

Attributes of schematic faces in preschoolers' use of names of emotions

PRATIBHA PALIWAL and ALBERT E. GOSS
Rutgers University, New Brunswick, New Jersey 08903

Eyebrow curvature, opening of the eyes, and, within naturalistic or stylistic mouth, opening or form of the mouth were related to occurrences of the names of the emotions "afraid," "happy," "mad," "surprised," and "sad" with 4-, 5-, and 6-year-old females and males who were predominantly white and middle class in background. With naturalistic mouths, combinations of arched eyebrows, open eyes, and open mouth evoked "afraid" and, less often, "surprised." Arched eyebrows with relatively closed eyes and mouth evoked "happy," and straight eyebrows, regardless of eyes and mouth, evoked "mad." "Sad" occurred infrequently. The stylistic U-shaped mouth evoked "happy," and the stylistic inverted-U mouth evoked "sad," both regardless of eyebrows and eyes. These generalizations held across age, sex, repetition of presentation, and place and time of participation of the children.

Much of the pertinent research on the perception of emotional expression by young children begins with experimenter development of a set of black-and-white photographs of the faces or faces plus figures of real persons, usually adults. The experimenter then selects those faces or faces plus figures that are judged to express each of the target emotions of a particular study. Thus, Gates (1923) selected black-and-white photographs of adult faces that were judged to express laughter, pain, surprise, or scorn. These were presented to 485 children of ages 3-14 years and to 36 adults, with instructions to name the particular one of the four emotions that was expressed in the face of each photograph. Appropriate use of the names of these emotions increased with age. Laughter and pain were used appropriately earlier and better than surprise and scorn.

Through the ensuing years, similar studies have appeared. Among the more notable of these are the many experiments of Honckavaara's (1961) monograph. Her considerable variety of specific kinds of stimuli included black-and-white photographs of faces, as well as schematic line drawings. In general, accuracy of judgment of common emotions increased with age. However, these age-related trends varied markedly among kinds of stimuli, response modalities, specific emotions, and kinds of subjects.

Subsequently, Izard (1971) prepared black-and-white still photographs of faces that were judged to express interest-excitement, enjoyment-joy, surprise-startle, distress-anguish, disgust-repulsion, anger-rage, shame-humiliation, fear-terror, and contempt-scorn. French and American children of ages 2-9 years saw two examples of faces that expressed each of these emotions. They

answered the question "How is the person feeling?" and they also selected the picture within picture triads that expressed each emotion as named by an experimenter. Regardless of nationality, both across emotions and for each emotion separately, correct labels and correct choices increased with age. There were differences among emotions in correct labels and correct choices, with anger-rage recognized most accurately and contempt-scorn recognized least accurately.

Unfortunately, the results of these and similar investigations show only that black-and-white photographs of faces and other kinds of stimuli that have been judged by experimenters to show particular emotions are also judged as showing these emotions by children and by other adults. The particular attributes and values of attributes of faces that were judged to express one or more emotions were rarely identified. A few relatively fragmentary experiments of Honckavaara excepted, facial attributes were not varied systematically within a set of stimuli of further, more analytical studies. Unless there are such identifications and manipulations, variations in attributes that are likely to influence use of names of particular emotions cannot be generated a priori. Sets of stimuli must always be prepared de novo, with subsequent selection of those members of the set that are judged to express each of the emotions of interest.

Eyebrow curvature, width or form of eye opening, and opening or form of mouth within type of mouth were varied here partly because, more recently, Ekman (1975), with black-and-white photographs of female and male adults, had isolated shape of mouth and shape of eyes as primary cues. Subsequently, Federici and Krakoff (Note 1) found that adults drew different shapes of eyebrows, as well as different shapes of eyes and mouths, to express angry or mad, frightened or afraid, happy, sad or unhappy, and neutral.

