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THE EFFECT OF PAIRED ASSOCIATE LEARNING OF AUGMENTING CONTOUR CUES AND REDUCING IRRELEVANT CUES IN THE PICTORIAL STIMULI.

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THE EFFECTS OF SELECTIVE MANIPULATION OF PICTORIAL CONTENT UPON PAIRED ASSOCIATE LEARNING WERE TESTED AND EVALUATED. STIMULUS MATERIAL WAS VARIED BY AUGMENTING CONTOUR CUES AND DIMINISHING IRRELEVANT CUES. FIFTH-GRADE STUDENTS WERE ASSIGNED TO NINE DIFFERENT TREATMENTS, INVOLVING STIMULUS SLIDES THAT VARIED IN TREATMENT OF CONTOUR AND CONTEXTUAL CUES. A TRIAL AND ERROR SYSTEM WAS USED UNTIL CRITERION PERFORMANCE OF TWO PERMUTATIONS WITHOUT ERROR WAS ACHIEVED. ANALYSIS OF VARIANCE OF TRIALS AND ERRORS WAS USED TO TEST FOR DIFFERENCES AMONG THE NINE CONDITIONS. FINDINGS WERE THAT, IN PAIRED ASSOCIATION, THERE WERE NO SIGNIFICANT DIFFERENCES AS A RESULT OF AUGMENTING CONTOUR CUES. IN ADDITION, THERE WERE NO SIGNIFICANT DIFFERENCES BETWEEN LEVELS OF REDUCED IRRELEVANT CONTEXTUAL CUES ON EITHER TRIALS OR ERRORS TO CRITERION, AND NO SIGNIFICANT INTERACTION EFFECTS BETWEEN AUGMENTED CONTOUR CUES AND REDUCED IRRELEVANT CUES. (GD)

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CHAPTER I

INTRODUCTION

General Statement of the Problem

This study was designed to test the effects of selective manipulation of pictorial content upon paired associate learning. Earlier discussions of pictorial manipulation have been primarily in terms of the concrete to abstract continuum (Finn, 1953). More recently other analytical approacnes have emphasized the asso iative process (Bern, 1958) or the relevancy of cues (Attneave, 1954). These more recent analytic approaches represent attempts to describe pictorial stimulus materials within a framework of more traditional learning theories.

In order to identify potentially effective strategies for manipulating pictorial cues several of the available analytic approaches were considered.

Historically Dale was one of the first writers to relate the abstract concrete continuum to an educational application. It was graphically summarized in his "Cone of Experience" (Dale, 1954). He emphasized that, "It is merely a visual aid in explaining the interrelationships of the various types of audio-visual materials, as well as their individual 'positions' in the learning process. . . . The cone device, then, is a visual metaphor of learning exper-

iences, in which the various types of audio-visual materials are arranged in the order of increasing abstractness as one proceeds from direct experiences" (Dale, 1954, p. 42). He further states that it is not to be mistaken for a hierarchy or rank order of learning processes. Dale was the first to point out incongruencies and was careful to warn the reader of possible misconceptions. It seems clear that Dale never intended that his abstract-concrete model, the "Cone of Experience" be considered to be an adequate model for audio-visual theoretical and research development; nevertheless it seemingly came to be considered as such by many.

The prominence of the abstract-concrete model as a theoretical formulation guiding audio-visual research was early recognized by Finn (1953). At that time he warned that the audio-visual movement was in danger of becoming stunted in its growth toward becoming a profession unless other more substantial theories from various related cognate areas were considered as bases for future research and development in audio-visual.

In attempting to identify the conceptual rationale for the audio-visual field Gerbner asserted that the conceptual rationale most widely held by audio-visual practitioners was the abstract concrete model. He then argued that it was not a rationale at all but a rationalization (Gerbner, 1960). More emphatically he declared, ". . . the

mechanical application of the dubious dichotomy between the 'abstract' and the 'concrete' to the ordering of media and channels of communication into a hierarchy is a ritual which --as indeed the very name of the tribe--blocks attempts at clear thinking" (1960, p. 52).

Gerbner's position appears to be closely related to that taken by Finn, that is, that a preoccupation with the abstract-concrete model has caused us to neglect other perhaps more potentially productive theoretical models such as are found in the behavioral sciences.

Knowlton indicated that, ". . . the A-V field's commonly stated 'conceptual rationale', which stresses the strengths of the concrete and the dangers of the abstract learning experience, is more properly of the order of a definition of the field" (Knowlton, 1960, p. 44). He suggested that once it is accepted as only a descriptive definition a sounder conceptual rationale will assert itself. He further pointed out that it is not true that the pictorial representation is inevitably real and rich and concrete but in fact can be highly abstruse, abstract, and noisy. He concluded that "the abstract-concrete dichotomy leads us into error, because it is no dichotomy, and also because both verbal and pictorial signs vary along an abstract-concrete continuum" (1960, p. 49).

The concern expressed by Finn, Gerbner and Knowlton regarding the heuristic value of the abstract-concrete model

seems well-founded. As research evidence accrues it is becoming more evident that the degree of iconicity or absolute physical fidelity with the referent does not reliably affect behavior learning in the direction expected (Miller, 1957; Lumsdaine, 1963). Therefore, other models must be considered if a reliable basis for pictorial manipulation is to be found.

The problem of communication through the pictorial media is not simply that of replicating events in nature, but to select those cues that determine what behavior is appropriate in the learning situation (Hoban and van Ormer, 1950). This concept pre-supposes the view that man does not respond uniformly to the vast wealth of detail available at the receptor level but instead compresses and edits information so that only a fractional part ever reaches the higher center of the brain (Attneave, 1954).

Despite apparent conceptual weaknesses there may be certain didactic advantages in using the abstract-concrete paradigm for pedigogical purposes. It would seem, however, that as a guide to empirical research there are severe practical limitations on using the abstract-concrete continuum for heuristic purposes and we should look for more useful models.

One of the most common inferences devised from the abstract-concrete model is a prediction of the facilitating effects of increasing the degree of stimulus realism. This

prediction has not received consistent support when subjected to critical analysis. Hochberg in referring to an experiment performed by Ryan and Schwartz, stated that, "Photographs have higher fidelity than outline drawings and still more than caricatures, yet the characteristics of a given object may be communicated better as the representational fidelity of the surrogate deteriorates" (Hochberg, 1962, p. 30). He concluded that "In preparing any picture, fidelity alone will not explain nor predict what object or scene will be perceived" (1962, p. 43). Thus both analytical and empirical observations provide indications that we must look elsewhere for more useful predictive models.

Gibson has presented one of the first attempts at developing a systematic theory of pictorial perception (Gibson, 1954). In attempting to specify the fundamental differences between pictures and words he proposed two concepts, "surrogate" and "correspondence." He defined a surrogate as a stimulus which is associated with some object, place, or event not at present affecting the sense organs of the perceiving individual. In the case of a surrogate the perceiver does not see the object, place or event as they exist in the natural environment but instead sees a substitute stimulus representing these objects, places, and events as produced by another individual. Thus words and pictures are both surrogates with the critical difference between them being the degree of "correspondence"

to their referents.

In discussing Gibson's position Bern stated that, "By implication, relative difficulty of associative learning in this theory is a function of the degree of correspondence between surrogates and referents" (Bern, 1958, p. 10). However Gibson does not suggest that under all conditions pictures should have a high degree of correspondence between them and the referent for optimal learning to occur. He specifically predicted facilitation as a function of correspondence during learning stages when the more arbitrary or abstract surrogates have not yet been acquired. He further stated that, "if we assume that a perceiver does not need to be given all the properties of an object in order to know how to deal with it, but only those which are relevant or significant, it is a waste of effort to simulate them all" (1954, p. 22). The point was demonstrated by Gibson when by distorting stimulus shapes into caricatures, he increased learning rate relative to non-distorted pictures (Gibson, 1947). Using a series of slides he experimented with aviation trainees who were learning to identify enemy aircraft. He found that exaggerating some feature of a certain airplane which differed from all others, led to improved identification of the aircraft in tests without the distortion.

It seems then, Gibson was observing that when making reference to concrete objects that a relatively concrete,

highly iconic or realistic surrogate may present more visual information than in the case with a less concrete more abstract surrogate. However, the perceiver does not necessarily need all the information available but can and does select that which is relevant to the perceptual task. Selective distortion of the figure may facilitate this selection process.

In relation to associative learning this is the pertinent question: is effective acquisition of associative responses, particularly verbal responses, a function of the degree of correspondence between the surrogate and the referent since with increasing correspondence greater visual information is transmitted? There is a degree of contradiction regarding the effects of correspondence in Gibson's discussion but Osgood's mediational theory seems to supply some promising leads.

In attempting to explain the "mechanics" of the process by which two stimulus events become associated Osgood conceptualized a mediation theory (Osgood, 1953). The key to this theory was the idea that our responses could be classified in two ways: "object tied responses" and "detachable responses". Object tied responses are dependent upon the sensory presence of the object for their occurrence. While detachable responses refer to those responses that are not dependent upon the sensory presence of the object for their occurrence. If detachable responses serve as poten-

tial mediational hooks or memory aids then the class (pictures or words) which elicits the greater number of detachable responses, would be learned and retained most readily.

It was hypothesized by Bern that pictorial materials, because of their greater detachable response potential and hence their greater association potential, should be learned more readily than words (1958). Perhaps this detachable response concept suggests a means for defining a basic continuum that could be useful in ordering words and pictures with regard to effectiveness of stimuli for learning.

Here then, in the Osgood-Bern model we find a potential answer to the question posed in relation to Gibson's paper regarding the effect of cue correspondence. The detachable response concept as interpreted by Bern with its effect on associative learning suggests a means for defining a basic continuum which permits differential predictions. We might then expect to find positive correlation between events ordered on Gibson's "correspondence" dimension and Osgood's "number of detachable responses" dimension. Some confirmation of this correlation was obtained by Bern in finding a positive relationship between rate of association and degree of cue correspondence when pictures were compared with words (195).

However, when considering stimuli that are positioned much closer on Gibson's correspondence scale, such as caricature and photographs, (Gibson, 1954) we may expect reversals

that seem more consistent with an interpretation of cue relevance rather than with gross number of cues present.

