1981

The effects of brief peer separation in the mother-infant relationship in rhesus monkeys.

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THE EFFECTS OF BRIEF PEER SEPARATION ON THE MOTHER-INFANT RELATIONSHIP IN RHESUS MONKEYS

A Thesis Presented

By

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Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

May 1981

Psychology Department

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ACKNOWLEDGEMENTS

I would like to express my gratitude to Dr. Melinda A. Novak, my major thesis advisor, who provided support and guidance throughout this project. Special thanks to Drs. Edward Tronick and Dalton Miller-Jones, members of my thesis committee, for their comments on the manuscript. Dr. Jerry Meyer sacrificed many a lunch hour to help us with the removal of the animals.

The excellent graphics were the handiwork of David Wilkie, to whom I am most appreciative. I would like to thank Janice Morelli, for her critical readings of the manuscript and her help in the final organization of this thesis.

I would like to thank my parents, Peter and Matilda Morelli, for their constant support, encouragement and love, and Dr. Raymond Schleef, who always had faith in my abilities. Finally, I would like to express my appreciation to David Wilkie, who provided unconditional positive regard throughout the various phases of this project and who encouraged me onward, even in my darkest hours of despair. Jolly good show, David!

ABSTRACT

The development and expression of the social skills necessary for an infant to become a functional member of its species-specific milieu are shaped by the transactions between the infant and its mother and between the infant and group members. Mechanisms underlying social development in rhesus monkeys (M. mulatta) were studied by monitoring two mother-infant dyads (one male, one female) during the brief separation of four juveniles from the social group. These juveniles varied in terms of relationship (sibling and non-sibling) and gender to the infant. Each juvenile was separated an hour each week for four consecutive weeks during the infant's fifth month of life. Data were collected on the mother-infant pairs during the removal of each juvenile from the social group and on 2 non-removal days when the colony was intact. Observations were recorded during 15 minute data sessions using a modified frequency scoring system in which the presence of absence of behaviors was recorded in each 15 second interval. The occurence of each behavior was also recorded.

Data analysis revealed that during removal days each infant spent less time: (1) off its mother; (2) greater than 60 cm from her; (3) engaged in non-maternal play; and (4) engaged in social activities or physical contact with other group members. When same sex peers in contrast to opposite sex peers were removed, the infants: (1) spent more time in maternal contact and within 60 cm of their mothers;

(2) received more maternal rejections; (3) spent less time engaged in non-maternal play; and (4) spent less time engaged in social activities or physical contact with other group members. Finally comparison of sibling and non-sibling removals show that during the removal of non-siblings each infant spent more time off and greater than 60 cm from its mother and less time engaged in social activities or physical contact with other group members. Changes in mother-infant interactions during removals were due to adjustments in the infant's behavior.

These data suggest that peers influence an infant's social development by effecting change in the mother-infant relationship. The nature of a peer's effect is related to its gender and kinship relative to that of the infant's. These findings are discussed in terms of the role of early social experience in the development of gender-related behaviors and adult social relationships.

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INTRODUCTION

Integration of an infant into its species-specific milieu depends on the infant's ability to develop appropriate social skills. The development and expression of these social skills are shaped by the interactions between an infant and members of its social group. From these ongoing social exchanges, an infant learns its role within the group and becomes a functional member of its species. Through this process, a group perpetuates both its particular social traditions and its species characteristic behavior patterns (Rosenblum & Coe, 1977).

Since group interactions so profoundly affect an infant's social development, study of the nature and quality of these interactions is fundamental to an understanding of the socialization process. Study of all the different types of group interaction has shown the mother-infant relationship to be the most significant of all interactions. Therefore, examination of the mother-infant relationship is essential to an understanding of the process of infant socialization.

The earliest, strongest, and perhaps longest lasting relationship develops between a mother and her infant. The maternal-affectional bond is the infant's primary bond (Harlow, 1962) and many regard it as pivotal in the development of all future social relationships. Actually, it may be the archetype for all subsequent bonds (Jensen, Bobbitt, & Gordon, 1968b). Thus, the mother-infant

relationship is the core of the group's social organization (Rosenblum & Alpert, 1977). But, while the importance of this relationship is widely accepted, exactly how it affects the infant's ability to integrate into its milieu remains unresolved (Hinde, 1971; Kaufmann, 1966).

The mother-infant relationship has been examined from several different perspectives and in varying depths. Several studies have simply surveyed behaviors comprising mother-infant interactions (Hinde, 1969; Hinde & Simpson, 1975). Other studies have undertaken an examination of the underlying factors influencing the nature of the interaction itself. This latter approach showed that factors both endogenous, i.e., maternal experience, parity, rank and infant gender, and exogenous, i.e., physical and social environment, to the mother-infant pair differentially temper the patterning of behavior within the dyad. One of the first steps therefore, toward understanding infant social development is to determine how and to what extent the exogenous and endogenous factors impact on the mother-infant relationship.

Endogenous Factors

The most dramatic demonstrations of the effect of early maternal experience on the mother-infant relationship comes from the work of Harlow and his colleagues. One study showed that rhesus females, raised in social isolation for the first year of life, were abusive or indifferent toward their first born. Other studies revealed that even mother-less mothers who accepted their infants exhibited more maternal rejection and less maternal contact than did mothered-mothers (see Harlow, Harlow, Dodsworth and Arling, 1966 for a review). While the

above studies are just a sampling of the literature on this subject, the findings are representative of what others have found.

On the other hand, studies of the effect of parity on the mother-infant relationship are in conflict. Several independent studies of mothered and mother-less females showed that behavior generally improved for both groups with the second and subsequent infant. Kuyk, Dazey and Erwin (1976a) found that normal (i.e., mothered) primiparous pigtail females (Macaca nemestrina) restrained and retrieved their infants more often than did normal multiparous females. Harlow, et al. (1966), found that the maternal behavior of rhesus monkeys raised in isolation (i.e., mother-less females) also improved with the second and subsequent infants. However, White and Hinde (1975) found that when females were matched for rearing experience, social status, infant gender and the presence of animals less than 2 years old when the infant was born, parity of a female did not categorically affect the mother-infant relationship.

White and Hinde (1975) showed that the third endogenous factor, social status, influenced the dynamics of the mother-infant relationship and the structure of her infant's social environment. Infants of high ranking mothers spent more time off and at a distance from their mothers than infants of low ranking females. Differences observed between offspring were attributed to maternal and not infant behaviors.

In addition, an infant was more likely to be the recipient of grooming, social contact (M. arctoides; Gouzoules, 1975), and play (M. irus; Fady, 1969) and less likely to be threatened (M. mulatta;

Berman, 1980) if its mother was a high ranking female. Lastly, the findings of Hanby (1980a, 1980b) and Agar & Mitchell (1975) show that infants were more likely to interact with individuals whose social status was similar to that of their mothers.

Gender-related behavioral differences, the last endogenous factor, are firmly rooted in the socialization process of males and females (see Mitchell, 1979 for a review of the literature). Gender-related behaviors first occur within the confines of the mother-infant relationship. In the first 10 weeks of life, male rhesus monkeys spent less time off their mothers and more time closer to her than did female rhesus monkeys (Hinde & Spencer-Booth, 1971; White & Hinde, 1975). However, this pattern of behavior was reversed by the 30th week of life when male infants spent more time off and at a distance from their mothers than did female infants. Furthermore, in the second half year of life, male rhesus infants received more maternal punishment and less maternal restraint than female rhesus infants. The mother's differing relationships with the male and female infants was attributed to differences in the behavior of the infant themselves (White & Hinde, 1975). Jensen, Bobbitt and Gordon (1968b) reported similar findings for the pigtail macaque.

While the importance of the endogenous factors cannot be overstated, the exogenous factors, that is the physical and social environment, are also significant. In fact, some consider these factors, especially the social environment, the most influential factors in the process of social development.

Exogenous Factors

Jensen, Bobbitt and Gordon (1968a) indicated how variation in the complexity of the physical environment has an effect on mother-infant interaction in pigtail macaques. The study revealed that in the first 15 weeks of life, infants raised in a stimulus-rich environment spent more time off their mother, oriented more behavior toward the environment, and engaged in less self directed behavior than did infants raised in a stimulus-poor environment. Later studies by Jensen and Gordon (1975), using sequential analysis of leaving and approaching behavior in a group of similarly reared mother-only infant pairs, also demonstrated that when infants in stimulus-rich environments left their mother, they were more likely to become involved with the environment and less likely to immediately return, than their counterparts in poorer environments.

Both studies concluded that differences in the mother-only infant dyads, resulting from manipulation of the complexity of the physical environment, were due to differences in the infant's, and not the mother's, behavior.

All the factors thus far considered play a role in shaping the mother and infant relationsip. But the last factor we shall consider, the social environment, is by no means least important. In fact, many consider it to play the leading role in the drama of social development. This factor enjoys such pre-eminence because it is the very context in which the other factors exist and from which they draw their significance. Even the physical environment, seemingly independent of

the social environment, loses its significance without the group as a referent. Chevalier-Skolnikoff and Porier (1977), as have others before them, noted that social experience is required for the younger primate to perform effectively as an adult of its species. Accordingly, the role of the social environment in the socialization process has received much attention.

Studies of rhesus monkey social environments show that mother and infant are an integral part of a social nexus and their relationship is embedded in a network of other social relationships (Hinde, 1976a). In order to fully understand infant social development, it is essential to consider how the mother regulates the infant's interactions with group members and, reciprocally, how group members influence interactions between a mother and infant (Spencer-Booth, 1968). The network of behavioral interchanges between a mother-infant dyad and the group is influenced by the individual relationships which the mother and infant have with certain group members. These individual relationships are, in turn, partly determined by the characteristics of both the mother and the infant.

Social companions influence an infant's development directly and indirectly by altering maternal responsiveness toward the infant. In turn, the mother regulates the social input to which her infant is exposed by being permissive or restrictive of her infant's movements and social contacts (Hrdy, 1976; Kaufmann, 1966). Kaufmann (1966), studying rhesus monkeys on Cayo Santiago, found that a mother's temperment limits her infant's socialization.

In a laboratory study investigating the effect of group member

presence on mother-infant behavior, Hinde and Spencer-Booth (1967b) found that rhesus monkey infants raised only with their mothers exhibited more exploratory behavior and were restrained less, during the first 6 months of life, than were infants raised in a group situation. The authors assumed, without further investigation, that this difference in behavior was due to the presence or absence of aunts.[1] Where present, the mother restricted her infant's movements in response to these overly solicitous and potentially threatening females. Conversely, during the second six months of life, mothers in the mother-only rearing situation were more punitive toward their young than were mothers in the group living situation. Here, the authors assumed, again without further testing, that the difference in behavior was due to presence or absence of playmates. Where absent, the infant sought the mother out as a playmate, inviting her retribution. These differences were corroborated by Wolfheim, Jensen and Bobbitt (1970) using pigtail macaques. Interestingly, even after the mother-only reared infants were introduced into the group living situation, earlier behavior patterns persisted (Spencer-Booth, 1969).

In another study of group member influence, Breuggeman (1973) showed that parental care was ubiquitous among a free- ranging group of rhesus monkeys. However, differences observed in the care-giving behavior of individual monkeys were measured quantitatively rather than qualitatively, suggesting only that some members of the social group played a role in the socialization of their young. Unfortunately,

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[1]Aunt refers to a female, other than the infant's mother and more than two years of age (Rowell, Hinde, Spencer-Booth, 1964).

precisely which group members did what remains unclear.

Spencer-Booth (1968) did recognize that certain group members have more impact than others on the socialization process. In a laboratory study of rhesus macaques, she found that both the type and frequency of social interaction varied as a function of the age, gender and parity of the member and the infant.

These studies indicate the appreciable effect which the social group has on mother-infant interaction. However most of the studies do not go far enough. They fail to show the impact which particular group members have on the mother-infant dyad. Poirier (1972), has suggested that age and gender of both socializing agent and infant are material factors in interindividual contact. Based on work by Poirier and others, the importance of knowing which group members interact with the infant and the nature of their interactions becomes clear.

Most studies of the interrelationship of the social environment and mother-infant behavior have focused on the contribution of older, non-related individuals. Only recently has the effect of infant's peers[2] on this relationship been examined (Lewis & Rosenblum, 1975).

Harlow & Harlow (1969) demonstrated that rhesus monkeys raised only with their mothers during the first 8 months of life showed aberrant affective behavior and hyper-aggression. Whereas, infants raised with surrogate mothers but permitted daily interactions with similarly reared animals exhibited normal social development. The use of peers as 'therapist' for monkeys exhibiting abnormal behavior grew

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[2]Peer is an individual who shares with the infant a series of capacities and common physical features (Lewis and Rosenblum, 1975).

out of these studies (Suomi, Harlow & Novak, 1974). Despite the limited research done on peer influence, Harlow's work makes clear that the importance of early peer relations on the socialization process is incontrovertible.

Peer availability was an important determinant of play patterns in pigtail macaques (Kuyk, Dazey and Erwin, 1976b) and rhesus macaques (White & Hinde, 1975). Infant pigtails raised in a social gropu without peers exhibited less total play and self-directed play and more play with older females than did infants raised in a social group with peers. Rhesus infants spent more time with their mothers if the social group lacked peers. Finally, Hinde & Spencer-Booth (1967b) demonstrated that mother-only reared rhesus infants were more likely to seek their mothers out as playmates than were infants housed with mothers and peers. Play with mother and older females may not, however, be an adequate substitute for the socialization functions of peer-play (Kuyk et al., 1976b).

The demonstration of the importance of peers on infant social development has prompted investigators to seek to discover which characteristics of a peer influences its interactions with a mother-infant dyad.

Gender of accessible peers has been shown to be an influential characteristic in the interactional patterns of Macaques. Among rhesus macaques, same-gender preference influenced the degree of parental care by individuals other than the mother (Breuggeman, 1973), proximity networks (Hanby, 1980a), grooming (Miller, Kling, Dicks, 1973), play and social contact (Redican, 1975). Iso-sexual preferences were more

marked in the male than in the female rhesus macaque. Suomi, Sackett and Harlow (1970) reported the development of iso-sexual preference in the rhesus macaque at 7 months of age. Preference development at 7 months may not be representative, however, since Suomi, et al. (1970) tested unsophisticated, unfamiliar animals using Sackett's self-selection circus (Sackett, Porter and Holmes, 1965). Simonds (1974), studying a free ranging group of bonnet macaques (M. radiata), found sex preferences occurring as early as 2 months of age.

The experiences that infant male and female monkeys have with same and opposite-sex peers may have different consequences for their socialization and may account for the observed gender-differences in the mother-infant relationship (see endogenous factors).

Whether or not a peer is also a sibling, has been shown to be a salient factor. Interactions occurring between older and younger siblings differed quantitatively and qualitatively from those occurring between older non-siblings and infants. Kaufmann (1966), studying infant development in a free-ranging group of rhesus monkeys, found that siblings had preferential access to infants, especially during the first few weeks of life. Immature rhesus siblings were more solicitous of infants--touching, grooming, holding, carrying and playing with them--whereas overtures from non-siblings were often thwarted by both the mother and older offspring. Spencer-Booth (1968) reported similar findings for a caged population of rhesus monkeys. Siblings, matched with non-siblings on the basis of age and gender, directed more approaches, touches and cuddles toward infants. These differences were most pronounced during the early weeks of life, when mother's

permissiveness controls her infant's accessibility to group members (Kaufmann, 1966; Spencer-Booth, 1968).

Although there is no generally agreed upon definition of the functional aspects of play, all acknowledge that it is a fundamental part of an infant's socialization (Baldwin & Baldwin, 1977; Caine & Mithcell, 1979; Gard & Mier, 1977; Harlow, 1969). Earlier, we noted the importance of peer availability to play. Here we add that play probably becomes an even more potent socializing factor when the peer is also a sibling.

