IMAGE MEDIATORS IN PAIRED-ASSOCIATE LEARNING: PROPERTIES OF VERBAL LABELS AND INSTRUCTIONS

by

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

In the Department

of

Educational Psychology

We accept this thesis as conforming to the

required standard

THE UNIVERSITY OF BRITISH COLUMBIA

May, 1975

Department of Educational Psychology

The University of British Columbia
Vancouver 8, Canada

Date May 7, 1975

Chairman: Dr. Stephen F. Foster

Stanzl, I. J. F. Image Mediators in paired-associate learning: Properties of verbal labels and instructions

ABSTRACT

This study investigated the effects of properties of verbal labels and instructions on paired-associate learning. Predictions concerning the independent effects of associative intra-pair relatedness, instructions, and the directing function of the verbal label were made for the dependent variable.

A mediation hypothesis stressing the role of imagery in associative learning and a coding hypothesis stating that "representative" verbal labels may function as conceptual rules, in that they direct stimulus selection and unitary encoding of stimulus and response, guided this work.

Unitary imagery instructions, requiring subjects to draw the unitary image, were expected to facilitate the directing function of the verbal label; separate imagery instructions, requiring subjects to draw only the stimulus image, were expected to inhibit it; standard paired-associate (PA) instructions were used as a control condition.

Two lists of 18 pairs of incomplete figure-stimulus and concrete noun-response combinations, each, were constructed. Each list was homogeneous, regarding the level of associative intra-pair relatedness, which was either high or low in the respective lists. The same stimulus figures and nouns were used in both lists, but in List 1, the response nouns were dominant associates of the incomplete figures, and in List 2, they were remote associates.

Subjects were given one of three sets of instructions to learn either List 1 or List 2. A study-test trial method was employed with one study trial (drawing activity) and two PA recall test trials.

The assumption that even originally remote associates would direct coding of incomplete figure stimuli as complete figures was supported. PA recall performance in the unitary imagery group was equal to PA recall performance in the standard PA group. Both groups correctly recalled a significantly greater number of responses than the separate imagery group, as had been hypothesized. Further the hypothesis that PA learning efficacy in List 1 was significantly greater than in List 2 was confirmed. The effect of associative intra-pair relatedness was found to be independent of the effect of the directing property of the verbal label on unitary encoding of stimulus and response items. The associative property of the verbal label affects unitary image generation because images are more readily available for associatively related pairs than for unrelated ones. The directing property of the verbal label seems to affect the coding process as such, since verbal labels seem to function as conceptual rules for relating the pair items, much as unitary imagery instructions do.

The results were interpreted to indicate that each of these factors independently exerts its influence at the acquisition phase of associative learning, because each affects the generation of unitary images which mediate recall of the response at the test trial.

Committee Chairman

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ACKNOWLEDGEMENT

Advisor: S. F. Foster

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N. Suzuki

I wish to acknowledge the cooperation and assistance of the Vancouver School Board in supplying subjects for the study.

To Dr. S. F. Foster, my advisor, go my thanks for his patience and advice over the last two years.

I am grateful to the members of my committee, Dr. N. Suzuki and Dr. S. S. Lee, for their interest and assistance in making this thesis possible.

Most of all I want to thank my family, my husband and my children, Claude, Linda, and Valerie, for their love, understanding, and help. It is to them that I dedicate this thesis.

I. J. F. S.

Dedication

to my

husband and children

Claude, Linda, and Valerie

CHAPTER I

INTRODUCTION

Most of the research concerning the functional significance of imagery in learning has been carried out with the paired-associate (PA) learning task. Interest has centered on the acquisition process of individual associations; factors responsible for single associations, such as, item properties, strategies employed by subjects in learning paired-associates, and the effect of instructions on performance have been investigated.

One approach to the study of imagery has been to use and manipulate materials designed to either evoke or inhibit the arousal of imagery. This took the form of using words, rated high or low in their image evoking capacity (e.g., Paivio, Smythe, & Yuille, 1968); it also took the form of actually providing subjects with images by showing them pictures (e.g., Epstein, Rock, & Zuckerman, 1960; Rohwer, Lynch, Suzuki, & Levin, 1967).

Another method to study the effect of imagery in associative learning involved the use of mnemonic instructions to induce subjects to use imaginal mediators in the performance of certain tasks (e.g., Bower, 1972; Bower & Winzenz, 1970; Bugelski, 1968; Bugelski, Kidd, & Segmen, 1968).

A. Studies of Pair Item Properties and Imagery Instructions

Wollen and Lowry (1971) attempted to manipulate mental images by varying the content of pictures which depicted either stimulus or response terms singly, side-by-side, or in some form of interaction as a pictorial compound. Subjects were instructed to use the pictures which accompanied both concrete and abstract noun pairs as mediators. The interactive picture mediation condition was the only condition that facilitated PA recall relative to a no-picture control. Facilitation was obtained for both types of pairs.

The results of the Wollen and Lowry study support and extend the findings of earlier work of others (e.g., Epstein, Rock, & Zuckerman, 1960; Rohwer, Lynch, Suzuki, & Levin, 1967). Epstein *et al*. demonstrated that picture pairs were easier to learn than word pairs. Furthermore, they showed that associative learning of pictorially represented object pairs was facilitated by unitary presentation compared to separate presentation of the same pictorial items. For instance, the picture pairs "hand in bowl", "pipe on top of clock", "chair beside tree", *etc*., facilitated PA performance compared to the picture pairs "hand and bowl", "pipe and clock", "chair and tree", *etc*., which did not. Pictorial compounds which depict stimulus and response objects in some kind of interactive relationship, or in some form of situational context,

constitute good "conceptual units" (e.g., Epstein et al., 1960); they show spatial relationships that confer "perceptual unity" upon the items to be associated (e.g., Asch, 1969).

Wollen and Lowry (1971) attributed their findings to the facilitation of relational associating, i.e., the presentation of pictures that showed relationships of the referent objects to which the noun pair items referred. Others have found that pictures which express different degrees of relationship with respect to the interactive unity achieved, differentially affect associative learning and PA recall efficacy. In the Rohwer et al., (1967) study, for instance, it was demonstrated that "locational" and "action" pictures produced equivalent learning; both conditions were superior to the "coincidental" condition in which the pictured objects appeared side-by-side.

This finding parallels and extends the Epstein et al., (1960) finding that picture pairs which make good conceptual units are easier to learn than pairs in which the members simply appear side-by-side. It also extends the finding that interaction pictures (i.e., interactive images) are better mediators than non-interacting pictures (Paivio, 1971a).

Davidson and Adams (1970), using children as subjects, investigated the effect of syntactic and imagery mediators

on PA learning of noun pairs. Both mediation conditions were found to be superior to a side-by-side condition; but, "a minimal language cue" in the form of a prepositional connective (over, under, around, through etc.) was found to mediate "more effectively than imagery alone" (p.433), when a recognition PA task was used to measure PA learning.

Kee and Rohwer (1974) examined the effects of aural and pictorial "elaborative prompts" on the response and associative stages of children's noun pair learning. He found that both types of prompts facilitate the associative stage of PA learning equally. Differential effects, regarding the type of elaborative prompt used, could not be found. The results show that the effect of elaborative facilitation is in the associative phase.

Similar findings were reported by Bower (1970), and in another study by Rowe and Paivio (1971), who both used different kinds of imagery instructions and different kinds of performance tasks, in order to investigate the locus of the imagery effect in PA learning of noun pairs with adult subjects.

In the study reported by Bower, subjects were instructed to learn concrete noun pairs, using one of three methods: rote repetition, interactive imagery, and separation imagery. In the interactive imagery condition, subjects were asked to imagine the referent objects of the two nouns in each pair in some form of interaction; in the separation

imagery condition, subjects were asked to imagine the two referent objects as separate entities. A stimulus recognition and a PA recall test were used in order to test the two alternative hypotheses, explaining the imagery effect in PA learning, either as being due to "increased reliability of stimulus encoding or to increased relational association produced by imagery" (Bower, 1970; p.529).

Stimulus recognition was equal for all instructional conditions. Associative recall was highest for the interactive imagery condition and lower, but equal, for the rote and separate imagery conditions. Only the interactive imagery condition appeared to facilitate associative recall; separate imagery and rote repetition instructions seem to have interfered with mediation which has been demonstrated to facilitate PA learning.

In the Rowe and Paivio (1971) study, subjects were administered either compound imagery, separate imagery, or rote repetition instructions. The purpose of the study was to test the effectiveness of imagery and repetition instructions in verbal discrimination and incidental associative learning. Discrimination learning was facilitated by single imagery or rote repetition; associative recall was facilitated only by compound imagery. Compound imagery presumably integrated the pair elements as spatial units.

The results of both studies show that the imagery effect is localized "in the associative rather than the stimulus

coding phase" of PA learning (Rowe & Paivio, 1971; p.671).

In summary, the studies that have been discussed up to now, all indicate that the efficacy of imagery in PA learning may best be attributed to associative processes rather than to processes involving stimuli or responses as isolated units. Such an interpretation supports the relational associating hypothesis (Bower, 1970), and the hypothesis that anything that "aids figural organization or unitization should increase the effectiveness of imaginal mediators", (Paivio, 1971b; p.14).

Bower suggested that imagery may act as a "relational organizer" in associative learning, emphasizing especially the integrating and unitizing function of imagery.

Paivio (1971b) restated the so-called "conceptual peg" hypothesis (1963, 1965, 1969, 1970), which emphasized the role of stimulus concreteness in associative learning, in the form of an integration hypothesis which stresses the role of concreteness of both pair members in unitary mediator generation and subsequent PA recall. The hypothesis states that concreteness of both pair members aids associative learning in the study trials by permitting subjects

> "to form compound images incorporating representations of both members of each pair. Concreteness of the stimulus member is especially important on recall trials, however, since that member must function as the retrieval cue (conceptual peg) which reintegrates the mediating image from which the response component can be decoded" (p.15).

Concrete noun pairs are learned more easily than abstract pairs;

for concrete nouns, presumably through contiguous association with referent objects, have developed the "capacity" to elicit a response similar to that evoked by the object(s), but abstract nouns, lacking contiguous association with referent objects, cannot evoke such images directly. By the same reasoning, it can be concluded that picture pairs are learned more easily than concrete noun pairs, since they constitute concrete images as such, which refer even more directly to the referent objects depicted by them.