Bourne and Restle, in developing a mathematical theory of concept identification, describe cues as being either relevant or irrelevant (Bourne and Restle, 1959). A cue, in the context of their usage, is relevant if it can be reliably used by the subject to predict how the problem could be solved and irrelevant if it can not be used by the subject to predict how the problem is to be solved. Similarly, Black refers to relevant cues as, ". . . (those) cues, the presence or absence of which determine what behavior is appropriate, that is what behavior is reinforced" (Black, 1962, p. 1). In reference to their mathematical theory of concept identification Bourne and Restle state that "the main parameter, or structural property of the problem is the proportion of relevant cues" (1959, p. 279). They found that concept identification could be controlled by the independent manipulation of relevant and irrelevant cues.

If relevancy of cues is assumed to apply more generally to discrimination learning it is not the gross number of cues or detachable responses alone that is critical but also whether or not the cues are relevant to the discrimination learning task. To the extent that cues correspond with detachable responses, relevance of the detachable response is equivalent to the relevance of the eliciting

cues. Thus the pictorial elements which are distinctive from one picture to another would provide relevant cues in a discrimination task while those picture elements that are common to the various pictures would provide irrelevant cues.

An increase in the proportion of distinctive cues or a decrease in proportion of common cues would then be expected to facilitate discrimination learning (Aukes and Simon, 1957). However, in a number of attempts to manipulate pictures along the abstract-concrete continuum, reduction techniques resulted in decreases in both formally relevant and irrelevant cues. This reduction procedure may not have changed the ratio of relevant cues present. For example, Coban treated three degrees of realism in biological subject matter in which the main variable of concreteness was manipulated by the varying of the gross number of cues through "perspective photographs", "detailed perspective drawings" and "outline diagramatic drawings" (Coban, 1961). The Coban study is one of several studies in which the total number of cues are manipulated while the proportion of relevant to irrelevant cues may have remained constant.

Even when there is systematic variation of the ratio of relevant to irrelevant cues present there remains a difficult problem associated with cue selection. This phenomenon is suggested by Underwood's distinction between the nominal stimulus, or the stimulus which E assumes to be

stimulus, and functional stimulus or the stimulus which S actually responds to (Underwood, 1964). Thus, although certain component pictorial physical stimulus elements may be present which are relevant as in the case of the Bourne and Restle study, they may not become conditioned. Underwood, Ham and Ekstrand (1962) attributed this observed failure to condition the relevant cue to a cue selection process which in this case was a function of meaningfulness of cues.

If meaningfulness is defined in terms of the number of associations to a given stimulus then it seems quite analagous to Osgood's detachable responses. Under cue selection conditions the subject may effectively ignore some portion of either relevant or irrelevant cues regardless of whether their sensory reception is assured. For example, if the subject is responding exclusively to the most meaningful cue present then manipulation of irrelevant cues present would be expected to have little or no effect.

Selection may be a function of factors other than meaningfulness. For example, Attneave considered perception from an information theory point of view. He stated that, "It appears likely that a major function of the perceptual machinery is to strip away some of the redundancy of stimulation, to describe or encode incoming information in a form more economical than that in which it impinges on the receptors" (Attneave, 1954, p. 189).

Attneave found that the human organism, in stripping away some of the redundancy of stimulation, utilized some information more than others and specifically pointed to boundaries or contours as being primary information carriers. In short, Attneave has suggested that total amount of pictorial information is functionally very uneven. That is, the typically textural cues are much less likely to be functionally effective than the contour cues, even though in a physical information theory sense the context cues may present much more information. Similarly, Traverse suggests that, "In the case of vision, the evidence seems clear that most of the information is transmitted through boundaries; hence, a representation which emphasized the boundaries and de-emphasizes other information provides an effective means of transmission" (Traverse, 1964, p. 9.04).

Traverse also points out that, "The line drawing satisfies the condition for the effective transmission of visual information and it has been demonstrated empirically that it is one of the most effective methods of presentation" (1964, p. 9.04). A possible implication is that in eliminating the gray scale, as is done when changing a photograph to a photo-sketch, there has been a large reduction in total number of nominal cues present which may not have significantly affected the number of functional cues present.

Sundland and Wickens (1962) found corroboratory

evidence for the Attneave's and Traverse's positions on the relatively high effectiveness of contours in an experiment dealing with the effect and role of contextual cues as the discriminability of the primary stimuli was varied. It was hypothesized that where the primary stimuli were highly discriminable the addition of discriminable context cues would not facilitate the learning task. An analysis of the data showed that there is no evidence in the data that context cues facilitated learning. Apparently responses to the highly discriminable primary cues dominated the stimulus situation during learning and competed with responses to the context cues. Sundland and Wickens state that, "It is as if these S's failed to respond to the context cue as a potentially helpful stimulus during the learning" (1962, p. 305).

Attneave also suggests that information criterial for recognition is concentrated at points of inflection where a contour changes direction most rapidly (Attneave, 1954). Thus in caricaturizing learning efficiency may be increased by reducing the redundancy of lines in the object to be caricaturized by exaggerating points of maximal inflection where contours change direction maximally.

A second aspect of caricaturization is the advantage attributed to caricaturization in learning a response which will generalize to a larger class of objects or situations. Miller suggests that, ". . . generalization can

be facilitated by using techniques, such as caricature and diagramatic simplification, to emphasize the cues that are common to all of the members of the class, and to minimize or omit the cues that differ" (Miller, 1957, p. 83).

Another type of procedure which has been shown to effect cue selection is the instructional stimuli. In a paper concerned with a detailed analysis of some of the conditions which limit and bias the S's response in the incidental learning situation Postman indicated that performance was determined not only by the physical stimulation but also by the content of the instructional stimulus (Postman, 1964). The instructional stimulus, which directs S to the relevant characteristics of the material and specifies the response required of him, interacts with the conditions of presentation to determine S's response. Postman observes that, ". . . intent per se is not a significant variable in learning but that the instruction stimulus influences the amount and characteristics of learning by determining the differential cue-producing responses, including deliberate rehearsal, which occur during the period of practice" (1964, p. 190).

If the initial instruction to S functions as effective instructional stimuli then those parts of a complex picture stimuli identified as relevant may be expected to be effectively selected while stimulus elements not so identified may be effectively ignored. Thus devices such

as arrows, color codes, and distinctive shading may result in the absence of conditioning of responses to elements not so distinguished.

Further, instructions by E or implicit instructions by S may indicate that certain stimulus components are not relevant and may reduce the potentially interference effect of these irrelevant stimuli (Bruner, Jacqueline, and Austin, 1957). The effect seems to be to decrease the amount of information that has to be processed to arrive at a solution and thus facilitate learning.

There also may be a task competition phenomenon such that instructions which direct S to the relevant cue may have the effect of reducing the effect associated with more irrelevant cues.

In summarizing related research and theory consideration was given to the abstract-concrete model as a research oriented analytic tool. Neither it nor the derived rationale for general superiority of realism received consistent support of empirical studies or critical analysis. Other models based on analytical approaches were examined within a framework of more traditional learning theories. An analysis of Gibson's theory indicated that total information was greater for "realism" but some of Gibson's own work indicated that considering total information alone was not sufficient condition for effective prediction of pictorial cue effectiveness in learning.

An examination of Osgood indicated a possible conceptual framework based on detachable responses which facilitate associative learning. Bern hypothesized that pictures may elicit more detachable responses than words and suggested that by virtue of their greater association potential may be learned more readily than words. However, Bourn and Restle supplied the background for the view that it is not simply a matter of number of detachable responses but that quality, as defined in terms of relevance, was also important for learning efficiency in a discrimination learning task. Various factors possibly effecting selectivity were then considered, including primarily physical characteristics (Attneave, 1954; Gibson, 1954; Traverse, 1964), meaningfulness (Underwood, 1963) and effects of instructions (Postman, 1964).

The above analysis of alternative positions underlines the need for further tests of the cue relevance model in the context of pictorial stimuli. The present study was a deviation from the studies which have treated the concrete-abstract issue in terms of gross information by giving consideration to the relevance of component parts of the stimulus material. By manipulation of levels of pictorial presentation there was a reduction of irrelevant context cues and an orthagonal attempt to control the ratio of irrelevant to relevant cues. Theory (Bourne and Restle, 1959) predicted that manipulation of

the total number of cues would be less related to learning than manipulating the ratio of relevant and irrelevant cues.

Summary of the Experimental Hypotheses

In Fig. I each figure in the nine different cells represents the set of pictorial stimuli used in the paired associate task. The successive columns represent primarily the augmentation of contour cues using a photograph (P), a photo-sketch (PS) treatment of the P, and finally a caricature (PSC) treatment of the PS. The rows represent levels of reduction of irrelevant context cues namely unreduced (UR), reduced (R), and further reduced (FR).

Through the use of a factorial design the following questions indicate the areas of investigation.

1. What is the effect of augmenting contour cues upon paired-associate learning?

2. What is the effect of reducing irrelevant context cues upon paired-associate learning?

3. What is the interaction effect between augmenting contour cues and reducing irrelevant cues?

	Augmented contour cues		
	P	PS	PSC
UR	I 	IV 	VII 
Reduced irrelevant cues R	II 	V 	VIII 
FR	III 	VI	IX

Fig. 1. Sample stimulus treatments associated with each of the nine different conditions.

CHAPTER II

METHOD

General

This study dealt with the effects of two methods of varying pictorial stimuli upon paired associate learning. The first was the variable of augmented contour cues (ACC) as represented by three levels of illustration; namely the photograph (P), the ph to-sketch (PS) and the photo-sketch caricature (PSC). The second was the variable of reduced irrelevant cues (RIC) as represented by three levels of irrelevant cue reduction; namely unreduced (UR), reduced (R) and further reduce' (FR). Seventeen Ss were assigned randomly to each of the nine cells in a simple 3 x 3 factorial design.

The hypotheses of this study were tested in a single experiment. Controls imposed by the assumptions governing the factorial design of the analysis of variance were observed. The levels of each variable were defined by presenting slides representing one of the three different levels of irrelevant context cue reductions and one of the three different augmented contour treatments.

The stimulus from which all pictorial variants were derived was a medium close shot, three quarter front pose photograph of a male. The oral response of S were hand recorded. Projection intervals and reinforcement contingen-

cies were automatically controlled. A post test was conducted as part of the same experiment to determine to what extent S had made associations between the French word to be learned and the English referent that E associated with each pictorial stimulus. Since the only difference between the training test and the post test was the stimulus slide the 3 x 3 factorial design was also used for the post test.

