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9. ABSTRACT

The three objectives of this study were to establish (1) what effect paragraph organization has on the free recall of sentences and on selection of clustering strategies; (2) how persons who differ in subjective organization differ on the free recall of sentences and selection of clustering strategies; and (3) what the relationship is between subjective organization and other task-relevant cognitive abilities. Subjects tested were 75 introductory psychology students at Florida State. Passages organized by concept names, concept attributes, and also randomized passages were presented to the students for study and recall. The students were then tested for verbal comprehension, verbal creativity, associate memory, closure, and subjective organization. The group that was presented passages organized by concept names recalled more correct statements than the other groups. Clustering by names was dominant for all groups, and unique patterns of correlations were obtained among cognitive factors and recall scores for each group. These results indicated that learning a highly organized passage and using a preferred recall strategy yielded superior recall. The analysis of the subjective organization data indicated that high organizers were not highly influenced by the inherent structure of the learning materials, whereas low organizers were. Thus students low in subjective organization require highly structured materials if they are to recall them adequately, while students high in subjective organization perform similarly on materials with high and low structure.

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Thomas G. James and Bobby R. Brown

August 1, 1973
Working Paper No. 3

Project NR 154-280
Sponsored by
Personnel & Training Research Programs
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The Effects of Prose Organization and Individual Differences on Free Recall

Thomas G. James and Bobby R. Brown
Florida State University

ABSTRACT

Passages organized by concept names, concept attributes, and by randomization were presented to students for study and recall, and measures of verbal comprehension, verbal creativity, associative memory, closure, and subjective organization were taken. The Name group recalled more correct statements than the other groups, clustering by names was predominant for all groups, and unique patterns of correlations were obtained among cognitive factors and recall scores for each group. These results indicated that learning a highly organized passage and using a preferred recall strategy yielded superior recall. The analysis of the subjective organization data indicated that high organizers were not highly influenced by the inherent structure of the learning materials, whereas low organizers were. Thus, students low in subjective organization require highly strucutred materials, while students high in subjective organization perform similarly on materials with high and low structure.

The Effects of Prose Organization and Individual Differences on Free Recall

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Adapting instructional procedures to the cognitive characteristics of learners is an important methodological development which could greatly affect future instructional design procedures. However, research designed to provide a rationale for adapting instruction to individual differences has not been particularly successful; that is, if one's criterion for success is significant disordinal aptitude-treatment interactions. For example, in an examination of 90 aptitude-treatment interaction studies, Bracht (1970) found only 5 which reported significant disordinal interactions, while 85 reported ordinal or no interactions whatsoever. He did, however, provide educational researchers with some optimistic data. For example, he found that aptitude-treatment interactions were most likely to be found if factorially simple aptitude variables were used rather than factorially complex ones. This finding supports the recommendation made earlier by Jensen (1967) and Melton (1967), that hypotheses about individual differences should be specified in terms of the basic processes proposed by current theories of learning. Furthermore, Bracht's results reinforce the view that in aptitude-treatment interaction research one should select the ability factors which correspond most closely to the requirements of the experimental task (Cronbach & Snow, 1969).

By measuring factorially simple aptitudes in research on instruction three outcomes will be facilitated: (a) a more precise conceptualization of the ability factors employed will be realized, (b) a contribution will be made toward the construction of a "taxonomy of processes" (Melton, 1967), and (c) the possibility of finding aptitude-treatment interactions will be enhanced. In the experiment reported here, the relationship of factorially simple cognitive abilities to learning from prose was investigated. Also, the effect of individual differences in the ability to subjectively organize (in memory) unrelated verbal input on the learning of organized and unorganized prose was examined.

Tulving (1962a, p. 345) cast the definition of subjective organization in terms of information processing theory (Miller, 1953) as the "information in the output not found in the input." However, such discrepencies are not due to error but represent individualistic recall strategies which serve to expand the capacity of the memory system. Subjective organization differs from processes such as chunking or unitization (Miller, 1956), associative (Jenkins & Russell, 1952) or conceptual (Bousfield, 1953) clustering, or the utilization of hierarchical retrieval schemes (Bower, 1970) in that the measurement paradigms of these latter processes require the learner to recognize and use the structure inherent in the materials (provided by the experimenter) rather than the generation of idiosyncratic organizations.

Attempts which have been made to clarify the relationship between organization in memory and performance at recall have been, for the most part, limited to the use of single words. Thus, the importance of

subjective organization to the recall of sentential material has not been established. For this reason the learning materials used in this study consisted of written verbal discourse dealing with various attributes (geographical, economic, political, etc.) of six imaginary nations.

The research reported here sought to answer the following questions: (a) What affect does paragraph organization have on the free recall of sentences and on the selection of clustering strategies? (b) How do persons who differ in subjective organization differ on the free-recall of sentences and on the selection of clustering strategies? and (c) What is the relationship between subjective organization and other task-relevant cognitive abilities?

Method

Subjects

Seventy-five male and female students enrolled in an introductory psychology course at Florida State University during the Fall and Winter Quarters (1971-72) participated in this experiment as part of their course requirements.

Learning Materials

A concept name by concept attribute matrix, developed by Schultz & DiVesta (1972), in which the names were imaginary nations and the attributes were characteristics of those nations, was used to construct the paragraphs used in this study (see Schultz & DiVesta, 1972, p. 246). Sentences were constructed by combining concept names and concept attributes

with one sentence for each cell in the matrix. These sentences were then combined into six paragraphs. In one condition each paragraph dealt with all the attributes of a single nation (name organization). In another condition each paragraph dealt with a single attribute of every nation (attribute organization). A third condition consisted of a random arrangement of the sentences.

The organization of these passages was determined quantitatively by computing a clustering index for each one. The clustering index was the same as that used by Frase (1969) and Schultz and DiVesta (1972). Clustering scores were computed by coding the sentences according to which name or attribute they referred to and listing them sequentially. A clustering index was then computed for both the reading passages and the recall protocols as follows:

$$CI = (R/T-K) \times 100$$

Where:

R = the number of repetitions of a concept name or attribute

T = the total number of sentences recalled

k = the total number of categories recalled

The percentage of name clustering for passages N, A, and R was 100%, 0%, and 0%, respectively. The percentage of attribute organization for passages N, A, and R was 0%, 100%, and 13%, respectively.