Variations in these attributes were realized in schematic black-and-white line drawings rather than in more representational drawings or in photographs. This was

We appreciate the cooperation of the directors, parents, and children of the REM Country Day School and Camp, of the Livingston College Daycare Center, and of the Pine Grove Cooperative Nursery School. Suggestions by Jean L. Burton and Richard K. Lore and by Donald F. Pratt were helpful.

done so that the variations occurred in simple, obvious fashion. Also, these simple variations could serve as a baseline to which successive elaborating details might be added to achieve increasingly representational drawings.

Although schematic, the resultant facial expressions were considered representative or ecologically valid with respect to various kinds of representations of human faces that children and adults encounter frequently in cartoons, in drawings that illustrate stories, and in other graphic media.

Brunswik and Reiter, as described by Brunswik (1956, pp. 99-110), constructed schematic faces that embodied variations in relatively fixed attributes of faces. Adults' judgments shifted from "gay" to "sad" with decreases in eye separation, forehead height, and mouth height. Although less pronounced, "sad" was relatively more frequent the closer the saddle of the nose was to the top of the head or the tip of the nose was to the chin.

METHOD

Design

With naturalistic or stylistic mouths (mouth type), three different curvatures of the eyebrows (eyebrows), three different openings of the eyes (eyes), and three different openings or forms of the mouths (mouth) were combined orthogonally. The expressions realized by each of these combinations were to be labeled with one of the names of common emotions.

Schematic Faces

The frame or outline of the schematic faces was a circle 10 cm in diameter. Approximately in its center was a nose in the form of an isosceles triangle with cut-off apex. It was 1.5 cm on each side and 1 cm wide at the bottom.

The three eyebrow curvatures were halves of ellipses that were defined by their long axes. Their source was the Pickett Template 1269, on which the specific ellipses were $60 \text{ deg}/\frac{3}{4} \text{ in.}$ and $30 \text{ deg}/\frac{3}{4} \text{ in.}$ for full (F) and half (H) curvature, respectively. The straight (St) eyebrow was 2.0 cm in length, essentially equal to the horizontal length of the curved eyebrows.

The three openings of the eyes were also ellipses from the same template, specifically, $45 \text{ deg}/\frac{5}{8} \text{ in.}$, $30 \text{ deg}/\frac{5}{8} \text{ in.}$, and $15 \text{ deg}/\frac{5}{8} \text{ in.}$ for fully (F), half- (H), and slightly (Sl) open eyes, respectively. Their horizontal length was about 1.6 cm and the maximum vertical widths were 1.2 cm for F, .8 cm for H, and .5 cm for Sl. Round, solid black irises-pupils, .5 cm in diameter, were placed at the center of each eye.

The upper curves of the naturalistic mouths were also halves of ellipses that were defined by their long axes. For the fully (F), half- (H), and slightly (Sl) open mouths, the specific ellipses were $30 \text{ deg}/\frac{3}{4} \text{ in.}$, $15 \text{ deg}/\frac{3}{4} \text{ in.}$, and $15 \text{ deg}/\frac{3}{4} \text{ in.}$, respectively. The lower curves of these mouths were $60 \text{ deg}/\frac{3}{4} \text{ in.}$, $45 \text{ deg}/\frac{3}{4} \text{ in.}$, and $15 \text{ deg}/\frac{3}{4} \text{ in.}$ Their horizontal lengths were 1.9 cm, and the maximum vertical widths were 1.3 cm for F, 1.0 cm for H, and .5 cm for Sl.

The stylistic inverted-U and U mouths were the long-axis halves of the $60\text{-deg}/\frac{3}{4}\text{-in.}$ Pickett ellipse. The St mouth was 2 cm horizontally.

These eyebrows, eyes, and mouths were placed appropriately in the circular form and then copied to generate the 27 combinations with naturalistic mouths and the 27 combinations with stylistic mouths. Each combination was then inserted in a separate plastic envelope and placed in a looseleaf notebook. The envelopes had coded tabs for quick selection of each face.