Preparation of stimuli

The design of the stimuli material will be described in as much technical detail as possible in order to facilitate further replication. However, there were a multitude of exposure and development conditions that could not be technically duplicated due to unique characteristics in relation to physical and chemical properties of specific films, developers and processes.

Treatment differences were defined by the differences in the stimulus material used. All stimuli in all treatments were pictorial variations of a single continuous tone photograph of a thirty-five year old male posed holding a small book. The rational for photo-sketching and caricaturizing the PS was to augment and emphasize the more relevant contour cues and de-emphasize the less relevant textural cues. In accordance with the Attneave position that contour shape cues are more likely to be effective

for the transmission of visual information than the typically textural cues, contour cues were operationally defined as being more relevant and textural cues as being less relevant (Attneave, 1954).

The photo-sketching technique utilized was a highly subjective process but an effort was made to emphasize with minimum shape distortion the most salient contour outlines and to reduce textural or gray scale renditions of non-contour elements in the photograph (P).

Similarly no entirely consistent set of rules was followed in caricaturizing the PS except that in the case of all component items that were paired with a French word there was an emphasizing of the defining contour lines by (1) increasing the thickness of the line and (2) increasing the component item in size in comparison to the gross outlines of the figure. There was also (3) some selective exaggeration of parts of the relevant figure in the direction of popular cartoon stereotyping.

In manipulating the RIC dimension irrelevance was defined independently of the ACC dimension. In the RIC dimension relevance was defined in terms of pictorial cues which elicit a given response term with high probability. That is, if the required response were "ear," any pictorial element defining uniquely the ear as distinct from any other part of the figure was defined as relevant. All other pictorial elements on that trial were defined as

irrelevant. Thus in manipulating the irrelevant cue dimension all pictorial details except the pictorial details defining the item most readily associated with the response term of a given trial of the paired associate task (relevant cue) were reduced in terms of intensity. The highly subjective task of determining, for example, just where the pictorial elements defining the cheek begin was governed by the procedure of systematically preserving the defining contour lines and including as little else as possible.

The three stages of RIC then consisted of the photograph unreduced (PUR) condition, the photqgraph reduced (PR) condition and the photograph further reduced (PFR) condition.

The stimulus material for the PUR condition was prepared in the following manner. The model was selected for his even features. He was posed under flat illumination in order to render good resolution of skin details. A medium close shot, three quarter front pose was made using a Rolleicord twin lens reflex camera. The Rolleicord was selected because of its quality and because the film it used gave a negative large enough to minimize graininess upon enlargement. The Panatomix-X film was developed in Microdol-X developer which had been mixed in the ratio of three parts of water to one part chemical in order to minimize graininess.

The negative was placed in a Besler enlarger having a 70-mm. lens. A single 8" x 10" print was made on Kodak single weight Polycontrast paper for use in the PUR condition. The figure in the print was cut out and dry mounted onto a neutral background of eight ply mounting board. A stick-on arrow was placed on the print adjacent to and pointing at the relevant item.

Using an H-1 Pentax 35-mm. camera with plus one Portra Lens mounted on a 55-mm. lens the above described manipulated figure was copied on Panatomic-X film. The arrow was similarly moved to each of the other eight relevant items and copied until all eight versions in a given treatment had been photographed.

The PR and PFR conditions were achieved in the following manner. Eight 8" x 10" underexposed Polycontrast prints were made using an f-16 setting for 16 seconds. The figures in these prints were then cut out and dry mounted for the PR condition. Eight more under-exposed prints were made using an f-16 setting for 5 seconds. In like manner these figures were cut out and dry mounted for the PFR condition. On top of these sixteen figures were dry mounted those items previously defined as relevant cues which had been printed on thesis photographic paper using a normal exposure.

The placing of the arrow and the making of the slides for the PR and PFR conditions were identical to the process

followed with the PUR condition.

The stimulus material for the photo-sketch unreduced condition (PSUR) was made in the following manner. A print like those used for the PUR condition was under-developed. After the print was dried the salient contours, as previously defined, were traced over with a crow quill pen using India ink. The photograph was then submersed in a tray of iodine which removed the photographic image leaving the India ink image intact. Hypo removed the iodine after which the print was washed and dried.

After mounting the photo-sketch the making of the slides proceeded as described with the PUR condition. However, the film used was high contrast film which was developed in D-19 developer using the recommended developing procedures for that film. This resulted in the slides used in the PSUR condition.

The photo-sketch caricature unreduced condition (PSCUR) was derived from the PSUR condition. A photo-sketch photographic paper print was caricaturized by using India ink and a small speed ball pen to exaggerate the main features following the rationale previously stated. The procedure from that point on of adding the arrow and copying was the same as that indicated for the PSUR condition.

The remaining four conditions, namely the reduced and further reduced condition of the photo-sketch (PSR and PSFR) and the reduced and further reduced conditions of the

photo-sketch caricature (PSCR and PSCFR) were of necessity treated somewhat differently. The problem was one of how to selectively reduce the intensity of the high contrast lines without altering their essential shape. This could not be achieved by the under exposing method used with continuous tone film. High contrast film when used with high contrast material has to have normal exposure and developing to retain its opaque and transparent characteristics.

The procedure chosen was to reduce the light transmitting power of the lines by blocking some of the light by use of a black dot screen. The dot screen thus preserved the shape of the lines while reducing the light transmitting power of the screened area.

The process used in conditions V, VI, VIII and IX was as follows. After mounting 8" x 10" photographic prints of the PS and PSC they were photographed with high contrast film to yield an 8" x 10" high contrast negative.

Kodak Autoscreen Ortho film was exposed in a large process camera with two different exposure settings which resulted in half-tone dot screens having two different sized dots. After normal processing parts were then cut out of the screen to correspond with the relevant cues of the PS. Relevant cues were to be rendered with un-screened black lines. A sandwich of high contrast figure, manipulated Auto-Screen film and Kodak Azo F-4 printing paper were placed on a contact print box where a normal exposure

was made. Following normal processing the print was then dry mounted on 11" x 14" sheets of eight ply mounting board in preparation to be photographed on slides.

Arrows were placed on the prints for the four reduced conditions and slides were made following the procedure previously described.

Figure 2 represents a single trial showing the stimulus slide, the response-alternative slide, the correct-response slide and the inter-trial interval slide.

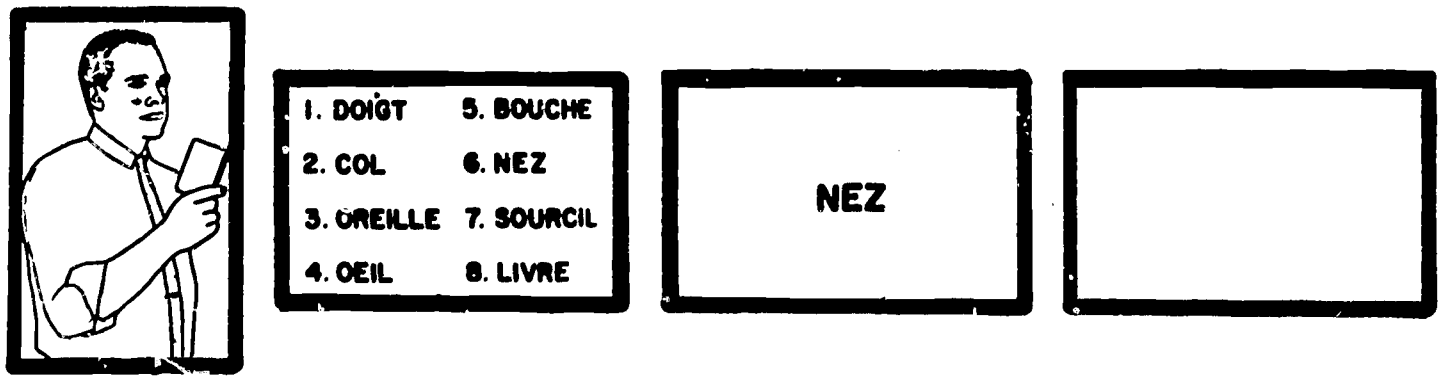


Fig. 2. Stimulus sequence of a single training trial.

The response alternative slides were prepared in the following manner. The eight French terms were lettered with a 500CL LEROY template on 11" x 14" mounting boards. A number seven pen was used. Forty of these boards were prepared with relative location of the terms repositioned on each board. The rotation order was determined by referring to a table of random permutations. Nine copies of the forty so lettered boards were made on 35-mm. high contrast film.

The correct-response slides were made in the same

manner. The inter-trial interval slide was a completely opaque slide used to present S with a blank screen for a five second duration during the inter-trial interval.

The only difference between the post test and the training test was the stimulus slide which was the English word for the relevant item instead of the figure (See Fig. 3).

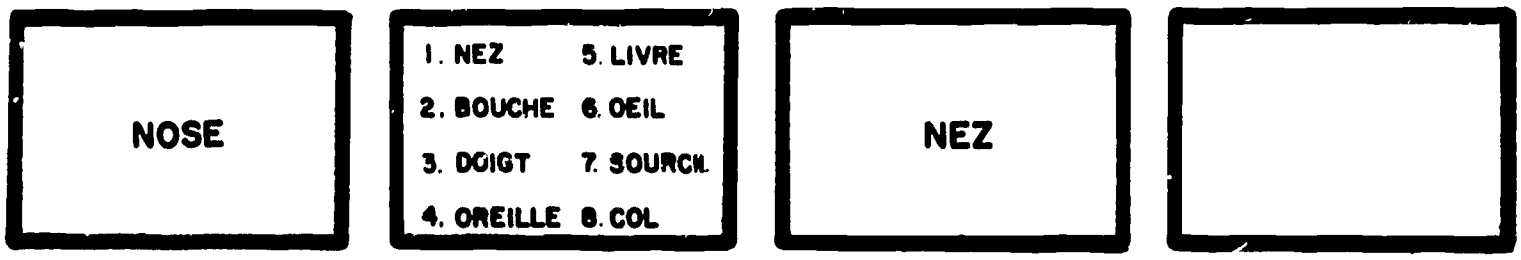


Fig. 3. Stimulus sequence of a single trial on post test.

The production of the slides included subjective aspects which cannot readily be described. For this reason the slides themselves can be duplicated for replication of this experiment by others.

A complete division of all stimuli material shows a total of 1440 slides arranged in eighteen Kodak Carousel Universal slide trays. Two trays of eighty slides each were used in each of the nine conditions.

