Journal of Autism and Developmental Disorders, Vol. 10, No. 1, 1980

Toward Objective Classification of Childhood Autism: Childhood Autism Rating Scale (CARS)

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In 1966, when we initiated an outpatient treatment program for autistic children and their families (Schopler & Reichler, 1971), there were two major sets of guidelines for diagnosing the children who were referred to our program. The first was Kanner's (1943) original definition of autism. At the start of our program the most promising attempt to translate the Kanner definition into an empirical rating scale was the Rimland Checklist (1964), later revised into a second form (Rimland, 1971). This checklist was completed for all children evaluated in our program. From the very beginning, however, we had the clinical impression that very few of our children were autistic according to Kanner's criteria. The Creak (1964) criteria served as a second system of classification. Like Kanner's, these were not entirely satisfactory from our perspective. Specifically, classification guidelines suitable for very young children were lacking. In response to the limitations of existing classification systems, we developed our own 15-scale rating system (Reichler & Schopler, 1971). These scales incorporated (a) Kanner's primary features, (b) other characteristics, noted by Creak, found

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0162-3257/80/0300-0091$03.00/0

in many, but not all children who might be considered autistic, and (c) additional scales to tap the symptoms characteristic of the younger child. The resulting instrument was initially called the Childhood Psychosis Rating Scale (CPRS). Because our scale reflected a broader conceptualization than Kanner's classic definition of autism, we had consciously chosen the term *psychosis* rather than *autism* so as to minimize confusion. However, in light of increasing evidence that the definition of autism has expanded and is no longer resricted to Kanner's use of the term (Schopler, Rutter, & Chess, 1979), we now call our instrument the Childhood Autism Rating Scale (CARS).

The recent trend toward broadening the definition is at least partly due to the confusion about the diagnosis during the past four decades. This may be traced to both the use of theoretical assumptions in the absence of research evidence and the complexity of the children and problems to be classified. We will not attempt a comprehensive comparison of these definitions here, since Rutter (1978) has already sorted out this confusion admirably. Instead, we will illustrate the issue using differences between the two extensively used and recently revised definitions of autism offered by Rutter (1978) and Ritvo and Freeman (1978). (The latter is also used by the U.S. National Society for Autistic Children.) These two definitions are of special interest because both investigators are committed to an empirical research basis rather than mere theoretical assumptions for their formulations. Both agree that the diagnosis requries certain features essential to the disorder of autism. They also agree that even while sharing these features, autistic children show specific behaviors with great individual variation. The essential features common to both of these classification systems are (a) impaired social development in relating to people, events, and objects; (b) disturbance of language and cognitive skills; and (c) early onset of the disorder, i.e., before 30 months of age.

Despite these similarities, there are other respects in which the two definitions clearly differ. The Rutter definition includes insistence on sameness as shown by stereotyped play patterns, abnormal preoccupations, or resistance to change as a specific feature of the disorder. This is subsumed in the Ritvo and NSAC definition under "Disturbance of the capacity to appropriately relate to people, events, and objects." On the other hand, sensory peculiarities are emphasized in the Ritvo and Freeman definition. These are acknowledged in the Rutter review, but they are included among the more specific characteristics, which vary for individual children. The Childhood Autism Rating Scale (CARS), reported below, includes the criteria for both of these definitions and thus enables us to test whether a specific criterion, such as sensory peculiarities, is an essential feature of autism as determined by the CARS or whether it is a nonessential characteristic found in some autistic children but not in others.

At the time of this report the CARS has been administered to 537 children served by our statewide program for autistic children. All diagnostic data, including the CARS, psychological assessments, and data from a 114-item history form have been stored on computer disks, thus constituting one of the largest available data sets describing the systematic evaluation of autistic children

The remainder of this paper will briefly describe the population with which the CARS was used, examine the contents and scoring of the scale itself, describe its reliability and validity, compare the categories of individuals that result from the scale's use, and compare the operational definition of autism reflected by the CARS to other definitions of the disorder.

METHOD

Subjects

The 537 children assessed with the CARS by our program over a 10-year span constituted the subject population. Approximately 75% of these children were boys, which is typical of populations of developmentally handicapped populations referred to diagnostic and treatment centers. Both boys and girls had approximately the same age distribution: 55% of the total group were less than 6 years old, while only 11% of the sample were 10 years or older.

