LINGUISTIC AND ORGANIZATIONAL FACTORS IN MEMORY FOR PARAGRAPHS

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY
SANDRA ELAINE GRAHAM

1970

ABSTRACT

LINGUISTIC AND ORGANIZATIONAL FACTORS

IN MEMORY FOR PARAGRAPHS

By

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A 2x2x2 factorial design was employed to test the effects of organization of paragraphs (name vs. attribute), grammatical position of the materials which served as the basis for the organization of the text (subject vs. predicate), and class in which subjects were enrolled (Human Learning-HL vs. General Psychology-GP). Sentence structure was manipulated as a within subject variable. Subjects were presented sentences containing a planet name and an attribute of the planet. The sentences were organized into paragraphs such that each paragraph was either about a single planet (name organization) or about a single attribute category (attribute organization). The grammatical position of the names and attributes in the sentences was manipulated such that both names and attributes occurred in both the subject and predicate positions of the sentence for each organization. An additional group was given the same information in tabular form. A total of 80 subjects were used. The materials were presented in a booklet and recall was written.

Sentence structure had no effect on recall. Subjects in Group HL attempted to recall more sentences of each structural type than did subjects in Group GP. Subjects in Group HL also associated significantly more names and attributes at recall than did the subjects in Group GP. However, the particular organization of the information (name vs. attribute; paragraph vs. table) that any given subject received did not influence the number of word pairs formed at recall. The main effect for grammatical position was not significant, but the grammatical position variable was involved in several interactions for Group GP. For subjects in Group GP, the organization of recall was influenced by whether the materials which served as the basis for the organization of the text was presented in the subject or predicate position of the sentence. No similar effect was found for subjects in Group HL. Organization of the text had a significant effect on the organization of recall.

Approved By Gordon Wood

Date October 29, 1970

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A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1970

ACKNOWLEDGEMENTS

The author wishes to thank her guidance committee Dr. Gordon Wood, chairman, Dr. Aream Barch, and DR. William Stellwagen for their help and guidance in the preparation of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

LIST OF APPENDICES

INTRODUCTION

The concept of mathemagentic behavior (Rothkopf,1970) has been defined as behavior that gives birth to learning, and as such provides a conceptual scheme for dealing with learning from written materials. Mathemagentic behavior implies that the learner's behavior plays an important and direct role in what is learned. Rothkopf (1970) cites three forms of mathemagentic activities for written materials: orientation, object acquisition, and translation and processing. Orientation involves getting the subject into the vicinity of the materials and oriented to them. Object acquisition involves the selection and presentation of appropriate instructional materials. In translation and processing the materials are translated into internal representations and processed through the mental machinery associated with reading. Orientation and object acquisition behaviors are rather gross activities that can be easily observed and measured. Mathemagentic behaviors associated with translation and processing involve very few directly observable components and can only be indirectly inferred from the observable component.

Frase (1970) has proposed some boundary conditions for

the control of mathemagentic behavior for the third class of mathemagentic behavior, translation and processing. He proposed that the type of mathemagentic behavior in which subjects engage while learning from witten materials can be influenced by orienting directions such as questions, the motivation of the subjects, and through the characteristics of the text. In regard to the last boundary condition, Frase suggested that rearranging the information in the text can alter the behavior in which subjects engage while reading and consequently affects what is remembered. Frase's (1969) study presenting written passages about chess provides evidence to support his hypothesis that characteristics of the text influence mathemagentic behaviors.

Frase (1969) studies the effect of conceptual organization of paragraphs on conceptual clustering at recall. Frase used the names of chessmen, king, queen, pawn, etc., and their attributes, number of squares moved by a man, color, method of capture, etc., to form sentences. Three presentation orders of the sentences were used. For the name group, each paragraph contained sentences which were statements of the attributes of a single chessman. For example, the paragraph about the queen contained statements about the queen's point value, color, moves, etc. Each paragraph for the attribute group contained one sentence for each chessman which stated the name of the piece and its value on a single attribute. For example, The pawn is worth one point; The

bishop is worth three points. A third group, labeled rote by Frase, received paragraphs that contained random orders of the sentences. Subjects were given three alternating study and test trials on the paragraphs. Five minutes were allowed for reading the stimulus passage, and six minutes were permitted for free recall. Subjects were told to write down everything they could recall from reading the passage.

The mean number of attribute-name associations correctly recalled out of 48 was 23.98, 22.50, 15.57 for the attribute, name, and rote groups, respectively. Attribute and name organized groups differed from the rote group but not from each other. The analysis for clustering of sentences in recall revealed the average number of sentences followed by a sentence either in the same name or attribute category to be 78.6% for the attribute group, 98.2% for the name group, and 79.4% for the rote group. The name group was significantly different from both the attribute and rote groups, but the attribute and rote groups did not differ. When clustering by name in recall was considered, the largest percentage of clustering by name was found for the name group (95%), the smallest for the attribute group (30%), and an intermediate percentage of clustering by name for the rote group (51%). The recall of both the attribute and rote groups showed a higher percentage of clustering by name than was present in the organization of the stimulus passage. The results suggest the powerfulness of paragraph organization in influencing

the order of recall. Frase suggested that name organization may have resulted in the least amount of change from sentence to sentence which would permit relatively direct classification of the information by concept name, and result in clustering by name during recall. He also suggested the occurrance of the name predominately in the first part of the sentence may have aided clustering by name.

