A Methodological Consideration in the Comparison of Two Explanatory Hypotheses of Imagery

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A METHODOLOGICAL CONSIDERATION IN THE COMPARISON
OF TWO EXPLANATORY HYPOTHESES OF IMAGERY

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Dean of the Graduate College
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A METHODOLOGICAL CONSIDERATION IN THE COMPARISON OF TWO EXPLANATORY HYPOTHESES OF IMAGERY

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A replication of the Carter and Craig (1975) investigation comparing the "conceptual peg" and "relational connective" explanations as to the effectiveness of an interaction imagery strategy in paired-associate learning was performed with the suggested changes in methodology. These changes included training the subjects and presenting the stimulus and response nouns on separate screens rather than visually side-by-side. In addition, two separation imagery strategies were investigated so that the nouns were visualized on opposite sides of the imaginary visual field or on opposite walls of an imaginary room.

An interaction imagery strategy, a separation imagery--space strategy, a separation imagery--wall strategy, and an overt repetition strategy were compared in terms of performance on a stimulus recognition-response recall task within a paired-associate stimulus interference situation. Pairs of synonyms were employed as stimulus components in the learning trial to produce stimulus interference. In the recognition-recall trial, subjects were presented a list of
stimulus and control nouns, and were asked to indicate which nouns had appeared during the learning trial (stimulus recognition) and what had been paired with each one (response recall).

The results were similar to those found in the Carter and Craig (1975) investigation in that the interaction imagery strategy was found to result in significantly greater response recall than the separation imagery strategies and the overt repetition strategy. Also, the imagery strategies resulted in greater stimulus recognition than the overt repetition strategy. Again, the conceptual peg hypothesis was supported.

In contrast with Carter and Craig (1975), the separation imagery strategy was found to be the least effective strategy in response recall and the most effective strategy in stimulus recognition. It appeared that the trained subjects were more successful in employing the instructed strategies and that the conflicting separation imagery data could be attributed to this. There was no significant effect for mode of presentation in either response recall or stimulus recognition. A ceiling effect was indicated from the stimulus recognition data.
Review of the Literature

Miller, Galanter, and Pribram (1960) have proposed that most subjects attempting a verbal learning task formulate a "plan" for remembering. They maintain that it is the effectiveness of the plan the subject formulates that is the key factor in the retention of the task material. An example of a plan that can be used to learn a list of number-word pairs is presented by Miller et al. (1960) and first involves learning a word that rhymes with each number stimulus. The rhyme scheme is as follows:

one is a bun, two is a shoe, three is a tree,
four is a door, five is a hive, six are sticks,
seven is heaven, eight is a gate, nine is a line,
and ten is a hen. (p. 135)

During the learning trial, the subject learns each number-word pair by forming a bizarre association containing the rhyme word and the response word. For example, if the pair were "one-ashtray," the subject would form a bizarre association with "bun" and "ashtray." When subjects were asked what the response word was to the number "one," the correct association was more readily evoked by those subjects employing the rhyme technique (Miller et al., 1960).

Bugelski (1968) and Bugelski, Kidd, and Segmen (1968) employed a variation of the Miller et al. (1960) technique. Subjects were instructed to form a mental image of the
rhyming word and the response word in some type of interaction; for example, to visualize an ashtray inside of a bun. Further variations have been employed in which the stimulus was a word, instead of a number, and the subject was instructed to create an image of the stimulus word and the response word interacting in some way (Bower, 1970; Dominowski & Gadlin, 1968; Sadalla & Loftness, 1972; Yuille & Paivio, 1967).

The effectiveness of this interaction imagery technique as a mnemonic device facilitating recall in paired-associate learning has been supported in numerous studies (Bower, 1970; Bugelski, 1968, 1970; Bugelski et al., 1968; Dominowski & Gadlin, 1968; Paivio, 1969; Sadalla & Loftness, 1972; Yarmey & Csapo, 1968; Yuille & Paivio, 1967, 1968). The basic approach has been to compare a group instructed to use an interaction imagery strategy with a group instructed to use a non-imagery strategy on their recall of response items when presented the stimulus items. In addition, several variables have been delineated as being important in determining whether the imagery strategy will be effective (Bower, 1970; Bugelski, 1968; Paivio, 1965, 1967, 1968, 1969; Paivio, Smythe, & Yuille, 1968). These variables include the attributes of the stimulus and response words, the presentation rate of the pairs, and the instructions to the subject.

**Imagery: Data**

**Word attributes.** Paivio (1965, 1968) studied the
concrete-abstract characteristics of words utilized in paired-associate lists and found that word pairs with concrete stimuli were more readily learned than word pairs with abstract stimuli. Yuille and Paivio (1967) instructed subjects to use either verbal mediators or images to learn paired-associate lists consisting of various concrete and abstract pairings. The pairs were either concrete-concrete, concrete-abstract, abstract-concrete, or abstract-abstract. The subjects controlled the presentation rate of the pairs, and the latency of forming a mediator (either an image or a verbal mediator) was measured. They found that there was a significant interaction between stimulus concreteness and mediation set in the direction that the "imaginal latencies increased with the abstractness of the stimuli while verbal latencies showed no systematic change with the stimulus attribute" (p. 542). When the stimulus was concrete, both verbal mediators and images were readily aroused. When the stimulus was abstract, however, verbal mediators were more readily aroused than images. In addition, Paivio (1965) found that the order of increasing difficulty in using imagery was from concrete-concrete, to concrete-abstract, to abstract-concrete, to abstract-abstract. The concreteness dimension was more crucial, therefore, to the stimulus members of the pairs than to the response members.

The possibility that the effective attribute might be meaningfulness was also investigated (Paivio, Smythe, & Yuille, 1968). Paivio, Smythe, and Yuille (1968) found that
when image-evoking value and meaningfulness were varied independently, image-evoking value was the more effective attribute. Similarly, when image-evoking value and meaningfulness were allowed to covary, image-evoking value was again more effective with meaningfulness having somewhat of a negative effect. Bugelski (1970) has pointed out that studies relating meaningfulness values to learning may be confounded by the role of the image-evoking value.

The attributes of concreteness and meaningfulness may also apply to the response item. Paivio (1969) stated that although the stimulus member appeared to be the more crucial item, mediation was facilitated when the response item was meaningful. The influence of other word attributes such as frequency, familiarity, distinctiveness, and association value have also been investigated (Hall, 1971; Paivio, 1968). Paivio (1968) did a factor analytic study to assess the influence of 27 noun attributes in the learning task. Image-evoking value was found to be the strongest factor.

