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Categorization Skills and Receptive Language Development in Autistic Children[1]

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The category knowledge and receptive language skills of 16 autistic, mentally retarded, and normal children were assessed. The autistic children's knowledge of function, form, and color categories was comparable to that of the mental-age-matched mentally retarded and normal comparison groups. Category knowledge and receptive language were more closely associated for mentally retarded and normal children than for autistic children. The findings indicate that category knowledge is not sufficient for the development of receptive language in autistic children.

One of the primary components of the autistic syndrome is a central cognitive deficit that incorporates impaired language, sequencing, abstraction, and coding skills (Rutter, 1979). In the youngest age groups, the language impairment is especially prominent and, apart from IQ, has been found to be

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the best predictor of psychosocial outome in autistic children (Lotter, 1978; Rutter & Lockyer, 1967). Autistic children who develop useful language by 5 years of age have a much better prognosis for social adjustment than those who develop no language or whose language is more severely delayed (Rutter, 1978).

The importance of language development in autistic children has led to research efforts to identify the specific nature of the language disorder. This research has taken two forms. First, the language of verbal autistic children has been compared to that of mentally retarded and dysphasic children to determine which components of the language disorder are specific to autism and are not shared by other clinical groups. These comparisons have revealed that the semantic and pragmatic functions of language are uniquely delayed in autistic children (Tager-Flusberg, 1981). Second, studies of preverbal autistic children have attempted to identify deficits in the cognitive skills thought to underly language development. The early onset of autistic symptoms and the pervasiveness of the impairment suggest that cognitive functions are disordered by the 1st or 2nd year of life in the earliest stages of language development.

Several studies have identified deficits in cognitive skills thought to underly the development of language, but the degree of impairment across skills has been variable. In the sensorimotor domain in normal children, the development of object permanence has been considered a prerequisite for the use of words to label objects (Moore & Meltzoff, 1978), and means–ends relations have been associated with the ability to use language for communicating with others (Bates, Camaioni, & Volterra, 1975). The development of these and many other sensorimotor skills in autistic children is not delayed beyond what would be expected from their general level of retardation. The performance of autistic children on many sensorimotor tasks has been shown to be equivalent to that of mentally retarded and normal children of comparable mental age (Sigman & Ungerer, 1984). In contrast, the development of symbolic skills as manifested in pretend play is specifically impaired in autistic groups. Autistic children show less pretend play in both structured and free-play settings than mentally retarded and normal children of comparable mental age, and autistic children with minimal or no language show less pretend play than those with clearly identifiable language skills (Sigman & Ungerer, 1984; Ungerer & Sigman, 1981). Finally, the ability to categorize objects has been investigated as a cognitive skill that is necessary for the comprehension and use of all language forms. Autistic children have been shown to be capable of forming object categories based on spatial relations and perceptual cues like form and color (Lancy & Goldstein, 1982; Slotnick, 1983), but the relation of these findings to the development of language has not been directly explored. Studies of language development in normal children indicate that the concepts that form the meanings of children's early words are based on functional as well as perceptual attributes of objects (Nelson, 1979). However, no studies of the autistic child's ability to form categories based on functional cues have been conducted.

The purpose of this research was to assess the autistic child's categorization skills in both functional and perceptual domains and to determine whether relations between the development of categorization and language skills could be found. Two main questions were addressed: (1) Is the autistic child's ability to categorize objects based on functional or perceptual cues specifically delayed beyond what would be expected from his/her general level of retardation? (2) Is there a relation between the ability to categorize objects on the basis of functional or perceptual cues and language skills within the autistic group? The ability to form functional and perceptual categories was assessed in an object-sorting task (Ricciuti, 1965), and the processes for generating categories as well as the types of categories produced were measured. Studies of categorization in normal preschool children suggest that measures of process may be important indices of category knowledge, particularly in younger age groups (Slotnick, 1983; Sugarman, 1983). The overall goal of the research was to further the understanding of the cognitive foundations of language development in autistic children.

