The Effect of Parental Eye Color on the Tendency of Students to Respond to Pupil Size

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Research with human subjects has demonstrated the usefulness of the autonomically regulated pupillary reflex as a measure of the affective value of visual stimuli. In Hess' studies he found that pupils constricted in response to unpleasant visual stimuli and dilated in response to pleasant or interesting visual stimuli (Hess, 1965; Hess & Polt, 1960; Hess, Seltzer & Shlien, 1965). Since Hess' research many studies have been done that link pupil size to preference, recognition, arousal and finally, as a factor in interpersonal communication.

The pupil tends to dilate more when the subject has a preference for or recognizes one stimulus over another. Beijk (1971) demonstrated that people who are hungry display larger pupils to food stimuli than when they are not hungry. Fitzgerald (1968) determined that the pupils of 1- and 4-month-old infants showed greater size change in response to seeing their mother's face as opposed to seeing a stranger's face.

Similarly, pupils tend to increase in size as arousal increases in intensity. Bernick, Kling and Borowitz (1968) found that male subjects who were more aroused while watching an erotic movie than while watching a suspense movie had greater pupil dilation during the erotic movie. Using pictorial stimuli on male subjects, Fredericks & Groves (1971), found that unpleasant

stimuli, such as slashed faces and starved children, elicited constricted pupils while pleasant stimuli, such as a reclining female nude or a bare-breasted female elicited a dilation response. Nunnally, Knott, Duchnowski and Parker (1967) similarly demonstrated that male subjects' pupils dilated upon viewing pictures of a pretty girl, and the size increased even more if that girl was shown only partially clothed.

Further research in this field has shown that adults tend to respond more positively to dilated pupils than to constricted pupils. This is consistent with Hess' (1975) finding that pupil dilation indicates a positive attitude toward the individual or object being contemplated. He obtained these results by using line drawn faces with smiling and scowling expressions and having his subjects fill in the pupil sizes they felt best fit each face. Flade and Lindner (1979) also found that dilated pupils are an expression of positive attention and esteem. They had students judge two face photos of a teacher, identical except that one had large pupils and the other had small pupils. All of the students rated the photos with larger pupils more positively. Sallas (1976) demonstrated that judgments of stimuli with varying pupil size depended upon the sex of the subjects, the sex of the stimulus and the color of the eyes. McLean (1975) determined that blue-eyed subjects were more likely to judge large pupils as being "happy" and small pupils as being "angry" than brown-eyed subjects. This was obtained by having his subjects compare

line drawn faces with large and small pupils and determine which faces were "friendlier" and "angrier" than the others.

Since interpersonal communication is a significant aspect of daily life, the importance of these findings is easily understood. An advantage is gained by the person who can tell what the other person's reactions are to a conversation merely by watching their pupils. It is important then to understand why some people tend to be better at this task than others. Blue irises, it seems, are typically lighter than brown irises and the pupil is easier to see in a lightly colored eye. It follows that people who have parents with lightly colored eyes may become accustomed to using pupil dilation and constriction as cues to their parents' reactions to a much greater degree than people who have parents with darkly colored eyes. It was predicted, therefore, that subjects who have parents with lightly colored irises will display a greater sense of difference between pupil sizes of "happy" and "angry" faces than subjects with parents who have darkly colored irises.

Method

Subjects

Subjects were drawn from a statistics class, a biology class, a computer science class, three psychology classes and

acquaintances of the experimenter at Lycoming College. There were 180 undergraduate students, 92 were male and 88 were female.

Apparatus

The experiment was conducted in a psychology lab room in the Academic Center of Lycoming College which contained one desk, two chairs, a couch, a storage cabinet, two tables and a two-way mirror. The experimenter was equipped with 15 faces. The first 13 faces were a mixture of single faces, disassembled faces and faces that were to be compared. The first two faces were the same male face except one had large pupils (see Figure 1) and one had small pupils (see Figure 2). The second set of faces were two of the same female face where one had large pupils (see Figure 3) and one had small pupils (see Figure 4). Next was a male face with pupils of different size and one ear missing (see Figure 5). Next were two of the same female face, one with large pupils (see Figure 6) and one with small pupils (see Figure 7) with two detached mouths, one smiling and one frowning. Next was a drawing of a female face with pupils of different size and with a crooked mouth (see Figure 8). There were three drawings of the same male face frowning with small pupils (see Figure 9), neutral with medium pupils (see Figure 10) and smiling with large pupils (see Figure 11) that were each divided into three sections: mouth, eyes and forehead. The last two faces had no pupils and

were drawn about three-fourths the size of an average adult face. One face was smiling (see Figure 12) and one face was scowling (see Figure 13).

The order of correct responses for the four comparison faces for half of the subjects were positioned as follows: L,R,R,L. The other half of the subjects received the correct responses in the following order: R,L,L,R. Half of the subjects received the angry face without pupils first and the happy face without pupils second while the other half of the subjects received them in the reverse order.

Also used were three Stoelting color mixers which resemble a fan but have a mounted flat circular disk instead of blades. One circular sheet of colored construction paper was mounted on the disk of each apparatus, blue on the first one, brown on the second one and green on the third. Also mounted on each disk, behind the construction paper, was a circular sheet of white paper and a circular sheet of black paper. The white, black and colored paper disks had one slit in them each so that the black or white could be overlapped on the colored paper. When the disk was rotated, the overlapped color would blend with the main color causing it to become either darker, if black was the overlapping color, or lighter, if white was the overlapping color (see Figure 14). The disk was calibrated in degrees from 0 to 360, which were used to measure the amount of white or black added in.

Insert Figures 1 through 14 about here.

Procedure

The subjects signed up for convenient times to be individually tested and upon entering the lab were seated across the desk from the experimenter. The experimenter introduced herself and said: "I am studying faces, and I have some drawings of faces here. I would like to ask you some questions about them." She then recorded their responses as follows.

1. Given the drawings of the two male faces (Figures 1 and 2):

   "Here are two men; which of these would you say is the happier of the two?"

2. Given the drawings of the two female faces (Figures 3 and 4):

   "Now, here are two women; which one of these is happier?"

3. Given the drawing of the male face with pupils of different size and with one ear missing (Figure 5):

   "What's wrong with this face?"

4. Given the drawings of the two female faces with different sized pupils and given two drawings of mouths, one smiling and one frowning (Figures 6 and 7):

   "With this one, see which mouth goes best with which face."

5. Given the drawing of a female face with pupils of different sizes and with a crooked mouth (Figure 8):

   "What's wrong with this face?"

6. Given the drawings of the same male face in three different expressions, smiling, neutral and frowning, divided into sections, with three forehead sections, three mouth sections and three eye sections -- one with large, one with medium and one with small pupils:

   "With these, find the pieces that go together to make the friendliest face. Now, find the pieces that go together to make the angriest face and use the rest of the pieces to make a third face."

7. Given one of the two faces without pupils and then the other (Figures 12 and 13):

   "Please draw in the pupils that you think best fit this face. And the pupils that best fit this face?"

The subjects were then asked what color their eyes were and to rank the degree of visibility of their pupils on a scale of 1 to 3 where 1 was a light eye with an easily visible pupil and 3 was a dark eye with a hard to see pupil. They were then asked the color and rank of their parents' eyes.

Next the subjects were asked to look at the disk with the same color as their eyes (blue,brown or green) and decide if their eyes were lighter or darker than that shade. Black or white was gradually added in until they felt the color was as close as possible to their own eyes. The degree of black or

white added in was recorded. This was repeated then with each of the subjects parents' eye colors.

The wheel rank was determined for light, medium and dark eyes in each of the three colors and this was compared to the subjects' personal rankings.

Finally the subject was asked which parent they spend more time with and which parent they cared for more; responses were limited to mother, father or both.

For questions 1 through 5 above, the subject got one point for each correct answer. For question 6 the subject got two points if he paired the medium pupils with one of the faces, angry or happy, and the dilated pupils with the happy face or the constricted pupils with the angry face. He got three points if he paired the constricted pupils with the angry face and the dilated pupils with the happy face. For question 7, the pupils were measured in millimeters, recorded and the differences were found.

Results

The subjects tended to draw their happy pupils larger than their angry pupils a mean difference of 1.339mm (n = 180). Subjects with light eyes (n = 67) generally differentiated 1.284mm and scored 69% correct on the comparisons (questions 1 through 6). Subjects with medium eyes (n = 83) drew happy pupils

a mean of 1.361mm larger than angry pupils and scored 71% correct on the comparisons. Dark eyed subjects (n = 30) made their happy pupils 1.400mm larger than their angry pupils on the average and scored about 71% on the comparisons (see Figure 15).

Females showed a greater tendency to associate large pupils with happiness and small pupils with anger ($\overline{X}$ = 1.580mm; score = 74%; n = 88) than males ($\overline{X}$ = 1.109mm; score = 68%; n = 92).

Subjects with two light eyed parents drew happy pupils a mean of 1.955mm (SD = 1.938; n = 22) larger than angry pupils and scored a mean of 74% correct on the comparisons. One light eyed parent and one medium eyed parent resulted in a pupil size difference of 1.535mm (SD = 2.054; n = 43) and an average score of 76%. Subjects with one light eyed parent and one dark eyed parent showed a mean of 1.242mm (SD = 2.100; n = 33) larger happy pupils and scored a mean of 68% correct on their comparisons. Subjects with two medium eyed parents had a mean pupil size difference of 1.552mm (SD = 2.418; n = 29) and a mean comparison score of 74%. One medium eyed parent and one dark eyed parent resulted in a happy pupil drawn a mean of .908mm (SD = 2.006; n = 38) larger and a mean comparison score of 66%. Two dark eyed parents resulted in the angry pupil being drawn a mean of .577mm (SD = 2.050; n = 13) larger than the happy pupil and a mean comparison score of only 56% (see Figure 16).

