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INFANTILE DEPRIVATION AND SOCIAL BEHAVIOR. A COMPARISON OF THE EFFECTS OF SPECIES ISOLATION, ISOLATION WITH MOTHER, AND ASSOCIATION WITH MOTHERS AND PEERS ON THE FREE SOCIAL BEHAVIOR OF JUVENILE SQUIRREL MONKEYS (SAIMIRI SCIUREUS).

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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

INFANTILE DEPRIVATION AND SOCIAL BEHAVIOR. A COMPARISON OF THE EFFECTS OF SPECIES ISOLATION, ISOLATION WITH MOTHER, AND ASSOCIATION WITH MOTHERS AND PEERS ON THE FREE SOCIAL BEHAVIOR OF JUVENILE SQUIRREL MONKEYS (SAIMIRI SCIUREUS)

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ROBERT CHARLES EDWARDS

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INFANTILE DEPRIVATION AND SOCIAL BEHAVIOR. A COMPARISON OF THE EFFECTS OF SPECIES ISOLATION, ISOLATION WITH MOTHER, AND ASSOCIATION WITH MOTHERS AND PEERS ON THE FREE SOCIAL BEHAVIOR OF JUVENILE SQUIRREL MONKEYS (SAIMIRI SCIUREUS)

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CHAPTER I

INTRODUCTION

It has long been assumed that social development is heavily dependent upon experience, and in recent years considerable data have been collected which support this assumption. Beach and Jaynes (1954), in a comprehensive review of studies in this area, suggest several reasons for the increasing interest in the role of early experience in determining later behavior. First, some studies seem to hold the promise of differentiating the relative importance of "maturation" and "practice" in the perfection of simple response patterns. Second, Freudian theory has led to studies in which the food supply or the feeding responses of young animals are limited in order to ascertain the results of such deprivation on later behavior. Third, the work of European ethologists who have for some time been studying the effects of early stimulation on the adult behavior of various species, has become available to psychological investigators. Finally, there is the work of Hebb (1949), which stresses the importance of perceptual learning in infancy on subsequent adult performance.

Cross and Harlow (1965) note that during the past decade a number of experiments dealing with social deprivation in apes and monkeys have been published. They cite the work of Menzel, Davenport, and Rogers (1963) who studied the effect of total social deprivation on infant chimpanzee behavior; and Mason and Sponholz (1963), Boelkins (1963), and Rowland (1964) who investigated the effects of total deprivation on the behavior of infant and preadolescent macaques. Mason (1960) and Harlow and Harlow (1962a) have investigated the effects of partial social deprivation. Maternal deprivation was investigated by Rosenblum (1961), Hansen (1962), Seay and Harlow (1964), and by Harlow and Harlow (1962b).

Each of these studies has yielded information of considerable importance. Harlow (1961) and his associates, for example, have challenged the view that nursing, through the mechanism of secondary reinforcement, is a variable of any real importance in affectional development. Sackett (1965) has attempted to explain the behavior of stimulus deprived monkeys by a "complexity dissonance preference theory" which assumes that normal behavioral development proceeds by a gradual process of paced increments in environmental complexity.

Extensive though it has become, however, a disproportionate amount of the present non-human primate experimental socialization data derives from the study of one

species - the rhesus monkey. Although there appears to be much value in these findings, the fact that they are largely concerned with a single species gives them a somewhat tentative character. The present study is directed primarily toward determining the generality of these findings by doing a similar study with a different species - the squirrel monkey.

Deprivation in Primates. The study of social deprivation in primates has been stimulated as much by the unexpected results of laboratory rearing conditions as by premeditated research strategies. Early among these laboratory "accidents" were those reported by Allee, Nissen, and Nimkoff (1953) and Nissen (1954), having to do with the difficulties encountered in getting laboratory reared chimpanzees to mate.

Systematic research gained momentum with the publication of work done at the Wisconsin Primate Laboratory. The effects of laboratory rearing on their infant rhesus monkeys led to a series of studies by Mason (1960, 1961a, 1961b, 1963) and by Mason and Green (1962), designed to investigate the effects of social restriction under several conditions. Mason, in agreement with van Wagenen (1950), found no evidence that early separation adversely affected the growth and viability of the infant macaque; that is, there seemed to be no adverse physical effect.

When it first appeared that social restriction

adversely affects later social behavior in their animals, there was little data to which investigators could turn, but Bowlby's (1952) work on human infants appeared relevant. He had reported that social deprivation, such as that found in some children's institutions, resulted in a wide range of personal and social deficiencies and aberrations including affective disorders, limited capacity for sustained and effective social relationships, and psychopathic tendencies. Although Bowlby's work has met with some criticism (Dennis, 1963), it appeared to be the most relevant data available at the time.

If early social restriction has adverse effects on humans, it would seem reasonable to expect similar effects in at least the Old World Monkeys. Like humans, the monkey's period of infantile dependence is followed by an interval during which the tie to the mother gradually weakens. The "juvenile" then associates with other young monkeys and does not participate fully in adult functions and activities. During these early years when the young monkey has great mobility, he experiences a wide range of social contacts. If, as seems reasonable, the basic social attachments are established during this time, restrictions on such experience might be expected to produce inadequacies in subsequent relations.

In a series of experiments on the effects of social restriction in rhesus monkeys, Mason compared feral with

restricted monkeys. "Restricted" animals were born in the laboratory, removed from their mothers shortly after birth, and raised in individual cages until two and one-half years of age. The subsequent test series was composed of several types of social situations, each a sample of the presumed effects of social restriction. The social situations were: (1) free social behavior (1960), (2) gregariousness (1961a), (3) dominance (1961b), (4) responses to a novel environment and to an alien species (1962).

Striking differences were found between restricted and feral groups in a test of free social behavior. The restricted animals showed more frequent and prolonged fighting and groomed each other less than did the feral pairs. The two groups differed in the frequency, duration, and integration of sexual behavior. Disturbances in sexual behavior were most evident in males. Mason notes that this is consistent with earlier findings (Bingham, 1928; Foley, 1935; Maslow, 1936; Yerkes and Elder, 1936). Moreover, his data supported Ford and Beach (1952) who concluded that social experience among non-human primates is relatively more important to male than to female sexual behavior. In addition to differences between groups in the form and frequency of these basic social responses, it appeared that responses to social cues are poorly established in monkeys with restricted social experience.

One way to test gregariousness is to offer an

animal a choice between a social and a non-social alternative. Mason's (1961) method involved confining an animal in a cage from which he could release himself by pulling a chain. This allowed the animal to enter a chamber which contained another animal. It was found that pairs of restricted animals made fewer subsequent social choices and fought more frequently following a social choice than did pairs of feral monkeys. When restricted and feral males were subsequently tested with the same socially experienced female incentive animals, the number of social choices by restricted males increased sharply as compared with their performance with restricted females. In other words, restricted males prefer feral to restricted females. Likewise, when given the opportunity, experienced females uniformly chose feral as opposed to restricted males. These results support the conclusion that orderly and harmonious intraspecies social reactions in rhesus monkeys are dependent upon previous socialization experience.

In order to explain the low level of social choices among the restricted animals, Mason assigns great importance to the high incidence of fighting in that group. There was a significant negative correlation between number of releases and frequency of aggression. These results are in agreement with Nowlis' (1941) finding with chimpanzees "that aggressive behavior is more frequent with non-preferred partners" (Mason, p. 290).

Another finding in this study was that, although the restricted females clearly preferred feral males, they presented to the restricted males more often. Mason notes that . . . .

> Although presentation is an essential component of the female mating pattern, several workers (Carpenter, 1942; Chance, 1956; Hamilton, 1914; Maslow, 1936) have indicated that this response is elicited in rhesus monkeys of both sexes by an actual or potential aggressor [p. 290].

Mason (1961b), following Maslow and Flanzbaum (1936), wrote that aggressive acts are less important in the establishment and maintenance of dominance relations than the display of stereotyped postures, gestures, and vocalizations among sophisticated monkeys. The acquisition of social cues appears to be dependent upon learning. When compared in a competitive food-getting situation, the restricted and feral animals differed appreciably with regard to dominance. During competitive interaction, fighting was infrequent among the feral animals and was initiated by dominant monkeys. The reverse was true for the restricted animals. Moreover, unlike the feral animals, non-competitive situations offered no basis for predicting dominance relations in subsequent competitive situations.

In the most recent of this group of experiments, Mason and Green (1962), investigated the behavior of restricted animals in a situation in which no other monkeys were directly involved. Comparisons were made of the

reactions of laboratory-reared and feral monkeys to an albino rat (an "alien species") and an unfamiliar room (a "novel environment"). The restricted monkeys were not as gentle with their rats; they made fewer contacts with the rat in the living cage; and in subsequent tests in which the rat was presented as a social incentive, they made fewer social choices. Sharp differences were found in the reactions of the two groups to an unfamiliar room. The restricted monkeys engaged in various stereotyped repetitive behaviors such as crouching, non-nutritive sucking, self-clasping, and rocking. None of these responses were observed in the feral groups. Feral animals had higher locomotor scores and more frequently engaged in gross motor activities such as jumping, turning backward somersaults, etc. The investigators concluded that the data supported the thesis that the self-directed responses observed in socially restricted monkeys are derived from infantile responses ordinarily made with reference to the mother.

Harlow (1962a) reported that isolation-raised monkeys between two and a half to three and a half years of age, as compared with feral monkeys, showed infantile sexual behavior, absence of grooming, exaggerated aggression, and absence of affectional interaction as measured by cooperation. This "sociopathic" syndrome is somewhat analogous to Bowlby's (1952) description of institution-

reared children. Harlow and Harlow (1962b) reported that the social development of rhesus monkeys is essentially normal if infants are raised by their mothers and given daily opportunities to interact with age mates. Infants raised apart from the mother and given frequent contact with peers are initially somewhat retarded in their development, but eventually attain normal social patterns. On the other hand, infants whose only social contacts are with the mother are more retarded than either of the other two groups. This suggests that the relationship with the mother is facilitative, but not essential to full social development. Contact with peers, on the other hand, apparently must occur if development is to follow a normal course. Mason and Riopelle (1964) note that this finding may come as a surprise to field primatologists and child psychologists. This is not to say, however, that maternal deprivation has no lasting effects. Non-nutritive sucking appears to be a reaction to maternal deprivation (Mason and Riopelle, 1964). The fact that such behavior occurs within the first ten days of life (Benjamin, 1961a, 1961b) supports this position.

Although the relationship between digit sucking and maternal deprivation might seem to be rather self-evident, such is not the case with another facet of social restriction, the physical relationship to the mother. The physical relationship to the mother may have important

consequences for postural adjustments as well as for more complex aspects of behavioral development (Mason and Riopelle, 1964). Interference with this relationship is offered as a possible explanation of the reduction in locomotor activity and the rare postures, such as rocking and head banging, seen in chimpanzees and rhesus monkeys under stress (Mason and Green, 1962; Menzel, Davenport, and Rogers, 1963). Mason and Riopelle (1964) offer the following hypothesis:

> . . . a reasonable assumption is that the physical relationship to the mother prevents the development of these responses by providing adequate sources of stimulation, and by placing constraints on the kinds of activities in which the infant can engage. The varied postures and movements of the mother presumably supply abundant stimulation; and it would be difficult for the infant to perform exaggerated rocking or swaying activities while clinging to the mother's fur [p. 170].

The lack of the experience of being "mothered" may account for the persistent and apparently irreversible (Harlow, 1962) disturbances in sexual posturing and orientation in males. The more severe effects of social deprivation on the sexual behavior of males as compared with the effect on females may be attributable to the complexity of the males' mating patterns (Mason and Riopelle, 1964).

Mason and Riopelle suggest a law or principal of social restriction: "The effects of restricted early social experience are roughly proportional to the amount and duration of restriction [p. 169]." This statement

makes no reference to the importance of when in the animal's life the restriction takes place, but the findings of several investigations suggest that the animal's age at the time of the restriction is also important, particularly so in that it may determine the resistance of such effects to modification. This may have important therapeutic implications in that psychotherapy is a technique for modifying pathological behavior.

Mason and Sponholz (1963) found that two rhesus monkeys raised in total isolation until the second year of life showed profound impairment in virtually every aspect of social behavior. They never displayed aggression or sexual activity, rarely engaged in grooming, and responded to aggression by submission or withdrawal. Animals raised in standard wire-mesh cages in a nursery environment, on the other hand, showed clear indications of sexual arousal, and fought more instead of less than wild-born controls.