Subjective Organization - Measurement Rationale

Current methods of measuring organizational processes are inadequate for several reasons. Measures based on the pairwise repetition of unrelated words, such as Tulving's Subjective Organization (SO) and

Bousfield and Bousfield's (1966) intertrial repetitions (ITRs), remain relatively low regardless of the level of recall. Also, reported correlations between measures of output consistency and recall are highly variable (Wood, 1972). These results indicate that either organizational processes play only a minor role in free recall learning or that the measures of organizational processes are inadequate (Postman, 1972). The latter alternative is preferred, because the research employing transfer designs has demonstrated the importance of organizational processes in recall. Postman (1971) suggested that measures of output consistency are inadequate because the organization imposed on unrelated words is in the form of multiple dependencies (associations) between words. Therefore, measures of organizational processes which are based on the pairwise comparison of recalled words only measure a portion of the true organization. Another weakness of current indices of organizational processes is that varied presentation orders prevent the formation of a single, well-defined organizational scheme (Wood, 1972). However, constant orders of presentation permit the use of serial position cues as a recall strategy, thus preventing the use of idiosyncratic clustering strategies. For several reasons, then, a more adequate measure of organizational processes is needed.

The rationale for the measure used in this study was based on the fact that categorized words are clustered to a greater extent than unrelated words. Thus, a high subjective organizer would be characterized by having an organization index for unrelated words which was nearly equivalent to his organization index for categorized words. Conversely, a low subjective organizer would be characterized by having an organization index for

unrelated words which was much lower than his organization index for categorized words. Such a measure may be operationalized by (1) presenting for free recall both categorized and unrelated words, (2) calculating organization indices for each type of material, and (3) forming a ratio of the index based on noncategorized words to the index based on categorized words. This ratio would range from 0 to an amount equal to the maximum of the noncategorized organization index. However, scores at the upper end of that range are unlikely if familiar categories are used. The words were all presented at once in order to minimize the effects of serial learning and to facilitate organization by having all words in view at all times.

Because a constant arrangement of words over trials might permit the use of spatial cues as a recall scheme, and because the organization indices utilized measure more structure, in terms of multiple dependencies, than simple pairwise comparison indices do, the words were presented in a different random order on each trial.

The stimulus materials were developed by Brown (1967) and consisted of ten low frequency nouns from each of three categories (kinds of cloth, four-footed animals, and musical instruments) chosen from the Cohen, Bousfield, and Whitmarsh (1957) norms, and 30 noncategorized nouns of the same frequency as the categorized nouns. Selection of the noncategorized nouns was restricted in that no noncategorized word chosen shared a primary associate with any other word on the list and that no noncategorized word was itself a primary associate of any other word. The 60 nouns were arranged randomly on legal size paper for administration in a total presentation format. The same words were presented on each trial but

the arrangement on the page differed for every trial. A total of eight study-recall trials were given, with 2.5 minutes for study and 5 minutes for free recall. Standard free-recall instructions were given prior to the first trial.

Calculation of Subjective Organization Index

The procedure used to compute the organization index on the recall protocols was programed in Fortran IV and implemented on the CDC 6500 computer at Florida State University. The program compares, by means of nested do-loops, successive pairs of recall trials (1 with 2, 2 with 3, 3 with 4, etc.) in search of words consistently recalled together. To illustrate the procedure, consider two recall protocols, one for trial N and one for trial N+1, where ten words are recalled on trial N+1. The first pass comparison, then, consists of n-4 or 6 comparisons, between words in serial positions 1 through 5 on trial N and words in serial positions 1 through 5, 2 through 6, 3 through 7, 4 through 8, 5 through 9, and 6 through 10 on trial N+1. For each of the 6 comparisons on this pass the program counts the number of words in common between the two word groups being compared. Two separate records are generated on the basis of the number of matches considered to form a cluster. The first record consists of the total number of matches. If there is only one word in common between group 1-5 on trial N and group 1-5 on trial N+1, then one match is recorded. Similarly, if two words are in common between those groups then two matches are recorded. This procedure counts isolated words and pairs as well as larger clusters in forming the clustering index. For this reason, another record is generated which

begins recording matches between groups only if the number of matches is ≥ 3. Thus, only clusters of words ≥ 3 within comparison groups of 5 words each are considered for inclusion in this latter clustering index.

The second pass comparisons are between trial N words 2 through 6 and trial N+1 words 1 through 5, 2 through 6, 3 through 7, etc. Again, the matching procedure counts the total matches and the matches per comparison ≥ 3. When n-4 passes are completed (n equals the number of words recalled on trial N), the program begins the same procedure with trial N+1 and trial N+2. The total number of matches is divided into the number of matches for categorized words and for noncategorized words. For the purposes of this investigation, the measure of subjective organization was taken as the ratio of number matches for noncategorized words to the number of matches for categorized words.

Reference tests. A battery of aptitude tests was administered to the subjects in order to partially establish the construct validity of subjective organization and to qualify the performance and clustering data obtained on the experimental passages. The test battery included the Advanced Vocabulary Test, the First and Last Names Test (French, Ekstrom, & Price, 1963), the Remote Associates Test (Mednick & Mednick, (1967), and the Mutilated Words Test (Thurstone, 1951). These tests measure, respectively, the following factors: verbal comprehension, associative memory, verbal creativity, and speed of closure.

Experimental design and scoring procedure. The three treatment groups (N, A, and R) were presented the appropriate passage for study and recall three consecutive times. This arrangement yields a 3-group multivariate design in which the three recall trials were multiple dependent measures. The dependent variables were the number of statements

correctly recalled, the number of errors, name and attribute clustering indices, a combined clustering index, and an average clustering index.

A statement was counted as correct if the name was paired with the appropriate attribute value. In the case of compound attribute values, only one member was required for the statement to be scored as correct Minor spelling errors were tolerated. Incorrect additions to correct name-attribute value pairs were ignored and the statement was scored as correct.

The combined clustering index was designed to reflect both name and attribute clustering within one index (Schultz & DiVesta, 1972). It is computed as follows: Name clustering index - Attribute clustering index + 100. This procedure produces a range of scores from zero to 200 High scores represent predominate name clustering, and low scores represent predominate attribute clustering. Scores falling around 100 indicate that neither name nor attribute clustering was predominant. The average clustering index was the arithmetic average of the name and attribute indexes.

