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Title: THE EFFECTS OF COGNITIVE TRANSFORMATION, SIZE, QUANTITY, AND MOVEMENT ON FREE RECALL

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Two experiments using one hundred and eighty-eight male and female college students studied the effects of cognitive transformation, size, quantity, and movement on free recall. In Experiment 1, (n=108) subjects were asked to imagine forty nouns in the form of pictures or words, one half of normal size, normal size, or two times normal size, and either in a stationary or moving position. Significantly more items were recalled when they were normal sized and imagined in the form of pictures. An interaction between the form of cognitive transformation and movement was found to be statistically significant.

In Experiment 2, (n=80) the subjects were asked to imagine the same forty nouns in the form of pictures or words, quantities of one or two, and in normal size or normal size expanding to two times normal size. In this experiment, none of the variables resulted in differences

in free recall. The explanation offered for this lack of significance is that the combination of various mental activities produced a debilitating effect on free recall.

THE EFFECTS OF COGNITIVE TRANSFORMATION, SIZE, QUANTITY, AND MOVEMENT ON FREE RECALL

A Thesis

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by

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CHAPTER 1

INTRODUCTION

This chapter has been devoted to information concerning factors which affect memory. In this study, four factors were manipulated: the cognitive transformation of auditorily presented nouns into the forms of pictures or words, the size of the imagined stimulus, the quantity of the imagined stimulus, and movement on free recall. The statements of the problem, the purpose, and the null hypotheses have also been discussed. The limitations placed on this study by uncontrolled variables as well as terms unique to this study seen as needing further clarification have been defined and included in this chapter.

Theoretical Formulation

The cognitive complexity of man has long been an area of exploration. One of the most recent areas of exploration has been that of memory, or more specifically, free recall.

Numerous studies have searched for the variables which influence free recall. For example, in a study conducted by Yuille and Paivio (1967), the results

supported the hypothesis that an association with a specific object or event facilitated the recall of the presented stimuli. A study conducted by Kaplan, Kaplan and Sampson (1968), reported that more items are recalled when pictures, rather than their equivalent word forms, are presented as stimuli. The explanation for this finding maintains that pictures evoke both verbal and figural encoding, but words evoke only verbal encoding. This has been called the double-encoding hypothesis.

As was pointed out by Joseph and Joseph (1980), it has been found that the presentation of pictures alone does not always lead to superior recall. The manner of presentation, the form of recall, the number of stimuli presentations, and even the instructions are crucial variables which may interact to influence the number of recalled stumuli when words and pictures are presented.

The results of a study conducted by Paivio and Csapo (1973), indicated that pictures were remembered best in free recall and recognition, followed by concrete words, with abstract words being least remembered.

Exploring other variables that have an effect on free recall, Joseph and Joseph (1980), found that no

significant difference in the number of recalled nouns occured when the subjects imagined rather than drew or printed the nouns. However, it was found that the manner of recall was a variable affecting memory. Printing the noun resulted in more items being recalled than recalling by drawing a picture of the noun.

In an extension of the Joseph and Joseph (1980) study, Joseph and Cowan (Note 1), manipulated types of stimuli, levels of concreteness, and manner of presentation. The findings of this study revealed that there were no significant differences, in free recall of the stimuli, between the presentation of nouns through auditory and visual means. There were also no significant differences between the levels of response concreteness on free recall. However, the data did support the previous findings that pictures are recalled better than words.

THE PROBLEM

Do various mental and imaginery activities affect the amount the individual is able to freely recall?

Statements of the Problem

Is there a significant difference in the recall of nouns as a result of cognitively transforming

auditorily presented nouns into words and pictures; as a result of the size of the imagined stimuli; as a result of the movement of the imagined stimuli; as a result of the quantity of the imagined stimuli; or as a result of an interaction of the above cited variables?

Statements of the Hypotheses

(Null Form)

There is no significant difference in the number of correctly recalled nouns as a result of the cognitive transformation of auditory stimuli into words or pictures; as a result of the size of the imagined stimuli being one-half of normal, normal or two times normal; as a result of the movement of the imagined stimuli being either stationary or moving; as a result of the quantity of the imagined stimuli being one or two; or as a result of an interaction of the above cited variables.

Purpose of the Study

The purpose of this study was to explore variables which influence free recall, to substantiate aspects of previous studies, and to provide information which may aid in the further understanding of the memory process. The study was also used to help gain more insight as to what factors merit further study.

Significance of the Study

Each time a study or particular aspect of a study is replicated and the results tend to follow those past studies, more credence and acknowledgement may be given to those factors. This study is in part, a replication and extension of previously conducted research in the area of free recall. The factors being replicated were the cognitive transformation of auditory stimuli into words and pictures and the size of the imagined stimuli. The new areas of exploration were the quantities and movement of the imagined stimuli. It was felt that the manipulation of these variables might add a further dimension to the understanding of the memory process.

DEFINITION OF TERMS

Definitions unique to this area of exploration are listed below.

Cognitive Transformation

The stimuli (nouns) were presented auditorily through the use of a tape recorder. The cognitive transformation required was to transform the auditory stimuli into the forms of printed words or pictures. The subjects were given written instructions on how to transform the stimuli.

Free Recall

Free recall is the ability of the subject to actively reproduce the presented stimuli without support from any re-exposure to the material.

Size of the Imagined Stimuli

Three levels of size of the imagined stimuli were investigated. Level one was one half the normal size; level two was of normal size; and level three was two times normal size.

Quantity of the Imagined Stimuli

Two levels of quantity of the imagined stimuli were investigated. Level one was that of a quantity of one with level two being of a quantity of two.

Imagery

Imagery is defined as forming a mental picture of the stimulus items.

Movement

Movement is defined as seeing, through imagery, the noun in either a moving or stationary position.

