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ABSTRACT

An aptitude treatment interaction was predicted in which 30 retarded adolescents were expected to profit most from associative training and 30 intellectually average third graders most from conceptual training. Ss received either associative training designed to strengthen direct associations among pairs of conceptually related members of a free recall list or members and their corresponding categories. Associative training facilitated free recall of trained items at both intellectual levels. For clustering data a treatment by groups interaction was found in which nonretarded Ss benefited relatively more than retardates from associative training. (Author)

Associative and Conceptual Training of Retarded and Normal Children[1]

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Associative and Conceptual Training of Retarded and Normal Children

The contemporary interest in psychological processes underlying human learning and recall has also been influential in the aptitude treatment interaction (ATI) literature. Glaser (1972) and DiVesta (1975) were among the first to urge that researchers study the differences in psychological processes engaged by different training methods. One convenient avenue for the study of such processes is to compare learning of traditional laboratory tasks by normal and retarded subjects. One would expect that a retarded population is much less likely than normal students to use high-order intellectual processes in a variety of learning tasks. The general purpose of this study was to test this hypothesis. Specifically, it was expected that normal subjects would profit more from an instructional strategy emphasizing high-order conceptual relationships among items in a free recall task than would retarded students, and the latter were expected to profit more from a less abstract, direct associative strategy.

Associative and Conceptual Learning

Cofer (1965) distinguished between associative and categorical bases for clustering in free recall. Randomly presented items may be clustered, or recalled in adjacent positions in terms of either associative relatedness (i.e., interitem associative strength as determined from word association norms) or via categorical relatedness (i.e, subordinate-superordinate relationships among items)(Shuell, 1969). In children's free recall, Lathey (Note 1) suggested that the emergence of an associative basis to accomplish clustering precedes that of a categorical one. In

Lathey's study an interaction was found in which fourth graders, in contrast to Kindergarten children, benefited from instructions to cluster categorically items with low and high associative relatedness.

It has been suggested that a main difference between associative and categorical clustering paradigms has to do with the extent to which organization or relatedness among stimuli is apparent to the subject (Shuell, 1969). The clustering observed in children's free recall in some studies may reflect highly practiced word associations, rather than the deliberate deployment of a conceptual strategy (Lange, 1973). Such a view may help clarify the processes involved in the onset of clustering in developmentally young subjects (Ornstein & Corsale, 1979).

Jensen (1970a) suggested that the associative--conceptual distinction in cognitive abilities, originally advanced by White (1965), might serve as a theoretical guide to generate hypotheses for ATI research with children. In this scheme, associative learning is defined as the formation of direct associations between stimulus inputs, whereas conceptual learning involves the elaboration and transformation of input (Jensen, 1970b; Jensen & Frederiksen, 1973).

In one study of associative and conceptual distinction the investigators expected to find conceptual ability related to learning performance, particularly under conditions conducive to the use of organizational strategies (Labouvie-Vief, Levin & Urberg, 1975). In Experiment 2 they found that third graders who had earned high scores on the Raven's Progressive Matrices Test (a test of reasoning) tended to show greater recall of a list of unrelated words, compared to low scorers. The predicted correlations between learning and scores on the Digit Span Test (a marker of associative learning ability), however, were not found to be significant. Labouvie-Vief (1976) suggested that future research in this area should implement potent treatment conditions that might more clearly demonstrate the causal role of posited cognitive processes.

Evans and Bilsky (1979) reported that surprisingly little research in the mental retardation literature has attempted to separate the influence of associative versus categorical relationships in free recall. They recommended that comparative research using retarded and normal subjects, in which the manipulation of theory-related independent variables yielded reliable treatment by group interactions, would provide the strongest evidence of differences in underlying cognitive processes. Evans & Bilsky suggested that if retarded persons were, in fact, slower to use organizational strategies than nonretarded subjects (Brown, 1974), it might be expected that they would rely more heavily upon direct item to item, rather than subordinate to superordinate, associations to facilitate free recall performance.