Procedure. The subjects reported to a typical classroom in groups ranging from two to ten. They were told that they would be participating in an experiment on how people learn from prose and that the session would last three hours.

The Remote Associates Test was given first followed by the experimental passages. The passages were shuffled to insure a random distribution of the conditions among the subjects. The passages were studied for five minutes and six minutes were allowed for free recall Three study-recall trials were given. When the third recall trial was completed the subjects were given a short break, after which subjective organization was measured

by the presentation of sixty nouns in a total presentation format for eight consecutive study-recall trials. Another break was then given, followed by the administration of the Advanced Vocabulary Test, the First and Last Names Test and the Mutilated Words Test. The subjects were then informed about the purpose of the experiment and thanked for their participation.

Results

Recall. Means and Standard Deviations over all trials for each treatment group on the number of correct statements recalled, errors of commition, and the total number of statements recalled, are presented in Table 1. Multivariate analyses of variance, in which trials represented multiple dependent variables for each subject, were computed separately for the number of correct statements, errors, and total recall scores. These analyses, summarized in Table 2, indicated that the number of correct statements recalled increased across trials for all groups (N,A,R). Group N recalled significantly more correct statements than group A on all trials. Group R recalled more correct statements than group A, but only the difference on trial 2 was significant. Similarly, group N recalled more statements than group R, but only the difference on trial 3 was significant.

For the number of statements recalled, group N recalled significantly more statements than group A on all trials, and significantly more than the random group on trials 1 and 2, but not on trial 3. The attribute and random groups did not differ on any trial on the total number of statements recalled. The three treatment groups did not differ on the

TABLE 1

Means and Standard Deviations of the Number of Correctly Recalled Statements, Errors, and Total Recall Scores on all Trials for the Name, Attribute, and Random Treatment Groups

Treatment Group	Trial I			Trial II			Trial III		
	Number Correct	Errors	Total Recall	Number Correct	Errors	Total Recall	Number Correct	Errors	Total Recall
Name									
M	8.36	3.16	11.52	11.84	2.20	14.04	15.88	1.92	17.80
SD	3.93	2.99	3.58	4.76	2.78	4.25	5.55	2.85	6.19
Attribute									
M	5.64	2.52	8.16	7.44	2.32	9.76	10.[illegible]	1.96	12.72
SD	3.31	3.11	3.76	3.46	1.90	3.66	5.46	3.19	5.94
Random									
M	6.36	2.76	9.12	9.88	1.60	11.48	12.84	2.16	15.00
SD	3.40	2.53	3.32	3.97	1.15	3.62	4.65	2.11	4.46

TABLE 2

Manova Summary Table for the Number of Correctly Recalled Statements, Errors, and Total Recall Scores

Variable	Hypothesis(null)[a]	df/df	f	Decision(1-α=.95)
	Group N Means are Equal	2/71	34.4	Reject
	Group A " " "	2/71	15.9	"
Number	Group R " " "	2/71	26.5	"
Correct	Trial I " " "	2/72	3.9	"
	Trial II " " "	2/72	7.2	"
	Trial III " " "	2/72	6.0	"
	Group N Means are Equal	2/71	2.0	Fail to Reject
	Group A " " "	2/71	.3	" " "
Errors	Group R " " "	2/71	2.3	" " "
	Trial I " " "	2/72	.3	" " "
	Trial II " " "	2/72	.8	" " "
	Trial III " " "	2/72	.0	" " "
	Group N Means are Equal	2/71	26.5	Reject
	Group A " " "	2/71	14.3	"
	Group R " " "	2/71	23.2	"
Total	Trial I " " "	2/72	5.9	"
Recall	Trial II " " "	2/72	7.7	"
	Trial III " " "	2/72	5.1	"

[a]The hypothesis "Group N means are equal" refers to the three trial means for that group, and the hypothesis "Trial I means are equal" refers to the three means for that trial.

number of errors made, and errors did not increase over trials for any group.

Clustering. Means and standard deviations for each treatment group over all trials for name, attribute, and combined clustering scores are presented in Table 3. Multivariate analyses (see Table 4) on name clustering indicated that group N clustered more by names than did group A and group R. Group A and group R did not differ in the extent to which they used the name clustering strategy. For group N and group A name clustering neither increased nor decreased across trials. In group R the only difference between trial means occurred on trial 2 and trial 3; trial 3 name clustering being significantly lower than trial 2 name clustering.

Analysis of attribute clustering (see Table 4) indicated that group A and group R did not differ in the extent to which they used that strategy, but these groups clustered more by attributes than did group N. Groups A and R clustered more by names than by attributes, as evidenced by their scores on the combined clustering index. Therefore, these significant results are due to the lack of attribute clustering by group N rather than by a predominance of attribute clustering by groups A and R.

In order to examine the amount of clustering reflected by both name and attribute scores simultaneously, the combined clustering index (Schultz & DiVesta, 1972) was calculated for each trial and used as a dependent measure. A multivariate analyses of variance on these means (see Table 4) indicated that group N clustered more by names than group A or R. These latter groups did not differ in the extent to which they used either the name or attribute clustering strategy. No group on any trial clustered more by attributes than by names.