Presentation rate. A second variable studied in relation to imagery has been presentation rate. Yuille and Paivio (1967) found that latency of forming an image mediator was a function of the concrete-abstract dimension of the stimulus word. The more abstract the stimulus, the longer it took the subject to create a mental image of the pair. The stimulus-response pairs were presented on separate slides, with the subjects controlling the rate of presentation. The latency measure was the duration of the projected pair.
Bugelski et al. (1968) provided subjects with the "one-bun" rhyme technique and varied pair presentation rates--2, 4, or 8 seconds. The results indicated that the technique was not effective at the 2-second rate. The 4-second and 8-second rates were more effective, with the 8-second rate resulting in near perfect scores. Bugelski (1968) found that subjects took an average of 7 seconds per pair to create an image when they were allowed to control the presentation rate.

Instructions to the subject. Paivio (1969) maintained that the instructional set presented to the subject was also important in determining the mnemonic technique the subject would employ. Three studies follow which utilized different instructional sets.

First, Bugelski et al. (1968) employed three groups of subjects, each group being provided with a different instructional set. One group was taught the rhyme technique that was presented by Miller et al. (1960). After learning the rhyme technique, the subjects were told that it could be used to facilitate the learning of a list of number (stimulus)-word (response) pairs by imagining the response item and the rhyme word in some type of interaction. A second group was taught the rhyme technique, but was not told of its possible application. A third group was not taught the rhyme technique at all. All three groups were then presented a list of number-word pairs. The measure was the number of response items correctly associated with the number stimuli when the
number stimuli were presented alone in the test trial. The group which had been taught the rhyme technique and its application exhibited significantly greater recall. This group was the only one reporting the use of the "one-bun" technique in learning the pairs. Bugelski et al. (1968) interpreted this finding as support for the notion that the pre-learned rhyme scheme served as a mnemonic aid. The paradigm is expressed as: AB-BC-AC where A is the number; B, the rhyming word; and C, the response word. The results indicated that the subjects in the group exhibiting greater recall made implicit use of the already learned B to facilitate the learning of AC.

A different instruction set was employed by Sadalla and Loftness (1972) in an investigation which attempted to assess the effectiveness of the use of emotion-laden images as a mnemonic technique. Subjects were presented with a list of stimulus-response pairs and were instructed to form images with either positive, negative, or neutral emotional content. In the positive condition, the subject was instructed to create an image which was so pleasurable that it actually produced a change in his feelings. In the negative condition, the subject was to create an image which was so uncomfortable that it would change his feelings. In the neutral condition, he was to create a strong image, but one that had no emotional content. Again, the measure was the number of response items recalled in the test trial when the stimulus items were presented alone. When presented
the stimulus word in the test trial, the subject was to recall his image then recall the response word. The results indicated that the images with emotional content were greater facilitators for recall than were the neutral images. There was no significant difference between the positive and negative images as facilitators.

Another type of instruction set has been tried by Bower (1970). Subjects were instructed to learn a list of noun pairs by employing either an interaction imagery strategy (creating an image relating the two nouns in each pair such that they were interacting in some way) or a separation imagery strategy (creating an image of each of the two nouns, keeping the images far separated in imaginary space) or a rote repetition strategy (repeating the pair over and over). In the test trial, subjects were presented a list of stimulus and control words, and were instructed to indicate which words had appeared in the paired list and to recall the response word that had been associated with each one. The results indicated that the interaction imagery group had significantly greater response recall than did the separation imagery group and the rote repetition group, with these latter two groups not being significantly different from each other. The three groups did not differ significantly from each other on stimulus recognition.

**Imagery: Theory**

As to the increased recall that results when an interaction imagery strategy is employed in the paired-associate
task, two explanations have been proposed. First, Paivio (1969), in his "conceptual peg" hypothesis, has suggested that the stimulus member of each pair becomes the conceptual peg to which the response item is associated through the formation of a compound image consisting of the stimulus and response within a spatial relationship. The image creates a stimulus compound that is more unique, distinct, and isolated than is the stimulus item alone. The stimulus item, when presented in the recall trial, serves as a cue to evoke the compound image which, in turn, serves to evoke the response. How high the stimulus item is rated in image-arousing capacity and concreteness will determine how effective it will be as a conceptual peg (Paivio, 1969; Yuille & Paivio, 1967).

A second explanation as to the effectiveness of interaction imagery has been proposed by Bower (1970). He has proposed that an interaction imagery strategy results in stronger associations between the stimulus and response items, rather than in more distinct stimuli. The image serves as a "relational connective" between the stimulus items and the response items that are to be associated. The emphasis is on the strengthened association between the stimulus and response, rather than on the uniqueness of the stimulus compound.

From both explanations, it would be predicted that an interaction imagery strategy would result in greater recall than a non-interacting imagery strategy or a non-imagery
strategy. In terms of the "conceptual peg" hypothesis, it would occur because the stimulus items become more distinct by the formation of the stimulus compounds of spatial relationships. In terms of the "relational connective" hypothesis, it would occur because the association between the stimulus and response is strengthened by the formation of the image. The Bower (1970) investigation, cited above, was an attempt to assess which explanatory hypothesis was most tenable. In comparing an interaction imagery strategy, a separation imagery strategy, and a rote repetition strategy, Bower (1970) found that the interaction imagery strategy resulted in significantly greater response recall than did the separation imagery strategy and the rote repetition strategy, with these latter two groups not being significantly different from each other. The three groups did not differ significantly from each other on stimulus recognition. Bower interpreted the results as supporting the "relational connective" hypothesis in that the stimulus items did not become more distinct by the use of the imagery strategies.

Another comparison of the two hypotheses was done by Carter and Craig (1975). They tested an interaction imagery strategy, a separation imagery strategy, and an overt repetition strategy on stimulus recognition and response recall in a paired-associate stimulus interference situation. Carter and Craig (1975) argued that the question of whether or not imagery produces distinct stimulus items could be more directly assessed by employing a stimulus interference
task in that some type of discrimination between like stimulus items would have to occur if the interference was to be reduced in the recognition-recall test. Interference was introduced into the paired-associate list by using pairs of synonyms as the stimulus nouns, each noun being paired with a different response. Saltz (1971) discussed this type of interference situation, maintaining that interference would occur because of the existing association between like stimulus items.

That stimulus interference is disruptive to recall in the paired-associate task has been noted by Fulton and Craig (1972). They used paired-associate lists in which each stimulus item was presented twice, each time paired with a different response. One pair was marked with an asterisk, while the other pair was unmarked. Subjects who had been taught a strategy (interaction imagery) for discriminating between the like stimulus items had significantly greater response recall than did subjects who had not been taught the strategy. That like stimulus items also produce false recognitions was supported by Anisfeld and Knapp (1968). They presented subjects with a list of words and then tested recognition with a list containing the words, their synonyms, and control words. They found that subjects had significantly more false recognitions for the synonyms than for the control words.

