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ABSTRACT

This study explores the development of visual self-recgonition by examining the effect of rouge application on the subsequent mirror behavior of 96 infants, ages 9-24 months. Each infant was observed in front of a mirror in four consecutive conditions: (1) with no rouge applied to infant's nose (baseline), (2) with a dot of rouge on infant's nose, (3) with mother, who has a dot of rouge on her nose, and (4) with infant (still rouged) alone. Behavioral responses were videotaped and coded according to six main categories: facial expressions, vocalizations, attention, mirror-directed behaviors, self-directed behaviors, and imitative behaviors. Results indicate that in the rouged condition, infants increased in nose-directed behaviors, interest and attention, some imitative behaviors, touching own image and body-directed behavior. These results are discussed in terms of self-awareness and stage theory. (GO)

MIRROR-IMAGE STIMULATION AND SELF RECOGNITION IN INFANCY[1]

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INTRODUCTION

Three questions are of interest in the study of the origins of self in man: How does the infant come to know itself? What does it mean for the infant to know itself? How can the infant's knowledge be know to us?

The above questions assume that the young child does have a concept of self, that his knowledge is active and changing, and that early self knowledge may be known by others. The present investigation is an attempt to study empirically the development of self in infancy.

One way of knowing the self is to find an aspect of self knowledge that is easy to define and to observe. One such aspect is visual self recognition. Visual self recognition, or at least facial recognition, is almost universal in our society due to repeated exposure to mirrors and to pictures. Though very young children have been thought not to recognize themselves, little systematic study has actually been undertaken. The present study attempts to remedy this lack of empirical investigation by exploring the development of visual self recognition in mirrors.

The history of the use of mirrors for self-appraisal is long. Humans have been known to look at themselves in mirror-like surfaces for at least 3,000 years (Swallow, 1937). The phylogenetic and ontogenetic histories are also rich. All adult humans, except for those who are psychotic (Frankel, 1964; Wittreich, 1959) or mentally retarded (Shentoub, Soulairac, & Rustin, 1954) recognize themselves in mirrors; whether human infants do so is uncertain. Phylogenetically, self recognition does not occur in any species except the great apes, including man (Gallup, 1968, 1973).

What do we know about self recognition and mirror behavior in the young? There are at least four sources of information: mother's report, diaries on infant development, infant intelligence tests, and experimental studies. Mothers often report that their infants enjoy mirror play, and they sometimes use a mirror to soothe a fussy infant. Social scientists have also made this observation and have realized that the mirror may be used to measure self recognition. Almost a hundred years age, Preyer (1893) and Darwin (1877) both observed that mirror-image stimulation elicited great interest and curiosity in their children. Darwin observed what he thought was self recognition in his 9-month-old son, as his son would turn toward a mirror when his name was called. Of course, today this observation would be attributed to learning, not self recognition.

Infant intelligence test developers were also interested in early mirror behavior, and all of them included mirror items in their scales (Bayley, 1969; Catell, 1940; Buhler, 1940; Griffiths, 1954; Gesell, 1928, 1934). However, none of them included behaviors which were indicative of self recognition. Gesell was the only infant test developer to comment

on the existence of self, believing that self recognition did not occur in the first two years of life. One preschool test developer did see self recognition as an ability present in the young child. In the standardization of the Merrill-Palmer Scale, Stutsman (1931) found that two-thirds of the two-year-olds recognized or labeled themselves upon seeing themselves in a mirror. Mirror self recognition was included in the test as a second-year item.

Even more surprising than the early test developers' lack of interest in self recognition is the experimental psychologists' lack of interest. Only two investigators, Dixon (1957) and Amsterdam (1972), have systematically studied the development of self recognition in terms of mirror-image stimulation. Both Dixon and Amsterdam observed different-aged infants in front of a mirror and postulated age-related stages of mirror behavior. Dixon outlined four stages--(1) "Mother", (2) "Playmate", (3) "Who do dat when I do dat?", and (4) "Coy". In the "Mother" stage, the infant enjoys observing another's movement in the mirror; in the "Playmate" stage, the infant responds playfully to his own image (as if it were a peer); in the "Who do dat when I do dat?" stage, the infant is interested in observing the actions performed by himself; and in the "Coy" stage, the infant acts coy, shy, or fearful in front of the mirror. Dixon believes the "Coy" stage to be indicative of self recognition.

Amsterdam's stages are similar; the first involves social responding to the mirror (smiling at, vocalizing to, approaching, and patting the mirror), the second is the beginning of self awareness (acting self-conscious, fearful, and coy and averting one's gaze), the third involves

self recognition (self-directed rather than other-directed behavior). The social stage is prevalent from six to 12 months of age, the transitional stage from 12 to 18 months of age, and the self recognition stage from 20 to 24 months of age. Amsterdam also reports little overlap between stages.

These two studies, although interesting, are inadequate for several reasons. First, the sample sizes are small (five infants were seen longitudinally by Dixon and four infants were seen each month through the first two years of life by Amsterdam). Second, there were procedural difficulties in that the infants could see their mothers and the observer in the mirror in both studies, and the infants were confined in a playpen for 7 1/2 minutes in the Amsterdam study. These procedural difficulties present two problems, the first having to do with the ecological validity of the situation (observers are not present in the home and infants do not usually engage in mirror play in a playpen), and the second having to do with the reflection to which the infant is responding (is the infant smiling and vocalizing to his image, his mother's or the observer's?). Third, the behavioral criteria for the existence of the stages could be more rigorously defined and observations could be better standardized. The present study was designed with these problems in mind.

