

INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.
2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.
3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in "sectioning" the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again — beginning below the first row and continuing on until complete.
4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from "photographs" if essential to the understanding of the dissertation. Silver prints of "photographs" may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.
5. PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Xerox University Microfilms

300 North Zeeb Road
Ann Arbor, Michigan 48106

76-20,847

OLSON, Andrew Manfred, 1943-
ENCODING SPECIFICITY: AN ARTIFACT OF
PARADIGM AND ANALYSIS?

City University of New York, Ph.D., 1976
Psychology, experimental

Xerox University Microfilms, Ann Arbor, Michigan 48106

© 1975

ANDREW MANFRED OLSON

ALL RIGHTS RESERVED

ENCODING SPECIFICITY: AN ARTIFACT OF PARADIGM AND ANALYSIS?

by

ANDREW M. OLSON

A dissertation submitted to the Graduate Faculty
in Psychology in partial fulfillment of the re-
quirements for the degree of Doctor of Philosophy,
The City University of New York.

1975

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

May 7, 1976
date

Solomon Weinstock
Chairman of Examining Committee

May 11, 1976
date

Florence L. Denmark
Executive Officer

Professor Solomon Weinstock

Professor May D'Amato

Professor Carl Zuckerman
Supervisory Committee

Abstract

ENCODING SPECIFICITY: AN ARTIFACT OF PARADIGM AND ANALYSIS?

by

Andrew M. Olson

Advisor: Professor Solomon Weinstock

The recent literature, initiated by Tulving and his colleagues, has presented data whereby a recognition failure of recallable words was produced. Such data would indicate that a two-process theory of recall and recognition cannot be maintained because recovery of information through two bottlenecks (generation and then recognition, as in recall) cannot be more effective than that through only one of the two (as in recognition). To account for this type of data, Tulving advances the encoding specificity principle that assumes that what is stored about the occurrence of a word in an experimental list is information about the specific encoding of the word in the context of the situation.

Each of the experiments in this investigation used undergraduate volunteers who were presented with three successive lists, each containing from 21 to 24 word pairs, with the second member of each pair designated as the to-be-remembered word, or target word (TW). The first two lists were to establish the "encoding context" for the TWs. The lists were either presented singly via a Kodak Carousel projector or a Lafayette memory drum. Immediately after presentation of a list, subjects were given the input cues and instructed to write down the

TWs. For the critical third list, some variation or simplification of the procedure below was used. Immediately after presentation, subjects were given a list of words for which the TW was a strong associate and asked to generate four associates to each of these words. Then they were instructed to examine the words just generated and circle any that they recognized as having been a TW on the third list. Subjects were then given the input cues and instructed to write down the TWs.

The initial experiments replicated recognition failure of recallable words. However, close analysis of the data indicated that the effect was for the most part, restricted to a specific kind of word pair: i.e., pairs composed of a noun as the input cue and an adjective as the TW. This suggested the possibility that asymmetries in the word pairs could somehow be responsible for the data. Thus, word pair lists were generated and word pairs with asymmetric associative probabilities were presented to subjects. These experiments indicated that superiority of recall or recognition performance was a function of the direction of the asymmetry. When the input cue word to TW association was higher than the reverse, recall performance was higher than for recognition. When the input cue word to TW association was lower than the reverse, then recognition performance was higher than that of recall performance. If the associations were symmetrical, no differences in performance was observed.

It has been suggested therefore, that the subject's task in this paradigm be conceptualized to be one of learning pairs of words. Under both cued recall and recognition test procedures, the subject

must recreate the original stimulus pair. In cued recall, the subject generates associates to the cue word, stops when he generates the second member of the original pair and recognizes the pair as the one presented. In recognition, it may be assumed that a similar process occurs. The subject generates associates to each of the alternatives and stops when he recognizes the pair as the one originally presented.

Thus, it has been concluded that Tulving's original purpose, disproving two-process theories of recall has failed. In a properly controlled study, recognition failure of recallable words was not demonstrated as a general phenomenon.

Acknowledgements

Grateful acknowledgement is made to the members of the thesis committee, Professor Carl Zuckerman, Professor May D'Amato and especially to Professor Solomon Weinstock whose guidance, support and cooperation were an essential part of this thesis.

Acknowledgement is also made to my wife, Josephine Olson, for her patience, understanding and encouragement throughout the course of these studies.

Special thanks are given to my colleague, Charles DeVito whose encouragement and insights have facilitated my intellectual progress to this point.

Table of Contents

ABSTRACT	iv
ACKNOWLEDGEMENTS	vii
LIST OF TABLES	ix
LIST OF FIGURES	xi
GENERAL INTRODUCTION	1
EXPERIMENT 1	
Introduction	7
Method	8
Results and Discussion	11
EXPERIMENT 2	
Introduction	14
Method	15
Results and Discussion	17
EXPERIMENT 3	
Introduction	22
Method	24
Results and Discussion	26
EXPERIMENT 4	
Introduction	31
Method	32
Results and Discussion	34
EXPERIMENT 5	
Introduction	39
Method	40
Results and Discussion	43
EXPERIMENT 6	
Introduction	49
Method	50
Results and Discussion	53
GENERAL DISCUSSION	59
REFERENCES	64

List of Tables

Table	page
1 Cue Words (Weak Cues), Strong Associates (Strong Cues) and Target Words for the Critical Third List of Experiment 1.	9
2 Proportion Correct Responses for Cued Recall and Recognition for Experiment 1.	12
3 Cue Words and Target Words for the Critical Third List of Experiment 2.	16
4 Mean Number (M) and Proportion (P) of Target Words Recalled and Recognized as a Function of Type of Syntactical Pairing for Experiment 2.	18
5 Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Different Types of Syntactical Pairings for Experiment 2.	21
6 Cue Words and Target Words for the Critical Third List of Experiment 3.	25
7 Mean Number (M) and Proportion (P) of Target Words Recalled and Recognized as a Function of Type of Syntactical Pairing and Backward Association Value for Experiment 3.	27
8 Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Different Types of Syntactical Pairings and Different Values of Backward Association for Experiment 3.	30
9 Cue Words and Target Words for the Critical Third List of Experiment 4	33
10 Mean Proportion of Target Words Recalled and Recognized as a Function of Association Value and Target Word Frequency for Experiment 4.	35
11 Analysis of Variance Based on Proportion of Correct Responses for Cued Recall and Recognition for Different Values of Forward Association and Different Target Word Frequencies for Experiment 4	38
12 Cue Words and Target Words for the Critical Third List with Low Frequency Target Words for Experiment 5.	41

Table	page
13 Cue Words and Target Words for the Critical Third List with High Frequency Target Words for Experiment 5. . .	42
14 Mean Number (M) and Proportion (P) of Target Words Recalled and Recognized as a Function of Association Direction and Target Word Frequency for Experiment 5. . . .	44
15 Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Differential Association Direction and Different Target Word Frequencies for Experiment 5.	47
16 Cue Words and Target Words for the Critical Third List with Low Frequency Target Words for Experiment 6 . . .	51
17 Cue Words and Target Words for the Critical Third List with High Frequency Target Words for Experiment 6. . .	52
18 Mean Number (M) and Proportion (P) of Target Words Recalled and Recognized as a Function of Syntactical Pairing and Target Word Frequency for Experiment 6.	54
19 Analysis of Variance Based on the Number of Correct Responses for Cued Recall and Recognition for Syntactical Pairing and Different Target Word Frequencies for Experiment 6.	57

List of Figures

Figure	page
1 Mean Number of Target Words Recalled and Recognized as a Function of Type of Syntactical Pairing for Experiment 2.	19
2 Mean Number of Target Words Recalled and Recognized as a Function of Type of Syntactical Pairing and Backward Association Value for Experiment 3	28
3 Mean Proportion of Target Words Recalled and Recognized as a Function of Association Value and Target Word Frequency for Experiment 4.	36
4 Mean Number of Target Words Correctly Recalled and Recognized as a Function of Association Direction and Target Word Frequency for Experiment 5.	45
5 Mean Number of Target Words Correctly Recalled and Recognized as a Function of Syntactical Pairing and Target Word Frequency for Experiment 6.	55

It is well-known experimentally that recognition is easier than recall (McDougall, 1904). The problem of gauging this superiority is a difficult one and leads to questions. Since the number of alternatives in recall cannot be determined precisely, how does one correct for guessing? Are different "criteria" used in recognition and recall (Kintsch, 1970)?

The question as to the ease and/or superiority of recognition has been modified to whether the psychological processes for free recall and for recognition are basically the same. McDougall (1904) formulated what is currently known as the threshold theory of recognition and recall. When an item is presented a "sense of familiarity" is aroused. When tested, the subject bases his response on a partially faded trace: low degrees suffice for recognition, while a greater degree of familiarity is needed for recall. On the other hand, James (1890) described recall as a search process that terminates when an item is implicitly retrieved; this item is then "recognized" as familiar or unfamiliar and a response is made. Thus, the so-called two-process theory. Kintsch (1970) states that recognition is "... a matter of checking the familiarity or response strength of an item, but that recall involves an additional process of search, or retrieval (p.333)."

The critical issue is therefore one of retrieval. Most current investigators favor some sort of a two-process approach with the assumption that in recognition, retrieval plays either a minimal role or none at all. Murdock (1968) assumes that "recognition eliminates

the search or retrieval problem (p. 79)." Bower, Clark, Lesgold and Winzenz (1969) state that recognition tests " ... clearly bypass the search and retrieval process by which the subject generates his recall (p. 329)." Wickelgren (1970) takes a stand for minimal retrieval, with recall presenting " ... a more complicated retrieval process to analyze (p. 221)."

Most of the current literature supports a two-process notion. It is known that organizational manipulations have strong effects on free recall (Mandler, 1967; Tulving, 1962, 1968). Should this not be true for recognition tasks, it would make sense to conclude in favor of two-process that recognition involves minimal or no retrieval.

Comparison has been made between incidental and intentional instructions. The assumption is that under the intentional learning instructions, subjects are able to organize the material to be learned. Yet these types of instruction have had little or no differential effects on recognition (Postman, Adams and Phillips, 1955; Eagle and Leiter, 1964; and Estes and DaPolito, 1967). The latter argue that their data were inconsistent with a three-state Markov model, the first two states of which allow for storage sufficient to yield recognition, and the third state of which is necessary for recall.

