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Developmental aspects of incidental learning in retarded children

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One hundred and fourteen educable mentally retarded children divided equally into two groups by mental age (older vs. younger) were exposed to one of three different orienting instructions (incidental-semantic, intentional-control, or incidental-categorize) within an incidental learning paradigm. The experimental task consisted of 18 pictures representing six instances of each of three common taxonomic categories. Older subjects recalled significantly more pictures with better clustering than younger subjects. Subjects receiving incidental-categorize instructions recalled significantly more items and showed significantly more clustering than subjects receiving the other instructions. The superiority of the categorize condition was maintained during a 24-h follow-up session.

The levels-of-processing model for memory research (Craik & Lockhart, 1972), which has recently been elaborated (Jacoby & Craik, 1979), maintains that stimuli processed to deep cognitive levels will be retained to a greater degree than material processed superficially. The Type I incidental learning paradigm (Postman, 1964) has been used to assess the memory processing model (Craik & Tulving, 1975). Incidental learning research with children (Owings & Baumeister, 1979) and adults (Walsh & Jenkins, 1973) has generally supported the levels approach for studying memory. For example, Murphy and Brown (1975, Experiment 2) provided preschool normal children three different orienting activities: semantic classification–placing pictures into nice, nasty, and in-between categories; taxonomic classification–placing pictures into class name categories (e.g., toys, wild animals, people); and superficial classification–placing pictures into categories based on the colors present in the pictures. Both the semantic and taxonomic classification conditions resulted in recall superior to that found in the superficial condition. The first two conditions, designed to produce deeper levels of processing than the superficial activity, did not differ from each other on a recall measure. Incidental learning research with the mentally retarded has produced findings inconsistent with those reported for the intellectually normal population. Fox and Rotatori (1979) found that a taxonomic classification condition produced greater and more durable recall than did semantic, superficial, or intentional learning conditions. The differences in findings obtained in this study may be because (1) the study's design was not sensitive to developmental differences, as relatively large ranges in chronological age (81-167 months) and mental age (44-135 months) were present across all experimental conditions, and/or (2) the subjects, especially the younger ones, had trouble understanding the semantic instructions (e.g., classifying the stimuli in terms of their inherent goodness or badness).

The present study attempted to correct these two potential problems. First, the retarded subject pool was divided into a younger and an older group on the basis of mental age to allow a developmental comparison. Second, in the semantic condition, subjects were instructed to classify the stimuli into one of three groups: "big," "little," or "in between." These simple semantic categories were chosen to reduce the confusion present in the previous study with the retarded.

METHOD

Subjects and Experimental Design

Subjects were 114 retarded children, 53 males and 61 females, drawn from special education classes from five counties in west central Illinois. The subjects were initially divided into two groups (N = 57 subjects/group) by mental age resulting in a younger mental age group and an older mental age group. The IQ scores and birth-date information used to compute each subject's mental age were obtained from the child's school file. The Stanford-Binet and Wechsler scales were the intelligence tests most frequently reported. The younger mental age group had mental ages ranging from 49 to 102 months, IQs from 44 to 82, and chronological ages from 68 to 187 months. The older mental age group had mental ages ranging from 102 to 142 months, IQs from 57 to 87, and chronological ages from 133 to 192 months. The independent variables included the two age groups and three orienting instruction conditions (semantic, control, categorize). A randomized-blocks design (Edwards, 1965) with mental age as the block variable was used to establish the mental age equivalence of the subjects in the three orienting instruction conditions within both the younger and the older mental age group·

Task Materials

The stimuli chosen as the experimental task were 18 common pictures, approximately 8 x 9 cm in size, selected from the Peabody Picture Vocabulary Test. The pictures were each colored in with one appropriate color (e.g., brown dog, red

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clown) to increase the attention value of the materials. The pictures were selected to represent easily identifiable objects and so that the question, "Is this one big or little?" would be reasonable. The 18 pictures represented three taxonomic categories with 6 pictures in each: people–man, girl, baby, woman, clown, soldier; animals–dog, squirrel, horse, chick, cat, cow; and vehicles–train, car, truck, bicycle, wagon, boat.

Experimental Procedure

Subjects were seen individually in a quiet room in the child's school. Each child was exposed to the task materials and one set of orienting instructions. The task materials were randomly prearranged in a 3 by 6 pattern, face downward, before the child entered the testing room. For each of the orienting instruction conditions, the subject was required to turn the pictures face upward.

The specific procedures for the three orienting instruction conditions were as follows:

(1) Semantic classification instructions (semantic)–The subjects were instructed to label the pictures and to put them in one of three groups: "big," "little," or "in between." Three circles (8, 5, and 2 cm in size) were placed on the table in front of the child approximately 8 in. apart to facilitate the child's location of the pictures. After the groups were assembled, the subjects were asked questions regarding their placement of the pictures in the various groups (e.g., "Is a squirrel bigger than a train?" "Show me how little a baby is.") for a total of 2 min. The questions were designed to help the children consider each task item more fully and thus deepen their level of processing.

