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## The effect of physical detail on picture recognition memory

Hsuan-Chih Chen

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THE EFFECT OF PHYSICAL DETAIL ON PICTURE RECOGNITION MEMORY

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A Thesis  
Presented to the  
Faculty of  
California State  
College, San Bernardino



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by  
Hsuan-Chih Chen  
July, 1979

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Approved by:

  
Chairperson

7/30/79  
Date

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In Partial Fulfillment  
of the Requirement for the Degree  
Master of Arts  
in  
Psychology

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## ABSTRACT

In the present study, the effect of physical detail in picture recognition memory was evaluated. In Experiment 1 subjects were shown a series of 44 pictures, half of which contained a simple amount of physical detail, and half were complex. A recognition test followed with pictures, half of which were the original pictures and half were changed pictures. The changed pictures were similar to the original pictures but changed in the addition or removal of physical detail. Higher  $d'$  values resulted in the simple than complex presentation condition. Experiment 2 was similar to Experiment 1, with the addition of a one-sentence verbal description of the picture (caption) as a between-subjects variable. The caption was presented before the corresponding picture. In the complex presentation condition the false alarm rates were significantly higher in the caption than no caption condition. With caption, higher  $d'$  values were found in the simple than complex presentation condition, but no significant difference was found in no caption condition. In both experiments, there were no hit rate differences between the simple and complex presentation conditions. The data were discussed in terms of disconfirming the hypothesis that the amount of physical detail contained in pictures determines the retention of the pictures.



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## INTRODUCTION

A number of investigators have demonstrated a large recognition memory capacity for pictures. This finding has been termed the pictorial superiority effect. One possible factor responsible for this impressive memory capacity has been considered to be the large amount of physical detail available in pictures. The evaluation of this explanation is the central issue addressed in the present study.

Impressive picture recognition memory performance has been reported by several researchers. For example, Shepard (1967) presented one group of subjects 612 pictures of common objects taken from magazine advertisements at a self-paced rate. Two other groups were presented words and sentences using a similar procedure. A forced-choice recognition test followed immediately. The mean percent correct were 88.4, 89.0 and 96.0 for words, sentences and pictures respectively. Even after one week, recognition memory accuracy for the pictures was 87.0%. Similarly, Nickerson (1965) reported 95% correct recognition of a series of 600 complex pictures in a continuous recognition test procedure. Standing, Conezio, and Haber (1970) presented subjects 2560 slides, for ten seconds each, in four daily sessions of two hours. Most of the slides were colored vacation pictures. The resulting mean correct recognition accuracy was 90.5%.

There are three main hypotheses concerning the role of physical detail in picture memory. The first explanation is the detail facilitation hypothesis. Haber (1970), Nickerson (1965), and Reese (1970a)

have proposed that pictures are well retained because as stimuli, they carry many more physical details than, for example, words. It is suggested that the amount of physical detail available is positively related to how well items are retained in memory, with more detailed pictures being remembered better than the less detailed pictures. The explanation is that the additional physical detail makes the stimuli more distinguishable and resistance to interference from other stimuli (Goldstein and Change, 1974; Friedman and Bourne, 1976).

The detail facilitation hypothesis has been supported by several experiments. Bevan and Steger (1971) reported that recall performance of children and adults was significantly affected by the physical complexity in items. They presented items in the forms of pictures, words, or as real objects, and found that the objects were recalled at a higher rate than pictures, and pictures more frequently than words. Thus recall was directly related to the amount of physical detail in the stimuli. Similar results have been reported by Evertson and Wicker (1974) with children in a paired-associate task using pairs of photographs and drawings. These results support the detail facilitation effect explanation for the pictorial superiority effect.

A second explanation for the role of detail is the detail distraction hypothesis (Holyoak, Hogeterp, and Yuille, 1972). They suggested that the additional physical detail contained in pictures serves a distraction function. Holyoak et al. (1972) tested children using a paired associate learning task with cued recall and recognition tests. They assumed that the photographs contained more physical detail such as color and shading than corresponding line drawings. They reported



that elaborated line drawings were better remembered than related photographs. This result suggested that the additional physical detail contained in the photographs might have served a distracting function in the subjects' picture memory performance.