The 1440 slides consisted of 360 stimulus slides, 360 response-alternative slides, 360 correct-response slides and 360 blank slides. The set of two trays used in each of the nine conditions contained a total of 40 stimulus slides, 40 response-alternative slides, 40 correct-response slides and 40 blank slides.

The post test stimuli material consisted of 64 slides contained in a single Kodak Carousel Universal slide tray. The 64 slides consisted of 16 English word stimulus slides, 16 response-alternative slides, 16 correct-response slides and 16 blank slides.

Subjects

The Ss for this study were taken from two school districts in Northwestern Pennsylvania. Two fifth grade classes from the Knox Grade School and one fifth grade class from each of the Ashland and Shippenville Schools were included from the Knox School District. Three fifth grade classes from the Clarion Grade School were included from the Clarion School District.

A total of one hundred and seventy-four Ss were tested. Twenty-one were rejected and were not statistically included in the study. One was rejected because of apparent failure to understand the instructions. Two were initially too knowledgeable in either Spanish or French. Seven were not used because of procedural errors by E and eleven did not reach criterial performance. The remaining Ss were included in the statistical analysis.

Apparatus and procedure

The stimulus materials were presented by a Kodak Carousel 800 slide projector (A) which was set on automatic cycling to provide a five second projection interval for

all slides (See Fig. 4).

A. Kodak Carousel 800 slide projector
B. Rear view screen
C. Subject position
D. Experimenter position

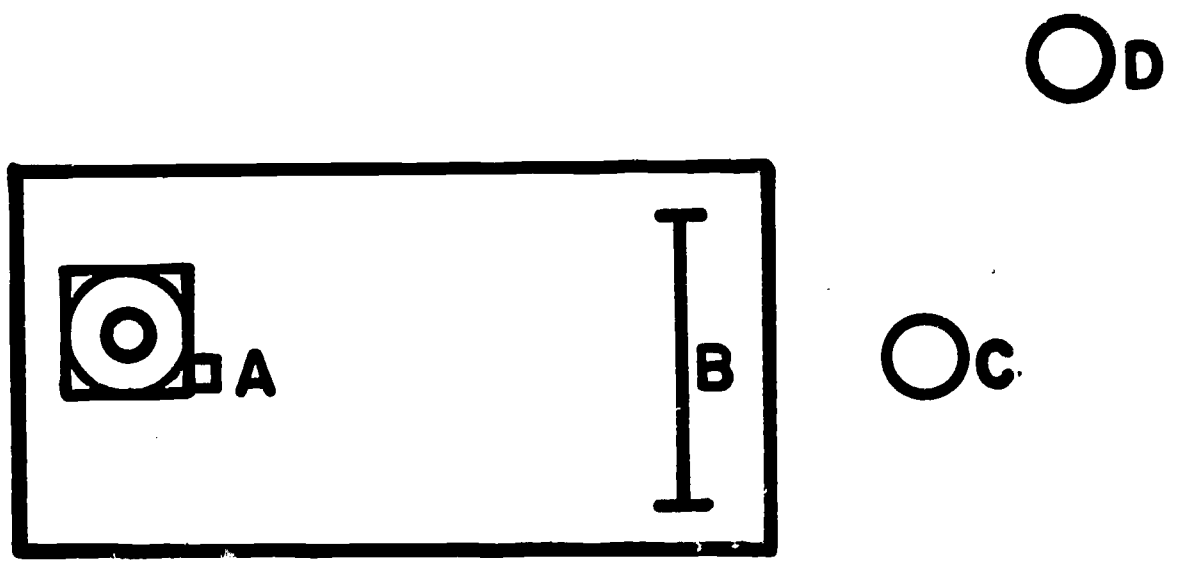


Fig. 4. Apparatus and seating arrangement.

The stimuli were projected on a 14" x 18" rear-view screen (B) and produced a projected image of 9" x 13". Each S (C) was seated approximately 36" in front of the screen. E (D) sat to the side and slightly to the rear of S in order to hear and record the oral responses.

A single trial consisted of a stimulus slide, a correct-response slide and an inter-trial interval slide. Eight trials were shown in random order to comprise a

permutation. Criterial performance was defined as responding on two successive permutations without errors. Criterion had to be achieved within twenty permutations in order for the data derived to be included in the statistical analysis.

Two and one-half permutations were included in each tray. Assuming that the S had not reached criterion performance within the first two permutations, half way through the third permutation there would be a brief interruption while E changed to the second tray of that condition. The second tray contained the remaining half of the third permutation plus the fourth and fifth permutations. If criterial performance had not been achieved by the end of the fifth permutation E would start over with the first tray. Thus a maximum of five permutations in the two trays would be shown four times for a total of twenty permutations.

Each S was instructed regarding his task as follows: "You will learn to identify eight different items by their French name. The first slide to appear on the screen will show the figure of a person with an arrow pointing toward an item you are to name in French. The second slide will show eight French words. From these eight French words you will guess which one is the correct answer. Since you don't know how to pronounce the word, all you need to do is tell me the number next to the word you have selected. The third slide will show the word that should have been

chosen in order to have been correct. The fourth slide is a blank to give a brief pause before you start over with another figure. Eight figures and the three slides that go with them will be repeated until you have learned the French words for the eight items indicated." (See appendix B for complete procedure and instructions).

Seventeen subjects were assigned randomly to each of the nine cells in a simple 3 x 3 factorial design (Table 1). The three ACC and three RIC cue conditions were previously defined.

Table 1

Factorial Design and Number of Ss per Cell in Experiment

		Augmented contour cues			Row
		P	PS	PSC	
Reduced irrelevant cues	UR	17	17	17	51
	R	17	17	17	51
	FR	17	17	17	51
Column total		51	51	51	

CHAPTER III

RESULTS

The total number of errors to criterion were obtained for each S. The means for cells and conditions are shown in Table 2. (Raw data are reported in Appendix A.)

Table 2

Mean Errors on Paired Associate Training

	P	PS	PSC	Row Mean
UR	29.12	29.29	28.00	28.80
R	33.76	34.71	26.06	31.51
FR	33.29	31.71	28.06	31.02
Column mean	32.06	31.90	27.37	30.44

An analysis of variance was then performed on this data which yielded the results summarized in Table 3.

Table 3

Analysis of Variance of the Number of Errors to Criterion in Paired Associate Training

Source	SS	df	MS	F
ACC (Augmented contour cues)	722.50	2	361.25	1.74
RIC (Reduced irrelevant cues)	212.00	2	106.00	.51
ACC x RIC	304.40	4	76.10	.03
Error	29926.90	144	207.83	

The mean error scores for the ACC conditions were 32.06 for P, 31.90 for PS and 27.37 for PSC. These mean scores yielded a non-significant F of 1.74 (df 2, 144, $p > .05$). The F of .51 for the reduced irrelevant condition indicates that the difference among the mean number of errors following this condition is not statistically significant. The test of the interaction between ACC and RIC also yielded an F ratio less than one.

Errors as a function of ACC and RIC are graphically compared in Fig. 5.

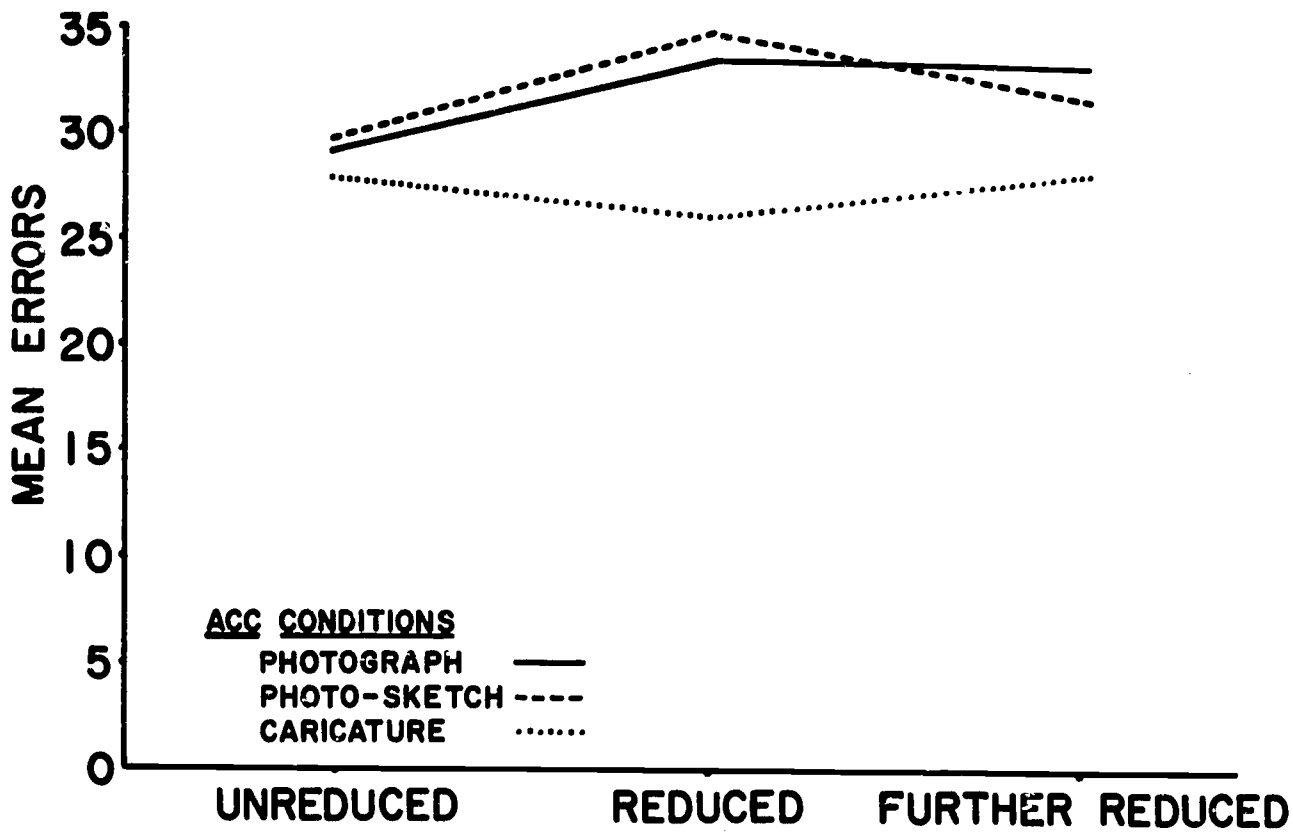


Fig. 5. Mean errors for 3 ACC conditions, P, PS, and PSC as a function of RIC.