Cofer (1967) used lists of words with varying amounts of interitem associative strength and hence organization. Free recall was an increasing function of associative strength while no relationship was shown for recognition.

Words with a high frequency of occurrence are typically better recalled than low-frequency words (Hall, 1954). One can make arguments that this effect is an organizational phenomenon. Several studies have shown that this relationship is reversed for recognition (Gorman, 1961;

Shephard, 1967). Correct recognition is negatively correlated with either Thorndike-Lorge frequency or Kucera-Francis frequency.

Tulving (Tulving and Thomson, 1971) is the major proponent of the notion that recognition memory involves a substantial retrieval process. He states that a subject is retrieving whenever he is utilizing " ... information stored in the past to meet the demands of the present" (p. 116). He further states that his experimental findings " ... make it increasingly difficult ... to cling to the view that there is something inherently different about the processes of recall and recognition, and that an important aspect of the retrieval process, access to available information, is present in recall but not in recognition" (p. 123).

In line with the above, there has been much recent research on context effects in memory. Light and Carter-Sobell (1970), Thomson (1972), Thomson and Tulving (1970), Tulving and Thomson (1971) and Winograd and Conn (1971) have demonstrated that the ability to recall or recognize a word can be impaired by changes from study to test of the context in which the word is presented.

One of the recent approaches to studying the effects of context on memory is the extralist cueing effect, facilitation of recall of a list item by a retrieval cue that was not explicitly a part of the input list. Extralist cue facilitation in recall is well supported empirically (Postman, Adams and Phillips, 1955; Bilodeau, 1967; Fox, Blick and Bilodeau, 1964). These investigators all report that strong extraexperimental associates of list items when presented to subjects as recall aids, increase the probability of correct responses.

Tulving and Thomson (1973) presented several theories that have been used to explain the extralist cueing effect; the major ones being the generation-recognition and encoding specificity hypotheses. The latter asserts that "what is stored is determined by what is perceived and how it is encoded, and what is stored determines what retrieval cues are effective in providing access to what is stored" (Tulving and Thomson, 1973, p. 369).

As stated before the generation-recognition models of recall assume that overt retrieval of stored information consists of two stages: (a) implicit generation of possible alternatives and (b) recognition of one of the generated alternatives. The generation phase could be guided by semantic information the subject possesses about the cue word. For example, given "table" as a cue, the implicitly generated responses consist of words semantically related to it, including "chair". The operations in the recognition phase can be successful only to the extent that relevant episodic (Tulving, 1972) information is available. Briefly, "... episodic memory is concerned with storage and retrieval of temporally dated, spatially located, and personally experienced events or episodes, and temporal-spatial relations among such events. Appearance of a word in a to-be-remembered list in an experimental task is such an event. Semantic memory is the system concerned with storage and the utilization of knowledge about words and concepts, their properties and interrelations." (Tulving and Thomson, 1973, p. 354). Thus, the generated response alternative "chair" would be identified as the desired word if its internal

representation carries an appropriate "occurrence tag" (Mandler, 1972) or "list marker" (Anderson and Bower, 1972), i.e., information about the membership of the word in a particular list in a particular situation. Effective retrieval cues facilitate recall because they increase the probability that the desired information, available in the memory store, is found. Cued recall produces a higher level of retrieval than does noncued recall for the same reason that recognition is higher than recall. Bahrck (1969) states that a cue

... is likely to produce a hierarchy of responses as a result of past learning One of these responses is likely to be the training response. The subject is thus unburdened of the search strategy involved in unaided recall tasks. He continues to produce responses associated with the prompt until he can identify one of them as the response presented during training. This portion of the prompted recall task functionally approximates a recognition task. (p. 217)

The encoding specificity principle as stated by Tulving assumes that what is stored about the occurrence of a word in an experimental list is information about the specific encoding of the word in the context in that situation. This information may or may not include the relation that the target word has with some other word in the semantic system. If it does, the other word may be an effective retrieval cue. If it does not, the other word cannot provide access to the stored information because its relation to the target word is not stored. Thus, the effectiveness of retrieval cues depends on the properties of the trace of the word event in the episodic system. It is independent of the semantic properties of the word except insofar as these properties were encoded as part of the trace of the event.

Both theories can account equally well for the finding that a given cue is effective. Thus, for instance if "table" does facilitate the recall of the target word, chair, it is possible that an implicit response "chair" was made to the cue at retrieval and subsequently recognized. It is also possible that the target, chair, was semantically encoded at the time of presentation in a specific way that rendered the cue word, table, effective.

To contrast the theories, some experimental control over encoding of target items must be exercised. For instance, the target word chair, could be presented, and the subject induced to encode it in the specific context of another word such as "glue" that is relatively a low associate of chair and table. If chair is encoded in relation to glue, it is less likely to be encoded at the same time in relation to table, and hence, according to the encoding specificity principle, the effectiveness of the extralist cue "table" should be reduced. According to the generation-recognition models, the effectiveness of table as an extralist cue should not be impaired as long as the semantic relation between table and chair is intact.

Tulving and Thomson (1973) report three experiments in which the two phases of retrieval as envisioned by generation-recognition theories could be directly observed. In these experiments, subjects studied a list of target words, such as chair, in the presence of a specific input cue, glue. A set was created in which the subject expected to be tested with these cues. After studying the list, subjects were asked to produce free associates to strong extra-experimental associates of target words, such as "table". Then, they

were asked to examine the generated words and indicate which ones they remembered as having been in the input list. Finally, a cued recall task giving the input cues, was given to the subjects to estimate the extent to which information about the target words was available in the memory store. In all three experiments, they found cued recall performance was superior to recognition with average values across the three experiments of 61% for cued recall and 27% for recognition.

Conditions were created in which information about a word event was available in the memory store in a form sufficient for the production of the appropriate response and yet a literal copy of the word was frequently not recognized. The recognition failure of recallable words, Tulving states, is an "empirical phenomenon that cannot occur according to the two-process theory of recall and recognition and other versions of the generation-recognition models of retrieval: recovery of information through two bottlenecks (generation and then recognition, as in recall) cannot be more effective than that through only one of the two (recognition).

The Tulving and Thomson experiments, however, are rather complex and leave open the possibility of confounding from a number of sources. It was intended originally to remove some of the sources of confounding in their experiments and, as a preliminary step, it was decided to replicate the basic Tulving and Thomson paradigm, using their materials and procedure. Thus, the first experiment in the series of six here reported was a replication study.

EXPERIMENT 1

Method

Subjects

The subjects were 18 male and female Brooklyn College students, members of introductory psychology classes, who volunteered to participate.

Apparatus

Three lists of 24 pairs each were used, the first member of each pair (lowercase letters) was the cue word; the second member (all capitals) was the target word. All target words were low-frequency associates (less than 1%) to its "weak cue" (Bilodeau and Howell, 1965; Riegel, 1965; and Palermo and Jenkins, 1964).

In addition there was a listing of words for which the target word (TW) in the third list was a high-frequency associate (mean of 52%). Table 1 contains the weak cues, strong cues and target words for the critical third list. The weak cue words and the strong cue words were themselves weakly associated (less than 1%).

The experiment was conducted in a small room (3.05m x 3.66m x 2.44m) illuminated by diffuse overhead lighting. The room contained a Kodak Carousel 800H programmable projector placed within a black plexiglass box, with one end consisting of an opaque illuminating screen. The box with projector was placed on a table approximately .3m in front of the subject's chair. Also in the room was a table and chair for the experimenter and a relay panel with the necessary controls for the programmable projector.

Table 1. Cue Words (Weak Cues), Strong Associates (Strong Cues) and Target Words for the Critical Third List of Experiment 1.

<u>Cue Word</u>	<u>Strong Associate</u>	<u>Target Word</u>
butter	rough	SMOOTH
cave	dry	WET
ground	hot	COLD
stomach	small	LARGE
cheese	grass	GREEN
cloth	lamb	SHEEP
plant	insect	BUG
fruit	bloom	FLOWER
lady	king	QUEEN
whistle	tennis	BALL
grasp	infant	BABY
glue	table	CHAIR
beat	ache	PAIN
wish	soap	WASH
head	dark	LIGHT
command	woman	MAN
sun	night	DAY
home	bitter	SWEET
bath	want	NEED
blade	scissors	CUT
noise	blow	WIND
pretty	sky	BLUE
drink	tobacco	SMOKE
swift	stop	GO

Procedure

The procedure used is that of Tulving and Thomson's (1973) basic paradigm. Subjects were run singly. Each subject was presented with three successive lists. The purpose of the first two lists was to establish the "encoding context" for the TWs. The TWs, each paired with its weak cue (weak cue on top and TW on the bottom) were presented via the programmable projector one at a time, in random order, at either a 3 sec. or 5 sec. rate. Immediately after presentation of a list (for lists one and two), the subjects were given the input cues in random order and instructed to write down the TWs. Three min. were allowed for the cued recall of TWs.

The critical third list was presented in the same way as the first two. After presentation, however, the subjects were given a list of words for which the TW was a strong associate and asked to generate four associates to each of these words. Immediately after this task was completed, the subjects were instructed to examine the words that they had just generated and circle any words they recognized as having been a TW on the third list. Subjects were then given a three min. cued recall for these same words.

Results and Discussion

Table 2 shows the proportion of correct responses for the critical third list for cued recall and recognition. The recognition measure corresponds to the conditional probability that a TW is recognized given that it appeared in the set of four words that each subject generated for each strong cue word. Across both the 3 sec. and 5 sec. rate groups, the proportion of TWs generated, given the strong cue word was .88.

Tulving and Thomson (1973) used a 3 sec. rate and found the proportion for cued recall to be .61 and the proportion for recognition to be .27, averaged across three experiments. By and large, the data for recognition correspond quite closely with those of Tulving and Thomson, while the cued recall data at 3 sec. in the present experiment departs drastically from the Tulving and Thomson data. In view of the existence of large differences, of the order of two-to-one, for the 5 sec. rate data, one may surmise that the discrepancies at the 3 sec. rate are due to differences in the populations of subjects employed in the two experiments.

