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Recognition of facial features in immediate memory

JOHN G. SEAMON, JENNIFER A. STOLZ, DOUGLAS H. BASS,
and ABBE I. CHATINOVER
Wesleyan University, Middletown, Connecticut 06457

This study sought to determine which facial features are best retained in a recognition test of immediate memory. Following a 30-sec viewing of an entire face in either a front or profile orientation, subjects were tested for feature recognition of the eyes, nose, or mouth in either the same or different orientation. Results showed (1) performance was significantly above chance in each condition, (2) feature selection was superior when study and test orientations were the same, (3) there were differences among the individual features when the study and test orientations were the same, but no differences when the orientations differed, and (4) when the study and test orientations were the same, the eyes and mouth were recognized better than the nose. These data provide converging evidence on the relative importance of the eyes and mouth for facial recognition.

The study of facial recognition has a long history in psychology. While much of the early work was concerned with the recognition of emotions (e.g., Allport, 1924; Boring & Titchener, 1923; Guilford, 1929), later work has been concerned with the cognitive processes underlying facial recognition. Studies of attentional processes and memory performance, for example, have shown that memory for faces is affected by different attentional tasks in the same manner as verbal stimuli in studies of intentional and incidental learning (e.g., Bower & Karlin, 1974; Patterson & Baddeley, 1977; Winograd, 1976).

If attention is an important determinant of performance, it is necessary to know what people attend to while looking at a face. Eye-movement recordings of subjects looking at a picture of a face (Yarbus, 1967) indicate that, while the eyes scan the entire facial area during free viewing, they focus again and again on the eyes and mouth. Similarly, in a paradigm measuring recognition of change, it was found that changes in the eyes and mouth were more likely to be noticed than a change in the nose (Davies, Ellis, & Shepherd, 1977). These data suggest that the eyes and mouth are what people attend to in a face when given free viewing, and these are the features that are best retained.

The purpose of this experiment is to attempt to provide additional converging evidence on which facial features are retained in a test of immediate memory. Following the previously cited findings, recognition of the eyes and mouth should exceed that of the nose. This experiment differs from the earlier studies by providing a direct test of feature recognition.

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A second purpose is to examine the relationship between the orientation of the study face and test features to determine whether a change in orientation between study and test will have important consequences on performance. Earlier research (Hochberg & Galper, 1967; Scapinello & Yarmey, 1970) studied facial recognition by changing the orientation of the facial stimuli on an upright-inverted dimension between study and test. Their results showed that changes in orientation reduce the probability of facial recognition. These studies, however, have varied orientation in a manner not usually found in everyday experience. Different results may be found if orientation is varied on a front vs. profile dimension. There is some evidence that pose position is less important when faces are shown in ecologically valid positions (Laughery, Alexander, & Lane, 1971), although strict comparisons between study and test positions have not been made.

METHOD

Subjects

The subjects were 120 Wesleyan University undergraduates who served as volunteers.

Materials

Study faces consisted of 10 black-and-white photographs which occupied the entirety of a 19 x 12 cm card. Head size and exposure quality were as uniform as possible. The 10 study pictures were obtained from front view and right-looking profile pictures of each of five models, three females and two males. All were comparable in terms of race (Caucasian), eye color (brown), age (18-21 years), facial expression (neutral), and lack of unusual features (e.g., scars, freckles, facial hair, etc.).

Test pictures for a particular feature (eyes, nose, or mouth) in a given orientation (front or profile) were obtained by placing the same feature from each of the five models on a separate

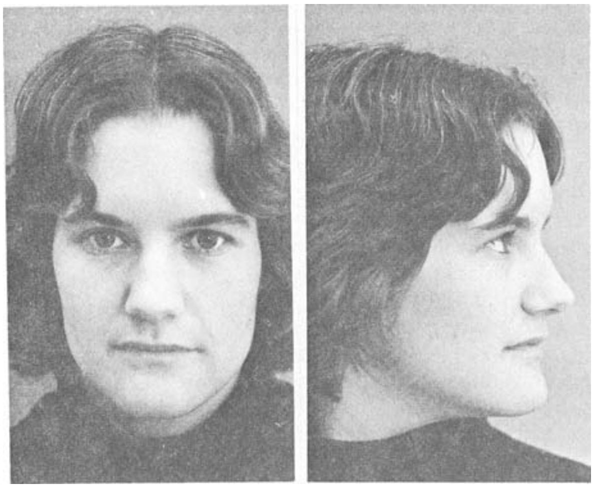

Figure 1. The two orientations of one of the five models used in the study portion of the experiment.

24 x 8 cm card. Features were randomly ordered and evenly spaced on the six different types (features by orientation) of test cards. Pattern templates were used to cut out each feature in each condition. Eyebrows and the bridge of the nose were not included in the test cards of eyes, and only the card of the front view of eyes showed both eyes for each model.