EXPERIMENTAL DESIGN AND PROCEDURE

Design

In the present study, infants' reactions to mirrors were observed using an ingenious technique independently developed by Gallup (1968, 1970, 1973) and by Amsterdam (1968, 1972). Sixteen infants (eight males and

eight females) in each of six age groups, were observed in the following mirror situation. Each infant was first placed in front of a large mirror and observed (No Rouge Condition). Then, a dot of rouge was placed on the infant's nose by his mother and he was again observed in front of the mirror (Rouge 1 Condition). Then, the experimenter applied a dot of rouge to the mother's nose and the infant's reaction to his mother's marked face was noted (Mother Rouge Condition). After he had seen his mother, the infant was placed in front of the mirror for a third time (Rouge 2 Condition). The four conditions were labeled No Rouge, Rouge 1, Mother Rouge, and Rouge 2.

Comparisons

The study was designed so that three comparisons could be made. However, only the data regarding the first comparison will be presented today. Briefly, the comparisons are as follows.

1). The Effect of Rouge Application on Self-Directed Behavior

Each infant's responses in the No Rouge and the Rouge 1 Conditions will be compared to see whether the presence of a mark on the infant's nose affects his behavior. Using an unmarked condition as a baseline is essential since the incidence of spontaneous face- or nose-directed behavior has never been systematically observed. Amsterdam's (1968, 1972) study may be criticized for not including an unmarked condition.

2). A Comparison of Mark Recognition on the Mother and on the Self

Each infant's ability to recognize a mark on his mother's nose as well as his own will also be compared. Although the Mother Rouge Condition was designed primarily as a training technique, as is discussed in the third comparison, the salience of a mark on the face in

general may be tested in this comparison. This is important since the effects of facial distortions per se, with the exception of scrambled features, have not been studied. Perhaps a small dot of rouge on the nose would not be discovered by a certain-aged infant, whereas a larger distortion would. The mother condition will give us information on facial distortion independent of self recognition.

3). The Effect of Maternal Mark Recognition on Subsequent Self-Directed Behavior

The mother mark condition may be seen as a training technique as well as a salience test, since recognition of rouge on the mother's nose might facilitate recognition of the rouge on oneself. Thus, the incidence of self-directed behavior in the Rouge 1 and Rouge 2 Conditions may be compared in terms of whether or not maternal mark recognition occurred. The crucial comparison involves the infants who do not touch their noses in the Rouge 1 Condition but do touch their mothers' noses. Are these infants more likely to recognize the mark in the Rouge 2 Condition than are infants who do not touch their mothers' noses?

Procedure

Infants were brought to the laboratory by their mothers and greeted by the experimenter. Each infant was given approximately five minutes to "warm-up" while the procedure was explained to the mother. The following instructions were given:

> We will observe your child's behavior in front of a mirror. Mirror play is of interest since we believe that it is related to self recognition. To test this idea, the following procedure has been designed and will be used. First, I will take you and your child to another room where a large mirror has been placed on the floor. There is a camera behind the mirror which will record your child's mirror play. After I have left the room, please encourage your child to go to the mirror. You may place him in front of the mirror, tell him to go to the

mirror, sit beside the mirror, or place the small chair in front of the mirror. Do not sit in front of the mirror yourself.

After I have observed your infant in front of the mirror from the observation window, I will re-enter the mirror room. I will give you a cloth which has rouge on it. Please wipe your child's nose with the rouge so that his nose is noticeably red. Tell the child that you are wiping his/her face because it is dirty. Do not mention the child's nose or the rouge. I will then leave the room and go to the observation window. I will knock on the window three or four times. Each time, try to get your child to look at himself in the mirror. Again, do not mention the child's nose or the rouge and do not sit where your image would reflect in the mirror.

After your infant has observed himself, I will come back into the room and apply rouge to your nose. Then I will leave and knock two different times on the observation window. At the first knock, get your child to look at you by sitting next to him or by picking him up. Talk to him but do not mention your nose, his nose, or the rouge. On the second knock, please have your child go to the mirror alone again. Are there any questions?

The infant was then taken to the mirror room, which was pleasantly decorated and which contained two chairs, a table, and wall posters. There were no toys in the room so as not to detract from the mirror. The mirror itself was a 46 cm. x 89 cm. one-way mirror mounted in a large 1.22-m. x 2.44 m. piece of plywood. The entire structure fit between two of the walls in the room and formed a triangle with the walls and the corner of the room. A camera was placed inside this triangle and was covered with a black cloth to reduce the amount of light on the back side of the one-way mirror.

The E left the room, only re-entering prior to the rouge applications. The mother applied the rouge to the infant, the E to the mother. The ruse of wiping the face was effective, as only one of the 96 infants touched his nose immediately after the rouge was applied and before looking in the mirror.

Measures

We were interested in a large number of behavioral responses. These may be classified as follows: (1) facial expressions, (2) vocalizations, (3) attention, (4) mirror-directed behaviors, (5) self-directed behaviors, and (6) imitative behaviors. The behaviors included in each category are presented in Table 1.

Insert Table 1 about here

Although all of these behaviors will not be discussed here, the listing gives an idea of the large range of behaviors exhibited toward the mirror by the infants.

Observer Reliability

The infants' responses to the mirror conditions were videotaped, and behavioral coding was done from these videotapes. Eleven subjects were randomly selected for reliability purposes and their tapes coded by two observers. Observer reliability was calculated by the following formula: number of agreements/number of agreements and disagreements. The percentage of agreements between the two observers for the 11 subjects was quite high. The percentages ranged from 88% to 100% for mirror-directed, self-directed, and imitative behaviors. Agreements were also high for smiling (93%), and frowning (100%), but were somewhat lower for the concentrate expression (70%).

Interobserver reliability for attention was calculated differently. Since number of looks was coded, the percentage of agreements may be calculated by using the number of looks as the denominator, the number

of agreements as the numerator. Using this method, the interobserver reliability for number of looks was 84%.

