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# Effect of Sex, Input-Response Mode, and Mnemonics on Free Recall

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Effect of Sex, Input-Response Mode,

and Mnemonics on Free Recall

(TITLE)

BY

John Thorne-Thomsen

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**THESIS**

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF

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IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY  
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1978

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING  
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## Abstract

Thirty two males and thirty two females performed at a memorization task in which lists of words were presented either auditorially or visually. In addition to mode of presentation and sex, two other independent variables included mode of response; words being recalled by writing or orally repeating them, and mnemonic device effect; subjects being instructed to use bizarre images aide or repetition memory aide. No significant sex differences were found in this experiment. There was a significant mode of presentation effect in which subjects who heard the words recalled significantly more than subjects who saw the words. There was also a significant mnemonic device effect in which subjects using the bizarre images memory aide recalled significantly more words than those using the repetition memory aide. There were two significant two-way interactions: a sex by mnemonic device interaction and sex by trials interaction. In the sex by mnemonic device interaction, males using a mnemonic aide recalled significantly more words than males using the nonmnemonic aide of repetition. Females, on the other hand, recalled slightly fewer words when using the bizarre images aide than when the repetition aid was employed. In the sex by trials interaction, females recalled more words when intermediate-length lists of words were presented where males recalled more words when long-length lists of words were presented. The auditory mode of presentation superiority may have been a procedural artifact. In the visual

condition, words were viewed for the duration of three seconds where in the auditory condition, words were heard and then followed by two seconds of silence. It may have been that this procedure forced the subjects in the auditory condition to rehearse the words more and rely more on imagery strategies. There are other possible interpretations of this finding: 1) the novelty of hearing words from a tape recorder; 2) the greater reliance of adults on verbal communication; and 3) the increased distractions during the visual condition. The mnemonic device effect was seen as being consistent with past literature in which the use of a mnemonic memory aide improves memorization. The sex by mnemonic device effect was viewed in terms of the idiosyncratic nature of mnemonic memory aides. Whereas males may have been more able to utilize the bizarre images aide, females might have preferred to employ a different memory aide. Recommendations for future research include: using reading ability as a covariable, and testing memory at several intervals after presentation.

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For many people, to have to memorize something is a very unpleasant task. Yet, a few people have always known special techniques which make a memorizing task possible with apparent ease. Not until recently have these techniques or devices attracted the attention of psychologists, for the techniques seemed like no more than tricks. It cannot be denied that such techniques often work and can be very useful in one's life. The realization that such mental devices do work should shed some light on the organization and operation of the mechanisms involved in memory.

Since different people have demonstrated the effectiveness of various mental techniques which aid memory, one might question the assumption that memory is simply a skill which improves with practice (Norman, 1969). Can the skill to memorize be strengthened in much the same way muscles can be developed by weight lifting? William James (1890) was one of the first to denounce this theory. James did this by conducting an experiment on himself which involved memorizing poetry by heart for eight consecutive days. He then continued by memorizing prose, hypothesizing that such memory work would aid in later poetry memorization. He found that he could not learn poetry more effectively having practiced with both prose and poetry.

Although James was basically correct in assuming that practice does not improve memory, he may have neglected the possibility of negative transfer or the influence of interference. The effect of learning prose after the memorization of poetry may have been detrimental to the later memorization

of poetry. James was also a bit premature in concluding that practice was all wasted effort. Practice alone may not improve memory, but skills and techniques may be attained through practice which facilitate memory. Practice is useless unless one establishes rules to govern his memorizing (Norman, 1969).

Woodrow (1927) conducted a similar experiment in which he asked the question, "Does practice improve the memorizing skill?" He found that a group of students, memorizing lists of words as practice, did no better than a control group on later memorization. A group of students who were instructed in proper techniques of memorizing, however, did much better after the same amount of study as those who simply practiced memorizing without instruction.

James and Woodrow did show that practice by itself offers little to improve memory but they answered few questions about the tools and aides that can improve memory. Psychologists have assumed that such techniques were simply clever usage of age old techniques. The fact that such techniques are not tangible or quantifiable complicates experimentation dealing with memory. Psychologists also assume that each subject in an experiment might employ these techniques in his own idiosyncratic way. Consequently, because of the difficulty in isolating universal factors in the process of memorizing, most of the knowledge to date is a collection of anecdotes rather than firm experimental evidence.

The memory techniques that people employ are devices to convert the content of the limited short term or primary memory



to the more commodious long term or secondary memory. Psychologists, interested in the process of coding information for storage in long term memory, would like to study LTM independently of STM. Because LTM and STM are virtually inseparable, both are extremely difficult to study experimentally (Norman, 1969). In contrast to short term memory, long term memory techniques, such as grouping, organizing, and distorting of material, are involved. Such mnemonic devices may be essential to the memorizing process. If mnemonic devices are actually an active part of rote memorization in the laboratory, as most psychologists now believe they are, intensive study of rote memorization could yield much to the study of memory processes.

The works of Miller, Galanter, and Pribram (1967), synthesizes the study of mnemonics into the hierarchical organization of flexible decision units. They suggest that a simplistic associationistic view of memory is inadequate. Such an association would refer to linking a piece of information in the primary memory with some information in the secondary memory. They expressed their associationistic views in terms of the Plan. They stated:

The usual approach to the study of memorization is to ask how the material is engraved on the nervous system, how the parts of it become learned or imprinted, or strengthened, or conditioned. The usual answers have to do with the amount of practice, the beneficent consequences of success, the facilitating or inhibiting effect arising from similarity among parts of the material or between

these materials and others, with the meaningfulness or other sources of transfer of previous learning, and so on. No one who knew the experimental data would question that all these factors are important in determining how fast and how well a person will be able to commit a particular string of symbols to memory. The reason for returning to this well cultivated plot and trying to crowd in another crop is that an important aspect of the memorizing process seems to have been largely ignored.