On the basis of these investigations on stimulus interference (Fulton & Craig, 1972; Saltz, 1971) and synonymity
(Anisfeld & Knapp, 1968; Saltz, 1971), Carter and Craig (1975) employed 10 synonym pairs as stimulus items in the paired-associate list to create a stimulus interference situation within which to compare the two explanations of the imagery process. They noted the recognition-recall predictions implicit in the conceptual peg and relational connective hypotheses, as discussed above, and maintained that these same predictions would be applicable in a stimulus interference situation. As was recognized by Bower (1970), one way to test between the two explanations is to test stimulus recognition. In the "conceptual peg" viewpoint, the imagery strategies would be expected to result in greater stimulus recognition than the overt repetition strategy as a result of the stimulus items becoming more distinct elements through the formation of stimulus compounds. In the "relational connective" viewpoint, however, no difference between the three strategies in stimulus recognition would be expected because, in this view, imagery does not function to produce more distinct stimuli.

The results of the Carter and Craig (1975) investigation indicated that the interaction imagery strategy resulted in significantly greater recall than did the separation imagery strategy and the overt repetition strategy, with these latter two groups not being significantly different from each other. Both imagery strategies, although not significantly different from each other, resulted in significantly greater stimulus recognition than did the overt repetition
strategy. The obtained means for each strategy on stimulus recognition and response recall are shown in Table 1.

Although support for the conceptual peg hypothesis was obtained, Carter and Craig (1975) noted several methodological problems in their investigation. Because response recall was "low" for all three groups and stimulus recognition was higher than expected for the overt repetition group (see Table 1), Carter and Craig (1975) maintained that the untrained subjects they employed might not have been successful in using the instructed strategy, creating a confounding factor in delineating the specific instructional groups. Also, they had presented the stimulus and response members of each pair such that they were visually side-by-side, and it was suggested on the basis of post-experimental questioning of the subjects that the "side-by-side" presentation of the nouns may have resulted in unintentional, immediate, interacting images during the 10-second learning periods. This "interference" may have resulted in lower scores on both recall and recognition for these subjects.
Table 1
Mean Number of Items Recognized and Recalled
for Three Instructional Strategies in a
Stimulus Interference Task

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Recognition*</th>
<th>Recall*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction Imagery</td>
<td>16.28</td>
<td>7.96</td>
</tr>
<tr>
<td>Separation Imagery</td>
<td>16.62</td>
<td>4.15</td>
</tr>
<tr>
<td>Overt Repetition</td>
<td>14.42</td>
<td>2.96</td>
</tr>
</tbody>
</table>

*Maximum score = 20.

Note. Adapted from "Imagery: A comparison between two explanatory hypotheses" by P. C. Carter and J. R. Craig, paper presented at the meeting of the Southeastern Psychological Association, Atlanta, March 1975.
Statement of Problem

Two hypotheses have been proposed to explain the effectiveness of an interaction imagery strategy employed in paired-associate learning. First, Paivio (1969), in his conceptual peg hypothesis, has suggested that the interacting image creates a stimulus compound that is more unique, distinct, and isolated than is the stimulus item alone. In contrast, Bower (1970) has suggested that the interacting image serves as a relational connective between the stimulus item and the response item that are to be associated. It would be predicted from both hypotheses that an interaction imagery strategy would result in greater recall than a non-interacting imagery strategy and a non-imagery strategy. In terms of the conceptual peg hypothesis, this would occur because the stimulus becomes more distinct by the formation of the compound image of a spatial relationship. In terms of the relational connective hypothesis, however, it would be expected because the association between the stimulus and response becomes strengthened by the formation of the image.

Carter and Craig (1975) attempted to support one imagery hypothesis or the other in a stimulus interference situation where synonym pairs were used as stimulus components in the
paired-associate list. An interaction imagery strategy, a separation imagery strategy, and an overt repetition strategy were compared on stimulus recognition and response recall. Although the recognition and recall data supported the conceptual peg hypothesis, Carter and Craig (1975) suggested that there were possible methodological problems in their investigation. These problems included employing untrained subjects and presenting the noun pairs visually side-by-side.

The present study will replicate the study done by Carter and Craig (1975) with the suggested changes in methodology. Also, two separation imagery strategies will be investigated. Again, support for one hypothesis over the other will be based on the differential predictions that can be drawn from the two hypotheses. It would be predicted from the conceptual peg hypothesis that the interaction imagery strategy and the separation imagery strategies would result in greater stimulus recognition than would the overt repetition strategy. It would be predicted from the relational connective hypothesis, however, that the strategies would not be significantly different from each other on stimulus recognition. It would be predicted from both hypotheses that an interaction imagery strategy would result in greater response recall than would a separation imagery strategy and an overt repetition strategy.
Subjects

Subjects were 69 volunteer students from introductory psychology classes at Western Kentucky University.

Design

A split-plot design with instructional strategy as the between groups factor and mode of presentation as the within group factor was employed. Four instructional strategies were used such that the subject was instructed to learn a pair of nouns either by creating a mental picture of the two nouns in some type of interaction (Interaction Imagery); or by creating a mental picture of each of the two nouns, keeping the images separated in imaginary space (Separation Imagery--Space); or by creating a mental picture of each of the two nouns on a separate wall of an imaginary room (Separation Imagery--Wall); or by repeating the pair over and over aloud (Overt Repetition). Two modes of presentation were employed within each of the four strategies such that the two nouns were presented side-by-side on the same screen (Together) or were presented on separate screens with the stimulus noun being presented to the left of the subject and the response noun to the right of the subject (Split). Each subject was tested in both modes of presen-
Stimulus recognition and response recall were measured. Stimulus recognition was the number of stimulus items the subject correctly identified, from a list of stimulus and control nouns, as those having appeared in the stimulus-response pairs presented during the learning phase. Response recall was the number of response items the subject correctly associated with the recognized stimulus items, as they were associated in the stimulus-response pairs presented during the learning phase.

**Apparatus**

**Stimulus materials.** Three paired-associate lists were used—one interference-free training list and two interference-relevant lists. The training list, as shown in Table A (see Appendix A), consisted of 10 stimulus-response noun pairs. The 20 nouns were randomly selected from those nouns rated high (6.0 or more) in imagery and concreteness in Paivio, Yuille, and Madigan's (1968) list of 925 nouns and then were randomly paired to form 10 paired-associates. A judgment was made to insure that none of the nouns could be considered a synonym of any other noun in the list.