TABLE 3

Means and Standard Deviations of the Name, Attribute, and Combined Clustering Indexes on all Trials for the Name, Attribute, and Random Groups

Treatment Group	Trial I Name Index	Trial I Attribute Index	Trial I Combined Index	Trial II Name Index	Trial II Attribute Index	Trial II Combined Index	Trial III Name Index	Trial III Attribute Index	Trial III Combined Index
Name									
M	65.36	2.60	182.76	92.12	5.32	186.80	93.20	7.32	185.88
SD	22.00	12.00	27.67	23.04	20.11	41.00	21.11	22.21	43.20
Attribute									
M	46.64	36.52	110.12	52.00	31.08	117.00	44.08	40.88	103.16
SD	41.79	39.82	70.60	43.00	37.64	75.17	45.38	45.55	83.38
Random									
M	52.44	21.76	131.16	59.12	25.00	134.16	42.00	42.08	100.00
SD	41.08	32.43	65.04	36.44	32.10	59.92	38.21	40.31	65.97

TABLE 4

Manova Summary Table for the Name, Attribute, and Combined Clustering Indexes

Variable	Hypothesis(null)[a]	df/df	F	Decision(1-α=.95)
	Group N Means are Equal	2/71	.43	Fail to Reject
	Group A " " "	2/71	.74	" " "
Name	Group R " " "	2/71	3.26	Reject
Index	Trial I " " "	2/72	8.34	"
	Trial II " " "	2/72	9.24	"
	Trial III " " "	2/72	15.88	"
	Group N Means are Equal	2/71	.13	Fail to Reject
	Group A " " "	2/71	1.15	" " "
Attribute	Group R " " "	2/71	3.89	Reject
Index	Trial I " " "	2/72	7.79	"
	Trial II " " "	2/72	4.76	"
	Trial III " " "	2/72	6.96	"
	Group N Means are Equal	2/71	.03	Fail to Reject
	Group A " " "	2/71	.85	" " "
Combined	Group R " " "	2/71	5.28	Reject
Index	Trial I " " "	2/72	10.49	"
	Trial II " " "	2/72	9.08	"
	Trial III " " "	2/72	13.50	"

[a]The hypothesis "Group N means are equal" refers to the three trial means for that group, and the hypothesis "Trial I means are equal" refers to the three group means for that trial.

Cognitive factors and performance. In Table 5 the significant correlations between cognitive factors and performance scores on each trial for the three experimental passages are presented. The performance measures included the number of correctly recalled statements, total number of statements recalled, and average clustering $(\frac{NI+AI}{2})$.

Unique patterns of significant correlations were obtained for each treatment group. Associative memory had a moderately high positive correlation with total recall on all three trials of group A and on trial 2 and trial 3 of group R, but a low correlation with total recall on all three trials of group N. In contrast, verbal comprehension and recall were positively related on all trials in group N, but not at all related in the A or R groups. Subjective organization and the number of correctly recalled statements were positively related on trials 2 and 3 of group A, not at all related in group N, and negatively related on trial 1 in group A, but not at all on trials 2 and 3.

Scores on the cognitive factor tests were used as predictors, and recall and average clustering indices were used as criterion variables in separate multivariate multiple linear prediction analyses for each group. In general, the null hypothesis for these analyses was stated as follows: Ho: In the five predictor model, variable x (or variable x + y) does not affect linear prediction on any of the three dependent variables (trials).

In group A this hypothesis was rejected for the linear prediction of recall scores from subjective organization ($F(3,17) = 3.73$, $p < .05$) and subjective organization plus verbal comprehension ($F(6,34) = 3.38$, $p < .05$). None of the factors significantly affected the linear prediction of recall, or average clustering scores in group N or R.

TABLE 5

Significant Correlations Between Individual Difference Measures and the Number of Statements Correctly Recalled, Total Recall, and Mean Combined Clustering Scores on all Trials for the Name, Attribute, and Random Groups

Group		Trial I			Trial II			Trial III		
		Number Correct	Total Recall	Mean Clustering	Number Correct	Total Recall	Mean Clustering	Number Correct	Total Recall	Mean Clustering
Name	Cr[a]									
	M[b]		.601		.387	.494		.356	.490	
	S[c]				.385			.494		
	V[d]	.365					.369			
	Cl[e]	.335	.373							
Attribute	Cr	.365	.602						.335	
	M						-.368			
	S									
	V		.350			.349		.328	.448	
	Cl									-.394

(Table 5 continued on next page)

TABLE 5 - (continued)

Significant Correlations Between Individual Difference Measures and the Number of Statements Correctly Recalled, Total Recall, and Mean Combined Clustering Scores on all Trials for the Name, Attribute, and Random Groups

		Trial I			Trial II			Trial III		
Group		Number Correct	Total Recall	Mean Clustering	Number Correct	Total Recall	Mean Clustering	Number Correct	Total Recall	Mean Clustering
	Cr	.413								
	M				.384	.380	.368			
Random	S	-.391								
	V									
	Cl	.346								

[a]Creativity

[b]Rote Memory

[c]Subjective Organization

[d]Verbal Comprehension

[e]Speed of Closure

In order to further examine the effect of subjective organization on recall and clustering performance, the distribution of subjective organization scores was ranked and the top and bottom quartiles were selected Table 6 presents the mean number correct and mean combined clustering scores on all trials for high and low subjective organizing in the name, attribute, and random groups. These extreme groups were

TABLE 6

Mean Number Correct and Mean Combined Clustering on All Trials for High and Low Subjective Organizers in the Name, Attribute, and Random Groups

Group	Mean Number Correct	Mean Combined Clustering	Mean Number Correct	Mean Combined Clustering	Mean Number Correct	Mean Combined Clustering
Name						
HSO	7.6	176.0	10.6	198.8	12.0	193.8
LSO	9.5	187.5	12.6	195.8	17.2	199.0
Attribute						
HSO	7.1	99.8	10.2	155.8	15.5	156.5
LSO	7.0	136.0	8.2	69.8	10.6	59.2
Random						
HSO	4.8	84.3	7.0	126.2	10.6	81.3
LSO	8.0	169.3	10.0	137.8	13.8	118.2

compared on recall and combined clustering scores. Graphs of these data for all treatment groups are presented in Figures 1 and 2.