A memorizer's task in the psychological laboratory is to learn how to produce a particular sequence of noises that he would never make ordinarily, and have no significance, and that will be of no use to him later. Rote serial memorization is a complicated, tricky thing to learn to do, and when it is mastered, it represents a rather special skill. The argument here is that such a skill could not run itself off successfully unless it were guided in its execution by a Plan of the sort we have been discussing. What the subject is telling us when he reports all the wild and improbable connections he had to use is the way in which he developed a Plan to control his performance during the test period. (pp. 125 & 128)

A plan then is simply a system of organizing material into a meaningful set of associations which have meaning through internal frames of reference. Psychologists are beginning to accept the study of mnemonics now, however, and feel that everyone's system has something in common with everyone else's,

although the common feature is difficult to pinpoint.

One type of mnemonic device is rhymes. Rhymes are especially effective in establishing order relations, for once it is well constructed, any mistake in the order of recall of the items destroys the rhyme. Thus, we find rhymes used when the difficulty in memorization centers around the difficulty of learning the proper order. A common example of a rhyme being used as a mnemonic device is, "Thirty days has September, April, June and November..." One problem with such a rhyme is that one finds it difficult to remember one particular thing, such as how many days are in October. A person often needs to recite the whole poem to recall one specific item.

The method of loci is another useful mnemonic device for many people. Here, one must imagine the various items to be memorized being located in different physical locations, loci. Recall is accomplished by visualizing each location and thereby discovering the object.

Blick, Buosassissi, and Boltwood (1972) studied the rate of occurrence of different mnemonic techniques as used by college students. They found no significant differences in usage of such techniques by males and females, a distinction which several psychologists have tried to make (Anderson, 1974; Blick, Buosassissi, & Boltwood, 1972; Jablonski, 1972; and Pishkin, 1972). College students were involved in serial recall tasks in which lists of words were being memorized. Subjects then reported what kind of memory strategy they employed in trying to memorize these words. Studies have been conducted in the

past (Blick & Boltwood, 1972; Blick & Waite, 1971; Boltwood & Blick, 1970; Bugelski, 1962; Clark, Lansford, & Dallenbach, 1960; Martin, Boersma, & Cox, 1965; Roberts, 1968; and Underwood & Schultz, 1960) to see what specific mnemonic devices were employed by subjects in paired-associate learning situations. Serial learning has been approached by having experimentors supply the particular mnemonic strategy and then study the efficiency of such techniques. Subjects had not chosen particular mnemonic devices by their own volition but were instructed how to memorize given material. Blick et al. (1972) attempted to study serial recall using the same methodology that has been employed in paired-associate learning tasks.

The number of mnemonic aides reported by a single subject ranged from one to seven techniques with no significant difference between the sexes. Males reported a mean number of 2.13 memory aides in their memorization and females reported a mean number of 2.53 devices. An examination of these results suggested eight different categories of mnemonic strategies. The classification of memory aides in both frequencies and percentages for males and females is presented in Table I. Blick et al. (1972) defined these eight classifications as follows: 1) first letter, any manipulation of the first letter of the word; 2) simple repetition, rote memorization void of any mnemonic system; 3) imagery, techniques that involve using visual images of the word; 4) descriptive stories, arrangement of the words into narrative form; 5) mediation, techniques where extra list words were somehow related to the

MNEMONIC TECHNIQUES IN SERIAL LEARNING

TABLE 1

FREQUENCY AND PERCENTAGE OF MEMORY AIDS  
CLASSIFIED BY CATEGORIES AND SEX OF "S"

Sex	Categories of Memory Aids								
	First Letter	Simple Repetition	Im-agery	Descript. Story	Medi-ation	Other	Phonetic Cluster	Semantic Cluster	Total Aids
<b>Males</b>									
f	34	25	8	8	8	14	8	6	111
%	31	23	7	7	7	13	7	5	
<b>Females</b>									
f	39	27	19	16	15	9	14	8	147
%	27	18	13	11	10	6	10	5	
<b>Total</b>									
f	73	52	27	24	23	23	22	14	258
%	28	20	10	9	9	9	9	5	
	( 1 )	( )	( )	( )	( 2 )	( )	( )	( )	

words in the list to be learned; 6) other; ambiguous and unexplained aides; 7) phonetic clustering; grouping words according to some similarity in sound; and 8) semantic clustering; technique which handles words on the basis of meaning.

As noted before, no significant sex differences were obtained in this study, but a comparison of the distribution of memory aides using the totals, irrespective of sex, yielded a significant difference among categories. The most predominant category was first letter and repetition which together accounted for approximately 48% of all memory aides. The remaining 52% was divided almost equally among the six remaining categories. These six categories did not differ significantly from each other in their rate of occurrence. This experiment found that 80% of the serial learning memory aides represented mnemonic strategies and only 20% involved rote memorization. On the basis of the types of learning strategies reported, the free recall and serial tasks appear to represent almost identical verbal tasks for college students while the paired-associate situation appeared more complex.

Anderson (1974) also attempted to study several different mnemonic techniques and how such techniques related to the sex of subjects using them. Subjects were required to learn a list of words, having been given instructions about how they should attempt to memorize the words. The control group used repetition as a memorizing technique. The experimental groups were instructed to use different mnemonic techniques including method of loci, clustering, bizarre images, first letter tech-

nique, and the sentence method. Subjects were requested to recall as many words as they could remember immediately after reading the words, one week after the initial reading, and three weeks after the initial reading.

Through all three recall periods, females performed better than males in the recall of words. This difference became significant during the three-week recall period. There was also significant interaction between the sex variable and the method used during the one-week and three-week recall period. Females performed well at the method of loci and bizarre images while males scored well on the first letter technique, bizarre images, and clustering. Females tended to do poorly with repetition and the sentence method. Males tended to do poorly with methods of loci and repetition. The first letter technique seemed to be the most effective mnemonic technique for both sexes and for the duration of the three weeks. Mnemonic devices were shown to produce greater retention as time elapsed.