The total number of trials to criterion were also obtained for each S. The means for cells and conditions are shown in Table 4.

Table 4

Mean Trials on Paired Associate Training

	P	PS	PSC	Row mean
UR	10.77	11.06	10.65	10.82
R	12.24	12.41	8.53	11.06
FR	11.65	11.29	10.12	11.02
Column mean	11.55	11.59	9.76	10.97

An analysis of variance for trials was performed on this data which yielded the results summarized in Table 5.

Table 5

Analysis of Variance of the Number of Trials to Criterion in Paired Associate Training

Source	SS	df	MS	F
ACC (Augmented contour cues)	110.69	2	55.35	3.78*
RIC (Reduced irrelevant cues)	1.63	2	.82	.01
ACC x RIC	76.05	4	14.01	.96
Error	2108.48	144	14.64	

*$p < .05$

The mean trial scores for the ACC conditions were 11.55 for P, 11.59 for PS and 9.76 for PSC. These mean

scores yielded a significant F of 3.78 (df 2, 144, $p < .05$). A Newman Keuls interval test (Winer, 1962) indicated that the PSC condition differed from both of the other conditions ($p < .05$), while PS and P did not differ significantly ($p > .05$). The mean number of trials for RIC groups did not differ significantly. The interactions of ACC and RIC yielded an F ratio of less than one.

Mean trials as a function of ACC and RIC is graphically compared in Fig. 6.

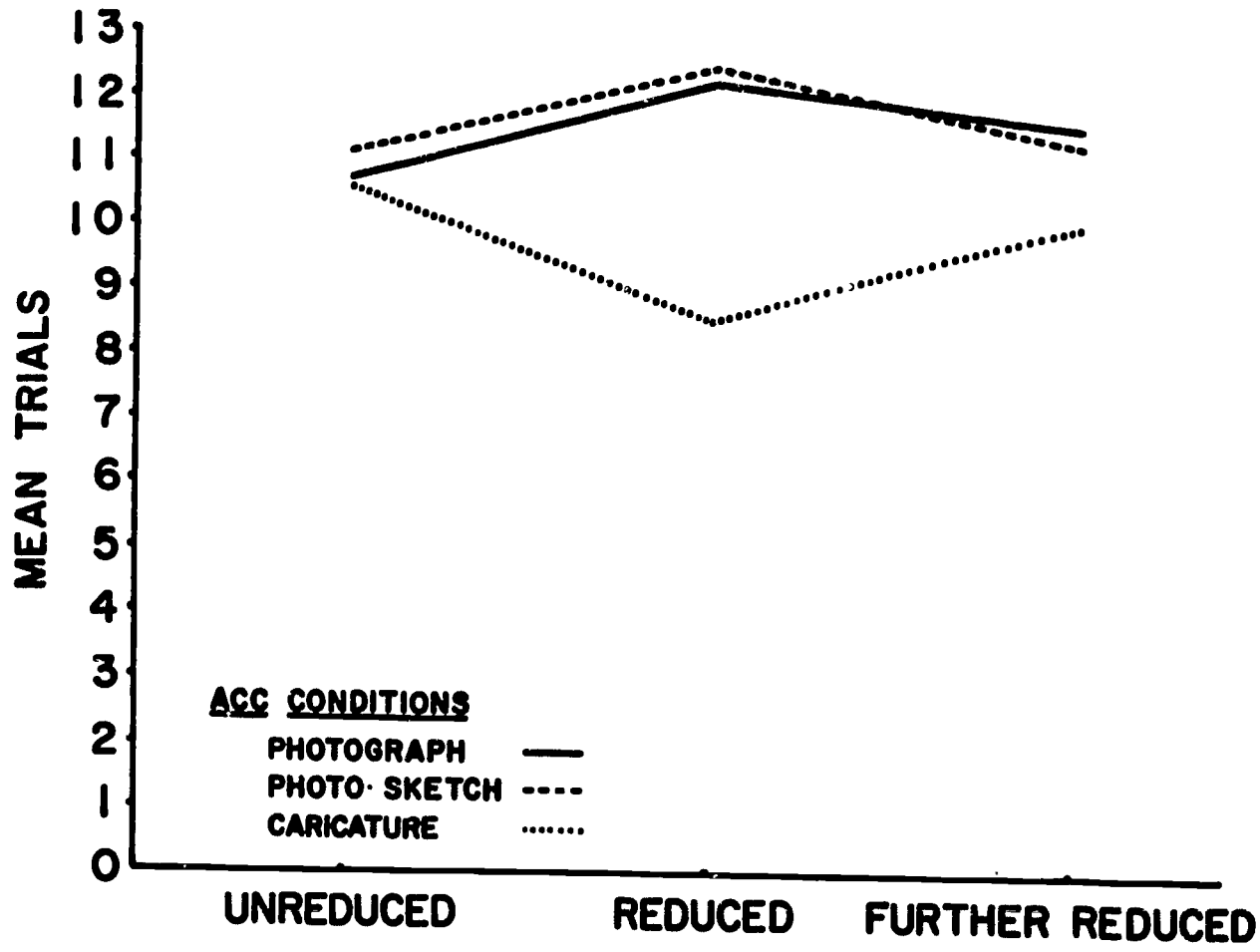


Fig. 6. Mean trials for 3 ACC condition, P, PS, and PSC as a function of RIC.

An analysis of variance was performed on the number of trials in the post test with the results shown in Table 6.

Table 6

Analysis of Variance of the Number of Trials in Post Test

Source	SS	df	MS	F
ACC (Augmented contour cues)	.21	2	.11	.16
RIC (Reduced irrelevant cues)	.56	2	.28	.43
ACC x RIC	2.89	4	.72	1.10
Error	94.59	144	.65	

The mean trial scores for the ACC conditions, the RIC conditions and the interaction conditions all yielded non-significant F scores.

An analysis of variance for errors was performed which yielded the results summarized in Table 7.

Table 7

Analysis of Variance of the Number of Errors in Post Test

Source	SS	df	MS	F
ACC (Augmented contour cues)	.17	2	.08	.27
RIC (Reduced irrelevant cues)	2.37	2	1.18	4.06*
ACC x RIC	8.92	4	2.23	7.68**
Error	42.66	144	.29	

* $p < .05$
** $p < .01$

The mean error scores for the ACC conditions yielded a non-significant F score. The mean error scores for the RIC conditions were 56.67 for UR, 47 for R and 22 for FR. These mean scores yielded a significant F of 4.06 (df 2, 144, $p < .05$). The mean error scores for the ACC x RIC conditions yielded a significant F of 7.68 (dr 4, 144, $p < .01$).

The significant results derived from the analysis of variance of mean errors should be interpreted cautiously. The very small residual error term resulted from the preponderance of zero scores while the high error scores on the part of only two Ss contributed most of the variance associated with the significant difference obtained.

The post test data gives some information concerning two questions of interest in this study. First there was no evidence of confusion at the end of training concerning the referent intended by E, associated with each arrow position. For example, the arrow pointing toward the mouth could have been interpreted as indicating the lips. This confusion did not seem to occur since an average of thirteen out of the seventeen Ss in each condition were able to make all correct responses on the first post test permutation. Secondly, the Ss had no apparent difficulty in making a transfer of learning to the English word stimuli.

CHAPTER IV

DISCUSSION

As a result of the analysis of trials there was indicated a significant difference between the ACC conditions of P, PS, and PSC reaching the five percent level. The interval test showed additionally that the PSC condition differed from both of the other conditions ($p < .05$) while PS and P did not. The reduction of irrelevant cues was not associated with significant differences. Despite the fact that there was in this study a generally high correlation between trials and errors there were no significant differences demonstrated in the analysis of variance of errors. A possible explanation, although clearly post-hoc, is derived from a finding of changing effects of supplementing relevant cues over trials. This finding was obtained in a study in which extra cues were added after S had achieved a partial learning level and seemed to require further discrimination cues to overcome initial generalization (Brown, Battig, Pearlstein, 1965). While it is true that extra cues were not added midway through this study it is suggested that the enhanced exaggerated cues found in the PSC condition possibly became the source for further discrimination association after the bulk errors associated with initial stimulus confusion were made early in training.

The overall findings of this study did not constitute evidence of a consistently strong effect associated with any of the variables. However, the findings may be interpreted as being consistent with certain positions outlined in the introductory chapter.

There was no evidence that the relatively more concrete or realistic treatment is superior to the more abstract. In fact, the obtained differences were in the opposite direction, that is the more distorted, less realistic condition was associated with fewer errors.

Further, this study does not support in a simple way the effectiveness of increasing relevant cues or decreasing irrelevant cues. If background textural cues are defined as being irrelevant cues and contour cues as being relevant then the effect of relevancy should have been most apparent in the PS condition since this is where the bulk of the irrelevant textural cues were eliminated. In fact, however, there was no significant difference associated with either irrelevant textural cues or relevant contour cues.

In giving further consideration to the effects of ACC Attneave's statement regarding the relative effectiveness of certain pictorial cues seems to be appropriate. In brief, he suggested that textural cues contribute little functional information while contour cues contribute much and further that points of inflection are most informative. Thus the

PSC condition may have been the only condition in which relevance was functionally varied since it was the only one in which there was gross manipulation of the contour cues. In other words if the Attneave notion of what is relevant and irrelevant is accepted then we might have expected that reducing textural cues as in the PS condition would have produced little effect.

The results of the Ryan and Schwartz study and the Gibson airplane study reported in the first chapter are consistent with the findings of the present study of relative effectiveness of the cartoon condition. In both cases the distortion of the figure by emphasis produced the most effective results (Ryan and Schwartz, 1956; Gibson, 1947).

There exists some theoretical basis for explaining the apparent superiority of the caricature condition in the Berlyne concept of drive associated with novel stimuli. If novelty correlates with discrepancy from the most frequently encountered stimuli then the caricature condition would be the most novel. Also if the caricature condition is associated with increased drive properties then maintenance of attention to stimulus material over an extended period of time is to be expected.

Although we should interpret no difference finding with great caution, it may be instructive for further research to point out some possibilities for the failure to

find significant difference on the RIC conditions.