It was further observed that the most pronounced superiority of cued recall over recognition was in the five instances that a noun-adjective pair was presented. It was found that the corresponding proportions of correct responses, averaged across the two presentation rates were .51 and .11. Minimal differences were found for cued recall and recognition for the noun-noun pairs, with proportions of correct responses of .39 and .41, respectively.

Table 2

Proportion Correct Responses for Cued Recall
and Recognition for Experiment 1

<u>Presentation Time</u>	<u>Cued Recall</u>	<u>Recognition</u>
3 sec.	.33	.27
5 sec.	.51	.25

15

Tulving's notion of encoding specificity yields the prediction that at a 5 sec. rate exposure, rather than 3 sec. exposure, there should be better specific encoding of the pair, hence inferior recognition performance relative to cued recall performance. As indicated in Table 2, marked differences were found for the 5 sec. rate and relatively minor ones for the 3 sec. rate.

In a broad sense, the present study replicates Tulving and Thomson's (1973) dramatic finding. In a narrow sense, it fails to replicate for noun-noun pairs and raises the possibility that some peculiarity of noun-adjective pairs is responsible for the effect. The next experiment was directed at determining the role of the type of pair presented on cued recall versus recognition of the TWs.

EXPERIMENT 2

Experiment 1 indicated that differences in cued recall and recognition performance were related to the different kinds of pairings used, with the superiority of cued recall over recognition found only for noun-adjective pairs. Since many of Tulving and Thomson's (1973) TWs were adjectives, there is a strong possibility that this factor was responsible for the inferior recognition performance observed by them.

Therefore, it was decided to investigate this possibility directly, by manipulating the syntactical nature of the pairings as a variable in the Tulving and Thomson paradigm. Specifically, lists containing noun-adjectives, noun-nouns and verb-noun pairs were presented. Verb-noun pairs were included because a major portion of their material could be considered to be this type. The expectation was that only the adjectives as TWs would show the Tulving and Thomson effect.

Method

A paradigm similar to that in Experiment 1 was used but the length of the lists was changed to 21 pairs. Sixteen subjects were employed. The critical third list contained 7 noun-adjective, 7 noun-noun and 7 verb-noun pairs. Table 3 presents the critical items. The procedure was the same as before, except that the generation of free associates to strong cues was eliminated. In its place, the items for the recognition task (distractor items) were composed as follows. For those pairs used originally in Experiment 1, the subject's protocols were used. For new pairs, the word association norms were used (Bilodeau and Howell, 1965; Riegel, 1965 and Palermo and Jenkins, 1964). Given a strong associate to the TW, the four most frequent associations (including the TW) were selected. A sheet of paper containing 21 rows of 5 words, with the first word in each row being the strong cue and the other four, the associates, was presented to each subject. The subject was instructed to choose one of the four words as the TW. They were given a total of 3 min. for the recognition task. The 5 sec. presentation rate of pairs was employed for all lists.

Table 3. Cue Words and Target Words for the Critical Third List of Experiment 2.

	<u>Cue Word</u>	<u>Target Word</u>
	stomach	LARGE
	train	BLACK
	stem	SHORT
Noun-Adjective	butter	SMOOTH
	glass	HARD
	cave	WET
	ground	COLD
<hr/>		
	glue	CHAIR
	grasp	BABY
	whistle	BALL
Verb-Noun	roll	RUG
	think	STUPID
	exist	BEING
	beat	PAIN
<hr/>		
	lady	QUEEN
	art	GIRL
	mountain	TREE
Noun-Noun	plant	BUG
	spider	BIRD
	fruit	FLOWER
	cloth	SHEEP

Results and Discussion

Table 4 and Figure 1 show the mean number of TWs recalled and recognized as a function of syntactical pairing. In addition, Table 4 shows the proportion of TWs recalled and recognized. This latter is presented merely for conformity with Tulving and Thomson's presentation. They were unable to use means in analyzing their data because the generation procedure did not always produce the TW, while the data in Experiment 2 results from a procedure where all TWs are available in the recognition phase.

A two-factor repeated measures analysis of variance was done and indicated that the effect of test procedure (cued recall vs recognition) was significant, $F(1,15) = 5.393$, $p < .05$, as shown in Table 5. While there was no significant effect of pairings (noun-adjective, verb-noun and noun-noun) there was a significant interaction of these two variables, $F(2,30) = 6.275$, $p < .05$.

Because of the significant interaction observed, correlated t tests were performed comparing performance for each of the types of pairings under the two test procedures. This analysis indicated that performance differed only for the noun-adjective pairings, $t(15) = 3.87$, $p < .01$.

This strongly suggests that the Tulving and Thomson (1973) results were restricted to differences in recall and recognition on the noun-adjective pairs. Thus, it brings into question the generality of the notion of encoding specificity. The next experiment was done to examine this question further and the attempt was made to extend these findings beyond the effect caused by noun-adjective pairs.

Table 4
 Mean Number (M) and Proportion (P) of Target Words Recalled and
 Recognized as a Function
 of Type of Syntactical Pairing for Experiment 2

	<u>Recall</u>		<u>Recognition</u>	
	<u>(M)</u>	<u>(P)</u>	<u>(M)</u>	<u>(P)</u>
Noun-Adjective	4.74	.68	3.25	.46
Verb-Noun	4.25	.61	3.81	.54
Noun-Noun	4.69	.67	4.63	.66

**Figure 1. Mean Number of Target Words Recalled and Recognized as
a Function of Type of Syntactical Pairing for Experiment 2.**

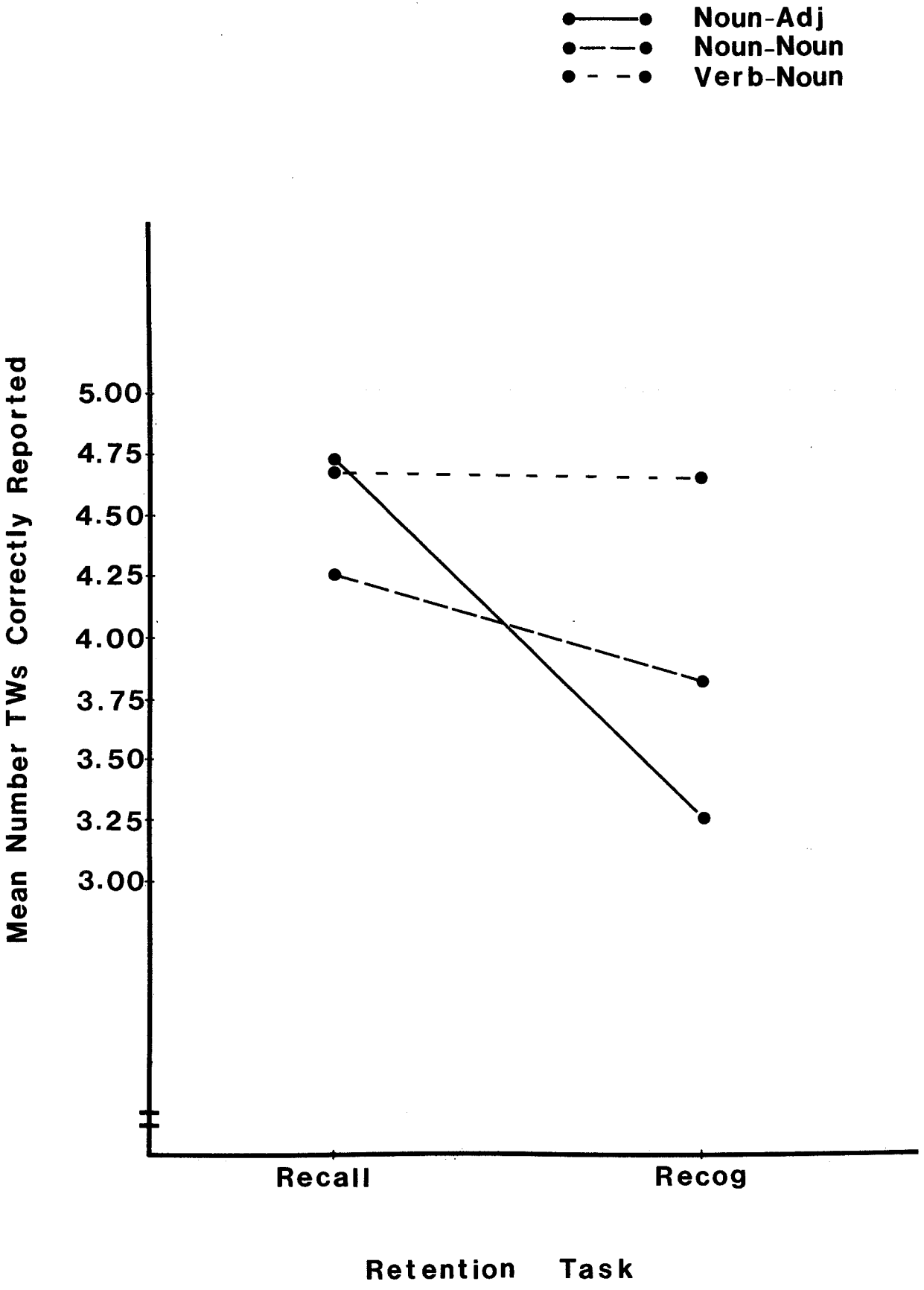


Table 5. Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Different Types of Syntactical Pairings for Experiment 2.

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Total	259.96	95	-	-
Subjects	124.63	15	-	-
Retention (R)	10.67	1	10.67	5.39*
Syntax (S)	8.77	2	4.39	2.68
R x S	8.90	2	4.45	6.28*
Error R	29.67	15	1.98	-
Error S	49.06	30	1.64	-
Error R x S	21.27	30	0.71	-

*p < .05

EXPERIMENT 3

Loftus (1972) proposes that the long term memory store is primarily organized into noun categories. She used nouns and adjectives as cue words and instructed her subjects to generate words in the same category and having the adjectival property, respectively. The mean number of responses given to noun stimuli was greater than the mean number of responses given to the adjective stimuli. Loftus suggests two reasons for this result. First, the subject must decide which category to enter, and this decision takes time, and then the subject must shift from one category to another and shifting takes time. This shifting from categories does not happen for nouns.