Social play first appears in rhesus monkeys at approximately one-month of age (Hinde & Spencer-Booth, 1967a; Lindburg, 1971) and occurs predominately among kin. Loy and Loy (1974) found that in an all juvenile group of rhesus macaques, related monkeys sought each other out as play mates four times more often than that expected from a random selection of partners. Sibling rhesus macaques of northern India played together more frequently than non-siblings (Lindburg, 1971); and Rosenblum, Coe and Bromley (1975) reported that 40% of pigtail play involved siblings.

Not only play, but other behavior as well, is more likely to occur between siblings than non-siblings. Japanese macaques (M. fuscata) siblings were shown to groom one another more often than non-siblings (Yamada, 1963) and siblings showed greater tendency to aid each other during altercations (Kurland, 1977). Lastly, Hanby (1980a) showed that when compared to rhesus non-siblings, rhesus siblings spent more time in proximity with each other.

The greater interaction observed among siblings of several

macaque species is believed to be a result of their matriarchal social organization. In a matriarchal society, a mother and her offspring (particularly females, but see Korford, 1963) maintain a relationship throughout their lifetime. Social interactions are modified by matrilineal ties. This is because play, defense, grooming, cofeeding, among others, are more likely to occur among closely related than distantly related or non related individuals (Kurland, 1977; Sade, 1965).

The mother is the common focus of interest for her offspring. They gravitate towards her, creating a greater opportunity for familiarity between an infant and its siblings. This early familiarity promotes the development of the later behavioral patterns observed among kin. The social bonds formed earlier among siblings are maintained even in the absence of the natal group. Loy and Loy (1974) found that juveniles separated from their natal group for 20-30 months still interacted in a predictable manner, with geneological relationships forming the core of their interactions.

In a matriarchal society, the mother-infant relationship is the hub of the social organization around which gather and revolve all other relationships.

In conclusion, although there is evidence implying that siblings differ from non-siblings in their affect on mother-infant interactions, and that the gender of the peer modulates this affect, to date no research has directly examined this hypothesis.

Perspective

The purpose of this study was to examine how geneology and gender of peers affect the mother-infant relationship in rhesus macaques (M. mulatta). Observations of group living mother-infant pairs were recorded and compared to the data collected on these pairs during the brief removal of specific colony members. The individuals removed were chosen on the basis of their matriline and gender.

Changes in a mother-infant relationship resulting from the removal of specific colony members were observed in a social group of patas monkeys (Erythrocebus patas) (Chalmers, 1970, cited in Hrdy, 1976). The group consisted of six members: (1) an adult male, (2) a multiparous female with her subadult and juvenile female offspring and; (3) a primiparious female with her six week old male infant. Of these, the adult male, multiparous female and juvenile female experienced two days of separation from the colony; separation days alternated with days when no separations occurred.

Chalmers found that the mother-infant dyad was most affected during the removal of the juvenile female, the male's 'favorite' aunt. In her absence, the male spent less time off his mother and more time in proximity to her than when other group members were removed. Changes in the mother-infant relationship during the juvenile's removal were due to adjustments in the infant's behavior. Chalmers concluded that if maternal separation is a reflection of an infant's confidence in its environment, then in this social group, the presence of the juvenile female contributed to the male infant's confidence.

The implications of Chalmer's work for the present study are: (1) it supports existing data showing that individuals differ in their effect on a mother-infant dyad; (2) it demonstrates that an individual's role in shaping mother-infant interactions can be assessed by its removal from the colony; and (3) it illustrates the nature of the adjustment occurring between a mother-infant dayd in response to changes in the composition of the social group.

Existing data show that siblings play a major role in the socialization of the infant. Siblings help create a social climate which encourages infant exploration and expansion of social relationships. Moreover, siblings provide an infant's main source of social companionship. In effect, siblings foster mother-infant separation. Hinde and Spencer-Booth (1967a) found that in the presence of siblings, infants were more likely to leave their mothers.

The influence of a peer's gender on mother-infant relationships depends, partially, on the expression of iso-sexual preference. If, contrary to Suomi et al. (1970) findings, same-sex preference develops before 7 months in the rhesus monkey, then removal of same-sex peers should influence mother-infant interactions more than the removal of opposite-sex peers. If, however, iso-sexual preference has not developed, then females, irrespective of the infant's gender, should have a greater affect on mother-infant behavior when removed from the social group. Females are more solicitous of the infant and more likely to be tolerated by the infant's mother than are males (Hinde and Spencer-Booth, 1968; Hrdy, 1976; Kaufmann, 1966).

It is thus predicted that an infant will: (1) spend less time

off its mother and at a distance from her; (2) assume more responsibility relative to the mother for initiating contact and maintaining proximity; (3) receive more maternal rejection; and (4) spend more time alone and less time engaged in non-maternal play when the peer removed is a sibling or a female.

CHAPTER II

METHODS

Subjects

The subjects were two rhesus monkeys (Macaca mulatta), one male (UM79) and one female (PF79), born 12 October 1979 to Ugli and Peanut respectively.

Social Group

Composition. The colony consisted of 13 rhesus monkeys. An analysis of the social group by age-class and sex shows that there were 2 adult males (Q44, Q50), 3 adult females (Peanut, Ugli, Zelda), 2 juvenile males (PM76, UM77), 2 juvenile females (UF76, PF77), 1 sub-juvenile male (PM78), 1 male infant (UM79) and 2 female infants (PF79, ZF79).* Geneological information is depicted in Figure 1. The matrilines Peanut and Ugli each contained 2 males and 2 female offspring and each had 1 male and 1 female offspring classified as a juvenile.

Rank. Dominance is defined as preferential access to a novel stimulus and is assessed each year for the adults Q44, Q50, Ugli, Peanut. The most dominant animal was Q44 followed by Peanut, Ugli and finally Q50.

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*The following mnemonics were used to identify all non-adult colony members: first letter indicates matriline (P=Peanut, U=Ugli, Z=Zelda); second letter indicates gender (M=male, F=Female); last 2 digits indicate year of birth.

Fig. 1. Geneologies of the Social Group

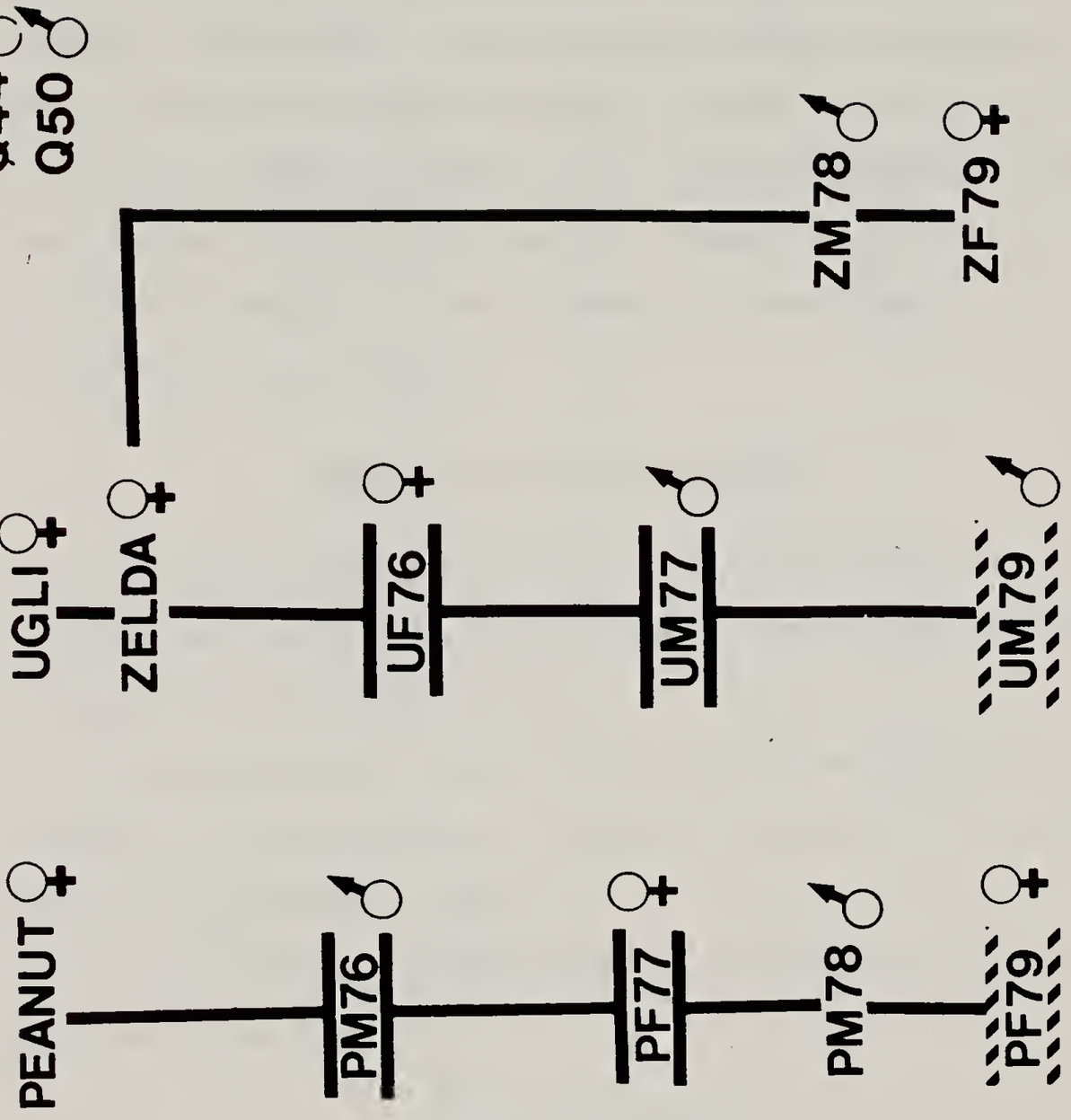

Q44
Q50
UGLI
ZELDA
PEANUT
UF76
UM77
UM79
ZM78
ZF79
PM76
PF77
PM78
PF79

Fig. 1

History. The adults Q44, Q50, Ugli and Peanut were born in 1971 at the University of Wisconsin Primate Center. They were surrogate-peer reared (for a description of this rearing condition see Harlow & Harlow, 1969) for the first 12 months of life and then housed as a group of four. During this time, they served as therapy monkeys for animals raised in total social isolation (Novak & Harlow, 1975). These monkeys were transported to the University of Massachusetts in 1974 and were housed as a social group.

Housing and Colony Maintenance

The living space provided for the colony consisted of 3 interconnected cages (465 x 211 x 112 cm) equipped with shelves, a swing, and a number of manipulable objects.

Cage maintenance occurred twice daily between the hours of 7:30-8:00 a.m. and 1:30-3:00 p.m. Feedings preceeded afternoon cleaning; water was provided ad lib.

Animals were maintained under a 13:11 light-dark cycle, with lights on at 7:30 a.m. E.S.T.

Behavior Categories

Behavioral measures used to monitor changes in the mother-infant dyad are described in Table 1 and include (see Hinde & Atkinson, 1970; Hinde & Herrmann, 1977 for a discussion of these measures):

Percentage of Intervals Off Mother (POFF). The number of intervals the infant was off its mother as a percentage of the total number of

TABLE 1

BEHAVIORAL DEFINITIONS OF DERIVED MEASURES

Behavioral Classification	Definition
Maternal Contact	
Percentage of intervals off mother (POFF)	$100 \times \frac{\text{number of intervals off mother}}{\text{total \# of intervals mother-infant dyad observed}}$
Percentage of Complete intervals off mother (PINOFF)	$100 \times \frac{\text{number of complete intervals off mother}}{\text{total \# of intervals mother-infant dyad observed}}$
Maternal Proximity	
Percentage of intervals greater than 60cm (PINGSX)	$100 \times \frac{\text{number of intervals greater than 60cm from mother}}{\text{total \# of intervals off mother}}$
Maternal Regulation	
Proximity Index	$100 \times \frac{\text{\# approaches initiated by infant}}{\text{\# approaches initiated by mother and infant}} - \frac{\text{\# leaves initiated by infant}}{\text{\# leaves initiated by mother and infant}}$
Regulated Maternal Contact (REGMC)	$100 \times \frac{\text{number of times access to ventrum denied}}{\text{\# times access to ventrum denied} + \text{\# mother-infant initiated contacts}}$

TABLE 1 (Continued)

Behavioral Classification	Definition
Non-Maternal Activities	
Percentage intervals non-maternal play (PINMP)	$100 \times \frac{\#\text{ intervals engaged in non-maternal play}}{\text{total }\#\text{ intervals off mother}}$
Percentage intervals alone (PIA)	$100 \times \frac{\text{number of intervals alone}}{\text{total }\#\text{ of intervals off mother}}$

intervals the mother-infant dayd was observed.

Percentage of Complete Intervals Off Mother (PINOFF). The number of complete intervals (i.e., 15 seconds) the infant was off its mother as a percentage of the total number of intervals the mother-infant dyad was observed.

Percentage of Intervals Greater than 60 cm (PINGSX). The number of intervals a mother and infant were separated by 60 cm as a percentage of the total number of intervals the infant spent off the mother.

Proximity index. The difference between the number of approaches initiated by the infant as a percentage of infant and mother initiated approaches, and the number of leaves initiated by the infant as a percentage of infant and mother initiated leaves. This index assessed what member of the mother-infant dyad was responsible for the distance maintained between them. A positive value indicated infant responsibility, a negative value indicated maternal responsibility.

Contact index. The difference between the number of physical contacts initiated by the infant as a percentage of physical contacts initiated by infant and mother, and the number of physical contacts terminated by the infant as a percentage of the physical contacts terminated by infant and mother. This index assessed which member of the mother-infant dyad was responsible for the physical contact between them. A positive value indicated infant responsibility, a negative value indicated maternal responsibility.

Percentage of Regulated Maternal Contacts (REGMC). The number of times the infant was denied access to the mother's ventrum as a percentage of the number of times infant and mother initiated physical contact. This measure assessed the percentage of maternal rejections.

Percentage of Intervals Engaged in Non-maternal Play (PINMP). The number of intervals the infant engaged in non-maternal play as a percentage of the total number of intervals the infant spent off the mother.

Percentage of Intervals Alone (PIA). The number of intervals an infant was physically alone and not engaged in social activities as a percentage of intervals the infant spent off the mother.

Behaviors were recorded sequentially using a 15 second time base to signal the end of one interval and the beginning of the next interval. Data were collected using the focal animal sampling technique (Altmann, 1974); the infant was the focal animal of this study.

The measures were grouped into four classifications: (1) Maternal Contact: POFF, PINOFF; (2) Maternal Proximity: PINGSX; (3) Maternal Responsibility: Proximity Index, Contact Index, REGMC; and (4) Non-maternal Activities: PINMP, PIA. Behavioral constituents of these measures are defined in Appendix A, and Appendix B presents the inter-observer reliability estimate for each of the constituent behaviors. Each estimate is a percent agreement score (# agreements/# agreements + # disagreements x 100) based on two-hundred and forty 15 second intervals. Reliability tests were divided equally between PF79 and UM79, and between morning and evening data sessions. To insure that the majority of behavior patterns were represented, observations

spanned a period of 5 days and were collected during the infant's fourth month of life. Reliability estimates ranged from 72 - 100%.

Procedure

This study was divided into four stages: preseparation, habituation, separation and post-separation. For all phases, data on each infant were collected six times per week during 15 minute sessions. Observations were evenly divided and alternated between morning (8:30-10:30 a.m.) and evening hours (5:00-7:00 p.m.). Variations in this data collection schedule are discussed where appropriate.

