IMAGERY IN ASSOCIATIVE LEARNING AND MEMORY

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ABSTRACT

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Recent research has indicated that mnemonic systems based on a series of cues or "pegs" can produce marked facilitation in the recall of an unrelated response list. Earlier studies have employed either a well-memorized peg list or an unfamiliar peg list presented on both learning and recall trials. The present study was conducted to test the hypothesis that picture pegs presented only on the learning trial of a response list could facilitate the subsequent recall of the response words. The Ss presented pictures during learning were expected to "recall" or "imagine" the pictures during the recall trial and then use the pictures as cues for the recall of response words. A further hypothesis was that the arrangement of pictures would influence the ease with which they could be recalled. That is, pictures presented in a "meaningful" arrangement should be easier to recall than pictures presented in a random arrangement. It was assumed that better recall of cues would in turn result in better recall of the response words.

The results of Exp. I indicated that picture cues presented only during the learning trial could serve as effective cues for the recall of a concrete word list.

However, arrangement (organization) had no significant effect on performance. Word cues presented only at learning were ineffective in facilitating recall. The results of Exp. II indicated that the organization of picture cues influenced the number of cues recalled. This finding suggests that while organizing picture cues into a "meaningful" arrangement may increase the number of cues recalled, the availability of additional cues does not necessarily result in better response word recall. In Exp. III an attempt was made to determine whether the effectiveness of picture cues presented only at learning was independent of the abstractness of the response words. The picture cues facilitated the recall of concrete words but no facilitation was obtained for an abstract list.

The superiority of picture cues over word cues is attributed to two factors. Pictures are more easily recalled than words, and "picturability" or imagery facilitates the formation of associations. However, it is not clear why imagery facilitates recall or associative learning.

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INTRODUCTION

Recent research has indicated that non-verbal imagery may play an important mnemonic role in associative learning. Paivio (1963, 1965, 1969) has suggested that the image-arousing potential of words may be an important stimulus variable in paired-associate (P-A) learning, independent of instructions to make use of imagery. He hypothesized that a stimulus with a high image-arousing capacity, for example, a concrete noun, serves as a "conceptual peg" to which a response term may be linked during P-A learning. The response word may be retrieved by means of a mediating image when the stimulus is presented on the recall trial. The hypothesis leads to the prediction that word concreteness should facilitate P-A learning with this effect being greater on the stimulus side than on the response side of P-A pairs. This prediction has been confirmed (Paivio, 1965, 1967; Paivio and Yuille, 1966; Yarmey and Paivio, 1965).

Other studies have indicated that imagery is a better predictor of P-A learning than other word variables. Paivio, Yuille, and Smythe (1966) in comparing the influence of imagery, concreteness, and meaningfulness (m) on P-A learning found that stimulus imagery facilitated learning even

when concreteness and meaningfulness were held constant. Paivio (1968a) found that rated imagery was a better predictor of P-A learning than a large number of other word attributes such as meaningfulness, familiarity, and specificity.

Recently mnemonic systems which involve the use of imagery have undergone experimental investigation. The memory-training techniques which have received greatest attention are those based on the formation of associations between a well-learned series of words, or "pegs", and the set of response items to be remembered. The peg list often takes the form of a numerical rhyme such as "one is a bun, two is a shoe, three is a tree, etc." Once the peg list has been memorized, new words can be memorized by using imagery to link the new words with the peg words. At some later time, the peg words presumably will mediate recall of the response words by eliciting the images previously formed. Wood (1967a) found that when Ss were given an additional word list (peg list) on both learning and recall trials and instructed to make associations, during the learning trial, between the peg list and the response list, recall of the response words was greatly facilitated. Bugelski, Kidd, and Segmen (1968) had Ss memorize ten words which rhymed with the numerals one to ten. Ss who were instructed to use the numerical rhyme as a mnemonic device performed significantly better than Ss taught the rhyme but not its mnemonic function. Paivio (1968b) in

investigating both the nature of the peg list and instructions concerning its use had Ss learn a numerical rhyme consisting either of abstract nouns or concrete nouns. He found that both the abstract (e.g., one-fun) and concrete (e.g., one-bun) peg list facilitated recall if Ss were instructed to use images in linking the response words to the peg words. On the basis of these results Paivio argued that imagery instructions were an important component of the mnemonic technique. Yet there is some question about the appropriateness of Paivio's control groups. Comparisons were made between groups instructed to use images in linking response words to peg words and groups simply told to repeat each response word after the appropriate peg word. The study did not include a group which was told to link the response words to the peg words without reference to imagery.