The third explanation is the conservation of processing hypothesis (Nelson, Metzler, and Reed, 1974). The conservation of processing hypothesis proposes that a certain amount of information from a picture is stored during a constant amount of processing time, regardless of how much detail is provided in the picture. Nelson et al. (1974) tested whether the amount of detail accounts for the high recognition accuracy of pictures compared with verbal material. They presented subjects a sequence of black and white photographs, embellished line drawings of the photographs, unembellished line drawings of the photographs or one sentence verbal description of the main theme in the photographs. These four different forms of stimuli presented the same central information but varied the amount of visual detail available in the stimulus. Performance on a forced choice recognition test did not differ among the three pictorial conditions in either the immediate or the delayed tests. However, recognition accuracy was significantly lower in the sentence condition. Thus, they concluded that the amount of detail would not determine how well pictures were retained in memory. Similarly, Emmerich and Ackerman (1976) tested the quantity of detail hypothesis with young children. They manipulated the amount of detail in pictures by adding color, various shadings and additional lines to the black and white drawings. The items were also presented in an interactive or separate, noninteracting position within the pictures.

The results were that the amount of detail had no effect on recall, however interaction significantly aided retention.

These three hypotheses, the detail facilitate hypothesis, the detail distraction hypothesis and the conservation hypothesis, are concerned with the role of detail in picture memory. As indicated, research exists to support each of these hypothesis. However, since different types of stimuli (color photographs, black and white photographs and line drawings), and many test measures (recall vs. recognition) were used in these studies, it is difficult to compare the results and conclude which hypothesis more adequately describes the role of physical detail in picture memory. For example, both Nelson et al. (1974), and Emmerich and Ackerman (1976) used a recognition test, while Bevan and Steger (1971), and Evertson and Wicker (1974) used a recall test, in their study. However, Bartram (1976) and Goldstein and Chance (1974) have pointed out the danger of regarding different modes of pictorial representation as equivalent. Hence, the present study used only one type of pictorial stimuli, line drawings, to investigate the function of additional physical detail. Since the large recognition memory capacity for pictures is the primary interest in the present study, a recognition test was used.

A comparison of the detail facilitate hypothesis and the detail distraction hypothesis was the major focus of Experiment 1. In Experiment 1, the degree of physical detail was manipulated by adding lines, shading and background figures to the simple line drawings. Slides of simple and complex line drawings were presented to subjects. All the slides presented had the same central meaning but different amounts of



physical detail (see Figure 1). The presentation was followed by a three minute delay task and then a recognition test. Both simple and complex presentation pictures were tested in identical form, or changed form in which the amount of physical detail was altered. One of the major difference between the present experiment and previous experiments (Bevan and Steger, 1971; Holyoak et al., 1972; Nelson et al., 1974; etc.) is that in the present experiment the distractor test items were not completely new items. The new test items were changed versions of old items. These test items were used to increase the difficulty of the task and force subjects to use the total remembered physical detail information to make fine discrimination among test items.

The specific signal detection measure  $d'$  was used in this study. The application of signal detection theory to recognition memory is well documented (cf. Freud, Loftus, and Atkinson, 1969; Loftus and Bell, 1975; Loftus, 1976). Loftus (1976) suggested that the theory of signal detection provides a good working framework for picture recognition, because the measure of  $d'$  reflects recognition sensitivity to discriminate the old from new changed test items, independent of response bias factors. The  $d'$  values can be generally expressed as a ratio of hit rate (i.e.,  $P(\text{"Identical"}/\text{Identical})$ ) over false alarm rate (i.e.,  $P(\text{"Identical"}/\text{Changed})$ ).

