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ABSTRACT

The availability of semantic information in storage and the accessibility of that information for retrieval was studied with 40 retarded and 40 nonretarded adolescents. In Experiment I, Ss were required to retrieve information from semantic categories, as well as judge whether specific items were members of a given category. Results showed that retarded Ss retrieved only about 60% of the total number of items retrieved by nonretarded Ss, a difference which could not be wholly accounted for by the items available in storage. Experiment 2 was designed to remediate this retrieval deficit by introducing an organized retrieval plan consisting of subcategory cues. The organization facilitated retrieval as long as it was experimentally provided. Retrieval returned to its original level, however, when the cues were withdrawn. It was concluded that retarded individuals had an accessibility deficit in addition to an availability deficit; one aspect of this assessibility deficit involved the failure to spontaneously use mnemonic strategies that were consistent with the semantic organization. (Author/SBH)

Availability and Accessibility of Information in the Semantic Memory of Retarded and Nonretarded Adolescents

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Running head: Availability and Accessibility of Semantic Information

Abstract

The availability of semantic information in storage and the accessibility of that information for retrieval was studied in retarded and nonretarded adolescents. In Experiment 1, 40 normal and 40 equal-CA retarded subjects were required to retrieve information from semantic categories, as well as judge whether specific items were members of a given category. The results showed large IQ group differences on the retrieval task which could not be wholly accounted for by the items available in storage. Experiment 2 was designed as an attempt to remediate this retrieval deficit by introducing an organized retrieval plan consisting of subcategory cues. This organization facilitated retrieval as long as it was experimentally provided. Retrieval returned to its original level, however, when the cues were withdrawn. It was concluded that retarded persons had an accessibility deficit in addition to an availability deficit; one aspect of this accessibility deficit involved the failure to spontaneously use mnemonic strategies that were consistent with the semantic organization.

Availability and Accessibility of Information in the Semantic Memory of Retarded and Nonretarded Adolescents

We cannot always retrieve information that we have stored. The distinction between availability, or what is stored, and accessibility, or what is retrieved, was originally suggested by Tulving and his associates (Tulving & Pearlstone, 1966; Tulving & Osler, 1968). It has particular implications for assessing the memory capabilities of retarded subjects who may have difficulties with retrieval tasks, especially those that require active strategies for successful performance (Brown, 1974).

Although much of the documentation of a memory deficit in retarded persons comes from research which shows that they are less able to use strategies involving associative or conceptual relationships, e.g. clustering in free recall (Gerjuoy & Spitz, 1966), it is not known whether this deficit is manifested because retarded persons do not have category information as available to them as their nonretarded peers, or whether they have difficulty in retrieving information that is, in fact, in storage. Recent work, however, using a semantic priming technique, has shown that retarded subjects name second pictures in related pairs significantly faster than in unrelated pairs (Sperber, Ragain, & McCauley, Note 1), a finding which suggests that categorical relationships are available in the memory structure of retarded persons.

The following two experiments were concerned with exploring the relative accessibility and availability of category information in retarded persons in comparison with CA-equivalent nonretarded subjects. Experiment 1 was designed to directly compare the performance of these different IQ-MA groups on two tasks, one having a high accessibility component, the other

assessing the availability of category information. It was predicted that retarded subjects would show a retrieval deficit in addition to any storage or availability deficit they might manifest, since optimal performance in the retrieval of category information involves the development and monitoring of a plan, a strategy which most retarded persons do not spontaneously adopt.

Experiment 1

The accessibility task was similar to that used by Lazar and Buschke (1972). Subjects were required to retrieve instances from two given categories, SPORTS and ANIMALS. The availability task involved semantic decisions of whether specific instances were members of the categories. The instances used were selected from pilot data which tabulated frequencies of all instances retrieved when both retarded and nonretarded subjects were required to name as many sports and animals as they could. Instances were chosen to represent different levels of retrieval frequency, High, Moderate, and Low. These levels corresponded to, respectively, 75-43%, 39-22%, and 7-3% of nonretarded subjects retrieving the items. In addition, specific items were selected within these three levels on the basis of low frequency of retrieval for retarded subjects. Thus, the decision task was made as difficult as possible for the retarded subjects so as to conservatively test the prediction that the accessibility task differences could not be the result of lack of availability. By choosing the lowest frequency items for the sample of retarded subjects we would be underestimating the availability of category item information for them, making it less likely that we would commit a Type I error.