Experimental investigations of mnemonic systems based on a series of cues or "pegs" have consistently utilized verbal cues even though Ss have almost always been instructed to transform the verbal cues to images of objects before employing them. If imagery does play an important mediational function, as some research seems to indicate, then pictures which presumably evoke images directly should be particularly effective cues. A number of studies have demonstrated the superiority of pictures over words in P-A learning (e.g., Dominowski and Gadlin, 1968; Epstein, Rock, and Zuckerman, 1960; Paivio and Yarmey, 1966). Free recall

has also been found to be higher for objects or pictures than for their labels (e.g., Liebermann and Culpepper, 1965; Paivio, Rogers, and Smythe, 1968).

Earlier studies (Crouse, 1968; Tulving and Osler, 1968; Wood, 1967b) investigating the use of verbal cues in free recall have indicated that the presence of a cue during learning has no effect unless the cue is presented at recall. That is, word cues presented only during the learning trial have no effect. However, no attempt has been made to investigate whether a group which receives picture cues on the learning trial and no cues at recall will have higher performance than a group which does not receive any cues. It seems plausible that pictures presented only on the study trial could facilitate learning provided Ss are instructed to link the response words to the pictures. On the test trial the pictures, being easier to recall than the words, should mediate recall of the response list. Of course, the picture cues must be readily available if they are to facilitate learning. The recall of pictures may be affected by their arrangement or "organization." Reynolds (1966, 1968) found that prefamiliarization of verbal items embedded in an integrated pictorial map produced positive transfer to the learning of simple sentences. The simple sentences contained the verbal items as well as factual material closely related to the previously-studied map. Since prefamiliarization with an integrated structure produced greater transfer to sentence learning than did

prefamiliarization with the same map which had been fragmented into separate and discrete pictures, it was concluded that "cognitive organization" may facilitate verbal learning. Although Reynolds did not specify what he meant by "cognitive organization," his results can be explained on the basis that an integrated group of pictures is easier to recall than the same pictures presented in a random arrangement. If the pictures serve as cues for the recall of response words, facilitating recall of the pictures should facilitate recall of the response words. It seems reasonable, moreover, that the importance of the "structure" or arrangement of the picture cues would be relative to the number of cues utilized. That is, the arrangement of a small number of cues should be insignificant; one should be able to recall them regardless of their "structure." Yet arrangement should have a significant effect with a relatively large number of cues.

A pilot study was designed to test whether the nature and number of cues influenced recall when the cues were only presented for the learning trial. The nature of the cues (words, organized pictures, unorganized pictures) and the number of cues (8, 16, 32) were factorially manipulated. The cues were presented for the study trial and Ss were instructed to use imagery to link the 32 response words to the cues. A control group received standard free recall instructions and no cues. No cues were presented on the

test trial. Although groups presented word cues did not differ significantly from the control group given standard free recall instructions, groups presented pictures as cues did significantly better than the control group. Thus when pictures are used as cues during the learning trial, but not at recall, recall is facilitated. However, when words are used as cues, recall is not facilitated if the cues are present only on the learning trial. The arrangement or organization of picture cues also had a significant effect on performance with recall for groups presented the picture cues in a meaningful arrangement being higher than the recall for groups presented the pictures in a random arrangement. Varying the number of cues had no significant effect on performance. The failure to obtain an interaction between number of cues and the nature of the cues was unexpected since it had been predicted that the arrangement of cues would have a significant effect only when a fairly large number of cues were provided. However, arrangement of the cues was apparently just as important for Ss given eight cues as for Ss receiving 16 or 32 cues. It is possible, of course, that Ss given 16 or 32 cues only used about eight cues. In any case, picture cues were superior to word cues and the arrangement of picture cues had a significant effect.

EXPERIMENT I

This experiment was a replication and extension of the pilot study. One could argue that the superiority of groups given picture cues over groups given word cues may be due, in part, to the positioning of the pictures. That is, the presentation of the pictures in various positions on a single sheet of paper allowed for the use of position as a cue. To evaluate this interpretation for the superiority of pictures over words, word cues were presented to one group in the same relative positions that pictures occupied for other groups.