Paivio and his associates have demonstrated repeatedly that noun concreteness facilitates PA learning; futhermore, it has been shown that picture pairs were learned more easily than word pairs. When the differential effect of noun concreteness was contrasted on both the stimulus and response side of pairs, it was found that stimulus concreteness facilitated PA learning, compared to response concreteness. The four possible combinations of stimulus-response concreteness were recalled in increasing order of difficulty, concrete-concrete (C-C), concrete-abstract (C-A), abstract-concrete (A-C), and abstract-abstract (A-A). The results were interpreted to provide support for the "conceptual peg" hypothesis (Paivio, 1965). The generality of these findings is indicated by similar results obtained with children as subjects (Paivio & Yuille, 1966).

Using adult subjects, Paivio and Yarmey (1966) carried out a subsequent study in which they tested the effectiveness

of pictures versus words as either stimuli or responses. When contrasted on both the stimulus and response side of pairs, pictures were found to be superior to their respective concrete-noun labels; this effect being greater on the stimulus side of pairs. The results were interpreted as being analogous to the finding for word abstractness-concreteness, pictures being even more concrete than words.

The finding that pictures facilitated learning as stimulus items was interpreted to support the "conceptual peg" hypothesis (picture-word pairs were superior to word-picture pairs) but the additional finding that picture-word pairs were superior to picture-picture pairs, could not be explained this way.

The experimenters suggested that to decode a picture into a verbal response form might require more time - a decoding problem - but they could not adequately explain why subjects would then have less difficulty in learning word-picture pairs compared to word-word pairs.

Using the four possible combinations of stimulus-response concreteness, pairs were recalled in increasing order of difficulty, picture-word (P-W), picture-picture (P-P), word-picture (W-P), and word-word (W-W).

A study by Dilley and Paivio (1968) investigated the generality of the finding that pictures are superior to words as stimulus members and the decoding interpretation of the inconsistent effect of pictures as response members

of PA pairs, by extending the Paivio and Yarmey study to young children. The results of this study indicated that pictures facilitate learning as stimuli, but hinder learning as responses. Compared with the findings for adults, only the children's data show a general negative effect of pictures as response items. This finding was explained in terms of the decoding hypothesis advanced by Paivio.

Paivio's decoding hypothesis (which relates the problem to response retrieval rather than to associative learning) was tested against an alternative hypothesis, advanced by Rohwer (1970), which relates the problem to the storage phase of PA learning. Kee, Guy, & Rohwer (1971), who conducted the above mentioned study with children as subjects, demonstrated that neither hypothesis can adequately explain the results.

If one considers the findings of other researchers who investigated the locus of the imagery effect in associative learning, one is led to believe that another explanation of the inconsistent effect of response concreteness, compared to the consistent superiority of stimulus concreteness with picture-word paired-associates, is possible.

Bower (1970) as well as Rowe and Paivio (1971) have emphasized that "a localization of the imagery effect in the associative rather than the stimulus encoding phase of PA learning" is indicated (Rowe & Paivio, p. 671). Additionally, it has been pointed out that unitary encoding of the pair

members, and the degree of figural organization, or the degree of interaction will differentially affect PA performance. Unitary imagery instructions, compared to separation imagery instructions, have been shown to facilitate PA learning, because unitary imagery instructions encourage subjects to actively generate unitary compounds which mediate PA recall. In fact, Bower (1972) reported that instructions to use imagery facilitated learning performance only, when the instructions included a set to form interacting images. As mentioned before, instructions to image the referents of a pair side-by-side did not facilitate performance.

These findings apply to verbal and nonverbal materials alike. If one varies either words (Paivio, 1965; Paivio, & Foth, 1970), pictures (Epstein, Rock, & Zuckerman, 1960; Rohwer, Lynch, Suzuki, & Levin, 1967; Wollen & Lowry, 1971), or shapes and nonsense figures (Asch, Ceraso, & Heimer, 1960; Prentice & Asch, 1958; Kaswan, 1957), according to the level of concreteness and imagery value (words), the level of interactive relationship (pictures), the level of perceptual relatedness and "fittingness for good continuation" (shapes and nonsense figures), then one will find that the level of PA recall performance is a function of unitary mediator production which was assumed to have occurred in the various conditions, regardless of which materials have been used.

The above cited studies had one thing in common: The PA pair items consisted of either verbal or nonverbal

items, combinations of both were not employed.

In contrast to these studies, Paivio and Yarmey (1966) and Dilley and Paivio (1968) have used both verbal and non-verbal stimulus and response items in order to construct the four different combinations of pictures and words, P-P, P-W, W-P, W-W, which were employed as paired-associates in their respective studies. Paivio and his associates considered the findings in the above mentioned studies only in terms of the "conceptual peg" hypothesis, with its emphasis on the "crucial role" of stimulus concreteness on the PA recall test trial. As stated previously, the superiority of P-P pairs over W-W pairs as well as the superiority of P-W pairs over W-P pairs can be explained by the "conceptual peg" hypothesis; but, the superiority of P-W pairs over P-P pairs needs another explanation.

Paivio defined "concreteness" in terms of direct reference to an object, thereby implying that words and pictures are contained unidirectionally on the same abstractness- concreteness dimension. In the present study, concreteness is understood as being bidirectionally extended - words are contained in one abstractness-concreteness dimension and shapes are considered to vary correspondingly with respect to direct reference to a common object referent, as illustrated in figure 1.

```
                                 O
                                 B
                                 J                    Words
PICTURE = E <-> CONCRETE NOUN -> ABSTRACT NOUN
                                 C
                                 T
                                 S
```

Concreteness as defined by Paivio

```
                                 O
                                 B
          Shapes                 J                    Words
RANDOM SHAPE <- PICTURE <-> E <-> CONCRETE NOUN -> ABSTRACT NOUN
                                 C
                                 T
                                 S
                   \ /
                Incomplete Figure
```

Concreteness as defined in this study

Figure 1: Abstractness-Concreteness Dimensions of Shapes and Words

If we consider the findings of the Paivio and Yarmey study with respect to the imagery encoding unitization hypothesis, we may be able to explain the surprising superiority of the P-W pairs over the P-P pairs in PA learning and recall. According to the view that unitary encoding of stimulus and response in the form of an interactive image facilitates PA learning and recall, we would expect that somehow unitary encoding was more effective in the P-W pairs than in the P-P pairs, or that alternatively, unitary encoding occurred only in the P-W condition but not in the P-P condition. The latter possibility seems less probable, since the P-P pairs were superior to the W-W pairs.

B. Studies of P-W pairs and the Underlying Processes

Ellis (1968) investigated the role of the verbal label in stimulus predifferentiation and transfer to shape recognition. Ellis used random shapes of either high or low association value (i.e., six-point random shapes scaled by Vanderplas & Garvin, 1959) and meaningful-relevant labels which were representative of the shapes. The meaningful-relevant labels were dominant associates given to the shapes, as defined by scaling procedures (Ellis, Muller, & Tosti, 1966). The same meaningful-relevant labels were paired with 24-point shapes in a second study in order to examine the generality of the findings in the first study. The findings indicated that response label relevance contributed to gain in recognition for both six - point and twenty - four - point

random shapes when the association value of the shapes was high. Relevance of the verbal label did not facilitate recognition of 24-point low association value shapes.

These findings were interpreted to mean that "representative" verbal labels direct subject's attention "to those distinctive aspects of the stimuli of which they are descriptive" (Ellis, 1968; p.407). Furthermore, it was argued that, "representative" verbal labels provide a concept to which the shape can be related (Ellis & Muller, 1964; Ellis & Daniel, 1971).

Ellis and Daniel (1971) conducted three studies: the first and the second investigated the temporal course of stimulus-shape recognition, after pretraining by either observing the stimulus shapes or by associating them with representative verbal responses, with 0-delay, 15 minutes-delay, 30-minutes delay and extended delay intervals of two and seven days. The third study measured aided and free recall of the responses through a 28 day retention interval. The results showed that stimulus recognition was invariant over time and that association formation facilitated recognition performance. PA recall performance was equal to recognition over short time intervals, but declined over longer time intervals. Recognition performance did not depend upon recall of associated responses at the time of recognition testing.

The findings were interpreted to mean that stimulus recognition was independent from the recall of the verbal label at the time of testing, although, association formation was assumed to have played an important role at the time of stimulus encoding and storage.

This interpretation was supported by the Daniel and Ellis (1972) study which examined the role of distinctive verbal labels and scaled codeability of the shapes on the temporal course of recognition memory for complex random shapes. The stimuli were 24-point Vanderplas and Garvin shapes which were scaled for codeability by asking subjects to give a "name or verbal association" for each shape as quickly as possible." The mean latency of the first associative response is the scale value for each shape, short latencies indicating high codeable shapes" (p.84). The relevant verbal labels were taken from previous scaling data (Ellis & Muller, 1964).

The findings of both, the Ellis and Daniel (1971) and the Daniel and Ellis (1972) study, suggest that verbal labels aid a process of stimulus selection by encouraging attention to distinctive features of the stimuli. It was concluded that the effect of verbal labels on recognition memory is "best attributed to processes occurring during the encoding or acquisition phase of the memory task" (Daniel & Ellis, 1972; p.83).

Furthermore, it was suggested that the label directs unitary encoding of the stimulus and response items of each pair:

> When the response terms bear some conceptual relationship to the stimulus term, image-like mediators can be employed by S to relate the terms, and properties of the response encourage S to attend to particular features of the stimuli. What gets encoded may be some representation of a stimulus-response unit, as distinct from separate encoding of stimulus and response terms (Ellis & Daniel; p.26).

Ellis (1968) distinguished between the confirming and the directing property of the verbal label. The confirming property is assumed to characterize the general function of the label but the directing property of the verbal label is assumed to serve in an additional function: This more specific function, according to Ellis:

> emphasizes the directing properties of the verbal label in which additional distinctive features of the stimuli are learned over and beyond those minimal aspects associated with the label's confirming function (p.408).

To summarize the findings of the stimulus-shape predifferentiation studies with respect to their relevance to findings in imagery research, regarding picture-word paired-associates, we conclude that the hypothesized effect of the directing property of the verbal label on stimulus encoding processes may be most important.

