open to criticisms of selection bias than other studies. However, the results are limited by the small number of autistic children found in the particular area (16 boys, 1 girl).

On the basis of the above results, Wing offered some interesting speculations about the relationship between sex differences in the normal population (Maccoby & Jacklin, 1975) and differences in sex ratios for autism and related disorders. Wing noted that sex differences have been repeatedly found in the general population such that males as a group are described as superior in visuo-spatial skills while females as a group are seen to be superior in language development. *If* these differences are constitutional, then "it could be suggested that boys are more susceptible to the types of language and communication problems characteristic of autism and related conditions, but, when they lack these skills, they are more likely than girls to have some useful visuo-spatial abilities. Girls would be less vulnerable to loss of language and communication skills, but when they were affected, would be less likely to have compensatory visuo-spatial abilities and would therefore be more likely to function as profoundly retarded" (Wing, 1981, p. 135).

While, as Wing herself points out, there are a number of facts that do not fit with this formulation (e.g., sex differences in the normal population are most apparent during adolescence), the above hypothesis could account for the excessive number of males as compared to females with autism in Wing's epidemiological study: In order to develop routines of sufficient elaboration to be placed in the subgroup defined as autistic according to Wing's criteria, a child would need relatively strong visuo-spatial skills and abilities in manipulating objects. According to the hypothesis above, these abilities would be more likely found in boys than in girls. Wing suggested that further evidence for this hypothesis, which does not seem to be available at this time, might be that females are superior to males in social areas and less vulnerable than males to social impairments as well as language impairments.

The current paper presents data from 384 male and 91 female autistic children between the ages of 3 and 8 years, inclusive. These data were collected at each child's initial diagnostic assessment at the TEACCH program, an outpatient, developmentally based treatment center for children and adolescents with severe disorders of communication. Only children who were rated as mildly to severely autistic on the Childhood Autism Rating Scale (CARS) (Schopler, Reichler, DeVellis, & Daly, 1980) were included in the study. The present paper is an attempt to look more closely at sex differences on a number of different cognitive and affective dimensions within an autistic population.

First, a larger sample within a narrower age range was used to replicate sex differences found most recently by Tsai et al. (1981) and Wing

(1981) in the intelligence of children with autism. In addition, a measure of adaptive functioning, the Vineland Social Maturity Scale (Doll, 1965), is also provided for each child. The purpose of the Vineland Social Maturity Scale is to provide another measure of level of functioning that may be less confounded with visuo-spatial skills than the nonverbal intelligence tests typically administered to children with autism (see below).

Second, males and females *with* autism are compared on a variety of measures relating to visuo-spatial skills and interest in visual stimuli. Taking Wing's speculations one step further, the question is raised as to whether, within the syndrome of autism, males and females differ in terms of interest and abilities to perceive visual and spatial relationships and to use these relationships to better organize the use of objects. It is also proposed that if autistic males, as opposed to females with autism, do show more advanced visuo-spatial behavior in appropriate contexts, males might also be expected to show more frequent inappropriate visual interests and use of objects in space (e.g., elaborate routines). Scores on eye-hand integration and perception scales of the Psychoeducational Profile (PEP) (Schopler & Reichler, 1979) are compared across sex. In order to test Wing's hypothesis concerning stronger language skills in females than in males, scores on a language test, the Peabody Picture Vocabulary Test (Dunn, 1965), are also provided. In addition, ratings drawn from the PEP (Schopler & Reichler, 1979) and the CARS (Schopler et al., 1980) of behaviors associated with autism that involve stereotypic play and unusual visual interests are also compared for boys and girls. Ratings from the PEP (Schopler & Reichler, 1979) of social skills and affective behaviors are compared for autistic girls and boys in order to address the question of whether autistic females show more appropriate social interactions and emotions than males.

Thus, the present study tests four major hypotheses: (1) The average intelligence and level of adaptive functioning of the male autistic children will be greater than the average intelligence and adaptive functioning of the female autistic children. This difference will be accounted for by a higher proportion of males with autism who have IQs greater than 54 than females with autism in the same intellectual range. (2) The autistic boys will perform at more advanced levels on visuo-spatial tasks (i.e., PEP eye-hand integration scale, PEP perception scale) than the autistic females. Correspondingly, the autistic males will be rated as showing more stereotypic play and elaborate routines, and more unusual visual interests than the autistic females (i.e., PEP play subscale, CARS peculiar visual responsiveness rating). (3) Autistic females will be superior to autistic males on a test of receptive vocabulary (PPVT). (4) Autistic females will be rated (PEP affect and relating to people subscales) as showing more appropriate affect and relations to people than will autistic males.