Jablonski (1972) studied memory in a similar way as Anderson when he conducted an experiment on cued and uncued multi-trial free recall as a function of age, mnemonic instruction, and sex. Jablonski was also studying mediator utilization deficiency which refers to the tendency to fail to use an available mediator between learning and recall. He hypothesized that one factor which might contribute to the presence of the deficiency, (found mostly in young children), was the absence of specific retrieval cues at the time of recall. This hypoth-

esis was tested by presenting category labels as retrieval cues at the time of recall. Another hypothesis stated that providing retrieval cues would primarily increase recall and clustering for long term memory.

In Jablonski's experiment, subjects were chosen from the first and sixth grade and from college age subjects. Subjects from each age group were given standard free recall instructions, repetition instructions, or chunking instructions as mediational strategies. Words were given to the subjects over five trials, and these words were presented orally. The recall period was four minutes long with the first two minutes devoted to uncued free recall and the next two minutes devoted to cued free recall.

It was found that first grader's recall increased at a slower rate than recall of the other age groups. Trials was a significant variable in this experiment but did not interact with age. The age by mnemonic instruction by sex interaction was also significant. Females clustered better on the chunking mnemonic and first grade and college males clustered better under the repetition mnemonic. Jablonski concluded that cuing at the time of recall reduces the magnitude of the mediator utilization deficiency by adding retrieval of available but inaccessible items for long term storage.

Pishkin (1972) studied a less common memory aide; availability of task correct performance cues and task incorrect performance cues and the interaction of this aide with the sex variable. Boys and girls had to categorize cards which contained two different dimensions; a color and a shape dimension.



In some cases, subjects were given only one instance of task performance; either right or wrong response in the categorization. In another condition, subjects were given two instances of task performance; right-right instance, right-wrong instance, and wrong-wrong instance. As past studies have indicated (Pishkin, Wolfgang, & Rasmussen, 1967), Pishkin's study revealed that greater performance resulted when subjects were given two instances of task performance than when only one instance was given. At the first grade level, both males and females were unable to utilize instances of right-wrong and wrong-wrong performance cues. At the third grade level, females showed marked superiority when instances of right-right cues were available. Females were also better able to utilize cases of right-wrong and wrong-wrong performance cues than males. Performance of all subjects declined progressively from instances of right-right task performance cues to instances of right-wrong cues to instances of wrong-wrong performance cues. This finding was of interest since the results of his previous study (Pishkin, Wolfgang, & Rasmussen, 1967) revealed that for ten to eighteen year old subjects, performance is facilitated by availability of right and right-wrong instances. Pishkin points out that instances of right task performance cues are directly usable by the subjects where wrong performance cues have to be transformed in the minds of subjects before the information can be used. Pishkin explains superiority of first grade females and of third grade females as being due to the maturation rate of the two sexes, or the fact that the

teachers of the two classes and the experimentors were all females. Thus, the experiment might have been somewhat female orientated. The males might have considered the experiment a type of sissy play. Pishkin concluded that attitudinal and motivational factors were perhaps more influential than the maturation process.

Watson (1967) studied learning in children by conducting an experiment in which ten-week-old and fourteen-week-old infants were operantly conditioned to fixate upon a visual target. Reinforcement consisted either of visual or auditory stimuli. Watson reported a significant interaction of sex and modality of reinforcement with girls learning under auditory reinforcement but not visual and boys learning under visual but not auditory.

A second study of 24 ten-week-old infants found consistent results for girls but no significant learning for boys under visual, auditory, or combined reinforcement. Watson found a significant interaction between sex and reinforcement which he attributed in part to sex differences in the development of verbal skills favoring girls and the development of visual-spatial skills favoring boys. Watson considered alternative hypotheses concerning the interaction between sex and reinforcement:

One alternative interpretation of the modality X sex interaction would be that it only reflects a sex difference in maturation which, in turn, determines modality

sensitivity. If one further assumed that girls mature more rapidly than boys, then one could expect girls to show better learning under visual reinforcement at some point earlier than 14 weeks of age and boys to show better learning under auditory reinforcement at some point later than 14 weeks.

Another alternative interpretation exists in the possibility that the particular visual and auditory stimuli of the first study differed in their arousal value. (p. 512)

In light of the stimulus intensity interpretation, the modality times reinforcement duration interaction is notable. Since limiting the duration of reinforcement increases the functional effectiveness of the auditory and decreases the effectiveness of the visual stimulus, it would seem that if a difference in intensity existed, the auditory reinforcement was the more arousing stimulus (Watson, 1967). If one is to accept this interpretation, it could be hypothesized that girls are affected positively with the shortening of duration of reinforcement where boys are affected negatively.

Brosnan (1973) also attempted to study memory with young children. In his study, he sought to answer the question dealing with the existence of "one process" or "two process" theories of memory. That is, are recall and recognition two distinct forms of memory or one basic kind? He approached this study with the belief that some prior research had confounded the memory type being measured with coding process or form of symbolic representation. Thus, a verbal response on a picture

recall task would not be conducive to clarifying the memory process itself. Developmental data which shows improvement with age in memory skills have been interpreted as demonstrating the increasing use of verbal encoding to facilitate retention. Brosnan attempted to remove the confounding factor of age by developing a nonverbal measure of picture recall. By keeping the response mode and encoding process in the same mode, Brosnan hoped to examine the short term recognition and recall memory of young children and to explore for possible sex differences according to the stimulus.

The results obtained by Brosnan were seen as being consistent with the "two process" theory of memory because the correlation between the two memory types was found to be quite insignificant. Brosnan did find the usual age difference in memory but found little evidence of the dual coding hypothesis. Surprisingly, he found few sex differences except that males retained meaningless material slightly better than females.