RESULTS

The present paper deals with the effect of rouge application on subsequent mirror behavior. We were interested in whether or not certain behaviors changed as a function of the mark application and as a function of age. That is, were some behavioral changes more likely to occur in the older than in the younger infants?

Five different behavioral categories were examined; these are (1) attention, (2) facial expression, (3) mirror-directed behavior, (4) self-directed behavior, and (5) imitative behavior. The absence or presence of each behavior for each condition was coded. Thus, the data to be presented are in the form of percentage of subjects exhibiting each behavior. The following figures present the percentage difference scores for each age group between the No Rouge and Rouge 1 Conditions. These percentages reflect both the magnitude and the direction of change. Positive scores indicate that more infants exhibited a specific behavior in the Rouge than in the No Rouge Condition.

Nose-Directed Behavior

The central issue of the study was whether or not the infants noticed the rouge. Nose- (or mark-) directed behavior increased dramatically from the No Rouge to the Rouge 1 Condition, occurring only twice in the former and 30 times in the latter condition. Nose-touching was also highly related to age. None of the 9- or 12-, three of the 15-, four of the 18-, 11 of the 21-, and 12 of the 24-month-olds exhibited

mark-directed behavior ($\underline{X}^2_{(5)} = 40.05$, $p < .001$). This increase was a monotonically increasing function.

Insert Figure 1 about here

Figure 1 presents pictorially the age of subject x stimulus condition interaction, which was highly significant ($\underline{X}^2_{(2)} = 32.63$, $p < .001$). The increase in nose-touching, of course, only occurred in the older age groups.

Thus, nose-touching was directly related to the rouge application as it rarely occurred in the base condition. In addition, the age of the infant strongly dictated whether or not mark-directed behavior occurred. Would other behaviors exhibit such trends?

Attention

The number of looks directed toward the mirror increased dramatically after the rouge application. There were one and one-half times as many looks in the Rouge 1 as in the No Rouge Condition ($\underline{F}_{(1, 66)} = 38.92$, $p < .001$). The increase was found for all age groups, as is shown in Figure 2.

Insert Figure 2 about here

Another measure of attention or interest is the concentrate expression. The concentrate face has only recently been considered noteworthy (Brooks & Lewis, 1975; Sroufe, Waters & Matas, 1974) and in fact has often been considered a negative response (Lewis & Brooks, 1974; Morgan & Ricciuti, 1969; Scarr & Salapatek, 1970). However,

the characteristics of this expression (open mouth shaped like an "O" or an ellipse, eyes wide open, eyebrows raised) are related to cardiac deceleration (Sroufe, Waters & Matas, 1974), which suggests that this expression may be associated with attention and interest rather than negative affect.

Insert Figure 3 about here

In fact, the concentrate facial expression data complement the looking data well. More infants exhibited a concentrate expression in the marked than in the unmarked condition ($\underline{X}^2 = 21.95$, $p < .001$). Figure 3 presents the percentage difference scores for the concentrate expression by age. As can be seen, there were no age differences, as the increase in concentrate expression was found for all age groups.

Thus, increased interest and attention were associated with the mark application. This was true for all age groups, even the younger ones who did not exhibit mark recognition.

Affect

There were no stimulus condition or age group differences with respect to pleasant and negative vocalizations or facial expressions. All age groups were highly likely to exhibit positive affect and were not likely to exhibit negative affect in either condition.

Mirror-Directed Behavior

In general, mirror-directed behaviors were not affected by the rouge application for the total sample. There was one interesting exception. More infants touched their own image in the mirror during the marked

than the unmarked condition ($\underline{X}^2 = 4.36$, $p < .05$). This stimulus effect was influenced by age. As can be seen in Figure 4, the older infants were more likely to touch the image in the marked than the unmarked condition than were the younger ones ($\underline{X}^2_{(2)} = 7.87$, $p < .02$).

Insert Figure 4 about here

Imitation

Three imitative categories were coded; these are (1) bouncing, waving, and clapping, (2) making faces, and (3) acting silly or coy. Only acting silly or coy was affected by the mark application. As is shown in Figure 5, the older but not the younger infants were more likely to act silly or coy in the marked condition ($\underline{X}^2_{(2)} = 6.84$, $p < .05$).

Insert Figure 5 about here

Body-Directed Behavior

Body-directed as well as nose-directed behavior might also increase in the marked condition, as recognition of the mark might result in more general exploration of the body as well as of the mark itself. In fact, such an increase did occur, as the difference scores in Figure 6 indicate. As is shown in Figure 6, the increase in body-directed behavior was seen in all age groups, even in those which did not exhibit mark recognition.

Insert Figure 6 about here

DISCUSSION

Mark Recognition

The central issue of the study was whether or not the rouge application would affect infants' responses to the mirror and would result in mark recognition. Recognition of the rouge was clearly demonstrated, as 30 infants touched, wiped, or verbally referred to the marked nose immediately following the rouge application. Only two infants touched the nose prior to the mark application, indicating that spontaneous nose-touching did not affect our results. Striking developmental trends were found as none of the 9-12-, one-quarter of the 15-18-, and three-quarters of the 21-24-month-olds touched their noses.

How do our findings relate to those of others? Only Amsterdam's study is comparable since she also used a mark-on-the-face technique. However, mark recognition occurred earlier (15 versus 18 months) and more frequently (32% versus 17%) in the present study than in Amsterdam's (1968).