A one-way ANOVA on comparison scores and subject sex demonstrated that women tended to score better than men

($f(1,178)=2.98$, $p=.0859$). Students with light eye ranked parents tended to score better than those with dark eye ranked parents ($f(5,172)=1.90$, $p=.0969$). Significant differences were demonstrated using t-tests between parental eye ranks. Students with two light eyed parents scored higher than those with two dark eyed parents ($t(172)=2.21$, $p=.0288$). Those with one light and one medium eyed parent scored higher than those with two dark eyed parents ($t(172)=2.57$, $p=.011$). Those with two medium eyed parents scored higher than those with two dark eyed parents ($t(172)=2.25$, $p=.0257$) (see Figure 17).

Females' comparison scores differed somewhat according to the eye rank of the parent they spent more time with ($f(2,51)=2.84$, $p=.0676$). Those females who spent more time with a light eyed parent demonstrated higher scores according to a t-test than those who spent more time with a dark eyed parent ($t(11)=2.22$, $p=.0483$). When the sex of the parent that the female spent more time with was considered a significant difference was found in comparison scores ($f(2,48)=4.13$, $p=.0221$). Significantly better scores were found between females who spent more time with mothers with light or medium eyes than those who spent more time with dark eyed fathers (Mother Light vs Father Dark $t(7)=4.24$, $p=.0035$; Mother Medium vs Father Dark $t(5)=3.66$, $p=.0123$). In addition to this, females who spent more time with a light eyed father scored significantly better than females who spent more time with a dark eyed father (Father Light

vs Father Dark $t(6)=4.40$, $p=.0033$) (see Figure 18). Males did not display a significant difference in any of these instances.

Significant distributions were found for the eye ranks of both mothers and fathers with brown or blue eyes using chi-square tests (brown eyed mothers $X^2(4)= 14.459$, $p=.0060$; blue eyed mothers $X^2(4)= 13.009$, $p=.0090$; brown eyed fathers $X^2(4)= 18.910$, $p=.0015$; blue eyed fathers $X^2(4)= 17.589$, $p=.0015$). Three-way ANOVAs were conducted and a significant relationship was found between the females' comparison scores and the (disk) eye ranks of the blue eyed parent they cared for more ($f(1,20)=4.675$, $p=.0429$). Further analysis showed that there was a significant relationship between the comparison scores of the females who cared more for their fathers, and the (disk) eye rank of their blue or brown eyed fathers (brown eyed father $f(1,2)=48.96$, $p=.0198$; blue eyed father $f(1,6)=5.548$, $p=.0561$).

Males who cared more for their fathers had comparison scores that had a significant relationship with their brown eyed fathers' (disk) eye ranks ($f(1,6)=6.196$, $p=.0472$). Males who spent more time with their mothers had comparison scores with a significant relationship to their brown eyed mothers' (disk) eye ranks ($f(1,7)=4.820$, $p=.0642$). Males who spent more time with their mothers also had drawn pupil size differences with a significant relationship to their green eyed mothers' (disk) eye ranks ($f(1,7)=5.989$, $p=.0443$).

Discussion

The results seem to support the hypothesis that parental eye rank effects a subject's tendency to use pupil size as a cue to affect. The results also indicate that a subject's tendency to use this affect cue depends on the subject's sex, relationship with their mother and father and the parent the subject spends more time with.

While pupil size differentiation according to affect does not appear to be related to subject eye rank, it does appear to be related to parental eye rank. The subjects who had light or medium eyed parents tended to display greater awareness of the pupil cue, when drawing pupils, than subjects with one or two dark eyed parents.

A significant difference in comparison scores was found between subjects with two light eyed parents and two dark eyed parents, a light and a medium eyed parent and two dark eyed parents, and two medium eyed parents and two dark eyed parents. No significance was found between the medium and light and the medium and medium eyed parents and the medium and light or medium and medium dark eyed parents. These groups did, however, display the same trend: subjects whose parents eyes were ranked light/medium did better than those with parents whose eyes were ranked light/dark, and those whose parents eyes were ranked

medium/medium did better than those whose parents eyes were ranked light/dark, and medium/dark did better than dark/dark.

Although these results do not replicate McLean's findings that blue eyed subjects are better at this task than brown eyed subjects, they may help account for his results. Blue eyed people usually have light eyes, and their parents probably have light eyes, whereas brown eyed people seem to have dark eyes and their parents also seem to have dark eyes. If this was true of McLean's subjects then his results may have been due to his subjects' parents' eye ranks.

Disk eye ranks were found to be equivalent to the nominal eye ranking of light, medium or dark eyes, for the brown and blue eye colors, but not for the green. This is probably due to the lightness and unnatural color of the green disk, which suggests that if this study were to be repeated, care should be taken to find construction paper in a rich enough color to approximate eye color.

Interestingly, females' comparison scores displayed significantly more awareness of pupil size and its relation to affect than males. This may indicate that women are socialized to develop better interpersonal communication cues than those that men tend to develop. Parental eye ranks were found to have a significant influence on the females' response to pupil cues. Females who spent more time with their mothers, had responses that were significantly related to their mothers' eye ranks,

while those who spent more time with their fathers did not show the relationship or perform as well. Men showed these tendencies but did not show a significant relationship.

Students that spent more time with their mothers tended to respond to the pupil cue in relation to their mother's eye rank, females significantly and males only slightly significantly, but students that spent more time with their fathers neither did as well nor showed the eye rank relationship. This may have been due to the possibility that mothers may be more interpersonally involved than fathers and that a relationship with one's mother may involve more interaction or communication of feelings than a relationship with one's father.

It seemed that students grew up more often with their mothers as their main caretaker than their fathers and this may have effected the child/mother relationship differently than the child/father relationship. Male or female students who cared more for their father, tended to respond to the pupil cue in relation to their father's eye rank in a mildly significant manner, but students who cared more for their mother did not show this relationship at all. Perhaps the student/father relationship was more intense and less stressed than the student/mother relationship as a function of having seen the father less than the mother.

Unfortunately significant differences were not found between the drawn pupil sizes; this was probably due to the high standard

deviations of the size differences. This may have been an effect of the number of people tested and the fact that they were limited in the size they could draw the pupils, or perhaps the method of measurement was not fine enough to display significant differences.

Males also failed to show significant differences. This may be a function of the high number of male athletes that were tested; they may have been biased against sensitivity to affect cues.

Poor quality eye rankings by the subjects working with green eye colors may have been caused by the unnatural color of the green disk. Another cause may have been the relatively small sample size of people who cared more for or spent more time with a green eyed parent.

Despite these problems this study did appear to support that the tendency to respond to the affect pupil cue was better predicted by parent eye rank rather than subject eye color. In addition, some of the intermediate parental eye ranks were found to be significantly different through consideration of the sex of the subject, the sex of the parent that was most frequently present, and with which parent the better relationship was established.

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Figure Captions

Figure 1: Drawing of male face with large pupils used in first comparison. Obtained from McLean's Dissertation (1975).

Figure 2: Drawing of male face with small pupils used in first comparison. Obtained from McLean's Dissertation (1975).

Figure 3: Drawing of female face with large pupils used in second comparison. Obtained from McLean's Dissertation (1975).

Figure 4: Drawing of female face with small pupils used in second comparison. Obtained from McLean's Dissertation (1975).

Figure 5: Drawing of male face with two different sized pupils and one ear missing. Obtained from McLean's Dissertation (1975).

Figure 6: Drawing of one female face with large pupils and detached smile. Obtained from McLean's Dissertation (1975).

Figure 7: Drawing of one female face with small pupils and detached frown. Obtained from McLean's Dissertation (1975).

Figure 8: Drawing of a female face with two different sized pupils and a crooked mouth. Obtained from McLean's Dissertation (1975).

Figure 9: Drawing of a male face with small pupils and a frown, cut into sections. Obtained from McLean's Dissertation (1975).

Figure 10: Drawing of a male face with medium pupils and a neutral expression cut into sections. Obtained from McLean's Dissertation (1975).

Figure 11: Drawing of a male face with large pupils and a smiling expression, cut into sections. Obtained from McLean's Dissertation (1975).

Figure 12: Drawing of an average adult face, smiling, without pupils. Obtained from Hess' "The Tell-Tale Eye", 1975.

Figure 13: Drawing of an average adult face, scowling, without pupils. Obtained from Hess' "The Tell-Tale Eye", 1975.

Figure 14: Drawing depicting the Stoelting color mixer and the positions of the black, white and colored paper.