Names of Emotions

The names of the emotions were "afraid" (613; 04, 91) or its synonyms "frightened" (316; 04, 90) and "scared" (213; 04, 83), "happy" (1,092; 04, 92), "mad" (183; 04, 93) or its synonym "angry" (500; 04, 92), "sad" (470; 04, 93) or its synonym "unhappy" (164; 04, 89), and "surprised" (887; 04, 80). In the parentheses after each name, the number to the left of the semicolon is the total of frequencies of occurrence of that word in an edited Carroll, Davies, and Richman (1971) count that was prepared by Sakiey (Note 2), summing over all inflections. All of these names of emotions are among the 3,000 most frequent units of this edited count. The first number to the right of the semicolon is that grade level assigned to that word or to one of its inflections in Dale and O'Rourke's (1978) *The Living Word Vocabulary*. The second number is the percentage of correct choices of the meaning of that word among three choices by children at the accompanying grade level. Words with percentages of 86% or more can be considered to be at markedly lower grade levels, perhaps as low as kindergarten or Grade 1. By frequency of occurrence and by knowledge of meanings, the names of emotions are among the more frequent and more familiar in contemporary American usage.

Procedure

The children were told that they would see faces made up of different eyes, eyebrows, and mouths. They were instructed further to tell the experimenter the name of the feeling, expression, or emotion shown in each face, which was to be "afraid," "angry," "happy," "sad," "surprised," or "none of these." They were also told that "afraid" was the same as "frightened" or "scared," "angry" was the same as "mad," and "sad" was the same as "unhappy." Subsequently, "don't know" was added as equivalent to "none."

The children were then asked to recall the names of the emotions. In their recall, any one of the listed synonyms for afraid, angry, and sad was accepted. If a child failed to name five different emotions, the cycle of telling the child the names and the child's recall was repeated. This was continued until a child was able to name all five and to understand "none of these."

As soon as the child recalled the names correctly, the first face was presented. There was a different random order of faces for each child. If the child failed to name the emotion expressed within 5 sec, the experimenter prompted the child with the names of the emotions. Order of occurrence of these names was random from face to face and from child to child. The same procedure was followed with the remaining 53 faces.

The next day, on the average, 24 h later, the same procedure was repeated for each child with a random order that differed from that of the 1st day and differed among the children.

Subjects

No single nursery school that was conveniently close and willing to permit parents to be asked for permission for their children to participate had enough children to meet the desired numbers of a given age and sex. Consequently, it was necessary to draw children from three different places and, at two of those places, at two different times. These five combinations of place and time are referred to subsequently as "places."

One place was a large, private, suburban preschool and day-care center. Later, children were obtained from this place, which now functions as a summer day camp. Another place was a parent-sponsored day-care center housed in facilities of Livingston College of Rutgers University. Children were obtained from here at two different times. The third place was a cooperative nursery school, adjacent to one of the campuses of Rutgers University, that served children of Rutgers students from nearby apartment complexes and elsewhere. Twelve children, two boys and two girls at each of ages 4 (3.5-4.5), 5 (4.5-5.5), and 6 (5.5-6.5) years, were obtained from each place, to yield a total of 10 children in each age-sex cell.

The majority of the parents of these children were of or potentially of middle-middle and upper middle SES. They were employed predominantly in managerial and professional positions or were preparing for such roles. There were 45 white children, 10 manifestly black children, and 5 who were Oriental. In ethnicity, most of the children were native-born American; the birth-ethnic status of the Oriental children is not known. All spoke American English well. There were no systematic differences among places in ethnicity of the children.

RESULTS

Differences among distributions of frequencies of all six names of the emotions including "none"/"don't know" were assessed simultaneously by multiclassification, maximum-likelihood chi squares. Differences in frequencies of each of the six names separately were assessed by ANOVAs. For these, occurrences of a particular name (e.g., "afraid") were scored as "1," and occurrences of the other five names were each scored as "0." The focus of these analyses was differences in frequencies of the names that could be attributed to variations in eyebrows, eyes, and mouths within mouth types. Differences between mouth types were so pronounced that this factor was not included. In contrast, the statistical analyses indicated that place of obtaining the children, repetition of presentation, the children's ages, and their sex made essentially no difference. This held for each of these factors alone, for their interactions with each other, and for their interactions with eyebrows, eyes, and mouth. For this reason, effects of place, age, sex, and repetition are not described further.