Harlow (1966) separated sixteen infant rhesus monkeys from their mothers at birth. Twelve were placed in isolation chambers, four animals each, for three, six, and twelve months. The remaining four were raised in semi-isolation for six months and then in total isolation for six months. In semi-isolation, pairs were given extensive social experience in a play room with a pair of equal aged, semi-isolated control monkeys in order to examine their social behavior. The three-month isolates, after recovering

from the initial shock of social contact, made effective social contacts with controls and with each other. The six and twelve month isolates failed to adjust either to the controls or to each other. The social impairment of the six and twelve month groups appeared to be permanent.

The monkeys isolated for six months (after semi-isolation from birth to six months) reacted effectively with controls and with each other in a relatively short time, but showed excessive aggression. It appeared from this study that monkeys can withstand at least three months of total isolation starting at birth or six months of isolation starting at six months of age, but that their social potentialities are destroyed if isolation from birth persists for six or twelve months. In this, as in Sackett's study (1965), there was no evidence that deprivation produced intellectual impairment.

Cross and Harlow (1965) have reported on the long-term effects of maternal deprivation at birth and partial social isolation during early years. Self-sucking and non-nutritive sucking were virtually absent in mother-reared monkeys, but showed only a slight decline with age in the isolates. Chewing increased with age in both experimental conditions and was higher in the mother-reared monkeys. Self-clutching was almost non-existent in mother-raised monkeys and declined in the isolates by the age of three. In all cases, aggression increased sharply at about

age three, with the stimulated and maternally reared monkeys showing outer-directed responses and the isolates showing self-directed aggression.

The investigation by Mitchell, et al. (1966) of the "long-term effects of total isolation" upon rhesus monkey behavior is most relevant to the present study. Mitchell's subjects were the same ones used by Rowland (1964), and were very near the age range of the subjects of this investigation. Mitchell, et al. summarize Rowland's findings as follows:

> . . . . total social isolation of rhesus monkeys for 6 or 12 months after birth had a severe debilitating effect on their subsequent social behavior. He (Rowland) found that isolate monkeys were fearful, disturbed, and sexually abnormal when tested 12 to 20 months after birth [1966, p. 567].

Mitchell, et al.'s study was designed to obtain follow-up data on the same animals at 28 to 44 months of age. The investigators hoped (a) to determine whether the social deficiencies found earlier persisted during puberty, (b) to determine whether new abnormalities arose or old abnormalities strengthened with maturity, and (c) to develop a system of behavioral sampling.

Eight isolates were compared to eight socially sophisticated controls in brief cross-sectional pairings with 12 stimulus strangers: four adults, four age mates, and four juveniles. Three of the isolates were six-month-early isolates, i. e., were isolated from birth until six

months of age and then wire-cage housed for six months. Three were six-month-late isolates, i. e., were housed in wire cages for the first six months then totally isolated from six to 12 months of age; and two were 12-month isolates, i. e., were totally isolated for the first 12 months of life.

Infantile disturbances, less environmental orality, more fear, more aggression, less sex and play, and bizarre ritualistic movements were seen in the isolates. There were no apparent differences between six-month-early and six-month-late isolates. Such differences as Rowland had reported between the two six-month isolate groups had disappeared by this time. They now showed equal social inadequacy. The difference between them and the 12-month isolates was their aggression. Six-month isolates were fearful and physically aggressive while 12-month isolates were fearful but non-aggressive; however, the 12-month isolates threatened many attacks. It was concluded that six months of social isolation during the first year of life has negative effects on social behavior up to puberty. Twelve months of isolation appeared to have suppressed or delayed the abnormal aggression observed in six-month isolates.

Mitchell, et al. (1966) note that although hostile behavior occurred in the six-month isolates when Rowland (1964) tested them, it was not regarded as hypernormal

because the semi-social isolates used by Rowland as control animals showed at least as much hostility as the total social isolates. Moreover, while Rowland found no signs of hostility in the 12-month group, Mitchell, et al. found that they made more threat responses than both the six-month isolates and the controls. Mitchell, et al. state that it is probable that Rowland tested the isolates at the age when social fear had matured but hostility had not yet fully developed. In the isolates, no affectional ties were formed before these emotional behaviors unfolded. The control monkeys probably learned the appropriate use of the gestures of deference and dominance in the context of the early affectional stages. Since the isolates had no opportunity to learn the use of gestures in an atmosphere of developing affection, it is suggested that they subsequently misused the gestures when the full-blown agonistic emotional states matured.

The stimulus animals attacked the isolates more often than they attacked the control monkeys, and they engaged in more exploration of the playroom in the presence of an isolate animal. The authors conclude that the last of these results was probably due to the lower social responsiveness of the isolates.

The stimulus animals also withdrew more often from the controls than they did from the isolates, thus they did not evince more positive social behavior with the controls

than they did with deprived animals. There was one important difference in positive social behavior: the stimulus animals displayed more noncontact social play with the control monkeys. In addition, (a) the stimulus monkeys looked at the controls more frequently, (b) the stimulus animals sexually presented more often to the controls, and (c) they showed more autoeroticism in the presence of the socially-reared animals.

Sackett, Porter, and Holmes (1965) studied the effect of early social experience on approach choices at two and three years of age. Monkeys handled in infancy by humans and then raised in isolation preferred humans to monkeys in a choice test. Monkeys reared by their own mothers and those handled by humans but later raised with other monkeys chose their own species. Monkeys isolated from birth to one year spent less time with either monkeys or humans but preferred the former. Infant experience had a significant effect on later choice behavior but, as shown by the human-peer combination, the effect was reversible.

Pertinent to the question of reversibility of the effects of deprivation is the Seay and Harlow (1964) study of the maternal behavior of socially deprived rhesus monkeys. The behavior of feral mothers is characterized by nursing the infant, protective behavior, close physical contact, and no rejection of the baby during the first

sixty days. In contrast, "motherless mothers" are either extremely abusive or extremely passive. Motherless mothers generally do not nurse their infant or their nursing is very inconsistent. They show no protective behavior, begin rejecting their babies shortly after birth, often by brutal attacks upon them, and show a marked degree of infantile behavior themselves. The authors found that when three of the inadequate mothers gave birth to a second infant their behavior toward them was either normal or overprotective. Feral raised mothers, on the other hand, display no difference in their behavior toward first or later born infants. The birth of a second infant, then, can have a "corrective" effect on deprived mothers.

Bowlby (1958, 1960) has described the effects of maternal separation on the child as occurring in three phases: protest, despair, and detachment.

Seay, Hansen, and Harlow (1962) reported that the overt reactions of monkeys and humans to separation are similar, particularly with respect to the first two of Bowlby's three phases. Seay and Harlow (1965) separated six-month-old monkeys from their mothers for two weeks. They note that this may not be a period of sufficient duration to allow Bowlby's "detachment" phase to appear. All of the infant monkeys showed emotional disturbance in response to separation, as well as drastic decreases in play and other complex social behaviors while separated.

They concluded that infant-mother separation produces emotional disturbance in both human and macaque infants and that the patterns of responses following separation are similar in both species. They viewed these results as indicating that sheer physical separation is the crucial aspect of maternal separation for monkeys.

Hinde, Spencer-Booth, and Bruce (1966) studied the effects of six days of maternal deprivation on rhesus infants. They concluded that some rhesus infants are adversely affected by a six-day removal of their mothers, that the severity of the effects varies with the nature of the pre-separation mother-infant relationship, and that the effects may persist for at least some weeks after the return of the mother. The consistency between individuals allows for some generalizations to be drawn, but the individual differences were also revealing. None of their monkeys evidenced the "detachment" phase on the mother's return.

During the first few days after the mothers and infants were reunited the infants spent as much time on the mothers as they had prior to the separation. Then, for no apparent reason, there was a temporary reduction in the amount of time spent on the mothers. The permanent return to pre-separation norms occurred more slowly.

Kaufman and Rosenblum (1967), in a recent study of depression in infant monkeys (macaca nemestrina), separated

from their mothers for one month found that in three infants the reaction to separation fell into three phases: agitation, depression, and recovery. The fourth infant showed only the first and third phases; this infant was the offspring of the dominant female. During the agitation phase, unlike the other infants, he became actively involved in exercise play and in exploration of the inanimate environment, followed later in the month by social play. The authors' explanation is that the offspring of dominant females may develop greater coping ability and thus have a greater likelihood of survival if the mother is lost. Upon reunion, clinging by the infants, protective enclosure by the mother, and nipple contact all rose significantly. This trend continued into the third month after reunion.

Kaufman and Rosenblum view the different stages of the infants reaction to separation as successive efforts at adaptation. The agitated phase is likely to effect reunion with mother if she is available. The second stage is similar to the "anaclitic depression" reported by Spitz (1946). Its function is viewed as one of conserving energy and reducing the risk of injury. The third stage, recovery in the continued absence of the mother (which was not reported in human infants), may, in the monkey infant be attributed to his greater locomotor ability. This allows him to actively re-engage the environment on his own.

There is, as yet, no report of follow-up data on the Kaufman and Rosenblum study. It does seem, however, that the short-term effects of maternal separation and those of extended social deprivation may be rather different phenomena. In the former, a social attachment is terminated. In the latter, it is prevented or altered depending on the conditions of the deprivation. Jensen, et al. (1967) make a distinction between "privation" and "deprivation." A privation environment is devoid of stimuli, while deprivation occurs when at least some of the available stimuli are removed. The deprivation environment would be the "richer" of the two.

Studies of social deprivation have been particularly important in providing empirical data. There is evidence, for example, that increasingly greater deprivation during rearing produces, in monkeys, increasingly greater response deficits to social, sexual, maternal, and non-social novel stimulation. Kagan and Henker (1966) write that there are three domains of continuing interest in animal developmental psychology: imprinting, prenatal influences, and the long-term effects of selected infant experiences.

The nature of the organism-environment interactions is complex and possible explanations are myriad. For example, Scott (1962) has advanced the thesis that the speed of formation of a social bond is dependent upon the

degree of emotional arousal, irrespective of the nature of that arousal. Moltz (1963) finds a considerable body of evidence which indicates that behavior is largely governed in the very early ontogenetic stages of development by stimulus intensity rather than by stimulus quality. The young animal controls its level of emotional arousal by approaching or withdrawing from an object. In other words, if the object becomes too close the resultant increased emotional arousal would cause the animal to withdraw.

An example of how alternative explanations of experimental results can lead to controversy is found in a study of visual cliff performance (Lemmon and Patterson, 1964). Lemmon and Patterson reported that mother-deprived sheep show retardation in performance on the visual cliff, even in comparison with control animals deprived of patterned vision for twice the amount of time as their matched experimentals. Gordon and Green (1964) interpret the results of a related study with monkeys as negating the effect of the mother-object. Rather, they argue, it is probable that the experimental effect is mediated by reduced levels of exploratory behavior resulting from maternal deprivation. In other words, if an equivalent level of exploratory behavior had been provided for the maternally deprived sheep they would not have been retarded in visual cliff performance. Although Little (1966) in a

subsequent study of visual cliff performance and maternal-deprivation has provided data which supports the maternal deprivation explanation, this example illustrates the problems involved in specifying causal mechanisms.

There appears, then, to be a great deal of overlap in such seemingly diverse topics as perceptual learning, emotional-arousal, and social deprivation. Beach and Jaynes (1954, p. 243) seem to have recognized this when they pointed out that "there is no clear-cut line of division between the effects of early 'psychological' experience and certain physiological antecedents of adult behavior."

Although theories concerned with the effects of social deprivation do not appear to be keeping pace with the empirical findings, relevant theorizing has begun. Thus far, theorizing has dealt primarily with concepts related to the development of affectional and other emotional attachments (Harlow, 1962; Harlow and Harlow, 1962).

On relatively firm footing now is the idea that contact stimulation is a primary factor in the infant rhesus monkey's tie to its mother, although the precise mechanism of reinforcement is not known (Mason and Riopelle, 1964). Quite early (McCullock, 1939) it was shown that claspable objects serve as effective rewards for performance of discrimination and delayed response tasks by young chimpanzees provided that the subject is in a disturbed or excited condition. Neonatal chimpanzees' vocal responses to

painful shock increase with progressively increased levels of shock when they are not held, but remain consistently low while they are being held (Mason and Berkson, 1962). Jensen, et al. (1967), in their report on studies of macaca nemestrina, hypothesize that cradling has an inactivating effect on the infant. Rosenblum and Harlow (1963) noted that surrogate-reared monkeys spend more time on their surrogates than did controls if they are given intermittent aversive stimulation (air blast) while in contact with the surrogate. The fact that contact stimulation appears to play such an important role in forming the mother-infant social bond does not necessarily prove that contactual isolation has a greater effect than other kinds. One study has shown that rearing monkeys in visual isolation produces more severe effects than contactual isolation (Mason and Sponholz, 1963). This points up the need to keep in mind that the formation of social bonds is not an unidimensional process. As Scott (1967) has written:

> In general, the evidence indicates that the formation of primary social bonds is a complex process involving several subprocesses that further bond formation, and presumably the same process may take place at later periods in life, and that the formation of previous bonds affects (but does not completely determine) the capacity to form later ones [p. 78].