LIMITATIONS OF THE STUDY

The study was limited to volunteer undergraduate students at Emporia State University. From this group of volunteer students, treatment groups were randomly formed (n=9, Experiment 1; n=10, Experiment 2).

With the use of college students as the only subjects, an uncontrolable variable must be noted. As a whole, college students are more experienced with the necessity of correct immediate recall due to extensive studying and preparing for examinations. Therefore, the performance of these subjects may be slightly higher than would be expected in a stratified sampling population of subjects. Any attempt to generalize from the conclusions of this study must duely recognize this variable.

SUMMARY

A most recent area of exploration of man's cognitive abilities has been that of free recall. Evidence has been found to support the hypothesis that an association with a specific object or event facilitated the recall of the presented stimuli. Evidence was also found which supports a dual encoding hypothesis which suggests

that pictures are recalled more than the equivalent word form. The explanation offered is that pictures evoke both verbal and figural encoding, whereas words evoke only verbal encoding. However, many other factors are crucial to the recall process. The manner of presentation, the amount of stimulus presentation, and even the instructions are crucial variables which may interact to influence the number of recalled stimuli.

CHAPTER 2

REVIEW OF RELATED LITERATURE

This chapter presents a review and summary of literature related to free recall. Consideration is also given to the major variables involved in this study as well as including information related to the general theory of the memory process.

PRESENTATION OF STIMULI

It was found by Paivio and Csapo (1969) that the manner of stimulus presentation affects the free recall of the material. The stimuli used in Experiments 1 and 2 were presented auditorily through the use of a tape recorder. The stimuli were presented in this manner because the effects of simple transformation (absence of mnemonic devices) of auditory stimuli on free recall is a neglected area of exploration (Joseph and Joseph, 1980). Although recent studies (Laughery and Penkus, 1966; Craik, 1969) have shown that auditory presentation of stimuli is superior to visual presentation, Joseph and Joseph (1980) found no significant difference between free recall and visual or auditory presentation

of stimuli. More investigation is warrented in this area.

IMAGERY

The aspect of imagery and its effect upon free recall is one of the more researched areas in the study of memory. Since the subjects in this study were asked to imagine the stimuli in various forms, the use of imagery deserves recognition here.

Paivio's dual-coding hypothesis of retention (Sampson, 1970) predicts that stimuli high in imagery value facilitate imaginal processing, while high meaningfulness stimuli facilitate verbal processing. In other words, those stimuli which are high in imagery value or can be more easily imagined would facilitate imaginal processing and thus facilitate recall of the stimuli. However, when verbal and imaginal instructional sets have been used to test these predicted interactions, the findings have almost always been negative, indicating a lack of support for a dual-process theory of coding in retention (Wittrock and Goldberg, 1975). After further investigation, Wittrock and Goldberg concluded that the interaction predicted by the dual-process theory does occur, and it seems to be determined by attributes

of word lists or the specific words involved.

Experiments 1 and 2 of this investigation required the subjects to transform auditory verbal stimuli to an imagery form. As can be seen from the following studies, this is an area which needs further clarification. Kieras (1978) studied the information-processing approach to imagery effects in memory tasks. Kieras pointed out that there are three major positions in the transformation theory: the mental picture position, the dual-code position, and the propositional representation position. The mental picture position (Anderson and Bower, 1973; Pylyshyn, 1973) maintains that word and sentence meanings are themselves images, described as subjectively experienced mental pictures. The dual-code position of Paivio holds the availability of visual and verbal codes which are arousals of past sensory events, and the propositional representation position states that there is a network which consists of connecting links which represent the relations between concepts which then aids recall of material. Kieras (1978) indicates that the question between these alternative transformation models is whether the facilitation of memory produced by imagery is due to the actual storage of image information, is just a by-product of image

formation, or is through the use of high-imagery materials. In any light, imagery is an important factor in free recall and organization and it functions analogously to verbal processes (Lupiani, 1977).

PICTURES AND WORDS AS VARIABLES

In Experiments 1 and 2 of this investigation, the effects on free recall of transforming stimuli into pictorial and verbal forms were investigated. The following studies support the rationale for the inclusion of this variable.

Paivio (1971) has shown a consistent superiority in retention of pictures relative to words in a variety of standard verbal learning paradigms.

As stated by Dhawan and Pellegrino (1977):

> Both pictures and concrete words are assumed to have access to both a nonverbal and a verbal memory representation. However, pictures have a higher probability than concrete words of assuring both representations. The existence and higher probability of accessing two memory codes produces superior retention of pictures relative to concrete words; concrete words, in turn, are retained better than abstract words, which have only the single verbal representation.

There have been several investigations into the varying effects of pictures or words on the rate of remembering a series of items. In a study by Lieberman

and Culpepper (1965), actual objects were compared with the verbal label of the object. Those subjects who saw the object made fewer errors (intrusions) in free recall than did those who viewed the list of the names of the objects. Along the same line, Shepard (1973), found more intrusion errors for words than for pictures. In a study conducted by Fischler and Puff (1971), their results also substantiate the idea of superior recall of pictures over that of words.

Jones (1978) has shown that the memory trace resulting from the viewing of a picture corresponds to a fragment of that picture. A fragment is the stored trace corresponding to a part of a perceived situation which then serves as a cue for the recall process. In similiar fashion, Peeck, van Dam, and Uhlenbeck (1979) found evidence which supported the theory that the use of picture stimuli enhance retention and recall because of incidental cues which the pictures produce.

Sampson (1970), noted that pictures evoke both verbal and figural encoding but words evoke only verbal encoding. In other words, pictures are recalled more readily due to "the double encoding hypothesis" which states that pictures evoke an additional encoding

facility which increases recall. Or as Tversky (1973) stated, "Simple pictures of objects are richer in encoding possibilities than words..."