The socioeconomic status (SES) of the children's families was measured by the Hollingshead-Redlich (1958) two-factor (occupation and education) index. The modal SES level for our sample was IV—the second-lowest of five SES categories yielded by this classification system. About 71% of the sample is white, while most of the remaining 29% are black. Most of the children in the sample have intellectual deficits, with about 70% having IQs below 70 and about 11% having IQs above 85, as measured by standardized tests including the WISC, Merrill-Palmer, Bayley, and Leiter International Scales.

Administration and Composition of the Scale

The CARS is administered at the end of each child's first diagnostic session. These are conducted at each of our five regional centers, in a room provided with one-way observation and listening facilities. The raters observe the testing session through the one-way screen and make their ratings, based on their observations, immediately after the diagnostic session. The

complete CARS form is included in the Appendix.[2] It is made up of 15 scales. These are listed below along with the rationale for their inclusion.

1. *Impairment in Human Relationships.* This is considered one of the primary features of autism in virtually every description of autism found in the literature.

2. *Imitation.* This scale was included because we found that many of our children with severe language difficulties also had problems with both verbal and motor imitation. Piaget and others (e.g., Lovaas, 1979) have described the ability to imitate as an important basis for developing speech. Imitation is also a skill that is highly relevant to the treatment and education of younger children; therefore, though not considered a primary feature of autism, it was included in the CARS.

3. *Inappropriate Affect.* This is one of the primary characteristics included in the original Kanner (1943) definition, and one of the secondary characteristics described by Creak (1961) and Ritvo and Freeman (1978).

4. *Bizarre Use of Body Movement and Persistence of Stereotypes.* These manifestations are considered major features of the condition, according to Rutter (1978), Creak (1961), and Wing (1978).

5. *Peculiarities in Relating to Nonhuman Objects* (like toys and other materials.) This scale overlaps with others, especially 1 and 4. However, it was included as a separate scale because of its special significance for educational assessments and individualized programming (Schopler et al., 1979).

6. *Resistance to Environmental Change.* This is another of the primary features identified by Kanner (1943) (and maintained by Rutter, 1978, in light of subsequent research) but considered a subsidiary characteristic of autism by Ritvo and Freeman (1978).

7. *Peculiarities of Visual Responsiveness.* Avoidance of eye contact during personal interactions has frequently been reported for autistic children. Equally important is their visual avoidance of toys and educational materials. Both of these visual peculiarities have been reported as unusual receptor preferences by Goldfarb (1956), Schopler (1965), and Hermelin and O'Connor (1970). This scale, along with 8 and 9, is also indicative of the perceptual inconstancy considered a primary feature of autism by Ornitz and Ritvo (1968) and by Ritvo and Freeman (1978), though not by Rutter (1978) and others.

8. *Peculiarities of Auditory Responsiveness.* Parallel to their unusual visual responsiveness, autistic children also avoid auditory stimuli or overreact to certain sounds or noises. Their inconsistent responses in the auditory modality have important implications for learning speech or alternative communication skills.

[2]Copies of the Appendix are available from Dr. Eric Schopler.

9. *Near Receptor Responsiveness.* This scale was included to assess the frequently reported preoccupation with tactual exploration, mouthing, licking, smelling, and rubbing of objects. All three sensory scales (7, 8, and 9) often play a part in the overselection of stimuli reported by Schreibman and Lovaas (1973).

10. *Anxiety Reaction.* This is included to measure the intensity of the child's aversion response to any aspect of the observed interaction. Although not a primary characteristic, this is frequently observed and is included in the Creak criteria.

11. *Verbal Communication.* Most definitions of autism include the language peculiarities rated by this scale as a primary feature of the disorder. The CARS evaluates the degree of autistic language, ranging from echolalia, pronoun reversal, and peculiar language use to autism.

12. *Nonverbal Communication.* This scale is for assessing the child's use or response to gestures and nonverbal communication. It overlaps with visual responsiveness, measured by scale 7, but provides a separate rating for the child's response and use of gestures and signs.

13. *Activity Level.* This is a measure of the extremes of either apathy or hyperactivity observed during the session. Although this is not generally considered a primary feature of autism, it plays an important role in the child's classroom placement and need for teaching structure.

14. *Intellectual Functioning* is a rating of the uneven cognitive skills frequently reported in autistic children. This includes unusual peak skills, such as abilities with numbers or music, but is intended as a rating of the degree of intellectual discrepancies observed in any mental function during the testing sessions.

15. *General Impressions.* This is a global rating of the degree of autism observed in the child during the observation period, including both quantitative and qualitative judgments of all behaviors observed and rated during the diagnostic session. This rating is made prior to the summing up of scores from the previous 14 scales.