Method

Subjects. Forty nonretarded (Mean CA= 14.7 years, SD = .8) and 40 retarded (Mean CA = 15.3 years, SD = 1.0; Mean IQ = 60, SD = 6.9) students enrolled in different classes in the same New York City public schools served as subjects in this study.

Procedure. Following a practice retrieval, each subject was required to retrieve from each of the two categories, SPORTS and ANIMALS, twice. The order of retrieval was either SPORTS(S), ANIMALS(A), SPORTS, ANIMALS (SASA) or ASAS, with subjects randomly assigned to category order. Subjects were allowed four minutes for each retrieval, but the recording of responses was divided into one-minute subperiods. In summary, then, the subject retrieved twice from each of two categories. Whether the retrieval from a given category was the first or second retrieval from that category became a factor in the design and was labelled Retrieval Phase. Similarly, whether the category being retrieved from was the first or second category for that subject became another factor of interest and was labelled Category Phase. For example, if a subject retrieved in $A_1S_1A_2S_2$ order, the Retrieval Phase would compare A_1S_1 with A_2S_2 whereas Category Phase would compare A_1A_2 with S_1S_2. Following the last retrieval, the subject was given the 24 item semantic decision test, with items administered to all subjects in the same predetermined random order.

Results

Retrieval data. The design of the retrieval portion of this study corresponds to a Groups (Normal, Retarded) x Retrieval Phase (1,2) x Category Phase (1,2) x Minutes (1,2,3,4) factorial analysis of variance.

Figure 1 presents the retrieval data. The most interesting significant

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Insert Figure 1 about here

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results show that nonretarded subjects retrieve considerable more items than do retarded subjects ($F(1, 78) = 71.45$, $p < .01$), particularly in Minute 1 (Groups x Minutes interaction: $F(3, 234) = 31.45$; $p < .01$). Although several higher-order interactions were also significant they are not of concern to us, since they all involve Minutes and are the results of the bulk of the retrieval being accomplished in Minute 1.

Semantic decision task. Table 1 presents the cell means of correct responses for each of the three types of items. Since both

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Insert Table 1 about here

IQ groups clearly had no difficulty in recognizing to what category High Frequency items belonged, these data were not further treated. Since variances for Moderate Frequency items were not homogeneous for the two IQ groups (Normal = .07, Retarded = .56) the nonparametric Wilcoxen Matched Pairs Signed Ranks was used to evaluate the difference between the samples ($T = 213$, $N = 40$, $z = 2.56$, $p < .025$). The variances for Low Frequency items were homogeneous. A t test ($t = 2.67$, df=78, $p < .01$) led to the conclusion that the proportion of items recognized for normal subjects was significantly larger than for retarded subjects on Low Frequency items.

Discussion

The results of Experiment 1 suggest that the differences in accessibility of category information between retarded and nonretarded CA equivalents cannot be entirely accounted for by differences in availability of that information. The data for Moderate and Low Frequency items indicate that more uncommon category instances are not as available for retarded as they are for nonretarded subjects. However, these items, by definition, constituted a much smaller precentage of retrieved items than did the High Frequency items, for which there was no difference between IQ groups in identifying the semantic categories. Thus, the superordinate-instance relationships were, in fact, available in the memory system. The poorer retrieval performances by the retarded group implicates the presence of an accessibility deficit over and above an overall deficit in availability.