Goldstein and Chance (1974), warned that the use of "pictures" as a stimulus category was too vague and overinclusive. They saw the two stimuli, words and pictures, as not being two seperate and distinct entities, but rather as one and the same stimulus. They argue that pictures and words are functionally indistinguishable due to the fact that "although some studies demonstrate extremely impressive picture memory performance, other investigations do not."

It is clear that further clarification is needed concerning the effects of picture and word stimuli on free recall. This thesis attempts to further clarify variables that enhance and/or debilitate the memory process.

MOVEMENT AS A VARIABLE

In Experiment 1 of this investigation, the subjects were asked to imagine the stimuli in either a stationary or moving position. Only one related study has been performed in this area. Gunter (1980) investigated the use of "film-clip" items and "still-insert" items

in news broadcasts to see if there was a facilitation in the recall of the news story due to either stationary or moving inserts. No significant differences were found in regards to the investigated variables. The conclusion being that movement did not facilitate memory.

SUMMARY

A review of pertinent literature indicated that the manner of stimulus presentation affects the recall of the material. Studies have shown that auditory presentation is superior to visual presentation because auditorily presented material is encoded more easily. However, further investigation is warrented in this area.

The literature reviewed also indicated that material high in imagery value facilitates free recall. It is hypothesized that if subjects are presented materials high in imagery value, these materials would be recalled more readily than their counterparts. The question which arises is, is this facilitated recall due to the actual storage of the image formation, is it a by-product of image formation, or is it through the use of high-imagery materials? The author of this

question (Kieras, 1978) suggests that an answer is unobtainable at this time and further investigation is necessary.

Numerous presented studies demonstrated that under free recall, performance is superior when pictures rather than their equivalent word forms are presented as stimuli. The explanation offered for this occurance is that pictures evoke both verbal and figural encoding whereas words evoke only verbal encoding. Thus the recall of pictures as stimuli is facilitated. However, the major criticism of this theory is that these two types of stimuli (words and pictures) are actually involved in the same mental process (memory) and thus should not be used as an attempt to classify two different types of memory functions. The two stimuli are functionally indistinguishable.

An area of limited research in free recall is the movement of the stimuli, in either stationary or moving form, and its effect on recall. The conclusion of the research was that movement did not facilitate free recall.

The area of memory research is still relatively new and thus there are many neglected areas of study.

This investigation is an attempt to advance the study of memory into these areas.

CHAPTER 3

METHOD AND PROCEDURE

The procedure followed in this study is discussed in this chapter. This chapter includes population and sampling, design of the study, materials and instrumentation, procedure, data collection, and method of data analysis.

Population

Male and female college students enrolled in classes at Emporia State University were used. Students enrolled in Developmental and Social Psychology classes were used in Experiment 1, whereas Experiment 2 utilized students enrolled in Introductory Psychology classes. This population was selected due to its availability.

Sample

Volunteers were solicited from the forementioned psychology classes and received extra credit for participation. The sample in Experiment 1 consisted of 108 subjects with 9 subjects per experimental group. The sample in Experiment 2 consisted of 80 subjects with 10 subjects randomly assigned per experimental group.

The variables of sex, age, and education classification were left uncontrolled.

Design

A 2x3x2 between-subjects factorial design was employed in Experiment 1, (see, Appendix A). The variables under investigation were: form of cognitive transformation (the transformation of auditory stimuli into imaginal picture or word forms), size of the imagined stimuli (one-half normal size, normal size, or two times normal size), and movement of the imagined stimuli (stimuli in either a stationary or moving position).

A 2x2x2 between-subjects factorial design was employed in Experiment 2, (see Appendix B). The variables under investigation in this experiment were: form of cognitive transformation (the transformation of auditory stimuli into imaginal picture or word forms), the quantity of the imagined stimuli (stimuli in a quantity of one or two), and the size of the imagined stimuli (normal size or normal size expanding to that of two times normal size).

MATERIALS AND INSTRUMENTATION

Materials

The stimulus items, for Experiments 1 and 2, were 40 nouns taken from the Paivio, Yuille, and Madigan (1968) list of concrete, imagery, and meaningfulness values for 925 nouns. The nouns were as follows: dollar, thorn, horse, book, doll, fire, table, trumpet, window, car, nail, chair, noose, door, tree, claw, diamond, cigar, strawberry, butterfly, umbrella, pipe, pencil, fork, bird, elephant, hammer, shotgun, bullet, arrow, apple, macaroni, flag, cat, clock, potato, harp, snake, shoes, cane. The mean imagery, concreteness, and meaningfulness values (rated on a seven-point scale) of those nouns were 6.58, 6.93, and 6.98 respectively. The mean frequency value was 52.58 per million words spoken. The words were recorded on a tape recorder and presented at the rate of one every eight seconds. The nouns and presentation method have precidence in a study by Joseph and Joseph (1980).

PROCEDURES AND DATA COLLECTION

Group testing procedures were utilized in Experiments 1 and 2.

Experiment 1

As the subjects arrived at their classroom, they were instructed that they could, if they so chose, participate in a memory experiment. Different instructional packets were passed out in a random order to the subjects representing the various experimental conditions. The subjects were asked to read the instructions silently as they were read aloud (see Appendix C). Any questions in regards to the instructions were answered privately on an individual basis at this time. The 40 stimulus nouns were then presented through the use of a tape recorder. Following the presentation of the stimuli, the subjects engaged in an interim control activity (see Appendix D). The purpose for this activity was to reduce any practice effect engaged by the subjects. This activity was done for two minutes. The subjects were then given a five-minute-recall period (see Appendix E), in which they were instructed to recall as many of the presented nouns as possible. Following the recall period, the subjects were asked to rate how well they were able to perform their required task on a seven-point scale ranging from 1 (very poor) to 7 (very well), (see Appendix F).

Experiment 2

The procedure employed in Experiment 2 was identical to that used in Experiment 1. The methods of instructional presentation, presentation of stimuli, interim control activity, recall period, and the self-rating evaluation was the same as in Experiment 1. The only difference was the instructional sheets containing different directions regarding the variables under investigation in this experiment.