METHOD

Subjects

Of the 931 children (723 males, 208 females) who received complete initial evaluations at the TEACCH program from January 1975 to December 1980, all children who met each of the following criteria were included in the sample for this study: (1) an age of 3 to 8 years and (2) diagnosed as autistic by two independent raters using the Childhood Autism Rating Scale (CARS) (Schopler et al., 1980). Thus, the subjects were 475 autistic children, 384 boys (80.9%) and 91 girls (19.1%), yielding an overall ratio of 4.2 males to 1 female. Of the 456 children judged *not* be autistic, 339 were boys (76.3%) and 117 were girls (23.7%), yielding an overall ratio of 2.9 males to 1 female.

Intelligence and Vocabulary Tests

Each child was tested using a standardized intelligence test that emphasized nonverbal skills. The most common instruments used were the Merrill-Palmer Scale of Mental Abilities (Stutsman, 1931), Bayley Scales of Infant Development (Bayley, 1969), the Leiter International Performance Scale (Arthur, 1952), and the Wechsler Intelligence Scale for Children—Revised version performance scales (Wechsler, 1974). Generally, the most advanced test for which standardized instructions could be used was administered. Raw scores were transformed into deviation or ratio IQs in all cases. Social quotients (SQ) based on parent interviews scored on the Vineland Social Maturity Scale (Doll, 1965) were also included. Peabody Picture Vocabulary Test (PPVT) (Dunn, 1965) scores were obtained unless the child could not receive a basal. PPVT scores are reported as deviation IQs.

Psychoeducational Profile (PEP)

The PEP is a developmentally based prescriptive evaluation instrument designed to identify uneven and idiosyncratic learning patterns. There are developmental indices that measure skills such as imitation, perception, eye-hand integration, and cognition. In addition, pathology subscales are included that provide information concerning the degree of disorganized and autistic behaviors present in the child. Complete information regarding the PEP can be found in Schopler and Reichler (1979). For the purposes of the present study, three pathology subscales (affect, relating and human interest, play and interest in materials) and two developmental subscales (eye-hand integration and perception) were included.

Pathology items from the PEP are based on observations of specific autistic behaviors made during the test administration. Subscales for affect, relating and human interest, and play and interest in materials contain 7, 6, and 7 binomial items respectively, so that scores for an individual child on each subscale could range from 0 to 6 or 0 to 7. The higher the score, the smaller number of pathological behaviors and greater number of appropriate behaviors the child had shown. Thus, a low score on the play subscale would indicate frequent stereotypic play and routines and little appropriate use of objects, a low score on the affect scale would indicate frequent inappropriate affect, and a low score on the relating/human interest scale would indicate few or very limited social interactions.

The two developmental scales from the PEP are scored on the basis of specific tasks administered according to standard instructions. The perception scale contains 11 items; thus, scores range from 0 to 11. The perception scale includes tasks such as identifying the appropriate placement of a puzzle piece and finding candy under rotated cups. The eye-hand integration scale contains 14 items with a range of 0 to 14. It contains tasks such as stacking blocks and copying designs. Similar to the pathology subscales, for both developmental scales, higher scores indicate that the child passed more items and so is developmentally more advanced than a child with a lower score.

Childhood Autism Rating Scale (CARS)

The CARS was developed to evaluate children in several areas related to the salient characteristics of autism. For the purpose of the present study, one subscale of the CARS rating, peculiarities of visual responsiveness, was used. The scores on each CARS subscale range from 1 to 4, representing normal to severely abnormal. Satisfactory reliability and validity were reported in Schopler et al. (1980).

In summary, the nine dependent variables were nonverbal IQ, Vineland social quotient, Peabody Picture Vocabulary Test IQ, PEP Pathology subscales for affect, play, and relating and human interest, PEP developmental scales for eye-hand integration and perception, and CARS unusual visual responsiveness.