A basic factor not considered by Frase or Rothkopf in their analysis of learning from written materials is sentence structure, in particular the effect of deep structure on sentence learning. According to Chomsky (1965) the deep structures of a sentence are generated by the base component of the syntax of the grammar and enter the semantic component to receive a semantic interpretation. The semantic interpretation is then mapped into the surface structure of the sentence by transformational rules. Clark (1969) has considered deep structure in sentence memory and has proposed what he calls the principle of primacy of functional relations. He stated in the principle that the functional realtions such as subject, verb, and direct object, which are the deep structures of the sentences, are stored immediately after comprehension and are more readily available for recall than the transformational rules which map the deep structures into the surface structure and determine such things as theme of the sentence. Clark presented the following sentences as an example: (1) John watched the monkey. (2) The monkey was watched by John. In both sentences the deep structures are

the same, ie. the subject of the sentences is John, the verb, watch, and the object, monkey. However, Sentence 1 was produced by applying a set of transformational rules that resulted in an active sentence, while Sentence 2 was produced by applying a set of transformational rules that resulted in a passive sentence. The principle of the primacy of functional relations states that subjects would more readily recall that the subject of the sentence was "John", that the verb was "watch," and that the object was "monkey" than they would recall whether the sentence was active or passive. This effect is documented in studies by Miller (1962), Mehler (1963), and Clifton and Odom (1966) where subjects have been found to recall transformationally related sentences in place of the sentences presented to them for recall, such as recalling an active sentence in place of a passive sentence.

The psychological reality of deep structure has been demonstrated in a series of experiments by Rohrman (1968) in which he found that the complexity of the deep structure of sentences and not the complexity of the surface structure was the key factor in determining whether or not sentences were recalled correctly. He concluded that "since information contained only in deep structure is available and produces behaviorial differences, claiming psychological relevance for deep structures and postulating them as the memory representation of sentences seems reasonable (Rohrman, 1968, p.911)." Horowitz and Prylutak's (1969) review of redintegrative memory suggests, moreover, that one particular element in

the deep structure, the sentence subject, may influence sentence recall more than the other elements in the deep structure.

In redintegrative memory, the stimulus for recall of a response unit is part of the response unit. However, it is difficult to know whether part of a unit is eliciting the whole unit or merely the other part (unrecalled part) of the whole unit. Horowitz and Prylutak avoided this difficulty by arriving at an arbitrary definition of redintegrative memory. To be called redintegrative memory, the probability should be high that a subject recalls the whole unit, not just part of the unit. For the authors, 60% of the recalled materials were required to occur in the whole units in order to satisfy their criterion for redintegrative memory. For example, the probability of recalling a sentence given that a word from the sentence was recalled, had to exceed 0.60 in order for the sentence to satisfy the criterion of redintegrative memory.

Horowitz and Prylutak tested to see whether sentences satisfied their criterion of redintegrative memory by presenting subjects with six sentences for free recall. This was repeated ten times for a total of sixty sentences. The mean number of sentences recalled perfectly was 34.35. The mean recall of only the subject of the sentence was 7.20, the mean recall of only the verb was 3.85, and the mean recall of only the object was 6.25. The probability that the whole sentence was recalled given that either the subject, object,

or verb was recalled, was beyond 0,80. Thus, the recall of sentences met the criterion for redintegrative memory.

Horowitz and Prylutak also tested the material for redintegrative power. The principle of redintegrative power states that the more salient element of a response unit is the best cue for eliciting or retrieving the whole response unit. The more salient element has more redintegrative power than other elements in the response unit. To test the principle, the same sixty sentences were presented one at a time to new subjects. A test trial followed every sixth sentence. For one third of the sentences, the subject of the sentence was used as the cue for recall, for another third the object was used as the cue, and for the other third the verb was used as the cue for recall,. The mean number of correct responses to the subject cue was 13.55, to the verb cue, 10.80, and to the object cue, 12.15, $F=7.18$, $df=2/38$, $p < .01$. These results led Horowitz and Prylutak to conclude that in the recall of sentences, the subject of the sentence has more redintegrative power than the object or verb. Thus, the subject was the best cue or stimulus for eliciting the whole sentence.

Horowitz and Prylutak's finding imply that two sentences with a common subject should be perceived as more similar than two sentences with a common verb or a common object. The psychological similarity of sentences containing identical subjects and the principle of primacy of functional relations suggest an alternative explanation for the Frase

(1969) results. The greater clustering according to name in the Frase study may have been due to the fact that names were presented in the subject position and attributes in the predicate position. It is not surprising then that a high degree of clustering by name was found in the recall protocols for the name group. The clustering by name observed for the attribute group further suggests the operation of redintegrative memory and the powerfulness of the common subject in re-organization of the sentences to produce the recall order of sentences. That is, there was clustering by name even though the sentences were organized by attributes. Was this because names were "better" means of organization, or because the names occurred in the subject position?

Reconsideration of Frase's results in terms of redintegrative memory and the principle of primacy of functional relations suggest that it might be more appropriate to consider the clustering as clustering by subject of the sentences rather than clustering by name. The analysis further suggests that if the attributes occupied the position of subject of the sentence that clustering by attribute in recall would be similar to the clustering by name Frase observed in his name group. The present study was intended to test the hypothesis that for written materials organized into paragraphs, clustering during recall would center around whatever common event (name or attribute) occurred as the subject of the sentences.

METHOD

Design and materials. A 2x2x2 factorial design was used to assess the importance of amount of previous training with respect to the organizational variable, paragraph organization (name vs. attribute), and position of the "materials to be clustered" in the sentence (subject vs. predicate). Type of sentence structure was also manipulated as a within subject variable. Each sentence contained a planet name (e.g. Columbia) and a characteristic or attribute (e.g. high mountains). In the following description of the conditions the first letter of the abbreviation (e.g. NS) refers to the way the paragraph was organized.

The Name-Subject Condition (NS) received sentences with the name in the subject position and attributes in the predicate. The sentences were organized into paragraphs such that each paragraph contained sentences about only one planet. The Attribute-Predicate Condition (AP) also received sentences with the name in the subject position and attribute in the predicate. The sentences were organized into paragraphs such that each paragraph contained sentences for only one attribute category and all the planet names. The paragraphs for the Attribute-Subject Condition (AS) contained sentences with the attribute category items in the subject position and names in the prediacte. Each paragraph contained sentences for only one attribute category and all the planet names.