One mechanical possibility is that all stimulus elements were present on all treatments and quite visible even on the further reduced form. In another study the possible manipulation of total drop out of irrelevant cues should be considered, perhaps, in conjunction with discrete stimuli items. In the case of this study it seemed ill advised to use a maximum reduction of cues because of the integrated nature of the stimuli material.

In terms of a more theoretical point of view it is very possible that the lack of difference indicated could be a function of selective responding or selection. Postman's (1964) discussion of cue selection as a function of instruction in incidental learning may relate to the RIC variable in this study. The post test data indicates that the arrow provided very effective orientation for Ss probably due in part to the explicit instruction concerning its function. If, as in this case, one aspect of the stimulus is indicated in instructions as being the relevant cue then the probability of responding to other elements has been shown to be reduced (Bahrick, 1954). In other words, the S responds selectively to the arrow with little regard for other cues, be they relevant or irrelevant as defined by E.

As a result of this experiment it appears that although relevance and irrelevance may be defined in terms of physical cue elements present as identified by E the results

of this study and possible interpretation of cue literature indicates that such a definition of the relevance of a given stimulus may prove to be inadequate. The effect and relative influence of various cue selection factors may have been such as to offset the effects of those cue factors formally defined and controlled in this study.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The purpose of this study was to investigate the effects on paired associate learning of varying stimulus material by augmenting contour cues and diminishing irrelevant cues.

The problem was defined by three questions, namely:

1. What is the effect of augmenting contour cues upon paired associate learning?

2. What is the effect of reducing irrelevant context cues upon paired associate learning?

3. What is the interaction effect between augmenting contour cues and reducing irrelevant cues?

The questions were investigated in a paired associate experiment. One hundred and fifty-three Ss, tested individually and randomly assigned to nine different treatments, were shown stimulus slides that varied in terms of the treatment of contour and contextual cues. After viewing a stimulus slide which showed an arrow pointing toward the item to be responded to, S indicated his choice by orally calling out a number next to one of eight French words projected by the second slide. Confirmation of S's choice was made by a third slide which indicated the correct answer. Following a five second inter-trial interval S then viewed the subsequent trials until criterion perform-

ance of two permutations without error was achieved. The analysis of variance of trials and errors was used to test for differences among the nine different conditions. The results showed that:

1. In paired association, when measured by errors to criterion, there was no significant difference as a result of augmenting contour cues by either photo-sketching a photograph or caricaturizing a photo-sketch. However, there was a significant difference at the five percent level when measured by trials to criterion.

Further analysis of the augmented cue trials effect by the use of a Neuman Keuls interval test showed the photo-sketch caricature condition to differ from both the photograph and the photo-sketch conditions at the five percent level.

2. There are no significant differences between levels of reduced irrelevant contextual cues on either trials or errors to criterion.

3. There are no significant interaction effects between augmented contour cues and reduced irrelevant cues.

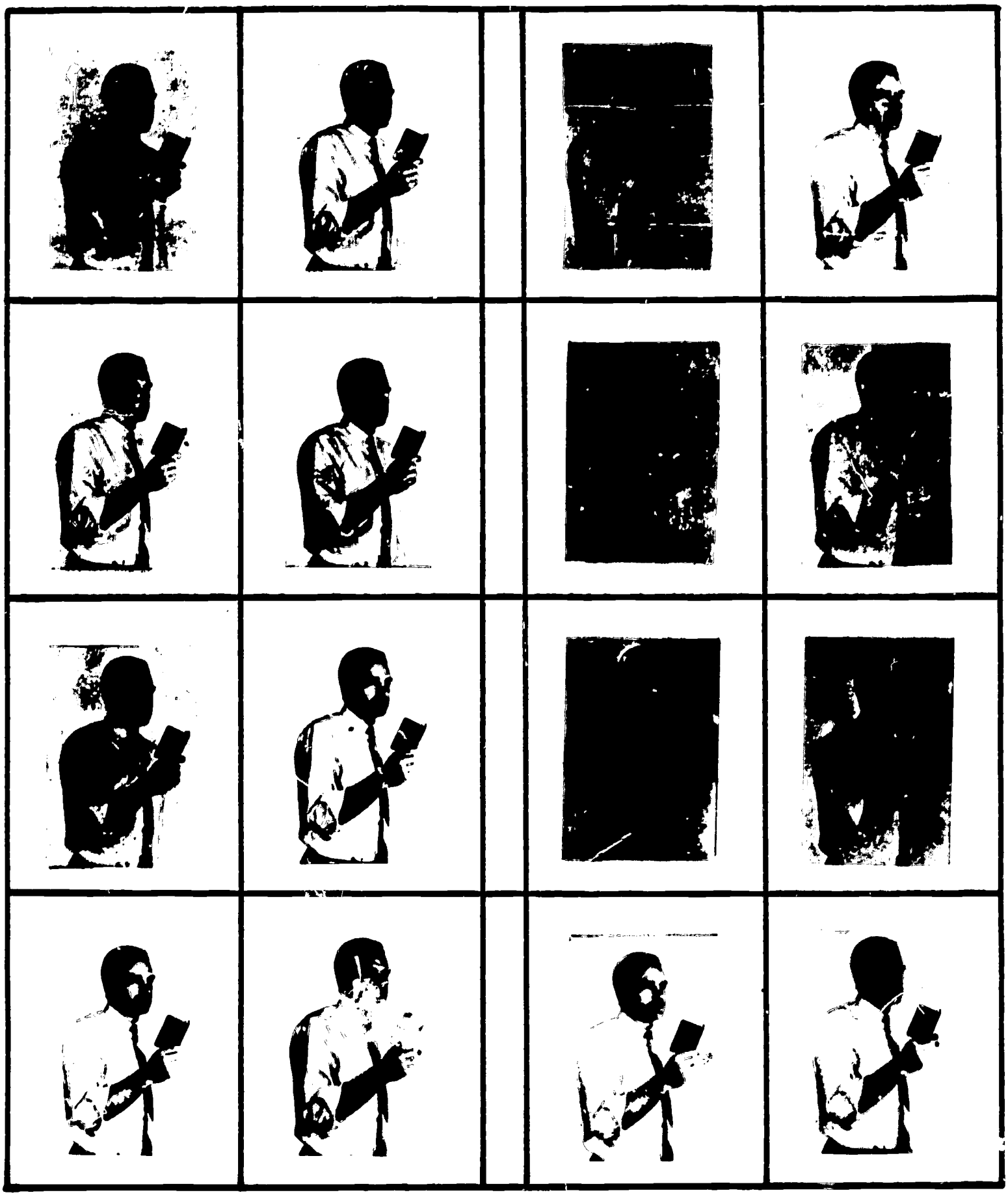
Suggestions for further study

In view of the apparent effect derived from the manipulation of contour cues it is suggested that further study is needed in which more explicit rationales for caricaturization are followed. Independent manipulation by

gross exaggeration and manipulation by abstraction of points of maximum curvature could provide a basis for such a study.

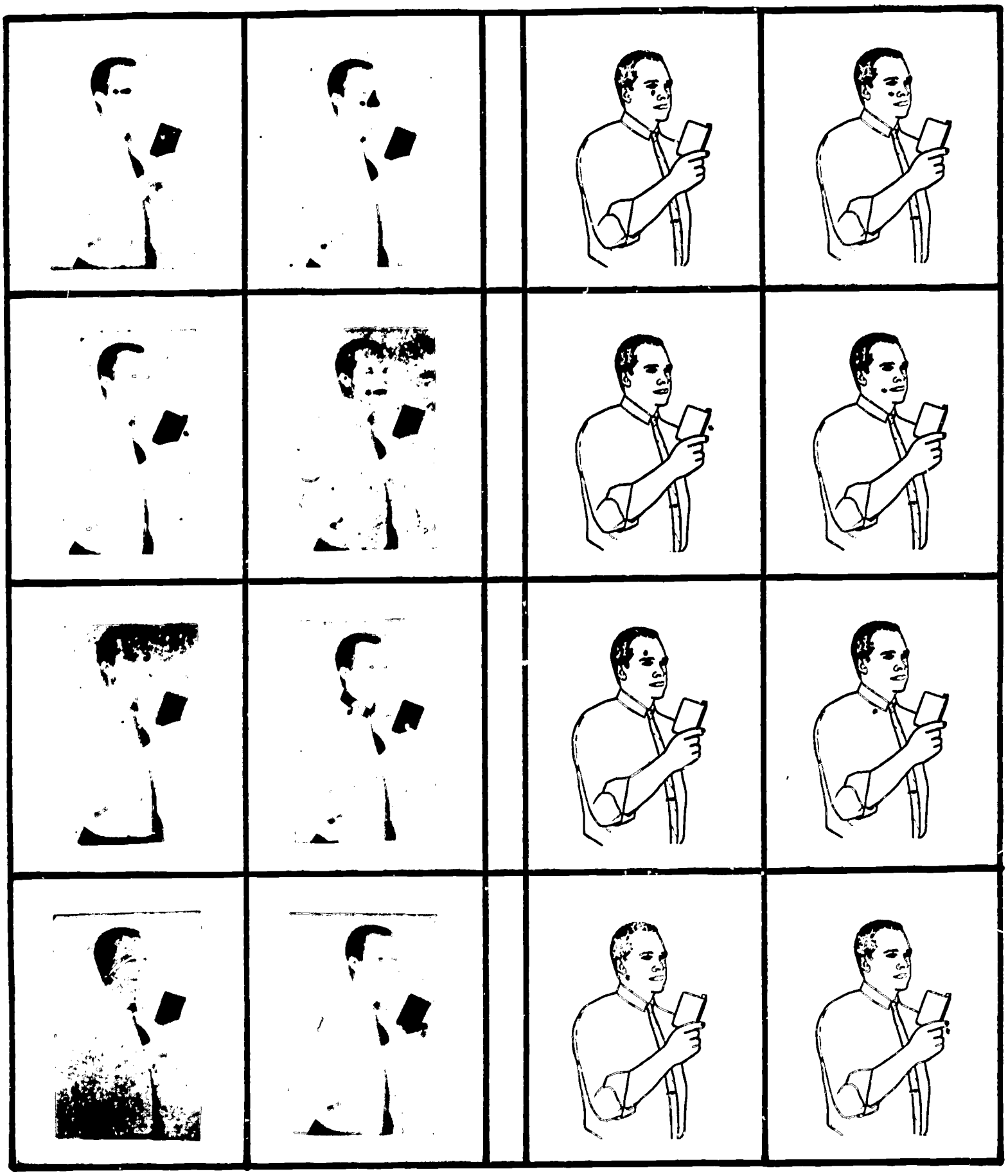
It appears that pictures in the response term position may have a greater effect than placing the same term in the stimulus position (Bern, 1958). Such a procedure may be more sensitive to small differences in pictorial stimuli than the present design.