What might account for the earlier and more frequent self recognition in our sample? First, procedural differences may have affected the results, since Amsterdam's infants were confined to a playpen for a long period of time, had had their clothes removed immediately before testing, were seen in conjunction with a medical check-up, and had an observer present. Thus, Amsterdam's situation may have been more stressful (and less ethologically valid) than ours. Second, the social class composition of the samples was somewhat different. Amsterdam's

sample was more hetereogeneous than was ours. However, there were no effects of social class with respect to self recognition within our sample, and Amsterdam (1972) reports no relationship between social class and self recognition.

Mark Recognition and Other Response Patterns

The rouge application also affected the expression of other behaviors. The infants looked at themselves more often, were more likely to touch their image in the mirror, act silly and coy, touch their own body and to exhibit a concentrate expression in the marked than in the unmarked condition. There were important age differences in the expression or differential responding. The increase in number of looks, concentrate expression, and body-directed behavior occurred in all age groups, while acting silly or coy, touching one's nose, and touching one's image only increased in the older infants.

From which measures are we to infer self awareness? If we use self-directed behavior as an indice, then all age groups were aware of themselves. If only nose-directed behavior is used, then self awareness is age related. The problem of measurement is not easily resolved, especially since age-related physical coordination may be affecting the ability to direct behavior visually toward the mark. Regardless of the measure used, by 15 months of a age, infants are able to exhibit behaviors clearly indicative of self awareness. That infants as young as 9 months may show self awareness is an unanswered question and awaits further measurement refinement.

The Development of Self Recognition: Does a Stage Theory Explain the Findings?

Both Amsterdam (1968, 1972) and Dixon (1957) suggested a stage theory to explain infants' responses to mirrors. In both conceptualizations, a stage seems to be defined by the appearance of certain behavior clusters which are superceded by new behavior clusters as a function of age. Each behavior cluster is predominant at a certain age, slowly disappearing as the new cluster enters the child's repertoire. Amsterdam outlines three stages: (1) social responding or playmate stage, (2) transitional or self-conscious stage, and (3) self recognition or mark-directed stage. She suggests that self recognition is not evident before a certain age and that it is preceded by transitional behaviors, such as coy or self-conscious behaviors.

Our data lend little support to such a stage theory. Most of the behaviors observed were not seen exclusively at one age. Some behaviors remained constant over the six age groups, some gradually increased and some decreased with age. All of the infants were interested in the mirror and interacted with it. Smiling, touching, and pleasant vocalizations, which had been considered evidence of a playmate stage by Dixon and Amsterdam, were exhibited by over three-fifths of all age groups. Other behaviors were affected by age. For example, mark-directed behavior and acting silly or coy increased with age. However, none of these behaviors formed discrete clusters or were exhibited in only one age group.

The fact that the rouge application affected responding also weakens the stage theory concept. Even the youngest infants, none of

whom exhibited mark recognition, reacted differently prior to and following the rouge application. This suggests that mark recognition is not a discontinuous phenomenon.

Thus, there is little evidence for stages in the development of visual self recognition in mirrors. The process of recognizing oneself seems to be gradual and continuous.

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Footnote

[1]This paper was presented at the Biennial meetings of the Society for Research in Child Development, Denver, April 1975.

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Table 1

Behaviors Observed in the Mirror Conditions

Facial Expression

Broad smile
Slight smile
Concentrate
Slight frown
Broad frown

Vocalization

Laugh, squeal
Coo, babble, lall
Whimper, whine, fret
Cry, scream

Mirror-Directed Behaviors

Points to mirror
Touches, pats mirror
Touches own image in mirror
Kisses, mouths mirror
Hits, kicks mirror

Imitation

Bounces
Claps
Waves
Skips
Acts silly, clowns
Acts coy
Makes faces
Sticks tongue out

Self-Directed Behaviors

Touches face
Touches body
Places hand in mouth
Touches nose
Wipes nose repeatedly
Points to self
Says name
Says nose

Attention

Number of brief looks
Number of moderate looks
Number of sustained looks
Number of total looks

Looks at Mother

Plays with Lights

Uses Mirror for Support

Sits in Small Chair

Fussy

Figure Captions

Figure 1. Nose-directed behavior: Percentage difference between the No Rouge and Rouge 1 Conditions by age.

Figure 2. Total number of looks: Mean difference score between the No Rouge and Rouge 1 Conditions by age.

Figure 3. Concentrate expression: Percentage difference between the No Rouge and Rouge 1 Conditions by age.

Figure 4. Touches image in the mirror: Percentage difference between the No Rouge and Rouge 1 Conditions by age.

Figure 5. Acts silly or coy: Percentage difference between the No Rouge and Rouge 1 Conditions by age.

Figure 6. Body-directed behavior: Percentage difference between the No Rouge and Rouge 1 Conditions by age.