Design and Statistical Analyses

T tests and Box tests for homogeneity of variances were used to ensure the comparability of age and social class distributions for the two sexes.

Table I. Demographic Data According to Sex of Subject

	Males (N = 384)	Females (N = 91)
Mean age in years (range = 3 to 8 years)	5.29 (.55)[a]	5.31 (.53)
Mean SES[b]	3.61 (1.23)	3.32 (1.28)
Number of subjects of each race		
White	236	60
Black	140	23
Other	8	8

[a]Numbers in parentheses are standard deviations.
[b]Socioeconomic status was measured using the Hollingshead-Redlich Scale (1958) where 1 = high SES and 5 = low SES.

There were no significant differences in means or variability of distributions of age or social class across sex, as reported in Table I. Two sets of 2(sex) × 3(age) multivariate analyses were performed on the basic set of 9 dependent variables. In the multivariate analysis of variance (MANOVA), intelligence was treated as a dependent variable. In the multivariate analysis of covariance (MANCOVA), intelligence was treated as a covariate. In order to avoid reducing the sample size because of the 238 children who did not receive a basal score on the Peabody Picture Vocabulary Test, a separate analysis of variance of 2(sex) × 3(age) and an analysis of covariance with IQ as a covariate were run on PPVT IQs. In addition, χ^2 was used to test the similarity of the distribution of intelligence scores and sex ratios according to levels of intelligence for the two sexes. For the purposes of the analyses described above, three age categories (3-4 years old, 5-6 years old, 7-8 years old) were created.

RESULTS

MANOVA

On the *MANOVA*, there were significant main effects for sex ($F(5, 469) = 2.83$, $p < .0015$) and age ($F(5, 469) = 2.47$, $p < .0002$). The sex × age interaction was nonsignificant. Means by sex and age are reported in Table II. A main effect for sex also occurred in several univariate analyses. Males showed significantly higher intelligence ($F(1, 469) = 5.00$, $p < .03$), higher social quotients ($F(1, 469) = 4.02$, $p < .05$), superior scores on both the eye-hand integration ($F(1, 469) = 5.43$, $p < .02$) and perception ($F(1, 469) = 5.38$, $p < .02$) scales of the PEP, and

Table II. Means by Sex and Age

	Sex		Age (in years)		
	M (N = 384)	F (N = 91)	3-4 (N = 226)	5-6 (N = 177)	7-8 (N = 72)
Nonverbal IQ	43.62	37.23[a]	39.93	41.49	29.83
	(20.24)[d]	(16.88)	(21.00)	(21.96)	(16.88)
Vineland SQ	48.10	41.79[a]	49.00	48.74	37.34[b]
	(20.78)	(21.22)	(20.56)	(20.28)	(19.66)
PEP eye-hand integration[e]	6.64	5.37[a]	5.48	6.89	6.99[c]
	(3.73)	(3.83)	(3.63)	(3.78)	(3.80)
PEP perception	8.25	7.35[a]	7.49	8.60	8.44[c]
	(2.53)	(2.62)	(3.06)	(2.56)	(2.45)
PEP affect	3.95	4.15	4.08	4.17	3.80
	(1.86)	(1.92)	(1.87)	(1.90)	(1.85)
PEP relating to people	3.92	3.91	3.79	3.90	3.70
	(2.06)	(1.88)	(2.06)	(1.94)	(2.02)
PEP play	2.88	3.03	2.88	3.00	2.75
	(1.99)	(2.02)	(2.00)	(1.89)	(1.78)
CARS peculiar visual[f]	2.60	2.37[a]	2.55	2.45	2.62
	(.61)	(.73)	(.63)	(.56)	(.69)
PPVT IQ[g]	40.72	31.58[a]	41.96	40.11	38.29
	(18.77)	(16.32)	(20.49)	(17.84)	(9.64)

[a] Main effects on univariate ANOVAs significant at $p < .05$.
[b] $p < .01$.
[c] $p < .001$.
[d] Standard deviations are indicated in parentheses.
[e] On PEP scales, the higher the score, the higher the level of development or appropriate behavior.
[f] On the CARS scale, the higher the score, the greater the abnormality.
[g] Data from smaller sample because of failures to achieve basals (male N = 189, female N = 48).