A plausible explanation for the superiority of groups given pictures over groups given word cues is that the pictures were more easily recalled than the word cues and thus were available as cues for mediating recall of the response list. The word groups probably had more difficulty in recalling the peg words and consequently their performance was not significantly different from that of the control group. A parallel explanation for the superiority of groups presented pictures in a meaningful arrangement over groups presented the pictures in a random arrangement is that the former were better able to recall the picture cues. To evaluate this interpretation the nature of recall

was manipulated in Exp. I by providing some groups with cues on both learning and recall trials while other groups were provided cues only on the learning trial. The prediction was that word cues would facilitate performance only when presented on both learning and recall trials. A further prediction was that the arrangement of pictures would affect performance only if the cues were not presented at recall. Manipulating cuing at recall also allowed a comparison to be made between the effectiveness of word cues and picture cues when both were presented at recall. Earlier studies (e.g., Dominowski and Gadlin, 1968) have indicated that pictures are more effective stimuli than words.

Method

Design.--Two groups were presented 32 picture cues. One group was given them in a "meaningful" arrangement (organized picture group), and the second group received the pictures in a random arrangement (unorganized picture group). A third group received 32 word cues. The cues were presented in the same relative positions that the pictures occupied in the organized picture group.

A second variable was the nature of recall. Half of the Ss in each of the above groups received the cues during both the learning and recall of the response list, while the remaining Ss received the same cues only during the learning trial. The design was a 3 X 2 factorial with

an additional control group receiving standard free recall instructions.

Materials.--Three sets of cues were utilized with each set consisting of 32 items presented on a 12" X 18" sheet of paper. One set was composed of 32 colored pictures presented in a meaningful arrangement. The pictures used and their arrangement were based on materials used by Reynolds (1966, 1968). When meaningfully arranged the pictures depicted a small village and included a gas station, shopping center, farm, church, truck, bus, mountains, tree, etc. A second list of cues consisted of the identical pictures presented in a random arrangement. The third set of cues consisted of 32 words in the same relative positions that the 32 arranged pictures occupied. The word cues were the labels for the 32 pictures.

A response list of 32 words was used. The response words were selected from the Paivio, Yuille, and Madigan (1968) norms and had concreteness values ranging from 6.38 to 7.00 with a mean rating of 6.86.

Procedure.--The Ss were 98 students from introductory psychology courses at Michigan State University. Fourteen Ss were randomly assigned to each of seven groups. All Ss were run individually and were given general information about the experiment such as the nature and number of words to be recalled and the rate at which the words would be presented. The six groups receiving cues were given instructions concerning their use, that is, they were told

to link the response words with the cues through imagery. Ss were told that they would be required to recall only the response words and not the cues. Ss were also informed about the nature of recall. That is, Ss cued only during learning were told that the cues would be removed prior to recall, and Ss cued both during learning and recall were informed that the cues would be presented during recall.

The response words were read at a 5-sec. rate. Following the presentation of the response list, Ss had as much time as they wanted to write down as many of the response words as they could recall.

Results and Discussion

The mean number of words correctly recalled for the six experimental groups is presented in Table 1. An examination of the table indicates that picture groups were superior to the corresponding word group and groups presented cues at both learning and recall tend to do better than groups presented the cues only at learning. A 3 X 2 analysis of variance indicated that both the nature of the cues, F (2, 78) = 5.06, $p < .01$, and the presence of cues during recall, F (1, 78) = 6.93, $p < .05$, were significant. However, neither the interaction between the main effects, F (2, 78) = 1.57, $p > .05$, nor an orthogonal comparison between the organized and unorganized picture conditions was significant, $F < 1$.

The failure to find a significant difference between the organized and unorganized picture conditions or a

Table 1. Mean Scores for the Six Experimental Groups of Experiment I

Nature of Recall	Nature of Cues		
	Words	Unorganized pictures	Organized pictures
No cues			
M	13.36	17.50	18.36
SD	3.64	3.50	3.39
Cues			
M	17,79	19.57	18.93
SD	5.60	4.27	2.69

significant interaction between the nature of cues and their presence at recall was unexpected. It was predicted that the arrangement of picture cues would affect performance when the cues were presented only at learning. This prediction was based on the assumption that picture cues presented in a meaningful arrangement should be easier to recall than pictures presented in a random arrangement. Better recall of cues should in turn facilitate recall of the response list. However, when picture cues were presented both at learning and recall, arrangement of cues should have no effect on performance since the cues would be readily available regardless of arrangement during the study trial. It is possible that the hypothesis of organized pictures being easier to recall than unorganized pictures is wrong. If this is the case, no difference between an organized and unorganized picture group would be expected even when cues are presented only at learning. However, it seems more likely that, while organized pictures may have been better recalled than unorganized pictures, the availability of additional cues did not result in better recall of the response list. The results of the pilot study gave some support to this interpretation in that eight pictures were as effective as 32 pictures in facilitating recall of the response list.