Finally, a more adequate manipulation of the ratio of relevant to irrelevant cues is suggested. In this study the ratio of relevant to irrelevant cues was not maximally manipulated. This was due in part to the integrated or non-independent nature of the stimulus components. Thus, even on the most reduced condition of reduced irrelevant cues the contextual cues were easily seen. A study of further manipulation of the cue ratio by photo-sketching only the relevant component item in the photograph and likewise caricaturizing only the relevant component item of the photo-sketch conditions is suggested.



Photograph Unreduced Photograph Reduced

Appendix A. Stimulus Figures



Photograph Further Reduced

Photo-Sketch Unreduced

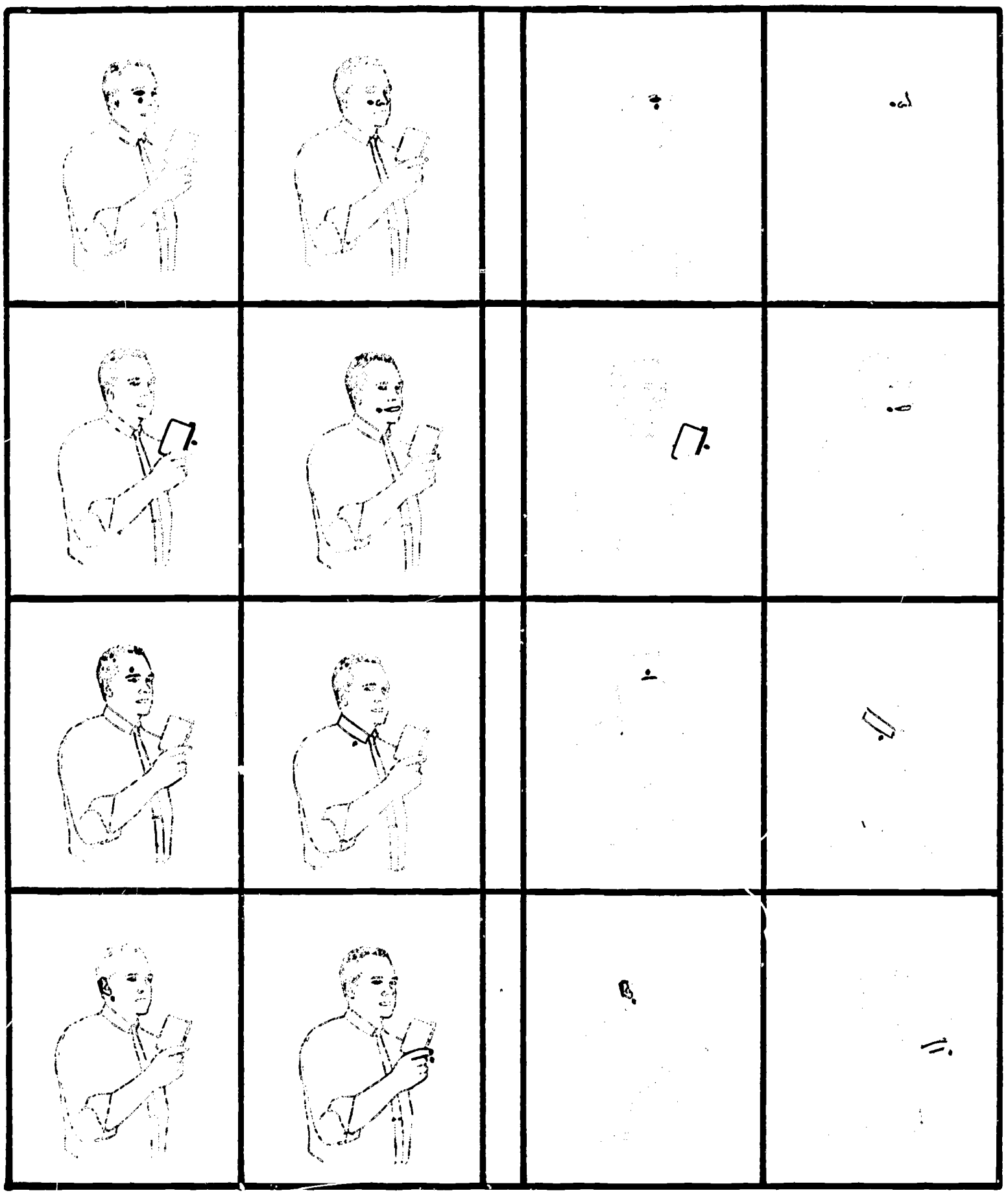


Photo-Sketch
Reduced

Photo-Sketch Further
Reduced

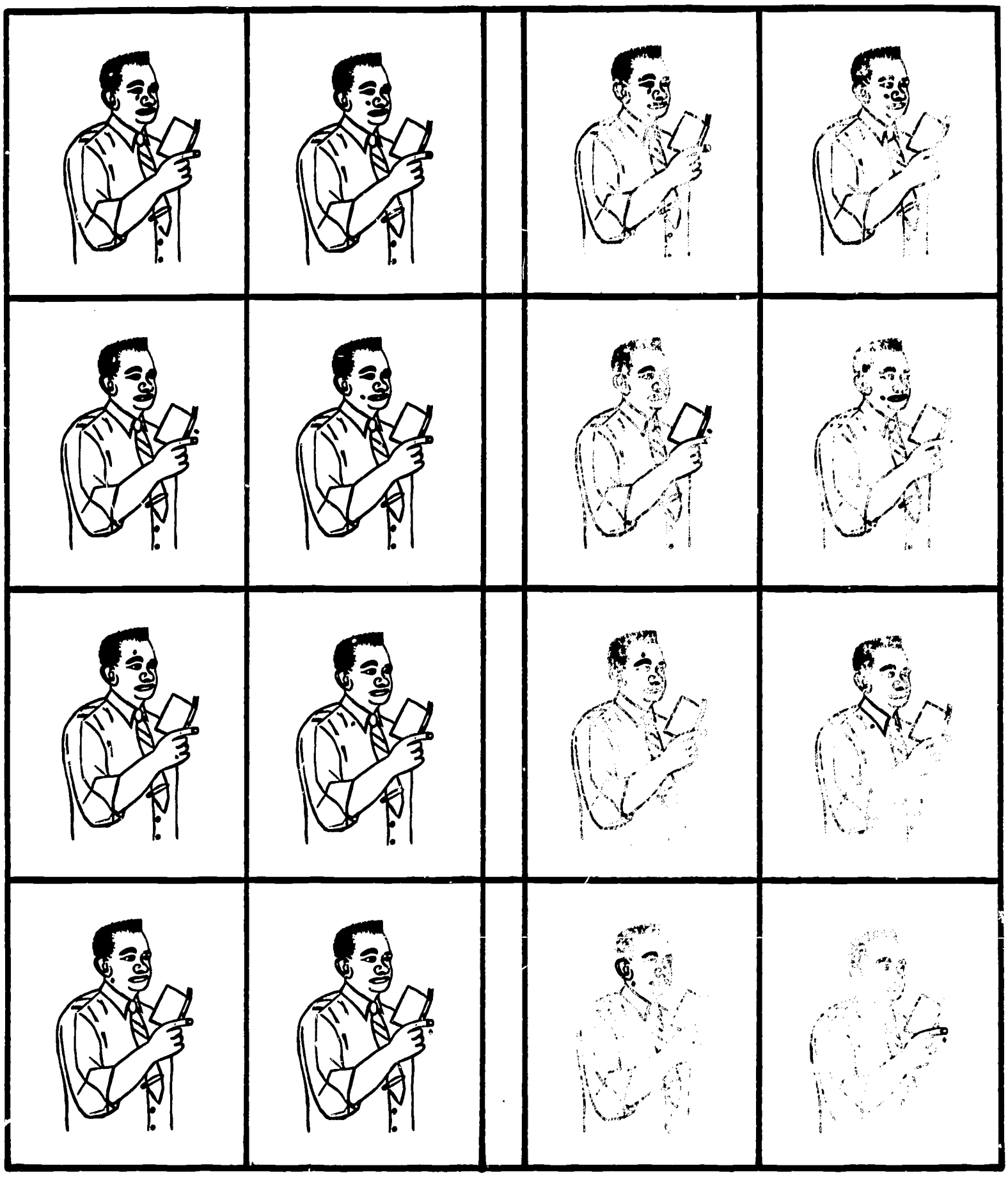


Photo-Sketch
Caricature
Unreduced

Photo-Sketch
Caricature
Reduced

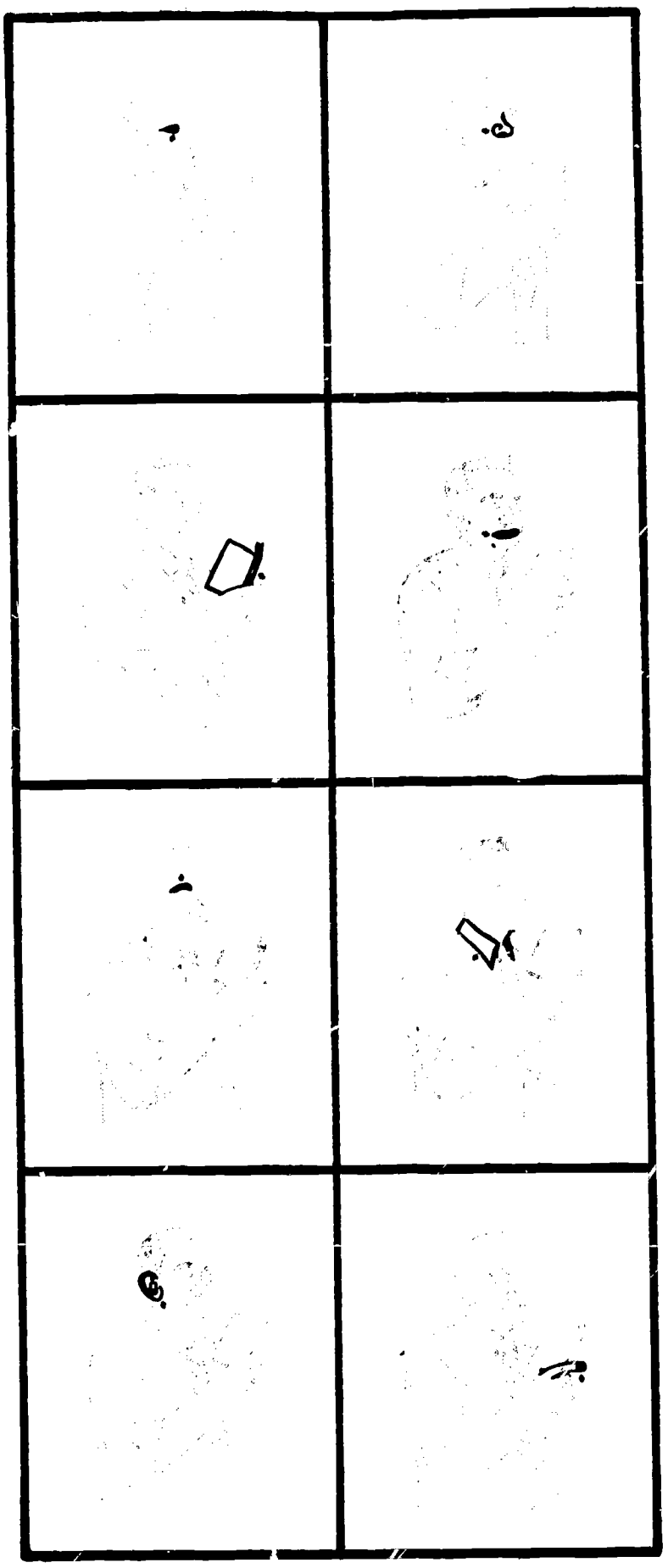


Photo-Sketch Caricature
Further Reduced

Appendix B

Instructions to Subjects
(Read to each subject)

When the S entered the testing room he was introduced to the experimental task in the following manner.

"Hello, my name is Mrs. Price. Would you please sit right here." (S was seated at the proper distance facing the rear projection screen. Mrs. Price then sat to the side and slightly to the rear of the S.)

"What is your name?" (The name was recorded on the testing form). "How old are you _____? (The S was addressed by his or her name and his age was recorded.)

"Have you ever studied French or Spanish?" (If the answer was no, the information was recorded and further instructions given. If the answer was yes, then further information was requested.)

"How long did you study _____, and when did you study it?" (Usually the S had learned a few words of greeting or a few numbers in one of the two languages. Only two Ss were rejected because of substantial previous language experience.)

"You will learn to identify eight different items by their French name. The first slide to appear on the screen will show the figure of a person with an arrow pointing toward an item you are to name in French. The second slide will show eight French words. From these eight French

words you will guess which one is the correct answer. Since you don't know how to pronounce the word, all you have to do is tell me the number next to the word you have selected. The third slide will show the word that should have been chosen in order to have been correct. The fourth slide is a blank to give a brief pause before you start over with another figure. Eight figures and the three slides that go with them will be repeated until you have learned the French words for the eight items indicated.

"Do you have any questions?" (No questions were asked and only one S indicated by his actions that he had misunderstood the instructions.) Projection of the slides was then begun.

Appendix C

Response Recording Sheet

French_____Spanish_____

Date_____Cond._____Time_____Subject No._____Name_____

			Training					Post					Training					Post	
Trial No.	S	Cor. Resp	R	R	R	R		R	R		Trial No.	S	Cor. Resp	R	R	R	R		R	R
1	1	5									21	6	6							
2	8	8									22	2	7							
3	6	8									23	1	2							
4	4	4									24	5	3							
5	5	6																		
6	2	7									25	1	8							
7	7	6									26	6	5							
8	3	8									27	5	2							
											28	3	1							
9	4	3									29	2	7							
10	7	7									30	8	7							
11	8	5									31	7	5							
12	1	7									32	4	5							
13	3	6																		
14	6	4									33	8	6							
15	5	1									34	6	1							
16	2	3									35	4	8							
											36	3	6							
17	8	3									37	5	1							
18	7	1									38	2	8							
19	3	1									39	7	2							