This implication was further supported by comparing the retrieval and category identification of High Frequency items by all subjects in Experiment 1. This comparison was made by tallying what proportion of High items given correct category identification by all subjects was actually retrieved by each subject. (Six out of eight High Frequency items on the recognition test were correctly recognized by all subjects.) The mean proportion for normal subjects was .58; the comparable proportion for retarded subjects was .28. A t test between these proportions was highly significant (t (78) = 5.83, $p < .001$). This evidence strongly suggests then, that normal subjects retrieve a greater proportion of their stored items than retarded subjects retrieve of theirs.

Experiment 2

Experiment 2 was designed to explore the accessibility deficit exhibited by retarded subjects in Experiment 1. Although information is stored and, therefore, available, it may be stored in an unorganized of differently organized fashion by retarded individuals. On the other hand, it may be stored in an organized system, but not searched and retrieved according to that system. More specifically, studies of semantic memory have shown that normal adults can more quickly verify statements in which an instance is directly connected to its immediate superordinate, e.g., A robin is a bird, rather than a more distant superordinate, e.g., A robin is an animal (Collins & Quillian, 1969; 1972; Smith, Shoben & Rips, 1974).

Extrapolating from these data with normal adults, we reasoned that if the semantic memories of retarded subjects were organized in a system similar to that of normal adults, then giving them more immediate superordinate, in comparison with more distant superordinate, retrieval cues would lead to an increased number of items retrieved. In addition, this increase would demonstrate that the accessibility deficit manifested in Experiment 1 was, at least partially, the result of the failure to spontaneously use optimal retrieval cues rather than the result of differently organized storage, since the cues would facilitate retrieval only if they were compatible with the semantic organization. Further, since an omnipresent goal of research in retardation concerns itself with the possibility of improvement of performance, Experiment 2 was also designed to assess whether any facilitation that occurred as a result of cuing would continue once the cues were not externally provided.

Method

Design. Three treatment groups were each given three successive retrieval phases. Retrieval 1 and Retrieval 3 were the same for all groups, whereas Retrieval 2 differed for the three groups. Group ISC (immediate superordinate cues) subjects received cues during Retrieval 2 which were closer superordinates than the category cue from which they were retrieving. Group C (control) subjects received only the category name as a cue. Group ER (experimenter retrieval) subjects listened to the experimenter retrieve instances of the category. Group ER was considered an additional control for evaluating transfer in Retrieval 3. If Group ISC subjects retrieved more items than did Group C subjects in Retrieval 3 as well as in Retrieval 2, it could be argued that they merely remembered some of the "extra" items from Retrieval 2. The inclusion of Group ER was designed to control for this possibility by having the subjects listen to the retrieval of 48 items, this number being considered the upper limit that a subject would retrieve. In addition, these 48 items were selected so that each of the subordinate categories cued in Group ISC was equally represented. This procedure controlled any additional influences on Group ISC retrieval resulting from the cuing by specific instances of a subcategory as distinct from cuing by the immediate superordinate itself.

Subjects. Sixty-three adolescents, 39 boys and 24 girls, enrolled in classes for the educable mentally retarded in New York City and New Jersey public schools served as subjects in Experiment 2. Twenty-one subjects were randomly assigned to each of the three treatment groups. The subject characteristics for each of the three groups are as follows:

Group ISC: Mean CA = 15.9, SD = 1.6 Mean IQ = 64.6, SD = 7.0;

Group ER: Mean CA = 16.0, SD = 1.8; Mean IQ = 65.4, SD = 6.4;

Group C: Mean CA = 15.9, SD = 1.8; Mean IQ = 62.0, SD = 6.7.