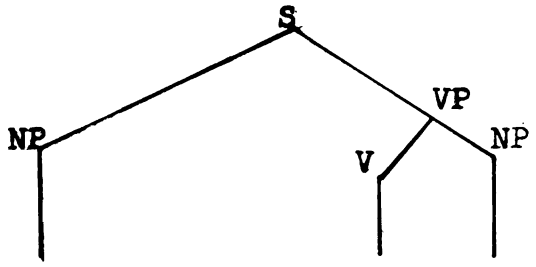
The Name-Predicate Condition (NP) also received sentences with the attribute category items in the subject position and names in the predicate. The paragraphs were organized such that each paragraph contained sentences about one planet.

Along with the four paragraph organized conditions a Table Condition (T) was employed as an alternative means of presenting the same information. It is possible that subjects faced with the task of learning materials from the paragraphs might try to condense the information into a form resembling the table to aid their recall. The Table Condition was, therefore, introduced to test the effect on recall of presenting information in a highly condensed and organized form. The table contained the same information as the paragraphs with the names and attribute categories forming the marginals of the matrix. Each cell contained one value of a particular attribute for a specific planet.

Six common names (Columbia, Johnson, Plymouth, Rochester, Springfield, and Washington) were used as the names of the planets. Six attribute categories (climate, color of clouds, mineral, number of moons, size, and terrain) were used with six different items in each attribute category. For example, the category "color of clouds" had six different colors, and each color was paired with a different planet. Subjects in the paragraph conditions received six paragraphs of six sentences each for a total of 36 sentences. The mean length of the sentences was 5.00 words.

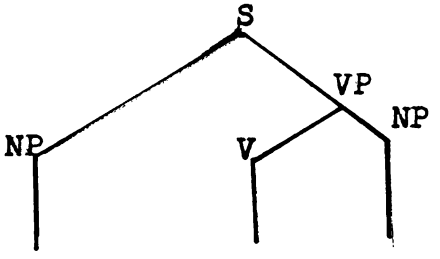
Four sentence structures of the general form, noun phrase + verb + noun phrase, were used. Grammatical diagrams of the sentence structures are presented in Figure 1. Two of the structures had a name-attribute word order and the other two structures had an attribute-name word order. The two word orders resulted from the manipulation of grammatical position of the "items to be clustered." Two grammatical structures were used for each word order to permit some degree of generality in the results with respect to sentence complexity.

Conditions AS and NP received 18 sentences of Type A structure and 18 sentences of Type B structure. As indicated in Figure 1, these sentences varied only in the internal structure of the initial noun phrase. The variations involved an additional determinator (a, an, or the) and an adjective in the initial noun phrase of the Type A sentences, making the Type A structure slightly more complex than the Type B structure. Condition NS and AP each received 18 sentences of Type C structure and 18 sentences of Type D structure, and as indicated in Figure 1, these sentences differed in the internal structure of the final noun phrase. The variations involved an additional determinator and adjective in the final noun phrase of Type C sentences, which made the Type C structure more complex than the Type D structure. In structural form, Type A sentences were the inverse of Type C sentences and vice versa, in that the initial noun phrases



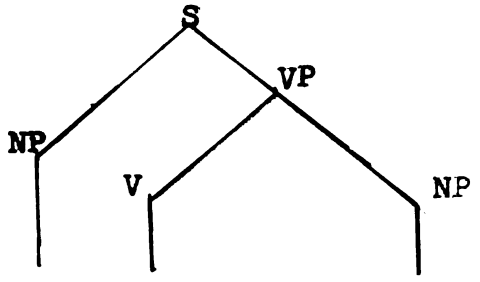
det adj adj noun verb noun
The zinc rich planet is Springfield.

Sentence Type A



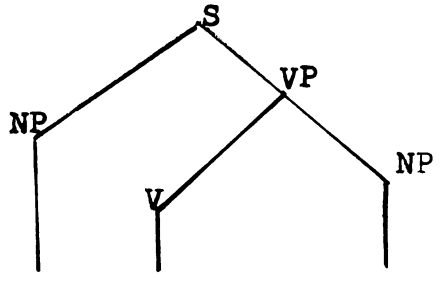
adj noun verb noun
Orange clouds surround Columbia.

Sentence Type B



noun verb det adj adj noun
Springfield is the zinc rich planet.

Sentence Type C



noun verb daj noun
Columbia exhibits orange clouds.

Sentence Type D

Figure 1. Syntactical structures of the four types of sentences presented to subjects. Note.- S= sentence; NP = noun phrase; VP = verb phrase; V = verb; adj = adjective; det = determinator.

of Type A sentences were the final noun phrase of Type C sentences, and the final noun phrases of Type A sentences were the initial noun phrases of Type C sentences. A similar relationship occurred between sentences of structural Types B and D.

Two groups of subjects were used. The two groups were belived to represent different levels of training with respect to the variable of organization. The General Psychology Group (GP) had had no known previous instruction as to the various psychological effects of organization on recall nor any instruction as to how organization of materials could be used as a mnemonic system. The Human Learning Group HL) had had some contact with information about the use and effect of organizational schemes in memory tasks in their class work. The groups also differed in class level (sophomore-Group GP vs. junior-Group HL) which suggests that subjects in Group HL were older, on the average, and since they were taking a course in human learning, may have been more interested in the task.

Procedure. Group HL and Group GP each consisted of 40 undergraduate psychology students who served as subjects in fulfillment of class requirements for a total of 80 subjects. Eight subjects in both groups were randomly assigned to each of the five conditions. A booklet presentation was used with one paragraph on each page for the paragraph conditions, and a table for the Table Condition. Two trials were given with

an immediate written free recall test following each study trial. All subjects were given a total of six minutes for each study trial. Those subjects in the paragraph reading conditions were paced at one minute for each paragraph. Ten minutes were permitted for each recall trial.