C. Needs for the Present Study

As noted earlier in section A, the studies that have been examined indicate that there is a problem in interpreting the fact that picture-word (P-W) pairs were recalled better than

picture-picture (P-P) pairs. It was also noted that Paivio's "conceptual peg" hypothesis along with the decoding hypothesis of response terms could not handle the problem of interpreting the observed fact. Therefore, an alternative way of explaining the observed fact needs to be formulated.

In this connection there appears to be a plausible hypothesis of unitization emerging from the studies by Rohwer and his associates (1967), Bower (1970), and Rowe and Paivio (1971). Particularly, Bower's "relational organizer" idea seems to be relevant to the problem in hand at this point. Although, Bower himself has not specified specific conditions under which the relational organizer should function. The present study specifically addresses itself to investigating underlying operations involved in learning the pairs similar to picture-word (P-W) pairs. More specifically, to investigate the processes involved in the learning of incomplete figure stimulus terms paired with common words as response items. For the present purpose, encoding is viewed as being of two classes: one representational and one elaborative encoding. The former refers to a selection process of stimulus components that are physically representative of the given stimulus item; the latter refers to further additive transformation of the given stimulus. In the present study, it was assumed that specific mechanisms involved in these two classes of stimulus encoding are the functions of characteristics of the response terms. In this regard Ellis and his associates have

investigated the functions of response terms as related to associative learning or stimulus recognition learning in terms of two functions, one confirmative and one directing function of the response label. Their studies, using such unintegrated stimulus items as random shapes and common words as response labels, seem to be in general supportive of the two hypothesized functions.

In the present study, the pairs to be studied are based upon incomplete figures as stimulus items and common words as response items. Given such pairs, it is assumed that elaborative stimulus encoding would be a major component of stimulus encoding processes involved, including some of the selection aspect too. One most interesting question arises as to what specific functions the response terms would take on. One can conceive of at least two major functions that can be assigned to the verbal response label, that is, associative and directive functions. The associative function refers to a role of the verbal response label to elicit "backwardly" its associated stimulus (or stimuli), which may well exist pre-experimentally between stimulus and response terms. The directive function refers to a role of the verbal label to direct how the elaborative stimulus encoding is to be carried out.

The operation of the associative function of the verbal label can be inferred from the acquisition rate as a function of intra-pair relatedness of the pair items and that of the directive function can be inferred from the specific imagery

instructions given to the learners. Given the categorization of the stimulus elaborative encoding process and its associated functions of the verbal response label, it was hypothesized that the higher degree of congruent intra-pair relatedness for each pair of terms would facilitate the stimulus encoding process. This would result in easier recall of pair items as a unit. It was also hypothesized that the elaborative stimulus encoding process would be aided by specific instructions to form unitary images involving stimulus and response items together, thus resulting in better recall of stimulus and response as a unit. Conversely, separate imagery instructions which direct subjects to generate separate stimulus and response images were expected to inhibit the elaborative encoding process. Separate encoding of the stimulus and response terms, compared to unitary encoding, was expected to result in less efficient recall of the response label.

As mentioned before, the present study will employ incomplete figures as stimuli in combination with concrete noun responses. Incomplete figures were chosen, instead of pictures, because they represent intermediary shapes (significant parts) which can be elaborated and completed) between pictures and random shapes. Both pictures and random shapes can be reduced to significant parts (or components), i.e., incomplete figures, which in turn can represent the shape characteristics (significant features) of original objects. Conversely, each incomplete figure can be elaborated or completed in order to

become a specific picture (image) or a characteristic part of a specific outline shape.

Thus, incomplete figures can be regarded as component part shapes, or as entities, capable of arousing a number of different images with different object referents, each of which shares the incomplete figure as a significant component part which differs from object to object.

In Figure 2, one can see an example of an incomplete figure used in this study. It shows the incomplete figure and three dominant associates (images and corresponding labels) evoked by this figure. Figure 3 shows a comparison of random shapes and associated labels with an incomplete figure and its associated labels.

What makes an incomplete figure entirely different from an impoverished picture, a minimal outline, or a schematic representation of an object, is the fact that the incomplete figure is "representative" of its associated images with their object referents, because of its significant features which are characteristic of the objects it refers to.

The incomplete figures used in this study were selected from the Torrance Tests of Creative Thinking: Figural Tests, Picture Completion Activity (Torrance, 1966). The response items were concrete nouns given as associated labels of pictures drawn by elaborating the incomplete figures according to instructions (Torrance, 1966). Two lists were constructed in order to vary the level of associative relationship between

INCOMPLETE FIGURE

DOMINANT ASSOCIATES

ASSOCIATED IMAGES

BOY HOUSE TREE

ASSOCIATED LABELS

BODY WALL TREE-TRUNK

ARM PART of ROOF BRANCH

LABEL of PART = INC. FIG.

Figure 2: Incomplete figure and associated images and labels

HOUSE

Six-point shape scaled for A.V.* in the study No 14

* Association Value

TREE

Twenty-four-point shape scaled for A.V. in the study No 10

HOUSE TREE BOY

Incomplete figure from Torrance (1966) Fig. Tests Picture Completion Activity:Form A Figure 2

Figure 3: Vanderplas and Garvin Shapes (Vanderplas & Garvin, 1959) and associated labels (Ellis & Muller, 1964), incomplete figure from Figural Tests, Picture Completion Activity, Form A (Torrance, 1966).

stimulus and response items in each list. The responses in List 1 were dominant associates of the incomplete figure stimuli and the responses in List 2 were remote associates of the incomplete figure stimuli. Thus, in terms of being descriptive of the stimulus shapes, the dominant responses in List 1 would qualify as "representative" labels (Ellis, 1968). The remote associates used as responses in List 2 would not qualify as such, instead, they could be regarded as unrelated response items, comparable to the response items used in the P-W pairs (Paivio & Yarmey, 1966). However, even if the response items in List 2 were comparable to the response items used in the P-W pairs in the Paivio and Yarmey study, we would expect imagery processes to vary because of the difference in the stimulus items. Although, both kinds of stimuli (pictures and incomplete figures) are nonverbal items, they differ with respect to the shape property of completeness as well as with respect to the property of concreteness, defined as the capacity to evoke associated imagery and corresponding labels.

The unitary encoding process as a function of the directing and relating property of the verbal label (response) would be expected to differ. In the P-W pairs, we would expect stimulus selection to occur in combination with interactive encoding of stimulus and response items; but in the incomplete figure-word pairs, we would expect stimulus elaboration to occur and the generation of unitary images.

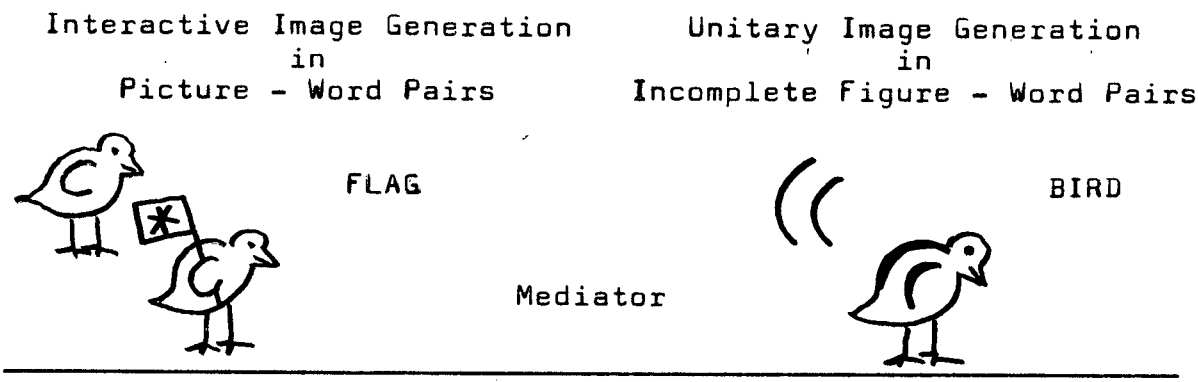

Figure 4: Interactive and unitary images generated as a function of the kind of nonverbal stimulus item used and as a function of the directing property of the verbal label.

If the hypothesized functions of the verbal response label are close approximations to psychological reality then some predictions can be made from the hypothesis. Given the operational definition of associative intra-pair relatedness as previously noted, it would be expected that high associative intra-pair relatedness would facilitate the learning of paired-associates compared to low associative intra-pair relatedness with the sub-hypothesis of associative function, given the elaborative stimulus encoding hypothesis. If the second sub-hypothesis of the directive function of the verbal response label is a close approximation of psychological reality then it would be expected that unitary instructions would facilitate the directive function of the verbal response label. In this way the learning of remotely associated pairs would be facilitated. Ordinary PA instructions would be as facilitative of the acquisition of pairs that are of high associative intra-

pair relatedness as unitary imagery instructions would be, assuming spontaneous elaborative encoding on the part of subjects under ordinary PA instructions. Of course, this assumption would have to be examined for its validity later. Of course, it may be the case that the effect of unitary imagery instructions may not interact with the degree of associative intra-pair relatedness in a multiplicative fashion but rather in additive fashion. However, if there is no expected effect of the unitary imagery instruction, as predicted, then we may view the fact as no significant effect of unitary imagery instructions, that is, unitary instruction does not do any good as far as the directive function of the response label is concerned. Therefore, it would be desirable to determine whether or not any other kind of instructions would be effective at all, that is, the separate imagery instructions. In this regard separate imagery instructions, as briefly defined earlier, were expected to inhibit the directive function of the verbal response label, and furthermore, to interfere with the associative function. In other words, the separate imagery instructions would discourage any kind of mental operation to relate stimulus and response terms.

If this is the case, then the recall of the pairs under the separate imagery instructions, whether high or low associative intra-pair relatedness, would be poorer under the separate imagery condition than under ordinary PA instructions.

The principal effect of the labeling response, given unitary imagery instructions, would be due to its directive function which encourages the generation of unitary images by directing attention to the significant features of the incomplete figure shape, thereby relating it to the concept the label implies. Given separate imagery instructions, the effect of the directive function of the verbal label would be inhibited and the generation of separate stimulus and response images would be attributable to the concreteness of stimulus and response items.

CHAPTER II

METHOD

Design

In order to answer questions regarding the effectiveness of associative intra-pair relatedness and the effect of the directing property of the labeling response on unitary encoding of stimulus and response items (i.e., coding of incomplete figure stimuli as complete figures) in the form of unitary images via imagery instructions, the experimental variables had to be operationally defined.