METHOD

Subjects

The sample consisted of 16 children in each of three groups: autistic, mentally retarded, and normal. The mean mental and chronological ages and the mean IQs of the three groups are listed in Table I. The autistic children (15 males and 1 female) were subjects in the Clinical Research Center (CRC) for the Study of Childhood Psychosis at UCLA and have been reported on in other publications (Sigman & Ungerer, 1984; Ungerer & Sigman, 1981). The diagnoses of autism were made independent of the experimenters by a group of CRC psychiatrists using DSM-III (American Psychiatric Association, 1980) criteria as follows: (1) onset before 30 months; (2) pervasive lack of responsiveness to other people; (3) gross deficits in language development; (4) if speech is present, peculiar speech patterns such as immediate and delayed echolalia, metaphorical language, pronominal reversal; (5) bizarre responses to various aspects of the environment, e.g., resistance to change or peculiar interest in, or attachments to, animate or inanimate objects; and (6) absence of delusions, hallucinations, loosening of associations, and incoherence as in schizophrenia. If the current syndrome fulfilled the criteria of the necessary

Table I. Age and Standardized Test Data for Autistic, Mentally Retarded, and Normal Children

	Autistic	Mentally retarded	Normal
Chronological age (months)	51.7	50.7	20.8
SD	10.7	12.6	3.0
Range	39–74	32–80	16–25
N	16	16	16
Cattell/Stanford-Binet			
Mental age (months)	24.8	26.6	24.6
SD	5.1	7.2	5.2
Range	18–38	17–38	17–35
IQ	48.1	48.0	116.0
SD	8.1	11.9	12.8
Range	35–62	28–71	92–147
N	16	16	16
Merrill-Palmer			
Mental age (months)	33.4	28.6	25.0
SD	7.8	7.1	5.4
Range	23–47	20–45	19–35
IQ	63.9	57.9	120.0
SD	14.9	15.8	12.9
Range	45–90	38–91	105–146
N[a]	14	15	16

[a]Two autistic children and one mentally retarded child did not achieve a basal level of performance on this test.

and sufficient symptoms above but was associated with known organic brain disease, the child was not included in the sample.

Each of the 16 mentally retarded children (10 males and 6 females) was matched with an autistic child on chronological age and on mental age as assessed by the Cattell or Stanford-Binet scales (see Table I). *T* tests indicated no significant differences between the mentally retarded and autistic groups for the chronological and mental age measures. Mental age scores as determined by the Merrill-Palmer scales also were available and showed no significant differences between the groups. The nature of the condition associated with mental retardation and the sex of the subject were allowed to vary because of the priority of identifying subjects matched on chronological and mental age with the autistic children. Half of the mentally retarded children had Down's syndrome, three had organic dysfunctions, including arrested hydrocephalus and seizure disorders, and five suffered from retardation of unidentified origin. Four of the children were subjects in the Clinical Research Center.

Each of the 16 normal children was matched with an autistic child on mental age as assessed by the Cattell or Stanford–Binet scales. A t test comparing the autistic and normal children on Cattell/Stanford-Binet mental age showed no significant differences between the groups. However, the groups were significantly different on mental age as assessed by the Merrill-Palmer scales, $t(26) = 3.01, p < .01$. This difference derived largely from the autistic children's superior scores on performance items like puzzles and form boards, which are a major component of the Merrill-Palmer scales.

Assessment of Categorization

Categorization was assessed using a spontaneous object sorting task. The stimuli were geometric forms and miniatures of common objects representing four color, three form, and four function categories. The color and form stimuli were square, triangular, and circular wooden shapes 1½ inches in height and ⅜ inches thick, and either red, yellow, blue, or green in color. The function stimuli were realistically colored plastic miniatures, roughly equivalent in size, representing the categories of animal, fruit, vehicle, and furniture. The specific exemplars for each function category were as follows: animal – cow, elephant, horse, lion; fruit – apple, banana, grapes, pear; vehicle – car, motorcycle, truck, airplane; and furniture – chair, lamp, couch, table. The exemplars were selected to be among the 10 most commonly reported members of each category according to norms established by Battig and Montague (1969). The color and form differences among exemplars within each category were maximized to ensure that sorting was done on the basis of function rather than perceptual cues. Many children gave evidence of understanding the functions of the objects by making functional arrangements of the objects or by using the objects in functionally appropriate ways – for example, placing the chair next to the table, biting the apple, walking the horse, or flying the airplane.

Each child was tested individually while seated at a table next to the experimenter. A test session consisted of seven sorting trials, including two function, two color, and three form trials. On each trial, the child was presented with two different sets of four objects (e.g., four red circles and four red squares), both from the same superordinate category (e.g., form). The objects initially were arranged in a pile in front of the child, whose spontaneous manipulation and sorting of the objects was recorded using a video camera. The form and color trials were 1 minute in length and the function trials were 2 minutes in length. If the child stopped manipulating the objects before the end of a trial or if he or she manipulated a single object continuously for 30 seconds, the experimenter reformed the objects into a pile and directed the child's attention to it. If the child was in the process of sorting the objects spatially or temporally when the trial time was over, the child was permitted to complete the sort before the next trial was initiated.