Pre-separation. The pre-separation stage spanned the first 30 days of an infant's life and was solely concerned with the collection of baseline data. During this phase the colony remained intact, and disturbances kept to a minimum.

Once infants born into the colony during 1979 reached the age of 30 days, the habituation phase began.

Habituation. The purpose of the habituation phase was to acclimate the monkeys to brief separation from group members. Four animals were removed from the colony for one hour a day, 4 days per week, between 11:30 a.m. and 1:00 p.m. These animals were chosen each day on a random basis with the stipulation that each adult (Q44, Q50, Peanut, Ugli, Zelda) and each juvenile (PM76, UF76, PF77, UM77) experienced a minimum of 16 and 10 separations, respectively, from the social group. Infants remained with their mother during all phases of the study.

The 4 separated monkeys were housed in wire mesh cages

(81 x 83 x 83 cm) located in a room adjacent to the colony room. Each cage contained a pair of monkeys kept separate from each other by a wire mesh partition, allowing visual and auditory but not tactile contact. Fruit was distributed to all monkeys during this time. After one hour elapsed, the animals were returned to their home cage.

The habituation phase lasted 60 days, from the infant's 30th to 90th day of life. Once the infants in the colony reached the age of 90 days, the separation phase began.

Separation. Four animals (PM76, UF76, PF77, UM77), chosen on the basis of their matrilineage and gender, experienced multiple separations from the social group during this phase. Figure 1 shows that PM76 and PF77 (UF76, UM77) are siblings. Moreover PM76 and UF76 (PF77, UM77) are of opposite sexes. Therefore, by removing these animals from the colony, the effect of the peer's matrilineage upon the mother-infant interaction, as well as the contribution of the peer's gender, was assessed.

Figure 2 shows the sequence planned for the sixteen separations, which were cross-classified into four blocks (A-D) and four positions (1-4). The order of removal within a block (or position) was subject to the following constraints: (1) each animal was removed once per block; (2) no animal was removed on two consecutive occasions (e.g., A-4 and B-1); and (3) no animal was removed twice in the same position in different blocks.

Separations occurred between 11:30 a.m. and 1:30 p.m. and lasted one hour. Housing of the separated monkey was identical to that

Fig. 2. Sequence of Removals during the Separation Phase

Blocks	Position 1	2	3	4
A	PF77	UF76	UM77	PM76
B	UM77	PM76	PF77	UF76
C	PM76	UM77	UF76	PF77
D	UF76	PF77	PM76	UM77

fig. 2

described for the habituation phase except that during this phase each monkey was paired with an adult colony male, Q50. By allowing the juveniles visual and auditory access to a familiar animal, stress resulting from separation was minimized (Gunnar, Gonzales, and Levine, 1980). Q50 was selected because, as a subordinate male, his absence from the colony did not drastically affect the social dynamics of the group. Fruit was distributed to all colony members immediately following the separations. Separations lasted one hour, after which both animals were returned to their home cage.

Observations were recorded for each mother-infant dyad during the time that the animal designated for removal and Q50 were absent from the social group (Removal Period). Observations were also recorded twice per block between the hours 11:30 a.m. and 1:00 p.m. on the days that removals did not occur. Data on each infant were collected during 15 minute sessions for both removal and non-removal days.

Each separation block consisted of 4 consecutive days of removal followed by 4 days in which the social group remained intact. The separation phase lasted 32 days and each juvenile monkey experienced a total of 4 hours of separation from group members.

Post-separation. For one month following the separation phase, the procedure was identical to that described for the pre-separation phase.

Data Analysis

The behaviors, for each infant, were analyzed using three separate analysis of variance designs. The first analysis examined the effect of removal on mother-infant interactions. A two-factor analysis of variance with Day (removal, non-removal) and Blocks (Block 1 through Block 4) as the within subject variables was used. The second examined the effect of kinship removal on mother-infant interactions. A two-factor analysis of variance with kinship (sibling removal; non-sibling removal; no removal) and Blocks (Block 1 through Blcok 4) as the within subject variables. The third examined the effect of gender of the animal removed on the mother-infant pair using a two factor analysis of variance with gender (male removal; female removal; no removal) and Blocks (Block 1 through Block 4) as the within subject variable.

Post hoc analysis. Newman Keuls' Multiple Range Test was used to identify the mean(s) contributing to the main effects. The F-Test for Simple Effects was used to identify the group means that differed within each block; the Newman Keuls' Multiple Range Test was used to determine if a group changed significantly across blocks.

CHAPTER III

RESULTS

In general, the data showed that: (1) compared to non-removal days, removal of peers from the social group fostered behaviors which resulted an increase of mother-infant proximity and contact, and a decrease in the infant's social activities (i.e., play); (2) Non-sibling removals had a greater affect on mother-infant interactions than sibling removals. That is, in the absence of non-siblings, the infants spent less time off their mothers and at a distance from them. Both play scores and the percentage of intervals alone decreased when a non-sibling was removed from the social group. The effect of non-sibling removals, compared to sibling removals, was more pronounced for PF79 than they were for UM79; (3) Separation of same-sex peers had a greater and more systematic affect on the mother-infant dyad than the separation of opposite-sex peers. In the absence of same-sex peers, an infant spent more time in proximity and contact with its mother and less time involved with the social environment; (4) Examination of the effect that each peer's absence had on the mother-infant dyad demonstrated that removal of UF76 had the greatest impact on PF79's relationship with her mother, while the removal of UM77 had the greatest impact on UM79's relationship with his mother.

The Effects of Removal

The behaviors grouped under Maternal Contact were less frequent during removal days compared to non-removal days for PF79 (POFF: $F = 15.2$, $(1,16)$, $p < .01$; PINOFF: $F = 13.4$, $(1,16)$, $p < .01$) and for UM79 (POFF: $F = 6.6$, $(1,16)$, $p < .05$). PF79 was more responsible for maintaining maternal proximity (Proximity Index: $F = 5.1$, $(1,16)$, p .05) and UM79 spent fewer intervals engaged in non-maternal play (PINMP: $F = 10.9$, $(1,16)$, $p < .01$) and alone (PIA: $F = 9.7$, $(1,16)$, $p < .01$) during brief removal of individuals from the colony.

Non-significant changes in the following behaviors for UM79 and PF79 during removal vs non-removal days were consistent with these findings. Both infants: (1) spent fewer intervals at a distance from their mothers (PINGSX); and (2) were more responsible for maintaining maternal contact (Contact Index) during the days that removals took place. UM79 spent fewer complete intervals off mother (PINOFF) and was more responsible for maintaining maternal proximity (Proximity Index) and PF79 spent fewer intervals engaged in non-maternal play (PINMP) and alone (PIA).

A summary of the effects of removal is presented in Table 2.

The Effect of Sibling-Non-sibling Removal

Maternal contact. The following non-significant trends were observed in maternal contact during the removal of siblings and non-siblings from the social group.

PF79 spent a greater percentage of intervals off (POFF) and

TABLE 2

CHANGES IN MOTHER-INFANT INTERACTION: COMPARISONS OF REMOVAL DAYS TO NON-REMOVAL DAYS

Behavioral Classification	PF79	UM79
Maternal Contact		
% Intervals off mother (POFF)	↓**	↓*
% Complete intervals off mother (PINOFF)	↓*	↓
Maternal Proximity		
% Intervals greater than 60cm from mother (PINGSX)	↓	↓
Maternal Regulation		
Proximity index	↑*	↑
Contact Index	↑	↑
% Regulated maternal contact (REGMC)	↑	↓
Non-Maternal Activity		
% Intervals non-maternal play (PINMP)	↓	↓**
% Intervals alone (PIA)	↓	↓

*p < .05

**p < .01

complete intervals off (PINOFF) Peanut when siblings were removed. Changes in PINOFF and POFF during sibling and non-sibling removals shown with PF79, were not exhibited for UM79 (Figures 3 and 4).

PF79's response to the removal of siblings and non-siblings remained consistent over time with respect to the percentage of intervals off (POFF) and complete intervals off (PINOFF) Peanut (Figures 5 and 6 respectively). This was not true for UM79, whose scores on these measures showed a non-significant increase across the blocks.

Maternal proximity. The percentage of intervals UM79 spent greater than 60 cm (PINGSX) from Ugli were significantly less when non-siblings were removed ($F = 5.7$, $(2,12)$, $p < .05$, Figure 7). No differences were found between sibling removal and non-removal days.

There was a significant Kinship by Block interaction in the percentage of intervals UM79 spent greater than 60cm from Ugli ($F = 4.8$, (6.12), $p < .01$, Figure 8). A gradual increase in this measure over time was observed when non-siblings were removed. Comparison of data for non-sibling removals in Block's 1 and 4 show that UM79 spent significantly fewer intervals greater than 60cm from Ugli in Block 1.

Although not statistically significant, comparison of sibling and non-sibling removals showed that PF79 scored lower on this measure when non-siblings were removed from the social group.

Maternal responsibility. The effects of removal on the mean percent proximity index and mean percent contact index are illustrated in Figures 9 and 10 respectively. The following nonsignificant trends in the data were noted. Peanut was responsible for maintaining proximity

Fig. 3. The Percentage of Intervals Off Mother during Sibling Removal, Non-Sibling Removal and Non-Removal Days.

Key:

Sibling Removal 

Non-Sibling Removal 

Non-Removal 

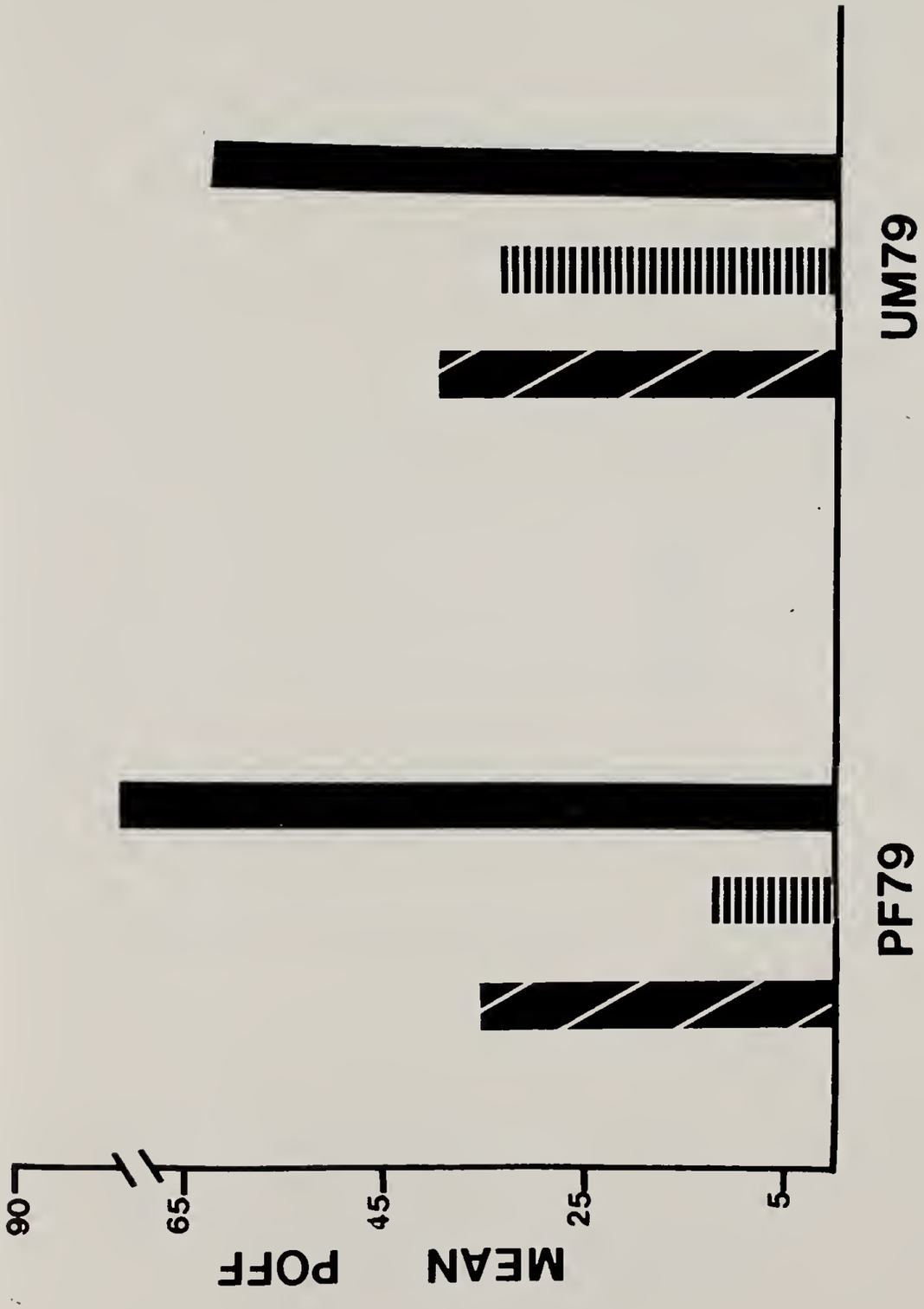


Fig. 3

Fig. 4. The Percentage of Complete Intervals Off Mother during Sibling Removal, Non-Sibling Removal and Non-Removal Days.

Key:

Sibling Removal 

Non-Sibling Removal 

Non-Removal 

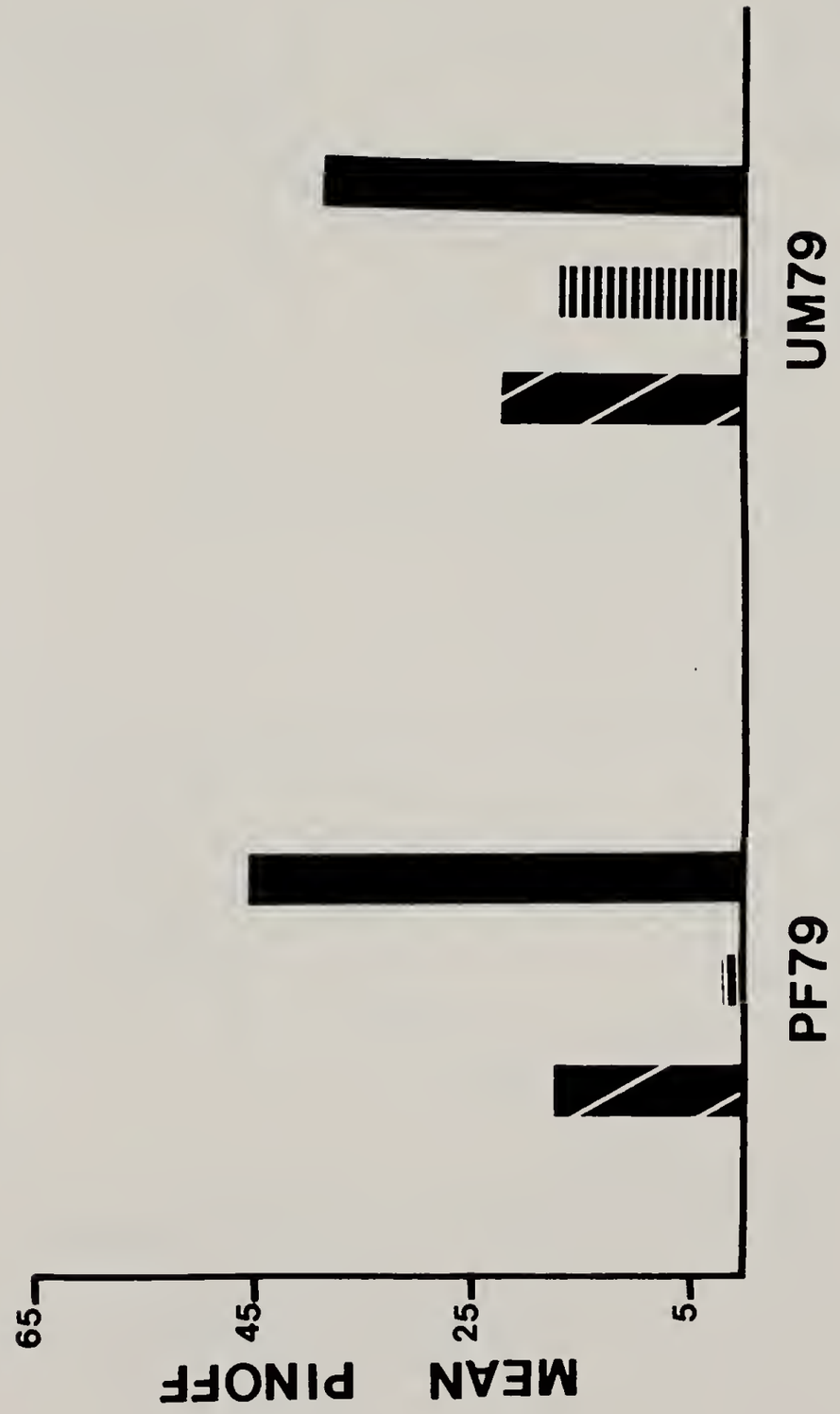


Fig. 4

Fig. 5. The Percentage of Intervals Off Mother during Sibling Removal, Non-Sibling Removal and Non-Removal Days, Over Blocks.

