Random shape recognition at brief exposure durations[1]

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Two groups of Ss were tested in a forced-choice recognition test for memory of 20 random shapes having two levels of complexity and two levels of association value (A). One group viewed each shape for 0.25 sec, and the other group viewed each shape for 0.50 sec. Shapes of high A were recognized more accurately (p < .01) than shapes of low A while the effects of complexity and exposure duration were statistically insignificant. Consideration of the characteristics of the distractor shapes paired with the observed shapes during the forced-choice recognition test suggested that they may also have influenced recognition accuracy. If simple and complex distractor shapes are not equated for amounts of stimulus confusion introduced into the recognition test, that test may be biased against simple shapes.

In an earlier study (Clark, 1965), groups of Ss observed 10 simple or 10 complex random shapes of high or low association value (A) and later attempted to recognize them in a forced-choice recognition test. In that experiment and the present one, complexity is defined as the number of points plotted in constructing the shape which determines inflections on the perimeter of the shape (Attneave, 1957), and A is defined as the percentage of 50 Ss making "yes" (I can make an association) or content responses to a shape during a 3 sec presentation (Vanderplas & Garvin, 1959a). Shapes were presented at 0.5 sec during both the observation and the recognition tasks. Results were that shapes of high A were recognized more accurately than shapes of low A, and simple (4- and 6-point) and complex (16- and 24-point) shapes were recognized equally well.

Unpublished research from this laboratory has corroborated these results and has also extended their generalizability. In one study, memory load was increased by having Ss remember 10 simple *and* 10 complex shapes of high and low A instead of 10 simple *or* 10 complex shapes of high or low A as in the 1965 study. Exposure duration was 0.5 sec. Results corresponded to the 1965 findings: shapes of high A were recognized more accurately than shapes of low A, and simple and complex shapes were recognized equally well.

In the present study, the effects of a shorter exposure duration were investigated. Again, a forced-choice recognition test was employed. Two independent groups were tested on the same shapes mentioned in the previous paragraph. One group viewed each shape for 0.25 sec (during both the observation and the recognition tasks), and the other group viewed each shape for 0.50 sec. It was expected that at the shorter exposure duration simple shapes would be recognized more accurately than complex shapes. This expectation was based on the assumption that complex shapes require more information processing time than simple shapes (Garner, 1962), and should, therefore, at some brief exposure duration, be recognized less accurately than simple shapes.

No predictions were made regarding the effects of reduced exposure duration on recognition accuracy as a function of A. The question asked was whether the previously obtained positive relationship between recognition and A would still be obtained at the shorter exposure duration.

Method

Subjects and experimental design. A partially hierarchal analysis of variance design was employed. Two independent groups of 15 males and 8 females each were tested on two different levels of shape complexity and two levels of shape association value. One group was tested at an exposure duration of 0.25 sec (Group 0.25), and the other group was tested at 0.50 sec (Group 0.50). All 46 Ss were paid, volunteer college students.

The experiment was conducted in two parts. In the first part (observation training), each group viewed 20 black on white two-dimensional shapes, one at a time. In the second part (recognition test), they attempted to identify those 20 shapes in a forced-choice (FC) recognition test in which the 20 observed shapes were paired with 20 distractor shapes. Each observed shape was paired with a distractor shape of the opposite complexity level.

Stimulus shapes and apparatus. Forty randomly constructed shapes mounted on 2 x 2 slides were the stimuli. They had 4- or 6-points (simple shapes) or 16- or 24-points (complex shapes), and were selected from a group of 180 uncurved shapes constructed by Vanderplas & Garvin (1959a). The shapes are shown in Fig. 1.

The observed shapes, shown during observation training, appear on the top half of Fig. 1. The distractor shapes that were paired with the observed shapes during the FC recognition test are shown on the bottom half of the figure. The letters CH, CL, SH, SL stand for complex high, complex low, simple high, and simple low, respectively, and denote the complexity level (simple or complex) and associative level (high or low) of the five shapes directly to the right of the letters. The first number to the right of each row of five shapes is the mean (M) Vanderplas and Garvin association value for these five shapes, and the second number is the standard deviation (SD). The two numbers under each shape denote, respectively, the number of points used in constructing that shape and its Vanderplas and Garvin identification number. Note that an attempt was made to match the means of simple and complex shapes of high and low A, respectively.