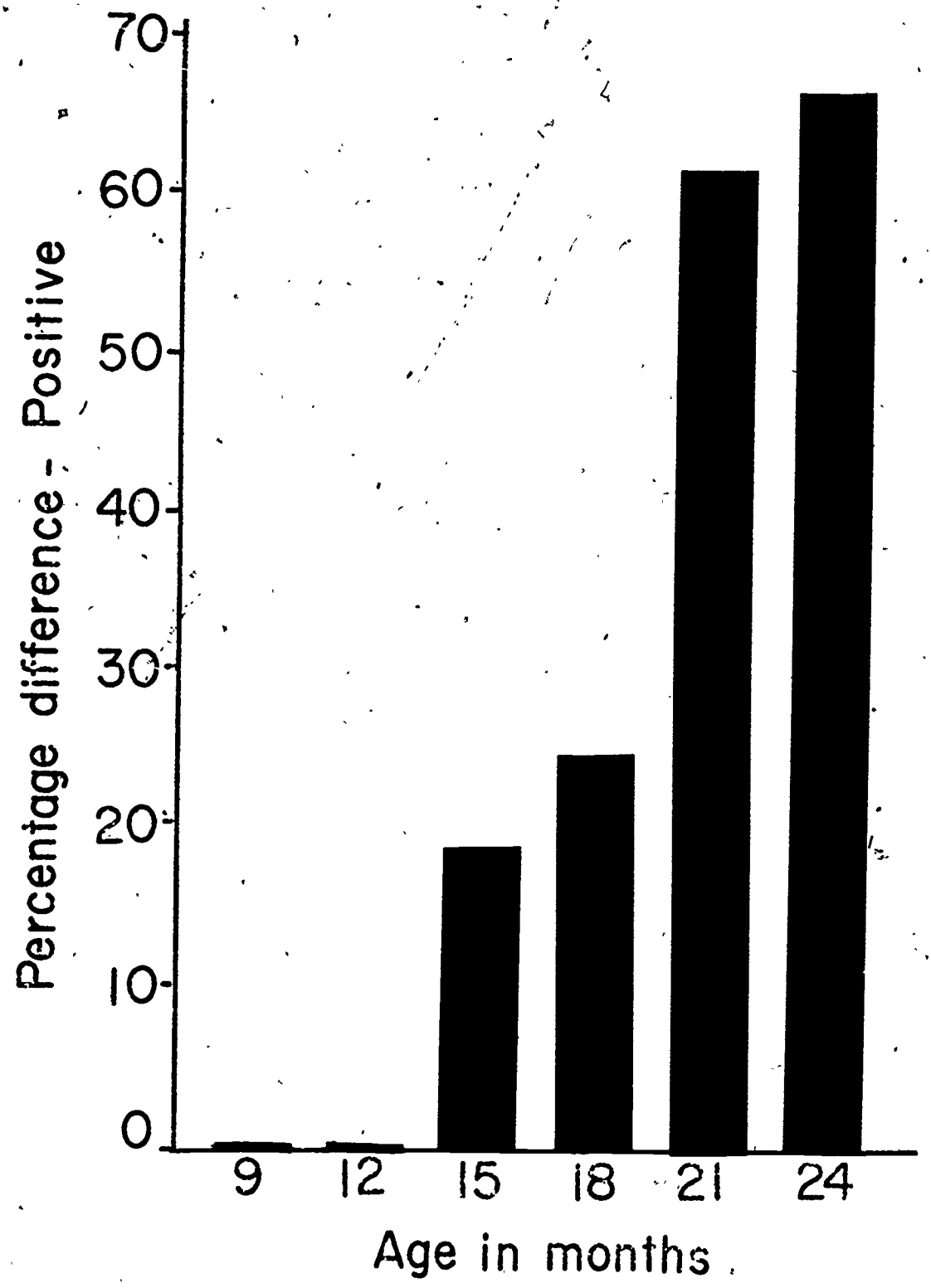

Figure 1. Nose-directed behavior: Percentage difference between the No Rouge and Rouge 1 conditions by age