The presentation order of the trials was randomized within blocks, each of which included one color, one form, and one function trial. Each child was presented with two blocks representing six trials. The seventh and final trial for each child was a form trial. The two sets of objects presented on a trial were randomly determined with the restriction that each set be presented only once. An exception occurred with the sets of form objects that were presented twice. When form categorization was tested, the color of the objects was invariant, and when color categorization was tested, the form of the objects was invariant.

Measures

The videotapes were transcribed to create written records of the sequence of objects touched on each trial and any spatial arrangements of objects (e.g., clusters, symmetrical patterns). Three types of categorization measures then were applied to the written records (Ricciuti, 1965; Sugarman, 1981). (1) A measure of the tendency to select same-category objects in succession on each trial was computed as follows: Beginning with the second object contacted on a trial, each different object contacted was scored for its relation to the object immediately preceding—same category or different category. The percentage of same-category selections was computed for each trial. (2) A second group of measures assessed the exhaustiveness of the category selections. The records were scored for instances of (a) temporal-1: the successive manipulation of three or four members of the same category, and (b) temporal-2: the successive manipulation of three or four members of one category followed by the successive manipulation of three or four members of the other category. When computing these measures, repetitive contacts of the same object or of previously selected same-category objects were not scored. For example, the sequence circle_1 - circle_2 - circle_1 - circle_3 - circle_2 would be scored as three different objects contacted. (3) The third group of measures assessed the spatial grouping of same-category objects. The records were scored for instances of (a) spatial-1: grouping three or four members of one category, and (b) spatial-2: grouping three or four members of one category separately from three or four members of the other category. The process used to create the spatial-2 groupings also was assessed. We noted whether the child spatially grouped the objects from one category before contacting and grouping objects from the other category (i.e., successive grouping), or whether objects from both categories were contacted before any spatial groupings were completed (i.e., simultaneous grouping). Research with normal children indicates that temporal grouping of same-category objects occurs developmentally earlier than spatial grouping, and that the spatial grouping of objects by successive means occurs prior to their spatial grouping by simultaneous means (Ricciuti, 1965; Sugarman, 1981). A final spatial grouping measure was matching: holding two same-category objects, one in each hand, and touching them together.

Reliability for these measures was established by having two observers independently score the videotapes of 15 subjects. Wilcoxon signed-ranks tests comparing the temporal, spatial, and matching measures, and the number of same-category selections and total number of selections on each trial yielded no significant differences between the two observers.

Assessment of Receptive Language

Receptive language was assessed using a receptive language measure developed by Beckwith and Thompson (1976). The child was shown pairs of slide pictures representing objects and events from the everyday meaningful experience of most young children. An initial 12 pairs of pictures were used for an operant training procedure during which the child learned to touch the member of the pair verbally labeled by the experimenter. Children who correctly identified at least 8 of the 12 training pairs then were presented with 34 pairs of pictures that were the test stimuli proper. The child's receptive language score was the number of correctly identified pictures for the 34 pairs. Children who identified less than 8 of the 12 training pairs received a score of zero for this measure.

RESULTS

Category Knowledge

Between Groups. Many of the measures of category knowledge used in this research were likely to vary as a function of the number of objects contacted in the sorting task. Differences among the groups on this variable were assessed and adjusted before any group comparisons of category knowledge were made. Analyses of variance comparing the autistic, mentally retarded, and normal children on the total number of objects contacted on the function, form, and color sorting trials indicated no significant differences among the groups for the function and color trials. However, in both cases the means for the autistic chilcren were higher than for the other two groups (see Table II). A marginally significant group difference was found for the number of objects contacted on the form trials ($F(2, 47) = 3.13$, $p = .053$), with the autistic children contacting more objects than the mentally retarded or normal children. Although the differences among the groups in the number of objects contacted were not statistically significant, the trends

Table II. Mean Number of Objects Contacted by Category and Group

Group	Category		
	Function	Form	Color
Autistic			
Mean	16.1	15.6	14.1
SD	9.2	9.7	10.7
Mentally retarded			
Mean	16.0	12.1	11.7
SD	6.2	4.0	7.8
Normal			
Mean	13.9	10.1	11.7
SD	4.8	2.9	4.3

were considered sufficient to warrant adjusting the data to equate the groups on this variable.