RESULTS AND DISCUSSION

Sentence structure. Sentence structure was considered first to determine if it had been an influential factor in subjects' recall performance. The mean number of sentences of each structural type for each condition for both groups of subjects is presented in Table 1. The main effect for sentence structure was not significant, $F < 1$. Thus, the findings of the present study are not limited to one sentence structure because sentence structure did not influence performance. The main effects for class level were significant. Group HL attempted to recall more Type A and Type B sentences than Group GP, $F = 4.49$, $df = 1/28$, $p < .05$. Group HL also attempted to recall more Type C and Type D sentences than Group GP, $F = 11.39$, $df = 1/28$, $p < .01$. These results suggest that subjects in Group HL were better able to use the organizational schemes presented to them in retaining and recalling the materials than subjects in Group GP. Newman-Keuls comparisons revealed no significant difference between structure Types A and B for Conditions AS and NP for both groups, nor between structure Types C and D for Conditions NS and AP for both groups. The sentence structure variable was, therefore, collasped for all remaining comparisons.

Table 1. Mean Number of Sentences of Each Structure Type Attempted at Recall.

Conditions		Group GP		Group HL	
		Type A	Type B	Type A	Type B
AS	$\bar{M}$	15.50	17.38	22.63	24.88
	s	5.16	8.06	9.27	9.73
NP	$\bar{M}$	21.88	19.00	25.00	23.13
	s	4.96	7.04	3.08	3.76
		Type C	Type D	TypeC	Type D
NS	$\bar{M}$	21.13	20.38	28.50	29.63
	s	4.40	10.87	3.46	5.93
AP	$\bar{M}$	23.25	20.13	26.25	28.25
	s	6.12	6.88	9.67	8.03

Note.- Trials 1 and 2 were combined. Means are based on a possible 36 sentences for each structure type per group. A sentence was considered attempted if some portion of the noun phrase concerned with the attribute was recalled.

Redintegrative memory. The mean number of whole sentences recalled is presented in Table 2. Subjects did not recall many whole sentences. Instead, they tended to produce word pairs linking a name with an attribute. The word pairs occurred in both name-attribute and attribute-name orders. Because of the low recall of whole sentences, redintegrative memory was considered in terms of these word pairs. The conditional probabilities of recalling a name-attribute word pair correctly given that the name was recalled, and the conditional probabilities of recalling an attribute-name word pair given the attribute was recalled are presented in Table 3. One striking fact about these probabilities is that except for Condition AS in Group GP and Condition NP in Group HL, the probability of recalling a name-attribute word pair is always greater than the probability of recalling an attribute-name word pair. This would seem to suggest that subjects perferred to make the word pairs in the name-attribute order. Work by Paivio (1963) with noun-adjective and adjective-noun paired associates indicated that the perferred form of the word pairs should be the name-attribute form. Paivio found that noun-adjective pairs were learned faster than adjective-noun pairs. Essentially, the name-attribute word pairs were the same as noun-adjective pairs since the attributes paired with a name generally consisted of one or two words which had served as adjectives in the sentences.

Table 2. Mean Number of Whole Sentences Recalled.

Conditions		Group GP		Group HL	
		Trial 1	Trial 2	Trial 1	Trial 2
NS	$\bar{M}$	4.00	7.12	7.62	10.50
	s	3.35	5.95	2.67	6.59
NP	$\bar{M}$	4.12	5.50	10.62	14.75
	s	3.99	6.61	6.71	9.61
AS	$\bar{M}$	2.25	11.50	4.12	10.37
	s	1.79	7.70	3.92	8.10
AP	$\bar{M}$	3.37	7.37	4.75	10.62
	s	3.74	7.87	4.12	12.03

Note.- Means are based on a possible 36 sentences per trial.

Table 3. Mean Conditional Probabilities for Recalling a Name-Attribute Word Pair Given the Name was Recalled and Mean Conditional Probabilities of Recalling an Attribute-Name Word Pair Given the Attribute was Recalled.

	Trial 1		Trial 2	
	Name-Attribute Word Pair	Attribute-Name Word Pair	Name-Attribute Word Pair	Attribute-Name Word Pair
Group GP				
NS	0.725*	0.000	0.880*	0.000
AP	0.775*	0.000	0.850*	0.000
AS	0.600*	0.324	0.700*	0.750*
NP	0.628*	0.565*	0.825*	0.645*
Group HL				
NS	0.780*	0.000	0.850*	0.000
AP	0.735*	0.000	0.985*	0.000
AS	0.625*	0.296	0.920*	0.505
NP	0.740*	0.770*	0.815*	0.870*

Note.- The number of name-attribute and attribute-name pairs recalled correctly, and the total number of names recalled first in the pairs and singly and the total number of attributes recalled first in the pairs and singly are presented in Appendix C.

*Probability satifies Horowitz and Prylutak's criterion for redintegrative memory.

It should also be noted that all 16 probabilities of recalling a name-attribute word pair given that the name was recalled reached Horowitz and Prylutak's criterion for redintegrative memory, but only 4 out of 16 probabilities of recalling an attribute-name word pair given the attribute was recalled reached the criterion. This indicates that subjects were more likely to recall whole word pairs if the name was recalled than if the attribute was recalled. This suggests that the name was a better stimulus for retrieving the whole word pair than was the attribute. Prentice's (1966) work on the influence of the response strength of a single word on sentence learning suggests a possible explanation for subjects' preference for recalling the name first. Prentice manipulated the response strength of nouns occurring early and late in the sentence. She found that when a word with high response strength occurred early in the sentence learning was faster than when the high response strength word occurred late in the sentence. This suggests that in the present study names were high response strength words and that name-attribute word pairs were stronger than attribute-name word pairs and hence, more likely to be recalled correctly.