Key: Sibling Removal

Non-Sibling Removal

Non-Removal

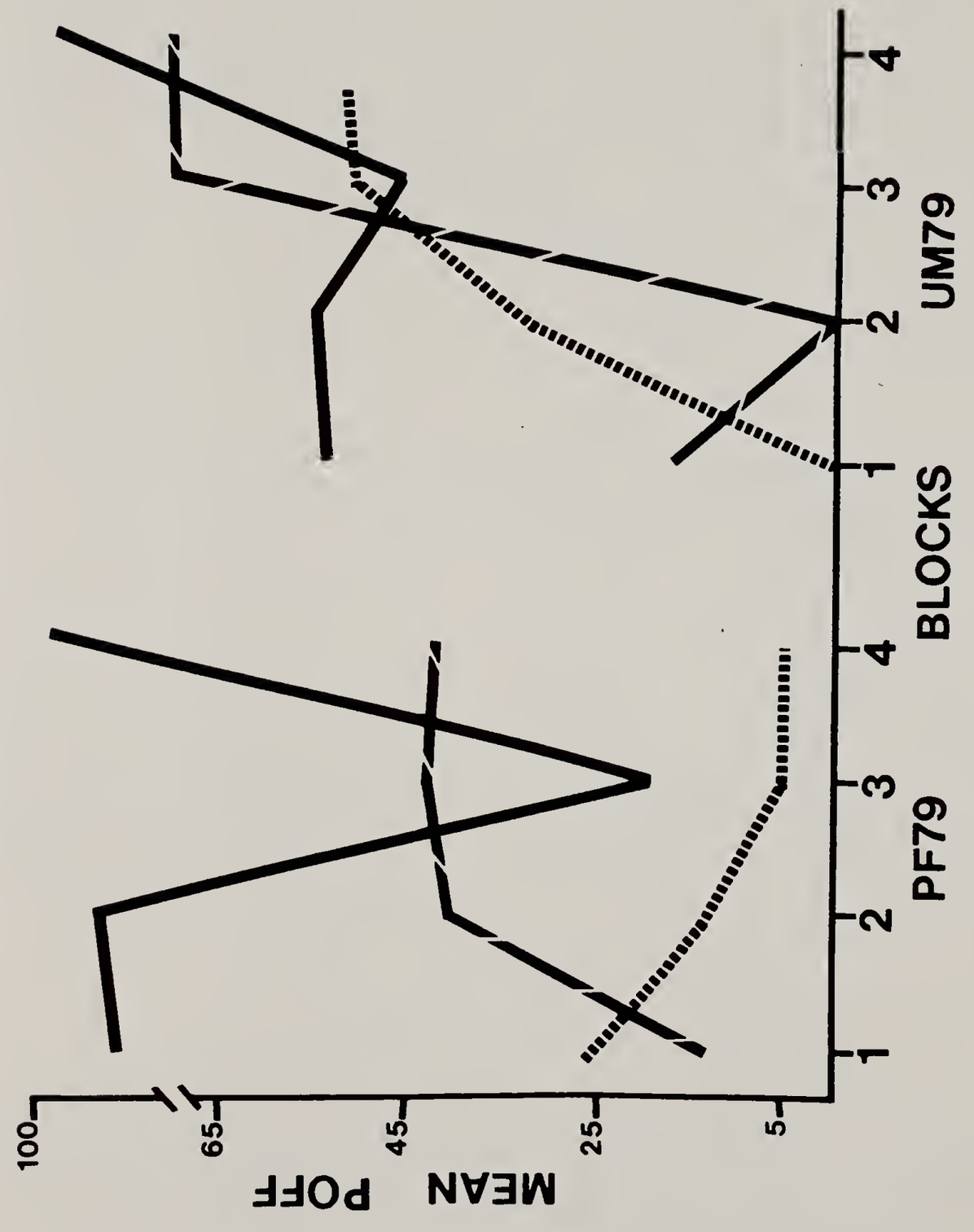


Fig. 5

Fig. 6. The Percentage of Complete Intervals Off Mother during Sibling Removal, Non-Sibling Removal and Non-Removal Days, Over Blocks.

Key: Sibling Removal

Non-Sibling Removal

Non-Removal

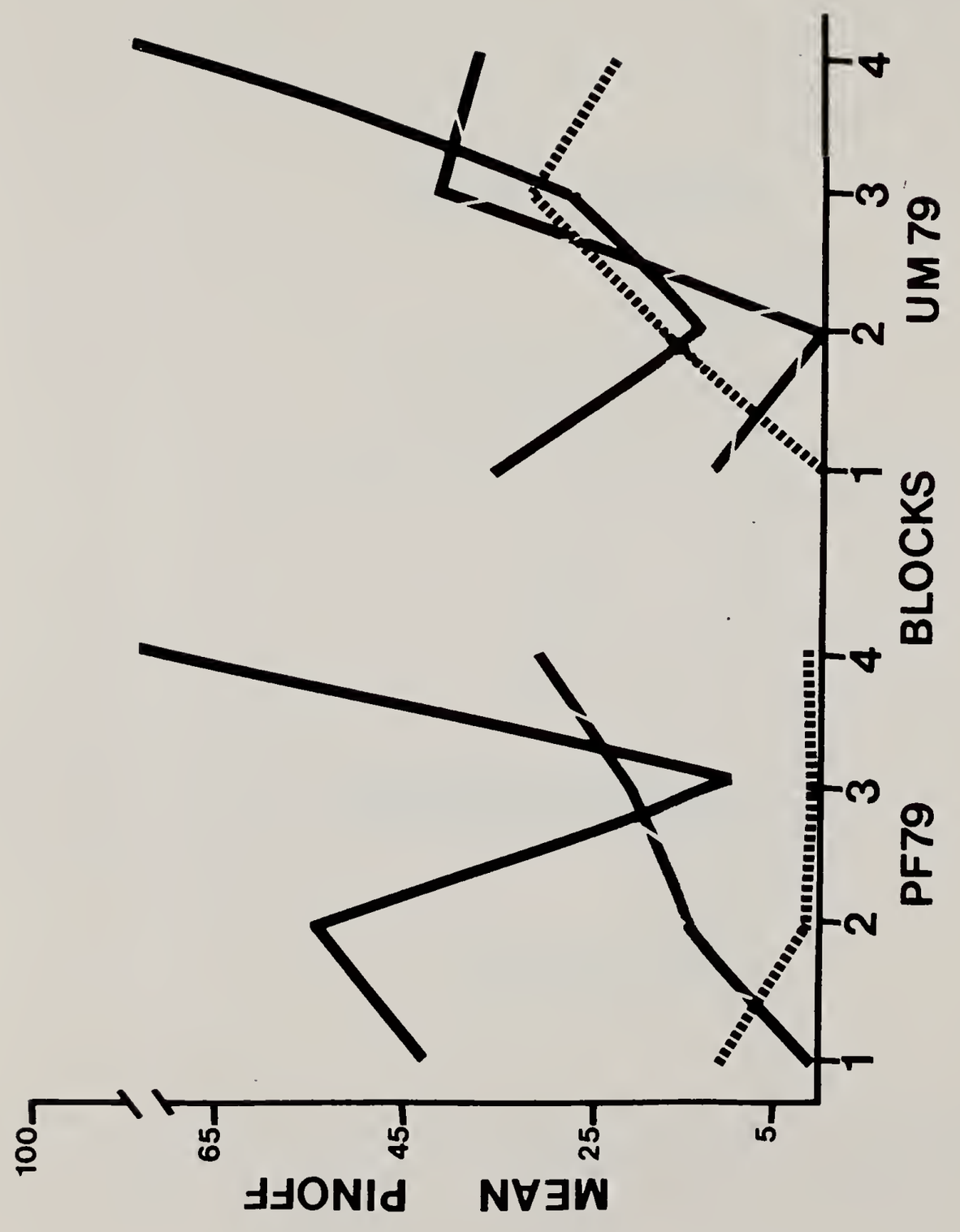


Fig. 6

Fig. 7. The Percentage of Intervals Greater Than 60cm during Sibling, Non-Sibling and Non-Removal Days.

Key: Sibling Removal 

Non-Sibling Removal 

Non-Removal 

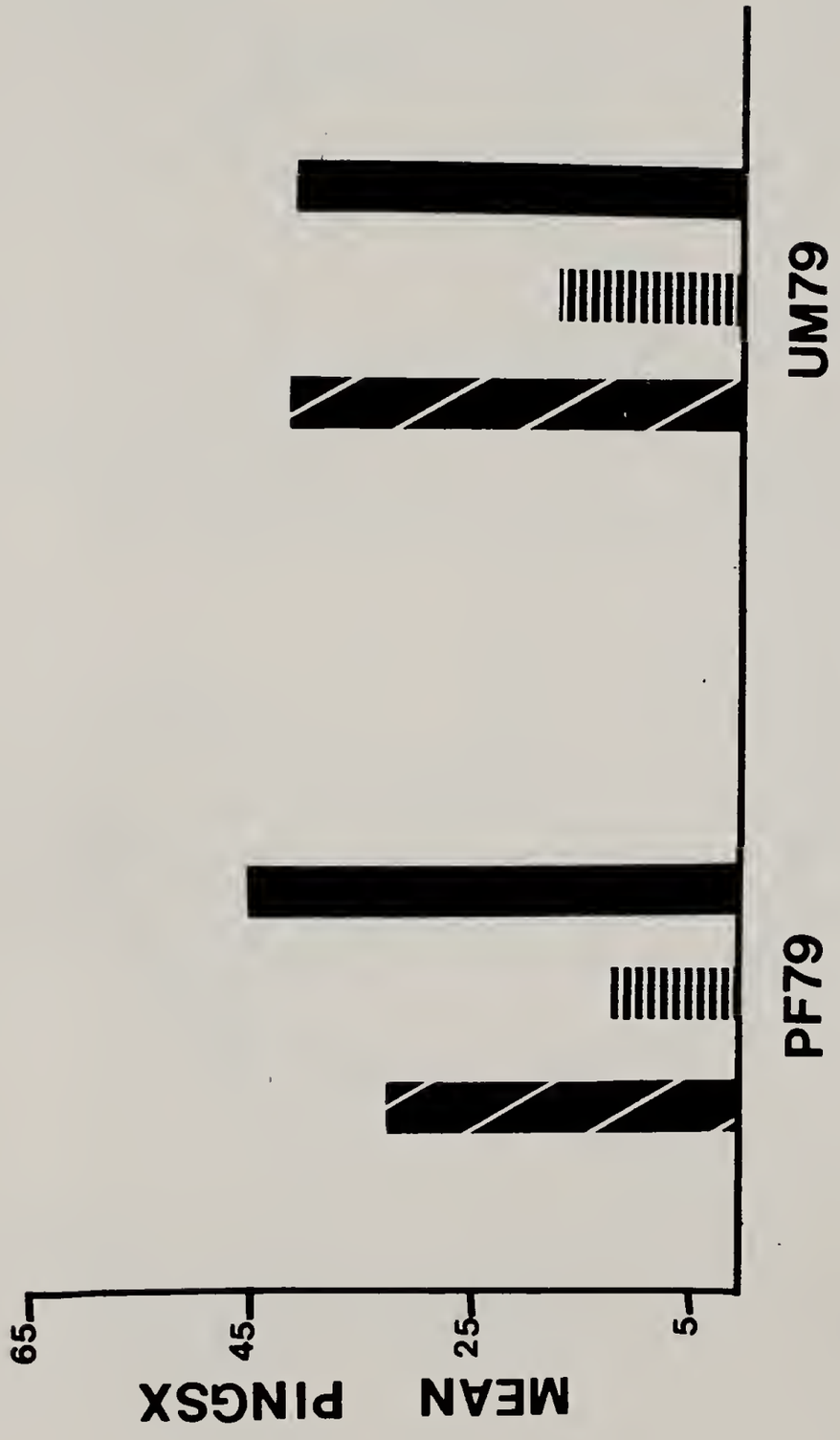
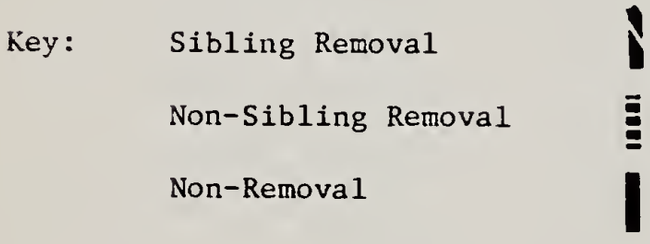


Fig. 7

Fig. 8. The Percentage of Intervals Greater Than 60cm during Sibling, Non-Sibling and Non-Removal Days, Over Blocks.