Social deprivation and the processes involved in the formation of social bonds appear to be closely related, perhaps interdependent, topics. So much so, in fact, that it is difficult to speak of one and not the other. There

are at least two reasons for this. First, they may be mediated by the same process, i.e., by emotional arousal or stimulation; that is, the object of the attachment provides the stimulation. Its absence, then, constitutes a type of social deprivation. Second, the disruption of the attachment, the quality, intensity, and duration of its effects are variables of central importance to some studies of separation and deprivation.

Cairns' (1966) work offers perhaps the clearest example of the interdependency of the two subjects as well as one of the more complex, though admittedly incomplete, attempts to explain social attachment and deprivation. Cairns makes no distinction between social and non-social attachments. Each is viewed as "inevitable outcomes of an associative conditioning process [p. 409]." He proposes then:

> . . . that an object, or class of objects, can acquire an essential cue function for the maintenance of the response pattern of an animal. Objects which appear in recurrent combination with other environmental or internal events can become significant components in the stimulus patterns which support S's behavior, including such basic maintenance response systems as drinking, reposing, eating, et cetera [p. 413].

From this theory, one could interpret the responses of infants to maternal separation as a series of disjointed responses, R_1, R_2, R_3 . . . R_n, to a remaining stimulus pattern following the removal of a heavily weighted cue, i.e., "mother."

Another contribution toward understanding "social"

deprivation is provided by Sackett (1965) who draws from the theory of Dember and Earl (1957). This theory holds that perceptual experiences with certain stimuli increase the psychological complexity of the individual. The only stimuli effective in increasing psychological complexity are those whose complexity is greater, but not too much greater, than the present complexity of the individual. Such stimuli are called "pacers." An individual in a free choice situation will approach and attend only to those stimulus sets that contain stimuli which can be classified as pacers for that individual.

> If the individual is forced to respond to stimuli above its pacer range, several consequences may follow: (a) the individual may simply refuse to respond or seek to escape; (b) the individual may become "fixated" at its present complexity level, becoming difficult or impossible to pace toward further increases; or (c) the individual may regress, choosing stimuli of lower complexity than its own level [p. 860].

Sackett and Cory (1965) studied the preference for visual complexity in monkeys reared under several levels of overall visual input. The rearing conditions were: (1) one-year total isolation, (2) six-months total isolation, (3) one-year wire cage, no peers, (4) two-year wire cage, with peers, (5) feral mother, with peers, and (6) mother-less-mother, with peers.

In rank order of visual complexity, the animals were exposed to homogeneous black or white squares; and striped, large checkerboard, bull's eye, and small

checkerboard patterns. Each stimulus was presented singly on a screen for 12 one-minute periods over five different days. The measure of stimulus preference was the duration of visual and tactile exploration per minute. Animals reared in more complex visual environments preferred visual patterns of greater complexity. In view of the fact that the animals were at least two and one-half years of age in this experiment, it was suggested that these are lasting effects.

At three years of age the monkeys were tested in a social situation. Each monkey was paired with a non-aggressive, lightly tranquilized, stimulus animal with whom it was free to interact. Isolates and wire-cage-reared monkeys tended to withdraw from social contact much more than they aggressed. The same was true for feral mother-peer-reared monkeys. This was not true, however, for the animals reared by the often brutal motherless-mothers. Those animals showed 81 per cent more aggressive than withdrawal behavior. It would appear that normal monkeys provided social stimulation that was too complex for the monkeys reared under restricted conditions. In other words, they were placed in a situation well outside of their "pacer range."

It was concluded that stimulus deprivation during rearing can produce a monkey that is inactive, prefers visual stimulation of low complexity, shows little exploration of his environment, and withdraws from social contact. Such effects seem to fit a theory of complexity dissonance

preference such as the one proposed by Dember and Earl (1957).

Pratt and Sackett (1967) investigated the selection of social partners as a function of peer contact during rearing. They used three groups of rhesus monkeys. During rearing one group was allowed no contact, another only visual and auditory contact, and the third complete and normal contact with peers. After being allowed to interact socially, they were tested for their performance with monkeys raised under the same conditions or with those raised under different conditions. They found that monkeys raised under the same conditions preferred each other even if the stimulus animals were completely strange to the test monkey. It was concluded that

> . . . animals of equal social capability, whether or not they are familiar with each other, can discriminate themselves from others, and not only discriminate but approach each other [p. 1134].

Thus, even the abnormal monkeys preferred each other, a finding that appears to be at variance with Mason's (1961a) conclusion that

> . . . monkeys whose social experience was restricted from infancy were not highly motivated to interact with individuals of the same social history . . . [p. 259].

The crucial methodological variable (s) here, for example, type of test situation, age at testing, etc., have not been determined.

Pratt and Sackett interpret their findings as

presenting difficulties for Cairn's theory. According to Cairns the subject will approach a social object as a function of having made many previous responses while the social object was part of the general stimulus situation. During rearing, the monkeys in group A (most deprived) did not have the same opportunity to learn the characteristics of other monkeys as did the monkeys in groups B and C. Yet, the monkeys in group A did prefer each other to the available alternatives. Pratt and Sackett suggest that the group A monkeys preferences may also have been motivated by avoidance of cues contained in the social behavior of the other two types of monkeys. This raises the possibility of there being at least two distinct kinds of processes involved in the choice of a social stimulus; i.e., the conditioning of specific social cues to the response systems of an animal may be one factor, and the avoidance of non-conditioned cues a second important factor.

Squirrel Monkeys (Saimiri sciureus)

Squirrel monkeys are found in South America in a territory that extends north as far as the North Atlantic Ocean and along the Amazon westwards to Equitos and deep into Central Brazil (Bantin, 1966). Sanderson (1957) writes that they are distributed from the San Juan Valley that separates Nicaragua from Costa Rica in Central America to the divide between the southern tributaries of the Amazon and the La Plata drainage basin to the south.

According to Sanderson they may well be the commonest of the New World primates and have been reported as living in troupes believed to have as many as 550 members. A recent field study (Thorington, 1967) reports the size of two troupes at 50-100 for one troupe and 30-40 for another.

Squirrel monkeys are usually classified within the primate family "pithecoid" and are said to have comparatively large, but simple brains which are most developed in those portions that control movement and physical actions (Sanderson, 1957).

Perhaps the first approximation of a field study of this species is reported by Cooper and DuMond (1965). In the "Monkey Jungle" at Goulds, Florida, the animals have fifteen acres, including a four-acre tract of tropical vegetation, in which to roam freely. At the time their paper was published, the colony numbered seventy-five to ninety. At that point there was no apparent population pressure. The males, females, and half-grown juveniles are said to run in separate groupings even though at any given time they may all be in the same area. The groups seem to stay together for the safety and security of members and for companionship. They arrive for food freely and randomly. Mating may occur en masse (as many as 30 animals), but occasional single matings reportedly do occur.

Thorington (1966) has made some field observations

of squirrel monkeys in their native habitat of Colombia. He reports that their social activity is greatly influenced by their pattern of feeding. When in fruiting trees they interact much more than when they are foraging; for example, there is considerable jockeying for position. The most intense social interactions take place in the early morning and late afternoon. This interaction appeared to Thorington to be related to selection of favorable resting places or feeding. The animals tended to congregate in one area at mid-day at which time the adults were quiet while the juveniles played.

The entire troupe appeared to congregate at night for sleeping. During the day they traveled throughout the forest in groups of five to eight animals. Dominant males, pregnant females and females with infants remain with each other. The young animals usually associate with the females.

Hopf (1967) has described the ontogenetic stages in the development of squirrel monkey social behavior. At birth the infant immediately clings to its' mother's fur. Within 10-100 minutes the infant locates the nipples by means of rooting movements. At two weeks of age the infant begins grasping objects and cage mates with its' hands, and at two to four weeks it leaves its' mother for brief periods. From the third week an aunt-infant (Ploog, 1967) relationship develops between the infant and an adult female. During

the fifth to seventh week a rapid increase in time on its own feet is noted and weaning behavior appears. By the seventh week the infant is able to run and climb by itself and frequently contacts many group members. During the fourth or fifth month the infant starts resting at the mother's side or alone. Weaning behavior becomes more varied and the aunt-infant relationship becomes less intense. At about nine months the mother's rejection of the infant becomes increasingly aggressive. Adults ignoring and rejecting infants up to this age now play with them. From ten months on, displays by the alpha-male (i.e., the dominant male) to the infant appear to threaten the infant and this seems to suppress the infant's genital displays. At one year threatening and genital displays become rare and contacts between the male infant and the alpha-animal increase. At fourteen months the infant becomes completely independent from its' mother. The male juvenile attempts to dominate adult females but he is treated as a scapegoat. At two years and nine months rival fighting and sexual maturity occur.

Ploog (1966, 1967), Ploog and MacLean (1963), and Ploog, Blitz, Ploog (1963) are the primary sources for laboratory studies of squirrel monkey social behavior. There are other sources, for example, Rumbaugh (1965), but to date none of these add significantly to the topic of this paper.

Behavior patterns of individuals in stable squirrel monkey groups change very little, but in unstable groups they change until each member has found the role he is to play. Factors influencing group stability are: the stage of rivalry between the males, the sex ratio, age distribution, and the time together in the group. Individual characteristics probably contribute also. The alpha animal is probably always a male. He tends to isolate himself and be occupied primarily with himself. He can effectively dominate the group with weak threats, displays, vigorous threats, and biting. A multi-directional social structure, rather than a linear hierarchy, best describes the social order.

Genital display is very characteristic of squirrel monkey social behavior. Although genital display is derived from sexual behavior, it is employed as a social stimulus. Infants who grow up alone with their mothers manifest this behavior at the time characteristic for its development; that is several weeks after birth. Presumably, then, it is an innate social signal stimulus, its initial appearance being dependent upon the social situation. Its meaning varies with age and circumstances.

Two main types of genital display have been observed. They are called the open and closed positions. In the open position the animals maintain a distance of 10 cm. to three or four m. from each other and remain

relatively erect. In the closed position the animals touch each other. The displaying animal bends over its partner and jabs the partner frontally with its penis. In both aforementioned positions a counter-position may be observed wherein both partners display to each other.

The situations in which genital displaying occurs imply the following meanings: demanding, self-assertion, courting, and desiring closer contact. Dominance is accentuated in the closed position. In young animals and females the open position may indicate frustration and defense.

CHAPTER II

PROBLEM

The goal of the present investigation was to determine the generality of the findings having to do with the effects of social restriction reported in the preceeding chapter by doing a related study with a different species, the squirrel monkey. Since it is a more primitive primate, it may be less sensitive to early social restriction.

Three types of social restriction were employed in this study. Under one condition of restriction the infants were delivered by Caesarean section and had no social experience with other members of their own species; they will be referred to as human-reared. The second experimental condition was peer restriction, and the monkeys so treated will be referred to as mother-reared. The animals in the third group, which served as a control, had contact with their own and their condition-mates' mothers, and with their condition-mates. They were deprived of their species' natural habitat and social organization, and will be referred to as mother-peer-reared.

The choice of these particular types of social

restriction was based on current theories of socialization motives and affectional systems (Harlow & Harlow, 1962; Alexander & Harlow, 1965; and Harlow, 1966). These investigators have suggested that the age mate or peer affectional system is the primary intraspecies socialization mechanism, determining subsequent successful heterosexual adjustment and maternal behavior. Although the subjects of this investigation were too young, as yet, to be compared on those particular dimensions, it would be useful to know if interfering with these two affectional systems has any, or a differential effect, on the juvenile social behavior of members of this species.

The first experiment was concerned with observations of intercondition behavior as well as observation of responses to condition mates versus non-condition mates. A second experiment was conducted in order to: (a) check the stability of the results obtained from observation of intercondition behaviors and (b) compare the responses of the infants to two mature squirrel monkeys and vice versa.

The problem was to determine (1) if early social restriction effects the free social behavior of juvenile squirrel monkeys, (2) if different types of restriction have different effects, and (3) if differences exist, how persistent the effects are. And, finally, the problem was to make a contribution to finding methods effective for studying the social behaviors of this species.

CHAPTER III

METHOD

Subjects. Two of the three pairs of squirrel monkeys (mother-peer-reared and mother-reared) were born at the University of Oklahoma's Psychological Clinic. The human-reared pair was delivered by Caesarean section by Dr. Warren Crosby of the Obstetrics Department of the University of Oklahoma Medical Center in the Animal Research Laboratory.

