The role of familiarity and orientation in immediate and delayed recognition of pictorial stimuli*

KEN F. SCAPINELLO and A. DANIEL YARMEY†
University of Guelph, Guelph, Ontario, Canada

The purpose of this study was to examine the effects of familiarity and changes in stimulus orientation on immediate and delayed recognition of human faces, canine faces, and buildings. Eighty Ss were assigned randomly to one of four experimental conditions: immediate or delayed recognition of stimuli presented and tested in the same orientation and immediate or delayed recognition of stimuli presented and tested in opposite orientations. Results indicated that familiar stimuli presented for seven successive inspection trials were significantly better recognized than were unfamiliar stimuli inspected only once. Recognition performance declined as a function of stimulus rotation and a 20-min delay in testing. This decline was significantly greater for human faces than for other stimuli, regardless of the recall interval used. It was concluded that increased familiarity improved recognition and that the disproportionate difficulty for rotated human faces was independent of familiarity.

It is well established (Köhler, 1940; Hochberg & Galper, 1967; Dallett, Wilcox, & D'Andrea, 1968) that inverted or rotated stimuli are more difficult to recognize than are the same stimuli viewed under their "normal" orientations. Investigators of this phenomenon have employed a variety of stimuli and experimental procedures. For example, Henle (1942) noted that familiar alphabetic letters were perceived more accurately than were their mirror reversals. Unfamiliar characters (Chinese script), however, were unaffected by image reversals, a fact which suggests that familiarity may be a prime factor affecting recognition performance. Yin (1969) has noted that human faces rotated through 180 deg were relatively more difficult to recognize than other stimuli under similar rotations. He concluded that the pronounced difficulty with facial recognition was contingent upon a universal factor of stimulus familiarity and an unspecified factor unique to human faces.

A number of experiments have attempted to investigate the effects of familiarity on recognition, while holding stimulus orientation constant. Studies employing verbal materials (Gorman, 1961; Olver, 1965; Shepard, 1967) have generally shown an increase in recognition errors with a corresponding increase in stimulus familiarity. These findings contradict not only intuitive thinking but also Noble's (1954) familiarity hypothesis, which proposes that increased familiarity leads to increased availability. Noble's hypothesis, however, has been supported by experiments using pictorial materials (Arnoult, 1956; Nickerson, 1968).

A number of studies, in addition to investigating familiarity, have sought to observe the effects of different recall intervals on recognition. Most of the research (Arnoult, 1956; Shepard, 1967; Nickerson, 1968) has shown little decline in recognition performance over short delay intervals (up to 5 h) but significant declines after longer intervals (from 1 to 360 days).

The present experiment was designed to test whether differences in stimulus familiarity affected immediate or delayed recognition of pictorial stimuli in either upright or rotated orientations. More specifically, the study was designed to compare recognition for human faces, canine faces, and architectural stimuli under the same orientation and familiarity conditions.

SUBJECTS

Eighty introductory psychology students (40 males and 40 females) were assigned randomly to one of four experimental conditions: upright or rotated recognition with immediate recall and upright or rotated recognition with delayed recall. Each treatment had an equal number of males and females.

MATERIALS

The materials consisted of a mixed list of three sets of stimuli: Set A consisted of 20 facial photographs of white male college students, Set B was composed of 20 facial photographs of similar canine species, and Set C contained 20 similar architectural stimuli. The human faces had no major distinguishing characteristics, such as beards or glasses. The canine faces also had a minimal number of distinguishing features, so that the arrangement of spots and shade of hair were relatively homogeneous. The canine portraits were not all of the same species, but care was taken to ensure that differences between species were not extreme. The buildings were photographic prints of early French architecture. Two independent judges rated the stimuli in each set for similarity on a 5-point bipolar scale. Only those stimuli correlating $r = .80$ or higher were used. All photographs were black and white and were fixed to 5 x 6 in. flash cards. A Hunter Klockounter was used to record latency of response times for each S.