The procedure used to equate the three groups for the number of objects contacted was as follows: For each trial for each task, children were rank-ordered within groups by the number of object contacts made on that trial. The number of contacts analyzed for each child on the trial was the lowest number made by any child at that same rank. For example, if the number of object contacts on the first function trial for the fifth-ranking child in each group was autistic 18, mentally retarded 15, and normal 14, only the first 14 object contacts for each of the three fifth-ranking children were analyzed. This method utilized the maximum amount of information while controlling for possible artifacts deriving from group differences in the tendency to contact the objects (Sugarman, 1981). All between-group analyses reported here used the adjusted date.

Differences in category knowledge among the three groups were first assessed by determining whether the groups differed in their tendency to touch objects from the same category in succession. Kruskal-Wallis one-way ANOVAs showed no significant differences among the three groups in the percentage of same-category object contacts for the function, form, and color tasks. These results were largely confirmed by MANOVA analyses comparing the three groups on the temporal grouping (1 or 2 categories), spatial grouping (1 or 2 categories), spatial process (simultaneous or successive grouping), and spatial matching variables (see Table III). Overall MANOVAs computed separately for the function, form, and color tasks showed no significant differences among the groups. In addition, only one univariate ANOVA in the MANOVA analyses showed significant group differences ($F(2, 45) = 4.53, p = .02$). Spatial grouping of a single form category (e.g., circles) occurred more often in the autistic than in the mentally retarded or normal group, Thus, category knowledge as manifested in the temporal or spatial

Table III. Mean Frequencies for Measures of Categorization by Category and Group

	Measures of categorization					
	Temporal 1	Temporal 2	Spatial 1	Spatial 2 successive	Spatial 2 simultaneous	Spatial matching
Autistic						
Function	.91	.19	.25	.03	.00	.19
Form	.71	.29	.54	.10	.13	.08
Color	.53	.31	.13	.19	.25	.16
Mentally retarded						
Function	.91	.28	.13	.03	.09	.16
Form	.67	.23	.23	.04	.08	.06
Color	.59	.09	.09	.09	.16	.16
Normal						
Function	1.15	.16	.13	.00	.03	.09
Form	.69	.23	.10	.02	.06	.06
Color	.59	.19	.13	.03	.09	.09

grouping) did not differentiate the groups. It is of interest to note that for all three groups, category knowledge was manifested most frequently by the touching of same-category objects in succession. This finding is consistent with research on young normal children showing temporal grouping of same-category objects occurring developmentally earlier than spatial grouping (Ricciuti, 1965; Sugarman, 1981).

Within Groups. Knowledge of function, form, and color categories was compared within the autistic, mentally retarded, and normal groups to determine whether level of category knowledge was equivalent across the three categories tested. Friedman two-way ANOVAs computed separately for each group with the mean percentage of same-category selections as the dependent variable yielded significant differences among categories for the autistic ($\chi^2(2) = 8.47, p = .01$) and normal ($\chi^2(2) = 11.63, p < .01$) children. In the autistic group, the mean percentage of same-category object selections was highest for the function and form trials and lowest for the color trials (mean percentage = 52.1, 49.8, and 34.5, respectively). For the normal children, mean percentage of same-category selections was higher on the function trials than on the form or color trials (mean percentage = 49.0, 32.4, and 30.7, respectively). No significant differences among categories were noted in the mentally retarded group, although the pattern of performance across categories was similar to that observed in the other two groups (mean percentage = 46.6, 37.5, 29.4 for function, form, and color, respectively). Comparisons among categories using the temporal and spatial grouping dependent variables were not conducted, because the unequal number of trials across categories (function and color = 2 trials; form = 3 trials) made it difficult to control for any differences in the tendency to contact the objects. However, informal analyses with the unadjusted data yielded results entirely consistent with those reported above.

Category Knowledge and Language

The relation between category knowledge and receptive language within the autistic, mentally retarded, and normal groups was assessed to determine the degree of association between these developing skills. Correlations were computed separately for each group between the number of correctly identified pictures in the receptive language task and four composite measures of category knowledge. The composite measures of categorization were derived by summing scores for the temporal and spatial grouping measures within each category to yield separate composite scores for the function, form, and color categories and by summing the temporal and spatial grouping measures across all three categories to yield a total category knowledge score. Point-biserial correlations were used for the autistic group because the distribu-

Table IV. Correlations Between Category Knowledge and Receptive Language within Groups

	Category knowledge			
	Function	Form	Color	Overall
Receptive language				
Autistic	.14	.22	.21	.21
Mentally retarded	.38[a]	.51[b]	.30	.54[b]
Normal	.01	.36[a]	.47[b]	.39[a]

[a] $p < .10$.
[b] $p < .05$.

tion of scores for this group on the receptive language task was dichotomous. Nine autistic children demonstrated minimal or no receptive language (0 to 3 correct responses), while seven children demonstrated clear receptive language skills (14 to 28 correct responses). Pearson product-moment correlations were used for the mentally retarded and normal groups. The mean number of correctly identified pictures in the receptive language task for these two groups was 17.0 (SD = 11.2, range 0 to 31) for the mentally retarded children and 20.4 (SD = 8.4, range = 3 to 32) for the normal children.