Each of the two interference-relevant lists were obtained in a similar manner. Twenty synonym pairs were selected from a list derived by Carter and Craig (1975).
Table 2

Representation of the Split-Plot Design

<table>
<thead>
<tr>
<th>Between Factor</th>
<th>Within Factor</th>
<th>Mode of Presentation</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Split</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Together</td>
</tr>
<tr>
<td>Interaction Imagery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separation Imagery--Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Separation Imagery--Wall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overt Repetition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mode of presentation and order of stimulus list were counterbalanced.
They had selected nouns rated high (4.5 or more) in imagery and concreteness in Paivio, Yuille, and Madigan (1968) and had paired these nouns on the basis of their possible synonymity. Subjects then rated each pair on a 5-point scale as to how closely the two nouns evoked the same image. The 20 nouns with the highest average ratings (3.865 or more) were selected and arranged into two equivalent groups of 10 pairs each. Equivalence was judged on the basis of the synonym rating of each pair, and the imagery and concreteness ratings of each noun (see Tables A and B in Appendix B). The 20 nouns in each group served as the stimulus component of the stimulus-response pairs in one of the interference-relevant lists. To each noun was randomly assigned a response component, avoiding obvious associations. The response nouns were also randomly selected from those nouns rated high (6.0 or more) in imagery and concreteness in Paivio, Yuille, and Madigan (1968). For each of the two groups of stimulus-response pairs, a paired-associate list was then obtained by randomly assigning each pair a position in the list. List 1 is shown in Table B and List 2 is shown in Table C (see Appendix A).

For each of the three lists, a stimulus recognition-response recall list was formed by combining the stimulus items from the list with control nouns randomly selected from Paivio, Yuille, and Madigan (1968) and rated high (6.0 or more) in imagery and concreteness. For the training list, the 10 stimulus nouns plus 10 control nouns were randomly
assigned a position to form the recognition-recall list as shown in Table D (see Appendix A). For each of the interference-relevant lists, the 20 stimulus nouns plus 20 control nouns were randomly assigned a position to form the recognition-recall list for List 1 as shown in Table E and for List 2 as shown in Table F (see Appendix A).

All nouns were presented on separate slides. The nouns (black, typed letters) were projected onto two white screens (22" x 28" art poster board) by means of two Kodak Carousel 800 projectors. The projectors were wired to present the slides automatically at one slide every 15 seconds. The slides were arranged in six slide trays such that for each paired-associate list, the stimulus nouns and the recognition-recall list were in one tray and the response nouns were in a separate tray. There was a 15-second interval between the learning trial and the test trial, denoted by a slide containing asterisks that was projected for the duration of the interval. Pre-recorded tapes of the instructions were played on a Concord 300 recorder.

Testing environment. The two screens were taped onto opposite walls of the experimental room so that one screen was positioned to the left of the subject's chair and one was to the right of the chair. Behind the subject's chair was a table on which were the two slide projectors and the tape recorder. The projectors were positioned so that one would project onto the left screen and the other would project onto the right screen. The "left" projector was loaded
with the tray containing the stimulus nouns and the recognition-recall nouns for the appropriate list. The "right" projector was loaded with the tray containing the response nouns for the appropriate list. Beside the table was a chair for the experimenter who remained present during each session. Illumination was provided by an overhead light during the presentation of the instructions and by the projectors during the trials.

**Procedure**

Subjects were randomly assigned to one of eight instructional combinations to be tested under both modes of presentation. Each subject was tested individually. All sessions were the same except for the instructions given. The subject was brought into the testing room and seated between the two screens. An initial recording that briefly explained what was going to take place and the importance of the subject's using only the instructed strategy was played (see Appendix C). Next, the subject was presented one of eight sets of instructional combinations. There were four types of instructions referring to strategy and, within each of these four, there were two types of instructions referring to mode of presentation.

One trial consisted of the presentation of the noun pairs and the test for stimulus recognition and response recall. Each subject received instructions for and performed the first interference-relevant trial (Trial 1), and
then received instructions for and performed the second interference-relevant trial (Trial 2). For each strategy, half of the subjects began with a training trial in the Split mode and the other half began with a training trial in the Together mode. For those subjects beginning with training in the Split mode, half of these had Trial 1 with List 1 in the Split mode, then Trial 2 with List 2 in the Together mode. The other half had Trial 1 with List 2 in the Split mode, then Trial 2 with List 1 in the Together mode. For those subjects beginning with training in the Together mode, half had Trial 1 with List 1 in the Together mode, then Trial 2 with List 2 in the Split mode. The other half had Trial 1 with List 2 in the Together mode, then Trial 2 with List 1 in the Split mode.

For each of the eight instructional combinations, the instructions were the same except for the necessary substitutions regarding strategy and mode of presentation (see Appendix C for complete instructions). Concerning mode of presentation, the subject was told either to read the noun to his left and then the noun to his right, both nouns being presented on the left screen (Together mode); or to read the noun on the left screen and then the noun on the right screen, both nouns being presented simultaneously (Split mode). For the Interaction Imagery strategy, the subject was instructed to learn each noun pair by creating an image that related the two nouns such that they would be interacting in some way. For the Separation Imagery—Space strategy, the
subject was instructed to create an image of the left noun in the left side of imaginary space and an image of the right noun in the right side of imaginary space. For the Separation Imagery--Wall strategy, the subject was instructed to create an image of the left noun on the left wall of an imaginary room and an image of the right noun on the right wall of the imaginary room. For the Overt Repetition strategy, the subject was instructed to learn each pair by repeating it over and over aloud until the next pair was presented; that is, for 15 seconds.

In the imagery strategies, the instructions stressed the importance of the image; that is, of visualizing the noun. For each pair in the learning phase, the subject was asked to briefly describe his image(s). During the recognition-recall phase, each subject was instructed to respond "yes" or "no" as to whether or not the noun had appeared in the noun pairs. If "yes," then he was to give the word that was paired with it and then briefly describe again his image(s). The descriptions of the images were checked to insure that the subject was creating images to learn the pairs. In the Overt Repetition test trial, the subject was instructed to respond "yes" or "no" as to whether or not the noun had appeared in the noun pairs and, if "yes," then to give the noun that was paired with it. All subjects were given an example of their strategy using the pair "mouse-cheese."

Each subject heard four series of instructions. First,
he was presented the initial instructions (same for all subjects), and then the instructions for the training trial. After completion of the training trial, he was presented the instructions for Trial 1 and, upon its completion, the instructions for Trial 2. Each series of instructions was ended with a brief step-by-step summary of the task.