PROCEDURE

Each S inspected 60 flash cards presented manually in an upright orientation. Each stimulus was inspected singly for 5 sec. Half of the 60 cards were presented only once (low familiarity) and half were presented for seven successive inspection trials (high familiarity). The presentation order was counterbalanced across all experimental Ss.

The test stage consisted of presenting each stimulus in either an upright or a rotated orientation, depending on the experimental condition. Thirty of the original stimuli were replaced with a new set of pictures, with the restriction that there be an equal number of human faces, canine faces, and architectural photographs. Ss had to identify within 10 sec whether the stimulus was old (previously seen) or new (never seen before). Measurement was in terms of mean error and mean latency scores. Half of the Ss ($N = 40$) were given the recognition test immediately after the inspection stage. Twenty of these Ss viewed the test stimuli in an upright orientation, and the remainder viewed the test stimuli upside down. Forty other Ss were tested in the same manner after a 20-min delay.

A postexperimental questionnaire encouraged Ss to list the stimuli that were the most difficult to learn and to give reasons for this difficulty. The questionnaire also encouraged Ss to state their particular learning strategies.

RESULTS

Mean error scores and standard deviations for all materials are given in Table 1.[1] Analysis of variance of these scores revealed significant differences as a function of familiarity ($F = 245.44$, $df = 1/76$, $p < .0001$) and orientation

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†Requests for reprints should be sent to A. D. Yarmey, Department of Psychology, University of Guelph, Ontario, Canada.

Table 1
Mean Errors for All Experimental Stimuli With Immediate and Delayed Recall

Presentation	Unfamiliar Faces M	Unfamiliar Faces SD	Familiar Faces M	Familiar Faces SD	Unfamiliar Canines M	Unfamiliar Canines SD	Familiar Canines M	Familiar Canines SD	Unfamiliar Architecture M	Unfamiliar Architecture SD	Familiar Architecture M	Familiar Architecture SD
Upright, Immediate Recognition	2.5	1.6	0.4	0.5	2.6	1.6	0.7	0.6	3.0	1.3	0.6	0.4
Rotated, Immediate Recognition	4.0	1.4	1.5	1.3	3.0	1.3	1.4	1.1	3.4	1.2	0.6	0.5
Upright, Delayed Recognition	2.4	1.2	0.5	0.5	2.2	1.1	0.7	0.9	2.8	1.3	0.5	0.6
Rotated, Delayed Recognition	3.8	1.6	2.1	0.9	2.8	1.3	2.0	1.0	3.6	1.8	1.6	1.1

($F = 48.41$, $df = 1/76$, $p < .0001$). Differences in materials ($F = 2.42$, $df = 2/152$, $p > .05$) and recall interval ($F = 1.44$, $df = 1/76$, $p > .05$) produced no significant effects. However, the lack of significance for the recall interval was due to the fact that, while familiar stimuli were significantly affected by delay ($F = 7.33$, $df = 1/456$, $p < .01$), unfamiliar stimuli were not ($F < 1.00$). Analyses also showed a significant Familiarity by Materials ($F = 10.49$, $df = 2/152$, $p < .001$) interaction and a significant Orientation by Materials ($F = 8.47$, $df = 2/152$, $p < .001$) interaction.

All materials were more difficult to recognize after rotation. However, the degree of difficulty varied with the materials. Planned comparisons showed the effects of rotation to be statistically greatest for both familiar ($F = 9.24$, $df = 1/456$, $p < .0005$) and unfamiliar ($F = 18.34$, $df = 1/456$, $p < .0001$) human faces and least for architecture, familiar ($F < 1.00$) and unfamiliar ($F < 1.00$). Similarly, canine faces were not significant for either familiar ($F = 3.23$, $df = 1/456$, $p > .05$) or unfamiliar ($F = 1.22$, $df = 1/456$, $p > .05$) conditions. Statistical comparisons for the delayed-recall condition produced similar results, such that the variance was greatest for rotated human faces as compared to architectural or canine counterparts.