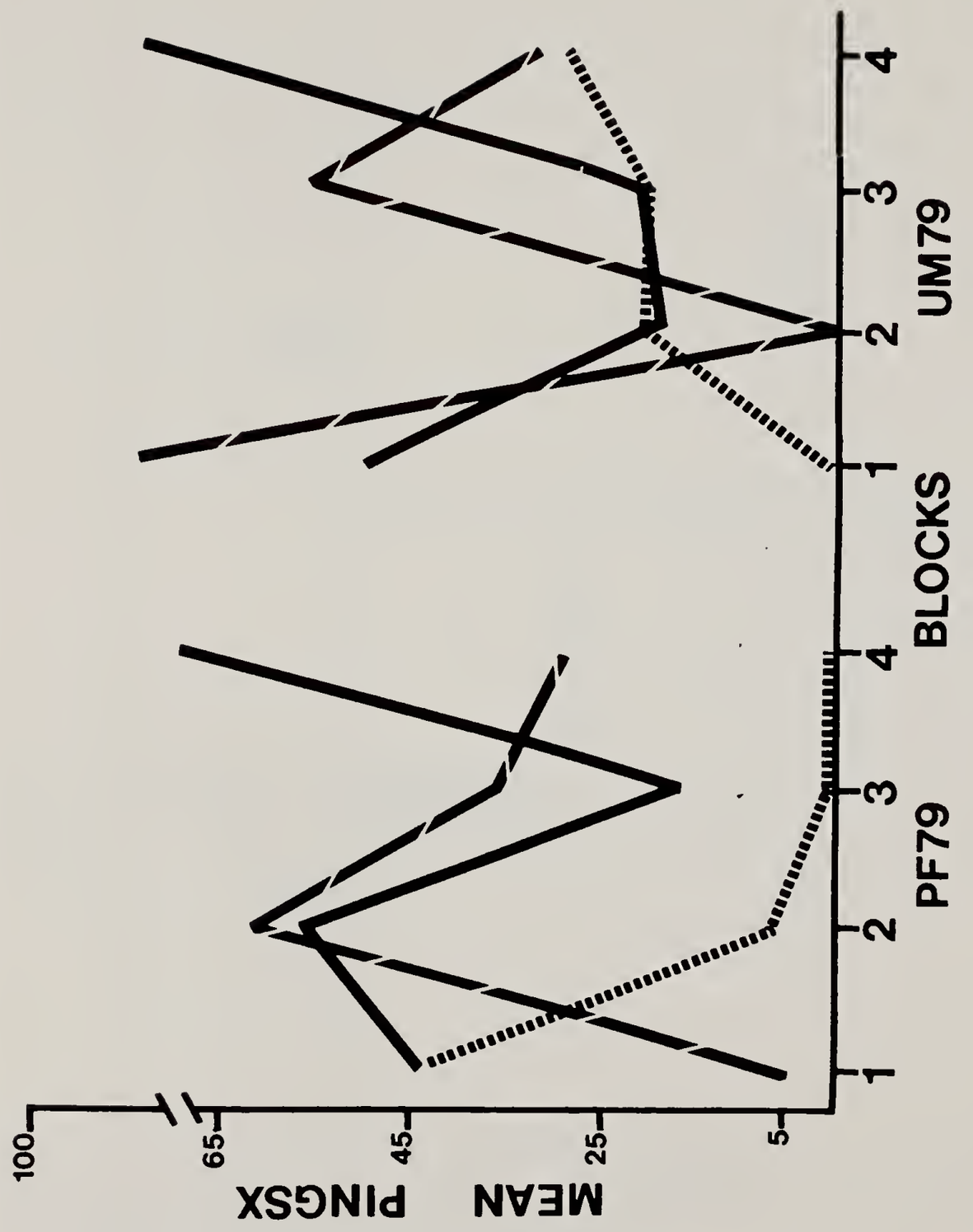
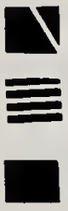


Fig. 8

Fig. 9. Mother-Infant Responsibility for Proximity during Sibling Removal, Non-Sibling Removal and Non-Removal Days.

Key:



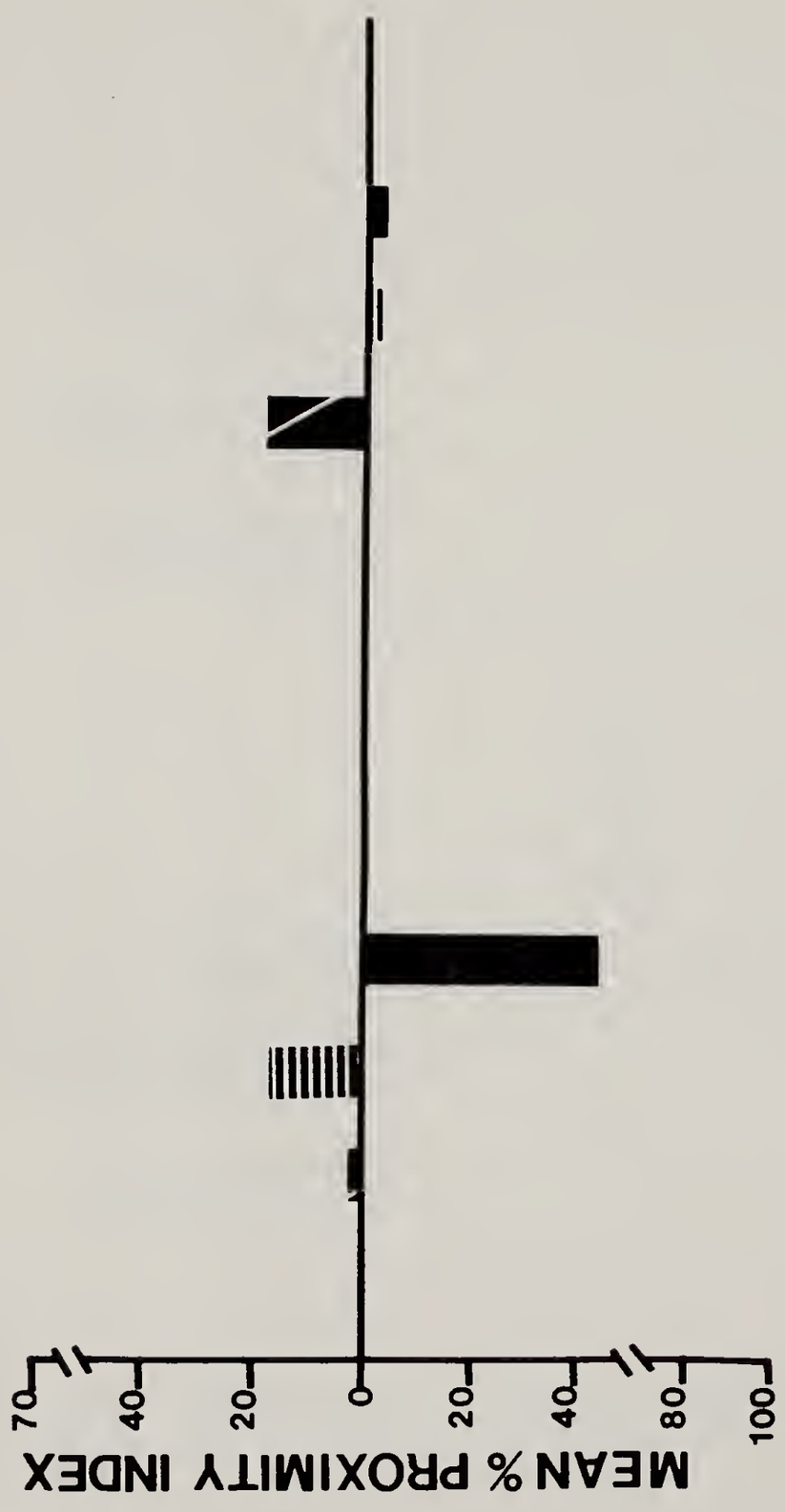


Fig. 9

Fig. 10. Mother-Infant Responsibility for Physical Contact during Sibling Removal, Non-Sibling Removal and Non-Removal Days.

Key: Sibling Removal 

Non-Sibling Removal 

Non-Removal 

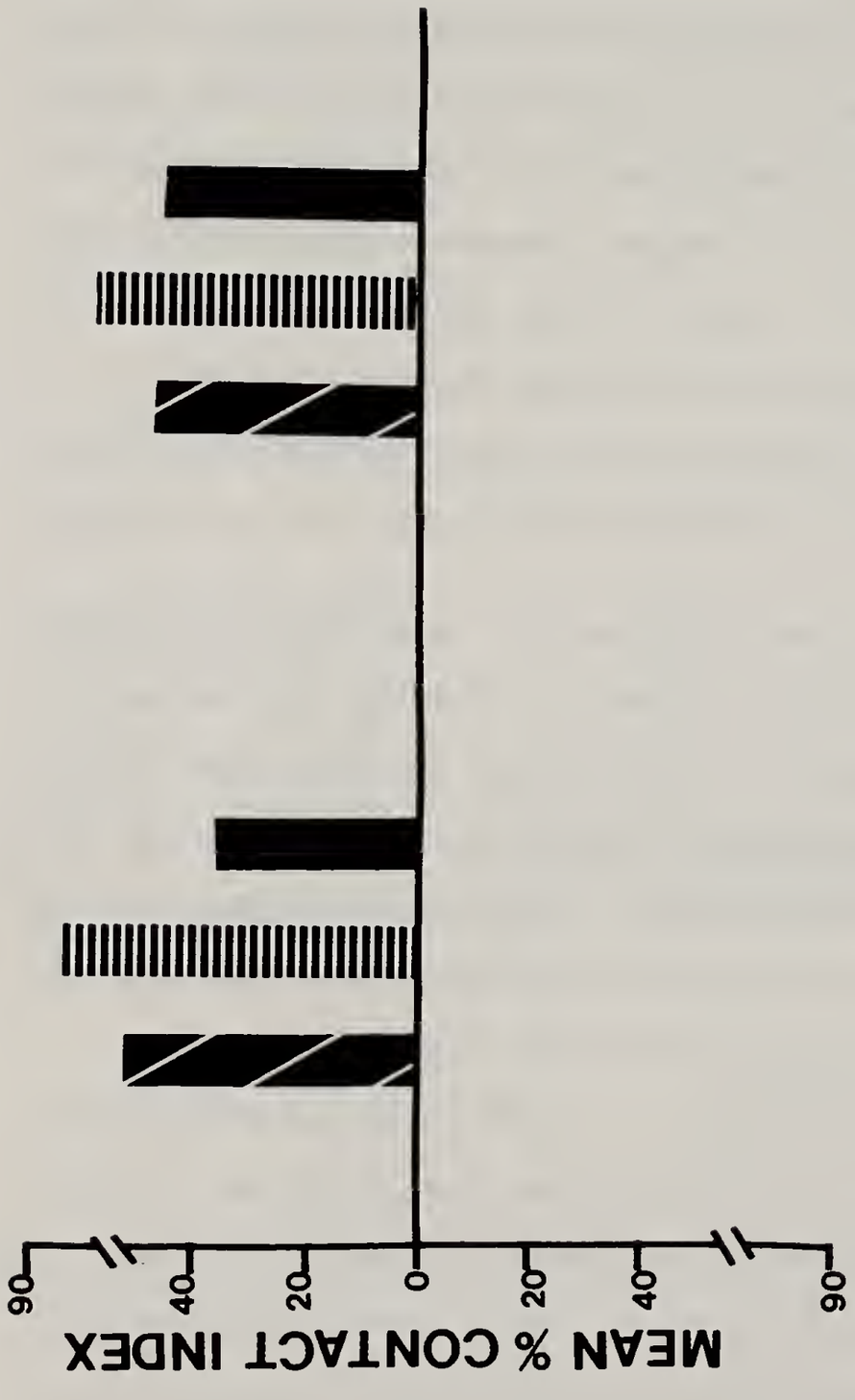


Fig. 10

to PF79 during non-removal days, whereas Ugli and UM79 contributed equally to maintaining proximity during this time (Figure 9). A shift in roles between mother and infant occurred during the removal process. Comparison of sibling and non-sibling removals show that the proximity index for PF79 was highest when non-siblings were removed. These data suggest that PF79 was more affected by the removal process than Peanut. In contrast, UM79 became the primary agent for maintaining proximity when sibling removals occurred, suggesting that UM79 was more affected by the removal of siblings than was Ugli.

Figure 10 presents data for the mean percent contact index. Comparison of sibling and non-sibling removals show that this index was greatest for both infants when non-siblings were removed.

Non-maternal activities. The mean percentage of intervals engaged in non-maternal play (PINMP) are presented in Figure 11. Although not significantly different, the percentage of intervals engaged in non-maternal play for PF79 was greatest when siblings were removed compared to the removal of non-siblings. This was not true for UM79, who showed no differences in PINMP during sibling and non-sibling removals.

Figure 12 presents data for the mean percentage of intervals PF79 and UM79 were alone (PIA). No significant differences were found for UM79 when sibling and non-sibling removals were compared. There was however a significant interaction between Kinship by Block in the percentage of intervals alone. ($F = 4.1$, $(6,12)$, $p < .05$, Figure 13). The percentage of intervals UM79 was alone significantly increased over time when siblings and non-siblings were removed. When no removals

Fig. 11. The Percentage of Intervals Engaged in Non-Maternal Play during Sibling Removal, Non-Sibling and Non-Removal Days.

Key:

Fig. 11

Fig. 12. The Percentage of Intervals Alone during Sibling Removal, Non-Sibling Removal and Non-Removal Days.

Key:

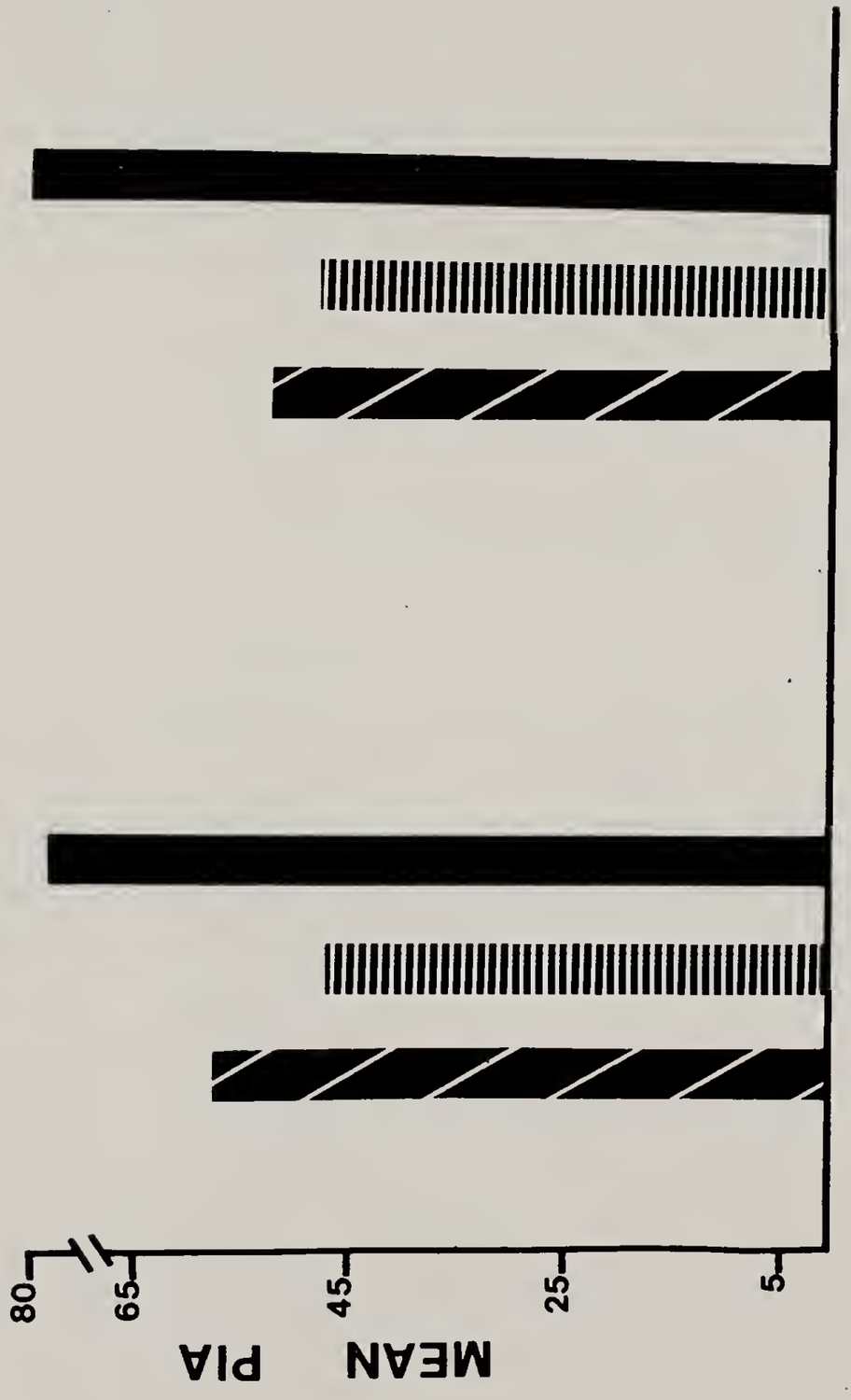


Fig. 12

Fig. 13. The Percentage of Intervals Alone during Sibling Removal, Non-Sibling, and Non-Removal Days, Across Blocks.