During all trials, the experimenter recorded the subject's responses. During the training trial, the experimenter helped the subject with any difficulty in learning the strategy. This included pointing out when the descriptions were definitions or associations rather than images. At no time did the experimenter help the subject in creating his images. During the recognition-recall phase of the training trial, the experimenter cued the subject as to the image he had created during the learning phase if he could not remember the image. During the administration of the two interference-relevant trials, the experimenter only recorded the subject's responses, providing no help and no cues. There was a rest period between trials while the projectors were loaded with the trays for the next list.

**Scoring and Analysis**

Scoring and analysis for the stimulus recognition data and the response recall data were done separately.

**Stimulus recognition.** Stimulus recognition was measured by counting the number of nouns in the test list that the subject correctly identified as having been presented in the corresponding noun pairs. Two stimulus recognition scores--
stimulus recognition in the Together mode and stimulus recognition in the Split mode—were obtained for each subject and then for each of the four instructional strategies. An analysis of variance of the split-plot design was performed.

Response recall. Response recall was measured by counting the number of response nouns the subject correctly recalled from the noun pairs, correctly associating them with the recognized stimulus nouns (variations of the nouns were counted; e.g., plurals). Two response recall scores—response recall in the Together mode and response recall in the Split mode—were obtained for each subject and then for each of the four instructional strategies. An analysis of variance of the split-plot design was performed.
Results

Data from two subjects were not complete due to experimenter difficulty with the apparatus. Data from one interaction imagery subject, one separation imagery--space subject, and one separation imagery--wall subject were discarded due to subject failure to follow instructions. These deletions resulted in there being 16 subjects in each instructional strategy.

Separate analyses were performed for the stimulus recognition data and the response recall data. The obtained means for each strategy on stimulus recognition and response recall are shown in Table 3. The analysis of variance of the recognition data, a summary of which is shown in Table 4, indicated that there was no significant effect for mode of presentation ($F = .071, p > .005$) and no significant interaction between instructional strategy and mode of presentation ($F = 1.444, p > .005$). However, there was a significant effect for instructional strategy ($F = 28.961, p < .005$). A Neuman–Keuls multiple comparison of the means for the instructional strategies indicated that the two separation imagery strategies, although not significantly different from each other, resulted in significantly greater stimulus recognition than did the interaction imagery strategy and
Table 3
Obtained Means for Stimulus Recognition and Response Recall

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Recognition*</th>
<th>Recall*</th>
</tr>
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<tbody>
<tr>
<td>Interaction Imagery</td>
<td>17.91</td>
<td>13.97</td>
</tr>
<tr>
<td>Separation Imagery--Space</td>
<td>19.41</td>
<td>.88</td>
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<tr>
<td>Separation Imagery--Wall</td>
<td>19.53</td>
<td>1.53</td>
</tr>
<tr>
<td>Overt Repetition</td>
<td>16.13</td>
<td>5.29</td>
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</table>

*Maximum score = 20.
Table 4
Summary of the Analysis of Variance for Stimulus Recognition

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
</tr>
</thead>
<tbody>
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<td>Strategy (A)</td>
<td>3</td>
<td>28.961*</td>
</tr>
<tr>
<td>Ss Within</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Mode of Presentation (B)</td>
<td>1</td>
<td>.071</td>
</tr>
<tr>
<td>AB</td>
<td>3</td>
<td>1.444</td>
</tr>
<tr>
<td>B X Ss Within</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td></td>
</tr>
</tbody>
</table>

*p < .005.
the overt repetition strategy. The interaction imagery strategy was found to result in significantly greater stimulus recognition than did the overt repetition strategy.

The analysis of variance of the response recall data, a summary of which is shown in Table 5, indicated that there was no significant effect for mode of presentation ($F = .031$, $p > .005$) and no significant interaction between instructional strategy and mode of presentation ($F = 2.12$, $p > .005$). There was a significant effect, however, for instructional strategy ($F = 188.197$, $p < .005$). A Neuman-Keuls multiple comparison of the means obtained for the instructional strategies indicated that the interaction imagery strategy resulted in significantly greater response recall than did the two separation imagery strategies and the overt repetition strategy. The separation imagery strategies, although not significantly different from each other, resulted in significantly lower response recall than did the overt repetition strategy.
Table 5  
Summary of the Analysis of Variance for  
Response Recall

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy (A)</td>
<td>3</td>
<td>188.197*</td>
</tr>
<tr>
<td>Ss Within</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Mode of Presentation (B)</td>
<td>1</td>
<td>.031</td>
</tr>
<tr>
<td>AB</td>
<td>3</td>
<td>2.120</td>
</tr>
<tr>
<td>B X Ss Within</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td></td>
</tr>
</tbody>
</table>

*p < .005.
Discussion

The results of the analyses of the stimulus recognition and response recall data indicated that there was no significant effect for mode of presentation as was anticipated from Carter and Craig (1975). The side-by-side presentation of the nouns in each pair, therefore, did not lead to any greater tendency for the occurrence of immediate interacting images in the separation imagery strategies and the overt repetition strategy, nor did the split presentation of the nouns hinder the formation of the interacting images in the interaction imagery strategy. It should be noted, however, that the subjects in the present investigation were trained to employ their instructed strategies and this most probably increased the likelihood that only the instructed strategy was employed. In addition, the results indicated that a separation imagery strategy in which the subject visualized the nouns of each pair on opposite sides of the imaginary visual field was no more or less effective than a separation imagery strategy in which the subject visualized the nouns of each pair on opposite walls of an imaginary room.

As in the Carter and Craig (1975) investigation, the interaction imagery strategy was again found to result in significantly greater response recall than the separation
imagery strategies and the overt repetition strategy. That the interaction imagery strategy resulted in greater response recall indicated that the stimulus interference produced by the synonyms was reduced by this strategy. It would be predicted from both the conceptual peg and relational connective hypotheses that an interaction imagery strategy would reduce stimulus interference. Therefore, each hypothesis is capable of accounting for such a finding even though the explanations they offer would be different. From the "conceptual peg" viewpoint, the reduction of stimulus interference occurred as a result of the stimulus items becoming more isolated and distinct by the formation of compound images of spatial relationships. From the "relational connective" viewpoint, on the other hand, the observed interference reduction occurred as a result of the association between each stimulus and response becoming strengthened by the formation of an image.

In contrast with Carter and Craig (1975), the overt repetition strategy was found to result in significantly greater response recall than the separation imagery strategies, although recall for the overt repetition strategy was again low with an average of 5.69 items recalled out of a possible 20 items. That the overt repetition strategy was more effective than the separation imagery strategies in response recall was very likely the result of the difficulty in obtaining a "pure" overt repetition performance. In post-experimental questioning, most subjects in this group
reported the use of some association "strategy." It was noted that although an attempt was made to present "non-obvious" pairs, some pairs, nevertheless, resulted in obvious associations for some subjects. That the separation imagery strategies resulted in extremely low response recall would be consistent with both hypotheses in that both maintain that an association or spatial relationship is a necessary condition for recall.