The Loftus view implies there should be asymmetries in the cued recall of pairs, particularly for noun-adjective or adjective-noun pairs. Thus, if a pair such as "butter-smooth" was presented to a subject, and in cued recall, "butter" was presented, the word "smooth" could be generated with reasonable probability, since smooth is a property of butter. On the other hand, if "smooth" is presented as the cueing word, the subject's task would involve a more difficult search, since many objects have the property smooth.

Although not so conceived by them, the subject's task in the Tulving and Thomson paradigm may be conceptualized to be one of learning or memorizing a pair of words. Under both cued recall and recognition test procedures, the subject must recreate the original stimulus pair. In cued recall, it may be assumed that the subject generates associates to the cue and stops when he generates the second member of the original pair and recognizes the pair as the

one presented. In recognition from a list of alternatives containing the target, it may be assumed that the subject generates associates to each of the alternatives and stops when he recognizes the pair as the one presented. In this view, at least for pairs, the processes involved for cued recall and recognition memory are essentially the same, both involving generation-recognition in a cued-recall type of paradigm.

Therefore, the inferior recognition performance could be explained by the asymmetrical cued recall for noun-adjective pairs that formed the bulk of the word pairs that Tulving and Thomson used in their experiments. In the present experiment, the attempt was made to exploit pre-experimental associative habits to produce these same type of asymmetries. A search of the free association norms was made for pairs of words that had asymmetric associative probabilities. Noun pairs were chosen because they more frequently appear in these norms and also to extend the findings in Experiment 2. A typical word pair of this type would be "cheese-bread", for which the free association norms indicate that the probability of the response "cheese" given the cue word "bread" is lower (0.3%), than is the reverse association (7.6%).

A further attempt was to produce a result in which cued recall would be markedly inferior to recognition. To these ends, asymmetric adjective-noun and noun-noun pairs were employed in the present study under the Tulving and Thomson paradigm. Since additional restrictions on the word pairs were imposed in this experiment, the distractor list for recognition was reduced to four words including the target word rather than five words including the target word and its strong cue.

Method

Three lists of 24 word pairs each were composed, each list containing 12 adjective-noun pairs and 12 noun-noun pairs. For six pairs of each type, the backward association (TW-cue word direction) was relatively high (mean of 14%) when compared with the forward association (cue word-TW direction) which was approximately 1%, as in the previous experiments. For the remainder of the items of each type of pair, the backward and forward association values were both low (mean of 1%). Table 6 presents the critical pairs. As in the previous study, a distractor list was used for the recognition task, with each of the 96 words (24 TWs and 72 distractors) randomly assigned a position on the sheet on which it was presented. As indicated before, the distractor list for recognition did not include the strong associate to the TW. This was eliminated because it was no longer needed in the present design and also because inclusion of such could lead to arguments that the strong associate to the TW caused confusion and hence a lowering of recognition performance.

Twelve subjects were presented all three lists via a Lafayette (Model #303) memory drum at a two-sec. rate. The faster presentation time was deemed necessary due to ceiling effects observed with four pilot subjects. Otherwise the procedure of Experiment 1 was employed.

Table 6. Cue Words and Target Words for the Critical Third List of Experiment 3.

	<u>Cue Word</u>	<u>Target Word</u>
	hungry	STOMACH
	loud	HAMMER
Low Backward	swift	EAGLE
	yellow	RIVER
	black	TABLE
Adjective-Noun	white	PEOPLE
	soft	CARPET
	high	MOUNTAIN
High Backward	sour	WHISKEY
	green	CABBAGE
	blue	OCEAN
	red	ANGER
	blossom	STEM
	doors	CARS
Low Backward	street	CITY
	doctor	NEEDLE
	dream	HEAD
Noun-Noun	fingers	NUMBERS
	house	COTTAGE
	sheep	MUTTON
High Backward	man	SOLDIER
	boy	BABY
	bed	SICKNESS
	bread	CHEESE

Results and Discussion

Table 7 and Figure 2 show the mean number of TWs recalled and correctly recognized as a function of type of syntactical pairing and backward association value.

The results of a three-factor analysis of variance are presented in Table 8. It indicates that the effect of the test procedure (cued recall vs recognition), $F(1,11) = 13.38$, $p < .05$, and of Backward association value (high backward vs low backward), $F(1,11) = 13.38$, $p < .05$ were significant. There was no significant effect of syntactical pairings and none of the interactions approached significance.

Correlated t tests were performed comparing performance for each of the types of pairs under recall and recognition. This analysis indicated that recall/recognition differences reached significance only for the adjective-noun pairs with high backward association, $t(11) = 3.391$, $p < .01$. The noun-noun pairs with high backward association did not quite reach the 5% level.

Given the information from the analysis of variance, it seems as if the "adjective" effect observed previously is rather a function of another variable, preexperimental associations. The critical factor appears to be the probability of generating a word given another word. The above should be tempered however, since the t test analysis suggests that an "adjective" effect may exist independently. In light of the small number of subjects used in the experiment, further discussion to this end will be delayed until Experiment 5.

Table 7
 Mean Number (M) and Proportion (P) of Target Words
 Recalled and Recognized as a Function of
 Type of Syntactical Pairing and Backward Association Value
 for Experiment 3

		<u>Adj-Noun</u>		<u>Noun-Noun</u>	
		<u>(M)</u>	<u>(P)</u>	<u>(M)</u>	<u>(P)</u>
Recall	High Back. Assoc.	2.92	.49	3.42	.57
	Low Back. Assoc.	2.50	.42	3.25	.54
Recognition	High Back. Assoc.	4.08	.68	4.25	.71
	Low Back. Assoc.	3.25	.54	3.25	.54

Figure 2. Mean Number of Target Words Recalled and Recognized as a Function of Type of Syntactical Pairing and Backward Association Value for Experiment 3.

- Noun-Noun, Hi Back Assn
- Adj-Noun, Hi Back Assn
- Noun-Noun, Lo Back Assn
- Adj-Noun, Lo Back Assn

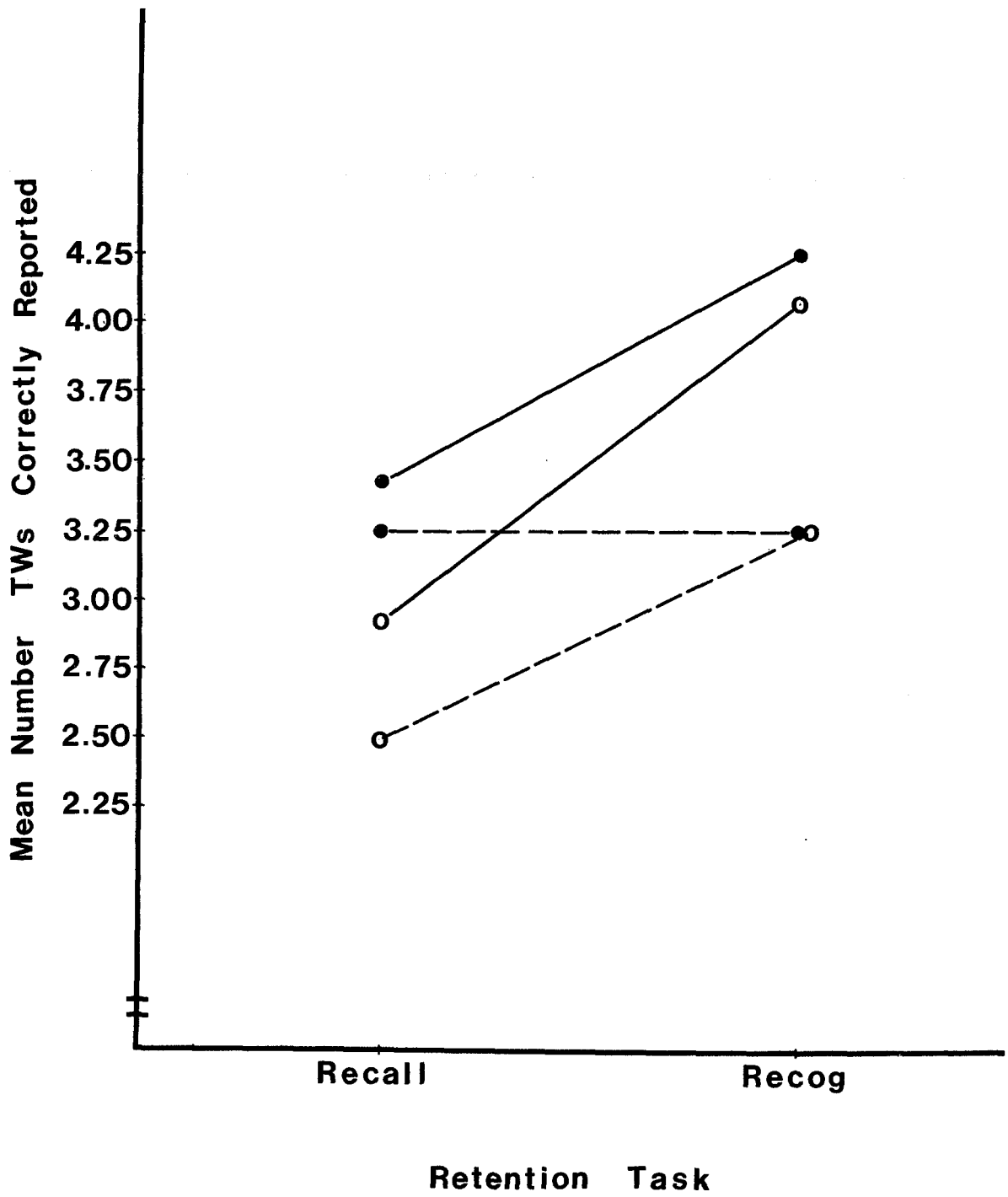


Table 8. Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Different Types of Syntactical Pairings and Different Values of Backward Association for Experiment 3.