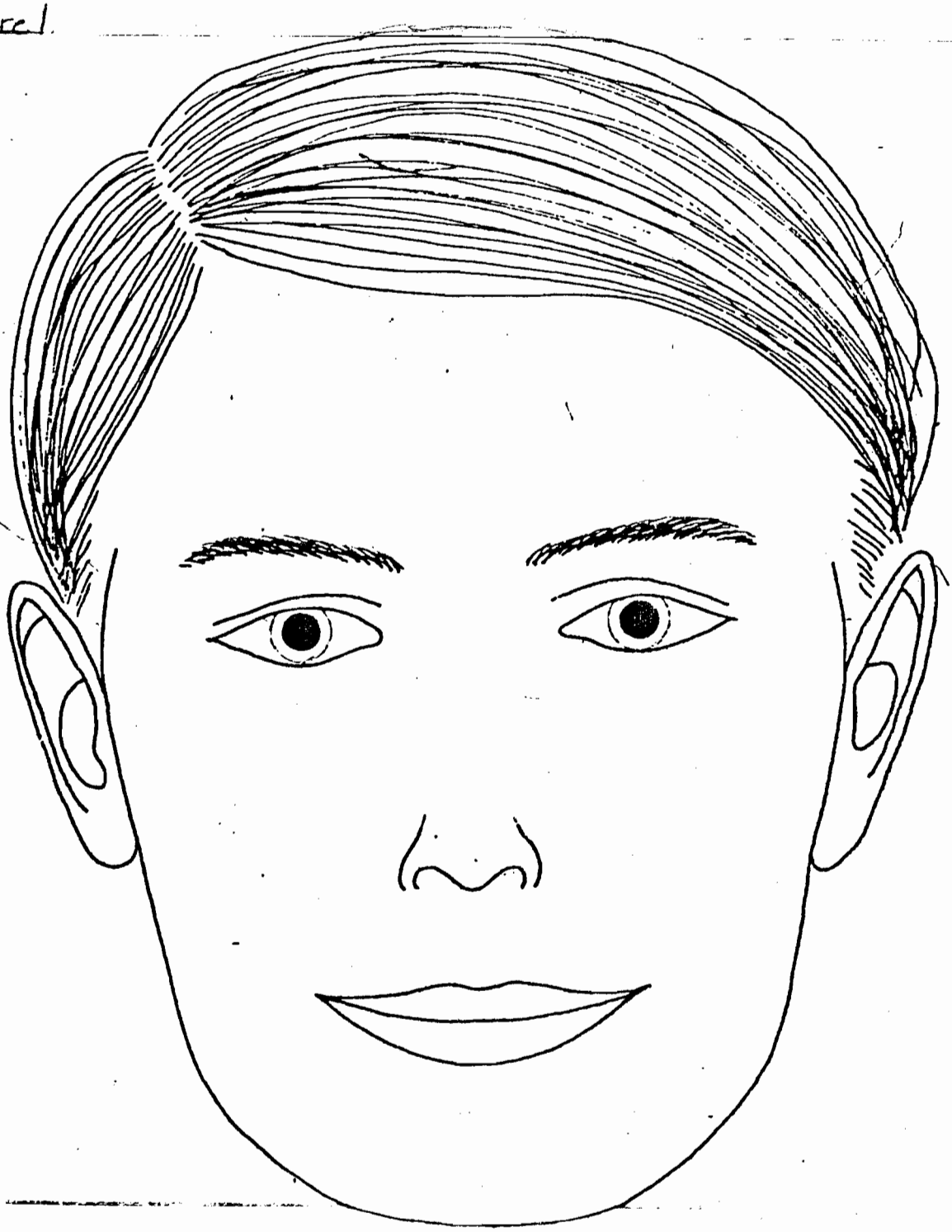
Figure 15: Graph of Subject Eye Rank with Mean Pupil Size Differences (Happy-Angry).

Figure 16: Graph of Parental Eye Rank with Mean Pupil Size Differences (Happy-Angry).

Figure 17: Graph of Parental Eye Ranks with Female Subjects' Mean Comparison Scores depicting the significantly different scores between those females with 2 light eyed parents or a light and a medium eyed parent or 2 medium eyed parents and those with 2 dark eyed parents.

Figure 18: Graph of the parent's eye rank that the female subject spent more time with and the female subjects' mean comparison scores depicting the significantly different scores between those who spent more time with a light eyed mother or a medium eyed mother or a dark eyed mother or a light eyed father and those who spent more time with a dark eyed father.

Figure 1.



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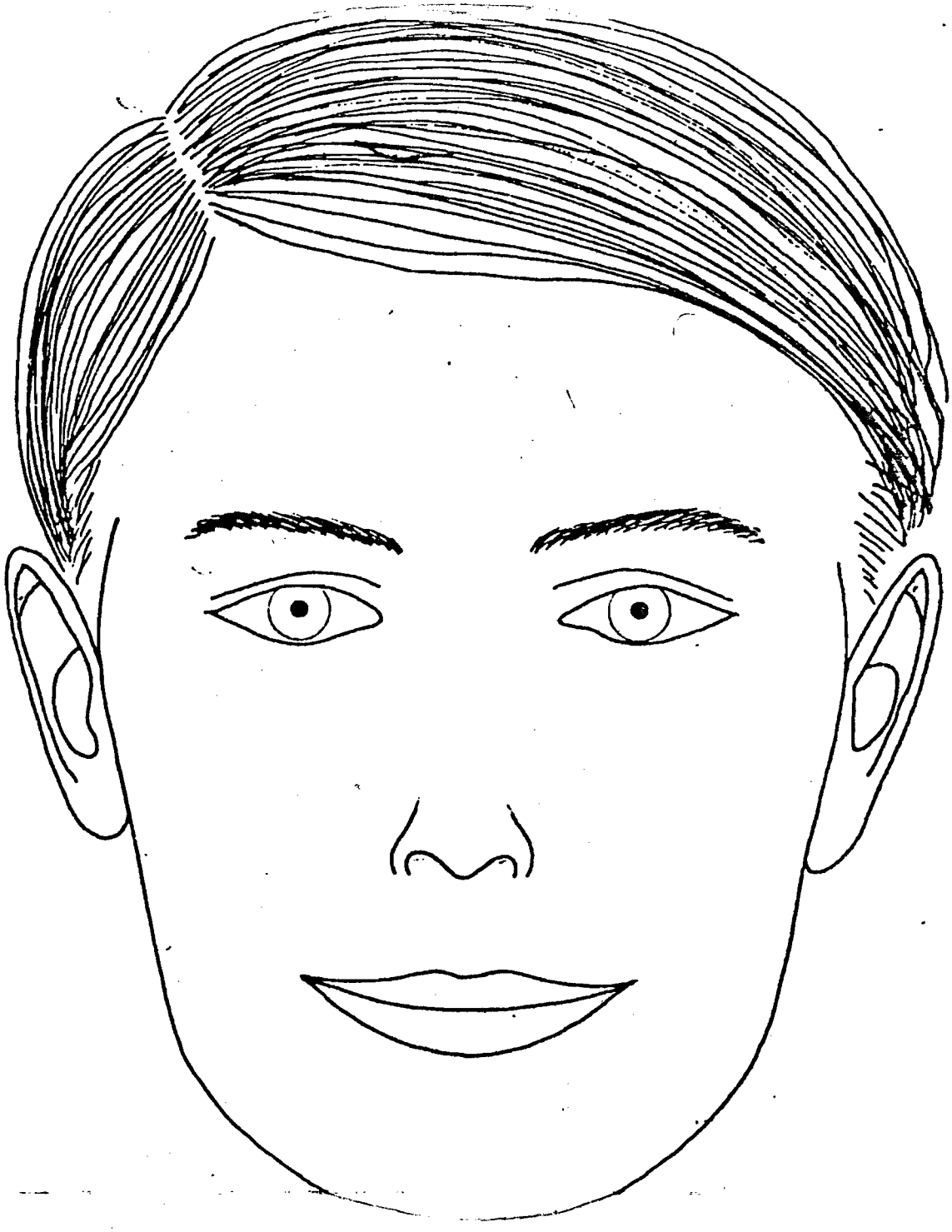

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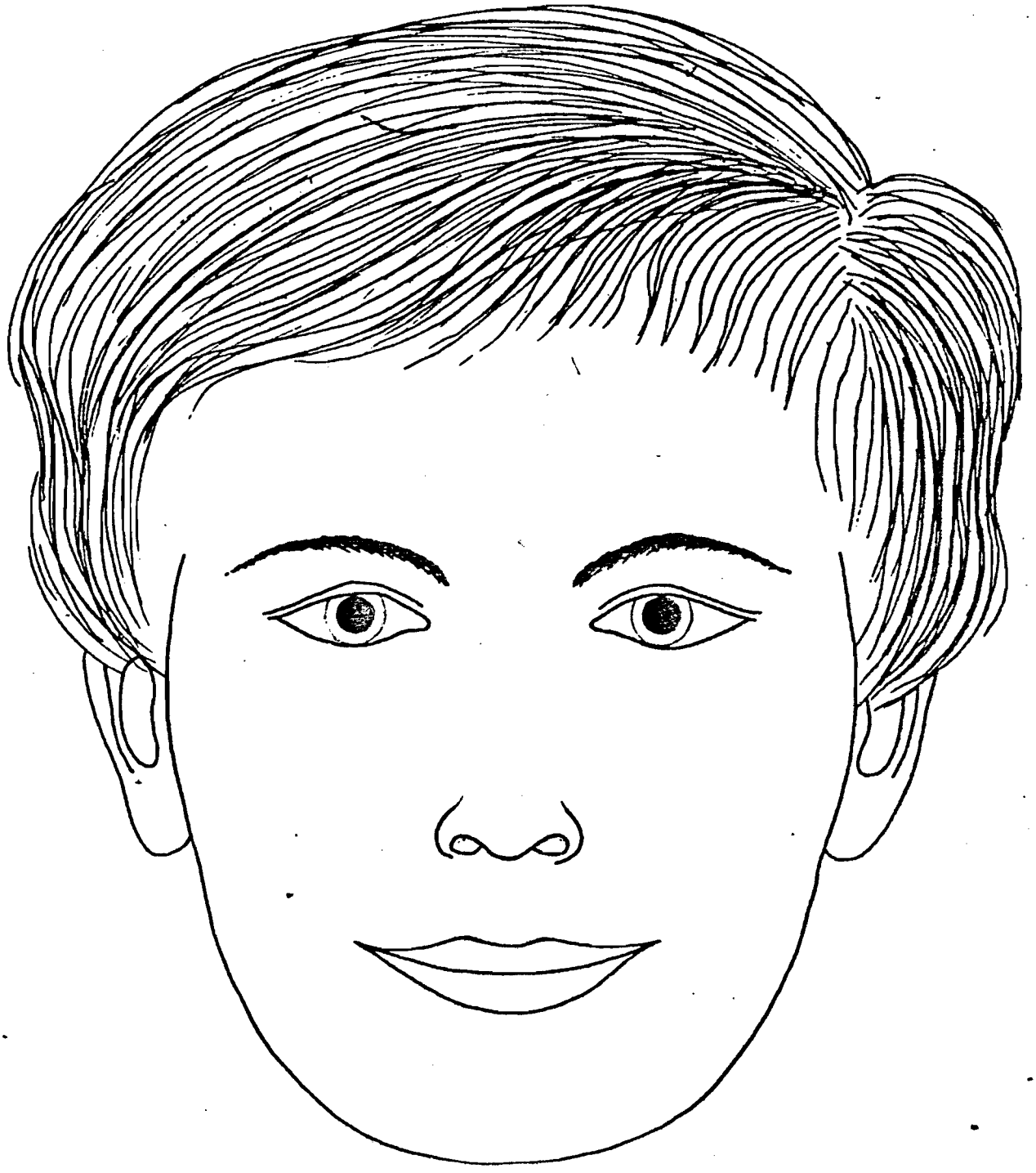