Like Brosnan, Griffith (1974) found no sex differences in memory with children. However, he did find interactions between sex and mode of input. His first hypothesis indicated that good readers of both sexes and black and white races make more correct identifications than poor readers in both auditory recognition and visual recognition testing. This hypothesis was supported using first graders who performed at the noun-noun paired associate learning task. Results of the experiment suggested that there is an interaction between reading ability and task performance in the auditory testing mode as

well as the visual testing mode. If, at the college level, one sex is found to be superior at task performance or memorization skills, one might choose to investigate the difference in reading ability even at the college level.

Griffith's second hypothesis said that the subjects tested by auditory recognition will make more correct identifications than those tested by visual recognition in both races, both sexes, and both levels of reading ability. This hypothesis was not supported in Griffith's research. This may simply indicate that neither sensory mode has an inherent superiority over the other. The third hypothesis stated that there will be no significant differences between the number of correct identifications made by males and by females within both races, both testing methods, and both reading levels. This hypothesis was supported. There was an interaction, however, between sex and the testing mode. Females tended to do better under the visual testing mode where males tended to do better under the auditory testing mode.

In Griffith's findings, one might ask if reading ability is simply an outward manifestation of intelligence. This assumption would tend to decrease the significance of the first hypothesis, since one would expect a more intelligent person to make more correct identifications than a less intelligent person. His findings in this regard could conflict with his findings dealing with the third hypothesis if one accepts the assumption that girls mature more rapidly than boys. If this is true, girls would be expected to perhaps be better readers

at the first grade level and thus do better at the auditory testing conditions as well as the visual. This question was partially answered in Griffith's research, for good readers performed much better than poor readers under the visual recognition testing method but only slightly better under the auditory recognition testing method.

Elliot (1973) found similar results as those of Griffith and obtained such results using junior high school students as subjects. Elliot attempted to study the effectiveness of auditory versus visual presentation in an educational setting. Elliot also examined the sex variable in conjunction with the mode of presentation variable and asked the question, "Would boys benefit more than girls from a particular method of instruction?" (Elliot, 1973) Elliot hypothesized that the oral mode of presentation would avoid penalizing poor readers in their classroom learning. In comparing instructional effectiveness, Elliot found that for boys who were poor readers, the auditory training was significantly better than the visual. In addition, all boys combined did significantly better with auditory instruction as compared with visual instruction. Girls, on the other hand, performed significantly better under the visual instruction condition. In comparing sex differences, it was found that girls obtained higher scores on tests containing questions pertaining to prose writing than boys. This superiority was found to be regardless of reading ability, treatment, or test mode. Elliot concluded that education might be improved by employing the auditory mode of instruction more frequently and by matching

the sensory mode of instruction with the mode of testing.

Birkett (1976) also studied sense modality in terms of sex differences but with college age subjects. In this study, he examined reasoning versus imagery strategy in the solution of visually and auditorially presented family relationship problems. Birkett studied the effects in the interaction of sex, mode of input, and the particular strategy used by each sex under each of the input conditions. Forty college age subjects were used, twenty males and twenty females with ten of each sex in the two respective input conditions. Subjects were solving family relationship problems like, "What relation is she to her mother's brother?"

The general results were that females showed shorter solution time in each of the input conditions, but only significantly so in the auditory condition. This type of problem might be misleading for such an experiment since females possess a stronger interest in family related matters. Wood and Shotter (1973) reported that females were superior in solving problems of this type whereas Wood, Shotter, and Godden (1974) found that males were better able to solve series problems of the kind, "Who is tallest; Fred or Bill if John is taller than Pete, Bill is taller than John, and John is taller than Fred?" This incongruity was considered by Birkett in light of the fact that one set of problems was presented visually and the other auditorially.

Whereas subjects in Birkett's experiment were trying to solve problems, subjects in the present experiment are trying only to memorize words. Subjects in the present experiment are

instructed on what mnemonics device they should use. Birkett's results might have been misleading, for strategies used by subjects were determined by the subject's introspection.

Visual input in Birkett's experiment was done by means of a slide projector as in the present experiment. In the auditory condition, subjects heard the problem read on a tape recorder just as subjects hear the words to be memorized in the present experiment. Though females showed superior performance in both the auditory and visual conditions in Birkett's experiment, both sexes demonstrated shorter solution time in the auditory condition as compared to the visual condition. This result could have been due to the type of strategy used by subjects, or the technique of presentation could also account for such differences. In the visual condition of Birkett's experiment, the problem was seen for a predetermined duration. In the auditory condition, the problem was spoken and the subject then had a period of silence during which his or her mind could process or categorize the information. This difference should be considered when comparing the differences between visual and auditory means of presentation.

The strategies used by males and females in a problem solving condition may yield increased understanding of strategies used by the different sexes in simple memorizing situations. Such strategies may indirectly point to male or female superiority in memorization under certain memorizing conditions.

In further explaining differences between input conditions, sexes, and even between individuals, Romney and D'Anderade (1964)



suggested that each individual possesses a cognitive map of kinship terms, and perhaps, of any specific word. The stronger the cognitive map formed by an individual or by a certain sex, the better the mastery of that term, concept, or word. Thus, females might have done better in Birkett's experiment because they have stronger cognitive maps of kinship terms and concepts. In recalling words, as in the present experiment, there could be differential strengths of cognitive maps by males and females or between individuals. These cognitive maps would be more employable under the auditory condition since verbal tasks relate to the visualization strategy. Verbal reasoning was the strategy believed by Birkett to be necessary in the visual condition of the family relationship problem.

Coltheart, Hull, and Slater (1975) obtained similar results as those of Birkett. They attempted to study imagery and reading by males and females of the college age. They began by making the generalization that females do better than males on verbal tasks while males are superior on visual-spatial tasks. Coltheart et al. (1975) made the point that sex differences in psychometric investigations have often been negligible and thus, are often ignored. They claim that this might be due to the instability of designing tasks which are purely verbal or purely visual-spatial. For example, a visual-spatial task might involve verbal reasoning to some degree, and the verbal task likewise could involve visual-spatial reasoning abilities or reasoning.

