Verbal and pictorial similarity in recognition of pictures*

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This experiment explored the role of pictorial and verbal coding in memory for pictures. Ss viewed slides for either 3 or 10 sec each. One hour after viewing they were given a two-alternative forced-choice recognition test. Test pairs had been previously rated on separate scales for visual similarity and for the ease with which the difference between them could be verbally described. Verbal descriptibility predicted recognition best after both 3- and 10-sec viewing times. At the 10-sec presentation rate, recognition accuracy was unrelated to rated visual similarity, but at the 3-sec rate, errors increased slightly as visual similarity increased. Memory for pictures is mediated at least in part by verbal coding, but memory storage itself is probably not exclusively verbal. Visual features of pictures remembered by Ss may be selected on the basis of verbal descriptions of the pictures.

Our capacity for remembering complex, meaningful, pictorial stimuli has been shown to be very great (Haber, 1970; Nickerson, 1965; Shepard, 1967; Standing, Conezio, & Haber, 1970). Shepard presented Ss with 612 color pictures and tested them using a two-alternative forced-choice paradigm with 68 pictures from the presentation series paired with 68 new pictures. Correct recognition for pictures was 96.7%, while it was only 88.4% for words and 39% for sentences in identical recognition tasks using visually presented words and sentences as stimuli. Nickerson found correct recognition to be 95% on a yes-no test for Ss who had initially seen 200 pictures.

Haber and Standing (see Haber, 1970, and Standing et al., 1970) extended Shepard's study by presenting Ss with a presentation series of 2,560 slides viewed for 10 sec each. On a forced-choice recognition test of 280 pairs, Ss correctly identified 85%-95%. Haber (1970) concluded

from the impressive demonstration of Ss' capacity for pictorial recognition that memory for pictures is essentially perfect and that there are separate memory processes for storing verbal and pictorial material. He suggested that images of pictures are received and stored in pictorial form without use of words, labels, or names. Presumably, Haber came to this conclusion because recognition of words and sentences is worse than that for pictures (cf. Shepard, 1967) and verbal coding thus could not underlie pictorial recognition.

Some researchers have suggested that perceptual memory is mediated by verbal coding (e.g., Glanzer & Clark, 1964). Impressive as pictorial recognition is, verbal coding has not been eliminated as a possible mechanism for storing pictorial information. If Ss verbally coded and retained a single, most salient feature of each picture presented for viewing, recognition scores could be good if distractors in the test series were not similar to the pictures previously viewed. Shepard, in fact, chose his pictures on the basis of salient features that would be memorable and not similar or confusable. Haber's randomly compiled test series is probably comparable in most cases to Shepard's in dissimilarity of distractors and target pictures.

It is possible to assess the relative importance of verbal coding and pictorial storage in memory for pictures. If memory for pictures is based on pictorial storage, visual similarity between targets and distractors in recognition tests should reduce recognition accuracy. If memory for pictures is mediated by verbal coding, recognition should

decline as the verbal code assigned to the target becomes less efficient at distinguishing it from distractors. Dallett, Wilcox, and D'Andrea (1968) manipulated both of these variables simultaneously by using a test series in which distractors and targets could be described with the same code and were also visually similar. They found recognition to be 60%-70%, even though only 40 pictures were in the learned set. Because they used a yes-no paradigm, it is difficult to compare their results with Haber's or Shepard's, but the poor recognition they found is probably the result of one or both of the similarity variables they used.

The present experiment attempts to separate visual similarity and verbal descriptibility to determine which factor is more significant in recognition memory for pictures. The strategy of the experiment was to generate test pairs for two-alternative forced-choice recognition that provided an orthogonal combination of visual similarity and verbal codability. The pairs used for recognition testing were selected from a large set of pairs previously rated on these two variables by a different group of Ss from the one which performed in the memory experiment. Presentation time during learning was also varied to assess differential effects of time on the two variables in recognition.