The detail facilitation hypothesis proposes that the additional physical detail in the complex pictures facilitates later picture recognition performance. Thus, higher  $d'$  values and hit rates are predicted in the complex presentation condition than in the simple presentation condition. On the other hand, the detail distraction

Simple

Complex

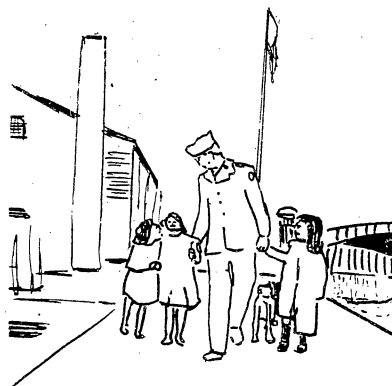
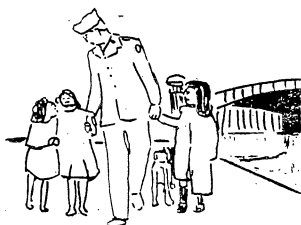
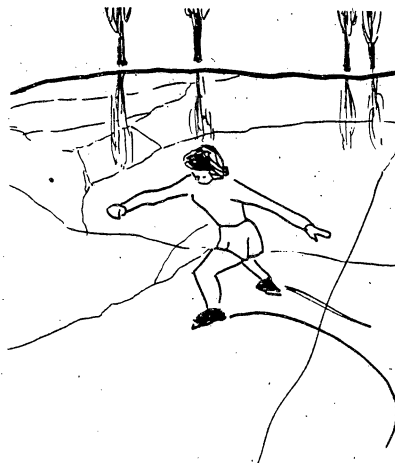


Figure 1: Examples of stimuli in either the simple presentation condition (left column) or the complex presentation condition (right column).

hypothesis proposes lower  $d'$  values and hit rates in the complex than simple presentation condition. The first experiment compares and tests these two hypotheses.



## EXPERIMENT 1

### Method

Subjects. The subjects were 20 college students, who volunteered to participate at the California State College, San Bernardino. Age and sex of subject was not specifically controlled for; subjects were tested in groups of 3 to 5, in one 20 minute session.

Materials. Forty four different pictures were used, with a simple and a complex line drawing of each, producing eighty eight total drawings. The stimulus items used in the study were selected from "the Unembellished Line Drawings", referred as "ULD", and "the Embellished Line Drawings", referred as "ELD", adopted by Nelson, Metzler, and Reed (1974). The ULD's made by Nelson et al. (1974) were based on the central meanings of a set of black and white photographs. To these ULD's, they added more detail based on the original photographs to make the ELD's. Thus the central meaning of these complex and simple pictures were the same with the only difference being the amount of physical details in each picture. For example, both simple and complex pictures show a young girl skating on the ice, but there are some trees, various shadings and lines were included in the complex picture to make it more detailed and realistic than the simple one. The selection of stimuli in the present experiment were restricted on an obvious distinction between the ULD and the ELD in each pair. The selection was made by two judges independently. Only the one selected by both

judges would be adopted.

Design. A diagrammatic representation of the experimental design is presented in Table 1. Each subject viewed both simple and complex presentation pictures, and both simple and complex test pictures. Half of the stimuli were independently and randomly assigned to the simple presentation condition, and remaining pictures were presented as complex pictures. Half of the stimuli in each of these two conditions were randomly chosen to be tested with identical test items, and the remaining pictures were tested with changed test items. Finally, all pictures were independently and randomly arranged in the presentation order. The corresponding test items were arranged by the same order as the presentation items.

Procedure. Subjects were presented a sequence of slides including forty four presentation items, followed immediately by a delay task, and then forty four test items. In the delay task subjects circled all of the odd numbers on a random number sheet. The purpose of this task was to eliminate short term memory effects on the subsequent recognition task. In the presentation phase, slides were presented by a Kodak Carousel Projector at an 8 second rate. Subjects were instructed to concentrate on studying each picture as it was presented. During the recognition test, the test items were presented in the same order as the corresponding presentation items. Thus, the number of distractors between the study and test phase were constant for each stimulus item. In the test the subjects were instructed to indicate on their answer sheets whether each picture was "identical" to one seen in the presentation phase or "changed".