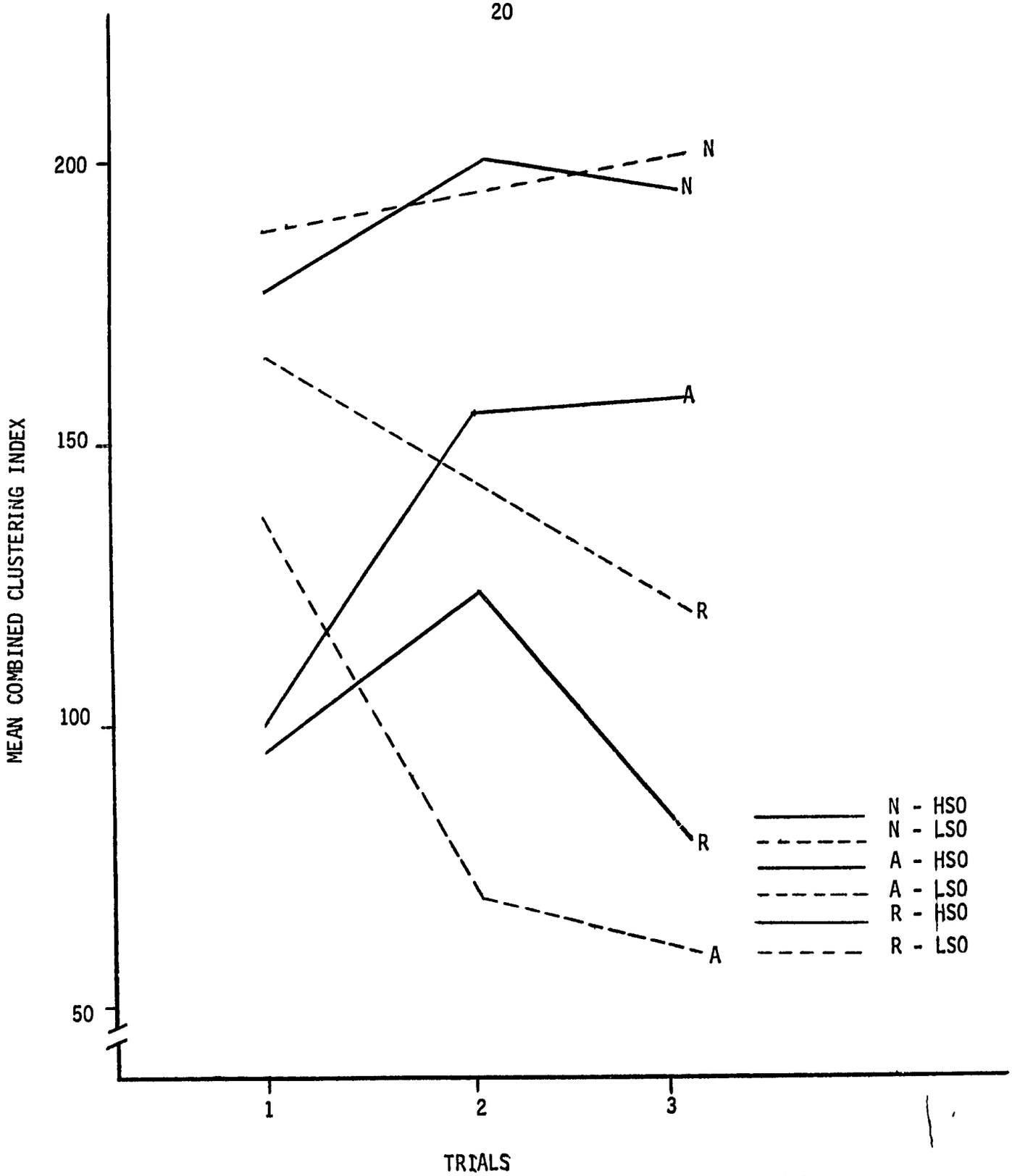

Figure 1.--Mean combined clustering index for high and low subjective organizers in the name, attribute, and random groups on the three recall trials.