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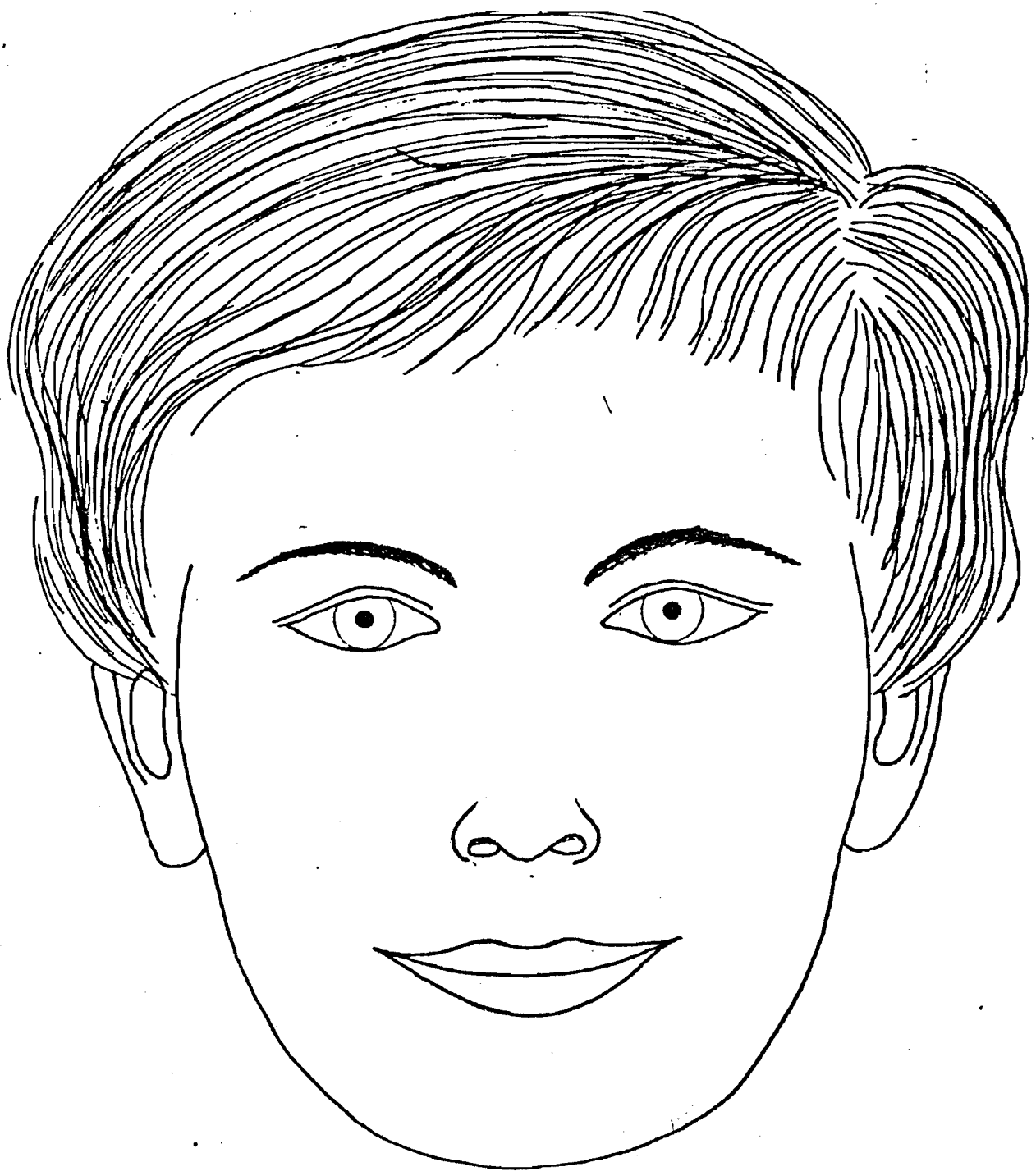