Recall of word pairs. The mean number of word pairs recalled correctly are presented in Table 4. Class level was found to affect the number of word pairs recalled with Group HL recalling more word pairs than Group GP, $F=10.15$,

Table 4. Mean Number of Word Pairs Correctly Recalled

Conditions		Group GP		Group HL	
		Trial 1	Trial 2	Trial 1	Trial 2
NS	$\bar{M}$	11.50	19.63	19.13	26.38
	s	4.33	5.85	6.31	5.99
NP	$\bar{M}$	11.50	18.88	13.13	22.00
	s	3.20	7.32	6.47	9.75
AS	$\bar{M}$	5.63	15.13	10.00	17.50
	s	3.81	7.42	4.12	9.17
AP	$\bar{M}$	12.13	23.13	16.50	23.36
	s	3.18	8.75	9.64	12.46
T	$\bar{M}$	9.88	13.00	21.38	27.38
	s	9.62	11.61	7.03	8.73

Note.- There were 36 possible word pairs per trial.

df=1/70. $p < .01$. These results may have been due to age or intelligence differences between the groups or to the amount of interest each group had in the task. The amount of knowledge the groups had with respect to the organization variable would also seem to be a resonable variable to consider and may account, at least in part, for the results. Considering the results in terms of level of training with respect to organization suggests that subjects in Group HL were not as naive as subjects in Group GP with respect to the use of organizational schemes. Consequently subjects in Group HL were better able to use the organizations presented to them in retaining and recalling the materials. The main effect for conditions was not significant. That is, the condition in which a subject was placed had no effect on the number of word pairs he recalled. Trials had a significant main effect, F=140.75, df=1/70, $p < .01$. None of the interactions was significant.

Clustering. The percentage of recall clustered by name and by attribute on each trial was computed for each subject using the formula, (R/T-K)x100, where "R" was the total number of repetitions of names or attributes; "T" was the total number of names or attributes recalled; and "K" was the number of names or attribute categories recalled. The mean percentages of clustering by name and attribute are presented in Table 5. Since Group HL and Group GP were found to differ significantly on several measures, the data were not pooled for the analysis of clustering, but rather two

Table 5. Percentage og Clustering by Name and Attribute for Paragraph Conditions.

Conditions		Clustering by Name			
		Group GP		Group HL	
		Trial 1	Trial 2	Trial 1	Trial 2
NS	$\bar{M}$	79.63	77.38	47.37	63.00
	s	11/53	17.18	36.79	37.07
NP	$\bar{M}$	57.25	52.38	66.88	77.75
	s	38.68	28.53	19.25	28.10
AS	$\bar{M}$	41.63	20.88	8.00	16.25
	s	37.39	24.39	12.86	32.30
AP	$\bar{M}$	20.88	29.88	5.75	0.50
	s	13.82	40.87	7.01	1.32
		Clustering by Attribute			
		Group GP		Group HL	
		Trial 1	Trial 2	Trial 1	Trial 2
NS	$\bar{M}$	25.00	12.50	46.13	27.50
	s	15.49	13.44	35.15	33.93
NP	$\bar{M}$	20.00	44.75	27.75	22.38
	s	19.75	36.45	19.25	24.95
AS	$\bar{M}$	58.88	85.25	76.50	80.13
	s	32.88	25.40	40.53	31.93
AP	$\bar{M}$	63.25	64.38	96.88	97.88
	s	24.04	36.48	4.40	5.62

separate analyses of variance, one for clustering by name and one for clustering by attribute, were carried out for each group.

The grammatical position variable was not found to have a significant main effect on clustering in any of the analyses performed. However, the Organization, Grammatical Position, and Trials interaction for clustering by attribute in Group GP was significant, $F=8.08$, $df=1/28$, $p < .01$. Newman-Keuls comparisons revealed Conditions AS and AP to show significantly ($p < .01$) more clustering by attribute than Conditions NS and NP on Trial 1. On Trial 2, Condition AS showed significantly ($p < .05$) more clustering by attribute than either Condition NP or Condition NS, but Condition AP differed significantly ($p < .05$) only from Condition NS. Conditions AS and AP did not differ significantly from each other on either trial, nor did Condition NS differ significantly from Condition NP on Trial 1, but they did differ significantly ($p < .05$) on Trial 2. The interaction indicates that for Group GP having the attribute in the subject position of the sentence did facilitate clustering by attribute on Trial 2, while having the attribute in the predicate of the sentence tended to depress clustering by attribute. This finding supports the hypothesis that clustering during recall is facilitated by the commonality of the subject of the sentences. However, the validity of this finding is in doubt because similar results were not found for Group HL.

The interaction of organization and grammatical position for clustering by name for Group GP was significant, $F=9.19$, $df=1/28$, $p < .01$. Newman-Keuls comparisons indicated that subjects in Conditions NS and NP clustered their recall significantly ($p < .01$) more by name than did subjects in Conditions AS and AP. Conditions AS and AP did not differ significantly from each other, but Condition NS had significantly ($p < .01$) more clustering by name than did Condition NP. The interaction indicates that while both name and attribute organized groups show less clustering by name when the common organizing event (name or attribute) was in the predicate of the sentence, grammatical position has a greater effect on name organized conditions than on attribute organized conditions. This interaction effect may have been produced by the fact that subjects tended to cluster their recall in terms of the imput organization that they received, but it also suggests that grammatical position did have an influence on clustering by name.

The interaction of grammatical position and trials for clustering by name in Group GP was also significant, $F=8.07$, $df=1/28$, $p < .01$. The interaction indicates that conditions with the organizing factor (name or attribute) in the subject of the sentence showed a larger decrease in the percentage of clustering by name from Trial 1 to Trial 2 than did the conditions with the organizing factor in the predicate. This suggests that the facilitation due to grammatical position was very transient and limited to the initial trial.

However, as with clustering by attribute, Group HL failed to show similar results, thus weakening any conclusion as to the effect of grammatical position on recall.

In constrast to the weak influence of grammatical position on clustering by name and attribute, organization was a powerful variable, for Group HL clustering by name, $F=48.86$, $df=1/28$, $p < .01$; for Group GP clustering by name, $F=14.36$, $df=1/28$, $p < .01$; for Group HL clustering by attribute, $F=48.88$, $df=1/28$, $p < .01$; for Group GP, clustering by attribute, $F=24.22$, $df=1/28$, $p < .01$. For both groups, conditions receiving name organization had larger mean percentages of clustering by name than clustering by attribute ($p < .01$), and conditions receiving attribute organization had larger mean percentages of clustering by attribute ($p < .01$) than by name. This indicates that subjects tended to cluster their recall in terms of the organization presented to them on the study trials. This reflects, as did the Frase (1969) study, the influence of the characteristics of the text on the behaviors in which subjects engage while learning the materials. That is, the results reflect the effect of the text characteristics on mathemagentic behaviors.