Two levels of associative intra-pair relatedness, operationally defined as lists (list 1 = high associative intra-pair relatedness; list 2 = low associative intra-pair relatedness) which reflected the effect of the associative property of the verbal label (e.g., its "representativeness", Ellis, 1968) on unitary encoding of stimulus and response terms, constituted the first experimental variable.

Three levels of instructions (unitary imagery, separate imagery, and standard PA instructions) constituted the second experimental variable. Thus, the variations in the two factors resulted in a 2 X 3 factorial design. The effect of the directing property of the verbal label was examined as a function of instructions.

Unitary imagery-drawing instructions which were designed to relate stimulus and response terms, were expected to facilitate elaborative encoding of the stimulus figure in relation to the response label concept and increase the effect of the directing property of the verbal label on unitary encoding. Separate imagery-drawing instructions which were designed to generate stimulus evoked images that were different from the concept (and associated image), implied by the response label, were expected to inhibit elaborative encoding in the form of stimulus-response units, and decrease the effect of the directing property of the verbal label on unitary encoding. Standard PA instructions were included as the third level of the instructions variable. Subjects in the PA condition had to report the method used in learning the paired-associates after completion of the PA recall test trials.

All levels of the lists and instructions variables were factorially combined to create six separate experimental conditions with 16 subjects to each condition. A subject was randomly assigned to one of the experimental conditions and received either unitary imagery, separate imagery, or standard PA instructions, and subsequently learned one of the two PA lists.

Following the study trial, subjects were administered two consecutive PA recall test trials which were included in the design as a third variable. Thus, the experimental design

was a 2 X 3 X 2 factorial with repeated measures on the last factor.

The following contrasts were constructed in order to test the experimental hypotheses stated earlier.

$$\hat{\psi}_1 = \bar{X}_{\text{List 1}} - \bar{X}_{\text{List 2}}$$

$$\hat{\psi}_2 = \bar{X}_{\text{PA(List 1)}} - \bar{X}_{\text{UI(List 2)}}$$

$$\hat{\psi}_3 = \bar{X}_{\text{PA(List 2)}} - \bar{X}_{\text{UI(List 2)}}$$

$$\hat{\psi}_4 = \bar{X}_{\text{PA(List 1)}} - \bar{X}_{\text{SI(List 2)}}$$

$$\hat{\psi}_5 = \bar{X}_{\text{PA(List 2)}} - \bar{X}_{\text{SI(List 2)}}$$

Subjects

Ninety-six elementary school children from the grade six population of a local public school served as subjects. Of the group of 96 children, 38 were males and 58 were females. Sixteen subjects were randomly assigned to each condition of the design.

Materials

The learning materials consisted of 18 incomplete figures and 18 concrete nouns. The incomplete figures and the corresponding noun-labels were selected from the Torrance Tests of Creative Thinking: Figural Tests, Form A and Form B, Picture Completion Activity (Torrance, 1966).

Each pair consisted of an incomplete figure stimulus and a concrete noun response item. Two sets of 18 pairs each were constructed: the first set constituted List 1, the second set constituted List 2. The same materials were used in both lists but the response-labels, used in the first list, were re-paired in the second list.

Thus, two homogeneous lists were created which used the same stimulus figures and nouns, but were varied with respect to the level of associative intra-pair relatedness between lists. Table 1 shows the stimulus figures and the corresponding labels which were used in List 1, and repaired in List 2, in combination with the appropriate originality score for responses given to the individual incomplete figures as listed in the Scoring Guide to the Figural Tests, Form A and Form B, Picture Completion Activity (Torrance, 1966).

TABLE 1

INCOMPLETE FIGURES AND NOUN LABELS

IN LIST 1 AND LIST 2

List 1 & 2 Stimulus	List 1 Response	Torrance Score	List 2 Response	Torrance Score
	BOY	1	BIRD	2
	SHOE	0	FISH	2
	HORSE	0	HOUSE	2
	FLAG	0	HEAD	2
	CAR	0	KITE	2
	TREE	0	BOAT	2
	HOUSE	1	BOY	2
	FLOWER	1	CAT	2
	KITE	1	CAR	2
	DRESS	1	SHOE	2
	BOAT	0	FLOWER	2
	FISH	1	FLAG	2
	WOMAN	1	DOG	2
	CAT	1	TREE	2
	HEAD	0	SHIP	2
	SHIP	1	DRESS	2
	DOG	1	WOMAN	2
	BIRD	1	HORSE	2

The Directions Manual and Scoring Guide for the Figural Tests, Form A and Form B, Picture Completion Activity (Research Edition, 1966) provides a separate guide for each of the incomplete figures, since each of them tends to elicit its own hierarchy of associated responses.

The scoring guide for scoring originality of responses to the individual incomplete figures in Form A is based on a tabulation of the responses submitted by 381 subjects from kindergarten through high school; the scoring guide for Form B is based on a tabulation of the responses submitted by 500 subjects from grades one through twelve.

Zero-point (5% or more of the responses) and one-point responses (2% to 4.99% of the responses) were used in List 1; two-point responses (less than 2% of the responses) were used in List 2.

The 18 nouns, used in this study, were descriptive labels of the individual incomplete figures in List 1 but not in List 2. They were "representative" labels (Ellis, 1968) of associated images that can be evoked by the incomplete figures. The response-labels in List 1 were regarded as dominant associates of the stimulus shapes; the response-labels in List 2 were regarded as remote associates of the stimulus shapes, as defined by scaling procedures (Torrance, 1966).

Norms for concreteness (C), imagery (I), meaningfulness (m; Noble, 1952), and frequency (F; Thorndike & Lorge, 1944), were provided for the selected nouns by the "Concreteness, Imagery, and Meaningfulness Values for 925 Nouns" (Paivio, Yuille, & Madigan, 1968). The nouns were rated high on C and I (mean C and I for 14 nouns was 6.67 and 6.91, respectively; "kite", "boat", "head", "dog" were not listed); the m value was 7.09; Thorndike-Lorge frequency values were high (AA = 100 or more occurrances per million for most nouns; except "cat" A, "flag" A, "kite" 10 per million).

Apparatus

The apparatus was very simple. It consisted of a blackboard, a 450mm X 600mm sheet of cardboard, a stop-watch, and the test booklets.

The blackboard was used for demonstration purposes. The cardboard represented the format of the study trial and the test trial worksheets. It was divided into 18 rectangles; each of these rectangles corresponded to the space provided for the PA pairs on the worksheets. However, on the cardboard example, the rectangles were numbered. These numbers were used for no other purpose than to show the subjects that the drawing sequence was to proceed in a vertical manner from frame 1 to frame 18.

A stop-watch was used to control the presentation and drawing time of each instance in the sequence.

The test booklets consisted of 6 pages which were stapled together. Each test (study trial activity: List 1 or List 2; PA recall test trials: Trial 1 and Trial 2) was contained on one page. There were three tests: the first one was preceded by a purple page, the second one by a green page, and the third one by a pink page.

The immediate purpose of the colored sheets was to separate the different trials. The functional purpose of the colored sheets was that subjects would be able to open the test booklets without leafing through them. In other words, it was supposed to prevent subjects from referring back to precious trials. Two original study trial worksheets (List 1 and List 2) and the two PA recall test trials are contained in Appendix A .

Procedure

The experimental setting was a separate area in the school library which was available from 9:00 A.M. to 12:00 A.M. on the day of the experiment. It contained six round tables with five chairs each, and two additional study desks with one chair each. This seating arrangement accommodated a group of 32 subjects to be tested at the same time.

The experiment was carried out in three consecutive sessions each of which corresponded to one of the different instructional conditions of the design.

A total of 96 subjects, 32 subjects from each class, were randomly selected to serve in the experiment. The three experimental groups of 32 subjects each were formed by assigning each subject a number tag which represented one of the three experimental conditions being tested in the three consecutive sessions constituting the experiment. The distribution was such that subjects from any of the three classes could be in any of the three groups: Subjects with a number "one" tag were assigned to the PA group being tested in session number one; subjects with a number "two" tag were assigned to the UI group being tested in session number two; and, subjects with a number "three" tag were assigned to the SI group being tested in session number three.

The experimental materials (List 1 and List 2) were distributed on the five tables and two study desks in the following order: 1,2,1,2,1; 2,1,2,1,2; 1,2,1,2,1; 2,1,2,1,2; 1,2,1,2,1; 2,1,2,1,2; 1,2, before the students entered the experimental room. Subjects were instructed to sit quietly at the table and place of their choice, and not to open their test booklets until told to do so. Pencils were provided by the experimenter.

All subjects received general instructions concerning the nature of the experiment, method of study, and general procedure regarding the administration of study and test trials.

The general instructions specified that the experiment was concerned with learning pairs of incomplete figure stimulus and concrete noun response items. Following an explanation of the associative learning procedure, subjects were given a practice trial with two examples; one example was representative of paired-associates in List 1 (high associative intra-pair relatedness) and the other was representative of paired-associates in List 2 (low associative intra-pair relatedness).

Subjects in the PA group (standard PA instructions) were asked to look at the practice pairs and think about a method of learning them most efficiently. They were asked further to keep their method a secret. Any mention of imagery was strictly avoided by the experimenter. Subjects in the two imagery groups were instructed to actively engage in generating mental images. The experimenter drew the instances which were either unitary images in the UI group (unitary imagery instructions) or separate images in the SI group (separate imagery instructions), provided by the subjects, on the blackboard.

Thus, the experimenter demonstrated the drawing technique to be used in the study trial, which involved the completion of the incomplete figure by adding lines to it, in such a way that a picture was produced which incorporated the incomplete figure as a significant part.

Following this practice session the study trial was administered. A study-test method was employed which was modified from the standard PA study-test method in that only one study trial was administered, followed by two PA recall test trials. Drawing of the specific instances (each pair) on the study trial was timed by a stop-watch. The time allowed for either drawing or observing each instance, according to the instructional group, was 15 seconds. Every 15 seconds the experimenter stamped on the floor, which was the signal to proceed to the next item. Total time allowed was 4 minutes for the study trial and 5 minutes for each test trial, which included the time needed to re-explain what a subject was required to do on the test trials. The order of the stimulus items on each test trial was different and the position of the stimulus on the page in both study trial and test trials was randomly determined.