Coltheart et al. (1975) performed an experiment designed to involve purely visual-spatial and purely verbal tasks. The verbal task was to mentally determine which letters of the alphabet have the "ee" sound in their names, such as the letters "B", "C", "D", etc. The visual-spatial task was to proceed mentally through the alphabet, counting the number of letters containing a curve in their upper case form. Males and females, all undergraduates, were tested at both of these tasks. Females completed the verbal task more rapidly than males while males completed the visual task more rapidly.

Coltheart et al. (1975) then performed a second experiment in which subjects were asked to scan through a passage of prose, crossing out all occurrences of the letter "H". Though this is apparently a visual-spatial task, verbal reasoning was shown to be taking place, for unpronounced "H's" were missed more frequently than pronounced "H's", and misses were more frequent with females than with males. This might further support the theory that females are superior with verbal tasks but somewhat inferior at verbal reasoning ability, the more covert aspect of memory and learning. This result also suggests that males are superior at visual-spatial tasks while somewhat inferior at visual-spatial reasoning ability, the more covert aspect of learning and memory. This result also suggests that phonological coding during reading is more prevalent in women than men (Coltheart et al., 1975).

The findings of Birkett (1976) conflicted with those of Coltheart et al. (1975) dealing with male or female superiority

in verbal reasoning and task performance. This conflict might be resolved by differentiating between the more overt performance on verbal tasks and the verbal reasoning strategy. At a verbal task, males and females often report using an imagery strategy in solving the problem. Females have been shown to be superior at verbal tasks which means, in effect, that they may be superior in visual-spatial imagery. The opposite may be true with males. With a visual-spatial task, males may encode material through a verbal strategy. Thus, one might hypothesize that males are better at solving visual-spatial problems while females are better at verbal problems, and males are superior at verbal reasoning abilities while females are superior at visual-spatial reasoning strategies.

King (1959) conducted a study which demonstrated female superiority at recall. He analyzed results of previous experiments in light of sex differences (King, 1959; King & Cofer, 1958). He studied both learning and forgetting of partly connected meaningful material in which subjects learned various passages from the Miller and Selfridge list of approximations to normal English (Miller & Selfridge, 1950). In the later analysis of the two previous learning experiments (King, 1959; King and Cofer, 1958), King sought to study the amount of material originally learned and the amount of material lost. Females were found to recall significantly more words in three fourths of the tested groups in the initial experiment. The mean delayed recall score was also a means of comparison in

which the immediate recall was subtracted to yield a score indicating the amount of material lost. In this comparison, no significant differences were found between males and females.

In summary, James (1890) and Woodrow (1927) were two of the first to question some of the common assumptions underlying memory. They asked whether memory is simply a skill which can be improved with practice. They tested memory in themselves and in others after practice in memorization and both found that practice did not facilitate memory. Norman (1969) points out that they were basically correct in their conclusions that practice alone does not improve memory, but he suggests that practice is helpful in developing different mental techniques and tools for memorization. In Norman's writing, he suggested that the use of such tools and techniques may be very idiosyncratic and consequently have been ignored by psychologists in the past. The fact that universal tools and techniques in memory are so difficult to pinpoint has made memory very difficult to study experimentally. Anderson (1974) and Blick et al. (1972) were four psychologists who attempted to categorize memory techniques into categories and related these different classifications of mnemonic techniques to the sexes.

In the writings of Miller et al. (1967), a differentiation was made between long term memory and short term memory and they spoke of the need for a Plan. Their discussion of Plans centered around the need for a person to have a tool or technique

for transforming material in the STM to the more commodious LTM. Anderson also pointed out the necessity of examining memory in different stages of the LTM. He examined memory of words by subjects immediately after memorization, one week afterwards, two weeks afterwards, and three weeks afterwards. He found that those who were instructed to employ a certain mnemonics device did progressively better during these three recall periods than those who were instructed to use a nonmnemonic technique of repetition.

In Pishkin's writing (1972), he attributed female superiority in memorization primarily to an attitudinal and motivational factor in the experiment. He noted that teachers and experimentors were all female which he regarded as an inhibiting factor for males in the experiment. This points to the fact that lab findings dealing with memory should be interpreted cautiously if they are going to be related to memory processes in practical application.

Jablonski (1972) was one of few psychologists to conduct a study on memory with various age groups; first graders, sixth graders, and college aged subjects. He found different rates of improvement for these age groups when retrieval cues were provided to try to reduce the mediator utilization deficiency. The fact that these age groups performed differently suggests that experiments in memory should be applied to the age group on whom the experiment was performed. An experiment on children should not be generalized to adults and vice versa.

The concept of transformation and associated difficulties

as a psychological phenomenon was discussed in several different contexts by different authors. Pishkin (1972) looked at the difficulty of transforming wrong performance cues to a usable piece of information which can be directly applied by an individual. Miller et al. (1967) looked at the process of transforming material in the STM to the LTM and the need for a Plan to conduct such transformation. Brosnan (1973) regarded the difficulty of transformation when the individual encodes material under one sensory mode and then is tested under a different sensory mode. He thought that past experimentation on memory has been confounded by forcing subjects to make such transformations rather than testing subjects in the same sensory mode as the encoding mode.

Watson (1967), Griffith (1974), Elliot (1973), Birkett (1976), and Coltheart et al. (1975) all examined differential input preference between males and females. Watson found a differential preference between males and females in terms of the functional effectiveness of reinforcement, either auditory reinforcement or visual reinforcement. He found that males were more responsive to visual reinforcement and females were more responsive under the auditory reinforcement. Griffith found that first grade males showed a preference for auditory input where females showed a preference for visual input. Elliot found that with junior high school aged subjects, the same preference was found among males and females. Birkett and Coltheart et al. experimented with college aged subjects and found another shift in sensory input preference. In their research, males tended

to perform better at visual-spatial tasks while females performed better at auditory tasks. It was hypothesized that males were superior at verbal reasoning ability where females were better at visual-spatial imagery. No hypotheses were made about why such shifts take place.