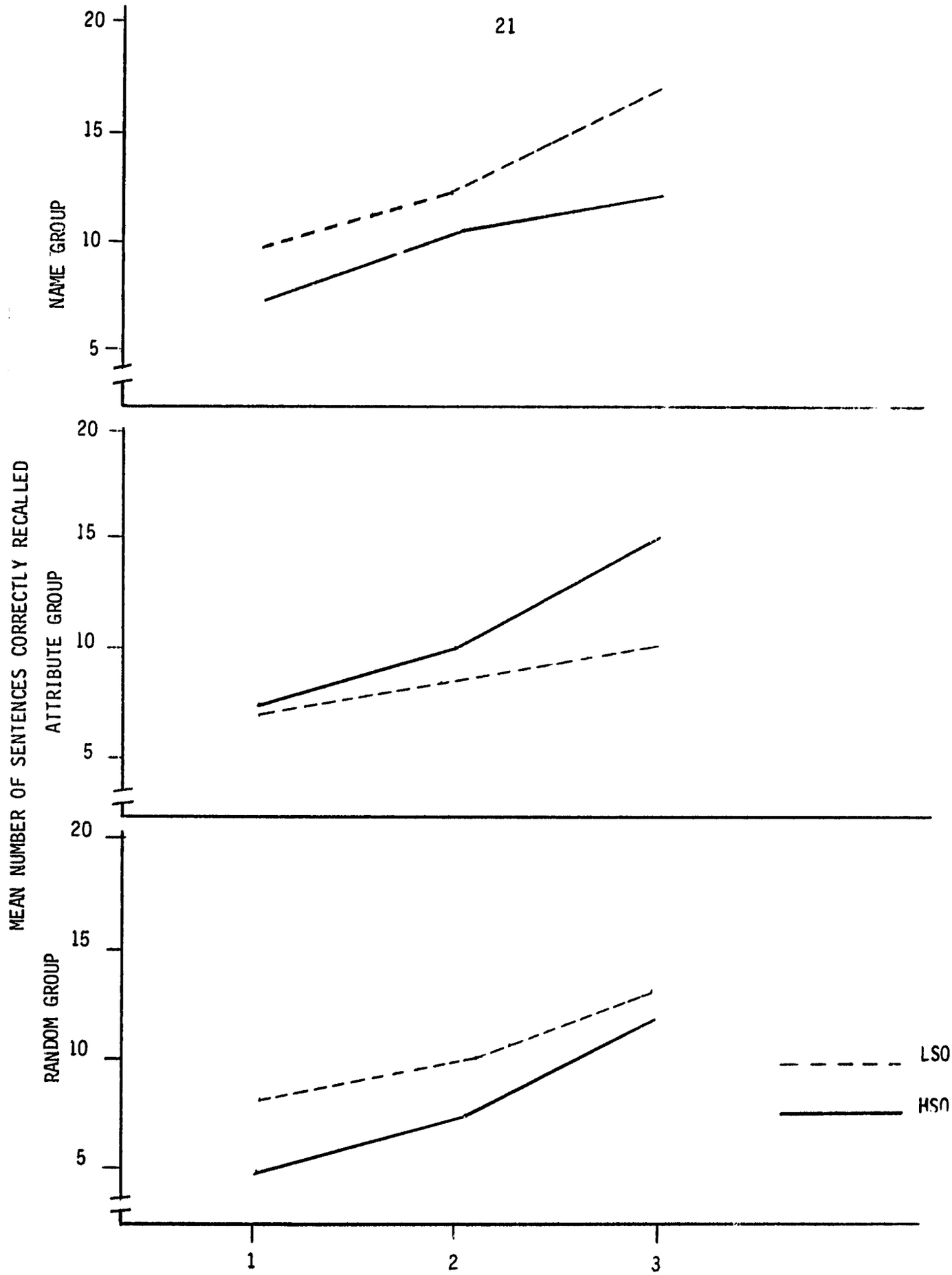

Figure 2.--Mean number of sentences correctly recalled by high and low subjective organizers in the name, attribute, and random groups on the three recall trials.

As can be seen in these figures, high and low subjective organizers performed rather differently. Consider first the combined clustering index. In group R low subjective organizers organized their recall predominately by names. The high subjective organizers used the attribute strategy to a greater extent than the name strategy on trials 1 and 3, but just the reverse on trial 2. The only significant difference between high and low organizers in group R was on trial 1 ($F(1,10) = 8.72$, $p < .05$). In group A the high subjective organizers began by using neither strategy to a greater extent than the other, but on later trials they predominately used the name strategy. The low subjective organizers, on the other hand, began by using the name strategy, but by the third trial were using the organization inherent in the passage. In group A high and low organizers did not differ significantly on combined clustering on any trial. In group N, low subjective organizers never utilized the attribute strategy, but the high subjective organizers used a small amount of attribute clustering on trials 2 and 3. There were no significant differences between high and low organizers in group N on combined clustering.

On the number of correct statements recalled, the high and low subjective organizers again performed in markedly different ways. In group R low subjective organizers recalled more correct statements than high subjective organizers on all trials, but the only significant difference was on trial 1 ($F(1,10) = 7.36$, $p < .05$). In group A, the

reverse was true; high subjective organizers recalled more correct statements than low subjective organizers. F-ratios for the differences between groups on trials were very low for trials 1 and 2, but the difference on trial 3 was significant at the .10 level ($F(1,10) = 3.48$, $p < .10$). The differences between high and low organizers increased across trials resulting in an interaction between subjective organization and trials. This interaction was only significant at the .10 level, however ($F(2,9) = 3.88$, $p < .10$). In group N, high and low subjective organizers recalled a similar amount, but the high group recalled less than the low group on all trials. F-ratios for the differences on trials 1 and 2 were less than 1, but the difference on trial 3 was significant at the .10 level ($F(1,10) = 4.58$, $p < .10$).

Although the differences in recall between high and low organizers in groups N and A were not highly reliable, the fact that high organizers in group N recalled less than low organizers, and low organizers in group A recalled less than high organizers is indicative of an aptitude-treatment interaction. The interaction was tested by comparing means from only the third recall trial. These means are presented graphically in Figure 3.

A 2 x 2 analysis of variance, in which subjective organization (high and low) and passage organization (name and attribute) were factors, was computed. Both main effects were nonsignificant, but the subjective organization by passage organization interaction was significant ($F(1,20) = 7.98$, $p < .05$). Given a prior F-test, it is appropriate to use the Fisher Least Significant Difference to determine which differences contributed to the significant interaction effect. Using this procedure,

