Recognition of human faces from isolated facial features: A developmental study

ALVIN G. GOLDSTEIN, *UNIVERSITY OF MISSOURI*
EDMUND J. MACKENBERG, *CLARK UNIVERSITY*

Identification of a whole from only a part of a visual stimulus was shown to be an age related function in children from age 4½ to 10½. Stimuli were facial photographs of Ss' classmates, masked to show only limited portions of the face. Several other consistencies of response were also found.

When a familiar visual stimulus is presented upside down, the physical stimuli remain unaffected by this transformation, but there are often important psychological effects (e.g., Brooks & Goldstein, 1963; Ghent, 1960, 1961; Goldstein, 1965). Recent studies using children and adolescent Ss, show that children's ability to recognize an inverted mono-oriented stimulus increases with age (Brooks & Goldstein, 1963; Ghent, 1960, 1961). In an attempt to explain these results, Ghent hypothesized that, for correct identification, older children need to see a smaller portion of a figure than do younger children (Ghent, 1960). The present experiment tested this hypothesis, and explored what features of human faces carry information about identity.

Stimuli

Use of human faces as stimuli was based upon two considerations. Although we are not here directly concerned with stimulus inversion, we were interested ultimately in understanding those data. Faces are almost perfect examples of mono-oriented objects and are, therefore, nearly ideal choices for stimuli. The second reason for using faces was a desire to move away from the schematic drawings of "realistic" objects traditionally used as stimuli in many earlier studies (Braine, 1965; Ghent, 1960; Gollin, 1960). The major disadvantage of "realistic" stimuli—especially in studies of part-whole perception or stimulus inversion—is the large interstimulus differences, producing relatively "easy" perceptual tasks. Because the stimuli are usually vastly different in size, configuration, and class membership, it is not surprising when, for example, only a small piece of a horse is needed by S to distinguish it from a wagon.

Subjects

Seventy-six Ss (37 boys, 39 girls) were obtained from two first grades, two fifth grades and one kindergarten (median ages 4.5, 6.5, and 10.5 yr.).

Procedure

The individually administered procedure consisted of a control and a test session. In the control session, which always came first, S was asked to identify by name standardized black-white Polaroid photographs of all of S's classmates (face only, front view, unsmiling, black cloth below chin, face size 1-3/4 in. wide by 2 in. high). From the control session five sets (one set per classroom) of 13 pictures were obtained. All faces in these sets were identified within 5 sec. by their classmates. During the test session, two weeks later, Ss were shown the appropriate set of pictures, with each face covered by a mask as shown in Fig. 1. S's task was to name the child in the masked picture within a 5 sec. per picture time limit. Each S was told that anyone in his class could be under the masks. Knowledge of results was delayed until after the experiment. Photographs from each class were presented one at a time to all Ss in that class in a fixed order; however, the mask-conditions were systematically varied. Thus, many different noses contributed to the mean response in Condition J (Fig. 1). In summary, during the test session, S was shown masked photos of children he had readily recognized by name unmasked two weeks earlier.

Results and Discussion

Statistical analyses were performed on the combined data of the two first grade classes, the combined fifth grade classes, and the single kindergarten class. With 13 as the maximum number correct per S, the means for kindergarten, first and fifth grades were 2.96, 5.11, and 5.77, respectively; standard deviations were 1.75, 1.49, and 1.79, respectively. Analysis of variance applied to these data yielded a significant effect for age

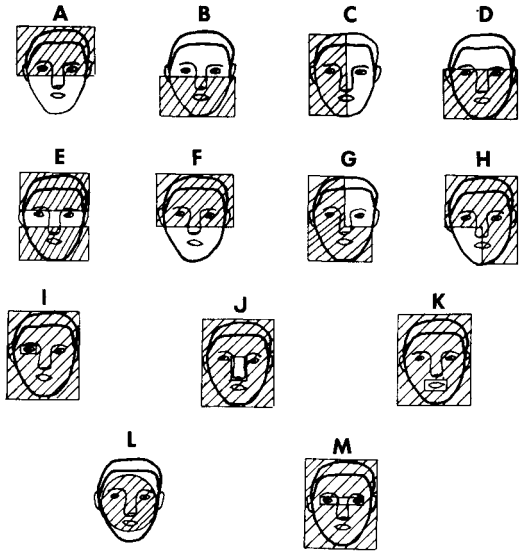

Fig. 1. Schematic representation of experimental conditions. An opaque mask was used to occlude crosshatched sections. Symmetrical features, such as Cond. H, were randomly varied to sample left and right sides.