The present study sought to extend the notion of an associative--conceptual distinction to the exploration of process differences in the learning of retarded and intellectually normal students. Normal children have been found to profit from training that stresses the use of category organization (Moely & Jeffrey, 1974). By contrast, attempts to remediate categorical clustering deficits in retarded children have yielded equivocal results (Whittemore & Bilsky, Note 2). For retarded subjects the frequent co-occurrence in training of items from a taxonomic category may provide for categorical clustering on an associative basis (Palmer, 1974). The availability of an associative basis for clustering by retarded children is suggested by superior organization in recall for items of high, rather than low, associative strength (Drew & Prehm, 1970; Lathey, 1979). Associative learning abilities have not, however, been systematically capitalized upon to enhance the free recall performance of retarded subjects.

The effects of paired-associate training may be observed in the subsequent organization of trained items presented for free recall (Segal & Mandler, 1967). In the present study paired associate training was designed to strengthen experimentally formed associations among stimulus items. Subjects were given either associative training intended to strengthen direct associations among pairs of conceptually related members of a free recall list or conceptual training intended to strengthen associations between list members and their corresponding category name. A treatment by groups interaction was expected in which free recall performance of educable mentally retarded and nonretarded students would be most facilitated by associative training whereas conceptual training was expected to be optimal for normal students. A further purpose of this study was to investigate differences in transfer between retarded and nonretarded subjects. Retarded subjects have been found to perform poorly on transfer lists in free recall (Bilsky, 1976). An additional question addressed in this investigation was whether this finding could be, partially, attributed to the instructional method employed.

Method

Subjects

The subjects were 16 male and 14 female noninstitutionalized educable mentally retarded students selected from special education classes in two lower Hudson Valley (New York) public school districts and 14 male and 16 female third grade students selected from comparable districts. The chronological (CA) age range of the retarded subjects was from 9.83 to 19.00 years, with a mean of 13.74 and a standard deviation (SD) of 2.38. The IQ range was from 50 to 81, with a mean of 68.97 and an SD of 8.62. All IQ scores were obtained from the Wechsler Intelligence Scale for Children-Revised or the Stanford-Binet intelligence Scale; there was no significant difference between treatment groups in IQ. The average mental age for this sample was determined to be 9.48 years by the ratio IQ method (Palmer, 1974).

The third grade subjects were selected by their classroom teachers, who were asked to recommend children reading at grade level and free of handicapping conditions. The CA for this nonretarded sample ranged from 8.42 to 9.42 years, with a mean of 8.96 and an SD of .30. No IQ score data were available for this group. They were judged to be of average intelligence due to regular class placement and, thereby, provided a rough mental age match to the retarded sample.

Materials & Apparatus

A 16-item stimulus list (List A) to be presented for free recall consisted of four infrequent associates to each of the following category names: animals, sports, clothing, and fruit (Battig & Montague, 1969). A 16-item transfer list (List T) consisted of a new set of infrequent associates to the same four conceptual categories represented in List A, taken from the same source of category norms.

The paired-associate lists used in training included two stimulus items drawn from each of the conceptual categories represented in List A. The Associative Training list was composed of 8 pairs, in which both stimulus and response terms were members of the same conceptual category (e.g., watermelon-blueberry). The Conceptual Training list was composed of 8 pairs, in which stimulus terms were identical to those of the Associative Training list and response terms were corresponding superordinate category names (e.g., watermelon-fruit). The Associative Training group, then, received half of the terms in List A as stimulus members, and the other half as response members. The Conceptual Training group, on the other hand, was administered half of the terms in List A as stimuli, paired with category names as responses.

Procedure

Subjects were seen individually in a quiet room near their classroom in a session which lasted approximately 40 minutes. Subjects received free recall instructions, informing them that some words would be played to which they should listen and then repeat all the words they remembered. Stimulus words were presented at the rate of one every two seconds by means of a portable General Electric cartridge tape recorder. The order of presentation of items in each trial was randomized with the restriction that no members of the same conceptual category appear in adjacent positions. After each presentation, the tape recorder was turned off and the subject provided 60 seconds for recall. Prior to training, subjects were administered List A for two "baseline" trials.