The mean percentages of clustering by name and attribute for the three types of organization (name, attribute, and table) employed are presented in Table 6. The unweighted means analyses of variance revealed significant interactions of class level and type of organization, for clustering by

Table 6. Mean Percentage of Clustering by Name and Attribute for Name, Attribute, and Table Organizations.

	Table Organization[a]			
	Group GP		Group HL	
	Trial 1	Trial 2	Trial 1	Trial 2
Name				
$\bar{M}$	26.13	34.00	81.13	87.88
s	42.75	43.68	23.94	16.60
Attribute				
$\bar{M}$	73.25	73.00	26.13	5.88
s	42.39	42.46	38.40	6.77
	Name Organization[b]			
	Group GP		Group HL	
	Trial 1	Trial 2	Troal 1	Trial 2
Name				
$\bar{M}$	68.44	64.88	57.13	70.38
s	30.66	26.66	30.93	33.71
Attribute				
$\bar{M}$	22.50	32.38	36.94	24.94
s	18.28	31.79	27.81	30.30
	Attribute Organization[c]			
	Group GP		Group HL	
	Trial 1	Trial 2	Trial 1	Trial 2
Name				
$\bar{M}$	31.25	25.38	6.88	8.38
s	30.04	33.95	10.41	24.17
Attribute				
$\bar{M}$	61.06	68.65	86.69	89.00
s	28.89	36.99	24.06	24.58

[a]Mean percentages of clustering based on eight subjects.

[b] Mean percentages of clustering for Conditions NS and NP combined base on 16 subjects.

[c] Mean percentages of clustering for Conditions AS abd AP combined based on 16 subjects.

attribute, $F=16.23$, $df=1/74$, $p < .01$, for clustering by name, $F=16.97$, $df=1/74$, $p < .01$. The interaction for clustering by attribute was due to the fact that Groups GP and HL showed similar percentages of clustering by attribute for name and attribute organization but Group GP showed significantly ($p < .01$) more clustering by attribute for the table organization than Group HL. Similarly for clustering by name, the interaction was due to the fact that while Group GP and Group HL did not differ significantly on the percentages of clustering by name for name and attribute organization, Group HL showed significantly ($p < .01$) more clustering by name in the table organized condition than did Group GP.

An explanation for these interactions can be found in the mean numbers of names and attributes recalled by the Table Condition in each group. Group GP had a mean recall of 14.00 names on Trial 1 and 18.00 names on Trial 2, while Group HL recalled 26.00 and 30.25 names on Trials 1 and 2, respectively. Group GP had a mean recall of 25.38 attributes on Trial 1 and 30.25 on Trial 2. Group HL recalled 24.75 and 29.38 attributes on Trials 1 and 2, respectively. The groups did not differ significantly on the number of attributes recalled, but Group HL did recall more names than did Group GP, $F=6.90$, $df=1/24$, $p < .05$. Group HL also recalled more word pairs than Group GP in the table condition. These results suggest that Group GP either did not understand the instructions to recall

word pairs or disregarded them, and consequently tended to recall attributes alone rather than attribute-name pairs, resulting in a pronounced clustering by attribute. This suggests that when subjects are freed from the kind of organizational constraints imposed by exposing only part of the information at once (a paragraph) in a particular form (name or attribute organization), that the name forms the easiest peg on which to hang the associated attribute as was suggested by Frase (1969).

SUMMARY

A 2x2x2 factorial design was employed to study the effects of grammatical position, organization of text, and college class level on recall of sentences. An additional group of subjects was asked to study a table which contained the "basic information" that was in the text. Sentence structure was manipulated as a within subject variable. A total of 80 subjects were used. Sentence structure had no effect on recall. The upper college level group of subjects recalled significantly more word pairs than the lower level group of subjects. The main effect for grammatical position was not significant, but the grammatical position variable figured in several interactions for the lower college level group of subjects. For the lower college class, the organization of recall was influenced by whether the materials, which served as the basis for organization, were presented in the subject or predicate of the sentences. Organization of the text also had a significant effect on the organization of recall.

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APPENDICES

Name-Predicate Condition

High mountains cover Columbia. The fall climate planet is Columbia. Three moons orbit Columbia. The fourth largest planet is Columbia. Orange surround Columbia. The iron rich planet is Columbia.

The second largest planet is Plymouth. The sodium rich planet is Plymouth. Wide plains cover Plymouth. Four moons orbit Plymouth. The summer climate planet is Plymouth. Yellow clouds surround Plymouth.

The variable climate palnet is Springfield. The sixth largest planet is Springfield. The zinc rich planet is Springfield. No clouds surround Springfield. Deep craters cover Springfield. One moon orbits Springfield.

The copper rich planet is Johnson. Barren derests cover Johnson. Red clouds surround Johnson. Six moons orbit Johnson. The largest planet is Johnson. The constant climate planet is Johnson.

Two moons orbits Rochester. Blue clouds surround Rochester. The winter climate planet is Rochester. Shallow lakes cover Rochester. The aluminium rich planet is Rochester. The third largest planet is Rochester.

Brown clouds surround Washington. No moon orbits Washington. The fifth largest planet is Washington. The nickel rich planet is Washington. The spring climate planet is Washington. Inactive volcanoes cover Washington.

Attribute-Subject Condition

The spring climate planet is Washington. The constant climate planet is Johnson. The fall climate planet is Columbia. The variable climate planet is Springfield. The summer climate planet is Plymouth. The winter climate planet is Rochester.

The third largest planet is Rochester. The sixth largest planet is Springfield. The fifth largest planet is Washington. The second largest planet is Plymouth. The fourth largest planet is Columbia. The largest planet is Johnson.

The zinc rich planet is Springfield. The aluminium rich planet is Rochester. The copper rich planet is Johnson. The iron rich planet is Columbia. The nickel rich planet is Washington. The sodium rich planet is Plymouth.