DATA ANALYSIS

A three-way between-subjects analysis of variance (ANOVA) was used to analyze the data collected in Experiments 1 and 2. A three-way between subjects analysis of variance was also performed on the self-rating scales to determine any statistical significance between the self-ratings, the experimental conditions, and the number of correctly recalled nouns. The Tukey's Post Hoc Test was performed on any significant main effects.

CHAPTER 4

ANALYSIS OF DATA

The purpose of this chapter is to present the analysis of collected data. This study was designed to investigate various mental and imaginery activities and the effect these have on free recall. In both Experiments 1 and 2, a three-way between-subjects analysis of variance was employed in order to determine any significant differences between the experimental groups.

STATISTICAL ANALYSIS

Experiment 1

As was found in previous studies (Kaplan, Kaplan, and Sampson, 1968; Paivio, 1971; Dhawan and Pellegrino, 1977; Jones, 1978; Peeck, van Dam, and Uhlenbeck, 1979; Sampson, 1970; Tversky, 1973), Experiment 1 yielded statistical significance between the forms of response ($p < .05$). It was found that significantly more items were recalled when the stimuli were imagined in the form of a picture (mean = 16.68) as compared to that of words (mean = 14.87). No statistical significance was found to have resulted from the movement of the imagined stimuli on free recall.

Statistical significance was also found between the sizes of the imagined stimuli and the number of recalled nouns ($p < .01$). It was found that any deviance from normal size resulted in a debilitating effect on free recall. Through the use of the Tukey's Post Hoc Test, significantly more nouns were recalled when imagined in normal size, as was demonstrated by the means of the three levels: one-half of normal size (mean = 14.38), normal size (mean = 18.02), and twice that of normal size (mean = 14.91).

The interaction between the form of response and the movement of the imagined stimuli was also found to be statistically significant (p .05). It was further found that pictures were recalled better than words on both levels of movement. However, words in a stationary position were recalled better than words in a moving position, and moving pictures were recalled better than stationary pictures. In other words, when the subject imagined the stimuli as a moving picture, it enhanced free recall.

An ANOVA was also performed on the self-rating scale to determine any statistical significance between the self-rating, experimental conditions and the number of correctly recalled nouns. No significance was found within any of these variables thereby indicating no differences between the experimental groups in their ability to perform the imagery tasks.

TABLE 1

Analysis of Variance Source Table for Experiment 1

Source	df	SS	MS	F
A (Cognitive Transformation)	1	88.93	88.93	6.83*
B (Size)	2	278.39	139.19	10.69**
C (Movement)	1	42.82	42.82	3.28
AB (Transformation X Size)	2	3.12	1.56	.12
AC (Transformation X Movement)	1	62.25	62.25	4.78*
BC (Size X Movement)	2	14.68	7.34	.56
ABC (Transformation X Size X Movement)	2	24.70	12.35	.94
N-abc (Error)	96	1249.78	13.02	
TOTAL	107	1764.67		