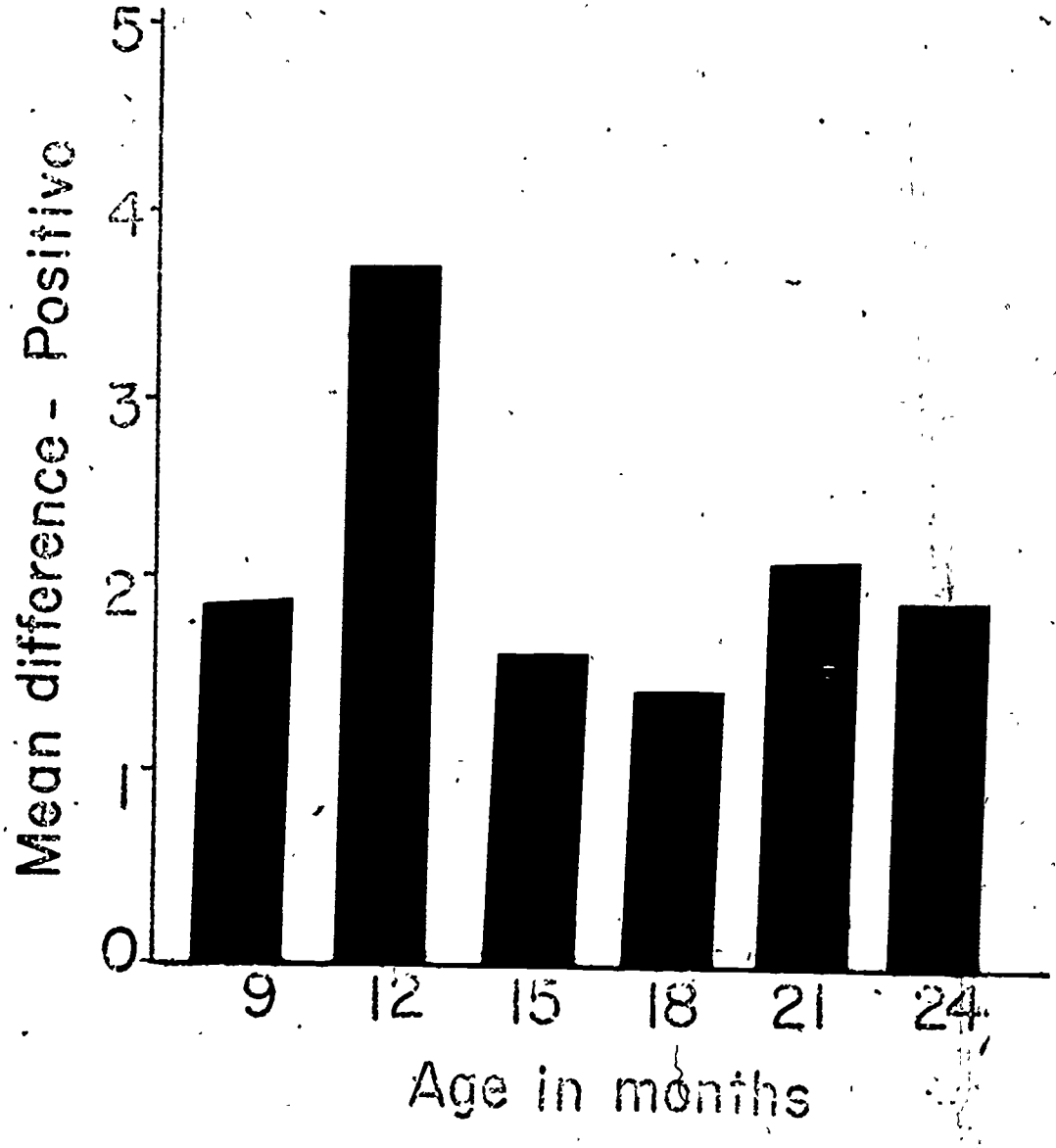

Figure 2. Total number of looks: Mean difference score between the No Rouge and Rouge 1 conditions by age

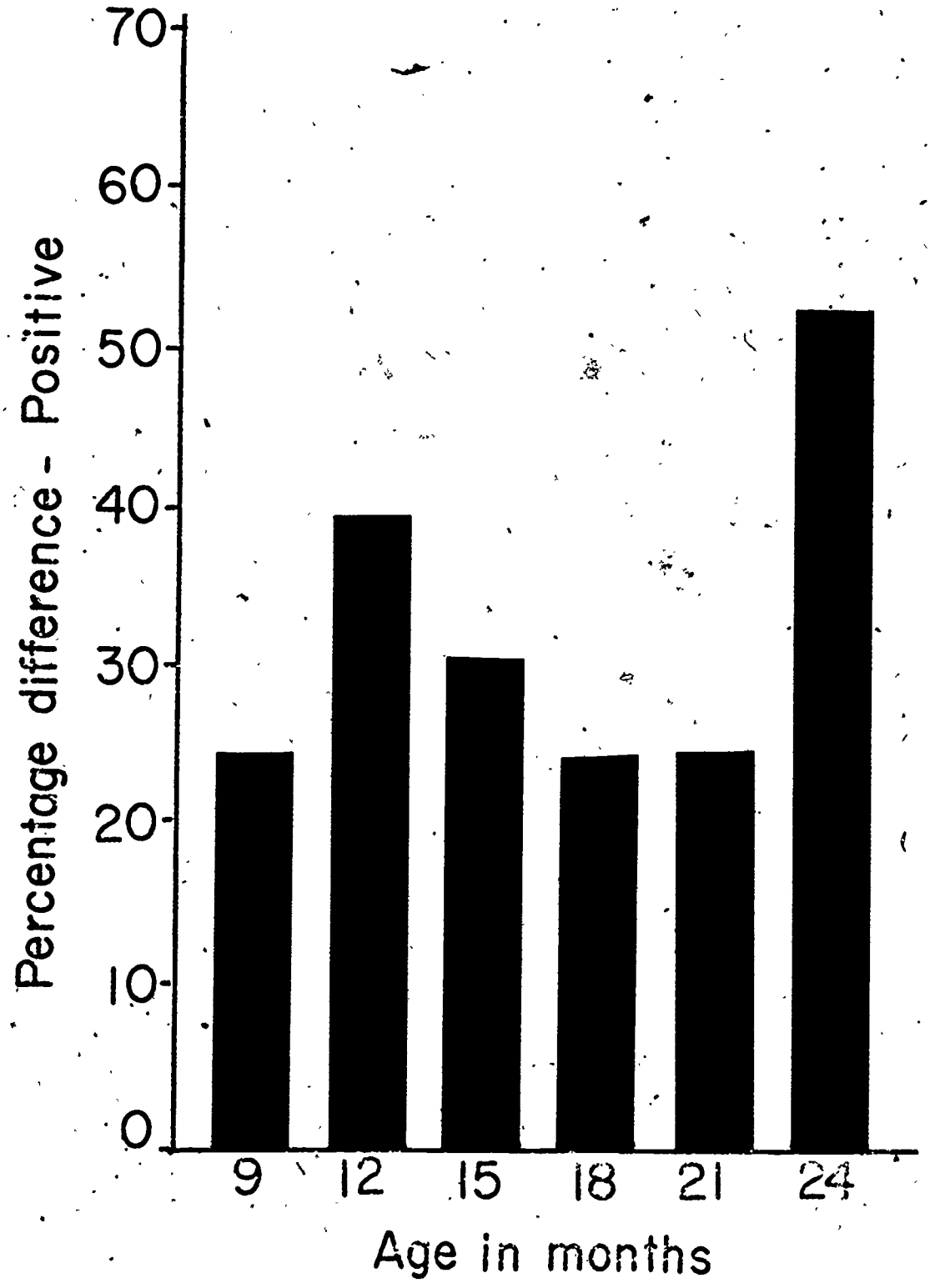

Figure 3. Concentrate expression: Percentage difference between the No Rouge and Rouge 1 conditions by age