Subjects were randomly assigned in equal numbers to treatment conditions, receiving either the Associative Training or the Conceptual Training list. Standard directions were used to introduce subjects to the paired-associate task. A study test method of presentation was employed in which recorded lists were presented for study as the rate of one pair every 6 seconds, with a 1-second pause between stimulus and response items and a 6-second intertrial interval. Test trial items were presented at the rate of one every 6 seconds. Subjects were required to learn the 8 paired-associates to a criterion of 2 errorless trials or to maximum of 10 trials, whichever came first.

Following training, subjects were presented List A for four additional free recall trials. After a 2-minute rest, subjects were presented the transfer list (List T) for four free recall trials.

Results

The dependent variables of primary interest were clustering, as measured by the Ratio of Repetition (RR), and number of correct words recalled (CWR). The Ratio of Repetition, which has been judged suitable for use in developmental research (Lange & Griffith, 1977), quantifies clustering according to the following formula:

$$RR = \frac{R}{N - 1}$$

where R is the number of repetitions or number of times a stimulus word is followed by another stimulus word from the same category, and N is the total number of items recalled.

Training

The training phase (List A) free recall data were analyzed by means of a 2 (IQ Classification) x 2 (training method) x 3 (trial blocks) analysis of variance with repeated measures on the last factor. A summary of the means and SDs are presented in Table 1. Analysis of the words recalled revealed significant main effects for IQ (F 1,56)=14.01 $p < .01$), training method (F (1,56)=8.34, $p < .01$) and trial block (F (2,112)=131.91, $p < .01$). Results of a Newman-Keuls test indicated that significantly more words were recalled at trial block 3 than 2 ($p < .01$) and at trial block 2 than 1 ($p < .01$).

The interaction between training method and trial block was significant (F (2,112)=6.82, $p < .05$). Simple effects tests revealed that this interaction is accounted for by the significantly greater number of words recalled by subjects who received associative compared to conceptual training, at trial Blocks 2 and 3. However, at trial block 1, which occurred prior to training, no significant differences in recall were associated with training condition. Recall data are displayed in Figure 1.

Analysis of variance of the clustering data revealed significant main effects for IQ (F (1,56)=4.15, $p < .05$), training method (F (1,56) =18.07, $p < .01$) and trial block (F (2,112)=51.77, $p < .01$). Results of a Newman-Keuls test indicated that subjects showed significantly greater clustering at trial block 2 than 1 ($p < .01$) and at trial block 3 than 2 ($p < .05$) Simple effects tests revealed that the interaction of IQ Classification and training method (F (1,56)=4.15, $p < .05$) is due to the significantly greater clustering of the third graders, compared to the retarded subjects, under the Associative Training condition.

The interactions of IQ Classification and trial block (F (2,112)=4.39, $< .05$) and training method by trial block (F (2,112) = 12.03. $p < .01$) were also significant. Simple effects tests indicated greater clustering by third graders, compared to retarded subjects, and greater clustering for the associative, compared to the conceptual training condition, at trial blocks 2 and 3, with no significant differences at trial block 1.

The correlation coefficients between CWR and RR scores for the third graders were .19, .55, and .63 and for the retarded subjects were .29 .54, and .66 for trial Blocks 1, 2, and 3, respectively. All correlations at trial Blocks 2 and 3 were statistically significant at the .01 level. However, no correlations were significant at trial Block 1 for either group.

Transfer Data

The transfer (List data T) were analyzed by means of a 2 (IQ Classification) x 2 (Training Method) x 2 (Trial Blocks) analysis of variance with repeated measures on the last factor. A summary of the means and SDs are presented in Table 2. Analysis of variance of the recall data revealed significant main effects for IQ (F (1, 56) = 21.84, $p < .01$) and trial block (F (1,56) = 124.83, $p < .01$). Analysis of variance of the clustering data indicate that the main effect for IQ (F (1,56) = 4.24, $p < .05$) was significant. No interaction effects were found to be statistically significant.