* significant at .05 level

** significant at .01 level

FIGURE 1

A X C Interaction

Cognitive Transformation

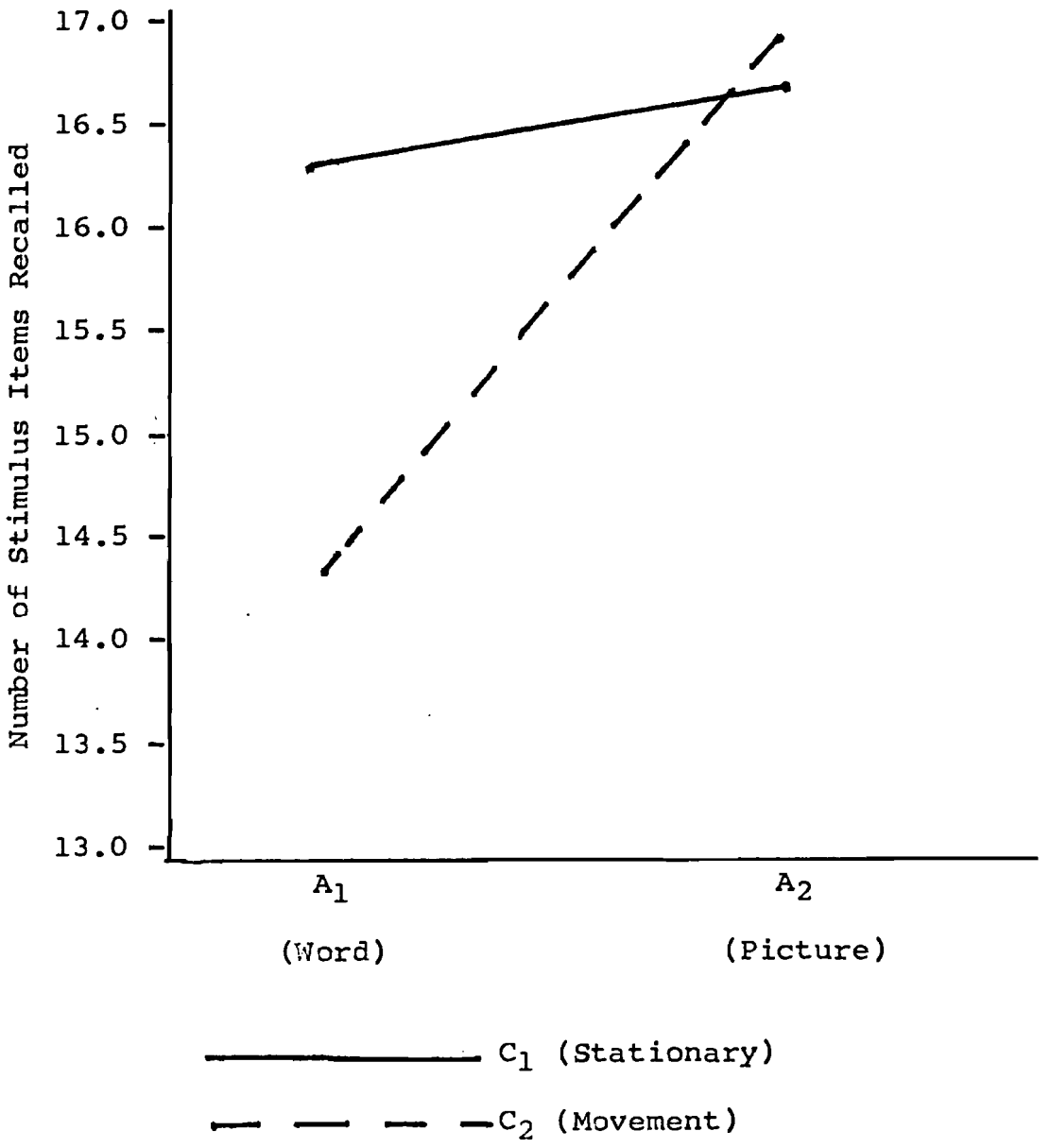

TABLE 2

Analysis of Variance Source Table
Self-Rating Scale
Experiment 1

Source	df	SS	MS	F
A (Cognitive Transformation)	1	4.48	4.48	1.64
B (Size)	2	11.13	5.57	2.03
C (Movement)	1	3.70	3.70	1.35
AB (Transformation X Size)	2	8.02	4.01	1.46
BC (Size X Movement)	2	2.02	1.01	.37
ABC (Transformation X Size X Movement)	2	9.72	4.86	1.77
N-abc (Error)	96	263.37	2.74	
TOTAL	107	303.74		

Experiment 2

Unlike previous studies or Experiment 1, Experiment 2 yielded no significant differences as a result of the cognitive transformation of imagined stimuli into words or pictures. In a similar fashion, no significant difference was found as a result of the size of imagined stimuli, as compared with Experiment 1. No significant differences were found as a result of the quantity of the imagined stimuli on free recall, nor were there any significant interactions. No statistical significance was found through the analysis of the self-rating scale with free recall, as in Experiment 1.

TABLE 3

Analysis of Variance Source Table for Experiment 2

Source	df	SS	MS	F
A (Cognitive Transformation)	1	30.02	30.02	1.25
B (Quantity)	1	2.82	2.82	.12
C (Size)	1	2.12	2.12	.09
AB (Transformation X Quantity)	1	44.84	44.84	1.87
AC (Transformation X Size)	1	39.94	39.94	1.67
BC (Quantity X Size)	1	12.74	12.59	.53
ABC (Transformation X Quantity X Size)	1	74.59	74.59	3.11
N-abc (Error)	72	1724.42	23.95	
TOTAL (N-1)	79	1931.49		

TABLE 4

Analysis of Variance Source Table
Self-Rating Scale
Experiment 2

Source	df	SS	MS	F
A (Cognitive Transformation)	1	.45	.45	.21
B (Quantity)	1	.05	.05	.02
C (Size)	1	0	0	0
AB (Transformation X Quantity)	1	1.30	1.30	.60
AC (Transformation X Size)	1	1.70	1.70	.79
BC (Quantity X Size)	1	2.50	2.50	1.16
ABC (Transformation X Quantity X Size)	1	5.20	5.20	2.42
N-abc (Error)	72	154.60	2.15	
TOTAL	79	165.80		

SUMMARY

As determined by the analysis of variance, two main effects were found to be statistically significant in Experiment 1. There was a statistically significant higher number of correctly recalled nouns when the subjects were asked to imagine the stimuli in the form of a picture as compared to the form of a word. Significance was also found in regards to the size of the imagined stimuli. It was found that as one moves away from normal size, in either direction, the number of recalled stimuli tends to decrease.

Significance was found in the interaction between the cognitive transformation of stimuli into word or picture form and movement. While pictures were recalled better than words on both levels of movement, when the subject imagines the stimuli as a moving picture, it enhances free recall.

As determined by the analysis of variance, there were no statistically significant main effects or interactions in Experiment 2. No significance was found between the self-rating scales, experimental conditions, or the number of correctly recalled nouns in either Experiment 1 or 2.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The problem investigated in this study was: Do various mental and imaginery activities affect the amount the individual is able to freely recall? The null hypotheses stated that there would be no significant differences in the number of correctly recalled nouns as a result of the cognitive transformation of auditory stimuli into words or pictures; as a result of the size of the imagined stimuli being one half of normal size, normal size, or two times normal size; as a result of the movement of the imagined stimuli being either in a stationary or moving position; as a result of the quantity of the imagined stimuli being either one or two; or as a result of an interaction of the above cited variables.

The purpose of this study was to explore variables which influence free recall, to substantiate aspects of previous studies, and to provide information which may aid in the future understanding of the memory process. This study was also used to help gain further insight as to what factors merit additional study.

It has been found that the manner of stimulus presentation will affect the recall of material (Craik, 1969; Joseph and Joseph, 1980; Laughery and Pinkus, 1966; Paivio and Csapo, 1969). These studies have shown that auditory presentation is superior to visual presentation because auditorily presented material is encoded more easily. The stimuli in Experiments 1 and 2 were presented auditorily through the use of a tape recorder with eight seconds between each item.

Research has shown that material high in imagery value facilitates free recall (Kieras, 1978; Lupiani, 1977; Paivio, 1971; Sampson, 1970; Wittrock and Goldberg, 1975). The hypothesis for this finding was that materials high in imagery would be more likely to form a "mental picture" and thus enhance free recall. In Experiments 1 and 2 of this investigation, the subjects were required to transform auditory stimuli to an imagery form.