(2) Intentional control instructions (control)–In this condition, the subjects first verbally labeled all of the task items. They then were told to try to remember as many task items as possible because they would be given a retention test following the completion of the task. Two minutes were allowed for the subjects to study the materials and prepare for the retention test.

(3) Taxonomic classification instructions (categorize)–In this condition, the subjects were instructed to label the pictures and to put all the animals, people, and vehicles together in spatially separate groups. After the groups were assembled, the children were instructed to name all pictures in each group for a total of 2 min (e.g., "Tell me all of the people.").

The 2-min time limit for the orienting activity was standard for all conditions. After the subjects completed the 2-min orienting activity, the task items were removed from their vision. Subjects were then asked to verbally recall as many items as possible. After it was clear that the subjects had finished their recall, a cued recall condition was given. The experimenter provided the three class names (i.e., vehicles, people, animals) to all subjects to elicit additional responses. After approximately 24 h, each child was seen again by the same experimenter in the same testing room. The child was asked to recall as many of the task items as possible, followed by another cued recall condition.

RESULTS AND DISCUSSION

The means and standard deviations of the subjects' mental ages, chronological ages, and IQs are presented by groups in Table 1. Three 2 by 3 analyses of variance with mental age (older vs. younger) and instructions (semantic, control, and categorize) as the independent variables were used to establish the homogeneity of the three orienting instruction groups on the blocked variable mental age, as well as on chronological age and IQ. Although the older mental age group scored significantly higher than the younger mental age group on all three measures (all $ps < .001$), the subjects in the three instructional conditions did not differ significantly on any of the three measures (all $Fs < 1$), and there were no significant interactions (all $Fs < 1$).

Table 1
Means and Standard Deviations of Subjects' Mental and Chronological Ages (in Months) and IQs

	Mental Age		Chronological Age		IQ	
Condition	Mean	SD	Mean	SD	Mean	SD
Younger Mental Age Group (N = 57)						
Semantic	79.20	14.04	120.84	26.04	67.16	10.79
Control	75.72	14.75	115.80	25.09	66.26	9.76
Categorize	76.80	15.96	119.64	33.00	65.63	14.22
Older Mental Age Group (N = 57)						
Semantic	117.96	10.68	159.36	18.72	74.47	6.26
Control	116.64	11.13	159.00	14.45	73.52	5.65
Categorize	118.44	11.16	163.08	14.76	73.11	6.15

Note–N = 19 subjects in each experimental condition.

The dependent variables used for recall were the number of items freely recalled and the number of items recalled after cuing on both Day 1 and Day 2. The measure used for the degree of clustering by category on the free recall tests was the adjusted ratio of clustering: $ARC = R - E(R)/\max R - E(R)$, where R = total number of observed category repetitions, $\max R$ = maximum possible category repetitions, and $E(R)$ = expected or chance number of category repetitions (Roenker, Thompson, & Brown, 1971). The mean number of task items recalled and the degree of clustering on Days 1 and 2 of testing are presented in Table 2. Due to absences on Day 2 and to the relative scarcity of other retarded children for testing, it was necessary to substitute cell means for missing free recall, cued recall, and clustering data on Day 2 for 19 subjects.

Three 2 by 3 by 2 mixed analyses of variance with mental age and instructions as between-groups variables and days as the within-groups variable were performed on the dependent variable measures. The analysis of the free recall data indicated that the older mental age group recalled significantly more items (mean = 11.61) than the younger mental age group (mean = 8.94) [$F(1,108) = 34.14$, $p < .001$]. There was also a significant main effect of instructions [$F(2,108) = 24.43$, $p < .001$]. Duncan's test revealed that the categorize instruction group recalled significantly more items (mean = 12.54) than either the semantic instruction group (mean = 9.18) or the control group (mean = 9.11) ($ps < .001$), but that the latter two groups did not differ significantly from each other. The Age by Instructions interaction was also significant [$F(2,108) = 3.22$, $p < .05$]. The significant interaction apparently was due to the fact that the difference between the performances of the older mental age subjects and the younger mental age subjects was much greater in the control condition (mean = 11.26 and 6.95, respectively; Duncan's $p < .001$) than in either of the other two conditions (Duncan's $ps < .05$). In addition, significantly more items were

Table 2
Mean Free Recall (FR), Cued Recall (CR), and Adjusted Ratios of Clustering (ARC) Scores as a Function of Subjects' Mental Ages and Instructional Conditions

Condition	Day 1			Day 2		
	FR	CR	ARC	FR	CR	ARC
Younger Mental Age Group (N = 57)						
Semantic	9.47	11.84	.24	6.95	10.37	.06
Control	8.63	10.47	.28	5.26	8.84	.37
Categorize	14.00	15.16	.74	9.32	12.84	.58
Older Mental Age Group (N = 57)						
Semantic	11.47	13.16	.33	8.84	10.79	.54
Control	12.32	13.74	.25	10.21	11.74	.61
Categorize	14.68	15.47	.93	12.16	14.32	.79

recalled on Day 1 (mean = 11.76) than on Day 2 (mean = 8.79) [$F(1,108) = 108.85$, $p < .001$].