METHOD

Materials

A collection of 1,676 color and black-and-white photographic slides from a variety of sources was assembled. Subject matter covered a wide range including landscapes, family scenes, crowd scenes, buildings, sculptures, paintings, single objects, and histology slides (tissues and cells). From these slides, 650 pairs were selected and presented to five Pomona College students who rated each pair on two separate scales: (1) verbal descriptibility ("How easy would it be to describe the difference between these two slides?") and (2) visual similarity ("How similar do these two slides look?"). Raters saw slide pairs for 10 sec and were given as much time as they needed between presentations to complete their ratings. Ratings on both scales were from 1 to 7, where 1 was easiest to describe on the descriptibility scale and most similar on the similarity scale. Two hundred and nineteen of the 650 pairs were sorted into a 3 by 3 matrix according to ratings on the two scales (see Table 1 for examples). The most desirable category was limited to slides with an average rating of 1.0-2.2; the intermediate category contained slides rated from 3.2-4.8; and the hardest to

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Table 1
Stimulus Categories, Descriptions of Sample Stimulus Pairs Falling into Each Cross-Classification, Number of Pairs in Each Cross-Classification, and Mean Percent of Correct Recognition for the 3-Sec Group and 10-Sec Group

Verbal Category	Visual Category			
	Visually Dissimilar	Intermediate	Visually Similar	
Easy to Describe Verbally	An office building in one picture and a camping scene in the other. (36 Pairs)	Two pictures of living room scenes with different families in each picture. (30 Pairs)	A picture of a farm scene and an identical picture with a twig across one corner. (29 Pairs)	
10 Sec	90.74	90.55	93.10	91.46
3 Sec	93.75	81.67	83.62	86.35
Intermediate	Two pictures of a street in a city—completely different streets and buildings in each picture. (31 Pairs)	Two pictures of children playing in a park. (30 Pairs)	A picture of a water-skier with boats in the background and a picture of the same water-skier with the shore in the background. (30 Pairs)	
10 Sec	82.26	75.00	74.44	77.23
3 Sec	81.45	82.50	66.67	76.87
Difficult to Describe Verbally	Two cross-sections of different tissues with different strains at different enlargements. (14 Pairs)	Two different close-up pictures of different flowers. (9 Pairs)	Two pictures of the same leaves on a sidewalk with the leaves scattered differently in the two pictures. (10 Pairs)	
10 Sec	47.62	55.55	58.33	53.83
3 Sec	64.42	55.56	50.00	56.66
10 Sec	73.54	73.70	75.29	
3 Sec	79.87	73.24	66.76	

describe category contained slides rated 6.0-7.0. The three categories of visual similarity were based on the same numerical boundaries. The categories were made noncontiguous to assure that the classes would be distinct.

A series of 960 slides was constructed for presentation to Ss in the learning experiment. One slide from each of the 219 test pairs was included in the presentation series, mixed with 741 other slides randomly selected from the pool of unused and rejected pairs of slides.

Procedure

Each S in the 10-sec group viewed the presentation series of 960 slides for 10 sec each and those in the 3-sec group viewed them for 3 sec, with about 1 sec between slides for both groups. The Ss were informed that later they would be asked to recognize the slides they saw. Total presentation time was approximately 3 h for the 10-sec group and 1.25 h for the 3-sec group. A 15-min break divided the experiment into two 90-min sessions for the 10-sec group. The 3-sec group had no break. Target slides (those to be presented in the test later) were not among the first or the last 40 pictures shown in any experimental session. At the end of the presentation series, Ss were given a 1-h break. The Ss then viewed each test pair and marked left or right on an answer sheet to indicate

which slide they had seen before. The correct item was shown randomly on the left or right. Each S was given as much time as desired to answer.

Subjects

The Ss were 10 students from the Claremont College who were paid for participating. There were 6 Ss in the 10-sec group and 4 in the 3-sec group.

RESULTS

Table 1 shows mean percent correct in each category at each presentation time. A split plot analysis of variance (Kirk, 1968) was performed on the arcsine transformation of the proportions of errors. Errors increased as verbal descriptibility became more difficult, $F(2,16) = 123.00$, $p < .001$, but there was no significant difference in performance across levels of visual similarity. Time alone was not a significant factor in recognition, $F(1,8) = .02$. The Presentation Time by Verbal Describability interaction fell short of significance with an $F(2,16)$ of 1.66. Verbal descriptibility was thus nearly as important at the 3-sec presentation rate as it was at the 10-sec rate. The interaction of Visual Similarity by Presentation Time was significant, $F(2,16) = 7.46$, $p < .01$. This significant interaction results from the fact that, at the 10-sec rate, visual similarity had no effect [$F(1,16) = .19$], but at the 3-sec rate of presentation, errors increased as visual

similarity increased, with an $F(1,16) = 10.1$, $p < .01$. The individual Ss' overall percent correct recognition ranged from 71.7% to 86.7% in the 10-sec group and from 72.6% to 92.8% in the 3-sec group.