Numerous studies have shown that more items are recalled when pictures rather than their equivalent word forms are presented as stimuli (Dhawan and Pellegrino, 1977; Fischler and Puff, 1971; Jones, 1978; Kaplan, Kaplan, and Sampson, 1968; Lieberman and Culpepper, 1965; Paivio, 1971; Sampson, 1970; Shepard, 1973; and Tversky, 1973). The explanation offered for this

finding maintains that pictures evoke both verbal and figural encoding whereas words evoke only verbal encoding. This variable was further explored in both Experiments 1 and 2.

Little research has been conducted studying the effects of movement on free recall. Gunter (1980) found no significant difference in recall as a result of the stimuli being in a moving or stationary position. This variable was further explored in Experiment 1.

The other variables under exploration in this investigation (i.e., the size and quantity of imagined stimuli on free recall) have never been previously examined. Therefore, a genuine difference between this study and other studies in the area of free recall exists.

The administration of the experiment consisted of four parts. First was the presentation procedure. Group testing procedures were employed. Each subject was given a set of instructions which were read aloud as he read them silently. After any questions were answered individually, the subjects were asked to close their eyes and do as instructed. The stimulus items were then presented through the use of a tape recorder. The forty stimulus items were presented with eight

seconds between each item. The second part of the experiment consisted of an interim control activity. For two minutes the subjects were instructed to write backwards, by twos, from 300 to 0. The purpose of this task was to prevent the subjects from rehearsing the stimulus items. The third part of this study was the recall period. As instructed, the subjects were given five minutes to call as many of the nouns, that were presented, as possible. The final part of this experiment was the self-rating section. The subjects were asked to rate how well they were able to perform their required imaginery task on a seven-point scale ranging from 1 (very poorly) to 7 (very well).

A total of 188 subjects were used in the two experiments: 108 subjects in Experiment 1 and 80 subjects in Experiment 2. All subjects were randomly selected from undergraduate psychology classes at Emporia State University.

After the raw data was collected, a three-way between-subjects analysis of variance was performed on each experiment plus the self-rating scales. Tukey's post hoc test was performed on any condition found to be statistically significant through the ANOVA.

As was found in previous studies, Experiment 1 yielded statistical significance between the cognitive transformation of auditory stimuli into pictures and words and free recall. It was found that more items were recalled when imagined in the form of a picture (mean = 16.68) as compared to that of words (mean = 14.87).

Statistical significance was also found between the sizes of the imagined stimuli and the number of recalled nouns. It was found that any deviance away from normal size resulted in a debilitating effect on free recall.

One interaction between the form of cognitive transformation (word or picture) and the movement of the imagined stimuli was found to be statistically significant in Experiment 1. It was found that pictures were recalled better than words on both levels of movement. However, words in a stationary position are recalled better than words in a moving position, and moving pictures are recalled better than stationary pictures. In other words, when the subject imagines the stimuli as a moving picture, it enhances free recall.

No significance was found to have resulted from the movement of the imagined stimuli nor from the

self-rating, on free recall, in either Experiment 1 or 2. Therefore, there were no differences between the experimental groups in their ability to perform the imagery tasks.

It is of great interest to note that none of the experimental conditions of Experiment 2 yielded any statistical significance. These findings and others are discussed under the Conclusions section of this chapter.

It is therefore possible to reject the following null hypotheses: There is no significant difference in the number of correctly recalled nouns as a result of the cognitive transformation of auditory stimuli into various forms; as a result of the size of the imagined stimuli; or as a result of an interaction of experimental variables. The following null hypotheses must then be retained: There is no significant difference in the number of correctly recalled nouns as a result of the movement of the imagined stimuli or as a result of the quantity of the imagined stimuli.

CONCLUSIONS

The present studies treated the subjects as active participants who transformed auditory stimuli into various forms, sizes, quantities and movements. It was of interest to determine whether these transformations resulted in differences in recall.

The findings of Experiments 1 and 2 are in partial agreement with previous studies. Experiment 1 yielded a significant difference in the transformation of auditory stimuli into word or picture form on free recall. This is in support of previous research. Experiment 2 did not yield such significance. However, Experiment 2 is in agreement with a study conducted by Gunter (1980) which stated that the movement of the stimuli does not affect the recall of the material.

An aspect which was of interest to this study, and had not been previously investigated, was the effect of the size of the imagined stimuli on free recall. As was found in Experiment 1, any deviation from the imagined normal size of the stimuli tended to produce a debilitating effect on free recall. This finding suggests that producing a mental image of an object, which is not of normal size, does not allow for any

associations or cues for recall to be formed and thus reduces the chance of the object being recalled.

The effects of quantity and movement of the imagined stimuli were also aspects under which no previous studies had been completed. As found in both Experiments 1 and 2, these variables did not produce a significant difference in the number of stimuli recalled. The only explanation offered for these findings is that these cognitive transformations were not as active as other transformations and thus produced no significant differences. In other words, these mental imagery activities produced neither a facilitating or a debilitating effect on free recall.

In regards to Experiment 2, no significant differences were found between any of the investigated variables and free recall. The explanation offered for this finding is that the numerous cognitive activities required such an extreme amount of mental activity that the stimuli was unachievable for recall. The various mental activities tended to "cloud up" the subjects ability to recall the material. This finding warrents further exploration.

RECOMMENDATIONS

As was previously noted, the subjects used in this investigation were undergraduate students enrolled at Emporia State University in Social, Developmental, and Introductory Psychology classes. The variables of sex, race, age, and educational classification were left uncontrolled. Further areas of exploration may be built upon this material controlling the forementioned variables.

There is no way to ascertain, with certainty, that when asked to engage in an imagery activity that the subjects actually did so. Perhaps the subjects allowed their attention to wander from the task at hand and attend to various imaginal associations triggered by the stimulus item. The use of college students may have had an effect on the investigation. As previously noted, college students are more experienced with the necessity of correct immediate recall due to their studying and examinations. Any attempt to generalize from the conclusions of this study must duely recognize this variable.