The mother-peer-reared pair consisted of two females,[1] one born December 21, 1965, and the other November 30, 1965. They were housed with their mothers in 20x20 inch single cages from birth until two weeks of age. At that time the mother-infant dyads were transferred to a cylinder shaped wire cage 92 inches tall and 48 inches in diameter. This cage contained grapevine perches and platforms. From it, they had full view and hearing, but no physical contact, with three similarly housed mixed groups of adult squirrel monkeys. The pair remained in this cage

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[1] Originally it contained four; two males and two females. One male died at age 63 days, the second during the experimental isolation. See Chapter IV.

with their mothers and condition-mates until the period of isolation preceding Experiment I.

The mother-reared pair consisted of two males whose birth dates are: Number one, January 28, 1966; and number two, February 3, 1966. They were housed in the same type of cage as the Group I infants until age two weeks. At that time they were transferred with their mothers to larger (26x40x22 inch) cages. This housing condition was maintained until the infants were placed in pre-experimental isolation. They were housed with their mothers in a room that adjoined the one housing all other squirrel monkeys, as well as some other primates. Their only sensory access to the others was auditory. The two mother-infant dyads could not see nor touch each other because of a sheet metal partition between the cages.

The human-reared pair consisted of one male born December 21, 1965, and one female born February 11, 1966. These animals spent their first few weeks in an incubator. They were then transferred to 12x18 inch individual cages and later to 24 inch square cages. They were not allowed to see or touch each other. They were bottle fed until four months of age and gradually "weaned" to baby food and Purina monkey chow soaked in "Pet" brand of evaporated milk. They were given towels to cling to at all times and were allowed time to cling to a handler's arm after each feeding.

Test Apparatus. The test chamber was a 4x4x8 foot enclosure constructed of one-half inch plywood on a frame of 2x4 lumber. The inside of the cage was white. The floor was tiled. Grapevines and two platforms were provided for play and to permit avoidance behavior. The top of the chamber was covered with a semi-transparent plastic. Light was provided by fluorescent bulbs totaling 320 watts located above this cover.

When not being observed, the animals remained in 20 inch square cages on the side of the chamber. There were two cages on three of the four sides. Plywood dividers between the cages prevented the animals from seeing or touching each other while in these side cages. The chamber could be entered from the cages through pulley-operated sliding doors operated by the observers from the observation booth.

The observation booth formed one wall of the test chamber. This wall contained a one-way vision mirror through which the animals were observed. The observation area was painted a flat black to minimize reflection. There was no evidence that the animals were aware of the observers except when loud sounds were made.

Other apparatus included a checklist of behaviors, scoring sheets, stop-watch, and pencils. Some of the items on the checklist were taken from Cross and Harlow (1965), and Ploog (1967). Others were included on the basis of

preliminary observations at this laboratory. The full list is presented in Table 1. The list was modified for Experiment II; these modifications are described in this chapter under Experiment II.

The subjects were observed in four conditions of free social behavior: (1) with animals from each of the other two conditions, (2) with their condition mates and animals from the other conditions, (3) with all other infants in a single group following a period of "familiarization," and (4) with all infants plus an older male and female. The first two conditions make up Experiment I, the last two make up Experiment II.

Experiment I

Part I

Subjects. All six of the juveniles were used for this part of the investigation. No other animals were included.

Procedure.

Removal from Rearing Condition. Thirty days prior to the adaptation sessions all Ss were removed from their respective rearing conditions. They were transferred to the same room where each was placed in a 20 inch square wire cage. Plywood dividers between the cages prevented them from seeing or touching each other.

Adaptation to the Test Chamber. On the thirtieth

Table 1

Four Category Checklist of Infant Squirrel Monkey Behavior

Category	Description
A. PLAY BEHAVIORS:	
1. Contact Play:	Rough and tumble play consisting of mouthing, tumbling, and/or wrestling. May include biting but without the loud vocalizations of adult fights.
2. Non-contact Play:	Visually oriented charges and attack like maneuvers. Difficult to distinguish from some charges that appear aggressive in nature but distinct in that the "aggressor" will often run past the other animal.
B. SEXUAL BEHAVIORS:	
1. Mounting with pelvic thrusts:	
2. Presentation of ano-genital region:	
3. Genital Display:	Penil or clitoral display in closed or open position. If done with back to other animal, note.
4. Mounting:	Same as B1 without thrusts.
C. GENERAL BEHAVIORS:	
1. Orient:	Prolonged visual orientation toward another animal.
2. Approach:	Visually oriented movement of at least one body length toward another animal. Does not include charges of either play or aggressive types.
3. Withdraw:	Movement of at least one body length from another animal in response to any sort of social stimulation.

Table 1--Continued

Category	Description
4. Threat:	Visually oriented vocal threat, vine and/or object rattling. Includes threatening charge as opposed to play charge.
5. Grabbing:	Taking anything, such as food, from another animal.
6. Aggressions:	Extremely vigorous biting, hair or tail pulling, riding or mounting. Will probably involve loud vocalizations if the passive animal does not submit to a mount.
7. Submission:	Allowing another animal to ride or mount. Includes rigidity or immobilization in response to social stimulation.
8. Social Investigation:	Close visual, tactual, oral/olfactory investigation of another animal. Particular attention to ano-genital area.
D. INDIVIDUAL BEHAVIOR:	
1. "Cry":	Fairly high-pitched montonic vocalization. Usually accompanied by bipedal stance.
2. Self-mouth:	Any oral contact with self, excluding cleaning of hands.
3. Auto-erotic behavior:	Any manipulation of the ano-genital area or thrusting to inanimate objects.
4. Non-social exploration:	Sustained sniffing or examination of waste, examing doors or other parts of the apparatus, etc.
5. Non-social orality:	Any chewing or oral contact with inanimate materials excluding food scraps as in D4.

day of isolation, the animals were placed in the side cages adjoining the test chamber. On the following day, they began the first of six consecutive daily adaptation sessions in the test chamber. The first four of these lasted five minutes, the last two were of ten minutes duration. The purpose of the adaptation sessions was to allow the animals to become familiar with, and perhaps less fearful of this relatively novel environment.

Following these sessions in which the animals were allowed to explore the chamber individually, the behavior of each possible combination of three animals (one from each rearing condition) was observed for ten minutes as practice for the observers. Most of the practice, however, was done with adult animals.

Recording the data. One member from each of the three rearing conditions was permitted to enter the play area with one member from each of the other two conditions. Each observer recorded data on the three subjects, one at a time, for seven minutes. Consequently, for any one observational session 14 minutes of data was collected for each subject. Four such sessions were conducted daily. This allowed each subject to interact with all other subjects every day. The subjects for each observation session were randomly predetermined with the restriction that each participated an equal number of times and had its behavior recorded an equal number of times with each of the other

subjects. The order of observation was also randomly predetermined and directly reversed for the two observers. Each time a behavior on the checklist presented in Table 1 occurred it was recorded by the letter representing its category and the number representing its subcategory, for example, A1, B2, etc.

Part II

An interval of two days separated Parts I and II of the first experiment. Four animals were placed in the test chamber for each observational session; two from one rearing condition and one from each of the other two rearing conditions. The composition of a particular observation session was so arranged that each animal was observed interacting with all other animals an equal number of times. The composition of groups was predetermined. The order of observation was randomized with the restriction that animals from each rearing condition were observed daily and with each of the other animals an equal number of times.

Sixteen minutes of observational data was gathered per day on each animal, eight minutes per observer. The order of observation was reversed for the observers.

Experiment II

Part I

Subjects. Subject Number two, Group I, died in the period between Experiments I and II. All remaining animals

were used. A period of thirty days separated the last trial of Experiment I, Part II, and the first trial of Experiment II. During this period, the animals were returned to the "isolation" cages in which they were kept during the period immediately preceding the first experiment; however, the solid walls separating the cages were removed to allow the animals to see and touch each other. Moreover, all animals were allowed to play in a larger cage for one hour on alternate days, excluding weekends, beginning the fifth day. The purpose of this period of greater access to each other was to study the stability of the data gathered in the first experiment.

Apparatus. A much shorter list of behaviors was used. Experiment I can be thought of as providing something of a "baseline" for Experiment II. The shortened list is reproduced in Table 2.

Table 2

Checklist of Behaviors for Experiment II

Approach
Open Display
Closed Display
Play (Contact and Non-contact)
Pilfering, fondling, grabbing
Threat
Aggression
Avoidance
Self-Directed Behavior

Procedure. All five animals were put in the test chamber for each of the four daily trials. The same technique of observation was followed as used in earlier trials; that is, the order of observation was randomized and reversed for the two observers. Each observer watched each animal for seven minutes and following a thirty second break, recorded data on another animal. The recording of data began one minute after the last animal had come into the test chamber.

Part II

Subjects. A female adult and a nearly mature[2] male were added for this part of the investigation.

Apparatus. There was no change in the apparatus except that the two mature animals used the test chamber as a living cage. The infants continued to spend the time between the trials in the adjoining living cages. Wood shavings were placed on the floor of the test chamber at this time.

Procedure. Six daily sessions were conducted. The method of observation was changed for this part of the investigation. It seemed, from the preceding sessions, that a considerable amount of data was being lost by

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[2]Although this male was somewhat smaller than apparently fully mature males in the colony, he had begun to acquire the heavier more robust look of the adult males a few months earlier. His behavior retained some juvenile qualities, mainly play behavior.

recording the behavior of the animals by one observer at a time. Thus, the method was changed so that one observer watched and called the behavior out to the other observer who recorded it. The observers had both roles an equal number of times. Using the list of behaviors shown in Table 2, the responses of the infants to each other and to the mature animals, and that of the mature animals toward each other and the infants were recorded.

CHAPTER IV

RESULTS

The total frequency of response for each type of behavior according to rearing condition are presented in Table 3. It also shows the total of all responses and the percentage of responses which were "social," that is, responses to another animal.

The data gathered in Part I of the first experiment indicates that juvenile squirrel monkeys reared under the two most restricted conditions, human-reared and mother-reared, behave differently than the mother-peer-reared animals. Moreover, the different types of social restriction appear to produce different patterns of responding. Also, there are more differences in responses within the restricted groups than the less restricted mother-peer-reared group.

Table 3 lists the frequencies by subject for each type of behavior. Although they do not occur in the same order, the three most frequent behaviors for mother-peer-reared animals are the same; orient, (C 1), withdraw, (C 3), and non-social exploration, (D 4). This suggests that the basic character of their behavior could be called cautious. Moreover, their total number of rated behaviors were less

Table 3

Total Frequency of Free Social Behavior for Non Restricted, Peer Restricted, and Totally Restricted Juvenile Squirrel Monkeys in Basic and Subsidiary Categories

	Mother-Peer-Reared		Mother-Reared		Human-Reared	
	S 1	S 2	S 3	S 4	S 5	S 6
A. PLAY BEHAVIORS:						
1. Contact Play	5	13	23	2	0	17
2. Non-contact Play	1	0	10	2	0	6
B. SEXUAL BEHAVIORS:						
1. Mounting with pelvic thrusts	0	0	0	0	0	1
2. Presentation of ano-genital region	0	2	20	0	28	3
3. Genital Display	1	5	117*	0	19	3
4. Mounting	0	1	0	0	4	2
C. GENERAL BEHAVIORS:						
1. Orient	123*	115*	40	51	32	21
2. Approach	28	20	63	15	122*	112
3. Withdraw	93*	147*	121*	273*	16	22
4. Threat	21	17	1	12	44	162*
5. Grabbing	50	25	29	6	30	67
6. Aggressions	15	7	2	8	25	127
7. Submissions	1	6	19	29	1	1
8. Social Investigation	16	26	36	8	76*	52
Total Social Responses	354	384	481	406	397	596

Table 3--Continued

	Mother-Peer-Reared		Mother-Reared		Human-Reared	
	S 1	S 2	S 3	S 4	S 5	S 6
D. INDIVIDUAL BEHAVIOR:						
1. Cry	0	0	0	0	0	1
2. Self-mouth	0	0	5	4	17	137*
3. Auto-erotic behavior	1	1	12	3	3	7
4. Non-social exploration	98*	99*	114*	208*	149*	141*
5. Non-social orality	23	25	20	78	29	50
Total Individual Responses	122	125	151	293	198	336
Total all Responses	476	509	632	699	595	932
Per Cent Social Responses	74	75	76	58	67	64

*The three most frequent responses for Each S is marked by an asterisk.

than the rated behaviors of either of the restricted groups.

Withdraw was the most frequent response for both mother-reared animals. They made fewer orienting responses than the mother-peer-reared animals, but more approaches. Only two (versus three for the mother-peer-reared animals) of the mother-reared animals three most frequent responses were the same. Those responses were withdraw (C 3), and non-social exploration, (D 4). Quite unlike any other animal, animal number three of the mother-reared pair made 117 genital displays. His condition mate made none. Less extreme, but still unlike any other animal, was animal number four's high number of non-social oral responses (D 5). Judging from the many withdraw and non-social exploration responses, and genital displays, if this pair has any distinctive feature, it would seem to be one of fear and/or submission.