Table 1

Experiment Design in Experiment 1.

	Study item	Test item	Correct response
44	S	11	Identical
		11	Changed
	C	11	Identical
		11	Changed

Note. S=Simple line drawings. C=Complex line drawings.

## Results

The pattern of results predicted by the detail facilitation and the detail distraction hypotheses are presented in Table 2. The data were analyzed on the basis of signal detection measures. The dependent variables in the signal detection analysis were  $d'$  values, the probability of a hit, (i.e.,  $P(\text{"Identical"/Identical})$ ), and the probability of a false alarm, ( $P(\text{"Identical"/Changed})$ ). The means of these values are presented in Table 3.

Three t-tests for dependent samples were applied to these data. The region of rejection for all of the following tests was  $< .05$ . The  $d'$  values were significantly higher in the simple than in the complex presentation condition,  $t(19) = 2.88$ . There was a significantly higher false alarm rate in the complex presentation condition than the simple presentation condition,  $t(19) = 3.64$ . No significant difference was found between the hit rate in the simple and complex presentation conditions.

Table 2

Predicted Outcomes of the Detail Facilitation and the Detail Distraction Hypotheses.

Dependent Variable	Predicted Outcomes	
	Facilitation Hypothesis	Distraction Hypothesis
d'	S < C	S > C*
P(hit)	S < C	S > C

Note. S=the simple presentation condition; C=the complex presentation condition. \*= the predicted outcomes were consistent with obtained data in Experiment 1.



Table 3

Mean Values for Each Signal Detection Variable as a Function of Picture Presentation Form, Experiment 1.

Presentation			
Form	$d'$	P(hit)	P(false alarm)
Simple	2.03	0.71	0.16
Complex	1.18	0.69	0.38

## Discussion

The major focus of Experiment 1 was to test the detail facilitation hypothesis and the detail distraction hypothesis. The results were that subjects had higher  $d'$  values and lower false alarm rates in the simple than in the complex presentation conditions. The  $d'$  and false alarm results suggest that subjects were more sensitive in detecting the changed test items in the simple than complex presentation condition. These data are more consistent with the detail distraction hypothesis that proposes that additional physical detail contained in the complex pictures serves as a distraction function rather than as a facilitative function. But the absence of a significant difference in hit rate data was unexpected and seems inconsistent with the distraction hypothesis.

One alternative explanation for the obtained results is the conservation of processing hypothesis of Nelson, Metzler, and Reed (1974). The basic notion of the conservation hypothesis is that a fixed amount of information from a picture is encoded and stored during a constant amount of processing time, regardless of how much detail is provided in the picture. According to this notion, the fewer physical details the picture contains, the better retained is each physical detail. The more physical detail the picture contains, the less well retained in each physical detail. Hence, if the amount of processing time is equal for two pictures, regardless of the amount of physical detail, it would be predicted that the total amount of stored information would be the same for these pictures. It would be reasonable to assume that in this experiment the subject had an equal amount of processing time for simple and complex pictures. Thus, no hit rate

difference between the simple and complex presentation conditions would be expected.

Further, the conservation hypothesis could also explain the false alarm data. A false alarm response occurred when a subject reported that a changed test item was identical to the original stimulus. A false alarm in the simple presentation was not the same as that in the complex presentation condition. A changed test item in the simple presentation condition was a complex picture, while in the complex presentation condition it was a simple picture. According to the conservation hypothesis, the fewer physical details the picture contains, the better retained is each physical detail. It would thus be easier for subjects to detect and report the addition of physical details in the simple presentation condition. On the other hand, it would be more difficult for subjects to detect changes if the test picture already contained more physical details than the corresponding presentation pictures. The conservation hypothesis would predict that in Experiment 1 the retention of physical detail would be different for simple and complex pictures. The probability for a false alarm in the subsequent picture recognition test was predicted differently in the simple and complex presentation conditions. Thus, a lower false alarm rate would be expected in the simple presentation than in the complex presentation condition. Since no hit rate difference was found in this experiment, the significantly different  $d'$  values can be explained by the significantly different false alarm rates in the simple and complex presentations, because the  $d'$  values can be generally expressed as a ratio of hit rates over false alarm rates.