When the study trial was completed, instructions regarding the PA recall tests were briefly reiterated, in order that there would be no interruptions during the actual test trials. Both test trials were administered consecutively. After completion of the second test trial, subjects in the PA group only were asked to report which method they had used to learn each pair. Then all subjects were told to close their test booklets and leave them on the tables. Before they left the testing area, they were asked

not to discuss the test among themselves, or with any other student, until the experiment was over.

Instructions

Subjects in all three instructional conditions were informed that they would see 18 pairs of incomplete figure stimulus and concrete noun response items on the study trial worksheet. An example of a PA pair, representative of each list, was demonstrated on the blackboard. Subjects in the standard PA group were told that they would have to learn each pair in such a way that they would be able to produce the response item when shown only the stimulus item on the test trial. Subjects in the imagery groups received the same instructions as the PA group. In addition, they were shown how to generate images for the examples on the blackboard.

With unitary imagery, the emphasis was on "sameness" or "two things that can be related in such a way that they become one"; in separate imagery, the emphasis was on "separateness" or "two things that are unrelated and different from each other".

The instructions were administered orally. The process of generating either unitary or separate imagery, in order to learn the incomplete figure - word pairs, in the subsequent PA task, was demonstrated to the students through

examples as indicated below.

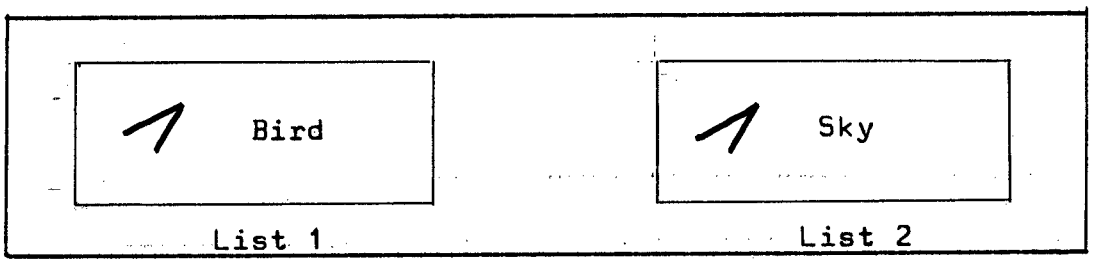

Figure 5: List 1 and list 2 examples used in practice trial to explain both unitary and separate imagery to students.

Using the list 1 example to explain unitary imagery, the experimenter pointed at the response "bird" and said: "Thinking bird what does this (pointing at the incomplete figure) incomplete figure remind you of?" When the students provided examples, such as, beak, wing, part of bird, shape of bird, etc., the experimenter drew the image bird, incorporating the suggested part, by adding lines to the incomplete figure.

Using the list 2 example to explain unitary imagery, the experimenter pointed at the response "sky" and said: "Thinking sky what does this incomplete figure (pointing at the incomplete figure) remind you of?" When the students provided examples, such as, rocket, star, etc., the experimenter drew the suggested image, by incorporating the incomplete figure as a part of the picture (completed figure). Examples of this procedure are shown in Figure 6.

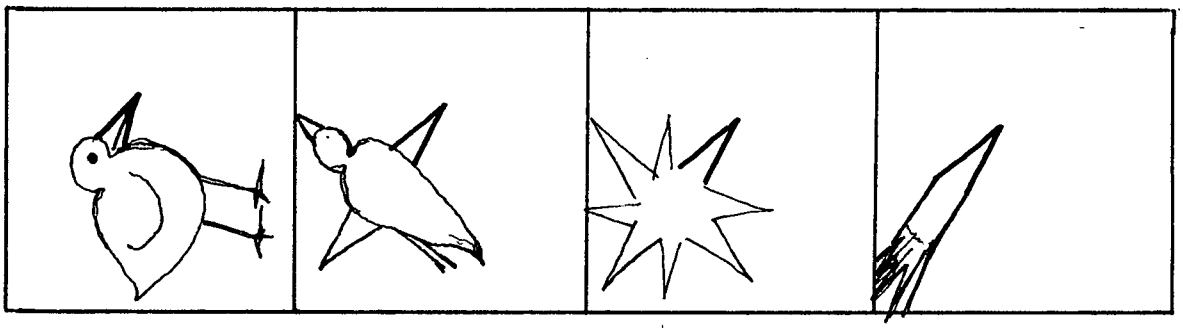

Figure 6: Unitary images suggested by the students and executed on the blackboard by the experimenter

Separate imagery was explained and demonstrated the same way. Pointing at the List 1 example on the blackboard, the experimenter said: "Look at this incomplete figure - word pair. We all know what a bird looks like, (the experimenter proceeded to draw a picture of a bird) but (pointing at the incomplete figure) what could this be?" To emphasize the difference between the two items, the experimenter repeated: "If it is not a bird, what else could it be?" When the students provided examples, the experimenter completed the incomplete figure in such a way that it represented the suggested images. The following images were suggested by the students: "the incomplete figure looks like the hat of a clown, it looks like an upside down icecream cone, it looks like the pointed end of a pencil, etc. This procedure was repeated until everyone knew what was expected of him and how to proceed on the study trial. The experimenter drew the pictures directly and simply to encourage subjects to believe that it would be easy to draw the respective images.

CHAPTER III

RESULTS

Subjects' performance on the PA recall test was observed in terms of the total number of correctly recalled responses for each trial. Total recall scores for each trial were computed for each subject. The means of these scores for each experimental condition are presented in Table 2.

A 2 x 3 x 2 analysis of variance was performed on these scores. The factors involved were two levels of associative intra-pair relatedness (lists), three kinds of instructions (PA, UI, SI), and two trials (PA recall test). The analysis of variance is summarized in Table 3.

Since there were repeated measures on the last factor, the within-cell variation was subdivided into two parts, the $SS_{subj\ w.groups}$ and the $SS_{CXsubj\ w.groups}$. Each of these error terms was subdivided and tested for homogeneity by means of F_{max} tests as outlined by Winer (1971). Partitioning of the two error terms and the F_{max} ratios are shown in Table 4. The F_{max} tests indicated that the assumption of homogeneity of the partitioned parts of the within-cell variation was tenable. Both error terms proved to be homogeneous in terms of the criterion scale of measurement being used. Since the criterion (the total

number of correctly recalled responses in two test trials) provided only two measurements on each subject, there was only one covariance, and the problem of homogeneity of covariance did not exist (p. 537, Winer, 1971). The analysis of the within-subject effects in this case was equivalent to an analysis of difference scores between the two test trials. The variance-covariance matrices associated with the basic data are given in Table 5. Note the ratio of the between-subject error term (22.45555) to the within-subject error term (.5652778) which is approximately 40:1.

The overall type I error of .05 was adopted for the experiment. The two major statistical hypotheses, one the main effect of associative intra-pair relatedness (lists) and the other the main effect of instructions, were each tested at the .01 level of significance. The remaining value of α_i = .03 was allocated equally to the List X Instructions interaction, the main effect of trials, and all interactions with trials; thus, testing each at the .006 level of significance.

Results of the three way analysis of variance, summarized in Table 3, showed a significant difference between the number of correct responses in List 1 and List 2, F (1,90)=38.2320, $p < .0000$. As predicted, scores in List 1 (high associative intra-pair relatedness) were significantly higher than those in List 2 (low associative intra-pair relatedness). This means that subjects learning paired-associates in List 1 recalled a greater number of responses

TABLE 2

MEAN NUMBER OF CORRECT RESPONSES AND STANDARD DEVIATIONS FOR LISTS, INSTRUCTIONS, AND PA RECALL TEST TRIALS

Lists	Instructions	PA Test Trials Trial 1		Trial 2	
		$\bar{X}$	S.D.	$\bar{X}$	S.D.
	PA	13.813	(2.810)	14.563	(2.393)
PR-high	UI	14.313	(3.219)	14.250	(3.173)
	SI	7.375	(4.129)	8.375	(4.209)
	PA	9.625	(4.209)	9.813	(4.415)
PR-low	UI	10.313	(3.400)	10.500	(3.366)
	SI	3.563	(2.220)	3.500	(2.065)

Abbreviations: PR-high = List 1 (high associative intra-pair relatedness); PR-low = List 2 (low associative intra-pair relatedness); PA stands for standard PA instructions, UI stands for unitary imagery instructions, and SI stands for separate imagery instructions.

TABLE 3

Summary of Analysis of Variance

of Total Number of Correctly Recalled Responses

for Two PA Recall Test Trials

Source	df	MS	F	p
Between subjects	95			
Lists (A)	1	858.5208	38.2320	0.0000
Instructions (B)	2	888.6719	39.5747	0.0000
A X B	2	1.5677	0.0698	0.9239
Subj w. groups	90	22.4555		
Within subjects	96			
Trials (C)	1	5.3333	9.4349	0.0029
A X C	1	2.5208	4.4595	0.0354
B X C	2	0.8802	1.5571	0.2147
A X B X C	2	1.7552	3.1050	0.0484
C X subj w. groups	90	0.5653		
Total	191			

TABLE 4

Partitioning of $SS_{error(between)}$ and $SS_{error(within)}$ for Tests for Homogeneity by Means of F_{max} Tests.