Procedure

Subjects were approached individually on the Wesleyan campus and asked to participate in a 2-min experiment on facial recognition. They were then given one of the 10 study pictures and instructed to look at the face for 30 sec. The study picture was then removed and replaced by one of the six test cards containing five features of a particular type in a given orientation. The subject's task was to select the feature from the list that was from the same person viewed in the study position. A confidence estimate (1 = guess, 2 = probable, 3 = positive) followed the feature choice.

Examples of study orientations for one of the five models and possible feature tests in each orientation are shown in Figures 1 and 2, respectively. Even though the reader is forewarned of the features to be tested, some appreciation of the difficulty of the task for uninformed subjects may be obtained by attempting to select the correct feature in each instance.

The experiment used a 2 by 3 by 2 factorial with one observation per subject. The factors included (1) the two study orientations (front or profile), (2) the three test features (eyes, nose, or mouth), and (3) the two test orientations (front or profile). Each of the 12 conditions had 10 subjects, or 120 subjects total. Within each condition, each of the 10 study pictures (5 models by 2 orientations) was used one time.

RESULTS

The performance of the subjects over the five different models varied little. The mean percent correct feature selection for each of the five models was 51.47%, with a standard error of 3.77%. Since recognition performance was comparable across all models, this factor was not considered further. All subsequent analyses were based on conditions employing each model an equal number of times.

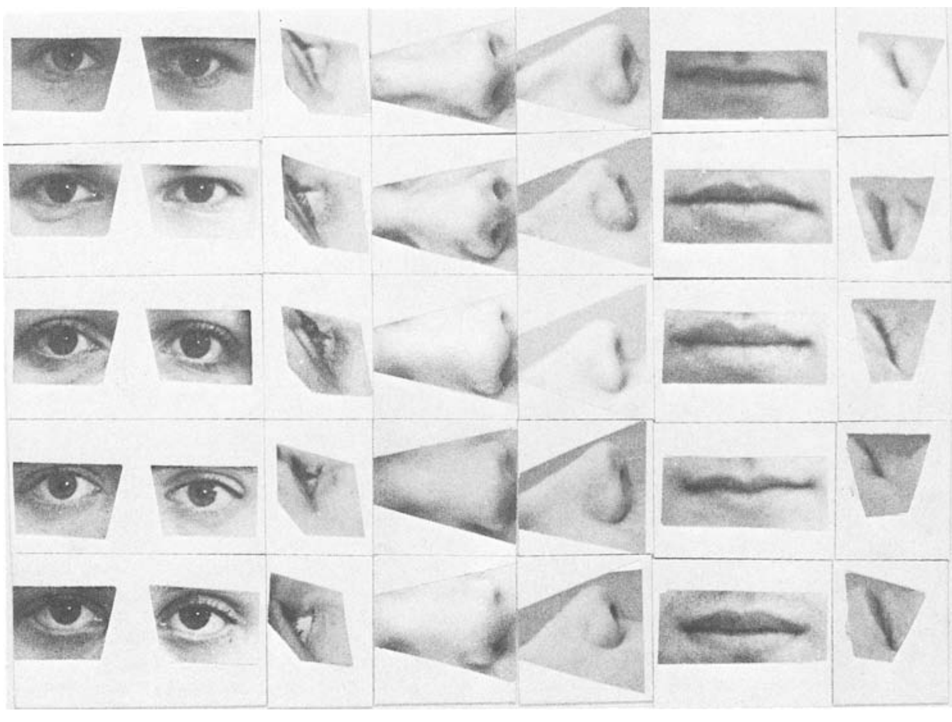

Figure 2. The facial features in front and profile orientations used in the test portion of the experiment.

Table 1
Percent Correct Study-Test Orientations and Feature Tested

Study-Test Orientation	Feature Tested		
	Eyes	Nose	Mouth
Same	75.00	47.36	70.00
Different	40.00	38.09	40.00

Note–Data are expressed as percentages based on 20 subjects for the eyes and mouth conditions. Due to an error, 19 subjects were tested in the nose-same condition and 21 subjects were tested in the nose-different condition. Chance performance equals 20%.

The basic findings are summarized in Table 1, which presents the percent correct feature selection for each of the features tested as a function of the study-test orientation conditions. Several observations are clearly apparent. First, performance in each instance was above the chance level of responding of 20%. This is supported by the finding of significantly more correct responses than expected when the study and test orientations were the same $[(\chi^2(2) = 62.37, p < .005)]$ or different $[(\chi^2(2) = 11.44, p < .005)]$. Second, correct feature selection was superior when the study and test orientations were the same (front-front or profile-profile) than when different (front-profile or profile-front). The difference between these percentages (64.41% and 39.34%, respectively) was highly significant ($z = 2.75$, $p < .003$). Third, there were differences among the individual features when the study and test orientations were the same, but no differences when these orientations were different. Where differences exist, the eyes and mouth were recognized better than the nose. These observations are supported by statistical analyses which found no difference between the eyes and mouth ($z = .35$, $p > .10$) but significant differences between the eyes and nose ($z = 1.77$, $p < .038$) and mouth and nose ($z = 1.44$, $p > .075$) when the study and test orientations were the same. No significant differences were found (all ps $> .10$) when the study and test orientations differed. Finally, since the data for the two study-test orientations-same and study-test orientations-different were collapsed in the above analyses to obtain a larger subject base for the purpose of evaluating the hypotheses, a comparison of the individual conditions not shown in Table 1 was performed. The results show feature recognition to be significantly better with profile than front view of study faces when the study and test orientations were the same (79.31% and 50.00%, respectively, $z = 2.35$, $p < .009$) but to have no effect when the orientations differed (38.71% and 42.86%, respectively, $z = .32$, $p > .10$). While the profile-profile study-test condition was better than the front-front, performance on the features tested within each condition showed the same effect for the eyes, nose, and mouth (90.00%, 66.67%, and 80.00% vs. 60.00%, 30.00%, and 60.00%, respectively).