more frequent unusual visual interests ($F(1, 469) = 5.16$, $p < .03$) than females. Main effects of age occurred in univariate analyses of eye-hand integration ($F(2, 469) = 7.82$, $p < .0005$) and perception ($F(2, 469) = 6.01$, $p < .0003$), such that 5- to 6- and 7- to 8-year-olds performed significantly better on these scales than 3- to 4-year-olds (Duncan multiple-range tests, *MS*s = 13.4, 8.23, respectively, *p*'s < .05). A main effect of age also occurred on the Vineland Social Maturity Scale ($F(2, 469) = 8.28$, $p < .003$), indicating that 3- to 4- and 5- to 6-year-olds showed significantly higher social quotients than the 7- and 8-year olds (Duncan multiple-range test, $MS = 404.9$, $p < .05$). There were no significant interactions of age and sex in the univariate analyses.

MANCOVA

On the MANCOVA there was a significant main effect for sex ($F(6, 468) = 2.06$, $p < .05$). The main effect of age and the sex by age interaction were not significant. IQ was a significant covariate for Vineland social quotients, eye-hand integration, perception, play, and peculiar visual interests. Main effects for sex when IQ was controlled occurred in several univariate analyses. Males continued to be rated as showing more frequent unusual visual interests than females ($F(1, 468) = 11.33$, $p < .001$). Finally, males were rated as showing less appropriate, more routinized and stereotypic play than females on the PEP rating subscales ($F(1, 468) = 4.19$, $p < .05$). A univariate main effect of age, controlling for IQ, on Vineland social quotients indicated that 3- to 4- and 5- to 6-year-olds continued to receive higher social quotients on the Vineland ($F(1, 468) = 7.08$, $p < .001$) than did 7- and 8-year-olds (Duncan multiple-range test, $MS = 43.49$, $p < .05$). Univariate main effects for eye-hand integration and perception occurred (*F*s(2, 468) = 16.94, 15.36, *p*'s < .0005) such that 5- to 6- and 7- to 8-year-old children performed better on eye-hand integration and perception scales from the PEP than did 3- to 4-year-olds (Duncan multiple-range tests, *MS*s = 14.6, 8.91, *p*'s < .05). A main effect of age ($F(2, 468) = 8.03$, $p < .0005$) also occurred for peculiar visual interests. Children who were 5- to 6-years-old showed fewer unusual visual behaviors than 7- to 8-year-olds or 3- to 4-year-olds (Duncan multiple-range tests, *MS*s = 8.56, *p*'s < .05).

Remaining Analyses

On a 2(sex) × 3(age) analysis of variance on PPVT IQ scores, which included data from the 237 subjects (189 males, 48 females) who received

Table III. Number of Autistic Children in Different IQ Ranges

IQ ranges	Male	Female	Ratio M:F
0-39	153 (39.8%)[a]	46 (50.5%)	3.3:1
40-54	104 (27.1%)	18 (19.8%)	5.8:1
55-69	62 (16.1%)	14 (15.4%)	4.4:1
70-79	34 (8.8%)	7 (7.7%)	4.9:1
80 +	31 (8.0%)	6 (6.6%)	5.2:1
	384 (100%)	91 (100%)	4.2:1

[a]Percent of subjects of relevant sex who fall in each IQ range.

basals, there was a significant main effect for sex ($F(1, 236) = 5.87$, $p < .05$), such that males received higher PPVT IQs ($\overline{X} = 40.72$) than females ($\overline{X} = 31.58$). IQ served as a significant covariate ($F(1, 235) = 16.63$, $p < .0004$) of PPVT scores; when IQ was partialed out, no significant sex differences remained. There were no age effects or interactions in either analysis.

χ^2 was used to compare the frequency of autistic children of the two sexes falling into six IQ ranges from 0-10 to 120 (Table III). There were no significant differences ($\chi^2(4) = 1.34$, n.s.) in the proportion of males or females in each level of intelligence.

DISCUSSION

Of the four hypotheses proposed, two were confirmed and two were not supported by the results of this investigation. As predicted, female autistic children as a group scored less well on intelligence tests than did male autistic children. This difference could not be attributed purely to the visual-spatial nature of the primarily nonverbal intelligence tests because males were also superior on a measure of adaptive functioning, even when IQ was partialed out. Contrary to the observations of Brask (cited in Wing, 1981) and Lotter (1974), this difference was not due to a higher proportion of males and females falling in near-normal (70+) ranges of intelligence.