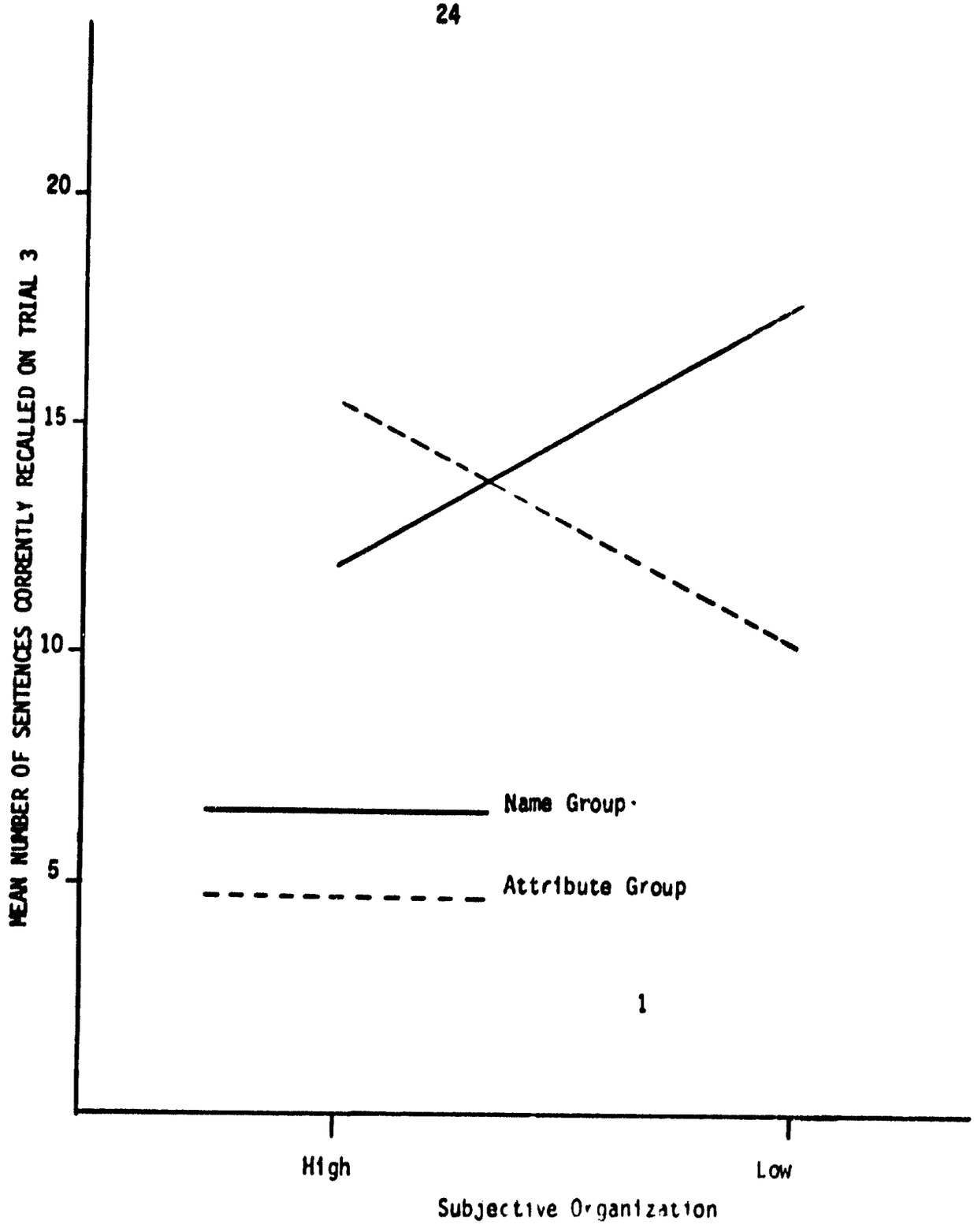

Figure 3.--Interaction or subjective organization and mean number correct on trial 3 for the name and attribute groups.

it was determined that the low subjective organizers in group N recalled significantly more sentences than the low subjective organizers in group A at $\alpha = .05$. However, recall of the high subjective organizers in group N did not differ from the recall of high subjective organizers in group A. Thus, the observed interaction is ordinal rather than disordinal.

Discussion

The discussion which follows is divided into three sections: (a) passage organization-recall and the selection of clustering strategies; (b) individual differences in organizational ability; and (c) summary and suggestions for further research.

Passage Organization-Recall and the Selection of Clustering Strategies

Passage organization was found to have a marked effect on recall and the selection of clustering atrategies. Recall was highest in the name condition and lowest in the attribute condition; with recall for the random condition falling between these extremes. The poor recall of the attribute group is not consistent with previous research (Frase, 1969; Schultz & DiVesta, 1972; Friedman & Greitzer, 1972). In these experiments the attribute condition yielded recall equal to or greater than the recall in the name condition. However, the poor recall of the attribute group in this study may be explained by an examination of the clustering strategies used by learners in the attribute and random conditions and the sequential structure of the attribute passage.

The clustering data indicated that the attribute group utilized the attribute strategy no more than did the random group. Since the attribute organization passage had no differential effect on the selection

of clustering strategies, the usefulness of attribute organization is questionable. In regard to sequential structure, Meyers, Pezdek, and Coulson (1972) have shown that serial position cues are used by students in the attribute group, but not by students in the name or random groups, and that when these cues are removed, recall of the attribute passage was debilitated. Furthermore, in the Schultz and DiVesta (1972) study, the concept names appeared in a constant order across concept attribute paragraphs (personal communication), thereby permitting the use of serial position cues which facilitated recall. In the attribute passage used in the present study, however, concept names were in a different random order for each concept attribute paragraph. Therefore, the benefit of having the concept names appear in the same sequential order across paragraphs was not available to the learners in the attribute group, and, consequently, recall for that group was depressed

With respect to the selection of clustering strategies, the name group clustered almost completely by names, whereas the other groups tended to use both the name and attribute clustering strategies However, clustering by names was the dominant strategy among the random and attribute groups. This preference for the name clustering strategy is very reliable, for it has been also noted in at least three other experiments (Frase, 1969; Schultz & DiVesta, 1972; Meyers, Pezdek, & Coulson, 1972). Two explanations of this finding have been offered by Schultz and DiVesta (1972) First, the dominance of the name strategy may be a function of the information processing requirements of that task. In that case, the name strategy would be chosen because it served to reduce the load placed on memory. Second, the dominance of the name strategy may be a function of cultural predilections. From an

organizational theory point of view, it is valid to say that learners typically organize information primarily by categories and secondarily by attributes of those categories. Thus, the name strategy is dominant because learners use adaptive, organizational processes in which recall of categories facilitates recall of attributes of those categories (Tulving & Pearlstone, 1966; Weist, 1970), and which serve to increase the capacity of the memory system. This data indicates, then, that students not only use organizational processes, but they tend to use the most parsimonious organizational scheme available as well.

Individual Differences in Organization Ability

The above discussion disregarded the effect of individual differences on recall and the selection of clustering strategies. Therefore, those statements must now be qualified by an examination of the differences between students high and low in their ability to subjectively organize verbal input.

In the attribute passage condition, high organizers began by using both clustering strategies to the same extent, but on later trials they chose to reorganize the passage and use the name strategy. The low organizers, however, exhibited an opposite pattern. Early in learning they used the name strategy to a greater degree than the attribute strategy, but on the second and third trials they used the structure inherent in the materials. These clustering results correspond closely with the recall data for the attribute group. On trial 1, when the low organizers were attempting to reorganize the passage, and the high organizers were attempting to find relationships among the sentences, they recalled the same amount. However, the low organizers could not reorganize

the material, and consequently were forced to gradually adopt the attribute strategy, a strategy which does not yield high recall. Thus, the differences between high and low organizers increased across trials creating the interaction between subjective organization and trials in the attribute condition.

Similar results were obtained in the name and random groups. In the name group, the high subjective organizers used the attribute strategy to an increasingly greater extent over trials, whereas low subjective organizers used the name strategy exclusively. In terms of the amount recalled, these groups differed significantly only on trial 3; the trial in which the high organizers were using the attribute strategy to the greatest extent. Furthermore, in the random group, the only trial on which high and low organizers differed significantly was the same trial (trial 1) on which the low organizers were predominately using the name strategy. On later trials, as the use of the name strategy by low organizers declined, low organizers did not recall more sentences than the high organizers. These results suggest that the adoption of a single effective strategy results in higher recall than the adoption of two strategies, one of which is inefficient. Thus, these results support the view that subjective organization and the recall of connected discourse are dependently related.

In the context of this experiment, low organizers may be characterized as being highly influenced by the external structure of the learning materials, and they tend to mirror that organization in their recall. High organizers, however, are able to reorganize the materials, but that was not to their advantage because of the time constraints involved.