Questionnaire reports revealed that Ss used a variety of learning strategies, the most popular (69%) being a "redintegrative cueing strategy" (see Horowitz & Prytulak, 1969), in which part of the stimulus was used to cue recognition of the whole stimulus. Reports also indicated that Ss considered the architecture the most difficult of all stimuli to learn, followed by human faces and then canines. However, as indicated above, the reports of subjective difficulty were not supported by the analysis of mean error scores.

DISCUSSION

The results indicate that different degrees of familiarity failed to change the unique effect that rotation has on recognition of human faces. These findings support Yin's (1969) thesis that the disproportionate difficulty in recognizing human faces is contingent upon a face-specific factor. The fact that this effect was not replicated with canine faces would seem to give added support to the specificity of this factor. However, the failure to control for differences among canine species, in contrast to using a homogeneous white adult sample of Ss, might have reduced the probability of replicating Yin's finding. Therefore, the specificity of this factor is still open to research.

One may speculate as to what this human face-specific factor might be. It has been shown (Tversky & Krantz, 1969) that the distribution of structural elements or cues in a human face affects the recognition of that face. It is possible, then, that the cues in a human face undergo greater distortion with rotation than do other stimuli, thus producing disproportionate effects. Results of the postexperimental questionnaire revealed that many Ss did, in fact, use a redintegrative cueing strategy. However, this explanation is not totally adequate, since canine faces appeared just as distorted after rotation as did human faces, yet their recognition was not as impaired. Additional research into structural and cognitive aspects of stimuli is obviously required to refine the above explanation.

The significant decline in recognition performance for familiar stimuli after a 20-min delay contradicts much of the previous research. However, the fact that familiarity improved recognition supports previous results from pictorial studies (Arnoult, 1956; Nickerson, 1968), as well as Noble's (1954) familiarity hypothesis, as opposed to the evidence from verbal studies (Gorman, 1961; Olver, 1965; Shepard, 1967). Noble's familiarity hypothesis may have to be modified to make a distinction between verbal and pictorial encoding strategies (see Paivio, 1969). Paivio suggests that encoding strategies may vary as a function of specific stimulus attributes. For example, verbal materials may be encoded in terms of word labels (verbal system) and in terms of images associated with the encoded word (imaginal system). If the word is concrete (e.g., car) and, thus, associated with tangible objects, then an imaginal processing system is favored. The reverse is true for abstract words (e.g., truth). Pictorial materials, such as those used in the present study, would be encoded primarily as images and secondarily as verbal codes. It is conceivable that verbal stimuli are subject to more intralist interference than are pictorial stimuli. As a result of such interference, recognition performance for words might be expected to decline with increased familiarity. Pictorial stimuli might be subject to less interference, since they are coded primarily as imaginal mnemonic devices. It is possible that these stimuli and their respective images become more distinctive with increased familiarity and, hence, recognition performance might be expected to improve.

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NOTE

1. Latency scores are not reported since they failed to offer any additional information. In addition, sex was not treated as a variable.

Part-whole transfer of a categorizable word list*

ROBERT L. HUDSON and JERRY L. DAVIS
Mississippi State University, State College, Miss. 39762

The Ss learned a part list where the words could be placed into one of four Underwood & Richardson (1956) categories and were then transferred to the whole list containing all the words of the part list plus additional words from each category. One group was told prior to part list learning that the words could be categorized, and another group was never given this information. An additional control group was included to assess the effects of information, per se. The results of whole-list learning, which were in the predicted direction but generally nonsignificant, showed a slight superiority for the group receiving information over the group not receiving information.