The result that the subject had higher  $d'$  values in the simple presentation condition than in the complex presentation condition was inconsistent with the detail facilitation hypothesis. This hypothesis proposed that additional physical detail contained by previously presented stimuli would improve later picture recognition performance. To further test the detail distraction hypothesis versus the conservation hypothesis, a second experiment was carried out.

## EXPERIMENT 2

Experiment 2 further examined the effect of physical detail in picture recognition memory, and specifically compared the distraction hypothesis with the conservation hypothesis. The pattern of results predicted by the detail distraction hypothesis and the conservation hypothesis are predicted in Table 4. The major difference between Experiment 2 and 1 was that in Experiment 2 encoding of the pictures was manipulated by providing a one sentence verbal description (caption) for each picture. The caption describes the central meaning of the picture and each caption is presented before the corresponding picture. Thus, the captions were expected to direct attention to the central meaning of the picture rather than to the extra physical detail.

The detail distraction hypothesis predicts that additional physical detail contained in complex pictures serves a distractive function. As indicated in Table 4, this distraction detail is predicted to cause a lower  $d'$  in the complex than simple presentation condition. Hence, in the no caption condition, higher  $d'$  values were expected in the simple presentation condition than in the complex presentation condition. If presenting a caption does increase subjects' encoding of the additional physical detail in the complex pictures, the detail distraction effect should disappear. Thus, similar  $d'$  values are predicted with simple and complex pictures in the caption condition.

The conservation hypothesis predicts that the total amount of stored information from a picture is a function of the amount of



Table 4

Predicted Outcomes of the Detail Distraction Hypothesis and the Conservation Hypothesis.

Dependent Variables	<u>Predicted Outcomes</u>			
	<u>Distraction Hypothesis</u>		<u>Conservation Hypothesis</u>	
	Caption	No Caption	Caption	No Caption
d'	S = C	S > C	S > C*	S > C
Hit rates			S = C*	S = C*
False alarms			S < C*	S < C*
False Alarms			C >	C*

Note. S=the simple presentation condition; C=the complex presentation condition; \*=the predicted outcomes were consistent with obtained data in Experiment 2.

processing time for the subject to view the picture, regardless of how much detail the picture contains. The retention of each detail directly relates to how much detail the picture contains. Thus, similar hit rates are predicted in simple and complex pictures in both caption and no caption conditions, because the picture processing time is constant in the present experiment. The higher false alarm rates and lower  $d'$  values are expected with complex than simple pictures in both the caption and no caption conditions. Because the presented caption was proposed to decrease the encoding of noncentral detail in complex pictures, the subject would find it more difficult to detect a changed test picture in the complex than simple presentation condition. Thus, the conservation hypothesis specifically predicts in the complex presentation condition the false alarm rates would be higher in the caption than in the no caption condition.

## Method

Subjects. The subjects were 40 college students who volunteered from classes at the California State College, San Bernardino. Sex and age of subjects was not specifically controlled for; subjects were tested in groups of 3 to 5, in one 30 minute session. No subject participated in both Experiment 1 and 2.

Materials. The 44 pairs of pictures from Experiment 1 provided the basis for the material used in this experiment. There were 44 different one sentence verbal descriptions for each pair of pictures; these verbal descriptions are referred to as "captions" in this study. These captions were also from "the Verbal Descriptions", adopted by Nelson et al. (1974). The sentences were generated by having subjects examine the set of black and white photographs from which the line drawings in Experiment 1 were derived, and having them generate a one sentence verbal description for each photograph.