Figure 1 is arranged so that each distractor shape is in a row and column corresponding to the row and column placement of the previously observed shape with which it was paired during the FC recognition test. For example, observed shape CH 16-4 was paired with distractor shape SH 6-10, and observed shape SH 4-17 was paired with distractor shape CH 16-2.

Each group was tested in a classroom in an area approximately 16 ft wide x 23 ft long. The center of that area was 17.5 ft in front of a 5.5 ft wide x 4.25 ft high silver projection screen. The ceiling of the room was 9 ft high. All shapes were projected onto the silver screen by a Kodak Carousel projector with the

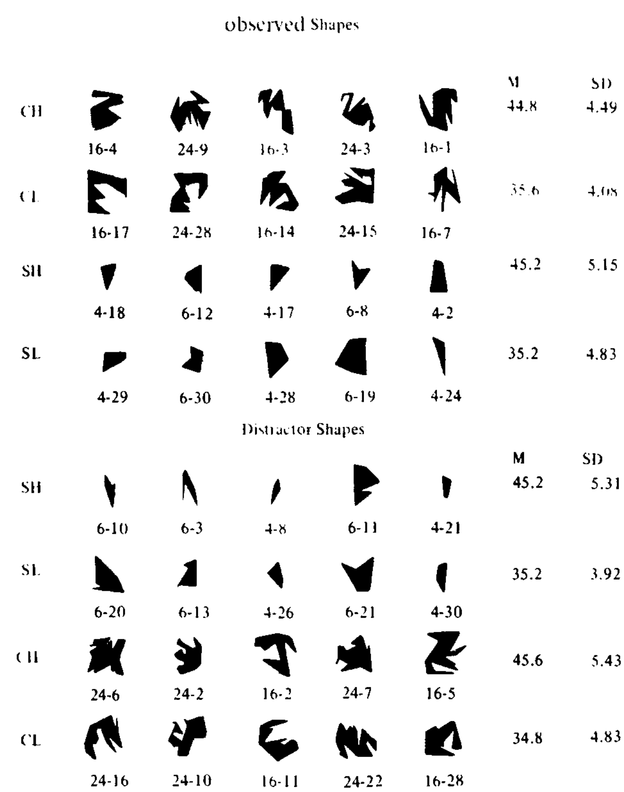

Fig. 1. The test stimuli.

Table 1

Mean Scores and Standard Deviations for Groups 0.25 and 0.50

	0.25		0.50	
	M	SD	M	SD
CH	3.83	.962	3.57	1.173
CL	3.09	.928	2.83	1.203
SH	3.96	.908	4.09	.823
SL	3.17	1.239	3.48	1.245

illumination selector set at the 300 W (low) position). Each shape could be contained within a circle having a 25 in. diameter. Stimulus presentation times and intertrial intervals were controlled by three timers. Ss reported seeing no after-images.

Observation training. The 20 observed shapes consisted of five complex high (CH), five complex low (CL), five simple high (SH), and five simple low (SL) shapes. They were presented one at a time in order, CH, SL, CL, SH, etc., throughout the series of 20 shapes. Each shape was presented for 0.25 or 0.50 (±.01) sec with a 6.8 sec dark slide interval between shapes. Ss were instructed to view the shapes with the intent of recognizing them later. A brief practice session preceded observation training, during which Ss were acquainted with the observation and recognition tasks. Similar Vanderplas and Garvin shapes were shown during practice.

Recognition test. Three min after observation training, Ss were given a FC recognition test. On each of 20 trials, they saw two shapes, one at a time, each for 0.25 or 0.50 (±.01) sec, with a 0.80 (±.05) sec interval between members of a pair. One was an observed shape and the other was a distractor shape of the opposite complexity level. The Ss' task was to write the number "1" or "2" designating whether the first or second shape presented was a previously observed shape. This was done during a 6.8 sec interval between pairs. On half the 20 trials (randomly determined) the first shape presented was an observed shape; on the other half, it was a distractor shape. The order of recurrence of the 20 observed shapes was the same as their order of presentation during observation training.