The proportion of females with autism at each intellectual level was slightly smaller than the proportion of males for all IQ ranges over 39. Overall, the distribution of intelligence was much the same for the two sexes, but the actual scores were several points lower for the females than for the males.

Similarly, within this *autistic* sample drawn from a clinic population (and so perhaps not truly representative of the population at large), the differences in *sex ratios* across intelligence ranges were not nearly so dramatic as those found by Wing (1981) in her epidemiological study of children, both autistic and not, with the triad of language and social impairments. On the other hand, though differences in sex ratios were not significant in our data, it is worth noting that, similar to children with Wing's triad of impairments, the lowest male:female ratio for the autistic children in our study occurred for those with IQs below 40.

Along with slightly but significantly higher intelligence, autistic boys were found to perform better than girls on eye-hand integration and perceptual tasks. These differences disappeared when IQ was controlled. They appeared to reflect developmental phenomena for both sexes; eye-hand integration and perception were the only two measures in which older children outperformed their younger counterparts. In confirmation of the prediction that boys would show more of the negative as well as positive aspects of visuo-spatial skills, boys with autism, regardless of intellectual level, were more likely than girls to exhibit unusual visual responses. When IQ was partialed out, boys were also rated as showing less appropriate play than girls. One explanation for this finding could be that the relatively more intelligent boys, with more advanced visuo-spatial skills than the girls, were more likely to show *some* interest in objects and *some* ability to use play materials than were the lower functioning girls. However, given the same level of skill and intelligence, the males were more likely than females to engage in stereotypic play or routines rather than appropriate activities.

The two hypotheses that were not supported by our data both had to do with predictions of female superiority. First, there were no sex differences in ratings of affect and relating to people for the males and females. In addition, the autistic girls as a group were not only *not superior* to the males on the measure of receptive vocabulary but were actually significantly lower than the boys. This difference disappeared when IQ was controlled. Overall, though there was substantial overlap in the performances of the girls and the boys, the females as a group were more impaired than the males as a group on every measure related to cognitive functioning: IQ, Vineland social quotient, receptive vocabulary, eye-hand integration tasks, and perceptual skills.

In all, our results provide indirect support for the hypothesis of multifactorial genetic transmission of autism described by Tsai et al. (1981).

These authors proposed that males may have a lower threshold for brain dysfunction, such that less significant genetic "liabilities" (Tsai et al., 1981) are required to produce a male child with autism than a female. Thus, females would be expected to show not only a lower incidence of autism, but to be more severely affected in all or many respects once their higher thresholds for autism or requisite cognitive and social deficits were surpassed. Both the lower incidence and the greater severity of cognitive deficits in females are supported by our data.

A further, speculative implication of the present results, and one that is not incompatible with the notion of sex differences in thresholds for polygenic factors, relates to sex differences in brain functioning in the normal population (Bryden, 1979; Springer & Deutsch, 1981). The uneven pattern in autism of severe language deficits and social impairments coupled with relatively less impaired perceptual and visuo-spatial skills has frequently been proposed as evidence of asymmetrical damage to the two hemispheres of the brain. That is, language deficits have been said to be due to left hemisphere damage, while relatively good perceptual skills have been used as evidence for more intact functioning of the right hemisphere (Prior & Bradshaw, 1979). Though lesions may be bilateral, they are probably not equivalent across hemispheres (Damasio & Maurer, 1978). Studies of normal adults and clinical populations have suggested that females as a group are less lateralized (i.e., show smaller differences in left-right hemisphere functioning) than males (Bradshaw, Gates, & Nettleton, 1977). It is important to note that quite a few studies for normal adults and children have shown no sex differences (see Bryden, 1979). However, when sex differences have been found, in almost all cases they have occurred in the direction of greater lateralization of males than females (Springer & Deutsch, 1981).