There were no significant correlations between measures of receptive language and category knowledge within the autistic group (see Table IV). However, analysis of data for individual autistic children indicated that a basic level of category knowledge may be prerequisite for the development of receptive language in this group. All the autistic children but one demonstrated category knowledge through either the manipulation or the grouping of same-category objects, but only seven of these children also demonstrated clear receptive language skills. The one autistic child who showed no category knowledge also gave no evidence of understanding words in the receptive language task. Thus, category knowledge appeared to be a prerequisite for the onset of receptive language, but more advanced category knowledge was not associated with more sophisticated receptive language in the autistic group. In contrast, significant correlations between category knowledge and receptive language were found for the mentally retarded and normal children (see Table IV). In the mentally retarded and normal groups, more advanced receptive language was associated with more frequent manipulation and grouping of same-category objects in the sorting task.

DISCUSSION

The results of this research permit clear statements regarding the nature of category knowledge and its association with receptive language development in autistic children. The autistic children in this study demonstrated knowledge of function, form, and color categories that was comparable to that of mentally retarded and normal children of matched mental age. The category knowledge of the autistic children was not delayed beyond what would be expected from their general level of retardation, and, thus, no impairment in category knowledge specific to autism was found.

The autistic children's ability to form categories was demonstrated with function as well as with form and color stimuli, and level of category knowledge for function stimuli was comparable to that demonstrated in the perceptual domains. Interestingly, the ability to categorize objects by function, form, or color was associated only minimally with receptive language in the autistic group. Thus, the autistic child's delayed language development cannot be attributed to a delay in the acquisition of categorization skills. Only a single measure of receptive language was used in this research, and broader assessments of language development may yield different findings. However, the receptive language assessment employed here did permit the identification of relations between category knowledge and receptive language in both the mentally retarded and normal groups. Category knowledge may be necessary for the development of receptive language in autistic children, but it clearly is not sufficient to explain the emergence of their receptive language skills.

Category knowledge and language may be expected to show some association developmentally because functioning in each domain depends on similar basic skills—that is, the ability to identify functional and perceptual properties of objects and to abstract and internally represent this information in the form of object concepts. Associations between category knowledge and receptive language were minimal in the autistic children but were clearly present in the mentally retarded and normal groups. Development across domains in autistic children appears to be more uneven than that observed in both mentally retarded and normal children, a finding that has been reported in other research with autistic groups (Ungerer, 1985). The autistic disorder is associated with deficits in specific cognitive, language, and social skills; not all areas of functioning are equally delayed.

The greater unevenness of the autistic child's development does not mean that associations between all skills are lacking. Ungerer and Sigman (1981) reported significant relations between receptive language and the functional and symbolic use of objects in play in this same group of autistic children. The development of play and language may be closely linked because both skills reflect the development of symbolic thought, a major cognitive achievement in the early childhood years. Similar relations between play and language also have been observed in other clinical and normal groups (Ungerer & Sigman, 1984), supporting the robustness of the association between these developmental domains.

In sum, the cognitive skills of autistic children are severely impaired from the earliest years, but not all areas of functioning are equally delayed. The ability to categorize objects is not specifically impaired and is not critical for explaining the autistic child's delayed language development. In contrast, the ability to use symbols in play is specifically delayed, and its association with receptive language development suggests factors that may underlie the autistic child's impaired cognitive, language and social skills.

The young autistic child is specifically delayed in the development and use of verbal and gestural symbols, tasks that are both cognitive and social in nature. The ability to form symbols is clearly a cognitive skill, but the meaning and communicative function of symbols are learned in the context of interaction with others. Autistic children appear to have particular difficulty acquiring information from social interactions (Rutter, 1983), which places them at considerable disadvantage when faced with the task of learning to generate and use verbal and gestural symbols. Their delayed development in these domains reflects inadequate cognitive skills and a failure to engage in and learn from social interactions. Thus, their disability is inherently cognitive and social, and cannot easily be reduced to a singular dysfunction in either domain (Ungerer, 1985).

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