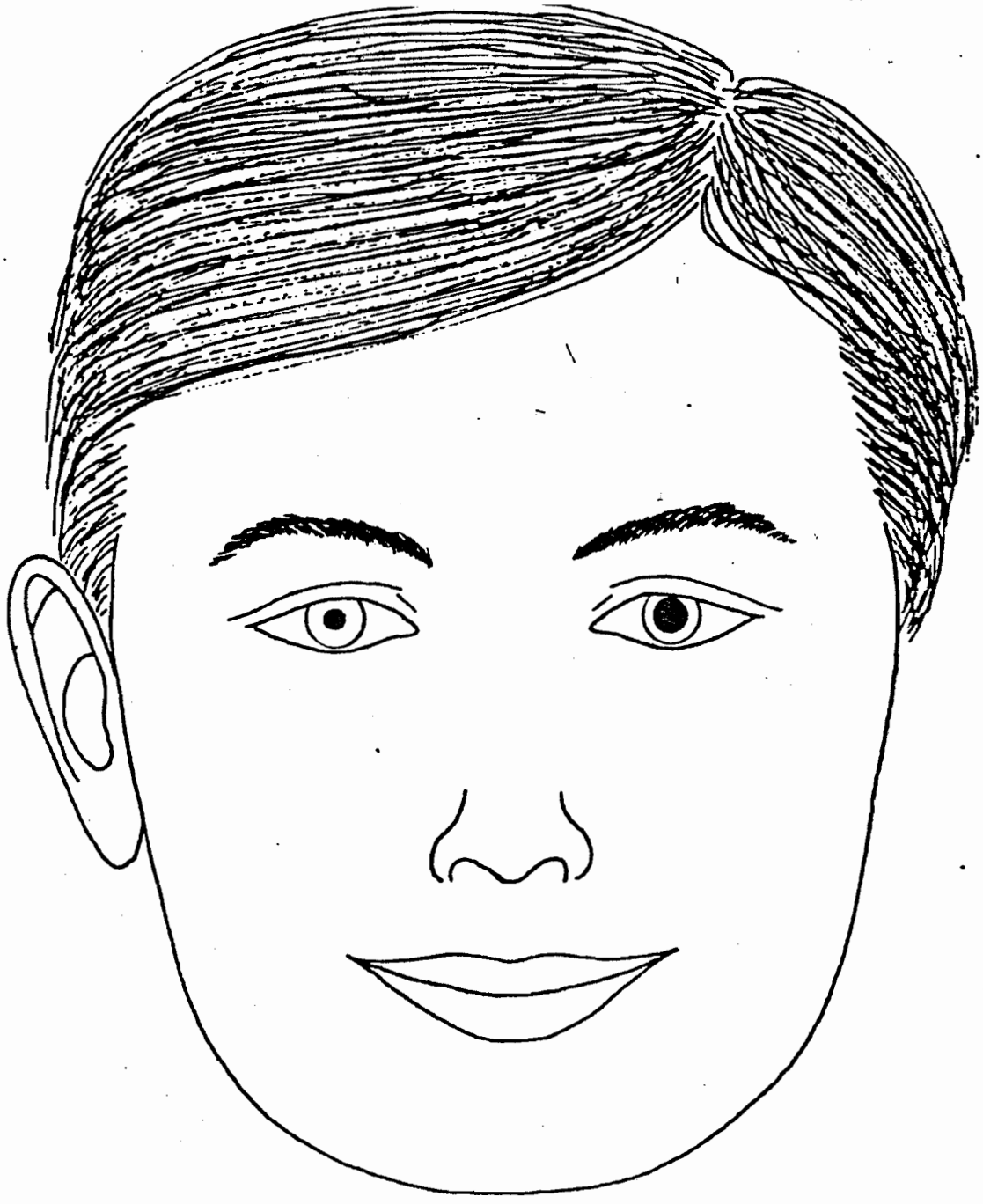

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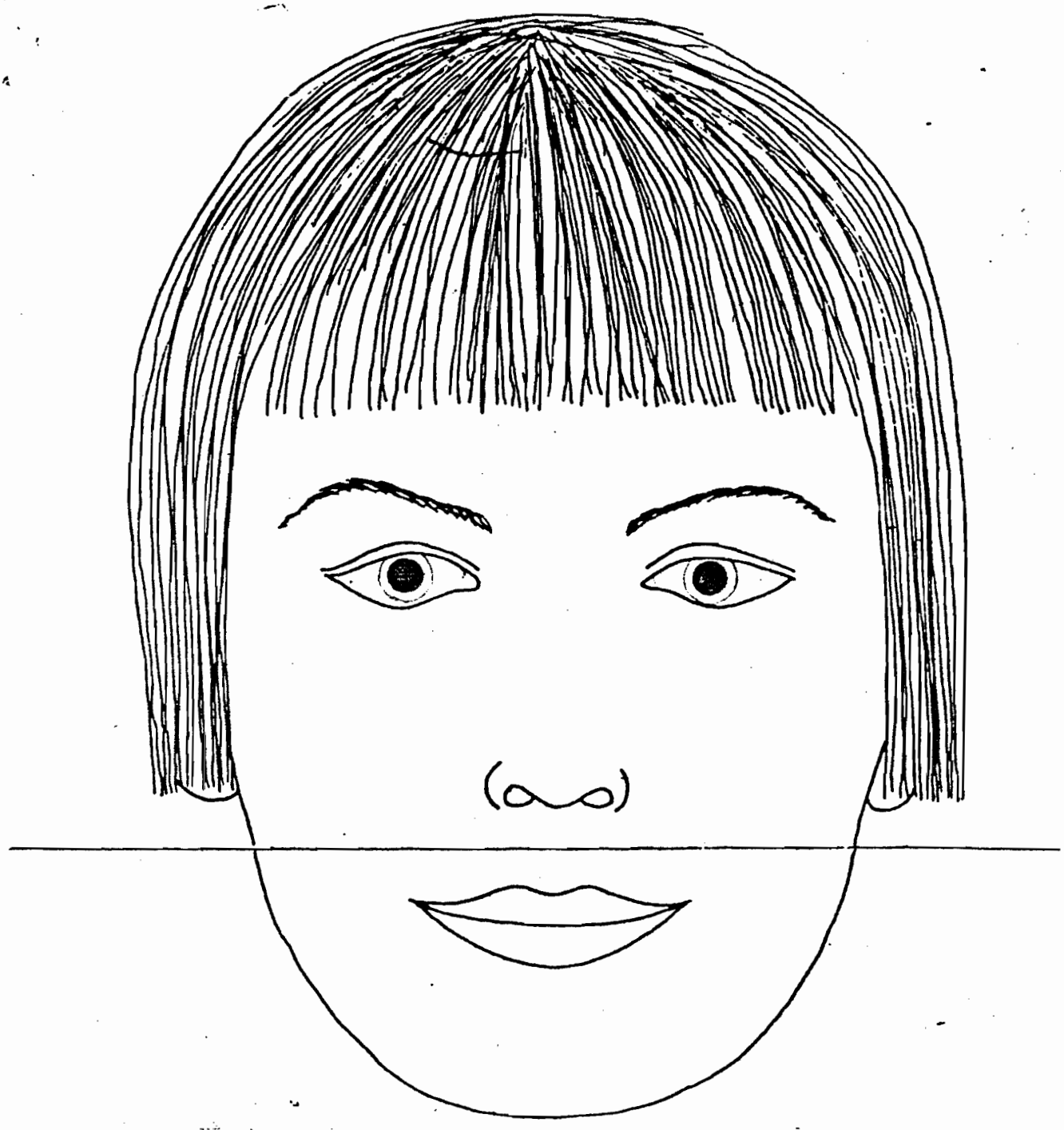


Figure 7

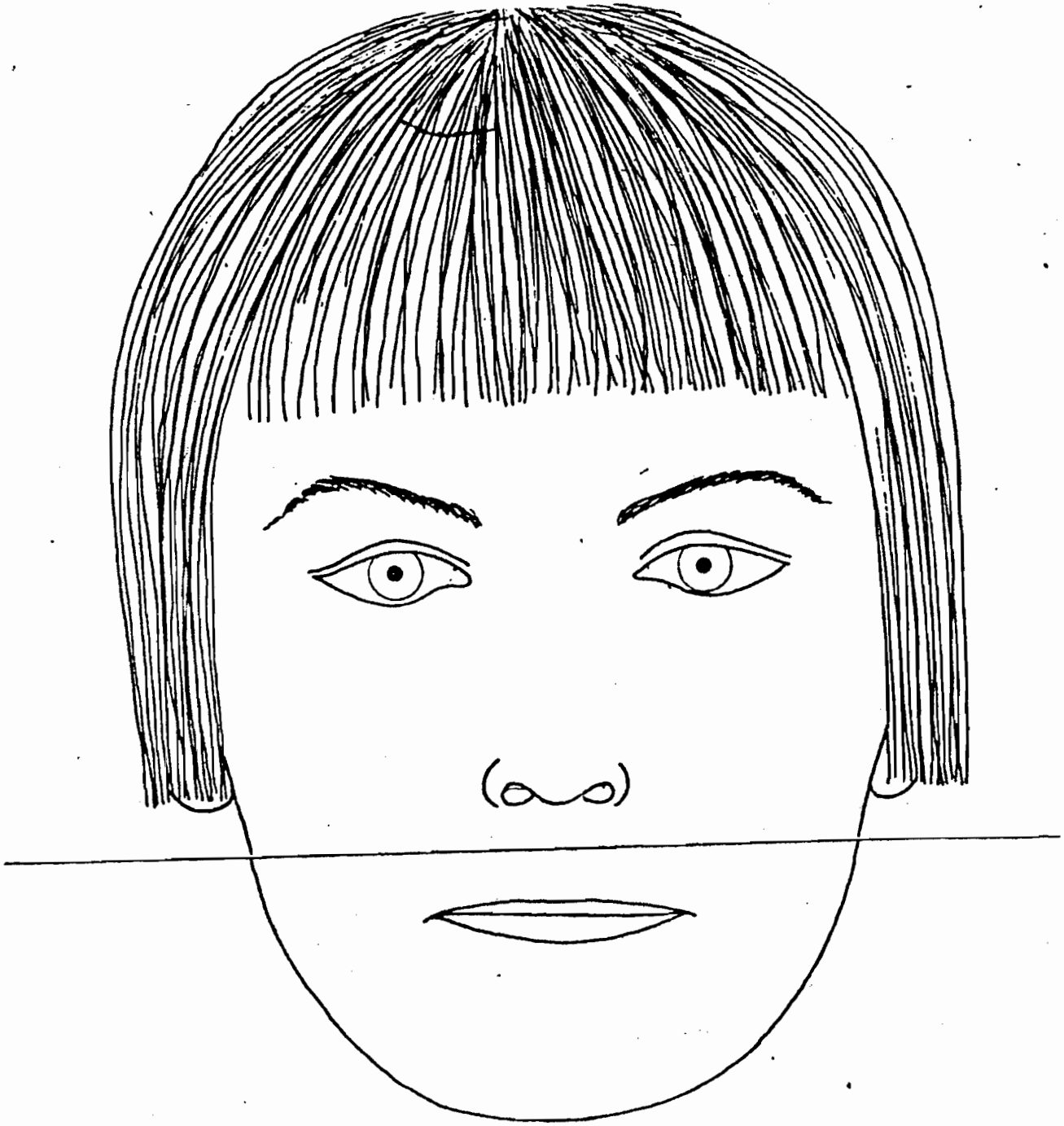
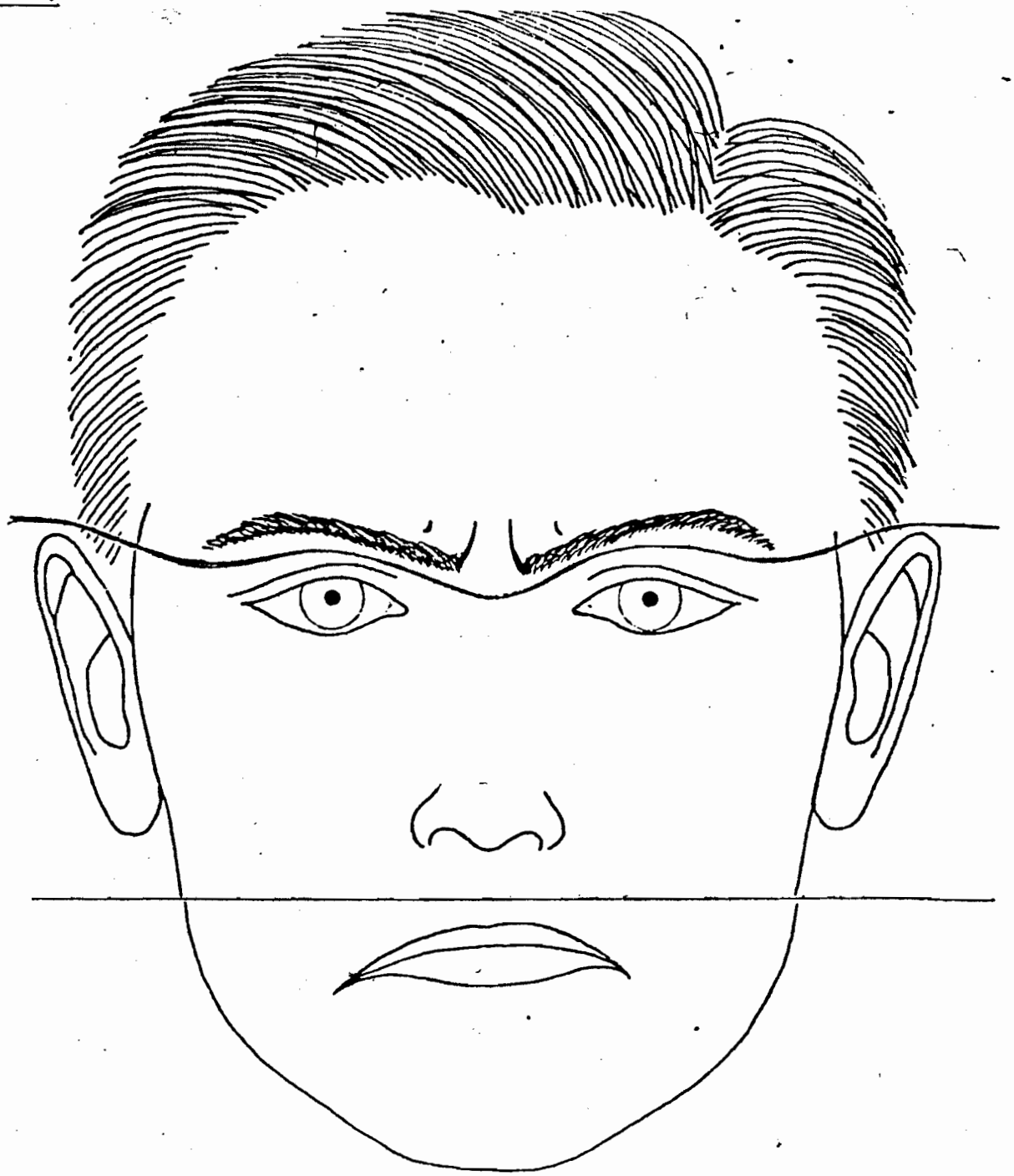


Figure 8.

Figure 9.