Further areas of exploration necessary are the effects of movement on free recall, the effects of

size of the stimuli on free recall, and the effects of numerous mental activities (Experiment 2) on free recall.

REFERENCE NOTE

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Joseph, C., & Cowan, D. Effects on free recall of transforming auditory and visual stimuli into various forms and levels of concreteness. (Research Grant). Emporia State University, 1980.

REFERENCES CITED

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Anderson, J.R., & Bower, G.H. Recognition and retrieval process in free recall. Psychological Review, 1972, 79, 97-132.

Craik, F. Modality effects in short-term storage. Journal of Verbal Learning & Verbal Behavior, 1969, 8, 658-664.

Dhawan, M., & Pellegrino, J.W. Acoustic and semantic interference effects in words and pictures. Memory and Cognition, 1977, 5, 340-346.

Fischler, I., & Puff, R. Organization in free recall with verbal and pictorial modes of input and output. Bulletin of the Psychonomic Society, 1971, 22, 85-86.

Goldstein, A., & Chance, J. Some factors in picture recognition memory. Journal of General Psychology, 1974, 90, 72-83.

Gunter, B. Remembering television news: Effects of picture content. Journal of General Psychology, 1980, 102, 127-133.

Jones, G.V. Tests of a structural theory of the memory trace. British Journal of Psychology, 1978, 69, 351-367.

Joseph, C., & Joseph, C.R. Effects on free recall of transforming orally presented nouns into printed or picture form. Journal of General Psychology, 1980, 102, 135-141.

Kieras, D. Beyond pictures and words: Alternative information processing models for imagery effects in verbal memory. Psychological Bulletin, 1978, 85, 532-554.

Kaplan, S., Kaplan, R., & Sampson, J. Encoding and arousal factors in free recall of verbal and visual material. Bulletin of the Psychonomic Society, 1968, 15, 73-74.

Laughery, K.R., & Pinkus, A.L. Short-term memory: Effects of acoustic similarity, presentation rate and presentation mode. Psychonomic Science, 1966, 6, 285-286.

Lieberman, L.R., & Culpepper, J.T. Words versus objects: Comparison of free recall. Psychological Report, 1965, 17, 983-988.

Linton, M., & Gallo, P.S. The Practical Statistician: Simplified Handbook of Statistics. Monterey, California: Brooks/Cole, 1975.

Lupiani, D. The facilitative effects of imagery instructions and stimulus characteristics on immediate and long-term free recall and clustering. Journal of General Psychology, 1977, 97, 73-87.

Madigan, S. Representational storage in picture memory. Bulletin of the Psychonomic Society, 1974, 4, 567-568.

Paivio, A. Imagery and Verbal Process. New York: Holt, Rinehart and Winston, 1971.

Paivio, A., & Csapo, K. Concrete image and verbal memory codes. Journal of Experimental Psychology, 1969, 80, 279-285.

Paivio, A., & Csapo, K. Picture superiority in free recall. Cognitive Psychology, 1973, 5, 176-206.

Paivio, A., Rogers, T.B., & Smythe, P.C. Why are pictures easier to recall than words? Bulletin of the Psychonomic Society, 1968, 11, 137-138.

Paivio, A., Yuille, J., & Madigan, S.A. Concreteness, imagery, and meaningfulness values for 925 nouns. Journal of Experimental Psychology, 1968, 76, 10-25.

Peeck, J., van Dam, G., & Uhlenbeck, R.W.F. Effects of incidental cues on free recall of pictures in mixed and unmixed lists. Journal of General Psychology, 1979, 101, 35-40.

Phlyshyn, Z.W. What the mind's eye tells the mind's brain: A critique of mental imagery. Psychological Bulletin, 1973, 80, 1-24.

Sampson, J.R. Free recall of verbal and non-verbal stimuli. Quarterly Journal of Experimental Psychology, 1970, 22, 215-221.

Shepard, O. Pictures versus words: Some discrepant results. Psychological Reports, 1973, 32, 620-624.

Tversky, R. Pictorial and verbal encoding in short-term memory tasks. Perception and Psychophysics, 1969, 6, 225-233.

Wittrock, M.C., & Goldberg, S.I. Imagery and meaningfulness in free recall: Word attributes and instructional sets. Journal of General Psychology, 1975, 92, 137-151.