Table 1 shows the percentage of occurrence of each name except "none"/"don't know" for each of the combinations of values of eyebrows (B), eyes (E), and mouth (M) within mouth type. For emphasis, percentages of occurrences of names that were $\geq 33.3\%$ are italicized.

Naturalistic

F or H eyebrows and F eyes, regardless of mouth, evoked "afraid" at percentages from 48% down to 39%. F or H eyebrows and H eyes, combined with F or H mouths, evoked afraid at slightly lower percentages, from 45% down to 34%.

Only the four combinations of F or H eyebrows, Sl eyes, and H or Sl mouth evoked "happy" at percentages $\geq 33.3\%$. "Mad" was evoked at these percentages only by the nine combinations of St eyebrows with all three eye openings and all three forms of the mouth. These percentages were from 62% down to 46%.

For all combinations of eyebrows, eyes, and mouth, each attribute alone and in all interactions yielded chi squares whose values were consistently significant at $p < .01$. These chi squares reflected differences among frequencies of all six names simultaneously. However, differences attributable to eyebrows, eyes, and mouth alone and together are easier to describe and easier to follow for each emotion separately.

"Afraid" occurred slightly more often with F (35%) than with H (31%) eyebrows, and considerably more

Table 1
Percentages of Occurrence of Afraid (A), Happy (H), Mad (M), Sad (SD), or Surprised (SP) for Each Combination of Fully Arched (F), Half-Arched (H), or Straight (St) Eyebrows (B), of Fully (F), Half- (H), or Slightly (Sl) Open Eyes (E), and of Fully (F), Half- (H), or Slightly (Sl) Open Naturalistic Mouths of Inverted-U (IU), U, or Straight (St) Stylistic Mouths

| B | E | M | Naturalistic | | | | | | Stylistic | | | | | | |
|----|----|----|--------------|----|----|----|----|----|-----------|----|----|----|----|--|--|
| | | | A | H | M | SD | SP | M | A | H | M | SD | SP | | |
| F | F | F | 49 | 6 | 9 | 2 | 29 | IU | 2 | 0 | 1 | 95 | 0 | | |
| | | H | 47 | 19 | 10 | 2 | 19 | U | 0 | 98 | 0 | 0 | 0 | | |
| | | Sl | 47 | 14 | 10 | 7 | 13 | St | 33 | 13 | 17 | 7 | 21 | | |
| | H | F | 45 | 12 | 12 | 6 | 20 | IU | 1 | 0 | 2 | 95 | 0 | | |
| | | H | 40 | 25 | 8 | 7 | 9 | U | 0 | 98 | 0 | 0 | 0 | | |
| | | Sl | 29 | 24 | 11 | 12 | 7 | St | 24 | 24 | 17 | 5 | 15 | | |
| Sl | F | F | 25 | 32 | 12 | 7 | 12 | IU | 0 | 0 | 3 | 95 | 0 | | |
| | | H | 12 | 42 | 15 | 7 | 9 | U | 0 | 97 | 0 | 0 | 0 | | |
| | | Sl | 21 | 36 | 12 | 6 | 5 | St | 10 | 30 | 25 | 5 | 7 | | |
| | H | F | 44 | 9 | 7 | 5 | 27 | IU | 1 | 0 | 0 | 97 | 0 | | |
| | | H | 45 | 14 | 7 | 3 | 24 | U | 1 | 97 | 0 | 0 | 0 | | |
| | | Sl | 39 | 19 | 8 | 6 | 19 | St | 25 | 13 | 16 | 10 | 22 | | |
| St | F | F | 43 | 17 | 7 | 5 | 17 | IU | 1 | 1 | 1 | 94 | 0 | | |
| | | H | 34 | 28 | 6 | 8 | 15 | U | 1 | 96 | 0 | 0 | 0 | | |
| | | Sl | 23 | 25 | 15 | 11 | 8 | St | 16 | 26 | 24 | 6 | 5 | | |
| | H | F | 22 | 27 | 14 | 5 | 13 | IU | 0 | 0 | 2 | 94 | 0 | | |
| | | H | 13 | 45 | 13 | 7 | 7 | U | 1 | 95 | 0 | 0 | 0 | | |
| | | Sl | 17 | 33 | 16 | 12 | 3 | St | 13 | 24 | 27 | 11 | 5 | | |
| St | F | F | 23 | 4 | 51 | 7 | 10 | IU | 1 | 0 | 2 | 95 | 0 | | |
| | | H | 23 | 6 | 46 | 6 | 10 | U | 0 | 95 | 2 | 0 | 1 | | |
| | | Sl | 23 | 5 | 46 | 7 | 7 | St | 12 | 2 | 65 | 3 | 8 | | |
| | H | F | 19 | 7 | 58 | 3 | 3 | IU | 0 | 0 | 5 | 92 | 0 | | |
| | | H | 15 | 11 | 55 | 9 | 3 | U | 0 | 90 | 7 | 0 | 1 | | |
| | | Sl | 13 | 6 | 58 | 11 | 1 | St | 11 | 4 | 70 | 5 | 2 | | |
| Sl | F | 13 | 8 | 55 | 7 | 4 | IU | 1 | 0 | 2 | 94 | 0 | | | |
| | H | 7 | 10 | 62 | 5 | 6 | U | 0 | 97 | 2 | 0 | 0 | | | |
| | Sl | 17 | 7 | 57 | 12 | 0 | St | 7 | 4 | 73 | 5 | 2 | | | |