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Total	213.66	95	-	-
Subjects	94.79	11	-	-
Retention (R)	10.01	1	10.01	13.38*
Association (A)	10.01	1	10.01	13.38*
Syntax (S)	3.76	1	3.76	1.97
R x A	3.02	1	3.02	2.36
R x S	1.27	1	1.27	1.49
A x S	0.10	1	0.10	<1.00
R x A x S	0.07	1	0.07	<1.00
error R	8.11	11	0.74	
error A	8.11	11	0.74	
error S	20.86	11	1.90	
error R x A	14.11	11	1.28	
error R x S	9.36	11	0.85	
error A x S	11.53	11	1.05	
error R x A x S	18.55	11	1.68	

*p < .05

EXPERIMENT 4

In each of the previous studies one factor has confounded all interpretations, namely that recognition performance was always measured prior to cued recall performance. The problem is especially acute when one would predict superior recognition performance. Therefore, in the present study, the type of recall task employed was an independent variable with some subjects having the recognition task and others the cued recall task presented at the same point of the procedure.

Another factor, which could lead to differential recognition performance, is TW frequency. Gorman (1961) found that high frequency words are not recognized as readily as are low frequency words. Thus, in the present study this variable was investigated.

Method

A critical third list of 24 Noun-Noun word pairs was constructed, consisting of eight pairs of words with high forward association value (mean of 25%) and high Kucera and Francis, 1971 TW frequency (mean of 200), eight pairs with high forward association value (mean of 17%) and low frequency TWs (mean of 27), four pairs with low forward association value (mean of 1%) and high frequency TWs (mean of 205), and four pairs with low forward association value (mean of 1%) and low frequency TWs (mean of 30). All pairs had low backward association value (mean of 2%). The critical third list is presented in Table 9. The lists were presented via the Lafayette memory drum at a two-sec. rate. For the critical third list, one group of ten subjects received the recognition task and the other group of ten received the cued recall task.

Table 9. Cue Words and Target Words for the Critical Third List of Experiment 4.

	<u>Cue Word</u>	<u>Target Word</u>
	street	CAR
	stomach	FOOD
	noon	NIGHT
High Frequency Target Word	hand	FOOT
	memory	MIND
	crown	KING
	infant	BABY
	kid	BOY
High Forward Associate	ground	SKY
	mutton	LAMB
	american	CITIZEN
Low Frequency Target Word	cottage	CHEESE
	bloom	FLOWER
	cabbage	VEGETABLE
	music	NOISE
	moth	INSECT
	box	PAPER
High Frequency Target Word	gun	CITY
	table	BED
Low Forward Associate	health	COLOR
	river	BATH
Low Frequency Target Word	knife	LION
	hair	SOAP
	doctor	NEEDLE

Results and Discussion

Figure 3 and Table 10 present the mean proportion of TWs recalled and recognized as a function of forward association value and TW frequency.

A three-factor mixed analysis of variance was done which indicated that the effect of test procedure (cued recall vs recognition) and association value (high forward vs low forward) was significant, $F(1,18) = 8.22$ and $F(1,18) = 4.73$, $p < .05$. As can be further seen in Table 11, there was a significant interaction of association value and TW frequency, $F(1,18) = 4.44$, $p < .05$.

Independent t tests were performed comparing performance for each of the types of pairs under recall and recognition. This analysis indicated that recall/recognition differences reached significance only for the high forward association pairs with high TW frequency and for the high forward association pairs with low TW frequency, $t(18) = 5.08$, $p < .01$ and $t(18) = 2.93$, $p < .01$, respectively.

This experiment supports the previous ones in that association direction seems to play the critical role in predicting differential performance for recall and recognition. Frequency of TWs did not appear to have any independent effect on performance. It was further noted that the change in procedure of presenting recall and recognition tasks to independent groups did not yield results different from those in the previous experiments.

Table 10

Mean Proportion of Target Words Recalled and Recognized
as a Function of
Association Value and Target Word Frequency for Experiment 4

	<u>Recall</u>		<u>Recognition</u>	
	<u>Hi TW Freq.</u>	<u>Lo TW Freq.</u>	<u>Hi TW Freq.</u>	<u>Lo TW Freq.</u>
Hi Forward Assoc.	.83	.79	.50	.60
Lo Forward Assoc.	.73	.50	.58	.48

Figure 3. Mean Proportion of Target Words Recalled and Recognized
as a Function of Association Value and Target Word Frequency for
Experiment 4.

●—● Hi TW Freq, Hi Forw Assn
○—○ Lo TW Freq, Hi Forw Assn
●---● Hi TW Freq, Lo Forw Assn
○---○ Lo TW Freq, Lo Forw Assn

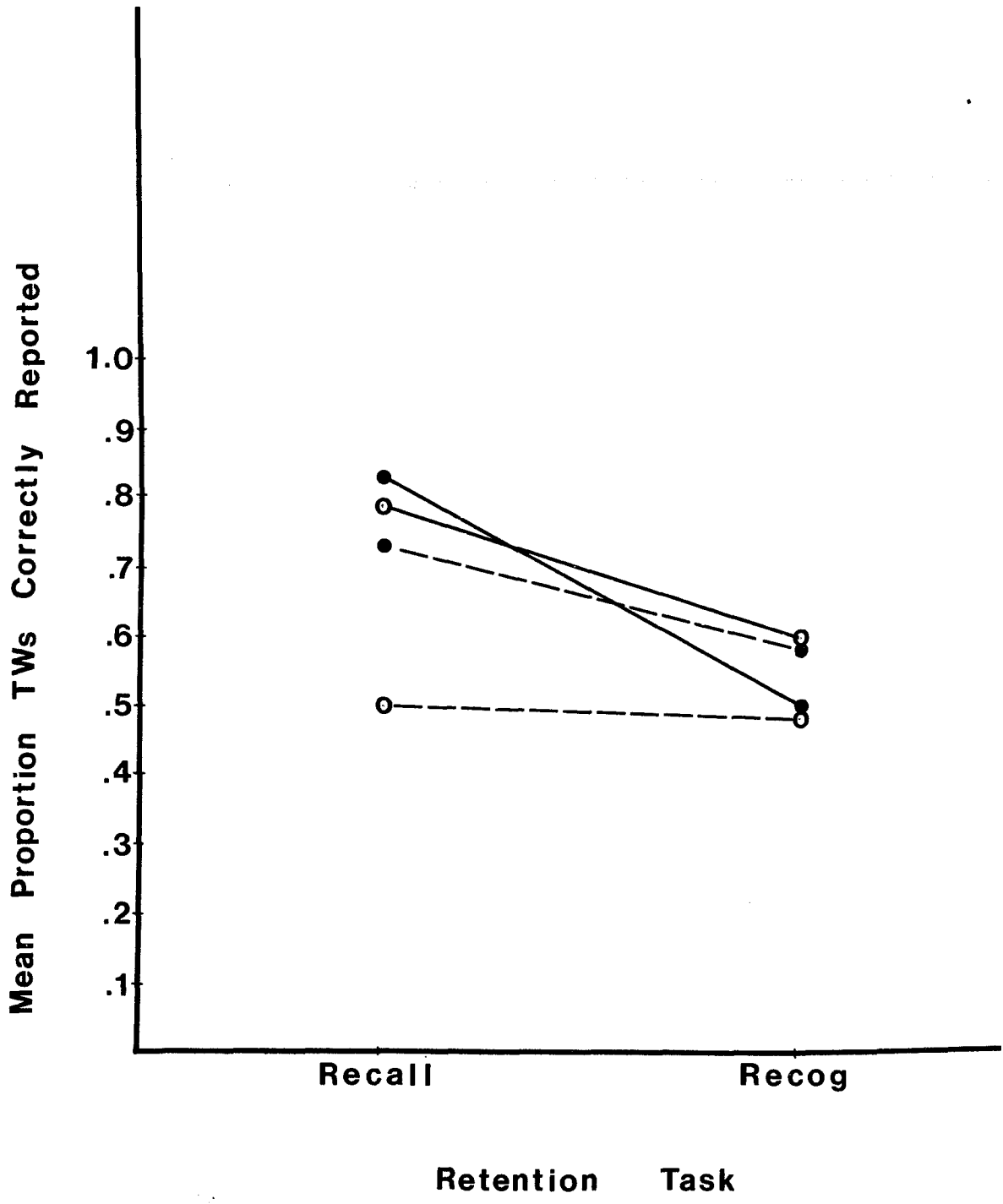


Table 11. Analysis of Variance Based on Proportion of Correct Responses for Cued Recall and Recognition for Different Values of Forward Association and Different Target Word Frequencies for Experiment 4.

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between Ss	1.89	19		
Retention (R)	.59	1	.59	8.22*
Error	1.30	18	.07	
Within Ss	3.00	60		
Association (A)	.24	1	.24	4.73*
R x A	.14	1	.14	2.81
error	.91	18	.05	
Frequency (F)	.09	1	.09	2.64
R x F	.09	1	.09	2.64
error	.59	18	.03	
A x F	.19	1	.19	4.44*
R x A x F	.00	1	.00	<1.00
error	.76	18	.04	

* $p < .05$

EXPERIMENT 5

In the previous experiments, a number of independent variables were examined in a relatively isolated fashion. It seemed desirable to combine these variables in a large-scale replication study. However, all the variables previously considered could not be incorporated within one experiment because of the difficulties in item selection. Therefore, two experiments were designed. In Experiment 5 only noun-noun pairs with different TW frequency and association direction were employed. In Experiment 6, TW frequency and type of pair (adjective-noun vs noun-adjective) were varied, with all words being low associated pairs (in both directions).

In the previous experiments, small numbers of subjects were used leading to a possibility of failing to detect some relationships. Therefore, a large number of subjects with a consequent increase in "power" was used in Experiments 5 and 6.

Method

Eighty undergraduates were used. They were presented with one of two critical third lists: one having 24 low frequency TWs (mean of 26), the other with 24 high frequency TWs (mean of 205). Both lists consisted of eight pairs with high forward association value (mean of 25%) and low backward association value (mean of 1%), eight with low forward association value (mean of 1.5%) and high backward association value (mean of 25%), and eight with low forward association value (mean of 1.5%) and low backward association value (mean of 1%). The mean frequency for the cueing words was 123. The critical third lists are presented in Tables 12 and 13.

A projector was used to present the lists at a two-sec. rate, with different random orders for all subjects. Cued recall and recognition were tested with one of three different random orders. For the critical third list, one-half the subjects received a recognition task and the other half received the cued recall task.