Orange clouds surround Columbia. Yellow clouds surround Plymouth. No clouds surround Springfield. Blue clouds surround Rochester. Red clouds surround Johnson. Brown clouds surround Washington.

Wide plains cover Plymouth. Inactive volcanoes cover Washington. Shallow lakes cover Rochester. Barren deserts cover Johnson. Deep craters cover Springfield. High mountains cover Columbia.

Six moons orbit Johnson. Three moons orbit Columbia. Four moons orbit Plymouth. Two moons orbit Rochester. No moon orbits Washington. One moon orbits Springfield.

Attribute-Predicate Condition

Washington is a spring climate planet. Johnson is a constant climate planet. Columbia is a fall climate planet. Springfield is a variable climate planet. Rochester is a summer climate planet. Rochester is a winter climate planet.

Rochester is the third largest planet. Springfield is the sixth largest planet. Washington is the fifth largest planet. Plymounth is the second largest planet. Columbia is the fourth largest planet. Johnson is the largest planet.

Springfield is a zinc rich planet. Rochester is an aluminium rich planet. Johnson is a copper rich planet. Columbia is an iron rich planet. Washington is a nickel rich planet. Plymouth is a sodium rich planet.

Columbia exhibits orange clouds. Plymouth exhibits yellow clouds. Springfield exhibits no clouds. Rochester exhibits blue clouds. Johnson exhibits red clouds. Washington exhibits brown clouds.

Plymouth features wide plains. Washington features inactive volcanoes. Rochester features shallow lakes. Johnson features barren deserts. Springfield features deep craters. Columbia features high mountains.

Johnson possesses six moons. Columbia possesses three moons. Plymouth possesses four moons. Rochester possesses two moons. Washington possesses no moon. Springfield possesses one moon.

Table Condition

Characteristics	Planets					
	Columbia	Plymouth	Springfield	Rochester	Johnson	Washington
Climate	fall	summer	variable	winter	constsnt	spring
Terrain	high mountains	wide plains	deep craters	shallow lakes	barren deserts	inactive volcanoes
Number of moons	3	4	1	2	6	0
Color of clouds	orange	yellow	no clouds	blue	red	brown
Mineral	iron	sodium	zinc	aluminium	copper	nickel
Size	fourth largest	second largest	sixth largest	third largest	the largest	fifth largest

APPENDIX B

Instructions

To Paragraph Conditions

You are going to be asked to read some paragraphs about a fictitious solar system. There is one paragraph on each page of the booklet. Once we have begun, do not turn to the next page until you are told to do so, even if you finish reading the paragraph. After you have read all the paragraphs, you will be asked to recall as much of the information about the solar system as you can. The larger booklet is the recall booklet in which you are to write everything you can remember. Write each sentence or part of a sentence that you remember on a separate line beginning with line one (1). If you use up all the lines on page one, continue on page two (2), but don't worry if you don't use page 2. You do not have to recall the sentences in the order you saw them, any order is fine. After the first study and recall trial, there will be a final study and recall trial. The procedure will be the same, and you will use pages 3 and 4 of the recall booklet.

To Table Condition

You are going to be presented with some information about a fictitous solar system in a table. You will have only one table to study so you should not pay any attention to the experimentor's directions to turn pages, just continue to study the table. When the study time is up you will be asked to recall as much of the information from the table as you can. The larger booklet is the recall booklet. Write each piece of information on a separate line beginning with line 1. If you use up all the lines on page one, continue on page 2, but don't worry if you don't use page 2. After the first study and recall trial, there will be a final study and recall trial. Once again you will have only one table and should not pay any attention to the experimentor's directions to turn pages. On the final recall trial use pages 3 and 4 in the recall booklet.

APPENDIX C

Raw Data

The number of sentences of each structural type attempted at recall. Trials 1 and 2 were combined. There were a possible 36 sentences for each structure type per condition per group.

Group GP

Condition AS		Condition NP		Condition NS		Condition AP	
Type A	Type B	Type A	Type B	Type C	Type D	Type C	Type D
8	7	24	19	29	27	26	27
17	17	28	27	15	15	15	15
16	23	21	13	24	27	27	28
21	20	22	16	25	23	26	24
29	34	21	25	16	16	34	28
10	10	29	28	21	22	19	15
11	12	17	18	19	21	14	10
12	16	13	6	20	12	15	14

Group HL

Condition AS		Condition NP		Condition NS		Condition AP	
Type A	Type B	Type A	Type B	Type C	Type D	Type C	Type D
20	16	29	30	28	26	28	27
25	19	30	30	32	28	28	33
23	24	26	26	27	32	36	36
25	24	5	11	25	21	35	36
28	24	27	33	32	25	9	10
31	29	24	36	26	33	12	30
24	23	6	7	34	36	36	31
24	26	34	26	24	36	25	23

The number of whole sentences recalled correctly.

There were a possible 36 sentences on each trial.

Group GP

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
0	2	0	0	1	11	11	24
3	4	6	8	5	27	0	1
4	10	4	8	5	12	0	5
8	12	0	0	2	13	3	16
0	0	9	8	0	18	6	6
8	13	3	0	3	10	1	0
1	0	11	20	1	7	6	6
8	16	0	0	1	4	0	1

Group HL

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 2	Trial 2
6	6	0	0	2	5	0	0
9	7	5	9	5	15	0	0
5	5	16	20	11	7	12	36
10	19	20	23	0	4	6	0
6	6	19	29	1	9	4	12
6	7	6	2	2	8	2	4
11	12	8	15	10	30	4	11
8	23	11	20	2	5	12	22

The number of word pairs recalled correctly. There were a possible 36 word pairs per trial.