Key: Sibling Removal

Non-Sibling Removal

Non-Removal

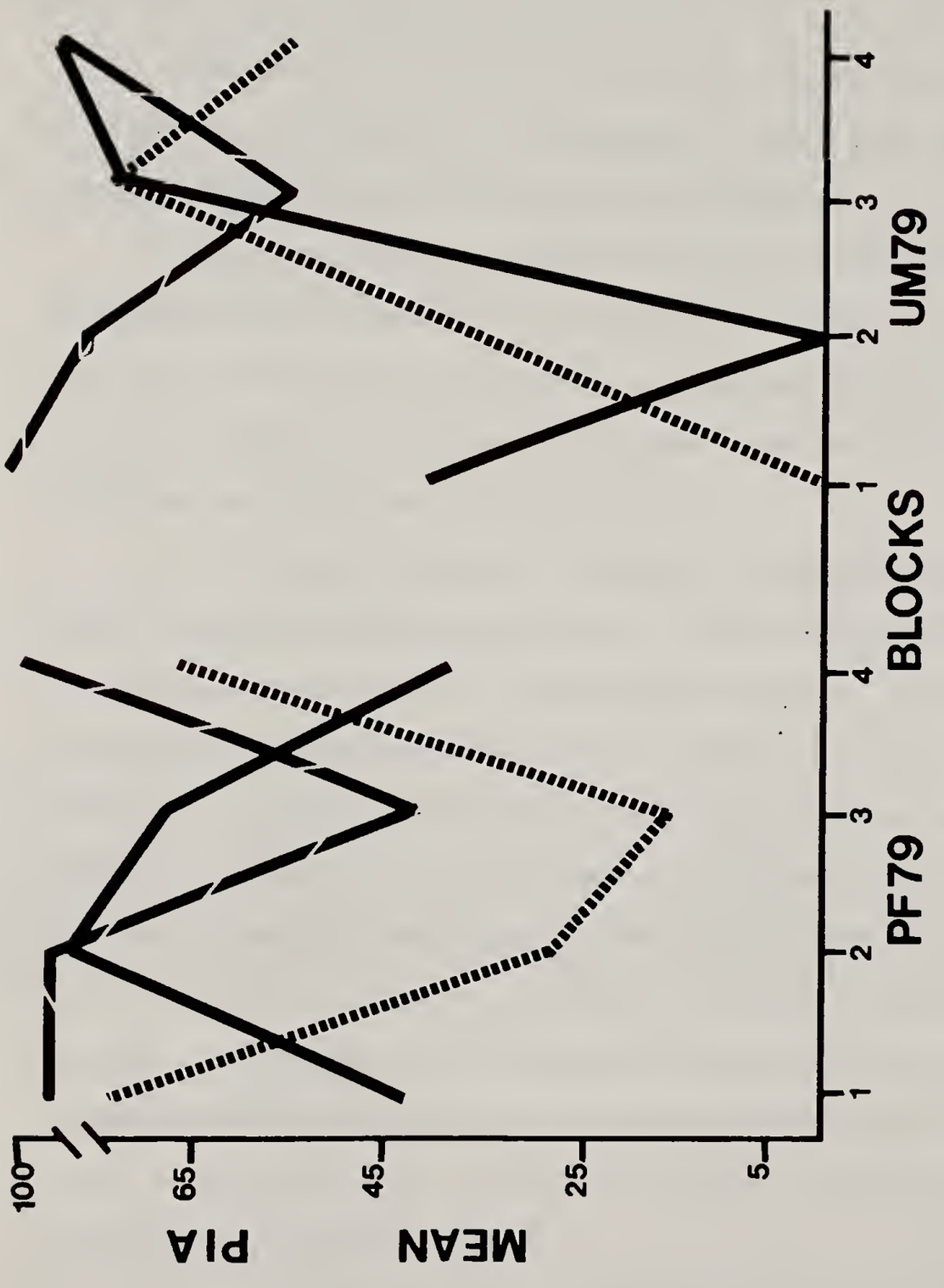


Fig. 13

occurred, the percentage of intervals alone were consistent across Blocks, with the exception of Block 3.

Comparison of sibling and non-sibling removal for PF79 showed no significant differences in this measure. Fewer intervals were spent alone, however, during the removal of non-siblings.

The effect of sibling removal compared to non-sibling removal on mother-infant interactions are summarized in Table 3. The responsibility for maintaining proximity was significantly greater for UM79 during the removal of siblings. The reverse was true for PF79, but the difference was not stastically significant.

The following behaviors, although not significantly different, showed a consistent pattern of change in mother-infant interactions when sibling and non-sibling removals were compared. Both PF79 and UM79 spent a greater percentage of (1) intervals off (POFF): (2) complete intervals off (PINOFF); and (3) intervals greater than 60cm (PINGSX) from mother during the removal of siblings. The infants were less responsible for initiating maternal contact when siblings were removed. PF79 spent a greater percentage of intervals engaged in non-maternal play (PINMP) when siblings were removed while no observable differences between sibling and non-sibling removals were noted for UM79. Both infants spent a greater percentage of intervals alone (PIA) when siblings were removed.

These data suggest that, contrary to predictions, the removal of non-siblings had a greater affect on the mother-infant relationship than the removal of siblings.

TABLE 3

CHANGES IN MOTHER-INFANT INTERACTION: COMPARISON OF SIBLING REMOVALS TO NON-SIBLING REMOVALS

Kinship	PF79	UM79
Percentage of Intervals Off Mother	↑	↑
Percentage of Complete Intervals Off Mother	↑	↑
Percentage of Intervals Greater than 60cm from Mother	↑	↑
Proximity Index	↓	↑
Contact Index	↓	↓
Percentage Intervals Non-maternal Play	↑	~
Percentage Intervals Alone	↑	↑

The Effects of Male-Female Removal

Maternal contact. The effects of gender of the animal removed on the percentage of intervals off (POFF) and complete intervals off (PINOFF) mother are presented in Figure 14 and 15, respectively. The following nonsignificant trends in the data were observed.

Comparison of male and female removals suggest that PF79 spent fewer intervals off (POFF) mother when females were removed, while UM79 spent fewer intervals off when males were removed. This pattern of responding was true for both infants with respect to the percentage of complete intervals off (PINOFF) mother. That is, PF79 spent more complete intervals off when females were removed and UM79 did so when males were removed.

A Gender by Block interaction was found in PINOFF for UM79 ($F = 3$, $(6,12)$, $p < .05$). Figure 16 illustrates that the percentage of complete intervals off Ugli increased significantly across Blocks when males and females were removed. PINOFF was stable for the first 3 Blocks when no removals occurred, and then increased significantly in Block 4. In the 4th Block, UM79 spent significantly more complete intervals off Ugli when no removals took place when compared to male and female removals.

Maternal proximity. The percentage of intervals each infant was greater than 60 cm from mother (PINGSX) are illustrated in Figure 17. Although there were no significant differences, PF79 spent more intervals greater than 60 cm from mother when females were removed, while UM79 did so when males were removed.

Fig. 14. The Percentage of Intervals Off Mother during Male Removal, Female Removal and Non-Removal Days.

Key:

Male Removal 

Female Removal 

Non-Removal 

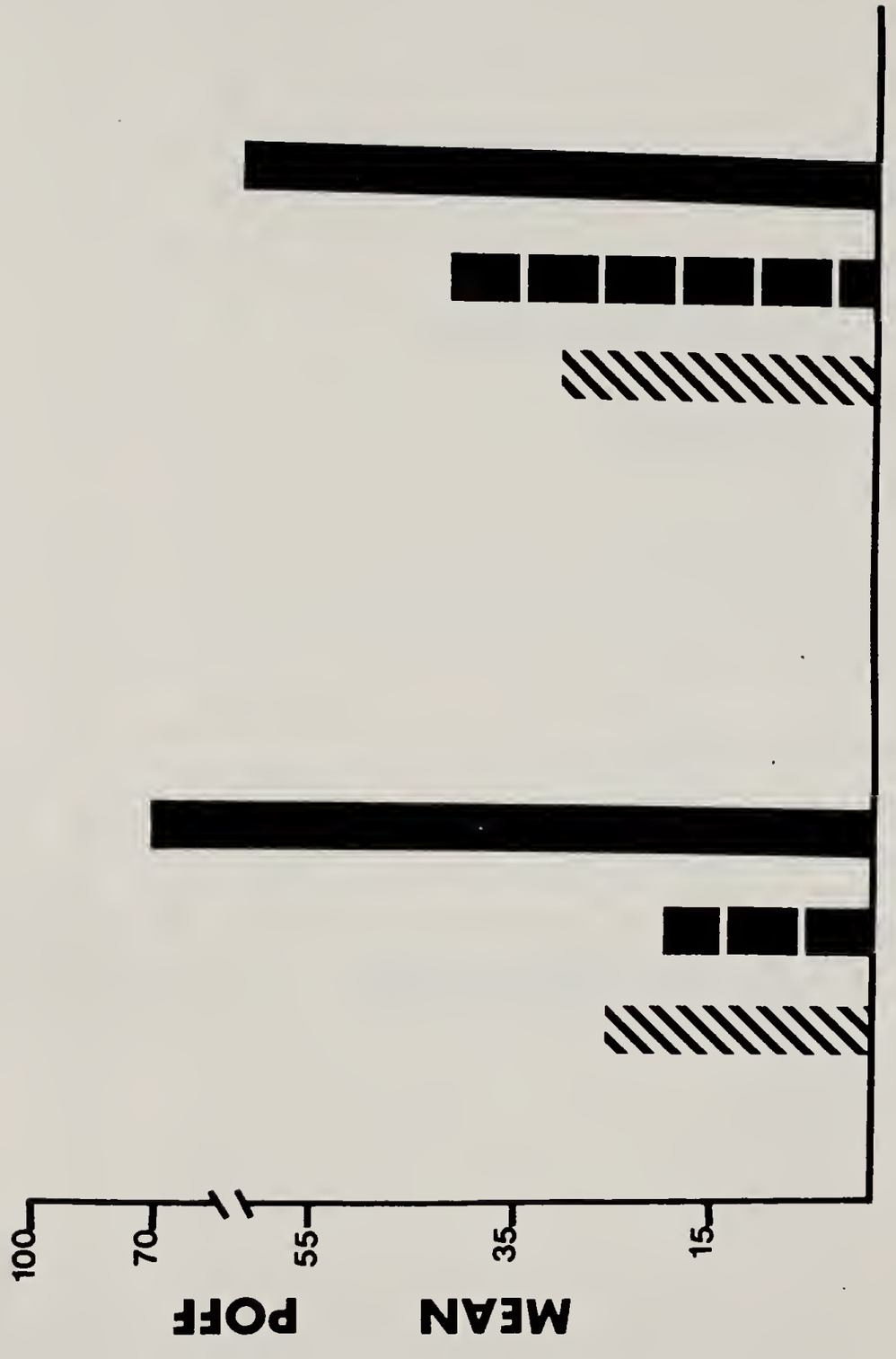


Fig. 14

Fig. 15. The Percentage of Complete Intervals Off Mother during Male Removal, Female Removal and Non-Removal Days.

Key:

Male Removal 

Female Removal 

Non-Removal 

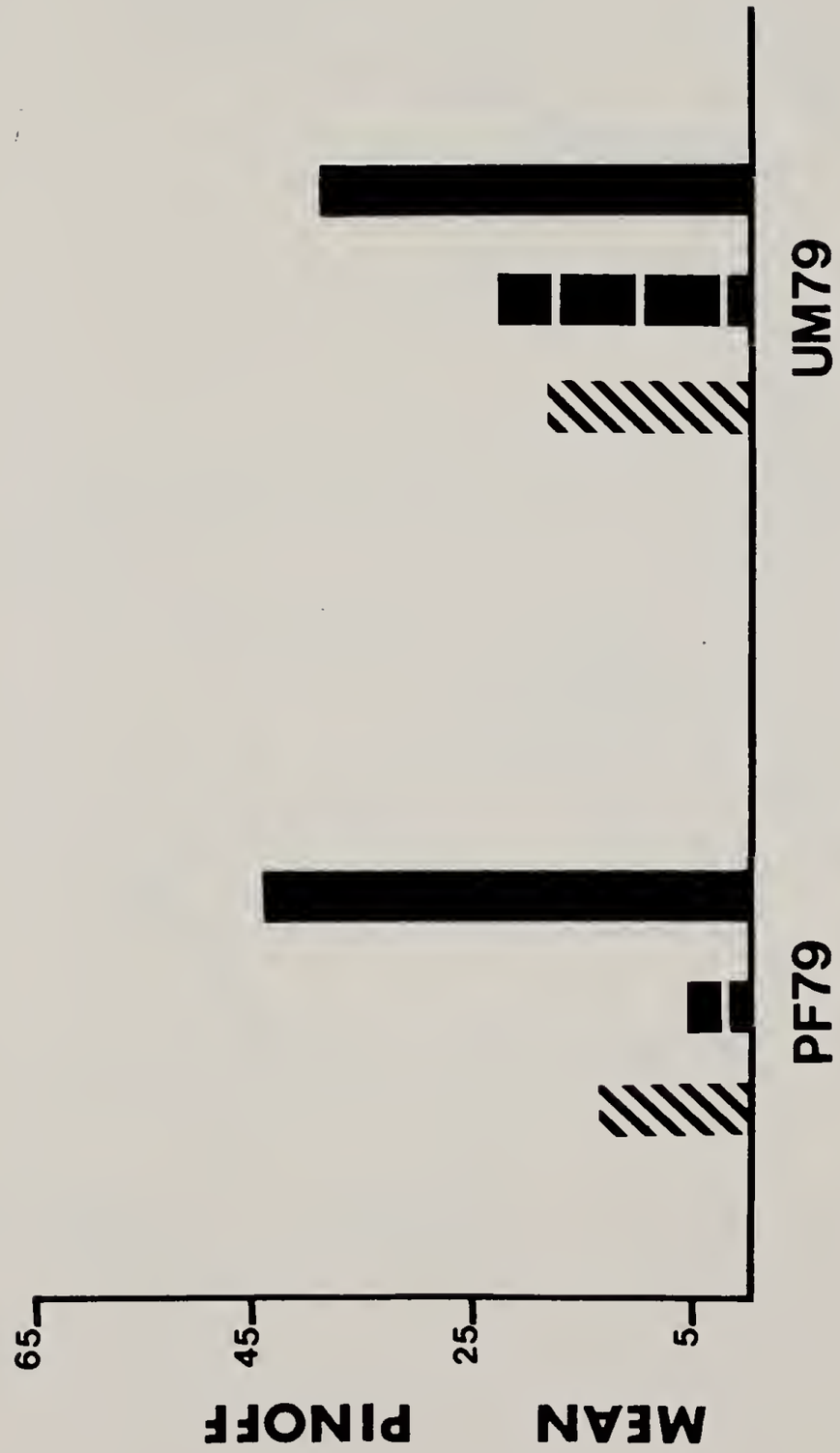


Fig. 15

Fig. 16. The Percentage of Complete Intervals Off Mother During Male Removal, Female Removal and Non-Removal Days, Across Blocks.