20	4	3									40	1	5							

Appendix D

Total Trials and Errors on Paired Associate Training and Post Test (Condition I)

	Photograph Unreduced		post test	
Subjects	Trials	Errors	Trials	Errors
2	5	6	1	0
14	9	17	1	0
26	5	12	1	0
28	9	22	1	0
45	10	30	1	0
47	16	44	1	0
59	14	40	1	0
71	11	42	3	2
73	13	40	3	3
90	6	9	1	0
92	6	16	1	0
104	14	40	1	0
116	18	69	2	2
118	13	30	1	0
135	10	29	1	0
137	6	14	2	1
149	18	35	1	0
Total	183	495	23	8
	$\bar{X}$=10.77	$\bar{X}$=29.12	$\bar{X}$=1.35	$\bar{X}$=.47

(Condition II)

	Photograph Reduced		post test	
Subjects	Trials	Errors	Trials	Errors
7	10	28	1	0
18	17	43	2	4
25	10	31	1	0
33	17	50	1	0
43	17	47	1	0
52	13	35	2	1
63	0	63	1	0
70	14	34	2	2
78	13	40	1	0
88	13	32	2	2
97	8	31	1	0
108	6	14	2	2
115	13	42	1	0
123	9	24	1	0
133	6	17	1	0
142	10	20	1	0
153	12	23	1	0
Total	208	574	22	11
	$\overline{X}$=12.2	$\overline{X}$=33.76	$\overline{X}$=1.29	$\overline{X}$=.65

(Condition III)

Subjects	Photograph Further Reduced Trials	Errors	post test Trials	Errors
9	10	22	2	1
15	7	16	1	0
22	11	36	1	0
32	15	53	1	0
40	20	44	1	0
54	6	13	3	2
60	13	33	1	0
67	16	62	1	0
77	10	29	3	4
85	16	56	2	2
99	8	21	1	0
105	11	31	1	0
112	12	28	1	0
122	6	12	1	0
130	10	29	1	0
144	13	42	1	0
150	14	39	1	0
Total	198	566	23	9
	$\overline{X}$=11.65	$\overline{X}$=33.29	$\overline{X}$=1.35	$\overline{X}$=.53

(Condition IV)

Subjects	Photo-Sketch Unreduced Trials	Errors	post test Trials	Errors
5	10	22	1	0
10	14	29	1	0
23	9	23	1	0
36	5	13	1	0
39	12	27	1	0
50	8	18	1	0
55	13	44	1	0
68	4	9	2	1
81	10	26	2	1
84	20	46	3	2
95	10	29	1	0
100	16	58	1	0
113	16	55	6	12
126	8	23	1	0
129	7	14	1	0
140	14	34	1	0
145	12	28	1	0
Total	188	498	26	16
	$\bar{X}$=11.06	$\bar{X}$=29.29	$\bar{X}$=1.53	$\bar{X}$=.94

(Condition V)

Subjects	Photo-Sketch Reduced Trials	Errors	post test Trials	Errors
6	10	27	1	0
17	17	40	1	0
27	20	77	2	1
30	18	52	3	2
42	17	25	2	1
51	14	54	1	0
62	10	29	1	0
72	9	3[illegible]	2	1
75	11	32	1	0
87	8	17	1	0
96	9	29	1	0
107	9	26	1	0
117	17	45	1	0
120	5	12	1	0
132	12	23	1	0
141	11	34	1	0
152	14	36	3	3
Total	211	590	24	8
	$\bar{X}$=12.41	$\bar{X}$=34.71	$\bar{X}$=1.41	$\bar{X}$=.47

(Condition VI)

Subjects	Photo-Sketch Further Reduced Trials	Errors	post test Trials	Errors
4	12	29	1	0
16	9	27	1	0
24	16	38	1	0
29	10	22	1	0
38	7	16	2	1
49	9	23	1	0
61	10	29	2	0
69	10	24	1	0
74	9	14	1	0
83	9	26	1	0
94	19	77	1	0
106	12	27	1	0
114	11	27	1	0
119	12	47	2	1
128	20	66	3	3
139	7	18	1	0
151	10	29	1	0
Total	192	539	22	8
	$\bar{X}$=11.29	$\bar{X}$=31.71	$\bar{X}$=1.29	$\bar{X}$=.47

(Condition VII)

Subjects	Photo-Sketch Caricature Unreduced Trials	Errors	post test Trials	Errors
8	7	29	2	2
12	12	30	2	2
20	11	24	1	0
35	13	36	1	0
44	6	11	1	0
53	9	17	1	0
57	14	37	1	0
65	10	33	1	0
80	12	26	1	0
89	10	24	1	0
98	5	16	1	0
102	8	35	1	0
110	19	55	1	0
125	9	28	1	0
134	10	35	1	0
143	13	24	1	0
147	13	26	1	0
Total	181	476	19	4
	$\bar{X}$=10.65	$\bar{X}$=28.00	$\bar{X}$=1.12	$\bar{X}$=.24

(Condition VIII)

Subjects	Photo-Sketch Caricature Reduced		post test	
	Trials	Errors	Trials	Errors
3	6	11	1	0
13	11	44	3	2
19	8	16	1	0
34	9	32	2	1
37	11	30	3	3
48	8	11	1	0
58	9	33	1	0
64	11	43	1	0
79	4	6	3	4
82	8	22	2	1
93	9	20	2	1
103	8	27	1	0
109	7	45	4	8
124	8	18	1	0
127	4	7	1	0
138	12	39	1	0
148	12	39	1	0
Total	145	443	29	20
	$\bar{X}$=8.53	$\bar{X}$=26.06	$\bar{X}$=1.71	$\bar{X}$=1.18

(Condition IX)

	Photo-Sketch Caricature Further Reduced		post test	
Subjects	Trials	Errors	Trials	Errors
1	7	19	1	0
11	18	58	1	0
21	11	26	1	0
31	10	22	1	0
41	5	7	1	0
46	14	34	1	0
56	6	14	1	0
66	10	35	2	1
76	12	49	5	4
86	7	24	1	0
91	14	43	3	2
101	13	31	1	0
111	14	39	1	0
121	13	41	1	0
131	8	17	1	0
136	6	10	1	0
146	4	8	1	0
Total	172	477	24	7
	$\bar{X}$=10.12	$\bar{X}$=28.06	$\bar{X}$=1.41	$\bar{X}$=.41

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