often with both of these eyebrows than with St (17%) eyebrows [$F(2,60) = 48.58, p < .01$]. F, H, and Sl eyes evoked "afraid" at percentages of 38%, 29%, and 16%, respectively [$F(2,60) = 54.75, p < .01$]. These decreases for F, H, and Sl eyes were sufficiently steeper with F than with H or St eyebrows to yield an Eyebrows by Eyes interaction [$F(4,120) = 6.26, p < .01$]. Differences were slight among percentages of 32% for F, 26% for H, and 25% for Sl mouths [however, $F(2,60) = 5.07, p = .01$]. The pattern of the Eyes by Mouth interaction [$F(4,120) = 5.18, p < .01$] was: (1) no difference among mouths with F eyes, (2) decreasing occurrences of "afraid" for F, H, and Sl mouths with H eyes, and (3) an increase from F to H and then a decrease from H to Sl mouth with Sl eyes.

"Happy" was evoked about equally often by H (23%) and M (24%) eyebrows, and much less often by St (7%) eyebrows [$F(2,60) = 58.24, p < .01$]. Occurrences of "happy" increased from 11% for F eyes to 17% and 27% for H and Sl eyes, respectively [$F(2,60) = 33.31, p < .01$]. The Eyebrows by Eyes interaction [$F(4,120) = 11.09, p < .01$] reflected increases for F, H, and Sl eyes that were slightly more pronounced with F than with H eyebrows, both of which were more pronounced than the relatively slight increase with St eyebrows.

For "mad," only $F(2,60) = 273.14$ for eyebrows and $F(2,60) = 12.90$ for eyes were significant at $p < .01$. "Mad" occurred at percentages of about 11% each for F and H eyebrows and of 54% for St eyebrows. It occurred at 22%, 26%, and 29% for F, H, and Sl eyes, respectively.

While "surprised" occurred at relatively low percentages, the $F_s(2,60)$ of 23.35 for eyebrows, 32.18 for eyes, and 14.25 for mouth were all significant at $p < .01$. The percentages underlying these F_s were 14%, 15%, and 5% for F, H, and St eyebrows, 18%, 9%, and 7% for F, H, and Sl eyes, and 15%, 11%, and 7% for F, H, and Sl mouths, respectively.