Key: Male Removal

Female Removal

Non-Removal

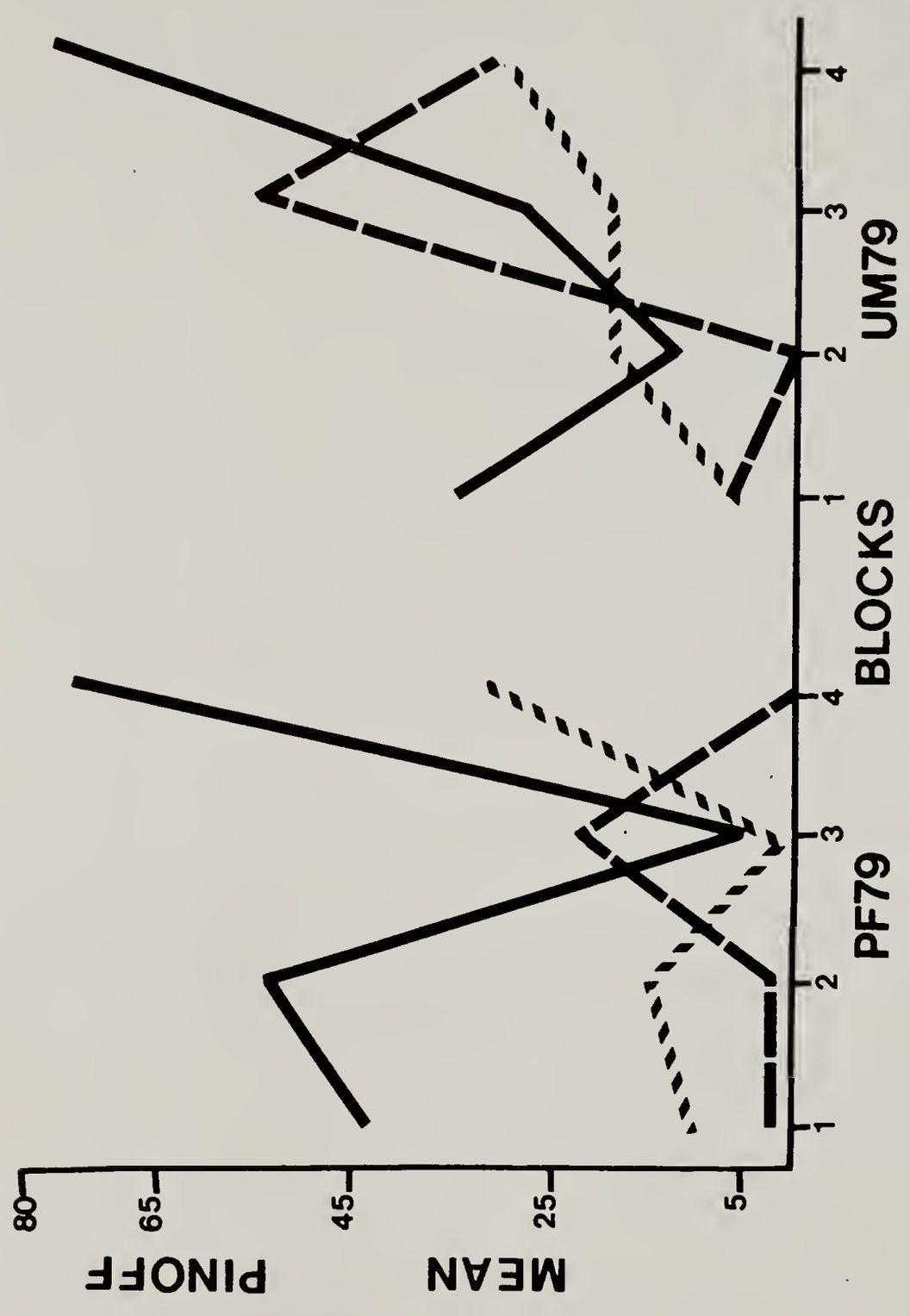


Fig. 16

Fig. 17. The Percentage of Intervals Greater Than 60cm during Male Removal, Female Removal and Non-Removal Days.

Key:

Male Removal 

Female Removal 

Non-Removal 

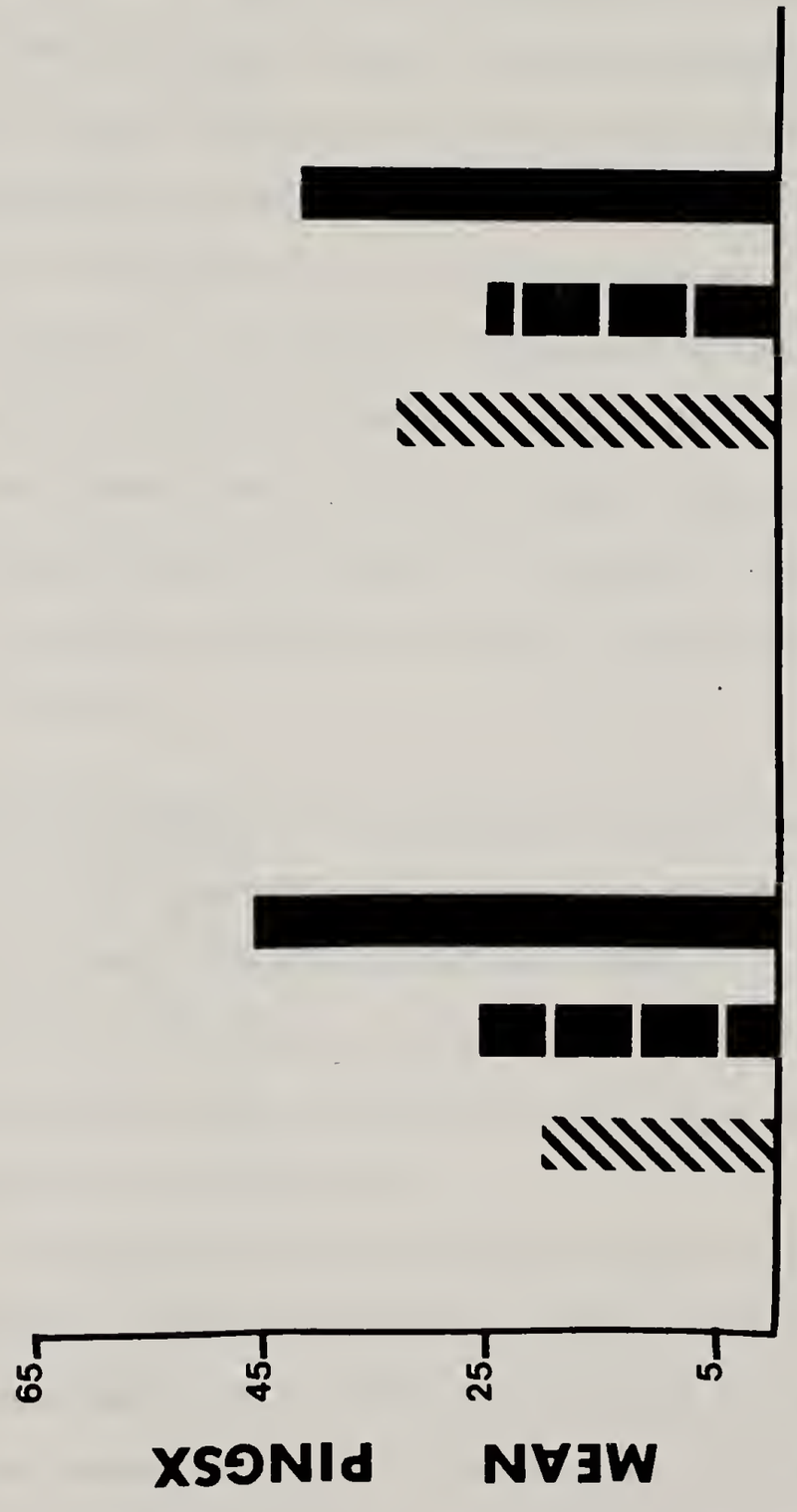


Fig. 17

Maternal responsibility. Figure 18 presents the mean percent Proximity Index. There was a non-significant shift in both infant's role for maintaining proximity during removal days. PF79 assumed responsibility for proximity when females were removed and UM79 was responsible for proximity when males were removed. These data suggest that removal affected the infant's behavior more than the mother's behavior; each infant differentially adjusted their respective roles in maintaining proximity, in response to male and female removals.

There were no significant differences in the percentage of regulated maternal contacts (REGMC), for either infant, when sibling and non-sibling removals were compared. However, this measure was greatest for PF79 when females were removed. In contrast, UM79 experienced a greater percentage of regulated maternal contacts when males were removed, (Figure 19).

Non-maternal activities. The following nonsignificant trends in the percentage of intervals engaged in non-maternal play (PINMP) and the percentage of intervals alone (PIA) were noted.

When male and female removals were compared, PF79 spent less time playing during female removals; no difference was observed in UM79's level of play (Figure 20).

The percentage of intervals UM79 engaged in non-maternal play increased across Blocks when males and females were removed (Figure 21). On non-removal days, PM79's level of play declined in the first half of the separation phase and increased in the second half. The percentage of intervals playing for PF79 increased overtime when males

Fig. 18. Mother-Infant Responsibility for Proximity during Male Removal, Female Removal and Non-Removal Days.

Key:

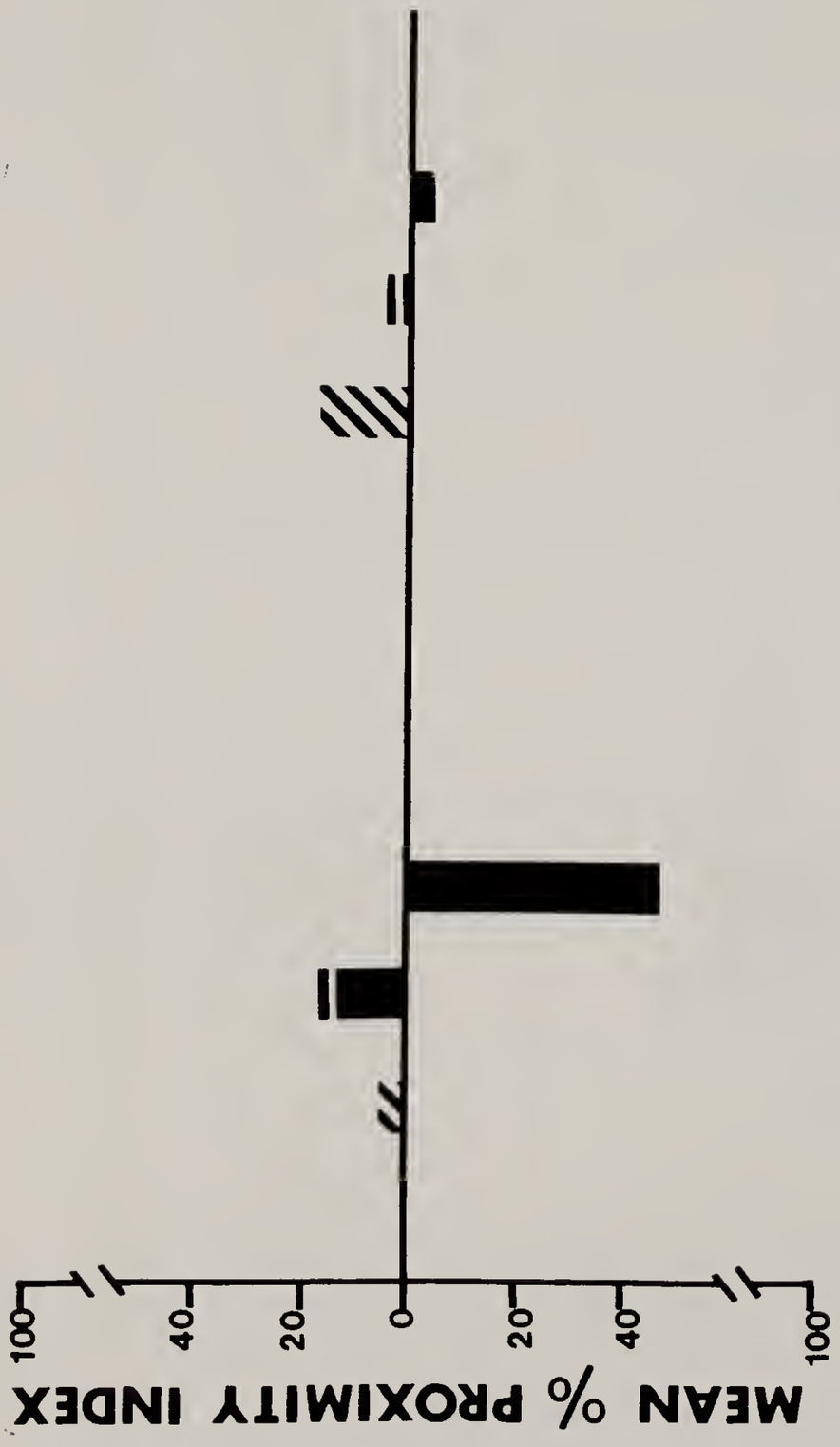


Fig. 18

Fig. 19. The Percentage of Regulated Maternal Contacts during Male Removal, Female Removal and Non-Removal Days.

Key:

Male Removal 

Female Removal 

Non-Removal 

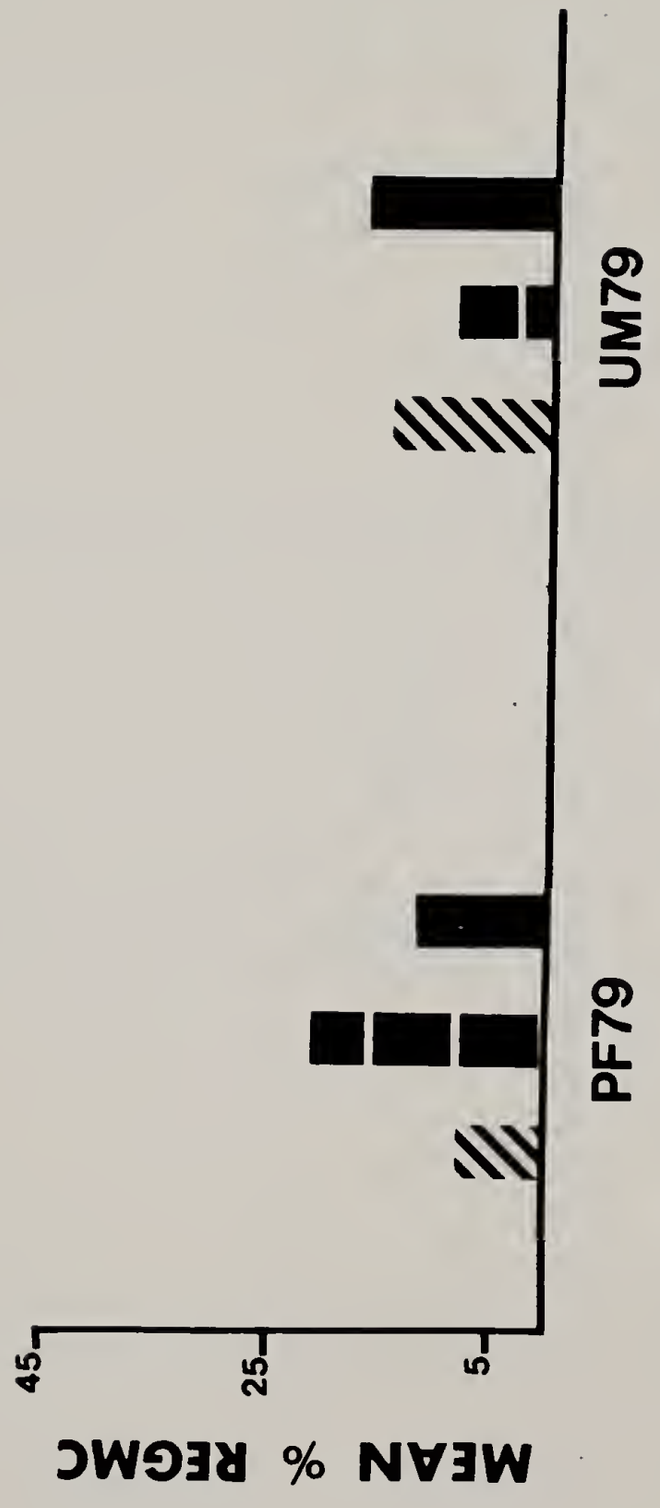


Fig. 19

Fig. 20. Percentage of Intervals Engaged in Non-Maternal Play during Male Removal, Female Removal and Non-Removal Days.