The stimulus recognition data are not so easily interpreted, however. The results indicated that all three strategies were significantly different from each other on stimulus recognition with the separation imagery strategies being the most effective and the overt repetition strategy, the least effective. That the imagery strategies resulted in greater stimulus recognition than the overt repetition strategy would be consistent with the conceptual peg hypothesis. The greater stimulus recognition exhibited by the imagery groups would indicate that the stimulus items became more distinct elements as a result of the stimulus compounds. Therefore, the stimulus interference would not be as disruptive to stimulus recognition for the imagery groups as for the overt repetition group. Such differential performance would not be anticipated from the relational connective hypothesis, however, since in this view imagery does not produce distinctive stimuli. Again, as in the Carter and Craig (1975) investigation, the conceptual peg hypothesis appears to be the most tenable explanation of the data.
observed.

A somewhat surprising finding in the present investigation was that the separation imagery strategies resulted in significantly greater stimulus recognition than did the interaction imagery strategy. The separation imagery strategies resulted in near perfect recognition scores. It was noted as the subjects described their images during the learning trial, that the separation imagery subjects provided elaborate descriptions of the stimulus and response objects themselves. In the interaction imagery strategy, however, the descriptions focused primarily on the interaction between the stimulus and response. The image of the stimulus member itself, therefore, was most likely more distinct, and thus more readily recognized, in the separation imagery strategy than in the interaction imagery strategy. It should be noted, however, that all the groups were high in stimulus recognition with the least effective overt repetition group still resulting in an average of 16.13 items recognized, suggesting a ceiling effect. For a more distinct delineation among the strategies for stimulus recognition, therefore, a list with more than 20 pairs should be investigated.
References


Appendix A
Table A
Training List

elbow-snake
ejail-tree
king-window
chair-street
piano-suds
mountain-butcher
peach-ship
scorpion-fire
newspaper-sugar
fox-toast
<table>
<thead>
<tr>
<th>college-flower</th>
</tr>
</thead>
<tbody>
<tr>
<td>boy-harp</td>
</tr>
<tr>
<td>basement-horse</td>
</tr>
<tr>
<td>pupil-skillet</td>
</tr>
<tr>
<td>woods-tower</td>
</tr>
<tr>
<td>material-ankle</td>
</tr>
<tr>
<td>dawn-acrobat</td>
</tr>
<tr>
<td>lad-storm</td>
</tr>
<tr>
<td>student-pepper</td>
</tr>
<tr>
<td>physician-refrigerator</td>
</tr>
<tr>
<td>picture-dust</td>
</tr>
<tr>
<td>university-alligator</td>
</tr>
<tr>
<td>cellar-shoes</td>
</tr>
<tr>
<td>rock-table</td>
</tr>
<tr>
<td>photograph-slave</td>
</tr>
<tr>
<td>daybreak-hospital</td>
</tr>
<tr>
<td>forest-doll</td>
</tr>
<tr>
<td>doctor-arrow</td>
</tr>
<tr>
<td>fabric-cat</td>
</tr>
<tr>
<td>stone-cane</td>
</tr>
</tbody>
</table>
Table C
List 2

car-body
clothing-oven
dirt-blood
baby-grass
skin-strawberry
plank-stagecoach
cranium-hammer
cash-beaver
speaker-bagpipe
damsel-headlight
infant-ink
garments-apple
flesh-alcohol
board-star
soil-circle
automobile-foam
maiden-thorn
skull-garden
lecturer-sunburn
money-locker
Table D

Stimulus recognition-response recall list for the Training List

- string
- chair
- water
- jail
- fox
- army
- elbow
- book
- peach
- library
- king
- newspaper
- river
- truck
- mountain
- clock
- volcano
- scorpion
- woman
- piano
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<th>Stimulus recognition-response recall list for List 1</th>
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<tr>
<td>boy</td>
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<tr>
<td>blister</td>
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<td>student</td>
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<td>cellar</td>
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<td>woods</td>
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<tr>
<td>fur</td>
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<tr>
<td>pupil</td>
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<tr>
<td>university</td>
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<td>bar</td>
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<td>stone</td>
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<td>Board</td>
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<td>Speaker</td>
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Appendix B
Table A
Synonymity, Imagery (I), and Concreteness (C)
Ratings for Nouns Used in List 1

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<th>Synonymity</th>
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<td>6.3</td>
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<td>6.6</td>
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<td>boy</td>
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<td>lad</td>
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<td>4.162</td>
<td>daybreak</td>
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Table B
Synonymity, Imagery (I), and Concreteness (C)
Ratings for Nouns Used in List 2

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<td>4.219</td>
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Instructional Sets

Preliminary Instructions

The present experiment is an attempt to study different strategies often employed in learning verbal material. You will be instructed to use a particular strategy which you may not have used before. Therefore, we will begin with a training session in which you will be taught the strategy. After training, you will be asked to use this strategy to learn sets of verbal material. You may feel that you could use an easier or more efficient strategy to learn the material; however, it is essential to the investigation that you attempt to use only the strategy that has been taught to you. This is not a test of your ability. I am not interested in how you perform as an individual, but rather I am interested in the mechanics of the particular strategy.
Interaction Imagery--Split

Training in the Split mode. On these two screens will appear two nouns simultaneously. You are to read the noun on the screen to your left, then the noun on the screen to your right, and then you are to create a mental picture, or image, that relates the two; that is, they are to be interacting in some way. For example, if the noun on the left screen were "mouse" and the noun on the right screen were "cheese," you might create an image of a mouse eating cheese or a mouse sneaking toward some cheese. You are then to briefly describe that mental picture you have created of the two nouns interacting. It is essential that you not only tell me about the two nouns interacting, but also that you visualize what you are describing. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear on the screen to your left. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and response either "yes" or "no." If you respond "yes," indicating that the noun had appeared in the pairs, you are to try to tell me the noun that was presented with it and the image, or mental picture, you had made of the two nouns interacting. In summary then, -read the noun to the left and then the noun to the right
- Create an image of the two nouns interacting and briefly describe the image you have visualized; for example, the mouse eating cheese.
- After all 10 pairs have been presented, asterisks will appear on the left screen followed by a series of nouns.
- For each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no".
- If "yes," then give the noun that was presented with it and briefly describe again the image of the two nouns interacting.