The human-reared pair had only one type of response in common, non-social exploration, (D 4). This is hardly an index of response similarity since it was one of the three most frequent responses for all animals. Thus, there is something of a steady progression from most to least common patterns of responding as extent of social restriction increases; however, this is the only pair in which the sex of the animals was not the same.

The human-reared animals appear to have been the most socially aggressive. Animal number five's second most

frequent response was Approach (C 2). For animal number six, aggressive responses, (C 6), were greater than those for all other animals combined. The frequency of his self-mouthing, (D 2), responses is 3.8 times greater than for all other animals combined. This apparent "sign of disturbance" is also evidenced in his condition mate. Although her self-mouthing responses were fewer in number than his, they were three times more frequent than the same response in any other animal. Not one such response was observed in the mother-peer-reared pair.

The total for all responses was also greater for the human-reared pair. This suggests that the total number of responses increases with the severity of social restriction.

Table 4 is a quantitative comparison of responses to condition mates versus non-condition mates, and of self-directed responses for each of the three pairs of animals.

Table 4

Per Cent and Mean Number of Responses to Condition Mate, Non-Condition Mate, and Self-Directed Responses for Juvenile Squirrel Monkeys Grouped According to Rearing Condition

Object of Response	Mother Peer-Reared		Mother-Reared		Human-Reared	
	%	$\bar{X}$	%	$\bar{X}$	%	$\bar{X}$
Condition Mate	50.9	73.0	30.6	59.0	36.6	74.0
Non-Condition Mate	33.4	49.5	83.8	84.5	42.6	85.0
Self	17.4	25.5	25.6	49.5	20.3	40.5

Table 4 indicates that of the three pairs, only the mother-peer-reared animals directed more responses to their condition-mate than to self or non-condition mate. The results for the mother-reared pair suggests that homogeneity of sex within the pair does not account for this finding. Moreover, the results for the human-reared female suggests that preference for condition-mate is not specific to females. It should be recognized that one member of each of the more restricted groups responded more to non-condition mates than to the conditioned mate.

The data in Table 4 permits only quantitative comparisons. By selecting from the total list of behaviors, some which can be thought of as "positive" in nature, and others that are "negative," qualitative comparisons can be made. This is done in Table 5. Positive and negative are here used as an indication of social preference and do not imply aberrant or pathological. The positive behaviors are: (1) approach, (2) grabbing, and (3) social investigation. Although it might be argued that grabbing is not a positive behavior, it was regarded as such because it seemed to be independent of aggression and dominance, and was responded to in a playful or matter-of-fact rather than fearful manner.

Table 5 indicates that only the mother-peer-reared pair directed more "positive" than "negative" responses to their condition-mates.

Table 5

Mean Number of "Positive" and "Negative" Responses to Condition Mate, Ss From Other Conditions, and Ss of the Same Sex, According to Rearing Condition

Object of Response	Means--Mother-Peer-Reared		Means--Mother-Reared		Means--Human-Reared	
	Pos.	Neg.	Pos.	Neg.	Pos.	Neg.
Condition Mate	39.5	20.0	10.5	31.0	13.5	27.5
Mother-Peer-Reared	----	----	16.5	2.5	4.5	3.0
Mother-Reared	2.0	5.5	----	----	11.0	22.0
Human-Reared	3.0	3.0	17.5	6.0	----	----
Ss of Same Sex	17.0	11.5	2.0	25.0	(♂) 9.0 (♀) 4.5	12.5 3.0

A thirty day interval separated the last trial of Experiment I, Part II, and the first trial of Experiment II. This interim period included nine one-hour group play sessions for all animals. Following a period of readaptation to the test chamber, Experiment II began.

The first part of Experiment II was a series of four free social sessions. Every animal participated in every session. The results are reported in Table 6. The shorter list of behaviors described in Chapter III, Table 2, was used for this and the final part of the study.

Table 6 shows that the remaining mother-peer-reared animal responded very little; actually, she slept through several sessions.

Table 6

Social Responses of Non-Deprived,[1] Peer-Deprived, and Totally-Deprived Juvenile Squirrel Monkeys Following a Period of Extended Social Contact

	Mother-Peer-Reared	Mother-Reared		Human-Reared	
	S 1	S 3	S 4	S 5	S 6
Behavior:					
Approach	2	19	4	13	10
Open Display	0	22	0	4	1
Closed Display	0	8	0	1	2
Play	0	26	0	1	26
Pilfering, fondling, grabbing	2	13	1	4	16
Threat	0	2	0	1	4
Aggression	0	2	0	1	3
Avoidance	3	20	38	9	0
Self-Directed	0	3	0	0	23
Total	7	115	43	34	85

[1]Subject number two died prior to this part of the study.

The mother-reared pair seems to have retained their basic pattern of responding. Number three continued to make a large number of genital displays, attempted to play a great deal, and continued high in avoidance. His avoidance behavior is not regarded as being inconsistent with the high number of genital displays since the latter were often of the submissive type. His condition-mate, number

four, did little other than avoid social contact. This is essentially his performance in the first experiment.

Table 7 indicates that the mother-peer-reared animal had, by the second part of the last experiment, returned to something approximating her Experiment I behavior. Her approach responses were somewhat fewer in number, but pilfering, which is similar in nature, occurred often. Her avoidance responses continued to be frequent.

Play responses are second in frequency for animal four--mother-reared--and are the most frequent response for number six--human-reared.

Deaths of two mother-peer-reared animals. Two of the mother-peer-reared animals died following a change in their environment. Post-mortem examination failed to reveal the cause of death in either case. The first death was that of the only male in that group, who was also the oldest, largest, and seemingly the healthiest of the males. This animal died during the isolation period following removal from the rearing condition. His death occurred without any visible signs of illness or injury. A few hours prior to his death he was found weak and nearly lifeless in his cage. When he was checked at a routine inspection 12 hours earlier he had appeared normal and healthy. A slight improvement was seen following injections of Rubramin[1] and AmBex,[2] but the period of improvement was

[1]E. R. Squibb & Sons, New York, Inc.
[2]Corvel, Inc., Omaha, Nebraska.

Table 7.--Total Frequency for 9 Types of Behavior in Mother-Peer-Reared, Mother-Reared, and Human-Reared Juvenile Squirrel Monkeys in the Presence of an Adult Male and Female Following Extended Social Experience. The number of times each S responded to an Adult appears in Parantheses to the Right of the Totals

Response	Mother-Peer-Reared	Mother-Reared		Human-Reared	
	S 1	S 3	S 4	S 5	S 6
Approach	7	10	6	3	15
Open Display	1	7	1	1	4
Closed Display	0	3	0	0	2
Play (Contact & Non-contact)	2	45	26	0	76
Pilfering, fondling, grabbing	24	33	6	4	58
Threat	1	0	7	6	8
Aggression	0	0	0	3	10
Avoidance	29	38	41	25	8
Self-Directed Behavior	0	0	0	1	5
Total	64(3)	136(6)	87(7)	43(3)	186(18)

brief and was followed by convulsions and death. The same series of events preceded the death of the second animal, a female from the same group. She died during the interval separating the first and last parts of the study. Unlike the other interval of isolation, at this time all animals were permitted to see each other and to socialize each day.

CHAPTER V

DISCUSSION

Response integration and social controls.

Response variance and the degree of response appears to have increased in proportion to the degree of social restriction. Thus, the behavior of a mother-peer-reared animal was more like that of its condition mate than the behavior of an animal from either of the more restricted conditions. The absence of aberrant behaviors in mother-peer-reared animals was notable and obviously contributed to the similarity of their responses.

Proponents of any of several theoretical positions might be able to account for this finding each within his own framework. An ethologist might view it in terms of innate releasing mechanisms and releasers. Thus, given normative rearing conditions, the behavior that has been built into the organism would be the behavior most likely to appear.

The concept of response generalizations held by the learning theorist might also be used to explain the response similarity in the mother-peer-reared pair. The neo-behaviorist (Cervin, 1957) would probably think of response

similarity in terms of habit strength. Habit strength would be conceived of in terms of the relative strength of negative transfer "interfering" with other responses. Presumably, the mother-peer-reared animal had "learned" more social responses prior to the experiment; therefore, there would be relatively more "transfer" which could have the effect of suppressing other responses. Presumably, aberrant responses would be more suppressed by this than the normal ones.

Social learning clearly plays some part in the primate socialization process. That socialization can be explained solely on the basis of any single learning model, however, seems doubtful. Harlow (1966), Rule(1967), and Ploog (1966) among others have challenged such a position.

Cervin's neo-behavioristic approach, on the other hand, does include behavioral controls and integration as part of the socialization process. To Cervin, the obsessive-compulsive neurotic and the sociopath represent psychological opposites. In the former, earlier responses have been overlearned and interfere with responses to situational variables. The person is then said to be rigid. The sociopath, on the other hand, has low habit strength because socialized responses have been "underlearned." Consequently, the sociopath responds to situational variables with little interference from previously learned responses, i.e., he lacks control. The sociopath,

responding as he does to situational variables, does not predictably respond according to society's dictates.

Harlow (1966) has applied the term sociopathic to the behavior of socially-restricted rhesus monkeys. His explanation of their behavior is based on an affectional socialization process as opposed to Cervin's learning model. There are other differences between the two approaches. Cervin argues, for example, that rigidity (control) is an unidimensional variable separate from emotional responsiveness. Harlow would probably take issue with this, but aside from these differences the fact is that one uses the descriptive term (sociopath) for behavior that the other explains in terms of the ineffectiveness of response control. Cervin's view of the sociopath, then, directly involves the concept of social-behavioral controls. Since it is difficult to conceive of a definition of the sociopath that does not include a consideration of internal controls, the problem of internal control is at least implicit in Harlow's reference to sociopathic behavior. This strengthens the view that an understanding of internal controls is probably one of the most basic prerequisites to our understanding of the results of studies of early social restriction.

If the roughly linear relationship between social restriction and number of responses in juvenile squirrel monkeys is one manifestation of the relative strength of

their controls and response integrative ability, the attempt by Butler and Rice (1963) to reformulate Drive Theory offers a useful conceptual framework.

Butler and Rice draw on Riesen's (1961a) work on sensory deprivation. They write that:

> . . . . motor neurones become hypersensitive in the absence of stimulation and that locomotor sequences may then be initiated by minimal excitation. With stimulus control absent or minimal during early development, intrinsic behavior patterns appear that are minimally responsive to environmental events [p. 83].

One of the phrases in the citation from Butler and Rice, "minimally responsive to environmental events," is open to alternative interpretations. Presumably they are speaking of bizarre, stereotyped, and "autistic" behaviors exhibited by some animals that have been subjected to severe long-term deprivation. In other words, they might have said that these subjects exhibit behavior which appears to be independent of, or inappropriate to, ongoing social stimulation.

Regardless of interpretation, the phrase "minimally responsive to environmental events," does not appear to be more than negligibly applicable to this data, largely because the animal did not exhibit the stereotyped behaviors reported in rhesus monkeys and chimpanzees raised in restricted environments. If those behaviors had been manifested, some response competition hypothesis might have to be offered to account for it. Riesen (1961b) has

hypothesized that the organism is handicapped in developing responses that require muscle-eye integration once the intrinsically developed movements have become established.

The phrase ". . . locomotor sequences may then be initiated by minimal excitation," is less ambiguous. In the present case it seemed that the mere presence of other animals elicited excited behavior in the human-reared male, more (than like sex Ss) responses in the human-reared female, and considerable arousal or possibly fear in the mother-reared animals. Thus, this part of Butler and Rice's hypothesis fits the results of the present investigation reasonably well. It may not, however, apply with the same degree to both sexes.

The Butler and Rice statement appears to be consistent with the finding of different type responses and a larger number of responses in the human-reared animals. It is also consistent with the finding that the human-reared animals were more aggressive and threatening. In fact, what is being called aggression or threat may have been, in part, hyper-responsiveness which the other animals feared and from which they withdrew.

Another observation that supports the importance of a control-integration explanation is the human-reared male's self-mouthing (D2) responses. These were very frequent and quite often occurred while he was attending to, or just before, he responded to another animal. It appeared as

though he was so reactive to social stimulation that he had to respond in some fashion, even if it took the form of self-directed behavior. For example, when most excited he would often bite his foot. It seems appropriate to call this an all-or-none type of responding because gross motor action was almost always involved; few of his responses could have been called subtle, integrated, or refined.