Group GP

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
4	6	11	25	3	5	17	34
17	24	14	24	11	29	7	10
8	17	11	21	12	17	14	27
15	26	15	15	3	18	13	29
17	22	11	99	3	22	15	34
10	23	16	31	3	10	12	16
12	21	6	17	2	18	11	22
9	18	8	9	8	17	8	13

Condition T	
Trial 1	Trial 2
16	26
22	27
3	7
14	24
24	20
0	0
0	0
0	0

Group HL

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 1	Trial 1	Trial 2
34	36	3	7	18	24	13	19
15	17	10	17	7	15	0	2
19	31	16	22	23	24	23	36
18	33	23	23	4	10	29	36
15	26	19	31	1	12	27	35
13	23	5	34	2	13	7	12
16	22	12	22	22	36	11	15
23	23	17	27	3	6	22	24

Condition T	
Trial 1	Trial 2
12	20
19	18
9	12
30	33
24	36
26	34
23	30
28	36

Percentages of recall clustered by name.

Group GP

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
67%	56%	100%	0%	31%	0%	100%	72%
85	100	41	46	25	8	25	0
86	85	11	88	0	100	18	12
80	80	100	67	36	4	0	0
59	50	88	50	0	0	100	48
80	79	30	21	20	8	50	17
100	100	0	87	17	19	0	18
80	69	88	60	38	100	40	0

Condition T	
Trial 1	Trial 2
9%	5%
100	100
0	67
0	0
0	0
0	0
0	0
0	0

Group HL

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
0%	100%	75%	100%	27%	0%	13%	0%
87	100	67	74	0	0	0	0
100	93	50	75	0	0	5	0
86	89	100	100	33	17	0	0
42	14	88	80	0	13	0	0
31	45	62	93	4	0	20	0
33	63	36	8	0	0	0	4
0	0	57	92	0	100	8	0

Condition T	
Trial 1	Trial 2
83%	100%
84	93
100	100
100	100
100	100
22	90
78	68
82	56

Percentages of recall clustered by attribute.

Group GP

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
60%	33%	0%	95%	0%	20%	38%	100%
16	0	24	23	50	100	67	0
17	0	43	20	27	100	43	77
22	0	0	48	60	100	67	85
41	35	19	100	100	100	95	100
11	11	17	66	84	86	67	62
8	6	57	6	100	91	100	82
25	15	0	0	50	85	29	9

Condition T	
Trial 1	Trial 2
92%	100%
0	0
94	84
100	100
94	100
100	100
100	100

Group HL

Condition NS		Condition NP		Condition AS		Condition AP	
Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
100%	0%	44%	31%	82%	92%	100%	100%
17	0	29	17	88	90	95	100
6	0	47	25	100	100	100	100
10	4	11	6	86	92	100	100
32	66	20	4	0	67	100	100
47	21	15	0	89	100	100	100
57	29	27	83	100	100	88	83
100	100	29	13	67	0	92	100

Condition T	
Trial 1	Trial 2
9%	0%
100	7
0	0
0	0
0	0
83	17
0	7
17	16

Number of name-attribute (N-A) pairs and attribute-name (A-N) pairs recalled correctly. The total number of names recalled first in pairs and singly, and the total number of attributes recalled first in the pairs and singly.

Group GP
Condition NS

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names First	A-N Pairs	Attributes First
12	18	0	0	21	22	0	0
10	14	0	0	23	25	0	0
4	6	0	0	6	12	0	0
17	22	0	0	22	29	0	0
15	20	0	0	26	26	0	0
8	11	0	0	17	19	0	0
17	25	0	0	24	36	0	0
9	14	0	0	18	19	0	0

Condition AP

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names Fisrt	A-N Pairs	Attributes First
17	18	0	0	34	34	0	0
7	12	0	0	10	18	0	0
14	19	0	0	27	36	0	0
13	17	0	0	29	34	0	0
15	21	0	0	34	36	0	0
12	15	0	0	16	19	0	0
11	11	0	0	22	24	0	0
8	12	0	0	13	17	0	0

Condition AS

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names First	A-N Pairs	Attributes First
2	3	1	2	4	6	1	4
0	1	8	10	0	0	12	17
3	6	0	22	6	6	18	29
0	0	3	17	0	0	18	24
0	4	2	3	3	11	5	5
5	8	7	10	3	3	14	20
0	3	3	10	0	0	10	11
11	13	0	0	7	7	22	23

Condition NP

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names First	A-N Pairs	Attributes First
0	0	11	22	0	0	9	24
8	12	7	8	15	21	0	0
5	6	6	7	3	3	18	18
14	23	0	0	24	32	0	0
6	10	5	10	25	25	0	0
8	15	0	0	9	13	0	0
5	7	1	6	12	19	2	3
16	26	0	0	31	35	0	0

Group HL

Condition NS

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names First	A-N Pairs	Attributes First
34	36	0	0	36	36	0	0
15	19	0	0	17	31	0	0
29	21	0	0	31	33	0	0
18	27	0	0	33	33	0	0
15	24	0	0	26	35	0	0
13	21	0	0	23	25	0	0
16	21	0	0	22	25	0	0
23	29	0	0	23	30	0	0

Condition AP

Trial 1				Trial 2			
N-A	Names	A-N	Attributes	N-A	Names	A-N	Attributes
13	22	0	0	19	25	0	0
0	4	0	0	2	6	0	0
23	25	0	0	36	36	0	0
29	36	0	0	36	36	0	0
27	35	0	0	35	36	0	0
7	7	0	0	12	12	0	0
11	20	0	0	15	30	0	0
22	29	0	0	34	36	0	0

Condition AS

Trial 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names Frist	A-N Pairs	Attributes First
0	0	22	24	0	0	36	36
0	0	7	23	0	0	15	36
13	23	5	5	24	28	0	0
0	3	3	4	3	3	3	3
0	5	2	27	0	0	13	28
1	2	0	0	5	5	7	7
1	3	3	18	1	1	9	31
20	20	4	4	34	36	0	0

Condition NP

Trail 1				Trial 2			
N-A Pairs	Names First	A-N Pairs	Attributes First	N-A Pairs	Names First	A-N Pairs	Attributes First
0	0	16	21	0	0	22	26
0	0	23	25	0	0	23	24
0	0	19	21	0	0	31	31
0	0	12	16	0	0	22	31
6	6	11	14	2	3	24	27
3	7	0	0	7	13	0	0
3	3	7	14	9	14	8	12
8	11	7	12	34	34	0	0