**Trial 1 in the Split mode.** In the following trial, you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,

- Read the noun to the left and then the noun to the right.
- Create an image of the two nouns interacting and briefly describe the image you have visualized; for example, the mouse eating cheese.
- After all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns.
- For each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no".
- If "yes," then give the noun that was presented with it.
it and briefly describe again the image of the two nouns interacting.

**Trial 2 in the Together mode.** The upcoming trial will be somewhat different. This time, all of the nouns will appear on the same screen—the screen to your left.

Remember,

- read the noun to the left and then the noun to the right
- create an image of the two nouns interacting and briefly describe the image you have visualized; for example, the mouse eating cheese
- after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns
- for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
- if "yes," then give the noun that was presented with it and briefly describe again the image of the two nouns interacting
Interaction Imagery--Together

Training in the Together mode. On the screen to your left will appear two nouns simultaneously. You are to read the noun to the left, then the noun to the right, and then you are to create a mental picture, or image, that relates the two; that is, they are to be interacting in some way. For example, if the noun to the left were "mouse" and the noun to the right were "cheese," you might create an image of a mouse eating cheese or a mouse sneaking toward some cheese. You are then to briefly describe that mental picture you have created of the two nouns interacting. It is essential that you not only tell me about the two nouns interacting, but also that you visualize what you are describing. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and response either "yes" or "no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it and the image, or mental picture, you had made of the two nouns interacting. In summary then,

-read the noun to the left and then the noun to
the right
-create an image of the two nouns interacting and
briefly describe the image you have visualized; for
example, the mouse eating cheese
-after all 10 pairs have been presented, asterisks will
appear, followed by a series of nouns
-for each noun, decide whether or not it had been
presented in the pairs--respond "yes" or "no"
-if "yes," then give the noun that was presented with
it and briefly describe again the image of the two
nouns interacting

Trial 1 in the Together mode. In the following trial,
you will be presented a second group of noun pairs and a
corresponding series of nouns. You are to follow the same
procedure as before. This time you will be presented 20
pairs. Remember,
-read the noun to the left and then the noun to the
right
-create an image of the two nouns interacting and
briefly describe the image you have visualized; for
example, the mouse eating cheese
-after all 20 pairs have been presented, asterisks will
appear, followed by a series of nouns
-for each noun, decide whether or not it had been
presented in the pairs--respond "yes" or "no"
-if "yes," then give the noun that was presented with
it and briefly describe again the image of the two
nouns interacting

**Trial 2 in the Split mode.** The upcoming trial will be somewhat different. This time, each of the two nouns will appear on separate screens simultaneously such that one noun will appear on the screen to your left and the other noun, on the screen to your right. Following the asterisks, the series of nouns will appear on the left screen. Remember,
- read the noun to the left and then the noun to the right
- create an image of the two noun interacting and briefly describe the image you have visualized; for example, the mouse eating cheese
- after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
- for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
- if "yes," then give the noun that was presented with it and briefly describe again the image of the two nouns interacting
Separation Imagery—Wall—Split

Training in the Split mode. On these two screens will appear two nouns simultaneously. You are to read the noun on the screen to your left, create a mental picture, or image, of the noun on the left wall of an imaginary room, and then briefly describe the mental picture that you see. Then you are to read the noun on the screen to your right, create a mental picture, or image, of that noun on the right wall of the imaginary room, and then briefly describe the mental picture that you see. For example, if the noun on the left screen were "mouse," you would create, on the left wall of an imaginary room, a mental picture of a mouse which you might describe as "small, gray, whiskers, long teeth." Then you would read the noun on the right screen, for example "cheese," and you would create, on the right wall of the imaginary room, a mental picture of cheese which you might describe as "yellow slab with holes in it." It is essential that you not only tell me about the images, but also that you visualize what you are describing and that they be visualized on the left and right walls of an imaginary room. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear on the screen to your left. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to
decide whether or not it had been presented before and respond either "yes" or "no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it and the images of each of the two nouns you had visualized on the walls of the imaginary room. In summary then,

- read the noun to the left, create a mental picture of the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
- then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary room, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
- after all 10 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
- for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
- if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room

**Trial 1 in the Split mode.** In the following trial, you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,
-read the noun to the left, create a mental picture of the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse.
-then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary room, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese.
-after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns.
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no".
-if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room.

**Trial 2 in the Together mode.** The upcoming trial will be somewhat different. This time, all of the nouns will appear on the same screen—the screen to your left.
Remember,
- read the noun to the left, create a mental picture of the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse.
- then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary
room, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese—after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns—

-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"

-if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room.
Separation Imagery--Wall--Together

Training in the Together mode. On the screen to your left will appear two nouns simultaneously. You are to read the noun to the left, create a mental picture, or image, of the noun on the left wall of an imaginary room, and then briefly describe the mental picture that you see. Then you are to read the noun to the right, create a mental picture, or image, of that noun on the right wall of the imaginary room, and then briefly describe the mental picture that you see. For example, if the noun to the left were "mouse," you would create, on the left wall of an imaginary room, a mental picture of a mouse which you might describe as "small, gray, whiskers, long teeth." Then you would read the noun to the right, for example "cheese," and you would create, on the right wall of the imaginary room, a mental picture of cheese which you might describe as "yellow slab with holes in it."

It is essential that you not only tell me about the images, but also that you visualize what you are describing and that they be visualized on the left and right walls of an imaginary room. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and respond either "yes" or
"no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it and the images of each of the two nouns you had visualized on the walls of the imaginary room. In summary then,

- read the noun to the left, create a mental picture of the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
- then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary room, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
- after all 10 pairs have been presented, asterisks will appear, followed by a series of nouns
- for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
- if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room

**Trial 1 in the Together mode.** In the following trial, you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,

- read the noun to the left, create a mental picture of
the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse

-then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary room, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese

-after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns

-for each noun, decide whether or not it had been presented in the pairs--respond "yes" or "no"

-if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room

**Trial 2 in the Split mode.** The upcoming trial will be somewhat different. This time, each of the two nouns will appear on separate screens simultaneously such that one noun will appear on the screen to your left and the other noun, on the screen to your right. Following the asterisks, the series of nouns will appear on the left screen. Remember,

- read the noun to the left, create a mental picture of the noun on the left wall of an imaginary room, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse

- then read the noun to the right, create a mental picture of the noun on the right wall of the imaginary room,
and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
—after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
—for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
—if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized on the walls of the imaginary room
Separation Imagery--Space--Split