Table 12. Cue Words and Target Words for the Critical Third List with Low Frequency Target Words of Experiment 5.

	<u>Cue Word</u>	<u>Target Word</u>
	bloom	FLOWER
	mutton	LAMB
	moth	INSECT
High Forward Association and Low Backward Association	cabbage	VEGETABLE
	stomach	ACHE
	american	SOLDIER
	ground	SKY
	music	NOISE
<hr/>		
	baby	INFANT
	king	CROWN
	water	OCEAN
Low Forward Association and High Backward Association	food	CAKE
	cloth	SILK
	chair	COMFORT
	religion	PRIEST
	cheese	COTTAGE
<hr/>		
	street	JOY
	paper	BOX
	foot	CUBE
Low Forward Association and Low Backward Association	lion	WOLF
	knife	MEAT
	rock	HAMMER
	city	GRASS
	coin	EAGLE

Table 13. Cue Words and Target Words for the Critical Third List with High Frequency Target Words of Experiment 5.

	<u>Cue Word</u>	<u>Target Word</u>
	woman	LADY
	flower	PLANT
	arm	SHOULDER
Low Forward Association and High Backward Association	water	SEA
	window	DOOR
	soldier	AMERICAN
	sky	GROUND
	noise	MUSIC
	<hr/>	
	infant	BABY
	crown	KING
	stomach	FOOD
High Forward Association and Low Backward Association	kid	BOY
	street	CAR
	memory	MIND
	hand	FOOT
	moon	NIGHT
	<hr/>	
	gun	CITY
	box	PAPER
	bed	TABLE
Low Forward Association and Low Backward Association	hair	DOGS
	bible	NUMBERS
	health	COLOR
	doctor	FRIEND
	river	TRAIN

Results and Discussion

Table 14 and Figure 4 present the mean number of TWs recalled and recognized as a function of association direction and target word frequency.

A three-factor analysis of variance was performed which indicated that the effect of association direction was significant, $F(2,152) = 11.29$, $p < .05$. There was also a significant interaction of association direction and retention task (cued recall vs. recognition), $F(2,152) = 27.85$, $p < .05$. See Table 15.

Independent t tests were performed comparing performance for each of the types of pairs under cued recall and recognition. The alpha-level for the tests was determined by a method suggested by Dunn (1961), whereby the desired level (5%) is divided by the number of comparisons to be made ($k = 6$). Thus, the tests were each made at the .0083 level, with 38 df, yielding a critical t value of 2.805. It was necessary to interpolate within the t table in a manner suggested by Biometrika Tables for Statiticians, Vol I, edited by E.S. Pearson and H.O. Hartley (1954). The results of these comparisons indicated that cued recall/recognition differences were significant for High Forward Association/Low Backward Association with High Frequency TWs ($t = 2.98$), Low Forward/High Backward Association with High Frequency TWs ($t = 3.10$), and Low Forward/High Backward Association with Low Frequency TWs ($t = 3.09$). High Forward/Low Backward Association with Low Frequency TWs just missed the .0083 level ($t = 2.77$). Neither of the Low Forward/Low Backward Association groups approached significance.

Table 14

Mean Number (M) and Proportion (P) of Target Words
Recalled and Recognized as a Function of
Association Direction and Target Word Frequency for Experiment 5

	<u>Hi TW Freq.</u>		<u>Lo TW Freq.</u>	
	<u>(M)</u>	<u>(P)</u>	<u>(M)</u>	<u>(P)</u>
<u>Recall</u>				
Hi Forw/Lo Back Assoc.	6.10	.76	6.00	.75
Lo Forw/Hi Back Assoc.	4.45	.56	4.90	.61
Lo Forw/Lo Back Assoc.	5.00	.63	4.40	.55
<u>Recognition</u>				
Hi Forw/Lo Back Assoc.	4.70	.59	4.60	.58
Lo Forw/Hi Back Assoc.	6.00	.75	6.15	.77
Lo Forw/Lo Back Assoc.	4.25	.53	4.70	.59

**Figure 4. Mean Number of Target Words Correctly Recalled and
Recognized as a Function of Association Direction and Target Word
Frequency for Experiment 5**

- Hi TW Freq, Hi-Lo Assn
- △—△ Lo TW Freq, Hi-Lo Assn
- -○ Hi TW Freq, Lo-Hi Assn
- △- -△ Lo TW Freq, Lo-Hi Assn
- -○ Hi TW Freq, Lo-Lo Assn
- △- -△ Lo TW Freq, Lo-Lo Assn

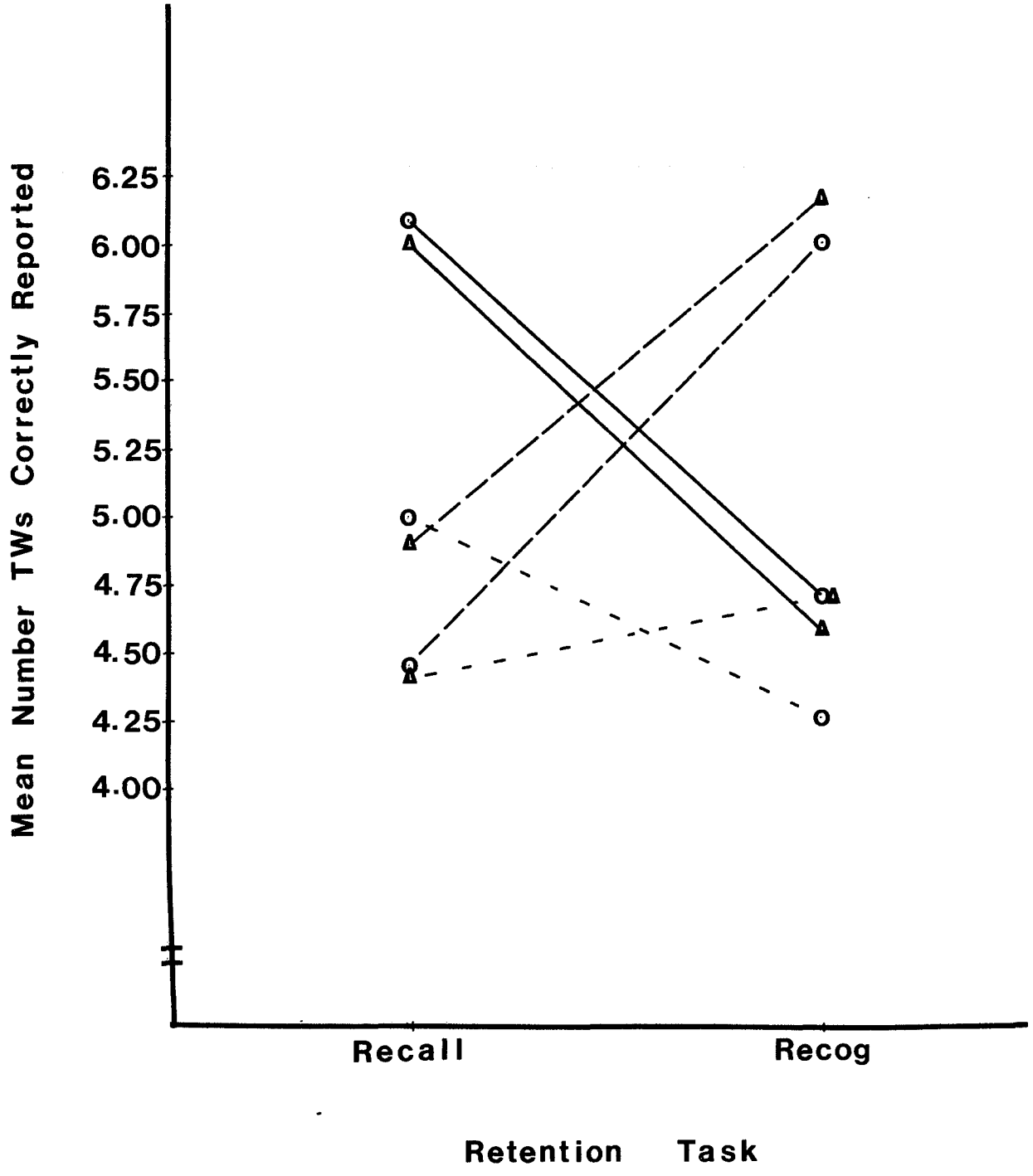


Table 15. Analysis of Variance Based on Number of Correct Responses for Cued Recall and Recognition for Differential Association Direction and Different Target Word Frequencies for Experiment 5.

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between Ss	351.73	79		
Frequency (F)	0.10	1	0.10	<1.00
Retention (R)	0.34	1	0.34	<1.00
F x R	0.94	1	0.94	<1.00
error b	350.35	76	4.61	
Within Ss	334.67	160		
Association (A)	32.06	2	16.03	11.29*
F x A	2.02	2	1.01	<1.00
R x A	79.08	2	39.54	27.85*
F x R x A	5.01	2	2.51	1.77
error w	216.50	152	1.42	

*p < .05

Thus, this replication indicated that the critical variable in predicting cued recall/recognition differences is the differences in pre-experimental associative habits. In the analysis above, the important features are the interaction effect of type of retention task with association direction and the independent t tests indicating the differences. If the forward associative probability is greater than the backward associative probability then one would expect greater cued recall than recognition performance. If the reverse were true, than recognition performance should be better than cued recall performance. If there are no differential associative probabilities than cued recall and recognition should be the same. It can be further seen from Table 14 and Figure 4, that performance is a function of the differential associative probabilities. By this I mean that the mean number of TWs given in the higher association direction for the two tasks was in the 6-word range. The mean number of TWs given in the lower association direction for the two tasks was in the 4.5-word range.

The presence of the main effect for association direction in the analysis indicates that there are differences among the three association direction conditions, particularly comparing the Low Forward/Low Backward with the other two. Once again, TW frequency had no differential effect on performance.

EXPERIMENT 6

In Experiment 3, a non-significant difference between cued recall and recognition was found for adjective-noun pairs where association value was low in both directions. It was decided to investigate the possibility of an adjective effect with a more powerful experiment.

