Mother and Peer Attachment Under Conditions of Fear in Rhesus Monkeys (*Macaca mulatta*)

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ABSTRACT. Attachment behavior of six infant rhesus monkeys was examined in a fear situation under two experimental conditions. When both a familiar agemate and the infant's mother were present in separate cages, the infants spent significantly more time in proximity to their mother than to their agemate. When a caged agemate and an empty cage were present, the infants distributed their time approximately equally between the empty cage and the agemate. Five additional behavioral measures also indicated that the infants did not use their peers as mother substitutes in a fear-arousing situation. These findings support HARLOW's postulate of independence of the infant-mother and agemate affectional systems.

INTRODUCTION

HARLOW (1966) has postulated the independence of the infant-mother and agemate or peer affectional systems in primates. If these systems in fact are independent, then differences should be seen in the topography of the behavior, in the conditions that elicit and control it, and in the function each system serves (MACCOBY & MASTERS, 1970). In previous studies of infant monkeys and their mothers, fear-arousing stimuli elicited mother contacting (BOWLBY, 1969). However, the infant's responses under fear conditions when a same-aged playmate was present have never been studied. If, in a stressful situation, an infant chose to contact and remain near its mother rather than an agemate when both were present, and did not seek proximity to the agemate when alone with him under similar conditions, then the hypothesis of system independence would be supported.

In contrast to HARLOW's position, LEWIS and BAN (1971) have argued that anxiety generates a general need for affiliation rather than for specific attachment. Presumably an agemate could function as an attachment object in the same way as the mother. SCHAFFER and EMERSON (1964) found evidence of multiple attachment figures in the majority of their subjects, and they also reported that a child could form strong attachments to individuals who were present for comparatively limited periods and who did not play a nurturant role toward the child.

In the present study, infant rhesus monkeys (*Macaca mulatta*) were exposed to a fear-inducing situation under two conditions: when both mother and an agemate were present and when only an agemate was present. Although a complete design would have also included a condition in which only the mother was present, it is already known that fear-inducing stimulation produces contacting of a mother or mother-surrogate (HARLOW & HARLOW, 1965). If a diffuse need for affiliation in a

stressful situation is operating, the infant should seek proximity to his peer when alone with him, and to either his mother or his peer when both are present. If the affectional systems are indeed independent, and a specific attachment is elicited, then the infant should seek proximity to his mother but not to his peer.

METHOD

SUBJECTS

Six infant rhesus monkeys (*M. mulatta*), four males and two females, ranging in age from 7 to 10 months, served as subjects. Favorite playmates of the same sex were paired as agemates in the experimental situation: two females, both 10-months old, two males, also both 10 months old, and two males aged 7 and 9 months. Infants were paired on the basis of their frequency of interaction with particular playmates, as determined by participation in 346 dyadic play encounters recorded periodically in the colony for the six months preceding the study. All of the infants played with each other, but the three pairings used in this experiment included only the partner of highest frequency for each of the infants. These infants had lived together from birth in a colony situation with their mothers, a dominant male, and six other adult and subadult monkeys of the same species. They were housed at the Stanford Animal Facility in a 6 ft × 12 ft × 8 ft room, with access to a 20 ft × 12 ft × 8 ft outdoor pen.

Procedure

All subjects were observed in both the agemate-mother and the agemate-only experimental conditions. In the agemate-mother condition, the infant's mother and favorite playmate were both present in the test room in separate cages. In the agemate-only condition the infant's favorite playmate was present in one cage, and another cage was empty. In each experimental condition the subject was released from his individual cage at three different times under essentially high fear conditions. Each subject was exposed to a pretested fear stimulus prior to his second release.

On a given day only three infants served as subjects; the remaining three were present in the experimental situation as agemates. Half of the subjects were randomly selected to receive the agemate-mother condition first. The agemate-only condition for these subjects was tested one week later. The other half of the subjects received the two conditions in reverse order.