Fox (1959) has done some work on short-term temporary sensory deprivation. On the basis of his experiments he postulated a "chronic activation level," which represents all of an organism's previous sensory input, especially that occurring early in its history. The "chronic activation level" changes little with time and is relatively permanent. More transient and situational is the "acute activation level." The organism, in its transactions with its environment, can be thought of as striving to maintain an optimal relationship or "fit" between its chronic and acute activation levels.

Just how applicable this formulation is to the present data is difficult to say because the degree to which sensory deprivation and social restriction overlap is not known. Moreover, whether the human-reared squirrel monkey receives more stimulation in the early months of life, particularly the first three, than the animal who remains with its mother is open to speculation. Such factors

as clinging to an inert object (towel) rather than a living one (mother), lack of experiencing the "aunt-infant" relationship, and the absence of interaction with cage-mates are among the stimulus deficits experienced by the human-reared animal. It would appear then that the human-reared animal experiences a general stimulus deficit.

With reference to Fox, the question is, which rearing condition leads to a higher "chronic activation level?" It would seem that the animals reared with other animals experienced greater stimulation after about the third month because at or near that time the human-reared infants were being handled less due to a shift from bottle feeding to solid food.

Just how close to "term" the infant is when delivered is also probably an important variable here. The more mature infants appear unable to find a satisfactory mother surrogate in a piece of cloth, however modified. Thus, they climbed about in the incubator, resting and clinging little, and as yet (in this laboratory) have never survived beyond the tenth day. The female of the human-reared pair is believed to have been taken prematurely, since her neck muscles appeared too weak to support nursing activity on the mother. She seemed much more content to cling to her cloth mother surrogate; in fact, she would cling to it when stressed or frightened up to the time of the isolation period.

Perhaps even more important than the amount of stimulation, however, was the lack of inhibitory stimulation. It is assumed that contact with the parent inhibits diffuse activity (Wolff, 1966), or as Jensen, et al. (1967, p. 47) state it, "We may hypothesize that cradling has an inactivating effect on the (macaca nemestrina) infant." With regard to the problem of controls, the question is, does a socially restricted environment produce a more uncontrolled animal due to a higher chronic activation level? Or, do such animals fail to develop adequate controls because of inadequate response inhibition in the early months of life? Attempts to answer this and similar questions can only result in circular reasoning so long as stimulation is defined only in terms of external stimulation. Wolff (1966) takes account of both internal and external sources of stimulation.

Jensen, et al. (1967) have investigated the relationship between the richness of the environment and mother-infant independence. This is one means of expanding the definition of "extrinsic stimulation." They found that:

> Environmentally oriented behavior increased at the same rate for infants in both (rich and privation) environments but is greater throughout for infants in rich environments . . . This supports our concept of the infant's becoming detached from his mother as he becomes reattached to other objects . . . [p. 48].

They also found that, initially, mother-infant pairs in the rich environments engaged in more interactive

locomotion than the deprived pairs. As the infant in the rich environment becomes capable of doing more in his wider environment he does so, that is, he becomes more interactive with it. The privation infant and mother, on the other hand, can only interact with each other; thus, they attain increasingly high levels of interactive behavior.

The experimental condition employed by Jensen, et al. is roughly analogous to that of the mother-reared as compared to the mother-peer-reared animals in the present study. The mother-reared animals had no social alternative to their mother. There was much interaction between mother and young with the infant appearing to initiate most of it. Most frequent among these interactions (after nine months) were fondling, sexual mounting, and thrusting. The mothers often seemed annoyed by these behaviors and were quite rejecting; however, the infants were observed sleeping on their mother's back in the normal (for the species) position at or near the time of experimental isolation. This was several months after the last time the peer-reared infants were observed sleeping on their mother's backs. It appears that the infant-mother social bond is extended in the mother-reared condition.

Hinde and Spencer-Booth (1967) reached a similar conclusion. They investigated the effect of social companions on mother-infant relations in rhesus monkeys. They found differences in the nature of mother-infant interactions

between isolated mother-infant pairs and group living mother-infant pairs. They ascribe these differences to two main environmental differences. First, due to the absence of aunts the isolated mothers were less restrictive and their infants ranged to a distance from their mothers more freely. Second, lacking play companions during the second six months, isolated infants returned more often to their mother, presumably because she was the only other animal in the pen. Hinde and Spencer-Booth conclude that during the first six months of life the effect of isolation seems to have been primarily due to the absence of aunts, and in the second six months to the lack of age-mate play companions. The extension of the infant-mother bond, then, appears to be an infant-initiated substitute for age-mate social interaction. Since the mother, in this case, is so rejecting, the effect on the young monkey is probably poor preparation for living in normative social conditions. This may be another way of saying what Jensen, et al. (1967) have stated but in purely social terms. In other words, a greater number of age mates represents one kind of environmental enrichment and another source of stimulation which might be assumed to compete with the infant-mother social bond.

A relationship between early stimulation, response integration, and social bond is strongly suggested. A useful context in which to place the topics of social

control and response integration is that of primary socialization.

Scott (1967) states that the general results of studies of social isolation and restriction are

> . . . unequivocal. There is a major disturbance of development of social behavior, including the agonistic, sexual, and maternal systems . . . .

Citing the work of Fuller and Clark, he adds that

> . . . there is in dogs a strong emotional reaction on emerging from the restricted area, and this results in a variety of bizarre behaviors, principally directed at avoiding social contacts and contact with the outside environment [p. 79].

In part, because this effect is not alleviated by providing play objects or a companion puppy in the restricted area, Scott infers that a second process, normal emotional development, is involved. He notes that when placed in a strange situation a puppy shows emotional distress, as indicated by vocalization, at about three weeks of age. Specific fear responses to strange objects begin to appear at about seven weeks of age. A puppy which has been kept in a uniform familiar environment during this time experiences on emerging a massive fear response which becomes associated with the outside world. This produces, according to Scott, an authentic case of experimentally induced shock.

The human-reared squirrel monkeys also appeared to have a "strong emotional reaction" to their first exposure to members of their own species, but Table 3 shows that it took the form of socially aggressive behavior. In other

words, their social reaction was almost the opposite of the dogs' social reaction. One factor (in addition to species and ontogenetic stage of the animal when tested) giving rise to this difference might be that, through the process of hand-rearing, our human-reared animals achieved something approximating an early stage of "primary socialization" experience. If this is the case, however, it would seem different from socialization as defined by Harlow (1966).

According to Harlow's scheme, socialization motives are defined in terms of the five affectional systems; the mother-infant or maternal affectional system, the infant-mother affectional system, the age-mate affectional system, the heterosexual system, and finally the paternal affectional system. Accordingly, affection, fear, and aggression are said to develop in that order. Affection (for the animal's own species) develops via mother-infant and normal peer relationships before full-fledged aggression has matured.

Harlow (1966) reports that when paired with control age-mates, macaque monkeys subjected to total social isolation for the first year of life show no aggressive tendencies. He suggests that this may be because their aggression is hidden by overwhelming social terror, an explanation which is at variance with the present data. The human-reared squirrel monkeys, both of whom were over one year of

age at the time of testing, were quite forward and aggressive.

In the same paper, Harlow reports that two monkeys subjected to total social isolation during the second half year of life turned out to be hyper-aggressive and two others were sufficiently aggressive to cope with the aggression of the controls. He offers the following explanation:

> We assume that while they had no opportunity to form affectional attachments in their first six months, they did have a chance to adjust to fear of strange situations, including other monkeys, leaving delayed aggression to flourish without tempering by affectional attachments after their release from isolation and introduction to social stimuli [p. 236].

Our own human-reared animals were quite aggressive. They inflicted no injuries on the other animals, but it was clear that they were being aggressive rather than playful. There was no opportunity for their aggression to have been tempered by affectional attachments to members of their own species, nor did they have an opportunity to adapt to fear of strange situations during the first six months of life via an affectional system developed with members of their own species. According to Harlow's theory of socialization, then, they should have been both fearful and hyperaggressive.

They were not fearful; in fact, some of their responses to the adults indicated that they did not possess even a minimally adaptive amount of fear. On the surface it appears that Harlow's theory is open to question; however,

the extensive handling during rearing may have provided sufficient basic social security during the development of the human-reared animals' fear responses to prevent severe disturbances of this emotion.

Since the conditions of restriction lasted beyond the first year of life, thereby allowing "delayed aggression to flourish without tempering by affectional attachments" (Harlow, 1966, p. 236), the human-reared animals' aggression can be explained within Harlow's theory. The possible primary socializing effects of hand-rearing would not discount his explanation because aggression directed by the human-reared animals to other squirrel monkeys would not, in a sense, be intraspecies aggression. Thus, it is probably not the same thing as the hyperaggressiveness of "isolate" macaques to members of their own species.

The therapeutic effects of social stimulation on the restricted male's aggressiveness seems to offer some difficulty for Harlow's socialization theory. In the relatively brief period of these two experiments a marked shift from aggression to submissiveness was observed. It seems unlikely that this behavioral change was mediated by an intraspecies affectional bond. The age-mate affectional system could have been involved; but if it was, Harlow's data on 6 and 12-month isolates does not appear to apply to this species. He found some of the effects of six and twelve months of isolation to be irremedial. In this

study the male's aggressiveness appears to have been greatly modified by social stimulation. On this point, a social learning explanation appears to be more adqaute than an affectional scheme.

Unlike Rowland (1964), who reported no signs of hostility in 12 to 20-month old rhesus isolates, Mitchell, et al. (1966) in testing the same animals at 28 to 44 months of age found that those animals made more threat responses than six-month-late and six-month-early isolates (see pp. 13-16 of this paper). As Mitchell, et al. point out, the different findings are not necessarily inconsistent because the animals concerned were not same age at the time of testing.

Rowland tested the macaques at 12 to 20 months of age. The squirrel monkeys were tested at 13 to 16 months of age. Rowland's 12-month isolates were fearful; the human-reared squirrel monkeys were aggressive. Thus, in terms of aggressivity the squirrel monkeys at 13 to 16 months of age are more like rhesus monkeys who are two years of age or older. This difference suggests a species difference but methodological variables must not be discounted.

A methodological consideration that deserves special attention is that of hand-rearing. Scott (1967) writes that "the usual technique for demonstrating the process of primary socialization and identifying the critical period

(in mammals) for it, is to hand-rear an animal [p. 78]." The present experiment was not intended to be a study of primary socialization, per se, but the human-reared pair was hand-reared and may well have formed primary social bonds with humans.

If the hand-rearing of this pair had that effect, according to Harlow's scheme, the animals would regard humans as security-providing objects. Hess' (1959) interpretation of imprinting (in birds) appears to be relevant. He notes that the increasing tendency toward imprinting corresponds to an increasing tendency to follow, made possible by increased motility. The tendency to follow decreases after the first 16 hours, reflecting the increase in fear of strange objects. This sequence of events is viewed by Hess as having great usefulness, for it provides for the development of a filial attachment to a protecting adult (and to the species) and, subsequently to a tendency to avoid all strange (potentially threatening) objects. It is conceivable that this view, which is very similar to Harlow's theory of emotional development, would be offered to explain the response of the human-reared animals in this study. In this case, aggression directed at humans rather than squirrel monkeys would constitute intraspecies aggression. The fact is that the human-reared animals acted rather tame when handled by humans.

Sackett (1965) found that rhesus monkeys reared in

isolation from other monkeys from birth and handled by humans during the first month of life preferred humans to monkeys when tested at age two to three years. Animals having both early human handling and physical contact with other monkeys, or physical contact with other monkeys and no human handling preferred monkeys. Animals reared in complete isolation from both humans and monkeys spent less time with either choice stimulus, but also preferred monkeys to humans.

Presumably, human handling had some effect on our animals' responses to other squirrel monkeys. This may represent a formidable barrier to future investigators who wish to study total sensory or social isolation (as opposed to social restriction) in squirrel monkeys because of the infant squirrel monkey's need for uninterrupted clinging. It may be that those who handled the human-reared infants provided more time for clinging to their arms than was necessary; however, the high infant mortality rate offers a strong argument to the contrary.

Fear and Submission in the Mother-Reared Pair.

As reported in Chapter IV, each of the three pairs of animals had something approximating a style of reacting that was specific to their rearing condition. Members of the mother-peer-reared pair were reasonably cautious, presumably because they found the behavior of the others rather incomprehensible. The human-reared pair was the

most aggressive. The mother-reared pair was essentially fearful and submissive.

Fear is probably the best descriptive term for the behavior of animal number four (mother-reared). He spent most of his time in the test chamber running from one wall to another and showed little inclination to interact with other animals. His few threatening and aggressive responses appeared to be reactions to non-aggressive or playful attempts by other animals to interact with him. His relatively high number of non-social orality responses appear to have been a form of displacement.