Results

The maximum possible recognition score for each S was 20 since he was tested on 5 CH, 5 CL, 5 SH, and 5 SL shapes. A response was judged correct and scored "1" if the previously observed shape was correctly identified. The total number of correct responses per S per level was counted and the sums used as scores in a 46 by 2 by 2 by 2 partially hierarchal analysis of variance. The average number correct (M) for the 23 Ss in Group 0.25 was 14.04 with a standard deviation (SD) of 2.42. Scores ranged from 10 through 19. The M for Group 0.50 was 13.96 with a SD of 2.44 and a range of 10 through 18.

Table 1 shows the mean recognition scores for each group for the four classes of stimuli: CH, CL, SH, and SL. Shapes of high A were recognized more accurately than shapes of low A ($F = 29.56$, $df = 1/44$, $p < .01$). No other effects were statistically significant. The strength of association between recognition accuracy and A was estimated as described by Hays (1963, p. 407). Sixty-one percent of the variance in recognition accuracy can be attributed to A.

Discussion

Results correspond to those obtained by the author in 1965 in that shapes of high A were recognized more accurately than shapes of low A. Ellis, Muller, & Tosti (1966) have also established that A has an incremental effect on shape recognition. They add that perceptual performance depends upon the meaningfulness of the stimuli only to the degree that such stimuli readily elicit a single association, and that additional associations do not contribute to further gain in perceptual performance. Ellis & Homan (1967) have found that experimenter-supplied verbal labels also enhance recognition performance. Whether in the present study differential verbal-labeling actually accounts for the obtained differences as a function of associative category can only be surmised. Although all but six of the 46 Ss reported verbal coding of some sort, it could not be established that shape of high A were coded more frequently than shapes of low A.

In other studies of random shape recognition, simple shapes have been recognized more accurately than complex shapes (Ellis & Muller, 1964; Ellis, Muller, & Tosti, 1966; White, 1957; Vanderplas & Garvin, 1959b). In those studies, presentation time for observed shapes ranged from 1/50 sec to 4 sec, and Ss viewed a single prototype shape and then a group of 4 or 5 shapes, one of which was the prototype. Then they attempted to identify the prototype among the alternatives. These alternatives (distractor shapes) were variations of the prototype and were constructed so that simple and complex distractor shapes presumably introduced equivalent amounts of stimulus confusion (between learned and distractor shapes) into the recognition test. For example, Vanderplas & Garvin (1959b) constructed their distractor shapes ". . .by first duplicating the prototype; then each point was moved up, down, right, or left at random through a constant distance, and the points connected as in the construction of the prototype [p. 57]." Ellis et al used the same procedure, and White's was similar.

No attempt was made in the present study or in the author's 1965 study to equate the amounts of simple and complex shape stimulus confusion introduced into the recognition test. As a consequence, these tests may have been biased. That is, if confusion between learned simple shapes and simple distractor shapes was not equal to the confusion between learned complex shapes and complex distractor shapes, the tests were biased. Evidence that the tests may have been biased has been obtained in this laboratory. Ss judged pairs of simple shapes to have more intragroup similarity (confusability) than pairs of complex shapes, thus indicating that the recognition tests were biased against simple shapes. In addition, White (1957) has shown that correct identification of shapes from homogeneous sets of shapes is significantly more difficult than correct identification of shapes from heterogeneous sets of shapes. The implication for the present study is that simple shapes would probably have been recognized more accurately than complex shapes if simple and complex distractor shapes had been equated for amounts of confusion introduced into the recognition test.

Other factors that should influence recognition accuracy include memory load and stimulus exposure duration. The absence of such effects in the present study are likely a consequence of not having been able to examine a wide enough range of these variables.

The principal finding of this study and others like it is that the association value of random shapes is a determining factor of shape recognition accuracy over a wide range of experimental conditions.

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NOTE

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