The testing room was a 20 ft × 12 ft × 8 ft indoor room, unfamiliar to the subjects. The infants and their mothers were hand-caught in their home cage about two hours prior to the start of an experimental session and placed in individual cages. The individual cages of the mothers and infants were placed next to each other for a two hour habituation period prior to being moved to the testing room.

The infant to be tested, and the infant's agemate and/or mother were moved into the test room in their individual cages 15 minutes prior to testing. The mother's and agemate's cages were placed on cage racks near the ceiling in opposite corners of the far end of the testing room, at equal distances from the subject's starting point. The two cages were 8.75 ft apart. In the agemate-mother condition, the subject's agemate was placed in one corner cage and the subject's mother in the other. In the

agemate-only condition, the subject's agemate was placed in one corner cage and an identical empty cage was placed in the other corner. The subject's cage was placed on the floor at the opposite end of the room, 15.5 ft away from the mother's and the agemate's cages. The door of the subject's cage faced the cages of the agemate and mother.

Both the agemate-mother and agemate-only experimental conditions were divided into three phases. The positions of the agemate and mother (or empty cage) were randomly varied except that neither agemate nor mother (or empty cage) occurred in the same position in all three phases. The scoring and procedure were the same within all three phases: each subject was released from his individual cage in the test room for 10 minutes, during which two observers scored his behavior for sixty 10-second intervals on measures of fear and of proximity to either the agemate, mother, or empty cage. At the end of phase I the subject was recaptured and returned to his cage for 15 minutes. The pretested fear stimulus, looming (the symmetrical expansion of a silhouette indicating impending collision), was then presented to the caged subject approximately one second prior to release and the beginning of phase II. At the end of phase II the subject was recaptured and removed from the testing room for one hour before beginning phase III. After the completion of phase III, the subject was returned to his home cage.

The pretested fear stimulus was the opening of a black, pushbutton umbrella at a distance of one foot from the subject. This stimulus was chosen because it reliably elicited a startle response on repeated trials with a 9½-month-old rhesus monkey from another colony, and because it resembles a "looming (the symmetrical expansion of a silhouette indicating impending collision)" stimulus known to provoke persistent fear responses in rhesus monkeys (SCHIFF, CAVINESS, & GIBSON, 1962). The original experimental design provided for comparisons between phase I (pre fear stimulus), phase II (fear stimulus), and phase III (post fear stimulus). However, the capuring of the animals prior to testing, the confinement in individual cages, and the unfamiliar testing room were so fear-inducing in themselves (as evidenced by the high level of distress vocalizations, threats, defecation, and urination in phase I) that the looming stimulus itself did not induce measurable behavioral changes across the three phases. Therefore, scores from the three phases were combined in the analysis.

Measures and Scoring

Six behavior categories were chosen as sources of information on attachment behavior. The proximity measure was differentiated on the basis of target: Mother, empty cage, or agemate.

1. *Proximity:* Number of time intervals during which the subject was the distance of one body length or less away from mother (or empty cage) or agemate.

2. *Activity Changes:* Number of time intervals during which the subject either crossed a line bisecting the distance between the two corner cages, or came into or withdrew from proximity to mother (or empty cage) or agemate.

3. *Distress Vocalizations:* Subject's total number of "whoo" (SPENCER-BOOTH & HINDE, 1966) or "coo" vocalizations (SEAY & HARLOW, 1965).

4. *Looks:* Number of time intervals during which the subject visually oriented to an observer.

5. *Grabs:* Total number of attempted or successful hand contacts made by subject through cage bars to mother or agemate.

6. *Threats:* Subject's total number of threats (flattening of the ears, opening of the mouth and bobbing of the head, often accompanied by a bark).

Scores were calculated by averaging the values obtained by two independent observers. An auditory prompting device (LEIFER & LEIFER, 1971) signaled the onset of the sixty 10-second scoring periods simultaneously to the two observers. Inter-observer's reliability coefficients (Spearman's rho) for distress vocalizations, threats, looks, and grabs were each above .92 over all test days. Percent agreement on proximity and activity change scores was 98%.