Design. The basic design in this experiment was the same as Experiment 1, with the addition of verbal caption as a between subjects variable. Each subject in the caption group saw a one sentence verbal description of the picture before the picture was presented. In the no caption group, the caption slides were replaced by blank slides was kept constant with the background brightness of the caption slides.

Procedure. The experiment consisted of a study phase followed immediately by a 3-minute searching delay task and then a test phase. In the study phase, slides were presented by a Kodak Carousel Projector

at a 5 second rate. The presentation sequence consisted of 88 slides -- 44 pictures each preceded by a verbal caption slide or a blank slide. Subjects were instructed to concentrate on studying each picture as it was presented. The subjects in the caption group were further instructed to keep each caption in mind while they studied the following related pictures. In the test, slides were exposed at a 8 second rate. During this time subjects responded on their answer sheets as to whether each picture was "identical" or "changed".

## Results

The average  $d'$  values and the probability of a hit and probability of a false alarm data are presented in Table 5. A 2 X 2 (caption condition X presentation form) analysis of variance was conducted on each of these measures. The rejection region for all comparison was  $p < .05$ .

The  $d'$  values were significantly higher in the simple presentation condition ( $d' = 1.65$ ) than in the complex presentation condition ( $d' = 0.87$ ),  $F(1,38) = 15.65$ ,  $MSe = 0.78$ . The main effect of caption condition was not significant. The caption condition X presentation form interaction was also significant,  $F(1,38) = 4.34$ ,  $MSe = 0.78$ . Planned comparisons were carried out for simple and complex presentation conditions for the  $d'$  values in the caption and no caption conditions. These comparisons resulted in one significant effect, with captions  $d'$  values were higher in the simple presentation condition than in the complex presentation condition,  $t(38) = 2.47$ .

No significant differences in the analysis of the hit rate data were found. The analysis of the false alarm data resulted in one significant effect. The false alarm rate in the complex presentation condition (0.44) was significantly higher than in the simple presentation condition (0.24),  $F(1,38) = 23.79$ ,  $MSe = 0.03$ .

Planned comparisons were carried out for the false alarm data in the simple and complex presentation conditions across the caption and no caption groups, and these comparisons resulted in one significant effect: the false alarm rates were higher in the caption group than in the no caption group in the complex presentation condition,  $t(38) = 2.10$ .

Table 5

Mean Values for Each Signal Detection Variable as a Function of Caption Condition and Picture Presentation Form, Experiment 2.

Caption	Picture Presentation Form					
	d'		P(hit)		P(false alarm)	
	Simple	Complex	Simple	Complex	Simple	Complex
Caption	1.95	0.76	0.77	0.74	0.26	0.53
No Caption	1.34	0.97	0.68	0.75	0.23	0.39

## Discussion

Experiment 2 tested the detail distraction hypothesis that assumes that the additional physical detail contained in a picture serves a distracting function and decreases picture recognition performance. As indicated in Table 4 this hypothesis predicts that in the no caption condition higher  $d'$  values would be obtained in the simple than complex presentation condition, and with caption, similar  $d'$  values would be obtained in the simple and complex presentation conditions.

The conservation hypothesis predicts that the amount of stored information from a picture would not be a function of the amount of detail in the picture. The amount of stored information directly relates to how much detail is provided by the picture, under a constant processing time. This hypothesis predicts, in both caption and no caption conditions, similar hit rates in simple and complex presentation pictures, and higher false alarm rates and lower  $d'$  values in the complex than simple presentation condition. It also suggests that if the caption decreases the encoding of noncentral detail in complex pictures, the false alarm rates in the complex presentation condition will be higher in the caption than no caption condition.

In the present experiment, the  $d'$  values were similar in both simple and complex presentation pictures in the no caption condition, but significantly higher in the simple than complex presentation conditions with captions. In both the caption and no caption conditions the hit rates were similar in simple and complex presented pictures, and the false alarm rates were significantly higher in the simple than complex presentation condition. The false alarm rates in the complex



presentation condition were significantly higher in the caption than no caption condition.