If one accepts the assumption that females have less lateralized brain function than males, it could be hypothesized that more extensive bilateral damage would be required to produce specific deficits, such as those seen in autism, in girls than in boys. More limited dysfunction or smaller lesions in a particular area or areas of the brain might be sufficient to produce the pattern of autistic behaviors in a male but not in a female where specific skills are not as associated with a particular hemisphere. One could speculate that the lowered performance on all cognitive measures of the females in this study was due to more extensive brain dysfunction than occurred in the males, in whom autistic characteristics could be produced without resulting in such massive dysfunction.

While these hypotheses are necessarily speculative, the sex differences in autism in incidence and cognitive skills appear to be reliable across a variety of samples and methods. As the search for the underlying neurological bases for autism becomes more intense (Wing, 1981), biological differences in the sexes that could account for the discrepancies in incidence and functioning provide a useful starting point for investigation. More work is needed, both in identifying patterns of behavior in females as well as males with autism and in beginning to address directly the biological bases of this complex disorder.

REFERENCES

Arthur, G. *The Arthur adaptation of the Leiter International Performance Scale.* Chicago: Psychological Service Center Press, 1952.

Bayley, N. *Manual for the Bayley Scales of Infant Development.* New York: Psychological Corporation, 1969.

Bradshaw, J. L., Gates, A., & Nettleton, N. C. Bihemispheric involvement in lexical decisions: Handedness and a possible sex difference. *Neuropsychologia,* 1977, *15,* 277-286.

Bryden, M. P. Sex-related differences in cerebral organization. In M. A. Wittig & A. C. Peterson (Eds.), *Sex-related differences in cognitive functioning.* New York: Academic Press, 1979. Pp. 121-144.

Coleman, M. A report on the autistic syndromes. In M. Rutter & E. Schopler (Eds.), *Autism: A reappraisal of concepts and treatment.* New York: Plenum Press, 1978.

Damasio, A., & Maurer, R. A neurological model for childhood autism. *Archives of Neurology,* 1978, *35,* 777-786.

Doll, E. A. *Vineland Social Maturity Scale.* Circle Pines, Minnesota: American Guidance Service, 1965.

Dunn, L. M. *Expanded manual for the Peabody Picture Vocabulary Test.* Minneapolis: American Guidance Service, 1965.

Hollingshead, A., & Redlich, F. *Social class and mental illness.* New York: Wiley, 1958.

Lotter, V. Factors related to outcome in autistic children. *Journal of Autism and Childhood Schizophrenia,* 1974, *4,* 263-277.

Maccoby, E., & Jacklin, C. N. *The psychology of sex differences.* London: Oxford University Press, 1975.

Prior, M. P., & Bradshaw J. L. Hemispheric functioning in autistic children. *Cortex,* 1979, *15,* 73-82.

Schopler, E., & Reichler, R. *Psychoeducational Profile: Individualized assessment and treatment for autistic and developmentally delayed children.* Baltimore: University Park Press, 1979.

Schopler, E., Reichler, R., DeVellis, R., & Daly, K. Toward objective classification of childhood autism: Childhood Autism Rating Scale (CARS). *Journal of Autism and Developmental Disorders,* 1980, *10,* 91-103.

Springer, S. P., & Deutsch, G. *Left brain, right brain.* San Francisco: W. H. Freeman, 1981.

Stutsman, R. Guide for administering the Merrill-Palmer Scale of Mental Tests. In L. M. Terman (Ed.), *Mental measurement of preschool children.* New York: Harcourt, Brace & World, 1931. Pp. 139-262.

Symmes, J. Evaluating competence and accessibility in autistic children. In M. Coleman (Ed.), *The autistic syndromes.* New York: Elsevier, 1976.

Tsai, L., Stewart, M. A., & August, G. Implication of sex differences in the familial transmission of infantile autism. *Journal of Autism and Developmental Disorders,* 1981, *11,* 165-173.

Wechsler, D. *Wechsler Intelligence Scale for Children—Revised.* New York: Psychological Corporation, 1974.

Wing, L. K. *Early childhood autism.* Oxford: Pergamon, 1976.
Wing, L. Sex ratios in early childhood autism and related conditions. *Psychiatry Research,* 1981, *5,* 129-137.
Wing, L., Gould, J., Yeates, S. R., & Brierley, L. M. Symbolic play in severely mentally retarded and in autistic children. *Journal of Child Psychology and Psychiatry,* 1977, *18,* 167-178.