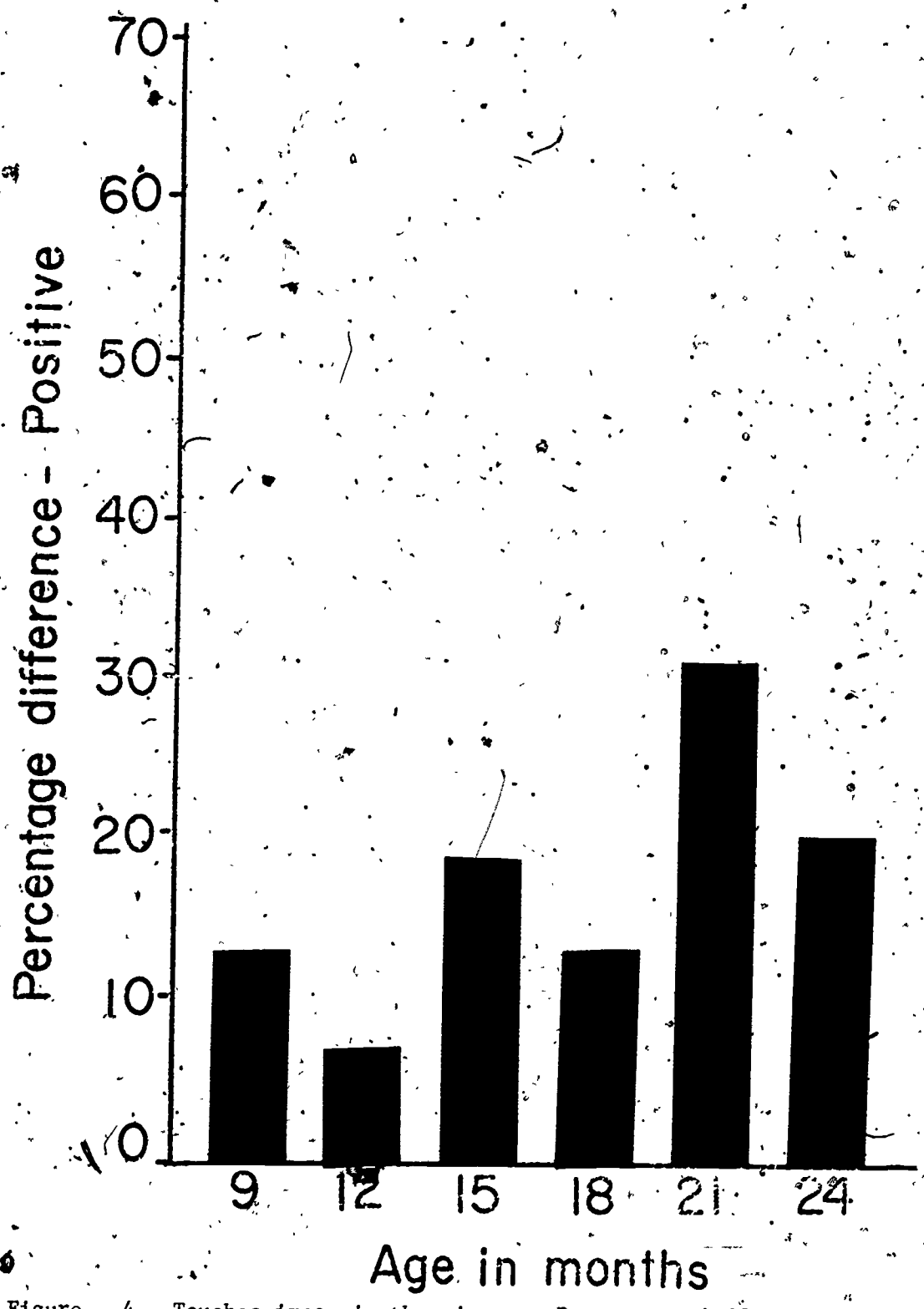

Figure 4. Touches image in the mirror: Percentage difference between the No Rouge and Rouge 1 conditions by age