Method

Eighty undergraduates served in this experiment. They were presented with one of two critical third lists either one with 24 low frequency TWs (mean = 29) or one with 24 high frequency TWs (mean = 204). For both lists, 12 were noun-adjective pairs and 12 were adjective-noun pairs. All pairs were low associates in both directions. Cue word frequency was similar to that used in Experiment 5 ($m = 121$). The critical third lists are presented in Tables 16 and 17.

A projector presented the lists at a two-sec. rate, with different random orders for all subjects. Cued recall was tested with one of three different random orders, as was recognition. For the critical third list, one-half the subjects received a recognition task and one-half received a cued recall task.

Table 16. Cue Words and Target Words for the Critical Third List with Low Frequency Target Words for Experiment 6.

	<u>Cue Word</u>	<u>Target Word</u>
	fruit	SOUR
	lake	SALTY
	sheep	THIRSTY
	music	LOUD
	boy	BRAVE
Noun-Adjective	bread	HUNGRY
	cars	SWIFT
	ocean	ROUGH
	table	SMOOTH
	tobacco	BITTER
	girl	TALL
	lion	YELLOW
<hr/>		
	heavy	HAMMER
	dark	MOON
	fast	BUTTERFLY
	green	CARPET
	square	RULER
Adjective-Noun	beautiful	BLOSSOM
	slow	ICE
	red	CLOTH
	easy	COMFORT
	blue	FLOWER
	quiet	STREAM
	soft	SOAP

Table 17. Cue Words and Target Words for the Critical Third List with High Frequency Target Words for Experiment 6.

	<u>Cue Words</u>	<u>Target Words</u>
	sky	LIGHT
	cars	WHITE
	cloth	BLACK
	anger	HARD
	chair	EASY
Noun-Adjective	earth	DARK
	girl	SHORT
	sea	LOW
	door	GREEN
	foot	COLD
	bread	SQUARE
	lake	HOT
	long	ARM
	rough	BOY
	heavy	HEAD
	bright	BABY
	sweet	FOOD
Adjective-Noun	clean	LADY
	dry	GROUND
	warm	BED
	slow	CITY
	yellow	HAND
	tall	KING
	bitter	SOUND

Results and Discussion

Table 18 and Figure 5 present the mean number of TWs recalled and recognized as a function of TW frequency and type of syntactical pairing.

A three-factor mixed analysis was performed which indicated that none of the main effects were significant, but that the interactions of TW frequency and retention task with syntactical pairing were significant, $F(1,76) = 12.67, p < .05$ and $F(1,76) = 35.21, p < .05$, respectively. See Table 19.

Independent t tests were performed comparing performance for each of the types of pairs under cued recall and recognition. This analysis indicated that recall/recognition differences reached significance only for the Noun-Adjective pairs with High TW frequency and for the Adjective-Noun pairs with Low Frequency TWs, $t(38) = 2.99, p < .01$ and $t(38) = -2.97, p < .01$, respectively.

The interaction of retention task with type of syntactical pair indicates that an adjective-cueing effect exists independently of "formal" association values (as measured by the free association norms). This possibility was suggested in Experiment 3. The above receives partial support in the t test analysis, where two of the comparisons reached significance.

The interaction of frequency of the TWs with type of syntactical pair was unexpected. Whatever is being said by this result seems to be supported by the t test analysis. Here performance during the recognition task (cueing with the adjective in the noun-adjective condition) with high frequency adjective TWs was inferior to the per-

Table 18

Mean Number (M) and Proportion (P) of Target Words
 Recalled and Recognized as a Function of
 Syntactical Pairing and Target Word Frequency for Experiment 6

	<u>Hi TW Freq.</u>		<u>Lo TW Freq.</u>	
	<u>(M)</u>	<u>(P)</u>	<u>(M)</u>	<u>(P)</u>
<u>Recall</u>				
Adjective-Noun	4.80	.40	4.25	.35
Noun-Adjective	5.70	.48	7.30	.61
<u>Recognition</u>				
Adjective-Noun	6.05	.50	6.75	.56
Noun-Adjective	3.90	.33	6.35	.53

Figure 5. Mean Number of Target Words Correctly Recalled and Recognized as a Function of Syntactical Pairing and Target Word Frequency for Experiment 6.

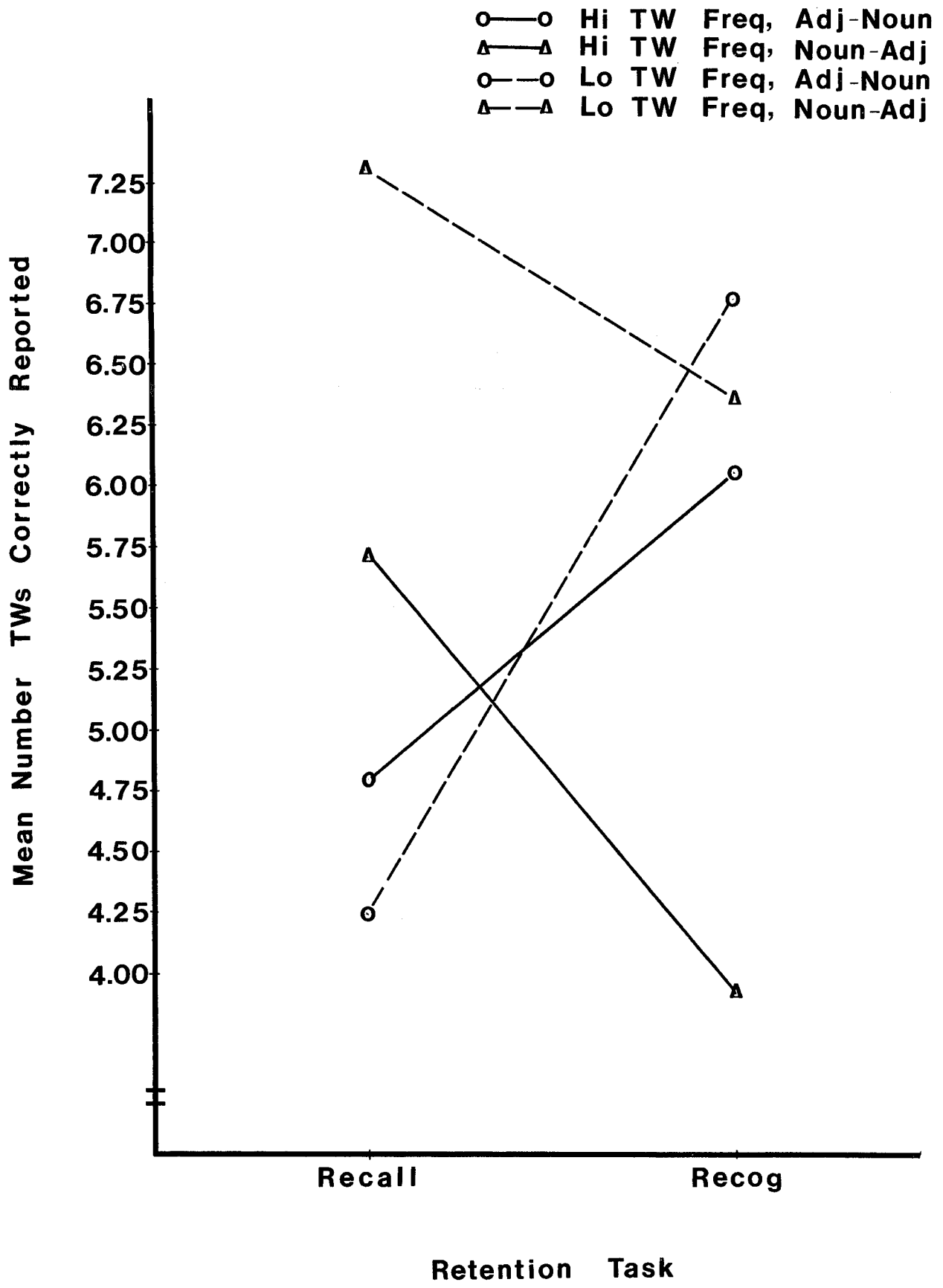


Table 19. Analysis of Variance Based on the Number of Correct Responses for Cued Recall and Recognition for Syntactical Pairing and Different Target Word Frequencies for Experiment 6.

<u>Source</u>	<u>SS</u>	<u>df</u>	<u>MS</u>	<u>F</u>
Between Ss	757.97	79		
Frequency (F)	44.10	1	44.10	3.81
Retention (R)	2.50	1	2.50	<1.00
F x R	11.02	1	11.02	1.20
error b	700.35	76	9.22	
Within Ss	377.00	80		
Syntax (S)	4.90	1	4.90	1.60
F x S	38.02	1	38.02	12.67*
R x S	105.62	1	105.62	35.21*
F x R x S	0.41	1	0.41	<1.00
error w	228.05	76	3.00	

*p < .05

formance on the recall task (cueing with the noun in the noun-adjective condition). In addition, where TWs of low frequency were used, for the adjective-noun condition, the findings were the opposite. The cause for this interaction with frequency and the adjectival-cueing effect is unclear and should be the impetus for future research.

General Discussion

The strategy behind the series of studies reported here was to replicate and extend Tulving and Thomson's (1973) dramatic finding of recognition failure of recallable words and to explore the consequences this would have on two-process theories of recall. Experiments 1 and 2 showed quite clearly that the most effective pairs of words in producing recognition failure of recallable words were noun-adjective pairs.

As suggested before, the subject's task in the Tulving and Thomson paradigm may be conceptualized to be one of learning or memorizing pairs of words. Under both cued recall and recognition procedures, the subject must recreate the original stimulus pair. Thus, the subject, given a "cue" - in this conceptualization, the "cue" could be either member of the pair presented originally - must generate the other member of the pair presented originally, and recognize the pair as the one presented.

If, as suggested by Loftus (1972), adjectives do not function well as cues to enter long term memory, then recognition failure of recallable words would be explained by the asymmetrical recall of noun-adjective pairs. Therefore, the attempt was made, in Experiments 3, 4 and 5 to exploit pre-experimental associative habits to produce the same type of asymmetries.