An orthogonal comparison between the average of the picture conditions and the word condition was significant, F (1, 78) = 10.10, $p < .01$. Previous research has indicated

a superiority of pictures over words both in free recall (e.g., Paivio, Rogers, and Smythe, 1968) and P-A learning (e.g., Dominowski and Gadlin, 1968). On the basis of these earlier findings it seems plausible that two factors may have contributed to the superiority of pictures over words in the present study. The first is that the picture cues may have been better recalled than the word cues. The availability of additional cues may have led to better recall of the response list for the picture groups when cues were only presented during the learning trial. However, it is also likely that associations were more readily formed between the picture cues and the response list. That is, pictures are "better" cues than words.

The mean number of correct responses for the control group was 13.14. Although there was no significant difference between the control group and the experimental group presented word cues only during learning, $F < 1$, the performance of the unorganized picture group presented picture cues only at learning was significantly better than that of the control group, $F\ (1, 91) = 7.76$, $p < .01$. Since the mean scores for the four remaining experimental groups are higher than that of the unorganized picture group presented cues only at learning, it may be concluded that the performance of each picture group and the word group presented cues during learning and recall is significantly better than that of the control group.

Both the pilot study and the present experiment clearly indicate that picture cues presented only during learning of a response list can facilitate recall. However, word cues presented only during learning are ineffective in facilitating recall. Word cues presented during both learning and recall trials did facilitate recall of the response list. The fact that word cues facilitated performance only when they were presented both at learning and recall is consistent with earlier investigations (e.g., Crouse, 1968; Tulving and Osler, 1968; Wood, 1967b) in which the presence of verbal cues at learning and recall was manipulated.

EXPERIMENT II

Both the results of the pilot study and Exp. I indicated a superiority of pictures over words in mediating recall of a response list. An unexpected finding of Exp. I was that unorganized pictures were as effective as organized pictures in mediating recall of the response list when the cues were presented only at learning. It had been predicted that if picture cues were presented only at learning, the recall of groups presented the pictures in a meaningful arrangement should be superior to the recall of groups presented the pictures in a random arrangement. The prediction was based on the assumption that organized picture cues should be easier to recall than unorganized picture cues. It was further assumed that the availability of additional cues should result in greater response word recall. However, in Exp. I recall of the response list by the group presented the picture cues in a meaningful arrangement was not significantly higher than recall by the group presented the pictures in a random arrangement. On the basis of this finding one could question the hypothesis that pictures are easier to recall when they are presented in a meaningful structure. This experiment was designed to test that hypothesis directly, and thereby clarify the failure to find an

effect due to organization in Exp. I. If organization does have an effect on the number of pictures recalled, it may be concluded that the availability of additional cues does not necessarily result in better recall of a response list.

Method

One group was presented 32 pictures in a meaningful arrangement, and a second group received the same pictures in a random arrangement. A third group was presented 32 words consisting of the names of the 32 pictures. The word cues were presented in the same relative positions that the pictures occupied in the organized picture group.

The materials utilized were the three sets of cues from Exp. I. The only difference was that in this experiment the names of the 32 pictures were printed next to the appropriate objects. The Ss were 48 students from introductory psychology courses at Michigan State University. Sixteen Ss were randomly assigned to each of the three groups. All Ss were run individually and were given free recall instructions. The pictures or words were presented for 30 sec. Following presentation each S was instructed to write down as many words, or in the case of pictures, as many labels as he could recall. Ss had as much time as they wanted for recall.