Procedure. Subjects were given instructions and practice as in Experiment 1, and were then required to begin Retrieval 1. Four minutes were allowed for subjects to name as many instances of the category, ANIMAL, as they could. Retrieval 2 differed for the three treatment groups. Group C subjects retrieved items just as in Retrievals 1 and 3. Group ISC subjects had 30 sec to retrieve items under each of seven different immediate superordinate cues (farms, woods, birds, zoo, insects, water, pets) and an eighth 30 sec period of "other animals." Seven different orders of presentation for the eight cues were used. The orders were determined by assigning each of the seven category cues to a different serial position in the presentation. The eighth cue was always "other animals". Three subjects in Group ISC were assigned to each of the seven orders

Group ER subjects listened to the experimenter retrieve 48 pre-determined instances of ANIMALS, read aloud at a rate of 5 sec/item for a total time of four minutes. These 48 items consisted of six different instances of the eight categories used as cues for Group ISC. Seven random orders of the items were constructed and three subjects assigned to each random order.

Results

Table 2 presents means and SDs for Treatment Groups at each Retrieval Phase. An initial 3 (Group ISC, ER, C) x 2 (Retrieval Phase 1,3) x 4 (Minutes 1,2,3,4) analysis of variance on the number of items retrieved

revealed significant main effects for Retrieval Phase ($F(1, 60) = 9.95$, $p < .01$) indicating greater retrieval during retrieval phase 3 than

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Insert Table 2 about here

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during Retrieval Phase 1, and Minutes ($F(3, 180) = 382.74$, $p < .01$) indicating that fewer items were retrieved from Minute 1 to Minute 4. No other main effects or interactions were significant. Since neither the group effect not the Group x Retrieval Phase interaction was significant, neither the Group ISC nor the Group ER treatment during Retrieval 2 had an effect on subsequent retrieval. In order to evaluate the effect of presenting cues during Retrieval Phase 2, as well as to clarify the nature of the performance improvement form Retrieval Phase 1 to 3, an additional Groups (ISC vs. C) x Retrieval Phase (1,2,3) analysis of variance was performed. This analysis did reveal a significant interaction between Groups and Retrieval Phase. Tests of simple effects showed that the Groups difference occurred only at Retrieval Phase 2 ($F(2, 80) = 13.94$, $p < .01$), indicating that providing immediate superordinate retrieval cues did improve performance, but that this improvement was not maintained in Retrieval 3 after the cues were no longer provided by the experimenter.

Discussion

The data from Experiment 2 indicate that providing immediate superordinate cues can facilitate retrieval of information from semantic memory. This facilitation suggests that the storage systems of retarded subjects are, in fact, organized according to these cues, but that the subjects do not use these cues to access their storage systems unless

the cues are externally provided as they were in Retrieval Phase 2 for Group ISC. In addition, subjects in Group ISC and Group ER failed to retrieve an increased number of items in Retrieval 3 as a result of the treatment during Retrieval 2. This result demonstrates a lack of transfer despite the similarity of and short interval between retrieval phases. This transfer failure has been found with many types of memory tasks (Bilsky, Evans & Gilbert, 1972; Green, 1974) and suggests that future remediation efforts should concentrate on techniques emphasizing generalization of strategies to new materals, tasks, and situations.

Reference Note

1. Sperber, R.D., Ragain, R.D., & McCauley, C. A reassessment of category knowledge in the retarded. Manuscript submitted for publication, 1976.

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Table 1

Mean Correct Decisions

as a Function of IQ Group and Item Frequency

IQ Group	Item Frequency		
	High	Moderate	Low
Nonretarded	8.00[a]	7.93	6.22
Retarded	7.95	7.53	5.52

[a] Maximum correct = 8.

Table 2

Means and Standard Deviations of Items Retrieved

as a Function of Treatment Group and Retrieval Phase

	Retrieval Phase		
Treatment Group	1	2	3
Immediate Superordinate Cues	18.96 (6.39)*	28.46 (9.39)	21.68 (8.69)
Experimenter Retrieval	21.71 (5.50)	-------	26.05 (8.92)
Control	20.04 (6.01)	19.76 (7.37)	21.40 (6.93)

*The numbers in parentheses are standard deviations

Figure Caption

Figure 1. Mean number of items retrieved as a function of IQ Groups, Minutes, Retrieval Phase, and Category Phase. Each data point is based on 40 observations.