His condition mate, number three, was the most "friendly" of all the animals. Perhaps the most distinctive characteristic of number three's behavior was genital display (117 in all). This compared to no genital displays for his condition mate and three genital displays for the remaining male. Most of these displays were of the type which Ploog, et al. (1963) describe in the following manner:

> Sometimes it happened quasi en passant, i.e., short thigh spreading and turning away with little or no erection [p. 35].

One can add to the description, for our animal, that he was in a sitting position with his shoulders bent forward. It appeared as though these were invitations to the other animal to play as well as an act of submission. The same behavior has been observed in a nearly adult male in response to the alpha animal upon the former's introduction to a

reasonably stable colony. In the latter case it is undoubtedly an act of submission. Ploog (1966) writes that in young animals and females the "open position" may indicate frustration and defense. For the mature male, submissive or defensive motives seem most likely.

Just what it is that gives mother-reared squirrel monkeys a basically fearful or submissive "character" may be of primary theoretical importance. Berkowitz offered what may be a highly relevant observation on this matter in a "personal communication" cited by Seay and Harlow (1965). Seay and Harlow had found that two rhesus infants directed aggression toward other infants during separation (from their mothers) and six infants behaved similarly following reunion with the mother. They report this as being extremely rare. Berkowitz suggested that

> . . . the mother, as a function of separation, may have become an aggression-evoking stimulus, but because of her intolerance of personal aggression, the aggressive behavior was displaced to peers [p. 440].

Since our mother-reared animals had experienced contact only with their mothers, it might be that they had no opportunity to express aggression prior to the experiment. As noted earlier, the most fearful animal in this group, number four, began to express aggression in Experiment II. Perhaps this was because for the first time there was an external object to which he could direct such a response, which is consistent with Berkowitz' interpretation.

The emergence of aggression in this mother-reared animal argues for fairly rapid social learning. This study presents an even more dramatic example of rapid social learning. As did Harlow's (1966) isolates, the two human-reared animals threatened adults. Harlow calls this a "suicidal" act. With his, as well as our own animals, social learning was rapid, such threats were observed only a few times in the early trials.

Intra- and Intercondition Social Preferences.

The mother-reared and human-reared animals had no contact with their condition-mates prior to the second part of the first experiment. This part of the study was the first time they had the opportunity to see or interact with each other. For the mother-peer-reared animals, on the other hand, this part of the study was a reunion. The pre-experimental isolation was intended as a partial control for this difference in familiarity.

Only the mother-peer-reared animals directed more responses to their condition-mates than to non-condition mates. The data for the mother-reared pair suggest that homogeneity of sex does not explain this finding. Nonetheless, the fact that the mother-peer-reared pair responded more often to each other than to non-condition mates does not necessarily mean that they preferred each other. For example, the hyper-responsiveness of an animal could overshadow its relative social incentive value. Consequently, other animals might be forced to direct their attention to

the hyper-responsive animal, not because of social preference but out of self defense. In this case the motivational determinant would be one of avoidance rather than one of preference.

Some of the uncertainty regarding avoidance vs. preference motivation in this part of the study is resolved by the data presented in Table 5. Here, some of the responses presented in Table 4 are divided into those which are "positive" and those which are "negative". This provides some indication of social preference. The mother-peer-reared animals were the only ones whose responses to their condition-mates were more positive than negative. Again, comparisons with the mother-reared animals contra-indicate an explanation in terms of honogeneity of sex. They, too, were like-sexed but did not appear to prefer each other.

This finding is considerably different from the findings of Pratt and Sackett (1967). Pratt and Sackett varied the amount of peer contact during rearing and investigated its effects on the physical approach to a social partner in order to determine whether monkeys (rhesus) reared under identical conditions prefer each other to monkeys reared under different conditions. They had three groups: One which had no early contact with peers, one which had visual but no physical contact with peers, and one that had complete peer contact during rearing.

They found that animals preferred animals that were

reared under the same condition. They conclude that:

> This result seems to strengthen the idea that animals of equal social capability, whether or not they are familiar with each other, can discriminate themselves from others, and not only discriminate but approach each other [p. 1134].

Pratt and Sackett (1967) have reported significant differences among familiar as compared to unfamiliar rhesus monkeys in several categories of behavior. With few exceptions the interactions involving familiar animals were judged to be more positive than those involving unfamiliar animals. The authors suggest that there may be at least two distinct processes involved in the choice of a social stimulus. One is the conditioning of specific social cues. This is consistent with Cairns' (1966) learning theory approach, but Pratt and Sackett believe that Cairns' explanation does not adequately handle the other process, the avoidance of non-conditioned cues.

Hansen, et al. (1966) discussed the problem of multiple factors operating in situations of social preference and noted that definitive interpretations are difficult to make because of the complexity of the behaviors involved. In this study comparisons were made across and within conditions with regard to positive and negative behaviors. Again, this is not to imply that social preference was the only motivational determinant operating. Hansen, et al. (1966) refer to Lewin as cited by Young (1961, pp. 9-10) who has "differentiated between motivational genotypes and

phenotypes [p. 277]." Motivational genotypes refer to behaviors that stem from the same motivational source. Motivational phenotypes refer to behaviors which appear the same but derive from different sources. Social preference may have been only one of several motivational determinants in this situation. Nonetheless, it seems very likely that future comparisons involving a larger number of juvenile squirrel monkeys will reveal an inverse relationship between early social restriction and positive or "friendly" behavior among animals whose early social contacts had been restricted. Such a conclusion could have profound implications for social psychology.

Persistence of reactions to social restriction.

The death of one of the mother-peer-reared animals necessarily modified this part of the investigation.[6] One of the major changes was that a single trial could no longer be made up of one animal from each condition while the time spent observing each animal remained equal. Nonetheless, since the two mother-peer-reared animals behaved so similarly, it seemed reasonable to consider the surviving one an "average" mother-peer-reared squirrel monkey. Just what effect the change from three to five animals per trial had on the behavior is not known. This makes comparison

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[6]That is to say that the original plan was modified. The method used is that reported in Chapter III.

with the results of Experiment I all the more tentative, but perhaps not unworthy of reporting.

Table 6 shows that the remaining mother-peer-reared animal made only seven responses in this part of the study. In fact, she sometimes slept through an entire session. It looked as though the other animals simply did not interest her. These sessions were conducted following periods of extensive interaction among all animals; therefore, familiarity does not appear to have enhanced the social value of the other animals to her. Also, the absence of her condition mate may have had a profound effect on her behavior.

The mother-reared animals showed little behavioral change up to this point. Number three remained high in genital display and play, and moderate in avoidance. Number four remained conspicuously high in avoidance. Number three displaced Number six (human-reared) as the most active animal.

The human-reared pair evidenced the most change, particularly the male. The male continued highest in the relative number of threats and aggression, but these did not constitute a large proportion of his total number of responses. He remained high in the number of self-directed responses (essentially non-nutritive orality). This suggests that disturbances in orality, which probably result from maternal deprivation, are more resistant to modification than aggressive behavior which appears later in the

ontogenetic development of the animal. The most striking change appears to have occurred in his play behavior. Play became his most frequent response, slightly ahead of self-directed behaviors. It looks very much as though play may have partially displaced aggression.

Play continued to be the human-reared male's most frequent response in the second part of this experiment also. He continued to be the most aggressive animal but play responses outnumber his combined threat and aggression responses by a ratio of approximately four to one, compared to roughly twelve to one in the first experiment. It seems reasonable at this point to say that his behavior had changed.

In the mother-reared pair, animal Number four began to evince a greater proportion of aggressive, including threat, and play responses. A proportionate decrease occurred in the percentage of his avoidance responses. The purpose of this part of the investigation was to extend the "check" on the reliability of the findings in Experiment I and to see if the three pairs would respond differently to adult animals. The indications are that what appeared to be definitive characteristics of the animals has undergone considerable modification. As in the case of the two animals already discussed (four and six), Number three (mother-reared) began to evidence a higher proportion of avoidance responses. Though fewer in number (38 vs. 41) than those

of his condition-mate, they were in sufficient number to suggest an important change.

As for the females, animal Number one (mother-peer-reared) became responsive again, more like she had behaved in Experiment I. The human-reared female (Number five), on the other hand, was not very interactive. Over half of her responses were avoidance. Animal Number one made several attempts to interact with her but was unequivocally rebuffed.

In summary, the greatest behavioral stability appears to have been in the mother-peer-reared female and, to a lesser extent in one of the mother-reared males. The remaining mother-reared and human-reared males acted quite different than they did in Experiment I. The human-reared females' social responses appeared to have deteriorated in that she became less responsive to the other animals.

In order to account for these findings, two changes in test conditions need to be considered; both were social changes. First, all animals, five as opposed to three, participated at a single time. Second, two adult animals were present. Thus, the sociology of the situation was considerably different. The writer would tend to minimize the importance of the change in the number of participating infants per trial. This conclusion is based on observations of the animals in the socialization sessions conducted between experiments. No data was recorded from these informal observations, but the behavior of the animals appeared

to be essentially the same as it had earlier.

If the presence of the adults had any real effect, the means by which it took place was not apparent. Table 7 reveals that only seven percent of the combined responses for all infants was directed at the adults. Moreover, the adults did not attempt to interact with the infants. A similar condition was used for observer training prior to the study. At that time one of the most dominant males was used. He ignored the infants even more completely than the less mature male used in the experiment; in fact, that is why the younger animal was used.

Bernstein (1964) has provided data which may have some relevance to this finding. He studied the influence of the removal and later reintroduction of the dominant male rhesus on group social patterns. He found that the removal of the dominant male was followed by an increase in the social activities of the remaining males. A socially active adolescent male achieved higher status in the group while a previously socially active mature male assumed a peripheral role. The adolescent's behavior lacked certain components considered typical of dominant males, and the other animals did not respond to him in the same way. Juveniles were found to be more active in the absence of adults.

The male that was used was more interactive than the older and presumably more dominant male. This finding

is consistent with Bernstein's results. For the most part, the subjects acted as if the adults were not present, but there were a few exceptions. The adult female kept the juveniles at a distance from herself and the male, and assisted his efforts to "police" them. The male generally ignored attempts by the infants to interact with him. Exceptions occurred when the human-reared pair attempted to interact with him or investigate him. This led to his threatening them. They responded in a manner that increased the intensity of his threats.

Often, the male's reactions to the juveniles were rage responses. This was "branch rattling rage" which appeared to be directed at all of the juveniles. On two occasions he quite aggressively herded them into a feeder cage and then went into the cage and did something (they were not open to view while in there) that led to wild screeching and general pandemonium. The two human-reared animals emerged from this with minor wounds.

The "adult" male appeared to intervene when the juveniles' play became too aggressive and noisy. Apart from these instances, however, the interaction between adults and juveniles was too infrequent for between group comparison. Ploog (1967) reports changes in the response of adults to infants and juveniles, and vice versa, as the animals mature. It would seem to follow, then, that the presence of adults would have some effect on juvenile group

behavior. That this effect varies as a function of early experience cannot be demonstrated by this study. It may be necessary to investigate this in groups which are more like natural squirrel monkey troupes.

Factoring out the relative contributions of the variable(s) that caused the behavioral changes occurring between Experiments I and II is a task for future investigators, but time and experience are probably involved. That the changes occurred at all, however, is of interest in and of itself in view of Cross and Harlow's (1965) findings. They found that some of the effects of early and prolonged restrictions are quite permanent.

Methodological Considerations.

This study represents an attempt to investigate a species of primate in a manner that has yet to be reported in the literature. Thus, the success or failure of the methods used represents perhaps the most important knowledge to come from it.

As of this writing, the disastrously high infant mortality rate, in both natural and Caesarean births, has yet to be overcome. Abortions were the problem in the natural births. The pregnant females were housed in individual wire cages, 20 inches square, and it was in these cages that they delivered infants which were for the most part dead or non-viable. The following year a much larger (9x5 foot) "gang

cage" that contained only pregnant females was used. Three abortions and two viable infants resulted from this. It is not yet known if this represents a real improvement.

The major problem with the caesarean-born infants, it seems, is feeding. Several infants that appeared viable, sometime within the third to tenth day of life, rapidly grew weak and died. It may be that food got in their lungs, but this is not known.

It was tempting to assign the deaths of the two juvenile mother-peer-reared animals to some form of social stress. The removal from rearing condition could have been stressful for them because it entailed an abrupt and total severing of established affectional ties. Such an explanation seems reasonable since the deaths occurred only among animals that had experienced infant-mother and age-mate social-affectional bonds.

Observation of the behavior of each animal immediately following its removal from the rearing condition supports the view that the mother-peer-reared animals were the most stressed. The females clung to the distal side of their cages when a human entered the room and remained virtually immobile as though this would prevent their being seen. The male would withdraw to the far side of his cage, orienting himself toward the person, or he would rather half-heartedly attack a finger if it were inserted into the cage. Members of both sexes from this rearing condition

were initially reluctant to take food, although no feeding problems were noticed prior to the isolation.