The results of the cued recall analysis were similar to those of the free recall analysis. There was a significant main effect for age [$F(1,108) = 18.67$, $p < .001$], with the older mental age subjects recalling more items (mean = 13.20) than the younger mental age subjects (mean = 11.59). The instructions main effect was also significant [$F(2,108) = 30.47$, $p < .001$], with the categorize instruction subjects recalling significantly more items (mean = 14.45) than either the semantic instruction group (mean = 11.54) or the control group (mean = 11.20) (Duncan's $ps < .001$) and with no difference between the latter two groups. Once again, the Age by Instructions interaction was significant [$F(2,108) = 3.845$, $p < .025$], with the interaction again due to the greater difference between the performances of the older mental age subjects and the younger mental age subjects in the control condition (means = 12.74 and 9.66, respectively; Duncan's $p < .001$) than in either of the other two conditions (Duncan's $ps < .05$). The main effect for days was also significant [$F(1,108) = 108.96$, $p < .001$], with more items recalled on Day 1 (mean = 13.31) than on Day 2 (mean = 11.48). Finally, there was a significant Age by Instructions by Days interaction [$F(2,108) = 3.10$, $p < .05$]. This interaction was accounted for by the fact that, under the control instructions on Day 1, the older mental age subjects recalled significantly more items (mean = 13.74) than the younger mental age subjects (mean = 10.47) (Duncan's $p < .001$). The same effect was observed on Day 2, with the older mental age subjects recalling significantly more items (mean = 11.74) under the control instructions than did the younger mental age subjects (mean = 8.84) (Duncan's $p < .001$). The only other similar significant comparison was on Day 2 in the categorize condition, for which the older mental age subjects recalled significantly more items (mean = 14.32) than the younger mental age subjects (mean = 12.84) (Duncan's $p < .05$).

The analysis of the clustering data indicated that the older mental age subjects showed significantly more clustering by category (mean = .57) than did the younger mental age subjects (mean = .38) [$F(1,108) = 14.46$, $p < .001$]. There was also a significant instructions main effect [$F(2,108) = 31.28$, $p < .001$]. Duncan's test indicated that the subjects who received the categorize instructions showed significantly more clustering (mean = .76) than did the subjects who received the control (mean = .38) or semantic instructions (mean = .29) ($ps < .001$), but the latter two groups did not differ significantly. Unlike the recall analyses, there was no significant Age by Instructions interaction and no significant main effect for days ($Fs < 1.00$). However, there was a significant Age by Days interaction [$F(1,108) = 8.22$, $p < .005$] and a significant Instructions by Days interaction [$F(2,108) = 7.33$, $p < .001$]. The Age by Days interaction is accounted for by the fact that there was no significant difference between the clustering scores of the older mental age subjects and the younger mental age subjects on Day 1 (means = .50 and .42, respectively), but there was a large significant difference on Day 2 (means = .64 and .34, respectively; Duncan's $p < .001$). In addition, the older mental age subjects showed significantly improved clustering scores from Day 1 (mean = .50) to Day 2 (mean = .64) (Duncan's $p < .05$), whereas the younger mental age subjects showed a tendency to cluster less on Day 2 (mean = .34) than on Day 1 (mean = .42). The Instructions by Days interaction was due to the fact that those subjects who had received categorize instructions showed significantly decreased clustering from Day 1 (mean = .83) to Day 2 (mean = .68) (Duncan's $p < .05$), while the control instructions subjects showed significantly increased clustering from Day 1 (mean = .27) to Day 2 (mean = .49) (Duncan's $p < .05$), and the semantic instructions subjects showed poor clustering on both days (means = .28 and .30).

The main developmental difference found in the present study was that the older mental age group recalled more items with greater clustering than did the younger mental age group. This finding lends support to the increasing linear function for Type I incidental learning with retarded children also found for intellectually normal children (Owings & Baumeister, 1979). The differential effects found for the incidental learning instructions were the same for both the younger and the older mental age groups, with the categorizing instructions consistently producing the greatest and most durable recall. This finding supported previous Type I incidental learning research with the retarded (Fox & Rotatori, 1979) but contradicted the findings of Murphy and Brown (1975, Experiment 2) with normal children.

The failure of the control condition to produce recall comparable to the categorize condition has been explained in previous research. Kellas, Ashcraft, and Johnson (1973) reported a tendency for retarded children to fail to spontaneously adopt active acquisition strategies for learning. Also, Brown (1974) contends that at least young retarded children may need to be provided specific rehearsal strategies for learning.

The categorize condition in the present study also produced recall superior to the semantic condition. In contrast to the potential confusion present in the semantic condition in the previous research with the retarded (Fox & Rotatori, 1979), all subjects in the present study clearly understood the semantic instructions. A more probable explanation for the superior recall in the categorize condition is that the class names in the categorize condition (vehicles, people, animals) were more specific and circumscribed retrieval cues (i.e., made better associations between the class names and other information already in the subjects repertoire) than the semantic group names (big, little, in between). Given this assumption, one would predict better memory performance for the categorize condition (Glass, Holyoak, & Santa, 1979). Also, the task stimuli (18 pictures) represented better instances of the class names in the categorize condition than in the semantic condition, which would certainly enhance their association in memory.

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