No support was found for the distraction hypothesis. The similar  $d'$  values in simple and complex presentation pictures in the no caption condition suggested that the additional physical detail the complex picture contained did not distract later picture recognition performance. Moreover, additional results were unexpected and seem inconsistent with the distraction hypothesis. According to this hypothesis, the higher  $d'$  values in the simple than complex presentation condition with caption might be explained by the suggestion that the presented caption failed to decrease the probability that subjects encode the extra physical detail provided by the complex pictures.

The results are more consistent with the conservation hypothesis. One result difficult to explain by the conservation hypothesis is that a significant difference was not found between the simple and complex presentation conditions in the no caption condition. However, the results obtained in this experiment suggested that the conservation of processing hypothesis was a more adequate explanation to account for the results obtained in Experiment 1 and 2. Since, this hypothesis can not completely explain the results obtained in this experiment, the present experiment might best be considered as disconfirming the detail distraction hypothesis.

## GENERAL DISCUSSION

The present experiments were designed to evaluate the function of additional physical detail in picture recognition memory. In Experiment 1, the detail facilitation hypothesis and the detail distraction hypothesis were compared. Experiment 2 evaluated the detail distraction hypothesis and the conservation of processing hypothesis.

In both Experiments 1 and 2, no support was found for the detail facilitation hypothesis (Haber, 1970; Nickerson, 1965). This hypothesis proposed that extra physical detail facilitates picture recognition performance. The detail distraction hypothesis (Holyoak et al., 1972) predicts that additional physical detail distracts picture recognition performance. This hypothesis received some support in Experiment 1. The  $d'$  values were significantly higher in the simple than complex presentation condition. However, the detail distraction hypothesis could not account for the hit rate data in both experiments nor the pattern of  $d'$  results in Experiment 2. In Experiment 2, the absence of a significant difference in the  $d'$  values between the simple and complex presentations in the no caption group was inconsistent with the detail distraction hypothesis. Moreover, there were no hit rate differences between the simple and complex presentation conditions in both Experiment 1 and 2 as predicted by the distraction hypothesis.

The results obtained in the present study were generally consistent with the conservation of processing hypothesis of Nelson, Metzler, and

Reed (1974). They suggested that in a certain amount of processing time, the subject can only encode a fixed amount of information from a picture, regardless how much detail the picture contained. In both Experiment 1 and 2, there were no hit rate differences between the simple and complex presentation conditions, and a significantly higher false alarm rate was found in the complex presentation condition. However, the conservation hypothesis can not completely explain the results obtained in the present study, specifically, the non-significant difference found between the simple and complex presentation conditions in the no caption group. Moreover, several other researchers have reported that in a constant processing time subjects did profit by the more physical detail stimuli (Bevan and Steger, 1971; Evertson and Wicker, 1974). It is difficult to explain such result with the conservation hypothesis.

The present finding that additional physical detail did not facilitate picture recognition performance is consistent with the result of several previous studies (Nelson et al., 1974; Emmerich and Ackerman, 1976). However, the results in the present study are not congruent with several other studies that showed subjects benefited from additional physical detail carried by stimulus items (Bevan and Steger, 1971; Evertson and Wicker, 1974). Both Nelson et al. (1974), and Emmerich and Ackerman (1976) used a recognition test, while Bevan and Steger (1971) and Evertson and Wicker (1974) used a recall test, in their study. Because different types of tests were used in these studies, one possible explanation for the contrary results is that detail may facilitate recall but not recognition of pictures (Emmerich and Ackerman, 1976). However the difference between a recognition and a recall

test could be explained by the generation-recognition hypothesis (Bahrick, 1970; Anderson and Bower, 1972). The generation-recognition hypothesis proposed that retrieval includes two processes, a search (or generation) process and a recognition (or differentiation) process. In the generation process subjects search in their memory possible responses, then they differentiate these alternatives and make their decision in the recognition process. In a recognition test situation the experimenter provides the items to be recognized, saving the subject the generation process, while those alternatives to be recognized are self-generated and self-provided by subjects in a recall test. It is possible that subjects profit by the additional physical detail to generate more adequate responses in the generation process. Thus, in a recognition test situation subjects fail to take the advantage of the additional physical detail due to the generation process is saved.