Training in the Split mode. On these two screens will appear two nouns simultaneously. You are to read the noun on the screen to your left, create a mental picture, or image, of the noun in the left side of imaginary space, and then briefly describe the mental picture that you see. Then you are to read the noun on the screen to your right, create a mental picture, or image, of that noun in the right side of imaginary space, and then briefly describe the mental picture that you see. For example, if the noun on the left screen were "mouse," you would create, in the left side of imaginary space, a mental picture of a mouse which you might describe as "small, gray, whiskers, long teeth." Then you would read the noun on the right screen, for example "cheese," and you would create, in the right side of imaginary space, a mental picture of cheese which you might describe as "yellow slab with holes in it." It is essential that you not only describe each image, but also that you visualize what you are describing and that they be visualized far separated in the left and right sides of imaginary space. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear on the screen to your left. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether
or not it had been presented before and respond either "yes" or "no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it and the images of each of the two nouns you had visualized in imaginary space. In summary then,

-read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse

-then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese

-after all 10 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns

-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"

-if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized in imaginary space

Trial 1 in the Split mode. In the following trial, you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,
-read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
-then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
-after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized in imaginary space

**Trial 2 in the Together mode.** The upcoming trial will be somewhat different. This time, all of the nouns will appear on the same screen—the screen to your left.

Remember,
- read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
- then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visu-
alized; for example, the yellow, holey slab of cheese
-after all 20 pairs have been presented, asterisks will
appear, followed by a series of nouns
-for each noun, decide whether or not it had been
presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with
it and briefly describe again the images of the two
nouns you had visualized in imaginary space
Separation Imagery--Space--Together

Training in the Together mode. On the screen to your left will appear two nouns simultaneously. You are to read the noun to the left, create a mental picture, or image, of the noun in the left side of imaginary space, and then briefly describe the mental picture that you see. Then you are to read the noun to the right, create a mental picture, or image, of that noun in the right side of imaginary space, and briefly describe the mental picture that you see. For example, if the noun to the left were "mouse," you would create, in the left side of imaginary space, a mental picture of a mouse which you might describe as "small, gray, whiskers, long teeth." Then you would read the noun to the right, for example "cheese," and you would create, in the right side of imaginary space, a mental picture of cheese which you might describe as "yellow slab with holes in it." It is essential that you not only describe each image, but also that you visualize what you are describing and that they be visualized far separated in the left and right sides of imaginary space. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and respond either "yes" or
"no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it and the images of each of the two nouns you had visualized in imaginary space. In summary then,

- read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
- then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
- after all 10 pairs have been presented, asterisks will appear, followed by a series of nouns
- for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
- if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized in imaginary space

Trial 1 in the Together mode. In the following trial, you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,

- read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and
briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns
for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
if "yes," then give the noun that was presented with it and briefly describe again the images of the two nouns you had visualized in imaginary space

Trial 2 in the Split mode. The upcoming trial will be somewhat different. This time, each of the two nouns will appear on separate screens simultaneously such that one noun will appear on the screen to your left and the other noun, on the screen to your right. Following the asterisks, the series of nouns will appear on the left screen. Remember,
·read the noun to the left, create a mental picture of the noun in the left side of imaginary space, and briefly describe the image you have visualized; for example, the small, gray, whiskered mouse
·then read the noun to the right, create a mental picture of the noun in the right side of imaginary space, and briefly describe the image you have visualized; for example, the yellow, holey slab of cheese
-after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns

-for each noun, decide whether or not it had been presented in the pairs--respond "yes" or "no"

-if "yes," then give the noun that was presented with it and briefly describe the images of the two nouns you had visualized in imaginary space
Overt Repetition—Split

Training in the Split mode. On these two screens will appear two nouns simultaneously. You are to read the noun on the screen to your left, then the noun on the screen to your right, and then you are to repeat this pair over and over aloud. For example, if the noun on the screen to your left were "mouse" and the noun on the screen to your right were "cheese," you would say "mouse-cheese, mouse-cheese, mouse-cheese," etc., until the next two nouns are presented. A pair of nouns will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear on the screen to your left. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and respond "yes" or "no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it. In summary then,

- read the noun to the left and then the noun to the right
- repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next two nouns are presented
- after all 10 pairs have been presented, asterisks will appear on the left screen, followed by a series of
nouns
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it

Trial 1 in the Split mode. In the following trial you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,
-read the noun to the left and then the noun to the right
-repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next two nouns are presented
-after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it

Trial 2 in the Together mode. The upcoming trial will be somewhat different. This time, all of the nouns will appear on the same screen—the screen to your left. Remember,
-read the noun to the left and then the noun to the right
-repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next
two nouns are presented
-after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it
Overt Repetition—Together

Training in the Together mode. On the screen to your left will appear two noun simultaneously. You are to read the noun to the left, then the noun to the right, and then you are to repeat this pair over and over aloud. For example, if the noun to the left were "mouse" and the noun to the right were "cheese," you would say "mouse-cheese, mouse-cheese, mouse-cheese," etc., until the next two nouns are presented. A pair of noun will be presented every 15 seconds for a total of 10 pairs. After 10 pairs have been presented, asterisks will appear. Following the asterisks will appear a series of nouns, one noun being presented each 15 seconds on the screen. Some of the nouns you will have seen in the pairs that had just been presented and others you will not have seen. For each noun you are to decide whether or not it had been presented before and respond "yes" or "no." If you respond "yes," indicating that the noun had been presented in the pairs, you are to try to tell me the noun that was presented with it. In summary then,

- read the noun to the left and then the noun to the right
- repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next two nouns are presented
- after all 10 pairs have been presented, asterisks will appear, followed by a series of nouns
- for each noun, decide whether or not it had been
presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it

**Trial 1 in the Together mode.** In the following trial you will be presented a second group of noun pairs and a corresponding series of nouns. You are to follow the same procedure as before. This time you will be presented 20 pairs. Remember,

-read the noun to the left and then the noun to the right
-repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next two nouns are presented
-after all 20 pairs have been presented, asterisks will appear, followed by a series of nouns
-for each noun, decide whether or not it had been presented in the pairs—respond "yes" or "no"
-if "yes," then give the noun that was presented with it

**Trial 2 in the Split mode.** The upcoming trial will be somewhat different. This time, each of the two nouns will appear on separate screens simultaneously such that one noun will appear on the screen to your left and the other noun, on the screen to your right. Following the asterisks, the series of nouns will appear on the left screen. Remember,

-read the noun to the left and then the noun to the right
-repeat the two nouns over and over aloud—for example, "mouse-cheese, mouse-cheese," etc.—until the next two
nouns are presented
-after all 20 pairs have been presented, asterisks will appear on the left screen, followed by a series of nouns
-for each noun, decide whether or not it had been presented in the pairs--respond "yes" or "no"
-if "yes," then give the noun that was presented with it