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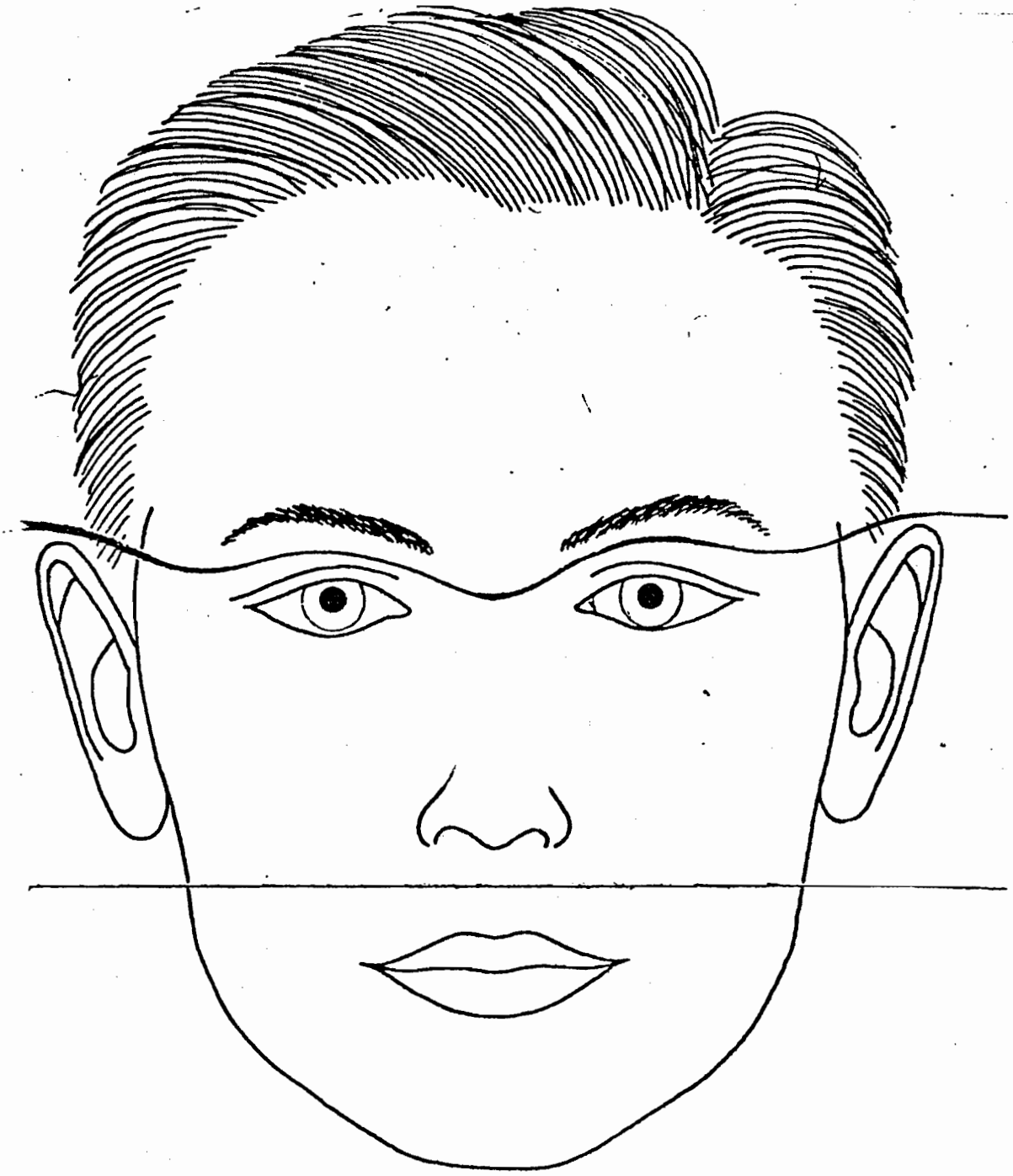

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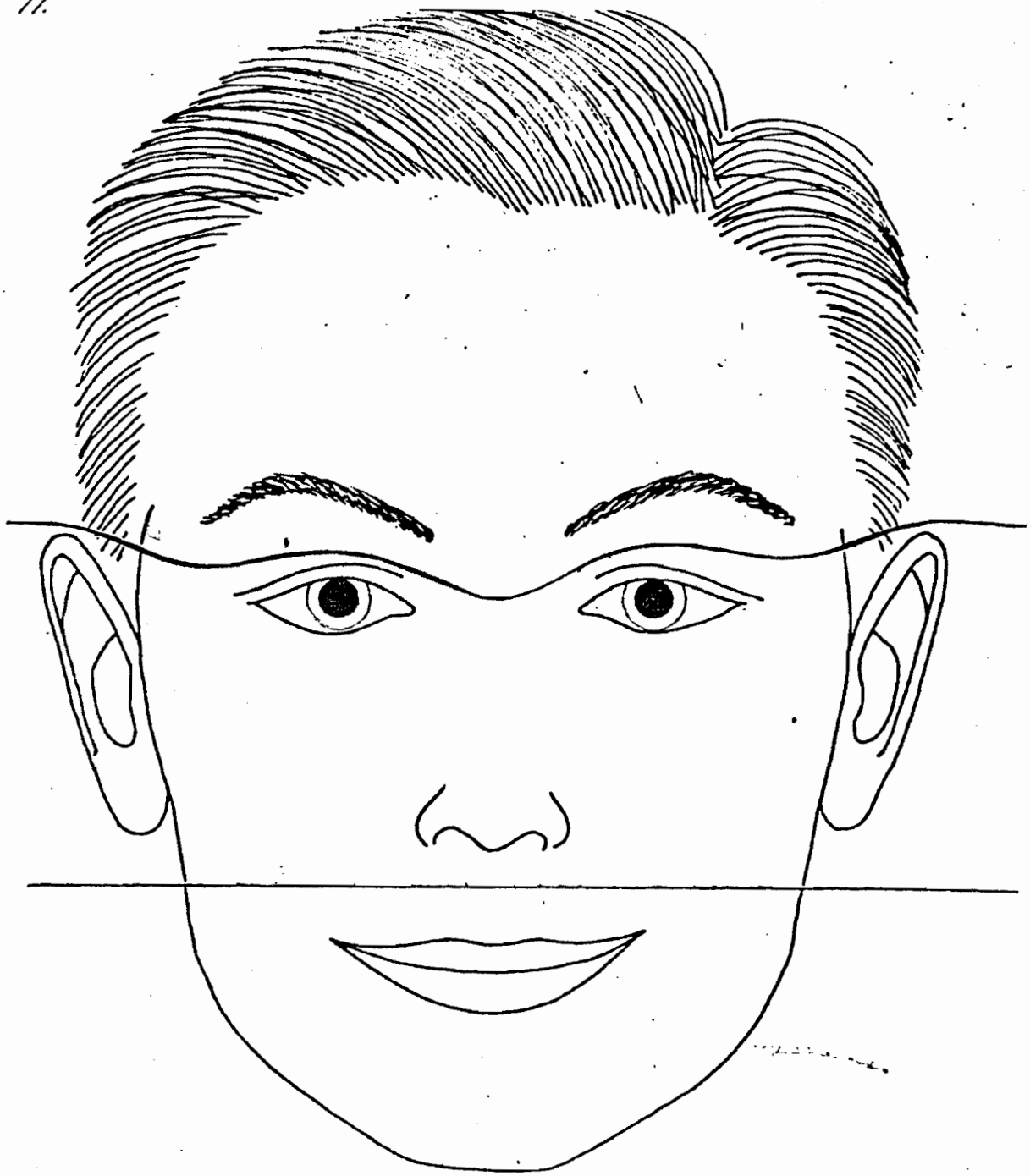