Stylistic

"Happy" occurred to faces with a U mouth at percentages from 90% to 98%. "Sad" occurred to faces with an inverted-U mouth at comparably high percentages. These occurrences were for all combinations of eyebrows and eyes. The combinations of St eyebrows and St mouth with F, H, or Sl eyes evoked "mad" at percentages of 65%, 70%, and 73%, respectively. Of the remaining combinations, only that of F eyebrows, F eyes, and an St mouth evoked a name (angry) at a percentage $\geq 33.3\%$.

For all of the names simultaneously, the $\chi^2(10)$ for eyebrows was 21.47 ($p = .02$) and the $\chi^2(10)$ for mouth was 920.17 ($p < .01$). For St eyebrows, the frequencies of "afraid," "happy," and "surprised" were slightly lower, the frequency of "mad" was three times higher, and the frequency of "sad" was about the same as the frequencies for the same names for F and H eyebrows. For F and H eyebrows, the distributions of frequencies of names were almost identical.

The values of F_s for occurrences of "afraid" were significant at $p < .01$ for eyebrows, eye, and mouth both alone and in all interactions except Eyebrows by Eyes. Similar patterns of values of F_s held for occurrences of "happy," "mad," and "surprised." The deviations were no Eyebrow by Eye by Mouth interactions for "happy" and for "mad." For occurrences of "sad," only eyebrows and mouth yielded values of F significant at $p < .01$.

Among the F_s with values significant at $p \leq .01$, only those that involved mouth occasioned differences in naming that were large enough to be of interest. The almost exclusive occurrences of "happy" for the U mouth and of "sad" for the inverted-U mouth, regardless of eyebrows or eyes, limited differences due to eyebrows and eyes to faces with the St mouth.

The Eyebrows by Mouth and Eyes by Mouth interactions for "afraid," "mad," and "surprised" [$F_s(4,120) = 3.96-93.44$] and the Eyebrows by Eyes by Mouth interactions for "afraid" and "surprised" [$F_s(8,240) = 3.41, 2.79$] involved zero or near-zero occurrences of these names for all combinations of eyebrows and eyes with inverted-U and U mouths. With the St mouth, occurrences of "afraid" and "surprised" decreased, whereas those of "mad" increased with decreasing eyebrow curvature and with decreasing openings of the eyes.

The decreases in occurrences of "afraid" for decreasing eye openings were progressively less pronounced with F, H, and St eyebrows, and occurrences of "surprised" decreased jointly with decreases in eyebrow curvature and eye openings.

For "happy," the patterns of the Eyebrows by Mouth and Eyes by Mouth interactions [$F_s(4,120) = 20.71, 9.45$] were similar. With the inverted-U mouth, "happy" occurred infrequently and, with the U mouth, it occurred at percentages from 94% to 98%. With the St mouth, it occurred less often as eyebrow curvature decreased and over twice as often with F eyes than with H and Sl eyes.

DISCUSSION

With naturalistic mouths in schematic faces, "afraid" was evoked disproportionately by combinations of arched eyebrows, open eyes, and open mouths. "Surprised" was evoked by essentially the same combinations, but much less often. "Happy" was evoked disproportionately by combinations of arched eyebrows with relatively closed eyes and mouths. St eyebrows, regardless of eyes and mouth, evoked "mad." "Sad" occurred infrequently.

The stylistic U mouth almost always evoked "happy," and the stylistic inverted-U mouth almost always evoked "sad," both regardless of eyebrows and eyes. The stylistic St mouth evoked "mad" disproportionately, regardless of eyebrows and eyes. These generalizations hold over place of obtaining the subjects, mostly white, middle-class males and females of 4, 5, and 6 years. They hold, too, through two presentations of the schematic faces that were 24 h apart.

These generalizations of the differential occurrences of names of common emotions to particular combinations of values of eyebrow curvature, eye opening, and mouth opening or form are consistent with general implications of Ekman's (1975) and of Federici and Krakoff's (Note 1) findings. Differences between sets of stimuli, responses, and procedures preclude more exact comparisons.

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(Received for publication October 8, 1980.)