Results and Discussion

The mean number of correct responses was 15.19, 11.44, and 9.00 for the organized picture, unorganized picture, and word groups, respectively. An orthogonal comparison

between the organized and unorganized picture groups was significant, F (1, 45) = 13.04, $p < .01$, indicating that pictures presented in a meaningful arrangement are more easily recalled than pictures presented in a random arrangement. An orthogonal comparison between the average of the picture groups and word group was also significant, F (1, 45) = 22.98, $p < .01$, indicating that pictures are more readily recalled than words. This is consistent with earlier studies (Liebermann and Culpepper, 1965; Paivio, Rogers, and Smythe, 1968), which have found recall to be higher for objects or pictures than for their labels.

That meaningfully arranged pictures are more easily recalled than randomly arranged pictures is consistent with other studies (e.g., Earhard, 1967; Tulving, 1962, 1964) in which the relationship of organization to recall has been investigated. Earlier studies, however, have utilized verbal items as materials with organization being experimentally manipulated through presentation order (e.g., Earhard, 1967; Tulving, 1965). The present experiment extends the investigation of the relationship between organization and recall to pictures with organization being manipulated through picture arrangement rather than presentation order.

EXPERIMENT III

In Exp. I and II as well as in the pilot study, only concrete nouns were used as response words. In this experiment an attempt was made to determine whether pictures presented only during learning could facilitate the recall of abstract nouns.

Method

Design and materials.--A 2 X 2 factorial was utilized in which cuing (picture cues or no cues), and nature of response list (concrete or abstract words), were manipulated. The 32 grouped pictures utilized in Exp. I were the only cues used in this experiment. Two response lists of 32 words each were composed of words drawn from the Paivio, Yuille, and Madigan (1968) norms. The concrete list contained words having a mean concreteness value of 6.82. The range in values was from 6.25 to 7.00. The concreteness values of the words in the abstract list ranged from 1.18 to 1.94, having a mean value of 1.69.

Procedure.--The procedure was similar to that of Exp. I. However, in this experiment nature of recall was not manipulated, that is, all Ss receiving cues received them only at learning. Presentation time was 5 sec. per item. Fifty-six students from introductory psychology courses

served as Ss and were randomly assigned to the four conditions with 14 Ss serving in each condition.

Results and Discussion

The mean number of words correctly recalled was 19.57, 15.21, 12.64, and 13.50 for the cued concrete, concrete control, cued abstract, and abstract control groups respectively. An analysis of variance on these data indicated that the nature of the response list significantly influenced performance, F (1, 52) = 6.08, $p < .05$, but that cuing did not, F (1, 52) = 2.74, $p > .05$. The most important result of this experiment, however, was the significant interaction between response list and cuing, F (1, 52) = 6.07, $p < .05$. This finding indicates that the effectiveness of picture cues in facilitating recall is dependent on the nature of the items being recalled. That is, while picture cues presented only at learning can improve recall of concrete nouns, they are clearly not effective in facilitating the single trial free recall of abstract nouns.

An important implication of the finding is that the effectiveness of a peg-list technique is dependent on the formation of strong associations between the cues or "pegs" and the response words. Recall of the "pegs" can be expected to facilitate recall of a response list only if strong associations have been previously formed between the "pegs" and the response words. In this experiment Ss probably had difficulty in forming associations between pictures and abstract words with only one study trial.

Perhaps with additional practice, Ss would be able to establish stronger associations and thus utilize the picture cues effectively.

The finding that recall is higher for concrete nouns than for abstract nouns is consistent with earlier findings (Dukes and Bastian, 1966; Winnick and Kressel, 1965). Again the greater image-arousing capacity of concrete nouns may, in part, account for their higher recall. Paivio (1967) as well as Tulving, McNulty, and Ozier (1965) have reported better recall for nouns rated high on imagery than for nouns rated low on imagery. Paivio, Yuille, and Rogers (1969) demonstrated further that noun I is more effective than m in free recall when the two attribute are varied over an equivalent range.

SUMMARY AND GENERAL DISCUSSION

The results of Exp. I indicated that pictures presented only during the learning trial can serve as effective cues for the recall of a concrete word list. The arrangement of picture cues had no significant effect on performance and word cues presented only at learning were ineffective in facilitating recall. The major finding of Exp. II was that the organization of picture cues influenced the number of cues recalled. The results also confirmed earlier studies which have found that free recall is higher for pictures than for words. The results of Exp. III indicated that while picture cues presented only at learning can facilitate recall of a concrete word list, they are ineffective in facilitating the single trial free recall of an abstract list.