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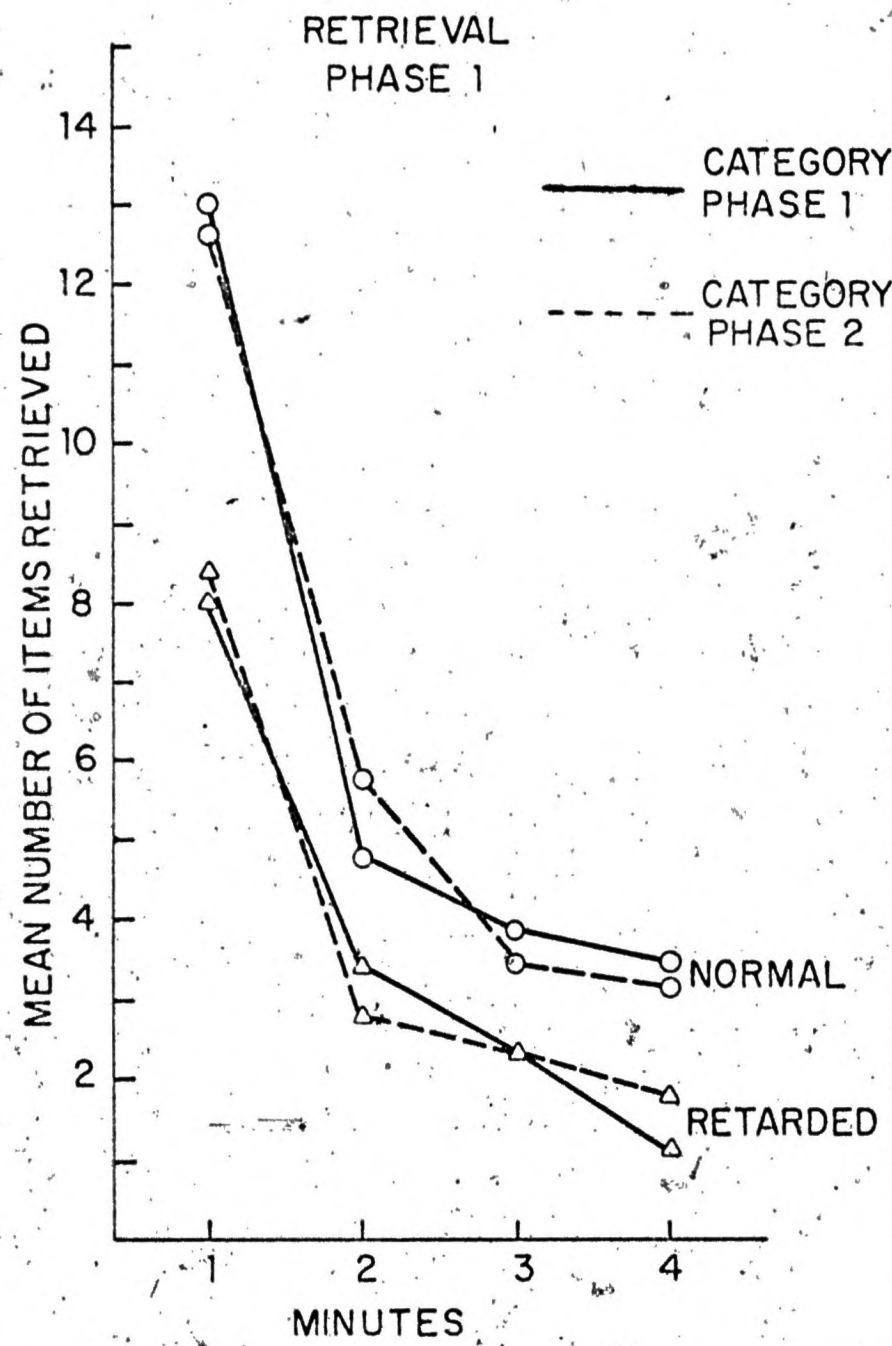
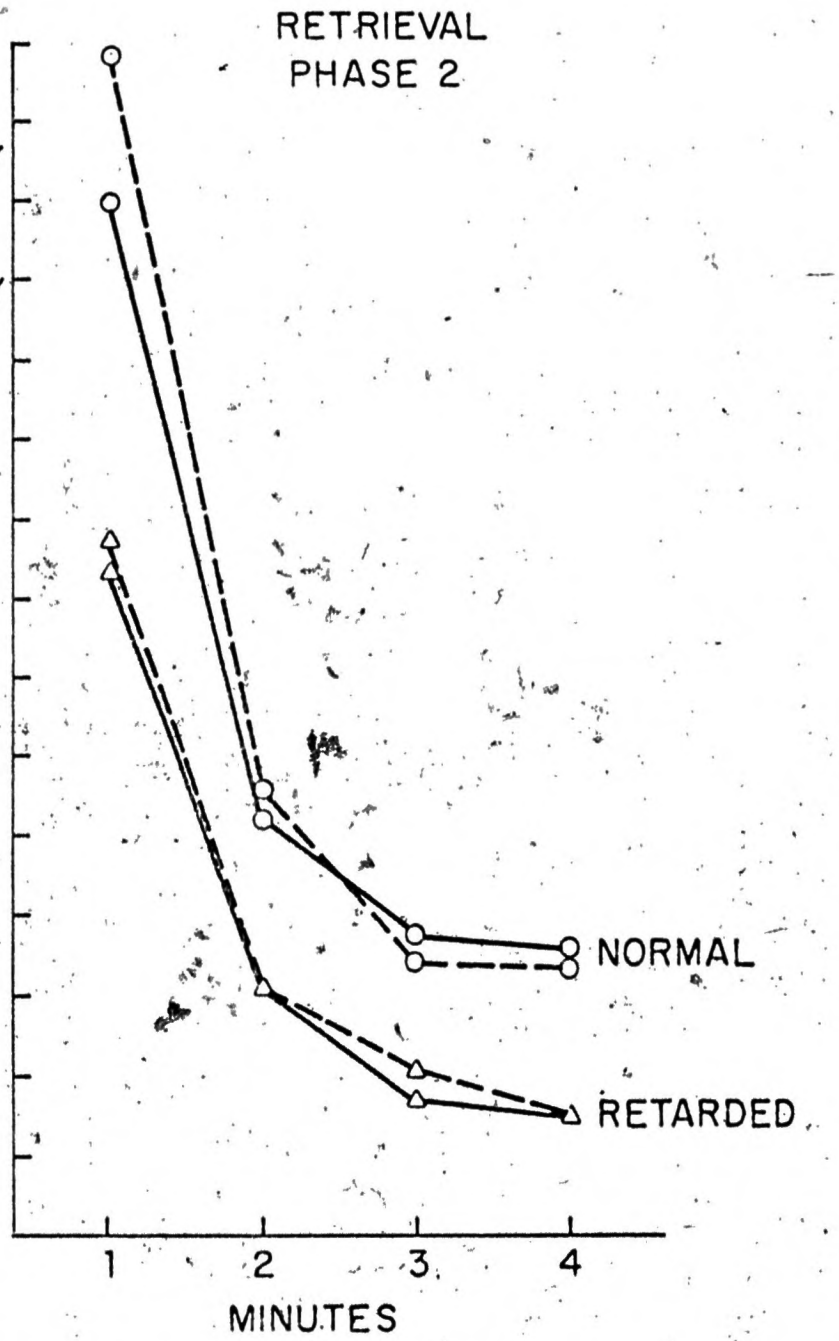

RETRIEVAL
PHASE 1
CATEGORY
PHASE 1
CATEGORY
PHASE 2
MEAN NUMBER OF ITEMS RETRIEVED
14
12
10
8
6
4
2
NORMAL
RETARDED
1
2
3
4
MINUTES


RETRIEVAL
PHASE 2
NORMAL
RETARDED
1
2
3
4
MINUTES