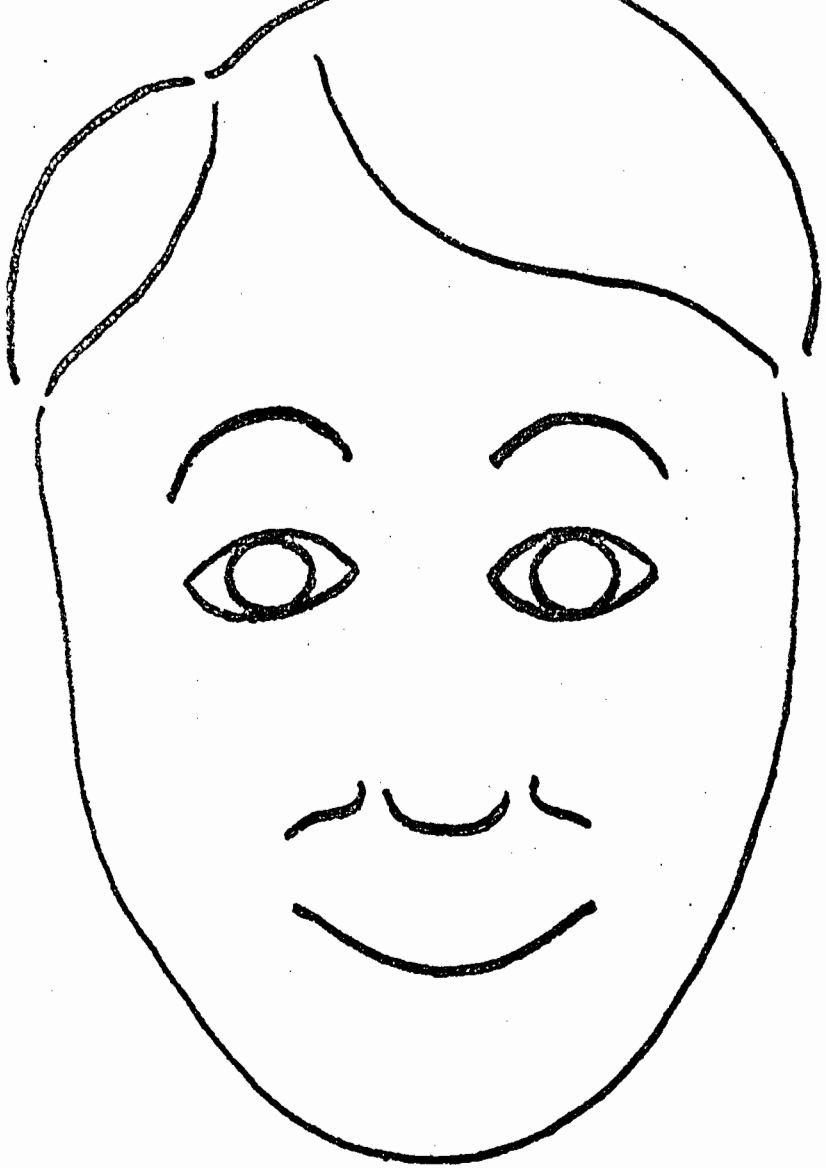

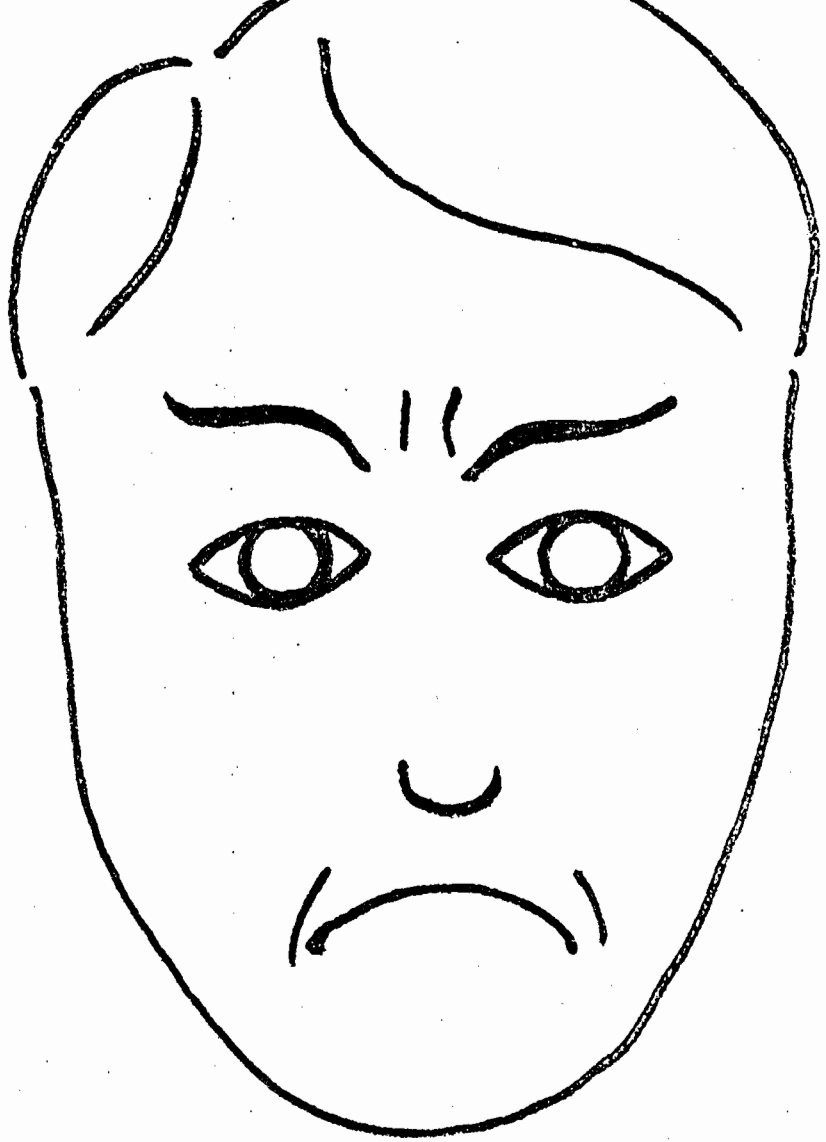

Figure 14.

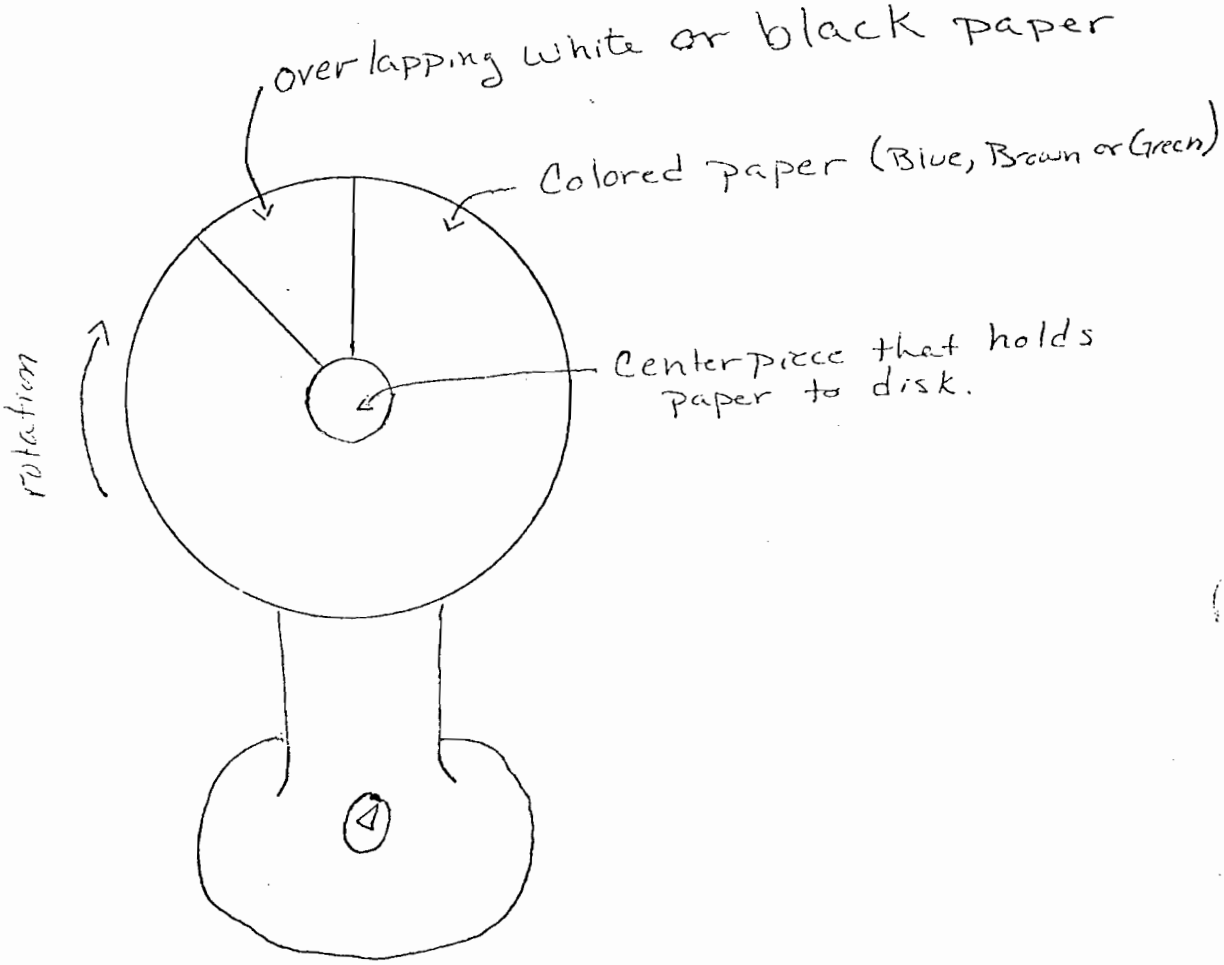
overlapping white or black paper
Colored paper (Blue, Brown or Green)
Centerpiece that holds paper to disk.
rotation

Figure 15.