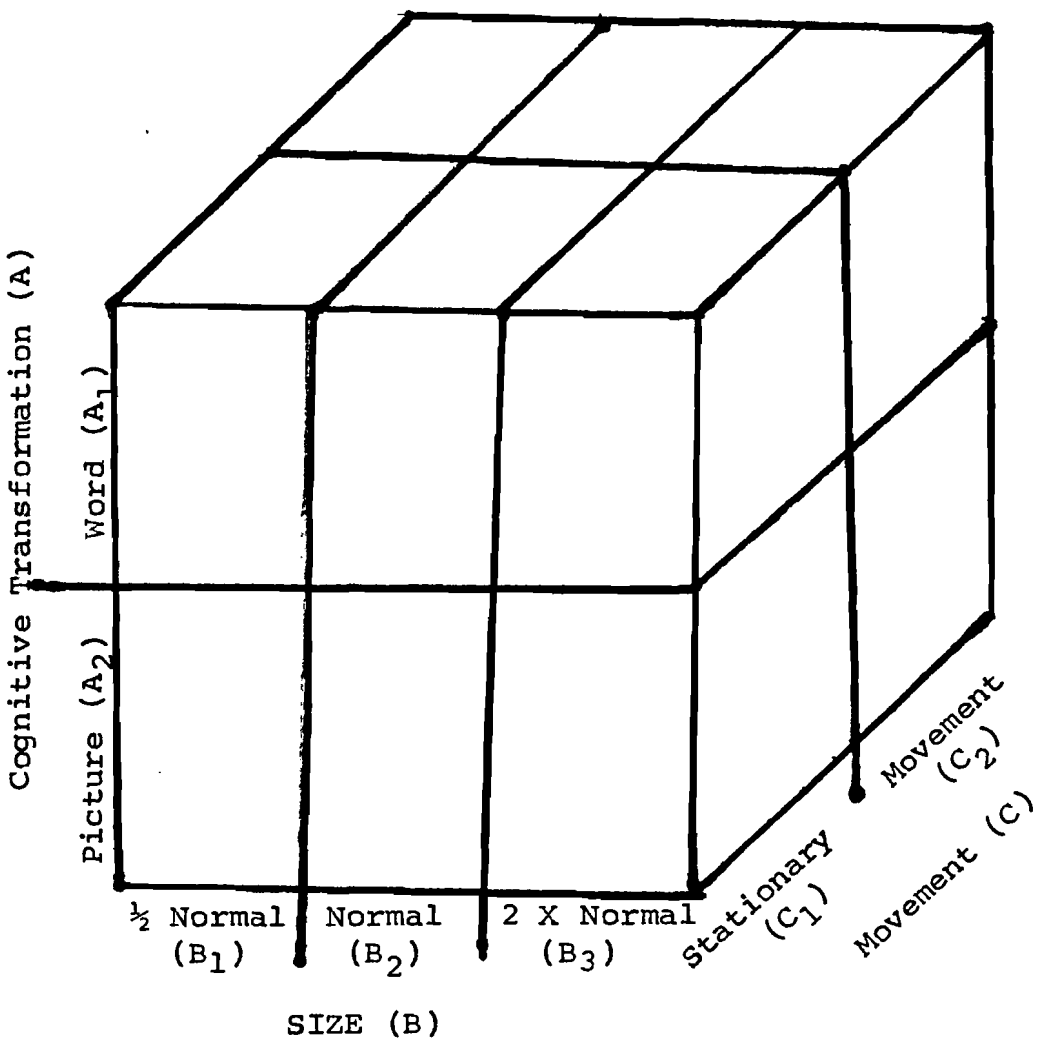
Yuille, J.C., & Paivio, A. Latency of imaginal and verbal mediators as a function of stimuli and response concreteness imagery. Journal of Experimental Psychology, 1967, 75, 540-544.

APPENDICES

APPENDIX A

Factorial Design - Experiment 1

Factorial Design - Experiment 1



APPENDIX B

Presentation Instructions

PRESENTATION INSTRUCTIONS

Forty nouns will be presented by a tape recorder with eight seconds between each noun. Your task will be to close your eyes and imagine ___(Place specific instructions here per experimental group)___. You may have to think quickly because the things are presented every eight seconds. Remember, you are to imagine _____.

Experiment 1

Group $A_1B_1C_1$ (word - one half of normal size - stationary)
...a printed word that is one half of its normal size of the noun that is presented.

Group $A_1B_2C_1$ (word - normal size - stationary)
...a printed word of the noun that is presented.

Group $A_1B_3C_1$ (word - twice as large - stationary)
...a printed word that is twice as large as its normal size of the noun that is presented.

Group $A_1B_1C_2$ (word - one half normal size - moving)
...a moving printed word that is one half of its normal size of the noun that is presented.

Group $A_1B_2C_2$ (word - normal size - moving)

...a moving printed word of the noun that is presented.

Group $A_1B_3C_2$ (word - twice as large - moving)

...a moving printed word that is twice as large as its normal size of the noun that is presented.

Group $A_2B_1C_1$ (picture - one half normal size - stationary)

...a picture that is one half of its normal size of the noun that is presented.

Group $A_2B_2C_1$ (picture - normal size - stationary)

...a picture of the noun that is presented.

Group $A_2B_3C_1$ (picture - twice as large - stationary)

...a picture that is twice as large as its normal size of the noun that is presented.

Group $A_2B_1C_2$ (picture - one half normal size - moving)

...a moving picture that is one half of its normal size of the noun that is presented.

Group $A_2B_2C_2$ (picture - normal size - moving)

...a moving picture of the noun that is presented.

Group $A_2B_3C_2$ (picture - twice as large - moving)

...a moving picture that is twice as large as its normal size of the noun that is presented.

Experiment 2

Group $A_1B_1C_1$ (word - one quantity - normal size)

...a printed word of the noun that is presented.

Group $A_1B_2C_1$ (word - two quantity - normal size)

...two printed words of the noun that is presented.

Group $A_1B_1C_2$ (word - one quantity - twice as large)

...a printed word of the noun that is presented expanding to that of two times its normal size.

Group $A_1B_2C_2$ (word - two quantity - twice as large)

...two printed words, of the noun that is presented expanding to that of two times its normal size.

Group $A_2B_1C_1$ (picture - one quantity - normal size)

...a picture of the noun that is presented.

Group $A_2B_2C_1$ (picture - two quantity - normal size)

...two pictures of the noun that is presented.

Group $A_2B_1C_2$ (picture - one quantity - twice as large)

...a picture that is of normal size expanding to that of two times the normal size.

Group $A_2B_2C_2$ (picture - two quantity - twice as large)

...two pictures of each presented noun that is of normal size expanding to that of two times the normal size.

APPENDIX C

Interim Activity Control Instructions

Begin at 300 and write backwards by twos. For example, 300, 298, 296, etc. Continue until you are told to stop.

APPENDIX D

Recall Instructions

List as many of the nouns that were presented on the tape recorder as you can. Continue until you are told to stop.

APPENDIX E

Self-Rating Instructions

Rate how well you were able to imagine what you were asked to do. Make your rating by marking with an X on the scale provided below.

very poorly _____: _____: _____: _____: _____: _____: _____ very well

APPENDIX F

Factorial Design - Experiment 2

Factorial Design - Experiment 2