Confidence ratings, which could vary on a scale of 1-3, showed little variation across any conditions. A mean rating of 2.03 with a standard error of .05 indicates that most people chose the midpoint of the scale under each condition.

DISCUSSION

Consistent with the earlier cited research on inversion of faces, the present study found superior performance when the study and test orientations of the face and features were the same rather than when the orientations differed. More important, however, were the findings that (1) regardless of study-test orientation, performance under all conditions was significantly greater than chance, and (2) differences among features were observed when the study and test conditions were the same. Consider the implications of each in turn.

The fact that people can recognize features when the orientation is changed between study and test is an important cognitive ability. Objects are rarely seen in exactly the same context and orientation each time they are viewed. Some means of recognizing consistency is necessary. In the present case, subjects may have been able to recognize features when the study and test conditions differed in several ways. One possibility is that during the free viewing of the study face, subjects stored a fairly accurate representation of that face in immediate memory and made the subsequent feature decision on the basis of similarity: person X's eyes, even in a changed orientation, are more similar to the stored representation than those of any other model. This could produce greater than chance performance under all conditions and superior performance when the study and test orientations were the same.

An alternative possibility is that subjects can act on the stored representation and transform it in mental space (see Shepard, 1975) when conditions so warrant. Since greater opportunity for error exists under mental transformation, performance would be poorer when the study and test conditions are different than when they are the same.

The finding that the eyes and mouth were recognized better than the nose where differences were observed is consistent with earlier findings (Davies et al., 1977; Yarbus, 1967) and may be viewed within the levels-of-processing framework (Craik & Lockhart, 1972). If memory is a by-product of attention and viewers typically look at the eyes and mouth, the present differences among the features are not surprising. What is surprising is that feature differences in recognition were found only when the study and test conditions were the same. It may be that the eyes and mouth change more in physical appearance than does the nose when orientation is changed on a front-profile dimension. As such, changing the orientation between study and test has a less deleterious effect on nose recognition than on eye or mouth recognition. Consistent with this view is the fact that greater differences in feature size are found with the eyes and mouth than the nose when study and test orientations vary; the nose stays approximately constant in size.

In summary, the present experiment has provided converging evidence (see also Davies et al., 1977; Yarbus, 1967) on the relative importance of the eyes and mouth for facial recognition and has specified some of the conditions that affect recognition performance.

REFERENCES

Allport, G. H. *Social psychology.* Boston: Houghton-Mifflin, 1924.

Boring, E. G., & Titchener, E. B. A model for the demonstration of facial expression. *American Journal of Psychology*, 1923, **34**, 471-486.

Bower, G. H., & Karlin, M. B. Depth of processing pictures of faces and recognition memory. *Journal of Experimental Psychology*, 1974, **103**, 751-757.

Craik, F. I. M., & Lockhart, R. S. Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, 1972, **11**, 671-684.

Davies, G., Ellis, H., & Shepherd, J. Cue saliency in faces as assessed by the "Photofit" technique. *Perception*, 1977, **6**, 263-269.

Guilford, J. P. An experiment in learning to read facial expressions. *Journal of Abnormal and Social Psychology*, 1929, **24**, 191-202.

Hochberg, J., & Galper, R. E. Recognition of faces: I. An exploratory study. *Psychonomic Science*, 1967, **9**, 619-620.

Laughery, K. R., Alexander, J. F., & Lane, A. B. Recognition of human faces: Effects of target exposure time, target position, pose position, and type of photograph. *Journal of Applied Psychology*, 1971, **55**, 477-483.

Patterson, K. E., & Baddeley, A. D. When face recognition fails. *Journal of Experimental Psychology: Human Learning and Memory*, 1977, **3**, 406-417.

Scapinello, K. F., & Yarmey, A. D. The role of familiarity and orientation in immediate and delayed recognition of pictorial stimuli. *Psychonomic Science*, 1970, **21**, 329-331.

Shepard, R. A. Form, formation, and transformation of internal representations. In R. Solso (Ed.), *Information processing and cognition: The Loyola symposium*. Hillsdale, N.J: Erlbaum, 1975.

Winograd, E. Recognition memory for faces following nine different judgments. *Bulletin of the Psychonomic Society*, 1976, **8**, 419-421.

Yarbus, A. L. *Eye movements and vision*. New York: Plenum, 1967.

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