### Method

Subjects. In this experiment, 64 volunteer undergraduates, 32 males and 32 females, were tested at Eastern Illinois University. Subjects were randomly assigned to combinations of type of mnemonic device, mode of presentation, and response mode.

Apparatus. In the visual presentation condition of this experiment, the 49 words to be presented were photographed onto slides and projected on a blank wall by means of Kodak Scan Slide projector. Since words were shown one every three seconds, a three-second timer was devised using a 20 RPM motor with a cam wheel attachment. In the auditory presentation condition, the instructions and words were recorded on a cassette tape. Responses of subjects were recorded onto a second cassette tape recorder.

Design and procedure. This experiment employed a two by two by two by two factorial, post-test only design. In addition to sex, the variables under investigation included: 1) two types of mnemonic devices; repetition memory aide and bizarre images memory aide; 2) two modes of input; visual and auditory; and 3) two modes of response; written and oral.

Subjects in the visual presentation condition first read typed instructions concerning what memory aides they should

utilize, how words were to be presented and how subjects would respond following presentation. After reading the instructions, subjects were given the opportunity to ask any questions they might have. Words were then shown, starting with a four word list. After subjects recalled as many words as they could remember, a five word list was then presented and each subsequent list increased in length by one word up to a ten word list.

Subjects in the auditory presentation condition heard identical instructions, explaining the mnemonic aide to be utilized, how words were to be presented and how subjects were to respond. Words were then heard from the same tape on which the instructions were recorded, beginning with a four word list. After subjects had recalled as many words as they could remember, subsequent lists of increasing length which increased up to a ten word list were heard.

In the written response condition of this experiment, subjects were requested to write as many words as they could remember following the presentation of one list. Time was allowed for subjects to write and then, the following list of increasing length was presented. In the oral response condition, words were orally repeated by the subject and recorded on a cassette tape recorder.

The four combinations of mode of input and mode of response included: visual presentation-written response, visual presentation-oral response, auditory presentation-written response, and auditory presentation-oral response. With the additional variables of sex of subject and type of mnemonic



device, there were sixteen four-factor combinations with four subjects in each combination.

Following is the set of instructions seen or heard by each individual:

Bizarre image mnemonic aide instructions: In the next few moments, you will see (hear) a list of words which you should try to memorize. In memorizing these words, try to picture the words as belonging in a group. For example, if you saw (heard) the words "chair", "dime", and "ham", you might picture a dime resting on top of a ham which is sitting in a chair. So, recalling these words simply involves recalling this vision of objects being clustered together. After you have heard the list of words, you will then proceed to write (orally repeat) as many of the words in the list as you can remember. You will then see (hear) another list of words, but the list will be longer. The order in which you recall words is not important. Are there any questions?

Repetition memory aide instructions: In the next few moments, you will see (hear) a list of words which you should try to memorize. In memorizing these words, continually repeat the words in your mind until they seem fixed in your memory. After you have seen (heard) the list of words, you will then proceed to write (orally repeat) as many words in the list as you can remember. You will then see (hear) another list of words but the list will be longer. The order in which you recall words

is not important. Are there any questions?

### Results

The independent variables in this experiment included the number of correctly repeated words and their percentage for each individual for each of seven lists of presented words. An analysis of variance was conducted on these variables with the following main effects: sex of subject, mode of presentation, mode of response, mnemonic device effect, and trials effect (see Table II for AOV). The means and standard deviations of the sixteen combinations of these variables are presented in Table III.

Mode of presentation had a significant  $F$  score ( $F=12.79$ ,  $df=1/48$ ,  $p.<.01$ ) in which subjects tended to score higher under the auditory mode of presentation (mean of words presented visually=5.05, mean of words presented auditorially=5.59). The mnemonic device effect ( $F=4.34$ ,  $df=1/48$ ,  $p.<.05$ ), in which subjects using repetition (mean of subjects using repetition=5.18, mean of subjects using mnemonic device=5.48), was significant. The significance with the trials effect ( $F=34.93$ ,  $df=6/288$ ,  $p.<.01$ ), in which memory improved for subjects in successive trials, was also significant. This effect was somewhat spurious since the initial AOV was conducted on raw data. When working with raw data, the maximum number of words recalled changes from trial to trial which restricts the interpretation of trial means. To compensate for this problem, raw data was converted to percentage data and then submitted to an analysis of variance (see Table IV for AOV with percentages). Under this testing, significant scores were mode of presentation

TABLE II  
ANALYSIS OF VARIANCE  
OF NUMBER OF WORDS RECALLED PER TRIAL

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Input (A)	1	29.52	12.79**
Response (B)	1	7.25	3.14
Sex (C)	1	2.73	1.19
Mnemonic	1	10.02	4.34*
A X B	1	3.40	1.47
A X C	1	7.77	3.37
B X C	1	.002	.001
A X D	1	2.73	1.19
B X D	1	4.52	1.96
C X D	1	12.56	5.44*
3 & 4 Factor interactions	5	2.59	1.12
Error I	48	2.31	
Trial (E)	6	39.36	34.93**
A X E	6	2.33	2.07
B X E	6	1.24	1.10
C X E	6	3.15	2.80*
D X E	6	2.04	1.81
3, 4, & 5 Factor interactions	66	1.00	.89
Error II	288	1.13	