DISCUSSION

As the rated difficulty of describing the difference between a pair of slides increases, recognition decreases. This finding holds for both presentation rates. The role of visual similarity in recognition is less straightforward. There is no evidence for visual confusion at the 10-sec presentation rate, but there is at the 3-sec rate. By the logic behind this study, the obvious interpretation of this result is that verbal coding operated at both presentation rates but that some purely visual coding of the pictures was used at the 3-sec rate. It seems reasonable to suppose, as Tversky (1969) has suggested, that memory for pictures utilizes both a pictorial and a verbal code. Verbal coding could be sufficiently more detailed than pictorial coding so that, given adequate time for the construction of verbal codes, the verbal mechanism overrides any pictorial coding that occurs. But, when time is at a premium or verbal coding is otherwise disrupted, reliance is placed on the quicker pictorial code. Since verbal descriptibility is still a significant factor at the shorter time, a complete switch seems unlikely.

The visual similarity effect at the 3-sec rate might, however, be explained in terms of verbal coding alone. If verbal coding proceeds from generalities to details or from more to less visually salient features while the S is viewing a picture, reducing viewing time would produce less detailed verbal codes. Thus, at the 3-sec rate the gross differences between visually dissimilar slides would be better encoded than finer, but often more verbally useful, differences.

A difference between the groups that is difficult to control is the overall elapsed time between viewing and testing. The elapsed time between the first presentation and first test was approximately 2 h longer for the 10-sec group than for the 3-sec group. To determine the effects of elapsed time, errors on slides presented in the first half of the series were compared with errors on slides in the last half of the series. In both the 3-sec and 10-sec groups, no significant differences were found.

Does the rating and classification system used in this experiment separate visual and verbal discriminability? The instructions given the raters were designed, of course, to separate the visual and

verbal factors, but it remains to be shown that the raters did follow the instructions. Whatever the raters did, however, they seemed to agree with each other fairly well. (Unfortunately, interrater reliabilities were not computed. The best that can be said is that those who tabulated the data felt that agreement was good.) The raters also found the ratings easy to make it seems, because they did it rapidly and with a minimum of complaints. Furthermore, the face validity of their ratings is good. The sample slide pairs described in Table 1 are meant to illustrate the face validity of the rating categories. Finally, the pattern of results of the experiment indicates that the two rating scales measure different things, whatever these things are. If the visual and verbal classifications are confounded, they should have shown similar effects but, at least at the 10-sec rate, their results were quite different.

The experiment, because it used histology slides, samples a range of pictures more diverse and unusual than was used in previous investigations of pictorial memory. It might be argued, therefore, that the results are forced by the unfamiliar pictures or are not applicable to situations where more ordinary pictures are recognized. The results, however, would be little altered if the histology slides were

removed from consideration. Although most of them were in the three difficult-to-describe cells, they appeared in all nine cells of the cross-classification. Mean errors for pairs of histology slides were in no case significantly different from the mean errors for the cells in which they fell. In fact, in seven of the nine cells, there were proportionally fewer errors on histology slides than for the cell as a whole.

The rated differential verbal descriptibility of slide pairs predicts memory-based discrimination best at both presentation rates, but it is not necessary to conclude from this that memory for pictures relies on a stored verbal code. The raters may have used the verbal scale to rate the discriminability given by the most describable features of the pictures. These would be visual features, but they would be selected on the basis of the ease of identifying and naming them. Storage, then, might be of visual features, but visual features selected on the basis of the requirements of verbal description. It seems highly unlikely that there is no capacity at all for purely visual memory. The capacity for remembering what is seen must exist for preverbal children and nonverbal animals. It is improbable that man loses this capacity with the development of language, but verbal

coding or verbally based strategies in selecting what is to be stored may make it more efficient.

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