Source	SS	df	MS
Subj w.group ab(11)	196.875	15	
Subj w.group ab(12)	291.969	15	
Subj w.group ab(13)	513.500	15	
Subj w.group ab(21)	550.969	15	
Subj w.group ab(22)	333.219	15	
Subj w.group ab(23)	134.469	15	
Subj w.groups	2021.000	90	22.45555

$F_{max(obs.)} = \frac{550.969/15}{134.469/15} = 4.097$ $F_{max(crit.).05(6,15)} = 4.680$*

CXsubj w.group ab(11)	7.500	15	
CXsubj w.group ab(12)	14.469	15	
CXsubj w.group ab(13)	8.000	15	
CXsubj w.group ab(21)	7.219	15	
CXsubj w.group ab(22)	10.219	15	
CXsubj w.group ab(23)	3.469	15	
CXsubj w.groups	50.875	90	0.5652778

$F_{max(obs.)} = \frac{14.469/15}{3.469/15} = 4.171$ $F_{max(crit.).05(6,15)} = 4.680$*

* Winer, B. J. (1971)

TABLE 5

Variance-Covariance Matrices

level ab(11)

	C_1	C_2
C_1	7.89583	6.31250
C_2	6.31250	5.72916

level ab(12)

	C_1	C_2
C_1	10.36250	9.25000
C_2	9.25000	10.06666

level ab(13)

	C_1	C_2
C_1	17.05000	16.85000
C_2	16.85000	17.71666

level ab(21)

	C_1	C_2
C_1	17.71666	18.12500
C_2	18.12500	19.49583

level ab(22)

	C_1	C_2
C_1	11.56250	10.76666
C_2	10.76666	11.33333

level ab(23)

	C_1	C_2
C_1	4.92916	4.36666
C_2	4.36666	4.26666

Pooled Variances and Covariances

	C_1	C_2
C_1	11.58611	10.94514
C_2	10.94514	11.43472

Average Variance and Covariance

	C_1	C_2
C_1	11.51042	10.94514
C_2	10.94514	11.51042

$MS_{subj\ w.groups} = MS_{error(between)} = \overline{VAR} + (r-1)\overline{COV} = 22.45555$

$MS_{CXsubj\ w.groups} = MS_{error(within)} = \overline{VAR} - \overline{COV} = 0.56528$

Within rounding error, these values are equal to those obtained for the corresponding mean squares in Table 3.

than subjects learning paired-associates in List 2.

The other significant main effects involved the instructions variable, F (2,90)=39.5747, $p < .0000$, and trials, F (1,90)=9.4349, $p < .0029$.

The interaction effect between lists and instructions was not significant, $F < 1$.

As predicted, subjects given unitary imagery instructions and subjects given standard PA instructions had higher recall for both types of pairs than subjects given separate imagery instructions. The mean number correct, with the data collapsed across lists and test trials, were 12.344 for unitary imagery instructions, 11.953 for standard PA instructions, and 5.703 for separate imagery instructions.
PA recall performance with standard PA instructions was approximately equal to PA recall performance with unitary imagery instructions.

Comparisons between the cell means were carried out using the Bonferroni (Dunn) procedure. Confidence intervals were established for the contrasts, $\hat{\psi}_2$, $\hat{\psi}_3$, $\hat{\psi}_4$, $\hat{\psi}_5$. The estimated contrasts and their respective confidence intervals are shown in Table 6.

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Insert Table 6 about here

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The contrast, $\hat{\psi}_2$, which tested the effect of PA instructions in List 1 versus the effect of unitary imagery instructions

in List 2 was statistically significant. This means that subjects learning pairs that were associatively related, given PA instructions, recalled a significantly greater number of responses than subjects learning associatively unrelated pairs, given unitary imagery instructions.

The contrast, $\hat{\psi}_3$, which tested the effect of PA instructions in List 2 versus the effect of unitary imagery instructions in List 2 was not statistically significant. This means that subjects learning associatively unrelated pairs, given unitary imagery instructions, did not recall a significantly greater number of responses than subjects learning associatively unrelated pairs, given PA instructions.

The contrast, $\hat{\psi}_4$, which tested the effect of PA instructions in List 1 versus the effect of separate imagery instructions in List 2 was statistically significant. This means that subjects learning associatively related pairs, given PA instructions, recalled a significantly greater number of responses than subjects learning associatively unrelated pairs, given separate imagery instructions.

The contrast, $\hat{\psi}_5$, which tested the effect of PA instructions in List 2 versus the effect of separate imagery instructions in List 2 was statistically significant. This means that subjects learning associatively unrelated pairs, given PA instructions, recalled a significantly greater number of responses than subjects learning associatively unrelated pairs, given separate imagery instructions.

The significant main effect for trials was due to generally higher scores on the second test trial. Nevertheless, there were no significant interactions with trials.

TABLE 6

Statistical Hypotheses, Comparisons, and Bonferroni's t-test of Significance between Instructional Conditions

Hypothesis		Treatment Means
$\hat{\psi}_1$	$H_o: \mu_{List\ 1} = \mu_{List\ 2}$ vs. $\neq$	
$\hat{\psi}_2$	$H_o: \mu_{PA(List\ 1)} = \mu_{UI(List\ 2)}$ vs. $\neq$	List 1=12.115
$\hat{\psi}_3$	$H_o: \mu_{PA(List\ 2)} = \mu_{UI(List\ 2)}$ vs. $\neq$	List 2= 7.885
$\hat{\psi}_4$	$H_o: \mu_{PA(List\ 1)} = \mu_{SI(List\ 2)}$ vs. $\neq$	UI =12.344
$\hat{\psi}_5$	$H_o: \mu_{PA(List\ 2)} = \mu_{SI(List\ 2)}$ vs. $\neq$	PA =11.953
Estimated Contrast		SI = 5.703
$\hat{\psi}_1$	12.115 - 7.885 = 4.230	Trial 1= 9.833
$\hat{\psi}_2$	14.188 -10.406 = 3.782	Trial 2=10.167
$\hat{\psi}_3$	9.719 -10.406 = -0.687	
$\hat{\psi}_4$	14.188 - 3.531 = 10.657	
$\hat{\psi}_5$	9.719 - 3.531 = 6.188	
Confidence Interval (α_o =.05) $t_{(90)}^{.05/2(5)}$ = 2.64		
$2.018 \leq \psi_1 \leq 6.442$	s.	Reject H_o
$1.570 \leq \psi_2 \leq 5.994$	s.	Reject H_o
$-2.899 \leq \psi_3 \leq 1.525$	n.s.	Retain H_o
$8.445 \leq \psi_4 \leq 12.869$	s.	Reject H_o
$3.976 \leq \psi_5 \leq 8.400$	s.	Reject H_o

MSerror(between) = MSsubjects w. groups = 22.45555, divisor=64

CHAPTER IV

DISCUSSION AND SUMMARY

As previously indicated, the main purpose of the present study was to evaluate the effect of the directing property of the verbal label on coding incomplete figure stimuli as complete figures. It was predicted that even originally remote associates of the incomplete figure stimuli would direct coding of the incomplete figures as complete figures.

Associative intra-pair relatedness was expected to affect unitary image generation differentially. Unitary images were expected to be easier to generate and possibly to be more readily available for paired-associates in List 1 (high associative intra-pair relatedness) than for paired-associates in List 2 (low associative intra-pair relatedness). Furthermore, since unitary images would mediate recall of the responses, the number of correctly recalled responses was expected to be higher in List 1 than in List 2. Thus, prediction 1 was made such that high associative intra-pair relatedness increases the number of correctly recalled responses while low associative intra-pair relatedness decreases it. This prediction was generally confirmed. This finding is consistent with the findings from stimulus predifferentiation studies carried out by Ellis (1968), Ellis and Daniel (1971), Daniel and Ellis (1972).

Unitary imagery instructions were expected to facilitate PA recall compared to separate imagery instructions which were expected to inhibit associative learning and subsequent PA recall. It was predicted that subjects given unitary imagery instructions would recall a greater number of responses correctly than subjects given separate imagery instructions. This prediction was also clearly supported. This finding is consistent with the results from imagery studies carried out by Bower (1970), and Rowe and Paivio (1971).

The operation of the associative function of the verbal label was inferred from the acquisition rate as a function of intra-pair relatedness of the pair items and the operation of the directive function of the verbal label was inferred from the specific imagery instructions given to the learners. It was hypothesized that the higher degree of congruent intra-pair relatedness would facilitate the stimulus encoding process. It was also hypothesized that unitary imagery instructions would facilitate the elaborative stimulus encoding process whereas separate imagery instructions would inhibit it.

Ordinary PA instructions were expected to be as facilitative of the acquisition of pairs that are of high associative intra-pair relatedness as unitary instructions would be, assuming spontaneous elaborative encoding on the part of subjects under ordinary PA instructions.

Unitary imagery instructions, by facilitating the directive function of the verbal label, would facilitate the learning of remotely related pairs.

The contrasts, $\hat{\psi}_2$, and $\hat{\psi}_3$, tested the assumption of spontaneity of elaborative encoding occurring on the part of the subjects given PA instructions versus the effect of unitary imagery instructions being additive to the associative function of the verbal label. Prediction 2 was made such that subjects given standard PA instructions will perform as well on List 1 as subjects given unitary imagery instructions will perform on List 2. Prediction 3 was made such that subjects given standard PA instructions will recall a smaller number of responses in List 2 than subjects given unitary imagery instructions.

Prediction 2 was not confirmed. There was a significant difference between PA(List 1) and UI(List 2), which means that subjects in the PA(List 1) condition performed much better than subjects in the UI(List 2) condition. Prediction 3 was not confirmed either. Subjects in the UI (List 2) condition, learning remotely related pairs, did not perform any better than subjects in the PA(List 2) condition, learning remotely related pairs. In other words, the number of correctly recalled responses in the PA condition (List 2) did not differ significantly from the number of correctly recalled responses in the unitary imagery (List 2) condition. These findings indicate that subjects

given PA instructions spontaneously generate unitary images by elaborating the stimulus figure in relation to the concept the label implies. Elaborative encoding occurred in both List 1 and List 2 with PA instructions, as can be seen in the post-experimental report data (c.f. Appendix B), concerning the method used in learning the PA lists. In both List conditions with PA instructions subjects used the same method of elaborating the stimulus figure in relation to the response label concept. For instance (referring to the stimulus figure) "looks like a cut off shoe..., looks like part of a shoe..., the heel of a shoe...", in List 1; in List 2 " it looks like a fish's tail..., looks like a fish..., fin of a fish...". These descriptions were used for the same stimulus figure (fig. # 3) paired with the response label "shoe" or "fish" in List 1 or List 2 respectively. One subject described the method used in the following way: "I looked at the word, pictured it, and remembered line..." which is identical to the method used in unitary imagery instructions. It seems that the mere presence of the verbal label encourages unitary encoding and elaboration of the incomplete figure in relation to the concept the label implies. Unitary imagery instructions do not seem to do any good as far as the directive function of the response label is concerned.

In order to test whether any other kind of instruction is effective, that is separate imagery instructions, the contrasts, $\hat{\psi}_4$, and $\hat{\psi}_5$, were used.