That is, high organizers actively sought alternative relationships among the sentences, thereby reducing the amount of time spent memorizing them. Thus, only in the case of the attribute group, when the low organizers were severely limited because of the explicit structure and the lack of serial position cues, did the high organizers recall more than the low organizers. Although mere speculation, it may be that in the random group high organizers would have recalled more than low organizers if more learning trials were given.

Given the significant ordinal interaction between paragraph organization and subjective organization on the number of correctly recalled statements, it is quite apparent that low subjective organizers require learning material which is highly and efficiently organized. Learning materials which place little constraint over the organization of recall cannot be effectively reorganized by subjects low in subjective organization. However, regardless of whether the name or attribute passage was studied, subjects high in subjective organization recalled similar amounts. These results serve to qualify results from previous research which was not concerned with individual differences in that the finding by Schultz and DiVesta (1972), that learners in the attribute condition gradually adopt the organization inherent in the passage, is only true for those low in subjective organization. In addition, the importance of a learner's subjective organization ability, as measured in this study, in learning from prose material was demonstrated. It remains to be seen, however, whether or not these results are replicable in more complex learning situations.

Summary and Suggestions for Further Research

In summary, the major conclusions of this research are as follows: (a) Passages organized by concept names are easier to learn than passages organized by attributes or by randomization; (b) The name strategy is dominate because it reduces memory load and because it represents most closely the way individuals organize verbal input; (c) The attribute organization must be inferred and when all students in that condition are considered, there is no effect of attribute organization on the selection of clustering strategies; (d) Although the appropriate controls were absent, it appears that a viable explanation of the poor recall performance of the attribute group revolves around the unavailability of serial position cues; (e) Low organizers are influenced by the apparent structure of the passage, whereas high organizers are not; (f) High organizers attempt to find relationships among the elements of the passages, and as a result, time for learning is reduced and recall suffers; (g) There exists an ordinal interaction between subjective organization and passage condition.

These conclusions are certainly not definitive, for they serve only to suggest streams for future research. Based on these conclusions then, the following recommendations are made: (a) The measurement of subjective organization should be examined carefully for possible artifacts resulting from the matching procedure; (b) Administration and scoring of the subjective organization measure takes a prohibitive amount of time. Therefore, before any volume of research is undertaken in this area an economical easy-to-administer instrument must be developed. In this regard, the potential use of a computer for real time presentation and scoring is

extremely attractive; (c) The construct of subjective organization must be empirically validated. The evidence to date is most suggestive, but conflicting results abound; and (d) The aptitude-treatment interaction must be explored for potential payoff with more meaningful and more complex instructional treatments. In addition, it would be profitable to measure subjective organization in different populations so that the entire range of that aptitude may be effectively studied.

REFERENCES

Bousfield, A. K., & Bousfield, W. A. Measurement of clustering and of sequential constancies in repeated free recall. Psychological Reports, 1966, 19, 935-942.

Bousfield, W. A. The occurrence of clustering in the recall of randomly arranged associates. Journal of General Psychology, 1953, 49, 229-240.

Bower, G. H. Organized memory. Cognitive Psychology, 1970, 1, 18-46.

Bracht, G. H. Experimental factors related to aptitude-treatment interactions. Review of Educational Research, 1970, 40(5), 627-645.

Brown, B. R. Free recall: Stimulus characteristics and Ss control Unpublished manuscript. The Pennsylvania State University, 1967.

Cohen, B. H., Bousfield, W. A., & Whitmarsh, G. A. Cultural norms for verbal items in 45 categories. Technical Report No. 22, Studies on the mediation of Verbal Behavior, University of Connecticut, Department of Psychology, August, 1957.

Cronbach, L. J., & Snow, R. E. Final report: Individual differences in learning ability as a function of instructional variables. Stanford, California: Stanford University, March, 1969.

Frase, L. T. Paragraph organization of written materials: The influence of conceptual clustering upon the level and organization of recall. Journal of Educational Psychology, 1969, 60(5), 394-401.

French, J. W., Ekstrom, R. B., & Price, L. Manual for kit of reference tests of cognitive factors. Educational Testing Service, Princeton, New Jersey, 1963.

Friedman, M. P., & Greitzer, F. L. Organization and study time in learning from reading. Journal of Educational Psychology, 1972, 63(6), 609-616.

Jenkins, J. J., & Russell, W. A. Associative clustering during recall. Journal of Abnormal and Social Psychology, 1952, 47, 818-821.

Jensen, A. R. Learning and individual differences. In R. M. Gagne (Ed.), Learning and individual differences. Columbus, Ohio: Merrill, Inc., 1967.

Mednick, S. A., & Mednick, M. T. Examiner's manual: Remote associates test: College and adult forms 1 and 2. Boston: Houghton Mifflin, 1967.

Melton, A. W. Individual differences and theoretical process variables: General comments on the conference. In R. M. Gagne (Ed.), Learning and individual differences. Columbus, Ohio: Merrill, Inc., 1967.

Meyers, J. L., Pezdek, K., & Coulson, D. Effects of prose organization upon free recall. Report 72-1, Cognitive Process Laboratory. Department of Psychology, University of Massachusetts, 1972.

Miller, G. A. Human memory and the storage of information. IRE Trans. Information Theory, 1956, 2, 129-137.

Postman, L. Organization and interference. Psychological Review, 1971, 78, 290-302.

Postman, L. A pragmatic view of organization theory. In E. Tulving and W. Donaldson (Eds.), Organization of memory New York: Academic Press, 1972.

Schultz, B. C., & DiVesta, F. J. The effects of passage organization and note-taking on the selection of clustering strategies and on recall of textual materials. Journal of Educational Psychology, 1972, 63(8), 244-252.

Thurstone, L. L. An analysis of mechanical aptitude. Psychometric Lab. Report No. 62, University of Chicago, 1951.

Tulving, E. Subjective organization in free recall of "unrelated" words. Psychological Review, 1962, 69, 344-354 (a)

Tulving, E., & Pearlstone, F. Availability versus accessibility of information in memory for words. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 381-391.

Weist, R. M. Optimal versus nonoptimal conditions for retrieval. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 311-316.

Wood, G. Organizational processes and free recall. In E. Tulving and W. Donaldson (Eds.), Organization of memory. New York: Academic Press, 1972.