The mother-reared animals also appeared to be disturbed by the presence of a human, but their behavior was more erratic. For example, they leaped about in their cages, often squealing and sometimes threatening. This pair appeared frightened and/or disturbed, but not nearly so terrorized as the non-restricted animals.

For the human-reared pair this period of isolation was basically the same as they had known since their fourth month of life. The cages were slightly smaller and they could hear the other animals for the first time, but neither of these factors seemed to have any effect. There was no noticeable change in their behavior during this period.

The foregoing observations seem to support an explanation in terms of the deaths being related to, or perhaps even caused by, some form of social stress. Future investigators may find that this phenomenon is related to the depression observed in infant rhesus monkeys separated from their mothers, in which case the critical variable would probably be that of interfering with established social bonds. It may be, moreover, that the ability to survive the effects of social separation (interruption of social bonds) is inversely related to the number of social bonds or affectional ties experienced by the animal prior to the separation. On the other hand, it may be that the

most important factor was that of changing from highly stimulating living conditions to the relatively sterile social conditions of isolation. Admittedly, neither hypothesis is proven, but the feasibility of further studies of social restriction in this species may rest on solving this problem.

Free social behavior was selected as the test situation because it was the first in Mason's series of experiments with rhesus monkeys and comparisons, however general, seemed desirable. Moreover, this approach allows something of a preliminary cataloging of behavior in a species for which none exists. Among the disadvantages of this technique, however, is the fact that squirrel monkey behavior does not occur in the clear patterns seen in rhesus and other species. Thus, the "who does what to whom" scheme breaks down somewhat.

Improvements in technique and method might come from two principal sources. The first would be a classification of behavioral elements such as Bobbitt, Jensen, and Gordon (1964) have devised for observing mother-infant-peer interaction in Macaca nemestrina, or the shorter system of recording developed by Locke, Morgan, and Zimmerman (1964) on infant rhesus monkeys. In order to resolve the problems of reliability and validity, large amounts of data are needed. This calls for the use of computers for working out the myriad combinations. The building that now houses the

University of Oklahoma's squirrel monkey colony provides adequate observation facilities with the added advantage of spaciousness. It would seem that this would be a good place to gather large amounts of data for computer analysis.

A second procedure which might yield fruitful results is an operant technique for measuring social preference and incentive, such as that employed by Mason (1961) with rhesus monkeys. Sackett (1965) reported that proprioceptive retardation occurs in rhesus isolates. Our human-reared pair was retarded in vine-climbing ability, which suggests proprioceptive retardation; therefore, plans for an operant social test employing lever pulling were abandoned.

One other alternative to the author's method would be a shorter list of behaviors categorized in terms of active and passive, but since little had been written on squirrel monkeys infants' behavioral repetoire at the time of this investigation, the choice of responses would have been somewhat arbitrary, and perhaps invalid.

General Observations.

Squirrel monkeys appear to have a rather loose social structure and evince relatively few refined species-specific gestures, postures, etc. The social events arising from the introduction of two new males to The University of Oklahoma population deserve special mention because these events included the most ritualized behavior observed there,

excluding genital display.

With the exception of the mothers and infants that were directly involved in the experiment, the animals had been housed in groups of approximately 12 for ten months when two fully mature males were added. One almost mature male was added to one of the cages about three weeks earlier. One of the two newer males was added to the cage which included this younger and presumably not very healthy male. The interaction that resulted from the introduction of the new animal to this cage will be described first. The new males were introduced to the colony in September when the level of sexual activity appeared to be very high.

The new male was at least twice the body weight and slightly taller than the male already in the cage. Nonetheless, on the first day that they shared the same cage the smaller one mounted the newcomer. When the new male attempted to go to the upper levels of the cage with the other animals the smaller male and several females chased him to the floor, by, what appeared to be, pulling at his fur. After the new male retreated to the floor the smaller male mounted a female who had gone over to the new male and had pulled rather gently at the fur on his arms. Meanwhile, the new animal appeared reticent about taking food and generally did so only when no other animals were near the feeder box.

Four hours later on the same day, the following behaviors occurred. The small male leaped down to a female

and put his face to her face and genitalia. Next, he made closed position penil displays to her right and her left. She moved to the area then occupied by the new male who by now had been admitted to the higher strata of the cage. Next, she put her face to his genitalia, apparently to inspect him, but perhaps in order to invite his penil display. The smaller male gave a slow chase to the larger male who retreated to another cage, after which the smaller male made pelvic thrusts to the female.

This was one of the very few times that a male was seen in a position similar to the sexual mount of the rhesus monkeys. One difference between this and the rhesus mount was that his feet were higher above the females knees. Also, his arms were tightly clasped about her middle.

The female offered the closest approximation to a sexual presentation seen thus far, yet, it too was not a highly differentiated posture. Essentially, it involved an elevation of her buttocks and a slight spreading of the hind quarters. There were no thrusts in this interaction, which is most uncommon in our observations. In most instances a male will quite unceremoniously clasp, mount, and make very rapid pelvic thrusts to a seemingly indifferent female; the entire event comprising perhaps 5-15 seconds. It is not known which of these two types of social-sexual interaction constitutes true copulation.

With either type of mount another female would pass

by or approach and investigate, causing the partners to lose their balance. In most instances neither partner retaliated. The female appeared the most coy and made a short movement away from the male. The effect on the male appears to be cumulative, that is, at first he did not retaliate. Several such intrusions, however, caused him to move toward the annoying female while making the sound heard by dominant males in "branch rattling rage". That this response had anything to do with the recent arrival of the new male is not known, but an increase in demonstrations of dominance were clearly in evidence.

Six hours after joining the group the new male was even more passive and defensive. Whereas at first he appeared to make an effort at admission, by this time he seemed to be only trying to avoid trouble. For example, if any conflict developed he would go to the floor of the cage, which is always a movement away from the others since they remain at the higher levels.

The females prevented this movement from providing the safety he apparently sought. The following incident is typical. The new male retreated to the bottom of the cage. Two females followed. The other male came down and threatened the females. The females then returned to the high part of the cage. On another occasion the new male was joined on a perch by a female. The other male immediately made face to face contact with the female followed by a

closed position penil display to the new male who turned away, apparently in deference to the other.

The second new male was added to a cage that had no male in it. All of the females had delivered, aborted, or been sectioned. The social interaction was quite different. Particulaly noteworthy was the fact that the male added to the all female cage did not move into a power or dominance vacuum. If anything, he faced longer and more vigorous resistance than did the male who was added to a cage that already had a male in it.

After having been in the cage for no more than thirty minutes the females, virtually all of them, chased him from the top of the cage. Two females followed him to the floor and attacked him with great vigor while screeching viciously. One of the females then went back to the top of the cage. The other remained with the male. She would gently reach for and touch him in the dorsal-shoulder area while apparently attempting to get behind and mount him. He resisted this by remaining oriented toward her, but his resistance was entirely of a submissive type. The cage became very still while this interaction took place, the other females quietly observing from above. During this relatively calm period the female picked up a piece of monkey chow, rubbed it, and returned with it to the male who moved away. She then took a few bites from the biscuit.

After 45 minutes had passed it appeared as though

another stage in the "initiation" had begun. The male was huddled on the floor of the cage with his tail wrapped about him in a manner that would afford maximum protection. On the branches above one female, probably the one who had been so active to this point, mounted another female. She then descended and fairly quickly walked near the male and up the other side of the cage. She was followed by another who did exactly the same thing. From the way the females crouched low as they looked at the male, it seemed that they were trying to see his genitalia. This went on for about two hours. After four hours the thoroughly intimidated male slowly ascended to the middle strata of the cage.

Eight hours after entering, the male was seated on a low branch and the females were again filing past him. One of them stopped and seated herself parallel to and touching him, facing the opposite direction. He displayed to her while making short low pitched, probably "arr" sounds (Ploog, 1967). Next, he put his face directly between her forelegs near her genitalia. When another female approached, he threatened her and she withdrew. The two partners just sat quietly.

After a brief period during which the male ate, the females resumed their filing past him again. The male prepared to display or mount the first one but another crawled over him and sat between them. This type of interaction characterized the male's early days in the cage. It took

him almost two days to win a secure place in the upper levels of the cage.

From these observations it appeared as though the male who moves into an all-female cage faces the most severe test but ultimately becomes the alpha animal. For the male who joins a cage already containing a male, the main task is coming to terms with the male. In this case the hostility between the males disappeared after a few days.

Size does not appear to be an asset in coping with the hostility of the new cage-mates since no male was seen to employ other than passive defenses. This may well be due to the fact that the stranger "knows" that he must fight the entire colony if he tries to take the offensive. There also seems to be a home cage effect because similar behavior has been observed in males introduced to a cage containing only two animals. Never did they appear to bring with them the rank they held in their home cage. The technique of adding strangers to colonies may hold real promise as a device for studying squirrel monkey social behavior. It may hold more promise for understanding dominance than the study of genital displays. Of course, any cage is a poor approximation of forest-arboreal life and interpretations must be made accordingly.

Experience with The University of Oklahoma squirrel monkey colony has provided observations of maternal care in

this species. Rumbaugh (1965) has observed that the "typical passive" maternal care given by the squirrel monkey mother is in part influenced by the behavior of the infant. He notes bipedal carrying and cradling as being two of the "improbable" behaviors evinced by some squirrel monkey mothers. These findings are supported by observations of mothers in response to premature infants at The University of Oklahoma. Not only did the mothers of such infants carry the infants bipedally and cradle them, they also placed the infants face to their breasts in vigorous attempts to nurse them.

There also appear to be differences in the maternal care of mothers of viable infants. One mother tried to pull her infant off her shortly after birth. Marked variations in time of weaning were noted and the degree of protection given in the face of threat varies from virtual abandonment to great maternal risk. Just what it is that gives rise to these individual variations in maternal care is not known but they indicate that students or primatology should not assume a lack of variability of maternal behavior in squirrel monkeys.

One attempt at foster-mothering was made. A large healthy-looking male infant was found clinging to its nearly dead mother. The mother died about two hours later and the infant was placed on the back of a pregnant female. The female became vicious at once and tried to bite and

remove the infant. Realizing that she would probably do both, the infant was removed. The infant was on the foster mother for no more than two or three minutes but it was clinging to her in the normal position. It would appear from this experience that the infant will accept another mother but that a mother will accept only her own infant.

CHAPTER VI

SUMMARY

The rhesus monkey has been the most widely used subject in laboratory investigations of primate social behavior. This work extends the primatological approach to the study of socialization to a heretofore virtually neglected, and more primitive primate--the squirrel monkey. The effect of social restriction during the first year of life on the free social behavior of juveniles of this species was investigated.

Three pairs of animals were used. Each pair represented a different rearing condition. One pair was raised with their mothers, age-mates, and the mothers of their age-mates. They were referred to as the mother-peer-reared animals. A second rearing condition deprived the animals of age-mate interaction. These animals were referred to as the mother-reared pair. A third rearing condition completely deprived the animals raised in it of contact with their species. These animals were referred to as the human-reared pair.

The problem was to determine (1) if early social

restriction effects the free social behavior of juvenile squirrel monkeys, (2) if different types of restriction have different effects, and (3) if differences exist, how persistent these effects are. And finally, the problem was to make a contribution to finding methods effective for studying the social behaviors of this species.

Each rearing condition seems to produce a specific style of social response. The mother-peer-reared pair reacted to the others with caution. The mother-reared pair was timid and submissive. The human-reared pair was markedly aggressive.

The data suggests that within-group response differences increased with the severity of the social restriction. This finding was discussed within the context of response integration and behavioral controls. Early stimulation and the absence of early inhibitory stimulation were considered as possible causal factors. Response integration was considered in terms of primary socialization, particularly Harlow's affectional socialization scheme. The hyperaggressiveness of the totally restricted pair seems to offer some difficulty for the Harlow system. Of the three pairs only the peer-reared one seemed to prefer condition-mate interactions. This finding was considered from an associationistic learning point of view and was compared with several of the social preference studies done with rhesus monkeys.

Experiment II was intended, in part, as a check on Experiment I. The most aberrant behaviors evinced by the two most severely restricted pairs underwent considerable modification. For example, the hyperaggressiveness of the human-reared male was almost replaced by solicitous play behavior. The timidity of one mother-reared male gave way to increased aggression. Disturbances in orality persisted, a finding which is in agreement with studies using rhesus monkeys and chimpanzees.

Methodological problems were discussed. The possible primary socializing effects of hand-rearing was given special attention because it may have considerable significance for aggressive behavior observed in the human-reared animals.

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