Separate imagery instructions were expected to inhibit both the associative and the directive functions of the verbal label. Prediction 4 was such that subjects given PA instructions on List 1 will perform significantly better than subjects in the separate imagery condition on List 2. Prediction 5 was such that subjects given PA instructions on List 2 will perform significantly better than subjects in the separate imagery condition on List 2. Both predictions were confirmed,which means that separate imagery instructions effectively inhibit the associative and directive functions of the response label.

To summarize the findings, we conclude that the effect of associative intra-pair relatedness and the effect of the directing property of the verbal label both facilitate PA performance. The data indicate that the directing property of the verbal label directs coding of the incomplete figure stimuli as complete figures by directing attention to the significant features of the shape in relation to the concept the response label implies.

This finding supports and extends the findings from stimulus predifferentiation studies carried out by Ellis (1968), Ellis and Daniel (1971), and Daniel and Ellis (1972). Notions concerning the effect of the directing property on encoding of stimulus and response items as unitary images (Ellis & Daniel, 1971) were confirmed.

The directing property of the verbal label can be regarded to function as a conceptual rule for relating pair items in the form of unitary images which mediate PA recall.

The findings of this study suggest a similar interpretation for the findings of the Pâivio and Yarmey (1966) study regarding the superiority of picture-word pairs over picture-picture pairs. With picture-word pairs the directing property of the response would be expected to facilitate interactive mediator generation by directing attention to outline properties of the shape (picture), specific aspects of which could be related to the image (evoked by the noun), i.e., to the concept the label implies, in a meaningful way.

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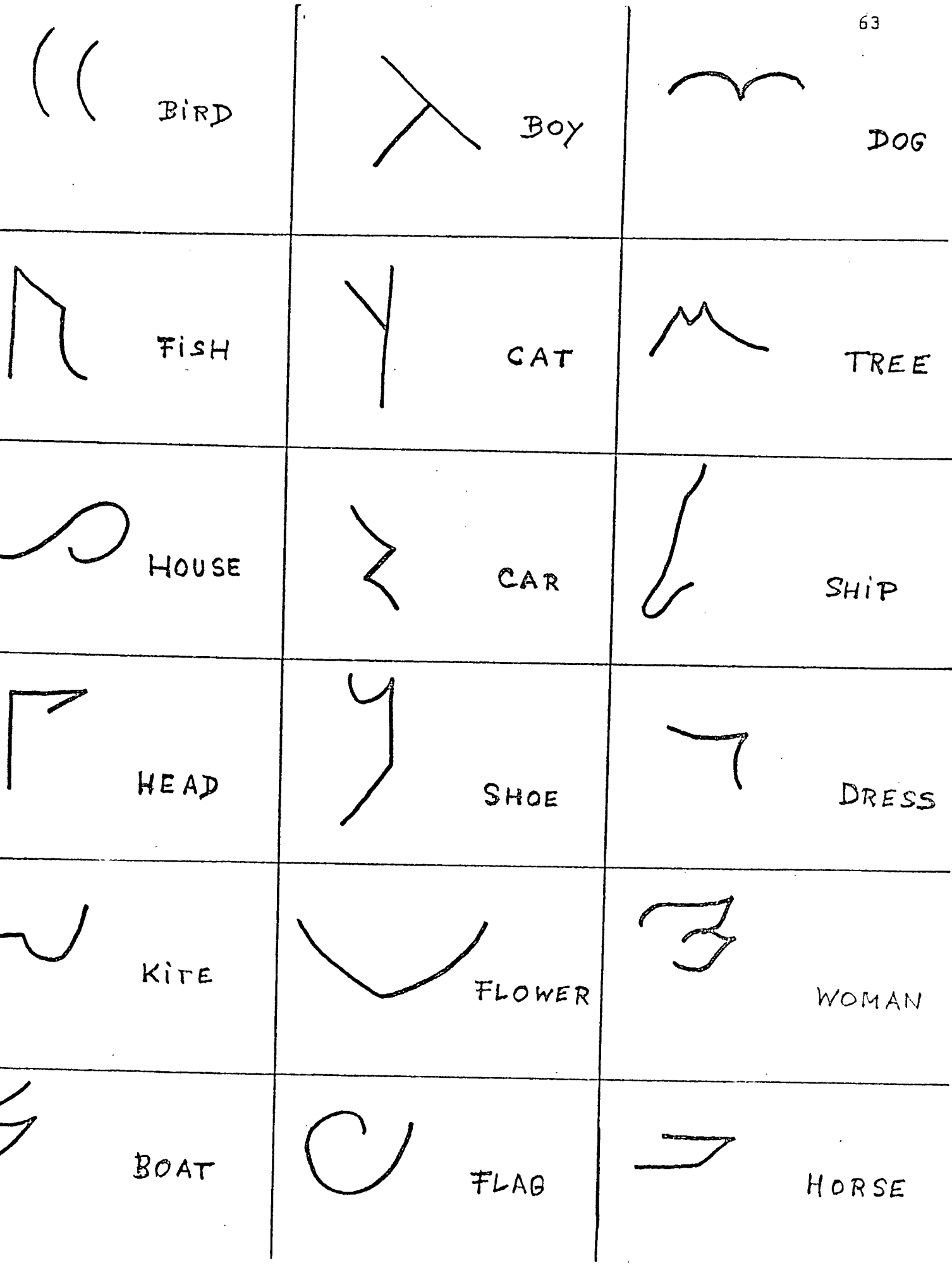
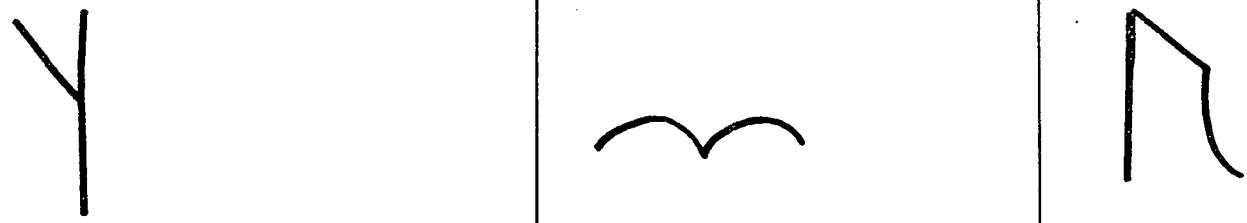
APPENDIX A

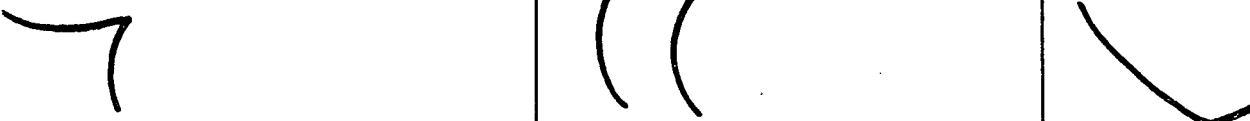
ORIGINAL STUDY WORK SHEETS: LIST 1 AND LIST 2

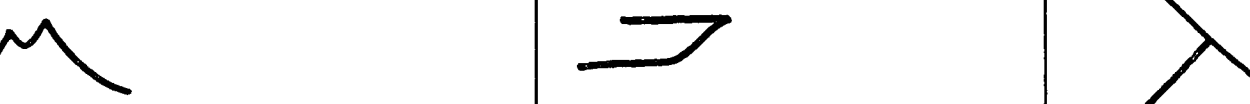
PA RECALL TEST TRIALS: TRIAL 1 AND TRIAL 2

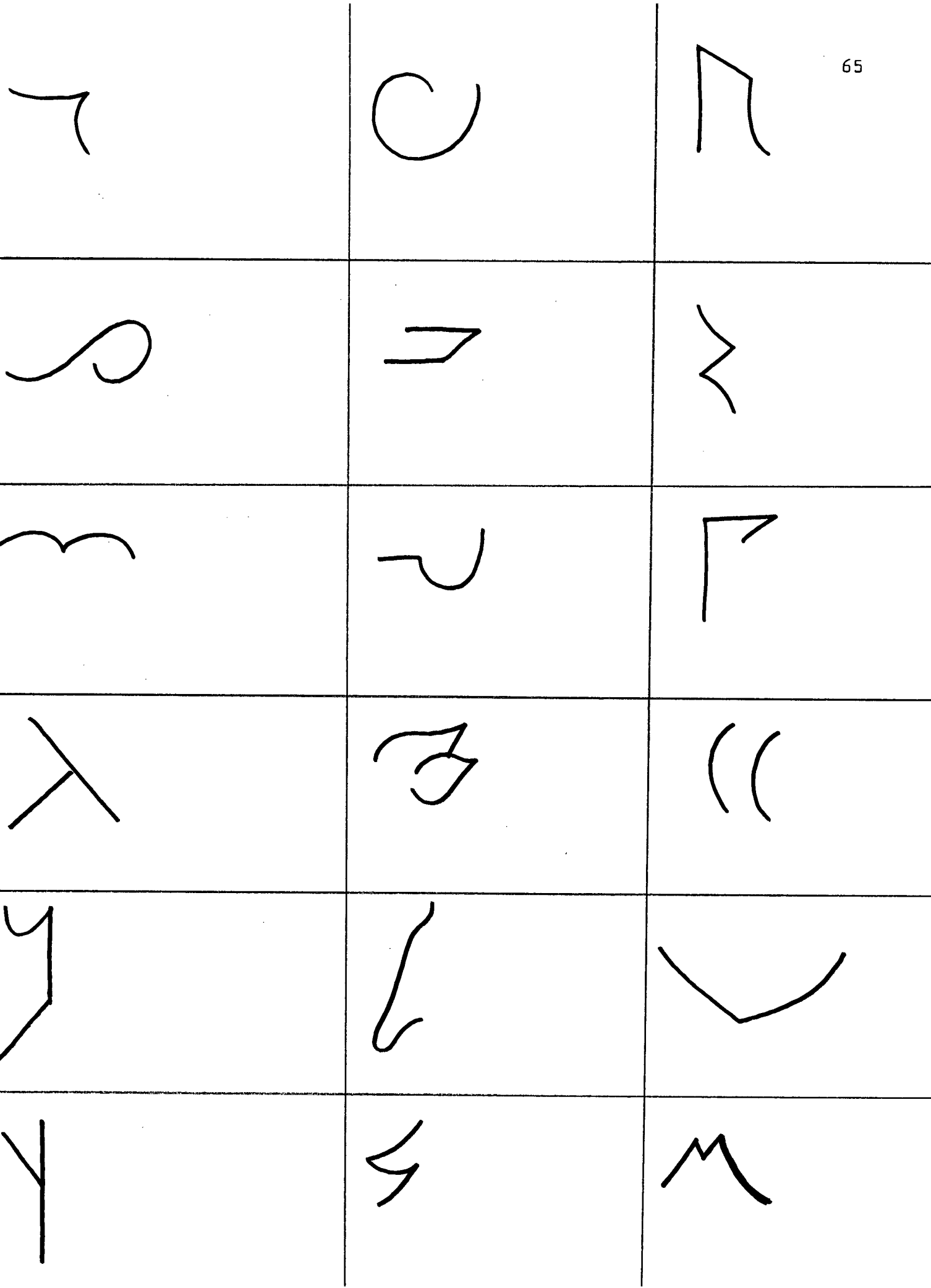
BOY	HOUSE	WOMAN
SHOE	FLOWER	CAT
HORSE	KITE	HEAD
FLAG	DRESS	SHIP
CAR	BOAT	DOG
TREE	FISH	BIRD