Tulving (1966) demonstrated that prior training on a part of a list of unrelated words resulted in negative transfer in learning of the whole list. The explanation offered by Tulving (1966) was that in the course of learning the part list, S forms subjective units which are inappropriate for organizing the whole list but which the S, nevertheless, carries over in his attempt to learn the whole list. Thus the persistence of old subjective units retards the discovery of new subjective units which would be optimal for organizing the whole list.

Bower & Lesgold (1969) reasoned that if the S could be forced into a part-list organization which would be compatible with the whole-list organization then positive transfer of number of words recalled should result. Their data indicated this to be true.

Hudson (1968, 1969) studied the effect on organization in recall (clustering) of giving Ss the category names of a list of words taken from the Underwood & Richardson (1956) norms prior to random presentation of words from four categories. The data indicated that those Ss who had been given the category names evidenced significantly more E-defined organization than did Ss who had not been given this information. There was, however, no concomitant increase in the actual number of words recalled, even though the correlations between the clustering index and the number of words recalled were relatively high within the separate groups. Thus, there seemed to be a paradox in that there is a tendency for Ss who cluster more to recall more words, yet, "artificially" increasing the tendency to organize into E-defined units did not increase the actual number of words recalled. The research literature, in general, has indicated that independent variables which affect clustering do not necessarily have an effect on the number of words recalled (see Cofer, 1967).

The present study was an attempt to demonstrate positive transfer of both clustering and number of words recalled in a part-to-whole transfer paradigm using words from the Underwood & Richardson (1956) norms. If Ss learn a part list where they have been instructed that the words can be placed into categories, then prior research (Hudson, 1968, 1969) has indicated that the words will be organized around the category name while such E-defined organization in a no-information control is minimal. Therefore, when the whole list consists of the part list plus additional words from each category, one should expect that the part list organization would be effective for organizing the whole list. Therefore, this group should exceed a no-information control in both organization (clustering) and number of words recalled for at least the early trials of whole-list learning.

SUBJECTS

The Ss were 45 male and female introductory psychology students who served in order to fulfill a course requirement.

MATERIALS

Thirty-two words were chosen from the Underwood & Richardson (1956) norms, with eight words from each of four categories. The category names and words used were as follows: Smalll: atom, germ, village, minnow, capsule, pup, pill, snail. Round: spool, dome, knob, head, button, saucer, balloon, platter. White: milk, bandage, snow, ivory, napkin, linen, rice, bread. Smelly: ammonia, skunk, ether, sewer, garlic, gasoline, pine, cigar.

Two part lists were developed, using half the words from each category. For a given category, the eight words were ranked in terms of response dominance. The odd-numbered ranks comprised one subset while the even-numbered ranks comprised a second subset. One part list was developed by choosing one subset at random from each category and the second part list was composed of the remaining four subsets. The mean response dominance for the words of the two part lists were 60.9 and 60.6 with standard deviations of 15.5 and 15.2, respectively.

For both the two part lists and the whole list, the order of the words on the memory drum tape was determined at random. There were four random orders of each part list and eight random orders of the whole list. Two Stowe memory drums were used to present the words. Booklets were prepared, with four pages having 16 lines and eight pages having 32 lines.

PROCEDURE

Three sets of instructions define the three levels of the independent variable. The information-before (IB) group was told prior to starting the part task that the words could be put into categories, and they were told the category names. They were given this same information again prior to learning the whole list. The no-information (NI) group was never given any indication that the words could be categorized. The third group was an information-between (IBe) group. These Ss were told nothing about the categorical nature of the words prior to learning the part list but were given the information and the category names prior to learning the whole list. This group was included to determine if any differences which might result between the IB and NI groups were the result of transfer from the part list or simply the effects of the information. Thus, it was expected that the IBe group would not perform as well on at least the early trials of whole-list learning as would the IB group. The whole-list instructions made no statement concerning the fact that the list the Ss were about to learn was, in fact, composed partly of the previously

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†Requests for reprints should be sent to Robert L. Hudson, P.O. Drawer PF, State College, Miss. 39762.