Additional Analyses

To determine whether differences existed between IQ Classification groups in the extent to which they produced 3- and 4-item clusters in free recall, chi square analyses were applied within each trial block of the List A data. These analyses revealed that the protocols of more third graders than retarded subjects contained at least one 3- or 4-item cluster of members of the same category at trial block 2 (χ^2 (1) = 8.07, $p < .01$) and Trial Block 3 (χ^2(1) = 5.71, $p < .05$), with no significant differences found at Trail Block 1.

Paired-Associate Data

A 2 (IQ Classification) x 2 (Training Method) analysis of variance of the paired-associate data was conducted. The dependent variable of primary interest was the number of trials to criterion. Main effects for IQ (F (1,56)=11.32, $p < .01$) and training method (F (1,56)=118.19, $p < .01$) were statistically significant. The third graders mastered both the associative and conceptual paired-associate lists in fewer trials, compared to the retarded subjects. The subjects reached criterion for the conceptual list in 2.6 trials, which was significantly less than the 8.2 trials needed to master the associative list. No interaction was found to be statistically significant.

Discussion

In the present study both retarded and nonretarded subjects mastered a conceptual paired-associate list in significantly fewer trials than a list organized in terms of direct associations among items. As suggested years ago, retarded persons appear able to take note of conceptual similarities in learning situations but are at no unique advantage, relative to nonretarded subjects, with respect to acquisition of rote associations (Hermelin & O'Connor, 1958).

Despite the apparent possession of categorical knowledge, the inferior free recall on trained and transfer items by retarded students in this study compared to their intellectually normal counterparts suggests that intelligence-related differences are to be found in ability to actively retrieve and strategically use category information (Brown, 1974; Sperber, Ragain & McCauley,197

Supplied with appropriate intervention, retarded children may show a pattern of performance on memory tasks similar to that of uninstructed nonretarded children (Campione & Brown, 1979). In the present study the recall scores for trained items across trial blocks of the associatively-trained retarded students closely resembled those of the third graders assigned to the less potent conceptual training condition. Thus, training did serve to reduce performance differences, at least for the trained items.

The correlational results perhaps offer the most interesting data of the present study. A positive correlation between recall and clustering scores frequently characterizes the free recall of adult subjects (Shuell, 1969). Burger, Blackman, Holmes and Zetlin (1978) observed that a "facilitative linkage" between these two variables is more often assumed than found in the mental retardation literature; they suggested that this may be a phenomenon which occurs at a higher developmental stage. The present results would suggest that such a facilitative relationship does obtain, when some meaningful basis for organization has been established. In the present study such a basis was presumably absent during the baseline trial block, although it emerged on Trial Blocks 2 and 3, where significant relationships were found for both retarded and nonretarded subjects. By contrast, an attempt to strengthen arbitrary associations among unrelated stimulus items through contiguous presentation resulted in insignificant correlations between measures of clustering and recall (Glidden, 1976).

General intelligence has been related to instructional support required for skilled performance (Resnick, 1976) and to ability to demonstrate proficiency on transfer tasks (Skanes, Sullivan, Rowe & Shannon, 1974). In the present study a significant treatment by groups interaction for the clustering data implied that nonretarded students benefitted disproportionately from associative training. However, recall scores for both IQ groups were facilitated by this training method. Differences associated with training condition, as measured by both clustering and recall scores, disappeared on a transfer list, where the free recall performance of the retarded students declined, compared to the performance of the nonretarded students.

Research addressed at the associative-conceptual distinction in mental abilities has achieved relatively little success in the prediction of learning from markers in the associative domain, which may engage higher-order conceptual operations, as well (Carroll & Maxwell, 1979). For example, the free recall of uncategorized lists, a task which has been used to define associative ability (Jensen & Frederiksen, 1973), was more strongly related to measures of conceptual ability than to Digit Span test scores in one study (Labouvie-Vief, Levin & Urberg, 1975). In the present study, the superior acquisition of paired-associates (see Baumeister & Kellas, 1971) and the greater production of 3- and 4- item clusters in the free recall pr[illegible] of the third graders, compared to the retarded students, may be attributed to a tendency on their part to employ coding strategies to enhance retention on a variety of learning tasks.