Subject Eye Rank vs. Mean Pupil Size Differences

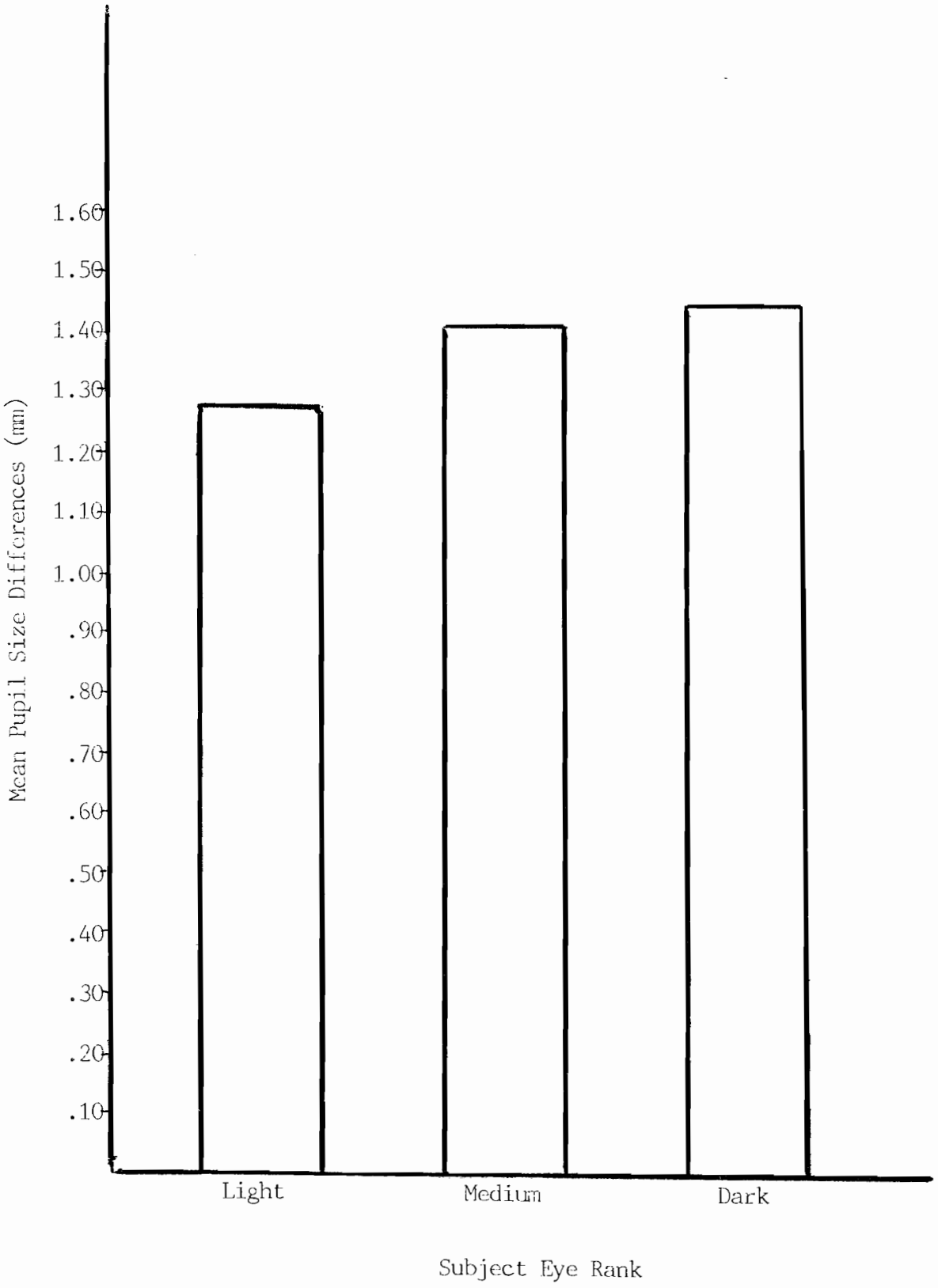

Figure 16.

Parental Eye Rank vs. Mean Pupil Size Differences

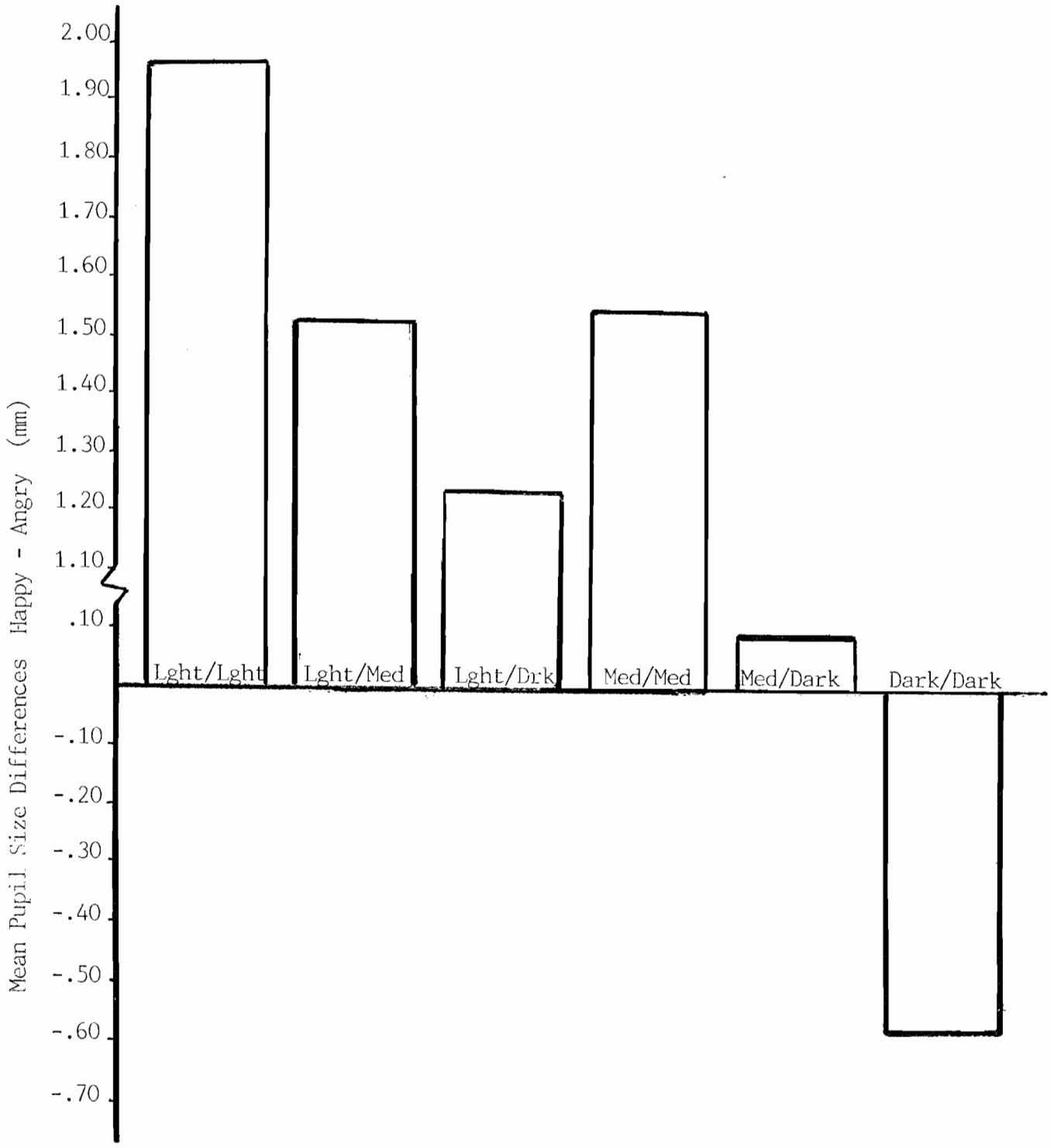

Figure 17.

Parental Eye Ranks vs. Female Mean Comparison Scores

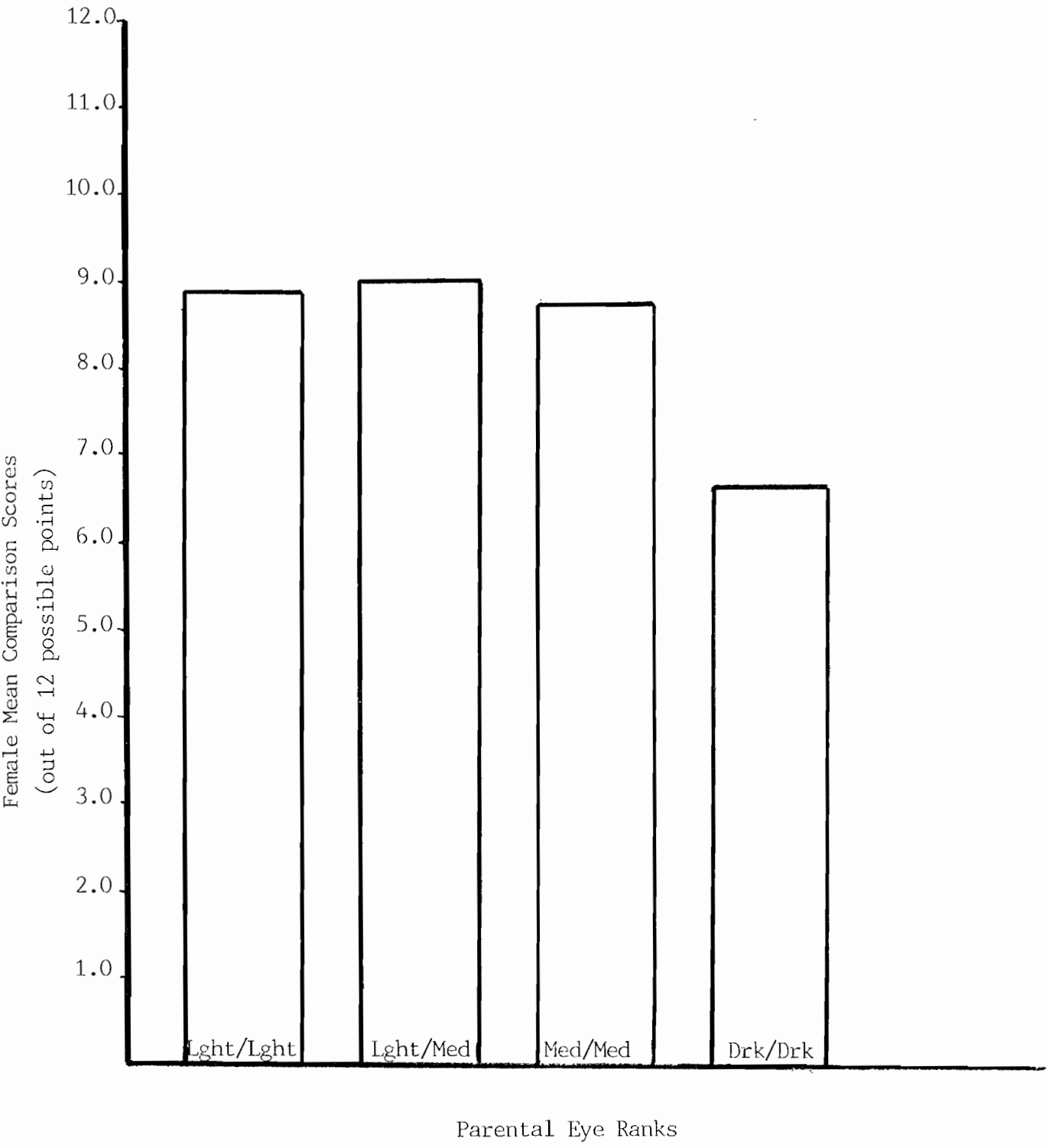

Figure 18.

Eye Rank Of Parent Female Subject Spends More Time With

vs.

Female Mean Comparison Scores