\*  $p < .05$

\*\*  $p < .01$

TABLE III

THE NUMBER OF WORDS RECALLED PER TRIAL FOR TREATMENT COMBINATIONS  
OF STIMULUS INPUT, RESPONSE MODE, SEX, AND MNEMONIC

		Male			
Input	Response	Control <u>X</u>	Control <u>SD</u>	Experimental <u>X</u>	Experimental <u>SD</u>
Visual	Visual	4.82	.54	5.64	.64
Visual	Auditory	4.64	.25	4.96	.59
Auditory	Visual	5.61	.82	6.07	.50
Auditory	Auditory	5.29	1.00	6.25	.38

  

		Female			
Input	Response	Control <u>X</u>	Control <u>SD</u>	Experimental <u>X</u>	Experimental <u>SD</u>
Visual	Visual	5.43	.76	5.25	.43
Visual	Auditory	5.11	.14	4.71	.50
Auditory	Visual	4.96	.49	5.86	.51
Auditory	Auditory	5.57	.68	5.11	.36

TABLE IV  
ANALYSIS OF VARIANCE  
OF PERCENT OF NUMBER OF WORDS RECALLED PER TRIAL

Source	<u>df</u>	<u>MS</u>	<u>F</u>
Input (A)	1	4925.69	14.46**
Response (B)	1	904.88	2.66
Sex (C)	1	142.31	.42
Mnemonic	1	1531.43	4.50*
A X B	1	409.85	1.20
A X C	1	1354.21	3.97
B X C	1	8.55	.03
A X D	1	401.85	1.18
B X D	1	1034.27	3.04
C X D	1	2230.80	6.55*
3 Factor interactions	4	166.82	.49
A X B X C X D	1	1537.35	4.51*
Error I	48	340.69	
Trial (E)	6	12624.90	71.33***
A X E	6	222.29	1.26
B X E	6	183.45	1.04
C X E	6	481.30	2.72*
D X E	6	279.04	1.58
3, 4, & 5 Factor interactions	66	161.89	.91
Error II	288	177.00	

\*p. < .05

\*\*p. < .01

\*\*\*p. < .001

( $F=14.46$ ,  $df=1/48$ ,  $p.<.01$ ), mnemonic device effect ( $F=4.50$ ,  $df=1/48$ ,  $p.<.05$ ), and trials effect ( $F=71.33$ ,  $df=6/288$ ,  $p.<.001$ ).

The sex by mnemonic device interaction was significant for raw scores ( $F=5.44$ ,  $df=1/48$ ,  $p.<.05$ ) and percentages ( $F=6.55$ ,  $df=1/48$ ,  $p.<.05$ ) in which males scored higher using a mnemonic aide as compared to when males used repetition memory aide (significant simple effect:  $F=5.76$ ,  $df=1/48$ ,  $p.<.05$ , mean of males using repetition=5.09, mean of males using mnemonic aide=5.72). Girls, on the other hand, declined slightly, though not significantly, in memory ability with the use of a mnemonic aide (mean of girls using repetition=5.27, mean of girls using mnemonic aide=5.23). A significant simple effect was found in showing males superior to females when using a mnemonic aide ( $F=6.63$ ,  $df=1/48$ ,  $p.<.05$ ). Sex by trials was another significant interaction ( $F=2.80$ ,  $df=6/288$ ,  $p.<.05$ ) in which males and females scored equally as well in the first two trials (four and five word list). Around the third and fourth trial (six and seven word list), females scored higher than males and through the fifth, sixth, and seventh trial (eight, nine, and ten word list), males improved considerably, obtaining higher scores than females. The greatest difference between males and females occurred at the last trial although the difference was not significant ( $F=.37$ ,  $df=1/288$ ,  $p.<.05$ ).

In the results of this experiment, there was no significant three-way interaction but there was a significant four-way interaction: sex by mode of presentation by mode of response

by mnemonic device effect ( $F=4.51$ ,  $df=1/48$ ,  $p.<.05$ ). Under the AOV with raw data, this interaction was not significant. As noted before, males tended to improve considerably with the use of a mnemonic aide compared to when repetition was used. For all females, except for those in the auditory-written response condition, memory declined slightly with the use of a mnemonic aide as compared to when repetition was used. In the auditory presentation-written response condition, females improved considerably so that the improvement resembled that made by males in all four presentation-response conditions (mean with repetition in auditory presentation-written response condition when using repetition=4.96, mean when using mnemonic aide=5.86).

#### Discussion

Based on the findings of Birkett (1976) and Coltheart et al. (1975), one might have expected a significant sex or sex by mode of input interaction in the present study. In such an interaction, one sex would memorize better under one sensory mode where the other sex would memorize better under the other sensory mode. Though such an effect was not found, a significant mode of input effect was found in which the auditory mode was found to be more effective than the visual mode of input. In the Birkett study, females were found to be superior in solving family relationship problems in both the visual and auditory input condition, but only significantly so in the auditory condition. In his conclusion, Birkett stated that this superiority could have been due to the nature of the problem since

females often show greater interest than males toward family related problems. In the experiment of Coltheart et al. (1975), it was found that females were superior in solving verbal tasks while males were better at visual-spatial tasks. In both these studies, tasks were involved where in the present study, memorization itself was involved. This difference may account for the lack of significant sex and sex by mode of input effects in the present experiment.

In the present experiment, memorization was superior under the auditory condition, an outcome not found in the experiment of Birkett (1976) or Coltheart et al. (1975). Birkett discussed such a possibility, though, and stated that in the visual condition in his experiment, problems were seen for a predetermined duration and could be viewed while the problem was being solved. In the auditory condition, subjects heard the problem only once and had to retain the problem while solving them. Subjects in the auditory condition also reported using a visualization strategy more often than subjects in the visual condition. Thus, in the auditory condition, subjects were required to utilize the memorization process more and also had to visualize the problems more when compared to the visual input condition. In the auditory portion of the present experiment, words were heard and then followed by two seconds of silence. This two-second period of silence may have forced subjects to utilize their memorization skill more and to visualize the word and its associated bizarre image to a greater extent than in the visual input condition. Memorization might



have been better in the auditory input condition because of the forced memory effect or because of the increased visualization of the word.