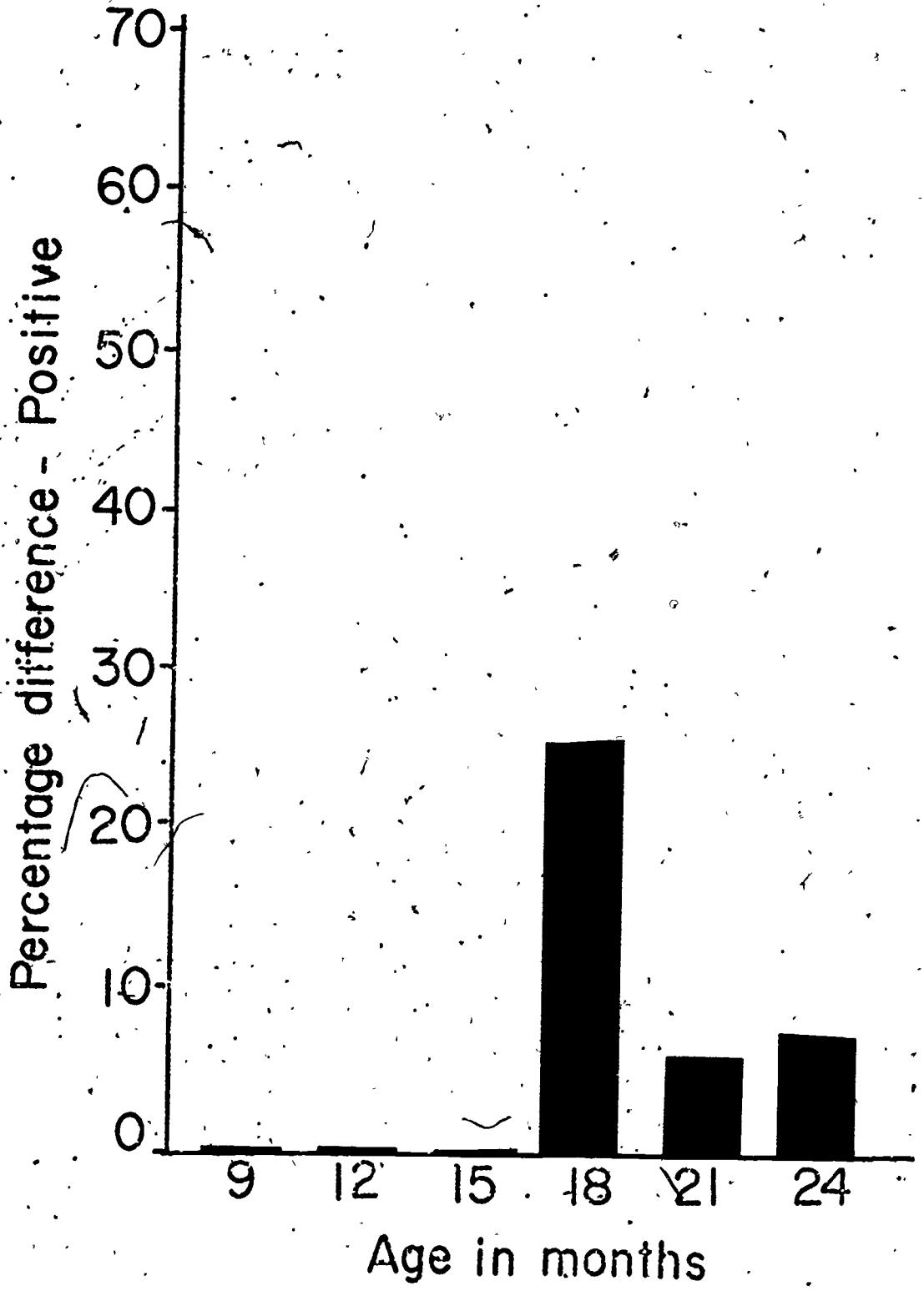

Figure 5. Acts silly or coy: Percentage difference between the No Rouge and Rouge 1 conditions by age.

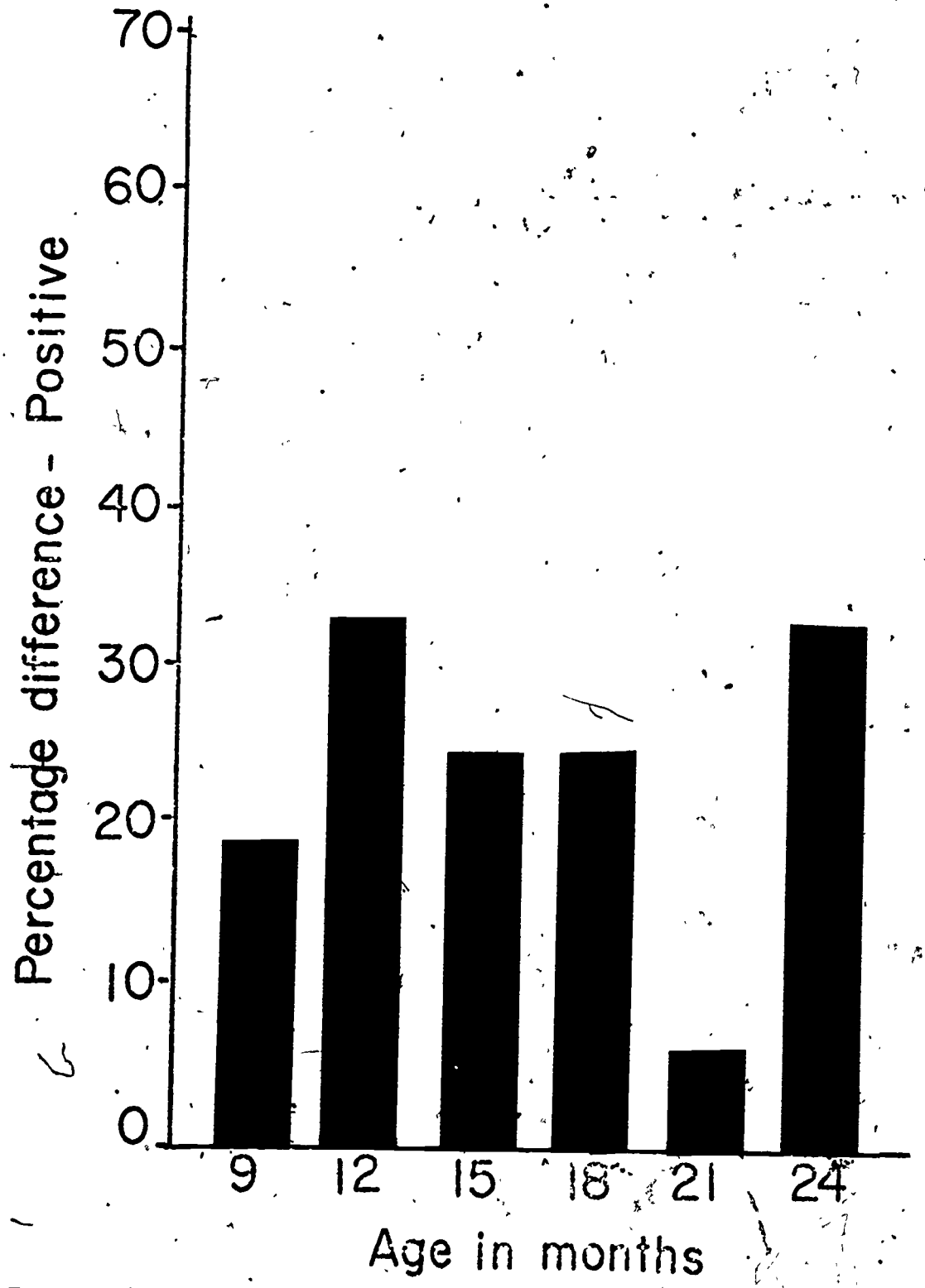

Figure 6. Body-directed behavior: Percentage difference between the No Rouge and Rouge 1 conditions by age