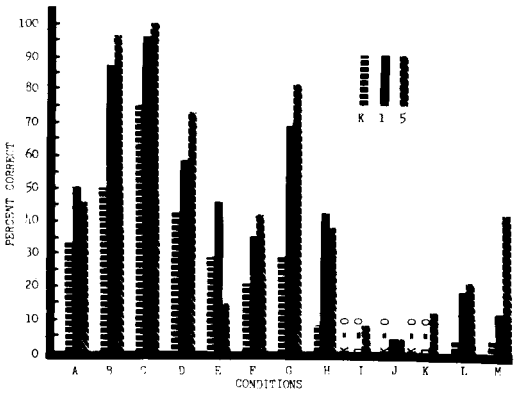

Fig. 2. Per cent correct identifications by kindergarten (K), first (1) and fifth (5) grade subjects on condition A to M.

($F = 19.05$, $df = 2/75$, $p < .01$). Kindergarten Ss performed significantly less well than both older groups of Ss. The difference between 1st and 5th graders was not quite significant (one tail $t = 1.41$, $df = 75$, $p < .10 > .05$). As Ghent suggested, older children, as compared to younger ones, are able to identify wholes more readily from parts. Mean percent correct responses to each of the 13 experimental conditions at the three grade levels, shown graphically in Fig. 2, also supports the hypothesis, and indicates that various parts of faces differ in how much they contribute to recognition. In 10 conditions, kindergarten Ss made fewer correct responses than both older groups, and in nine conditions the percent correct of the fifth graders exceeded the first graders. In seven conditions correct identification of wholes from parts is a regular function of age. When mean percent correct is used to rank the conditions within each age, and correlations among ages are computed, the following values of rho are obtained: +.97 (K with 1st), +.90 (K with 5th), and +.91 (1st with 5th). Parts of faces which have high (or low) recognizability for young children also have high (or low) values for older children.

Figure 2 also suggests that upper portions of the face are more helpful to identification than lower portions (e.g., in Fig. 2, A < B, F < D, H < G). This result is clearly related to Braine's finding that parts of a form are scanned and that this scanning has directionality (see Braine, 1965).

The method employed here and in an earlier study (Brooks & Goldstein, 1963) whereby *intact* groups of children were used as Ss *and* as stimuli provides a rather novel means of "training" Ss in a non-laboratory environment before they participate in a learning experiment. An apparent disadvantage of this technique when age is the independent variable is that older children may have known each other longer than younger children, especially in stable school populations. Thus, the difference in accuracy between kindergarten and first graders compared to the small difference between first and fifth graders could be explained by assuming that kindergarten Ss were less familiar with each other than were first graders, because the latter group had two more years of association. This interpretation is weak, as the kindergarten Ss had been together for at least seven months prior to the testing session. Furthermore, in a replication of this experiment with length of association as one of the variables, the ability to identify a face on the basis of viewing a part increases with age and is not a function of increased acquaintance (Chance, Goldstein, & Schicht, 1966).

These results demonstrate that, within the range tested, age is an important variable in part-whole perception. This finding, although interesting, does not come as a surprise. Similar conclusions have been made from the results of other investigations (e.g., Gollin, 1960) even though the stimuli used in the earlier research may have confounded the independent variable, age, with stimulus familiarity. The present study, in addition to increasing the generalizability of the developmental concept of part-whole perception in children also makes very clear the remarkable extent to which even young children recognize (and originally learn) a small part of a highly complex whole. This ability is not evident when the stimulus array is heterogeneous; it is shown here only because the stimuli were homogeneous. Furthermore, the stimuli used here have characteristics which make them important not only as one means of dealing with the part-whole problem, but also as a way of getting information about the development of responses to human faces.

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