Scoring the CARS

Each of the scales is scored on a continuum from normal to severely abnormal. A score of 1 indicates that the child's behavior is within normal limits for his or her age, 2 is scored for mildly abnormal, 3 for moderately abnormal, and 4 for severely abnormal behavior. The three midpoints between adjacent ratings are used when the child's behavior appears to be between any two of the four integer values. The child's age must be considered in making each rating. For example, a normal 2-year-old's attention to an adult tends to be shorter and less sustained than that of a

normal 5-year-old. Such an age-appropriate developmental difference should not be construed as an impairment in relatedness for the 2-year-old. More specific directions for the rating of each scale are given on the CARS form in the Appendix.

Reliability. In order to be maximally useful to a clinician or researcher, a scale must consistently measure some phenomenon—i.e., it must be reliable. As a means of assessing the internal consistency of the CARS, a reliability coefficient alpha (Nunnally, 1967) was computed. The alpha thus obtained was .94, indicating a high degree of internal consistency among the scale items. This finding suggests that, taken as a whole, the CARS measures some unitary, central characteristic rather than numerous unrelated facets of behavior. This fact, it should be noted, does not preclude the examination of specific item scores as a means of assessing particular areas of functioning. Rather, it suggests that these various areas are, in fact, components of the same phenomenon.

As another means of assessing reliability, the scores given to individual items by each of two independent, trained raters were correlated. Based on their ratings of 280 cases, an average interrater reliability of .71 was obtained. Correlation coefficients for each of the individual items are presented in Table I.

In summary, the correlation coefficients obtained indicate that the CARS is a highly reliable instrument as determined by an index of internal consistency (alpha) and interrater agreement.

Validity. While reliability is a necessary precondition to a scale's utility, it is not sufficient. In addition to measuring some phenomenon con-

Table I. Interrater Reliability for Individual Scales

Scale	r^a
1. Human relatedness	.93
2. Imitation	.79
3. Affect	.71
4. Use of body	.70
5. Relation to objects	.76
6. Adaptation to change	.63
7. Visual responsiveness	.73
8. Auditory responsiveness	.71
9. Near receptor responsiveness	.78
10. Anxiety reaction	.67
11. Verbal communication	.69
12. Nonverbal communication	.62
13. Activity level	.67
14. Intellectual consistency	.55
15. Global impression	.76

[a] Probability of all correlations is .0001.

sistently, a scale must measure the appropriate phenomenon. As an index of the validity of the CARS, total scores were compared to clinical ratings of psychosis obtained at the same evaluation sessions as the respective CARS scores. The correlation obtained between the scale scores and clinicians' ratings was $r = .84$, $p < .001$, indicating that CARS scores have much in common with clinicians' perceptions of autism. As an additional assessment of the validity of the CARS, total scores were correlated with independent clinical assessments made by a child psychiatrist and a child psychologist. These correlations ($r = .80$, $p < .001$) offer additional support for the validity of the CARS. In summary, the CARS yields results consistent with the judgments of clinical experts.

RESULTS

The total CARS score for each child has a possible range of from 15 to 60. Rather than classifying total scores into predetermined categories representing degrees of autism, we examined the distribution of the 537 scores obtained over the past 10 years, and devised scoring criteria that reflected the nature of that distribution. Individuals with scores of less than 30 were not autistic. Those with higher scores were autistic and bimodally distributed. Two criteria were used that best distinguished these two groups of autistic children. The designation of severe autism was used for those children whose total score exceeded 36 *and* who had a rating of 3 or higher on 5 or more of the 15 subscales. All scores that did not result in classification into these two extreme categories were placed in the middle category of mild to moderate psychosis. The proportions of the subject population falling into the nonautistic, mildly to moderately autistic, and severely autistic categories, respectively, are 49%, 33%, and 18%.

These three groupings were compared with respect to demographic characteristics including age of onset, age at diagnosis, sex, IQ, and family social class. One-way analyses of variance, followed by Scheffé's method of comparing individual cell means, were used for these comparisons.

Age of Onset. The mean age of onset for all three groups was 29 months for the nonautistic, 20 months for the mild-to-moderate group, and 21 months for the severe group. Although the mean age of onset was less than 30 months for all three groups, the age of onset for both autistic groups is significantly lower than for the nonautistic group ($F = 18.53$, $df = 2,50$, $p < .0001$). This finding supports the inclusion of this characteristic as a distinguishing feature of autism, also reported by most other investigators.