RESULTS

Table 1 presents means and t values (two-tailed) for the proximity measures, Table 2 for the measures of activity changes, distress vocalizations, and grabs, and Table 3 for the measures of behaviors directed towards the human observers—looks and threats.

Table 1. Mean proximity scores and t values (5df) for differences between targets within conditions.

Condition	Target	Mean proximity score	t
Agemate-mother	Mother	42.47	5.65
	Agemate	0.92	P<0.01
Agemate-only	Empty cage	11.28	0.56
	Agemate	16.92	NS

The subjects spent significantly more time in proximity to their mothers than to their agemates in the agemate-mother condition. However, in the agemate-only condition, the infants divided their time approximately equally between the agemate and the empty cage. In terms of the related measure of activity changes (Table 2), the infants moved back and forth across the testing room significantly less often in the agemate-mother condition than in the agemate-only condition.

The subjects made more distress vocalizations when their mothers were present

Table 2. Measures of the subjects' activity changes, distress vocalizations, and grabs under the two experimental conditions.

Dependent variable	Condition Agemate-mother (means)	Agemate-only (means)	t (5df)
Activity changes	10.77	17.83	4.70 P<0.01
Distress vocalizations	24.96	1.33	2.57 P<0.05
Grabs	1.26	0.00	2.93 P<0.05

Table 3. The subjects' behavior directed towards the human observers.

Dependent variable	Condition		
	Agemate-mother (means)	Agemate-only (means)	t (5df)
Looks	18.87	37.38	2.80 $P<0.05$
Threats	18.42	62.92	2.36 $P<0.10$

(but inaccessible in cages) than when they were absent. The infants grabbed only for their mothers, never for their agemates. In contrast, the infants looked at and threatened the observers more often when their mothers were absent (Table 3). The difference in the mean number of threats, however, approached significance ($p < .10$) only after a square root transformation was performed to homogenize the variance.

DISCUSSION

Our data indicate that an infant rhesus monkey does not use an agemate for "security" under conditions of fear. When the mother is present, the frightened infant goes only to her, not to a favorite playmate who is also present. When the mother is absent, the infant does not use his agemate as a substitute attachment figure; he looks at and threatens the observer, and moves frequently back and forth across the experimental room. Measures of proximity, activity changes, distress vocalizations, grabs, looks, and threats yielded evidence that the infants were not using their agemates in ways similar to their mothers. These findings support HARLOW's postulate of independence of the infant-mother and agemate affectional systems and fail to support the position that affiliation and not attachment is elicited in a fear-arousing situation. Also, the object-specificity of attachment behavior found in this study is in line with positions taken by BOWLBY (1969) and AINSWORTH (1969) and appears to conflict with expectations of behavioral generalization based on social-learning theory (GEWIRTZ, 1954; HEATHERS, 1953; ROSENTHAL, 1965).

One possible explanation for our finding of attachment behavior directed primarily towards the mother, as opposed to multiple attachments, may lie in the measures used. Other investigators (e.g., SCHAFFER & EMERSON, 1964) have used separation protest of an infant as the operational criterion for evaluating attachment; such protest could conceivably arise when any interesting or stimulating object was withdrawn from the infant (see also SPELKE, ZELAZO, KAGAN, & KOTELCHUCK, 1973). The use of proximity seeking in the present study possibly provides a more direct measure of attachment behavior; at least it appears to measure the kind of attachment that is activated under fear arousal. A second explanation is that the infant's failure to use his agemate for security might be due, in part, to the agemate's own fearful behavior. However, the caged agemates did not appear to manifest the same degree of fear as the test subjects.