As mentioned, the results obtained in both Experiment 1 and 2 were similar. There were no hit rate differences between the simple and complex presentation conditions, and the significantly higher false alarm rates was found in the complex presentation condition. The hit rate data suggested that the additional physical detail does not affect the picture recognition performance but the false alarm data suggests that the extra physical detail distracted the retention of information in pictures. One factor that might explain this inconsistency is that the false alarm data was confounded by the task variable. The false alarms are based on subjects' responses to changed items. The subjects' task was to detect and report the "addition" or "absence" of extra physical detail. In the present study the subject's cue to make a reject

decision is based on the additional physical detail rather than the central information in each picture. In the simple presentation condition this cue, the additional physical detail, was carried by the test item, and by the study item in the complex presentation condition. Hence, it would be easier for the subject in the simple presentation condition to detect a changed test item because (a) the extra physical detail is totally new information which would not interfere with the old stored information, and (b) the extra detail in the test item would not affect retrieval processes. On the other hand, it would be more difficult for subjects to detect changes in the complex presentation condition, because all the physical and meaning information contained in the test item would be old information, except the additional detail would be removed. The subject would have to "remember" the extra physical detail from the previous study item to make a correct rejection of a changed test item.

There are two interesting issues that were not tested in the present study but relate to the results of the present study. First, Nelson, Reed, and Walling (1976), Nelson, Reed, and McEvoy, (1977), and Rafnel and Klatzky (1978) suggested that the encoding information from a picture can be divided as the meaning information (or conceptual, semantic information) and the physical detail information (or structural, schematic, sensory, visual information). According to these assumptions, it is possible to explain the results obtained in the present study by proposing that subjects responded to identical test items based primarily on the meaning (semantic) information. This is due to the fact that there is enough meaning (semantic) information for the subject to dif-

ferentiate an item from other stimuli. Since the central meaning of the simple and complex pictures are the same, and both types of pictures are interactive and meaningful, no hit rate differences between the simple and complex presentation condition would be found. But when the test item was changed, the subject was forced to use the specific visual detail information to make decisions. The false alarm rates would consequently be different for the simple and complex presentation condition. This explanation of the obtained hit rate data is supported by Emmerich and Ackerman (1976). They reported that the physical detail had no effect on recall, but elaboration (objects drawing in an interactive phase) aided retention significantly.

The second issue related to the present study is the qualitative explanation for the pictorial superiority effect offered by Nelson, Reed, and Walling (1976), Nelson, Reed, and McEvoy (1977), and Nelson (1979). Generally, they manipulated the schematic (sensory features) and conceptual (label, meaning) similarity of stimuli terms in paired associate learning tasks, and found different effects on physical and semantic codes in memory. For example, Nelson et al., (1976) reported that when the conceptual similarity is varied, effects are similar for pictures and their verbal labels, suggesting that the meaning representation are the same for these stimuli. However, manipulating the schematic similarity of pictures either eliminates or reverses the typical pictorial superiority effect. This suggests that the visual code is primarily responsible for the pictorial superiority effect. They concluded that there is a qualitative difference between pictures and words in the effectiveness of their reintegrated visual codes.

The sensory code for a picture is apparently more differentiating and less susceptible to interference from successively occurring items. Applying this explanation to the present study, it is possible that the sensory codes for the simple and complex pictures are qualitatively similar. Thus, the additional physical detail did not facilitate picture recognition performance.

In summary, the results of the present study suggest that the quantity of physical detail is not a responsible factor for the subjects' retention of the picture. Thus, the present study disconfirms the notion that the quantity of physical detail hypothesis is an adequate explanation for the pictorial superiority effect. A systematic study of the nature of physical detail and the quality of different modes of pictorial stimuli could well provide some useful information for understanding the human picture memory capacity.



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