Although Watson (1967) worked with young infants, his findings could have an application in the present experiment. He reported that the reduction in duration of visual reinforcement made it less effective whereas reduction in duration of auditory reinforcement increased its effectiveness. In the present experiment, the auditory stimulus lasted for only a split second which is an extremely short duration. In the visual condition, stimuli lasted for a full three seconds, a relatively long duration for one written word. Whereas the shortness of the auditory stimulus may have increased its effective arousal value, the length of the visual stimulus may have allowed for a sort of habituation of the stimulus and consequent decrease of its effective arousal value. If Watson's findings are applicable to the present experiment, the duration of stimuli could explain the superiority of the auditory condition over the visual condition.

Griffith (1974) who worked with elementary children and Elliot (1973) who worked with junior high school age children found a significant sex by mode of input interaction. In both studies, boys were found to have better memorizing ability under the auditory condition and girls showed superior memorizing ability under the visual input mode. Whereas Birkett (1976) and Coltheart et al. (1975) may not have generalized to the present experiment because of the memorizing-problem solving

difference, Griffith and Elliot may not have generalized because of the age difference of subjects used.

Griffith (1974) hypothesized that memorization would be superior under the auditory input condition compared to the visual input condition. This hypothesis was not supported in his findings but was supported in the present experiment. Since reading ability improves with age, one might have expected children to memorize less under the visual input condition as compared to the auditory input condition whereas college subjects might be expected to memorize better under the visual condition. The discrepancy between these two studies may be due to the increased dependence on auditory communications by adults.

The auditory condition may have been more effective than the visual input condition because of less distractions in the auditory input condition. In the visual input condition, subjects were located in a room where other visual stimuli were present; chairs, table, projector, and even the sight of the experimenter. In the auditory input condition, all that the subjects heard was a voice emitted from the tape recorder along with some slight distractions arising outside the room. Had external distractions been eliminated under the visual input condition, the auditory and visual presentation conditions might have been equal in their effectiveness.

The novelty of hearing words and instructions read aloud from the tape recorder may have influenced the memorizing process. In one's day to day experience, it is not unusual to be exposed to single words on a screen, board, or page. One is

seldom exposed to single words, however, which are spoken from a machine and which lack a visual context behind them.

While the mnemonic effect is in agreement with the findings of Anderson (1974) and Blick et al. (1972), there is a conflict in terms of the sex by mnemonics interaction found in the present experiment. As in the two previous studies cited above, the present experiment also found memorization greater with the use of mnemonic aides. Both of the previous studies also found that bizarre images were used equally as well by both sexes and repetition was found to be less effective with both sexes. The present study found that females were slightly less efficient when memorizing with the bizarre images memory aide than when memorizing with the repetition memory aide. This conflict might be resolved by the discussion of mnemonic aides presented by Norman (1969). Norman describes the use of mnemonic aides as an idiosyncratic mental process. In the present experiment, subjects did not choose a mnemonic aide by their own volition but were instructed on what mnemonic aide should be employed. In Anderson's study (1974), subjects were also instructed on what mnemonic aide to use, but in the study of Blick et al. (1972), subjects simply reported what mental strategy they employed in memorization. For girls in the present study, the bizarre images aide may be a more foreign mental tool than for males.

The significance of the four-way interaction between sex of subject, mode of input, mode of response, and mnemonic aide

effect is less interpretable than the other significant effects. Since females improved considerably when using the bizarre images aide under the auditory input-written response condition, one might first acknowledge that all subjects in general memorized words better under the auditory presentation condition. Under the written response condition, girls may have felt less self-conscious than when they orally repeated words onto a tape recorder. Under the oral response condition, the experimenter often noted the self-conscious, insecure responses of girls. One might further assume that girls were able to employ the bizarre images aide only when feeling totally at ease in the memorizing task. This ease might have been felt only in the auditory presentation-written response condition. Since the experimenter was a male throughout most of the study, male subjects may not have had to cope with the feeling of ill ease and insecurity.

If this experiment were to be repeated, the major revision that should be made would be to eliminate the first two trials, i.e. four word list and five words list, from the memorizing task. With almost every subject, memorization was one hundred percent under both of these trial conditions. Since these two trials were averaged into the performance of each subject, differences between subjects in different memorizing conditions became somewhat attenuated.

Another revision to be made in a repetition of this experiment has already been mentioned; the reduction of external distractions in the visual presentation condition. Under ideal

conditions, the subject should be facing the screen on which words are flashed without any visual stimuli between the subject and the screen.

Since subjects in the oral response condition were all tested individually and subjects in the visual response condition were tested in small groups, a few of the visual response subjects might be tested individually in a repetition of this experiment to check for a group testing effect. Since females might have felt more self-conscious in different memorizing conditions when the experimenter was a male, a repetition of this experiment might systematically include female experimenters.

Another major revision of this experiment might be made in the methodology of the experiment. In addition to testing memory immediately after presentation of words, memory might be tested at different intervals following presentation, as in Anderson (1974). This procedure could demonstrate the effectiveness of mnemonic aides more thoroughly when a long range memory skill is tested.

In a repetition of this experiment, an additional independent variable, reading ability, might be controlled. Griffith (1974) found that memory was greatest among good readers, both in the visual and auditory presentation conditions. Although Griffith's study was conducted with elementary school subjects, reading ability could continue to be an influential variable up through adult age.

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## APPENDIX A

Chair	Ear	Tear
Farm	Gate	Bed
Grass	Lake	Coat
Meat	Prince	Ice
Rock	Soil	Paint
Stone	Yard	Skin
Bridge	Boat	Suit
Egg	Dog	Bear
Lip	Game	Cloud
Ring	Knee	Floor
Star	Snow	Hill
Branch	Train	Nose
Earth	Bird	Feet
Leg	Cup	Stream
Rain	Fruit	Ball
Song	Post	
Box	Sky	

List of presented words