The fact that pictures mediated recall better than words when the cues were presented only at learning was partially attributed to better recall of pictures. Yet, it is not clear why pictures are easier to recall than words. Tulving, McNulty, and Ozier (1965) have suggested that picturability may influence the ease with which items are grouped into higher order memory units. Tulving et al. found vivid words were not only recalled better than less

vivid words but were also organized to a greater extent than the less vivid words. Scott (1967) also reported higher clustering scores for objects than for words. However, Paivio, Rogers, and Smythe (1968) found that better recall of pictures could not be accounted for in terms of subjective organization. Thus the organization hypothesis is still open to question.

It is likely that picturability or imagery also facilitated the formation of associations between the cues and the response words. This view is supported by the fact that Ss given picture cues tended to be superior to Ss given word cues even when cues were presented at recall. Paivio's conceptual peg hypothesis implies that the superiority of pictures over words in associative learning is due to mediating imagery, that is, pictures evoke images directly which mediate the formation of associations. However, several investigators (Dominowski and Gadlin, 1968; Paivio, 1965, 1969; Wimer and Lambert, 1959) have suggested an alternative explanation, namely that imagery or picturability facilitates item differentiation. With greater differentiation among stimuli, intralist interference is reduced and learning is facilitated. Wimer and Lambert (1959) found some support for the differentiation hypothesis in that there seemed to be less meaningful similarity, as indicated by semantic differential ratings, among objects than among object names. However, Paivio (1965) using associative overlap, that is, the number of

associates which words have in common, as an index of distinctiveness found no support for the differentiation hypothesis. Further research may clarify the question of whether imagery primarily facilitates mediation or item differentiation.

Organization of the picture cues had no effect on performance in Exp. I. Unorganized picture cues seemed to be as effective as organized pictures in facilitating recall of a response list. The results of Exp. II indicated, however, that organized pictures were recalled better than unorganized pictures. This suggests that while organization influences the number of cues recalled, the availability of additional cues does not necessarily result in better response word recall. Perhaps Ss are able to use a small number of picture cues as effectively as a larger number. The number of cues Ss used in the present study cannot be determined. Research in which the number of cues is manipulated may clarify what is the optimal number of cues for facilitating recall of a response list.

The present study confirms and extends earlier studies (Bugelski, Kidd, and Segmen, 1968; Paivio, 1968b; Wood, 1967a) which have indicated that mnemonic systems based on a series of cues or pegs can produce marked facilitation in the recall of a response list. Previous studies have either employed a well-memorized peg list (Bugelski et al., 1968; Paivio, 1968b) or an unfamiliar peg list presented on both learning and recall trials (Wood, 1967a).

The present study indicates that a peg list consisting of pictures presented only at learning can also facilitate recall. The finding suggests that time and effort need not be invested in memorizing a peg list prior to its use. Simply presenting pictures as cues on the learning trial can facilitate the subsequent recall of concrete response words.

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APPENDIX

NUMBER CORRECT FOR EACH SUBJECT IN EXPERIMENT I

Organized pictures at learning only	Unorganized pictures at learning only	Words at learning only
19	17	8
15	17	14
23	23	10
15	23	13
21	21	13
21	13	19
20	15	16
24	15	15
15	19	17
17	13	16
15	16	9
22	22	16
13	18	15
17	13	6

Organized pictures at recall	Unorganized pictures at recall	Words at recall
18	10	18
19	18	14
13	25	8
19	19	22
16	24	19
24	23	17
19	14	24
21	23	21
19	18	29
19	25	7
17	20	19
22	16	16
22	17	15
17	22	20

Control
12
11
17
16
16
21
15
7
12
7
8
11
19
12

NUMBER CORRECT FOR EACH SUBJECT IN EXPERIMENT II

Organized pictures	Unorganized pictures	Words
14	12	9
21	14	12
17	14	8
14	13	10
12	9	9
16	13	7
6	16	13
13	13	9
16	10	5
13	11	11
15	9	12
22	9	8
19	11	6
13	9	8
19	11	6
13	9	11

NUMBER CORRECT FOR EACH SUBJECT IN EXPERIMENT III

Concrete control	Concrete cued	Abstract control	Abstract cued
15	19	14	10
22	17	14	16
15	22	16	17
12	31	8	16
18	18	14	11
19	21	9	15
14	17	11	14
22	15	17	14
13	15	11	5
13	23	11	14
14	21	25	8
7	18	12	15
17	18	12	11
12	19	15	11