It is interesting to compare our findings of higher frequencies of distress vocalizations in the agemate-mother condition and of threats in the agemate-only condition with the results of several previous studies. VAN HOOFF (1962) observed that

the distress vocalization "cooing" was a social call, expressing the infant's need to be given body comfort by the mother, and not merely a response indicative of diffuse disturbance. This finding was supported by MØLLER, HARLOW, and MITCHELL (1968), who showed that cooing decreased when the fear-eliciting properties of a social stimulus were increased. Our data also support VAN HOOFF's position. In addition, ROWELL and HINDE (1963), who found that the frequency of threats to an observer by monkeys in isolation was higher than when they were members of a group, concluded that temporary social isolation increases the effect of mildy disturbing situations. With respect to the relative frequency of threats in the agemate-only and agemate-mother conditions, our subjects resemble HINDE's social isolate and group conditions respectively. Thus, our results may indicate that the agemates were failing to provide any significant support for the subjects.

REFERENCES

AINSWORTH, M. D., 1969. Object relations, dependency, and attachment: A theoretical review of the infant-mother relationship. *Child Dev.,* 40: 969–1025.

BOWLBY, J., 1969. *Attachment and Loss.* Vol. 1, *Attachment.* Basic Books, New York.

GEWIRTZ, J. L., 1954. Three determinants of attention-seeking in young children. *Monogr. Soc. Res. Child Dev.,* 19 (2, Serial No. 59).

HARLOW, H. F., 1966. The primate socialization motives. *Trans. Stud. Coll. Physns. Philad.,* 33: 224–237.

———— & M. K. HARLOW, 1965. The affectional systems. In: *Behavior of Nonhuman Primates,* Vol. 2, A. M. SCHRIER, H. F. HARLOW, & F. STOLLNITZ (eds.), Academic Press, New York, pp. 287–334.

HEATHERS, G., 1953. Emotional dependence and independence in a physical threat situation. *Child Dev.,* 24: 169–179.

HOOFF, J. A., R. A. M. VAN, 1962. Facial expression in higher primates. *Symp. zool Soc. Lond.,* 8: 97–125.

LEIFER, A. D. & L. J. LEIFER, 1971. An auditory prompting device for behavior observation. *J. exp. Child Psychol.,* 11: 376–378.

LEWIS, M. & P. BAN, 1971. Stability of attachment behavior: a transformational analysis. Paper presented at the biennial meeting of *Soc. Res. Child Dev., Minneapolis, Minn.*

MACCOBY, E. E. & J. C. MASTERS, 1970. Attachment and dependency. In: *Carmichael's Manual of Child Psychology* Vol. 2, P. H. MUSSEN (ed.), 3rd ed., Wiley, New York, pp. 73–157.

MØLLER, G. W., H. F. HARLOW, & G. D. MITCHELL, 1968. Factors affecting agonistic communication in rhesus monkeys (*Macaca mulatta*). *Behaviour,* 31: 339–357.

ROSENTHAL, M. K., 1965. The generalization of dependency behaviors from mother to stranger. Stanford University Ph. D. Thesis.

ROWELL, T. E. & R. A. HINDE, 1963. Responses of rhesus monkeys to mildly stressful situations. *Anim. Behav.,* 11: 235–243.

SCHAFFER, H. R. & P. E. EMERSON, 1964. The development of social attachments in infancy. *Monogr. Soc. Res. Child Dev.,* 29 (3, Serial No. 94).

SCHIFF, W., J. A. CAVINESS, & J. J. GIBSON, 1962. Persistent fear responses in rhesus monkeys to the optical stimulus "looming." *Science*, 136: 982–983.

SEAY, B. & H. F. HARLOW, 1965. Maternal separation in the rhesus monkey. *J. nerv. ment. Dis.*, 140: 434–441.

SPELKE, E., P. ZELAZO, J. KAGAN, & M. KOTELCHUCK, 1973. Father interaction and separation protest. *Dev. Psychol.*, 9: 83–90.

SPENCER-BOOTH, Y. & R. A. HINDE, 1966. The effects of separating rhesus monkey infants from their mothers for six days. *J. child Psychol. Psychiat.*, 7: 179–197.

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