Sex and Age. The overall ratio of more than three boys to every girl in our total sample was also found in each of the three diagnostic groups, with

Table II. Distribution of Diagnostic Groups by Age and Sex

Group	Age in years						Total
	0-2	2-4	4-6	6-8	8-10	10	
Not autistic							266
male	2	20	80	60	24	18	204
female	1	6	22	18	8	7	62
Mildly to moderately autistic							146
male	0	31	41	19	9	14	114
female	0	11	12	4	3	2	32
Severely autistic							125
male	2	18	30	19	10	15	94
female	0	7	13	8	1	2	31
Total	5	93	198	128	55	58	537

no significant difference in the sex ratios among the three groups. This finding is consistent with the epidemiological literature reporting a similar disproportion of autistic boys to girls (Lotter, 1966). It is also a reminder that the disproportionate male-female ratio is characteristic of other developmental disorders besides autism. Table II shows the distribution by age at diagnosis and by sex, found in each of our three diagnostic groups.

The mean age at diagnosis for the group as a whole is 6 years, and there are no significant differences in age among the three diagnostic groups. Likewise, the sex ratio for each age group is generally the same as for the group as a whole. An exception is the severely autistic group above 8 years of age. Here we find a significant ($\chi^2 = 4.82$, $p < .05$) increase in male-female ratio. This may be because as severely autistic children reach adolescence, the girls show fewer management problems than the boys and are therefore more easily absorbed into the established special education system without referral for special help.

Intellectual Functioning. Table III shows the distribution of IQ scores among the three diagnostic groups. Fewer subjects (396) were available for this calculation than for our other comparisons. This is primarily because systematic diagnostic testing and recording took somewhat longer to institute during the early years of the program than did our other data-collection procedures. However, there is no reason to believe that the missing number introduced any diagnostic bias. The differences among the mean IQ scores for our three diagnostic groups were statistically significant ($F = 81.19$, $df = 2,39$, $p < .0001$). We found that the degree of retardation increased as the degree of autism increased. Accordingly, most of our profoundly retarded children were also the more severely autistic, while most of our intellectually near-normal children were in the nonautistic group. This finding is not consistent with the literature, based on Kanner's criteria, describing autistic children who are of near-normal or higher intelligence. This interesting finding will be discussed below.

Table III. Distribution of Diagnostic Groups by IQ

Group	IQ												Total	
	< 25		26-39		40-54		55-69		70-84		> 84			
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Not autistic	9	2	19	5	38	10	42	11	53	13	41	10	202	51
Mildly to moderately autistic	19	5	26	6	27	7	20	5	16	4	3	<1	111	28
Severely autistic	37	9	20	5	19	5	3	<1	4	1	0	0	83	21
Total	65	16	65	16	84	22	65	17	73	18	44	11	396	100

Family Socioeconomic Status (SES). As was the case for our entire subject pool described earlier, our autistic group does not come primarily from higher SES families. The five Hollingshead social class levels were collapsed into two: I and II were combined into a "High," and III, IV, and V into a "Low" category. This was done primarily to represent more clearly the high versus low SES frequently referred to in the literature in association with autism. As a secondary reason, it appears quite likely that the more refined social class distinctions defined by Hollingshead 20 years ago are less meaningful in our increasingly egalitarian society.

Table IV shows that over 74% of the autistic children come from lower SES families and less than 26% come from higher SES families. These results indicating lower SES among families of autistic children contradict the many studies reporting that autistics come from higher SES families.

Comparison with Other Definitions of Autism. We compared the groupings of children who were diagnosed as autistic by the CARS with those who would be similarly classified using the definitions of Rimland (1971), Rutter (1978), and Ritvo and Freeman (1978). A total of 450 of our sample of 532 children had been scored by Rimland on his E-2 Checklist as well as by us on the CARS. Only 8 out of these 450 were considered autistic by Rimland's criteria. Of these 8, 3 were classified by our criteria as nonautistic while the remaining were in one of our two autistic groups. These differences reflect the lack of correspondence between our definition of autism, based on direct behavioral observation, and Rimland's definition based on parents' recollections. Because the CARS is made up of 15 scales that include the different features of autism emphasized both by Rutter and by Ritvo and Freeman, it was possible to constitute and compare groups of children who approximate the Rutter and/or Ritvo and Freeman criteria for autism. As mentioned earlier, the major differences between the two sets of criteria is that Rutter's include insistence on sameness and stereotyped

Table IV. Distribution of Diagnostic Groups by Socioeconomic Status (SES)