The present results suggest that associative learning should be viewed as supportive of (Lathey, 1979), rather than antagonistic to conceptual processes (Kirby & Das, 1977; Salomon & Achenback, 1974). The treatment by groups interaction for clustering data indicated that associative-based training significantly fostered the organization of recall of the third graders. Previous investigation has found the amount of clustering in free recall of fourth grade children to be positively related to pre-experimental (normative) interitem associative strength (Wicklund, Palermo & Jenkins, 1965). These data are perhaps consistent with a formulation of cognitive development, such as Staat's (1968), in which words that occur frequently together may become associated as "word association clusters," which come to function as concept.

The predicted treatment by groups interaction was not found in this study. The extent to which intellectually average third graders activate processes responsible for organization in free recall was apparently overestimated. Further research, with a greater age range of subjects, is required to determine whether older nonretarded children would profit from the conceptual training as defined, in accordance with our initial expectation. At least in the primary elementary school-age years, nonretarded children appear to benefit from associative training and, for example, sound-symbol associations trained to the automatic level have been associated with gains in early reading achievement (McInnis, 1977).

Implications for ATI Research

The results of this study illustrate the difficulties in clarifying the psychological processes engaged in the learning of even such relatively simple tasks as the word lists used in this experiment. Similar difficulties have been encountered by Rohwer (1976) and by Labouvie-Vief *et al* (1975), among others. Some writers (Glaser, 1972; DiVesta, 1975) have urged that ATI researchers also adopt the research paradigm of isolating the psychological processes underlying different instructional methods and content areas. Tobias (Note 3, in press) has argued, how ever, that such ATI research may of limited usefulness in providing an empirical and theoretical basis for adaptive instructional practices.

Tobias (in press) indicated that process research offered several exciting possibilities. First, it could provide a substantive answer to questions concerning the variables accounting for individual differences in intelligence. Secondly, such research held out the exciting possibility of, eventually, being able to offer training on the processes of which intelligence is composed. Applying a process analysis research paradigm to instructional problems, however, was considered less likely to be fruitful since the content of meaningful instruction shifts so rapidly that processes accounting for learning from one instructional method at the outset of a learning sequence may well be useless in explaining learning at some later point in that sequence.

The present study offers further reasons for skepticism regarding the fruitfulness of applying a process analysis to instructional problems. The instructional materials utilized in this study were relatively simple compared to the instructional content in the elementary school curriculum. The results of this study offer renewed evidence regarding the difficulty in specifying the psychological processes involved in learning of even this simple content. It can be expected that clarifying the processes leading to the learning of content in the elementary school curriculum will magnify this complexity enoromously. In view of these difficulties the usefulness of this approach for instructional research remains in further doubt.

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TABLE 1

Means and Standard Deviations (SDs) of Ratio of Repetition

and Number of Correct Words Recalled

Ratio of Repetition

Subjects/ Condition	Training Phase						Transfer Phase			
	Trial Block 1		Trial Block 2		Trial Block 3		Trial Block 1		Trial Block 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
3rd Graders										
Superordinate	.147	.199	.213	.250	.311	.342	.244	.266	.226	.273
Direct	.180	.219	.486	.512	.505	.538	.235	.267	.275	.312
EMR										
Superordinate	.187	.229	.249	.286	.236	.311	.127	.187	.182	.226
Direct	.159	.221	.316	.364	.372	.408	.242	.290	.214	.256

Correct Words Recalled

Subjects/ Condition	Training Phase						Transfer Phase			
	Trial Block 1		Trial Block 2		Trial Block 3		Trial Block 1		Trial Block 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
3rd Graders										
Superordinate	6.43	6.89	8.90	9.48	10.60	12.14	7.36	7.75	9.96	10.47
Direct	6.73	7.10	10.90	11.66	12.70	13.22	7.86	8.36	10.86	11.55
EMR										
Superordinate	5.60	6.02	6.90	7.58	8.76	9.48	5.53	5.98	7.56	8.31
Direct	5.50	5.82	8.46	8.95	10.80	11.54	5.50	6.01	7.90	8.59

Figure 1. Number of words recalled by all groups over three training blocks.