Tulving and Thomson (1973), in considering tentative interpretations for recognition failure observed in their experiments, considered the concept of asymmetry of associations between the input cue and the TW. Their "data show and imply that the 'forward'

association between the cue and target ... was stronger than the 'backward' association between the target and cue Thus it would be possible to argue that the recognition failure of TWs was a result of the weak association between the target and the cue." (p. 366). For them, the problem with this approach is explaining the asymmetry of the associations between the input cue and the TW.

They offer as a general answer to the question, the principle of encoding specificity. If the view expressed above that the task is to recreate a pair and recognize it is correct, then they err in searching for the asymmetry within the task. It may be argued instead that the asymmetries were pre-existing and reflected in their choice of items.

Based on the results of these experiments, it would appear that the results reported by Tulving and Thomson (1973) as well as their earlier results (Thomson, 1972; Thomson and Tulving, 1970 and Tulving and Thomson, 1971) are subject to at least one of two confounds: asymmetries caused by adjectival cueing (Experiments 1, 2 and 6), or asymmetries caused by differential associative probabilities (Experiments 3, 4 and 5).

In the preceding experiments, pre-existing associative habits were used to yield differential generative probabilities. There is no a priori reason why pre-experimental habits only would be useful in this paradigm. It would seem that a presentation of words with little or no prior associative probability could be used. The critical aspect would be to build into the subjects, in situ, differential associations for the presented pair. This would not appear to

be an easy task, since in the reported procedures, the simple presentation of pairs with no existing associative probabilities in either direction, leads to no difference in cued recall and recognition, unless we are dealing with pairs where an adjective is the cueing word (for both the cued recall task and the recognition task).

Much recent research had been directed towards investigation of the Tulving and Thomson (1973) phenomena (e.g., Reder, Anderson, and Bjork (1974) and Santa and Lamwers (1974). Reder, et al (1974) tested a semantic interpretation of encoding specificity. Their model assumes that a subject does not recognize the words (TWs) per se, but rather semantic interpretations of these words. When a strong cue is presented, a subject implicitly generates words and attempts to recognize their meanings or senses. If he recognizes one of the senses as being a TW, he then recalls the corresponding word. The difficulty caused by a change in context is attributable to the recognition phase of recall; the subject can generate the TW to the strong cue, but he cannot recognize it because he assigns a different interpretation to it than he assigned when the word was paired with its weak cue. Words with few senses should be less vulnerable to changes in context in the Tulving and Thomson paradigm than should words with many senses. To achieve this, Reder, et al (1974), chose word frequency as an index of the number of word senses. Words of very low frequency (9/1,000,000, in Kucera and Frances, 1967) were contrasted with words of moderate to high frequency (more than 50/1,000,000). Generally, low frequency words (e.g., hippopotamus)

tend to have only one sense. Reder, et al, argue that this is probably attributable to there being little opportunity for multiple senses to become differentiated and to be maintained. Also, it may be that words with one unique sense are appropriate to only a few situations and as a result have low frequency of occurrence. Schnor and Atkinson (1970) found a strong positive correlation between word frequency and number of dictionary meanings, as did Reder, et al.

Reder, et al showed that recognition for high frequency TWs is inferior to recognition for low frequency TWs, especially where the subjects were to generate words to a strong cue and then recognize. Only in the former instance was cued recall performance superior to recognition.

In none of the studies reported here did TW frequency have a differential effect on either cued recall or recognition performance when differential associative probabilities were manipulated. Unfortunately, Reder, et al (1974) do not report the words they used. A major difficulty in making the lists for the present studies, Experiments 4, 5 and 6, was to find pairs for the high frequency TWs, when the forward association was lower than the backward association. For most pairs in the available pool, the greater relative association was in the direction of the higher frequency word. For example, in the pair "crown-king", the word "crown" has a frequency of 19, the word "king" has a frequency of 88. The associative probability of producing king given crown is 43%; the reverse association probability is only 4%. Reder, et al failed to indicate that they considered differential associative probabilities in the selection of their pairs.

One may surmise that their pairs containing a high frequency TW had a higher relative association in the "forward" direction and therefore led to inferior recognition performance. In Experiment 3, it was observed that the correlation between TW frequency and relative association was present as a potential confounding factor. One of the reasons for Experiment 4 was to differentiate these variables. As stated above, TW frequency had no differential effect where differential association was manipulated. In Experiment 6, however, TW frequency did interact with type of syntactical pairs in an unusual way, and in a way that is not clear at this time.

It can be argued that Tulving and Thomson's (1973) original purpose - that of disproving generation-recognition models of recall, failed. Their question was: how can recognition be a subprocess of recall if it can be demonstrated that recall is at times better than recognition? The answer is that this possibility has yet to be demonstrated in a well-controlled study. If nouns are used in the presentation, with equal associative probabilities, there are no differences between cued recall and recognition performance. On this level, at least, there is no evidence against a generation-recognition model of recall. Further, it has been suggested that Tulving and Thomson misconstrued the subject's task within their paradigm (as it developed), as being concerned with a to-be-remembered word. It has been argued here, that the subject's task consists, instead, of remembering the pair of words and that retention measures will reflect any asymmetries inherent in these pairs.

References

- Anderson, J. R. & Bower, G. H. Recognition and retrieval processes in free recall. Psychological Review, 1972, 79, 97-123.
- Bahrick, H. P. Measurement of memory by prompted recall. Journal of Experimental Psychology, 1969, 79, 213-219.
- Bilodeau, E. A. Experimental interference with primary associates and their subsequent recovery with rest. Journal of Experimental Psychology, 1967, 73, 328-332.
- Bilodeau, E. A. & Howell, D. C. Free association Norms. (Catalog No. D210.2: F87) Washington, D.C.: U.S. Government Printing Office, 1965.
- Bower, G.H., Clark, M., Lesgold, A.M. & Winzenz, D. Hierarchical retrieval schemes in recall of categorized word lists. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 323-343.
- Cofer, C.N. Does conceptual organization influence the amount retained in immediate free recall? In Kleinmütz, B.J. (Ed.), Concepts and the structure of memory. New York; Wiley, 1967.
- Dunn, O.J. Multiple comparisons among means. Journal of the American Statistical Association, 1961, 56, 52-64.
- Eagle, M. & Leiter, E. Recall and recognition in intentional and incidental learning. Journal of Experimental Psychology, 1964, 68, 58-63.
- Estes, W.K. & DaPolito, F. Independent variation of information storage and retrieval processes in paired-associate learning. Journal of Experimental Psychology, 1967, 75, 18-26.
- Fox, P.W., Blick, K.A. & Bilodeau, E.A. Stimulation and prediction of verbal recall and misrecall. Journal of Experimental Psychology, 1964, 68, 321-322.
- Gorman, A.M. Recognition memory for nouns as a function of abstractness and frequency. Journal of Experimental Psychology, 1961, 61, 23-29.
- Hall, J.F. Learning as a function of word frequency. American Journal of Psychology, 1954, 67, 138-140.
- James, W. Principles of psychology, Vol I, New York: Holt, 1890.
- Kintsch, W. Models for free recall and recognition. In D.A. Norman (Ed.), Models of human memory, New York: Academic Press, 1970.

- Kucera, H. & Francis, W.N. Computational analysis of present-day American English. Providence: Brown University Press, 1967
- Light, L.L. & Carter-Sobell, L. Effects of changed semantic context on recognition memory. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 1-11.
- Loftus, E.F. Nouns, adjectives and semantic memory. Journal of Experimental Psychology, 1972, 96, 213-215.
- Mandler, G. Organization and memory. In. K.W. Spence and J.T. Spence (Eds.), The psychology of learning and Motivation, vol I. New York: Academic Press, 1967.
- Mandler, G. Organization and recognition. In E. Tulving & W. Donaldson (Eds.), Organization of memory, New York: Academic Press, 1972.
- McDougal, R. Recognition and recall. Journal of Philosophical Psychology and Scientific Methods, 1904, 1, 229-233.
- Murdock, B.B.Jr. Modality effects in short-term memory: storage or retrieval? Journal of Experimental Psychology, 1968, 77, 79-86.
- Palermo, D.S. & Jenkins, J.J. Word association norms. Minneapolis: University of Minnesota Press, 1964.
- Pearson, E.S. & Hartley, H.O. Biometrika tables for Statisticians, vol I. Cambridge: The University Press, 1954.
- Postman, L., Adams, P.A. & Phillips, L.W. Studies in incidental learning: II. The effects of association value and the method of testing. Journal of Experimental Psychology, 1955, 49, 1-10.
- Reder, L.M., Anderson, J.R. & Bjork, R.A. A semantic interpretation of encoding specificity. Journal of Experimental Psychology, 1974, 102, 648-656.
- Riegel, K.F. Free associative responses to the 200 stimuli of the Michigan restricted associative norms. USPHS Technical Report No. 8, Grant MH 07619, University of Michigan, 1965.
- Santa, J.L. & Lamwers, L.L. Encoding specificity: Fact or artifact? Journal of Verbal Learning and Verbal Behavior, 1974, 13, 412-423.
- Shepherd, R.N. Recognition memory for words, sentences and pictures. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 156-163.
- Thomson, D.M. Context effects in recognition memory. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 497-511.

- Thomson, D.M. & Tulving, E. Associative encoding and retrieval: weak and strong cues. Journal of Experimental Psychology, 1970, 86, 255-262.
- Tulving, E. Subjective organization in free recall of "unrelated" words. Psychological Review, 1962, 69, 344-354.
- Tulving, E. Theoretical issues in free recall. In T.R. Dixon and D.L. Horton (Eds.), Verbal behavior and general behavior theory, Englewood Cliffs: Prentice Hall, 1968.
- Tulving, E. Episodic and semantic memory. In E. Tulving and W. Donaldson (Eds.), Organization of Memory, New York: Academic Press, 1972.
- Tulving, E. & Thomson, D.M. Retrieval processes in recognition memory: Effects of associative context. Journal of Experimental Psychology, 1971, 87, 116-124.
- Tulving, E. & Thomson, D.M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80, 352-373.
- Wickelgren, W.A. Time, interference and rate of presentation in short-term recognition memory for items. Journal of Mathematical Psychology, 1970, 7, 219-235.
- Winograd, E. & Conn, C.P. Evidence from recognition memory for specific encoding of unmodified homographs. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 702-706.