	SES					
	High		Low		Total	
Group	*N*	%	*N*	%	*N*	%
Not autistic	46	9	212	41	258	50
Mildly to moderately autistic	27	5	115	22	142	27
Severely autistic	32	6	90	17	122	23
Total	105	20	417	80	522	100

Table V. Distribution of Diagnostic Groups by Other Classification Systems

	System									
	Rutter only		Ritvo only		Neither		Both		Total	
Group	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Mildly to moderately autistic	2	1	35	13	100	38	4	1	141	53
Severely autistic	2	1	38	14	38	14	47	18	125	47
Total	4	2	73	27	138	52	51	19	266	100

behaviors as a primary feature, while Ritvo and Freeman's emphasize sensory peculiarities. Hence, children who conformed to the Rutter-compatible criteria were identified from their CARS data by using, as a criterion, a score of 2.5 or higher on the Human Relatedness Scale (1), Verbal Communication Scale (11), Adaptation to Change Scale (6), and Use of Body Scale (4). The children conforming to the Ritvo-compatible criteria were those who scored 2.5 or higher on the Human Relatedness (1) and Verbal Communication (11) Scales, and also on at least one of the three sensory scales: Visual Responsiveness (7), Auditory Responsiveness (8), and Near Receptor Responsiveness (9). Table V shows the distribution of autistic children in our sample who meet the Rutter criteria, the Ritvo criteria, neither, or both.

Although significantly more children in our sample meet the Ritvo and Freeman criteria than the Rutter criteria, there is no difference in the proportions classified as mildly to moderately autistic and severely autistic by our criteria. Of the children who conform to both the Rutter and the Ritvo and Freeman criteria, on the other hand, a significantly greater proportion are in our severely autistic category, while the proportion who meet neither of these criteria are significantly greater in our mildly to moderately autistic group ($\chi^2 = 200.91$, $df = 1$, $p < .001$). This shows a significant overlap of the Rutter and Ritvo and Freeman criteria in our group. Moreover, the greater frequency of autistic children in our sample who also show the sensory peculiarities specified in the Ritvo and Freeman definition supports the inclusion of these symptoms as a primary diagnostic feature of autism.

DISCUSSION

We have reported the use of a rating scale that successfully distinguishes two groups of autistic children from other developmentally disabled children. The strength of this instrument is that it is based on direct

behavioral observation rather than merely on psychoanalytic or other theoretical assumptions, which have contributed so much to the misunderstanding and misdiagnosis of this disorder in the past. Even though our data suggest a strong relationship between the ratings obtained from these behavioral observations and other clinical data, we are not suggesting that the diagnostic information from the CARS can or should replace diagnostic information from the child's history, home, school, and other experiences. Clearly, diagnostic understanding adequate for developing individualized treatment and education programs requires information from multiple sources (Schopler & Reichler, 1979). However, the CARS is especially useful for research and administrative classification and for deriving a descriptive summary of a child's pathological behavior.

One of the striking findings in this study, which was briefly mentioned earlier, is that none of our severely autistic children were in the near-normal intellectual range. This finding is at odds with descriptions by Kanner, and many other investigators using his classical definition, which report that autism is associated with near-normal intellectual functioning, at least in the performance area. There are several possible explanations for our discrepant findings. First, autistic children with higher intellectual functioning may be referred elsewhere, rather than to our program. However, such a conclusion is not consistent with our experience. We are unaware of any other program in our area to which autistic children of higher intelligence might be referred. Moreover, professionals who are familiar with our program do, in fact, refer some higher-functioning children to us whom they suspect to be autistic. Second, it may be that there may be fewer Kanner-autistic children in a predominantly rural area than in a densely populated area but there is no epidemiological evidence that high-intellectual-level autistic children may not be found in any particular geographic region. Third, it is possible that many of the Kanner-type autistic children are designated as functioning at higher intellectual levels on the basis of certain peak skills rather than on the basis of standard intelligence testing. Some children may then, according to our formal testing, appear in the more retarded categories. Fourth, it may be that the classically autistic child with higher intellectual functioning corresponds with our mild-to-moderate autistic group rather than the severely autistic group. This is most likely, since Kanner considered autism to be a specific disease syndrome rather than a syndrome within a continuum of certain developmental disabilities. Increasing evidence for the latter view has been cited by Rutter (1978), Ritvo and Freeman (1978), Wing (1978), and Schopler et al. (1979). Although further study of this issue is indicated, our findings regarding the relationship of autism to other developmental disorders are consistent with these and other currently developing research data.

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