BIRD
BOY
DOG
FISH
CAT
TREE
HOUSE
CAR
SHIP
HEAD
SHOE
DRESS
KITE
FLOWER
WOMAN
BOAT
FLAG
HORSE









APPENDIX B

1. EXAMPLES OF DESCRIPTIONS USED BY SUBJECTS IN REPORTING ON THE METHOD USED TO LEARN PAIRED-ASSOCIATES IN LIST 1 AND LIST 2 WITH STANDARD PA INSTRUCTIONS

2. METHOD OF LEARNING PAIRED-ASSOCIATES: REPORTED NUMBER OF UNITARY IMAGES, SEPARATE IMAGES, BLANKS, AND REPEATED ITEMS IN LIST 1 AND LIST 2 WITH STANDARD PA INSTRUCTIONS

HOUSE

House upside down...
Looks like a house...
Part of a house...
Roof of house...
House-shape...

FLOWER

Looks like stem and stem for leaf...
The stem for a flower...
Stem of flower...
Flower shape...
Remembered the picture...

KITE

Some kites are shaped that way...
Looks like half a kite...
Part of kite...
Shape of kite...
Half a kite...

DRESS

Side of dress...
Dress shape...
Part of dress...
Half of dress...
Just remembered it...

BOAT

Underside of boat...
Front of boat...
Boat, the way it is curved...
The bottom of a boat...
Part of a boat...
It just came to me...

FISH

Looks like fish egg, when fish is hatching...
Fish shape...
Like a fish...
Fish eye...
Remembered shape...

WOMAN

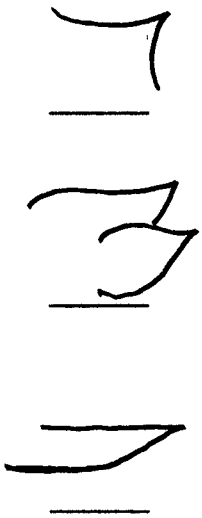
Looks like top of woman's head...
Woman's lips...
Looks like a woman...
The bust of the dress of a woman...
Woman (pictured word, remembered line)...

CAT

Looks like cat's ears...
Cat's shape...
Cat's ear...
Two ears...
Looks like cat...

HEAD

Looks like a nose...
Nose of head...
Looks like nose of head...
Head shape...
Nose...



SHIP

Looks like front of ship...
Looks like end of ship...
Looks like ship...
Part of ship...
ship shape...

DOG

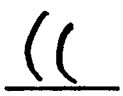
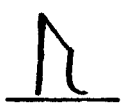
Two dogs...
Looks like dog's ears...
Ears of dog...

Dog's mouth...
Part of a dog...

BIRD

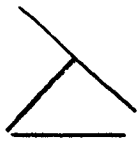
Bird's beak...
Bird's tail...
Looks like bird's beak...
Looks like part of bird...
Shape...

Examples of Descriptions Used by Subjects in Reporting on the Method Used to Learn Paired-Associates in List 2 with Standard Paired-Associate Instructions

List 2 Stimulus	Response	Description
	BIRD	A bird has two wings...
		It looks like wings ...
		Bird's wings...
		Shape of bird...
		Just remembered...
	FISH	It looks like a fish's tail...
		Looks like fish...
		Fin of fish...
		Looks like hook...
		Shape...
	HOUSE	Looks like smoke out of chimney...
		House curtains...
		House on hill...
		Figure...
		Shape...
	HEAD	Make it into a picture of a head...
		Head for hangman...
		Shape of head...
		Looks like hanger...
		Shape...
	KITE	A kite on a string...
		Kite on string...
		Remembered shape...
		Just remembered...
		Storm waves...

BOAT

Boat shape...
Boat on storm waves...
Just remembered...
Remembered...
Shape...



BOY

Shape of boy walking...
Looks like two legs and arm...
Looks like shape of boy...
I thought'boys write"T"!...
Boy shape...

CAT

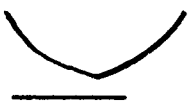
The long tail...
Cat shape...
Cat's noises begin with "Y"...
Just remembered...
Shape...

CAR

Car drives funny...
Car clutch...
Cars go zzzzz...
Just remembered...
Remembered...

SHOE

Looks like shoe...
Just remembered...
Remembered...
Shape...



FLOWER

Make it into round part of flower...
Looks like tulip...
It looks like a flower...
Looks like bottom of a tulip...
Flower stem...

FLAG

Flags fly funny...
Flag string...
Just remembered...
Shape...

DOG

Looks like top of dog's ears...
Dog's flappy ears...
Part of dog...
The ears...
Dogs like to chase birds...

TREE

Figure looks like trees...
Trees grow on hills...
Tops of trees...
Tree stump...
Shape...

SHIP

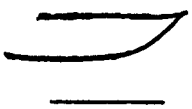
Front of ship has shape like this...
Part of ship...
Ship anchoring...
Looks like ship...
Just remembered...

DRESS

Part of dress...
Dress belt...
Shape of dress...
Remembered shape...
Shape...

WOMAN

Woman's lips...
Part of woman...
Reminds me of a lady...
Remembered shape...
Shape...



HORSE

Tail...
Remembered shape...
Just remembered...
Remembered...

TABLE 8

METHOD OF LEARNING PAIRED-ASSOCIATES:

REPORTED NUMBER OF UNITARY IMAGES, SEPARATE IMAGES,

REPEATED ITEMS, AND BLANKS IN LIST 1 AND LIST 2

WITH STANDARD PA INSTRUCTIONS*

LIST 1		REPORTED METHOD					LIST 2		REPORTED METHOD				
		UI	SI	B	R	SUM			UI	SI	B	R	SUM
	BOY	11	0	0	4	15		BIRD	6	0	1	5	12
	SHOE	6	0	1	2	9		FISH	5	0	2	0	7
	HORSE	9	0	2	1	12		HOUSE	6	0	3	1	10
	FLAG	14	0	0	1	15		HEAD	4	1	2	1	8
	CAR	8	0	0	2	10		KITE	4	1	1	3	9
	TREE	10	0	2	1	13		BOAT	6	0	0	2	8
	HOUSE	10	0	1	0	11		BOY	8	0	2	3	13
	FLOWER	14	0	0	1	15		CAT	4	0	1	3	8
	KITE	7	0	1	1	9		CAR	4	0	0	0	4
	DRESS	11	0	1	5	17		SHOE	1	0	2	1	4
	BOAT	12	0	0	3	15		FLOWER	8	0	2	2	12
	FISH	13	0	0	1	14		FLAG	3	0	3	1	7
	WOMAN	12	0	0	3	15		DOG	7	1	1	1	10
	CAT	13	0	0	0	13		TREE	5	0	2	6	13
	HEAD	13	0	1	1	15		SHIP	5	0	3	3	11
	SHIP	8	0	2	1	11		DRESS	6	0	0	2	8
	DOG	15	0	1	0	16		WOMAN	4	0	0	3	7
	BIRD	8	0	1	0	9		HORSE	2	0	0	4	6

*Reported method was checked only for correct responses on recall trials. UI=unitary imagery instructions; SI=separate imagery instructions; B=blank; R=repeated item.

APPENDIX C

GENERAL INSTRUCTIONS (PA)

Please listen carefully. This is an experiment on learning pairs of incomplete figures and words. An example of such an incomplete figure-word pair is this (E draws an example on the board). You will learn 18 such incomplete figure-word pairs in such a way that, when you are shown the incomplete figure shape by itself, you will remember the word that goes with it.

When I tell you to open up your test booklets, you will see before you a sheet with 18 incomplete figure-word pairs, each of which looks like a slide. It will look like this (E lifts a cardboard sheet with 18 rectangular divisions and shows it to the students.) We shall learn one pair and then the next one, the next one and the next one...always in a vertical order. What I mean is, you will learn the pair just below the one you have just learned until you have learned all 18 pairs. (E demonstrates on the cardboard sheet the procedure of learning the individual items in sequence).

Each item will look like this (E goes back to the blackboard and draws the second example on the board; then E draws a frame around the incomplete figure-word pair). This learning of pairs will not be done until later, however, and I will describe the method in detail then. What I want you to do now is this. I want you to look at these two pairs and think about a method of learning them. This will help you

to learn the pairs. Please do not tell anybody about your method. This is your very own method, so keep it a secret.

Now, as soon as I tell you to do so, you can open up your test booklets and the study trial will begin. Before we start, I want to tell you what I am going to do. (E takes the cardboard sheet again and points at it) Once again, we shall start with the first pair up in the left-hand corner and the next pair to be learned will be the one right below it. We shall proceed in that order until we are finished. Then you shall close your test booklets and when I tell you to open them again, you will do so at the first colored page and the test trial will begin.

All this I shall explain to you again at the proper time.

When you look at each pair in sequence, it may be a good idea to hold your hands around the pair to be learned, so that you cannot see the next pair. Doing this may help you to learn and remember the pair. You can look at each pair for 15 seconds. I shall stamp my foot on the floor as a signal to move on to the next pair. Are there any questions?

If you have no further questions, we can begin as soon as I say now. Now! (E stamps foot on floor and the students look at the first incomplete figure-word pair).

(The general instructions were repeated for unitary imagery and separate imagery conditions; reference to "thinking about a method of learning the pairs" was excluded).