Key:

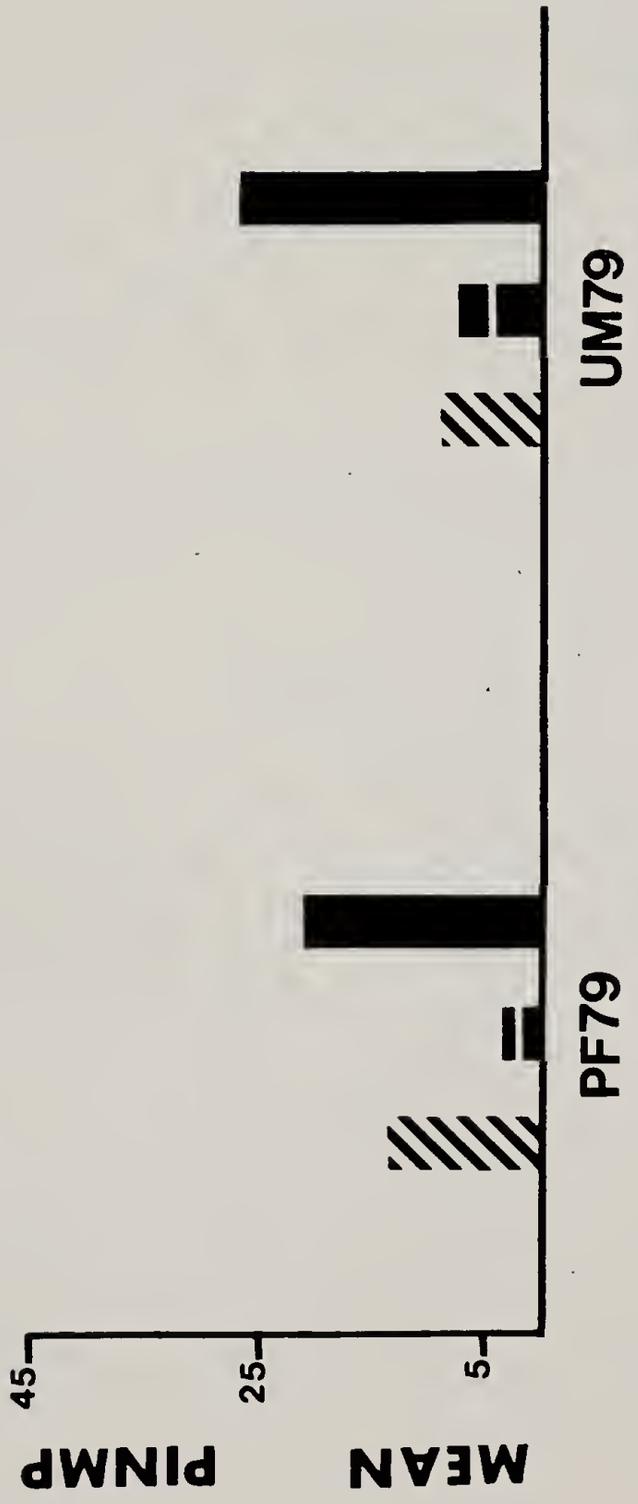


Fig. 20

Fig. 21. Percentage of Intervals Engaged in Non-Maternal Play during Male Removal, Female Removal and Non-Removal Days, Across Blocks.

Key: Male Removal

Female Removal

Non-Removal

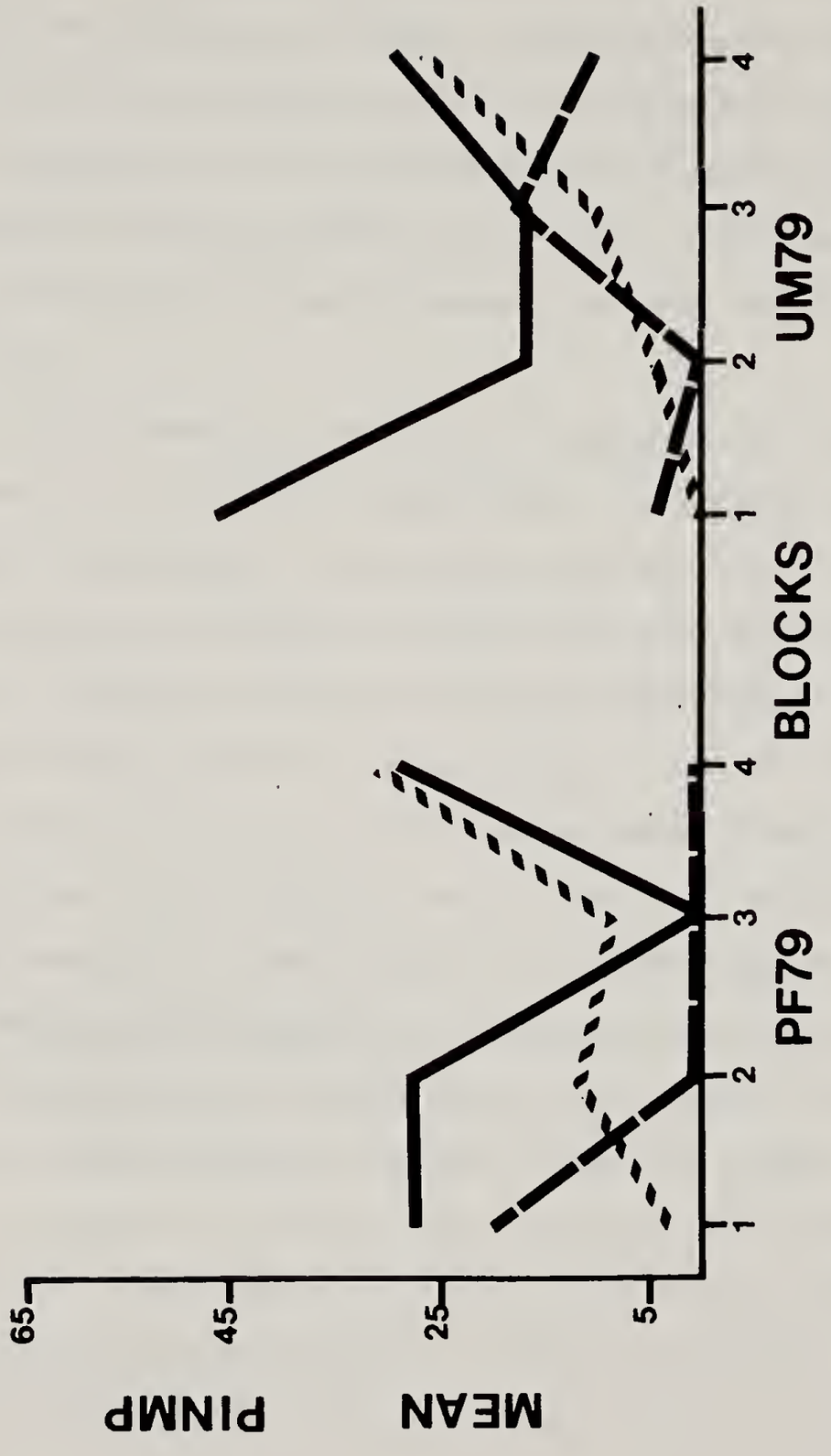


Fig. 21

were removed. Following the first Block of removals, non-maternal play was absent when females were removed. Play scores were consistent across Blocks for non-removal days, with the exception of Block 3.

Comparison of male and female removals suggest that PF79 spent more intervals alone when females were removed. Differences in this measure, during male and female removals, for UM79, were minimal (Figure 22).

Table 4 summarizes the effects of male removal compared to female removal on mother-infant interactions. The differences reported, although not significant, were consistent for intervals. Comparison of female and male removals show that while PF79 spent fewer percent intervals off (POFF) and complete intervals off (PINOFF) mother when females were removed, UM79 did so when males were removed. The percentage of intervals (1) greater than 60cm from mother (PINGSX); (2) regulated maternal contact (REGMC); and (3) along (PIA) were greater for PF79 when females were removed and greater for UM79 when males were removed. PF79 was more responsible for proximity and spent fewer intervals in non-maternal play (PINMP) during female removals, whereas this was true for UM79 during male removals. These data suggest that the removal of females had a greater impact on mother-infant behavior for PF79, a female infant, while the removal of males had a greater affect on the mother-infant relationship for UM79, a male infant.

Fig. 22. Percentage of Intervals Alone during Male Removal, Female Removal, and Non-Removal Days.

Key:

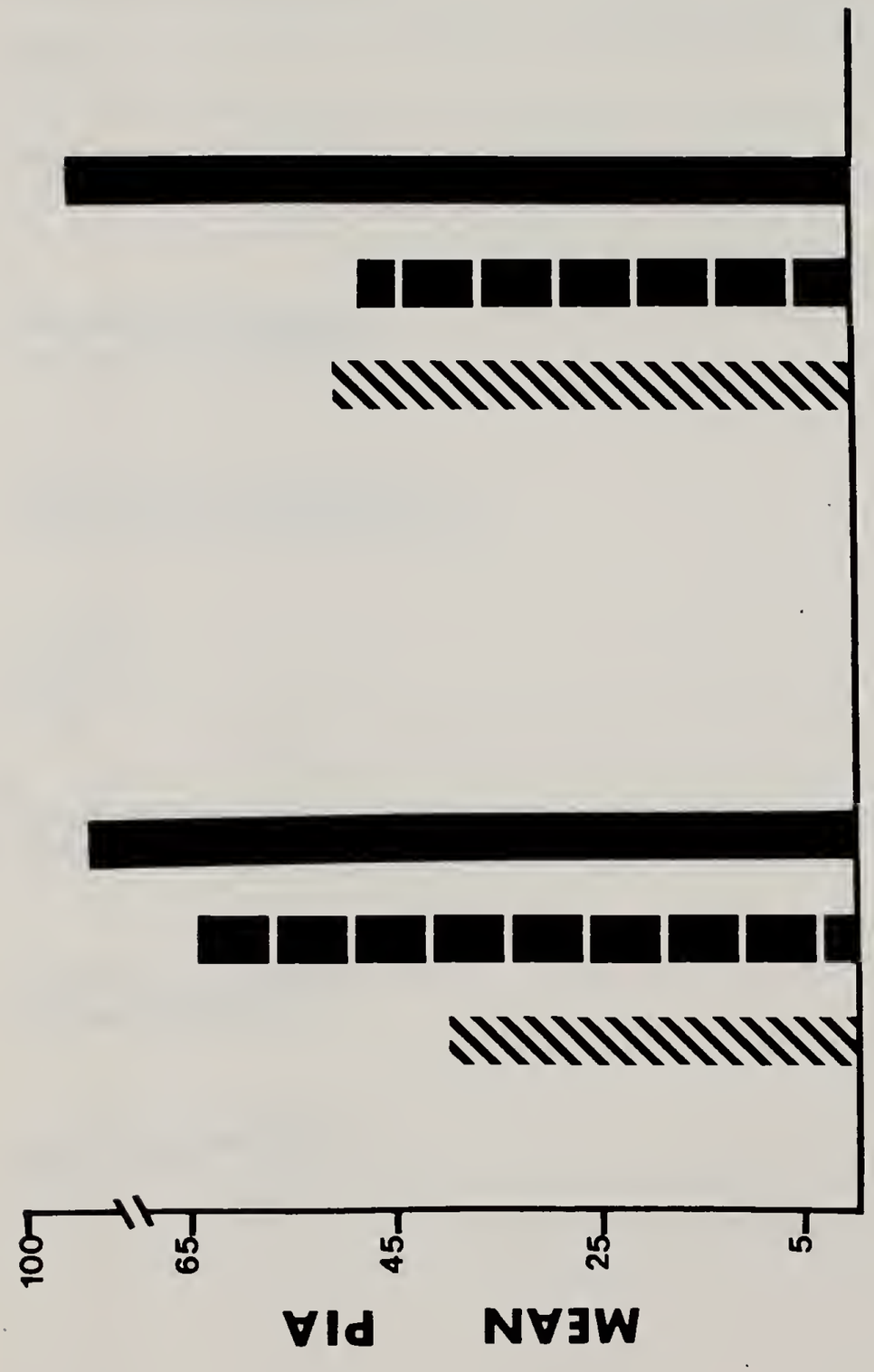


Fig. 22

TABLE 4

CHANGES IN MOTHER-INFANT INTERACTIONS: COMPARISON OF SAME-SEX PEER REMOVAL TO OPPOSITE-SEX PEER REMOVAL

Gender	PF79	UM79
Percentage of Intervals Off Mother	↓	↓
Percentage of Complete Intervals Off Mother	↓	↓
Percentage of Intervals Greater than 60cm from Mother	↑	↑
Proximity Index	↑	↑
Regulated Maternal Contact	↑	↑
Percentage Intervals Non-maternal Play	↓	↓
Percentage Intervals Alone	↑	↑

The Combined Effects of Sibling/Non-sibling and Male/Female Removal

The data show that the gender and matrilineal affiliation of the animal removed influenced the interactions between a mother and her infant. In order to independently assess the contribution of these factors (sibling female, sibling male, non-sibling female and non-sibling male) the effect of PM76, PF77, UM77, UF76 absence on each mother-infant dyad was examined.

The four animals were ranked on the basis of their impact on mother-infant interactions when removed from the social group; the ranks ranged from 1 (least affect) to 4 (greatest affect). For example, if an infant spent the least amount of time off its mother in the absence of a sibling female and the greatest amount of time off its mother in the absence of a non-sibling male, then the sibling female was assigned a rank of 4 and the non-sibling male a rank of 1. The monkeys were ranked on each of the following behaviors: Percentage of intervals off mother (POFF); Percentage of complete intervals off mother (PINOFF); Percentage of intervals greater than 60 cm (PINGSX); Proximity Index; Percentage of regulated maternal contact (REGMC); Percentage of intervals engaged in non-maternal play (PINMP); and Percentage of intervals alone (PIA). The overall impact of an individual's removal on a mother-infant pair was considered greater than that of another individual if it ranked higher on five of the behaviors examined. When this criteria was not met (ranked lower on 4 of the behaviors examined), the effect that these two animals had on a mother-infant during their removal was considered comparable. Individual

rankings for each behavior are presented in Appendix C.

Figure 23 illustrates the relative effect of each individual's removal on Peanut-PF79 and Ugli-UM79. Comparison of the roles of females and males within each matriline show that for PF79, females had a greater affect on the mother-infant relationship. This is indicated by the direction of the arrows. The sibling female (PF77), compared to the sibling male (PM76), ranked higher on all behaviors examined. This is true of the non-sibling female (UF76) when compared to the non-sibling male (UM77), with the exception of two behaviors: POFF and PINMP. Cross matrilineal comparisons for PF79 suggest that: (1) the non-sibling female had more of an affect on the mother-infant pair than either the sibling female or the sibling male, with the exception of non-maternal play; and (2) the non-sibling male had more of an affect on mother-infant interactions than either the sibling male or sibling female, with the exception of PINMP and PIA, REGMC, respectively. These data suggest that within each matriline, females affected mother-infant behavior more than males. However, non-siblings, male or female, had more influence on PF79's relationship with Peanut when absent from the colony than did siblings of either gender. The non-sibling most influential was the female, UF76, while the sibling male (PM76) was least influential.

The relative effect of PM76, UF76, PF77 and UM77's removal on the mother-infant dyad Ugli-UM79 was strikingly different from that described for the dyad Peanut-PF79. An examination of the role of gender within each matriline demonstrates that while the sibling male ranked higher than the sibling female on all behaviors, the nonsibling female

Fig. 23. The Effect of the Removal of Each Peer on the interactions within the Mother-Infant Dyad.

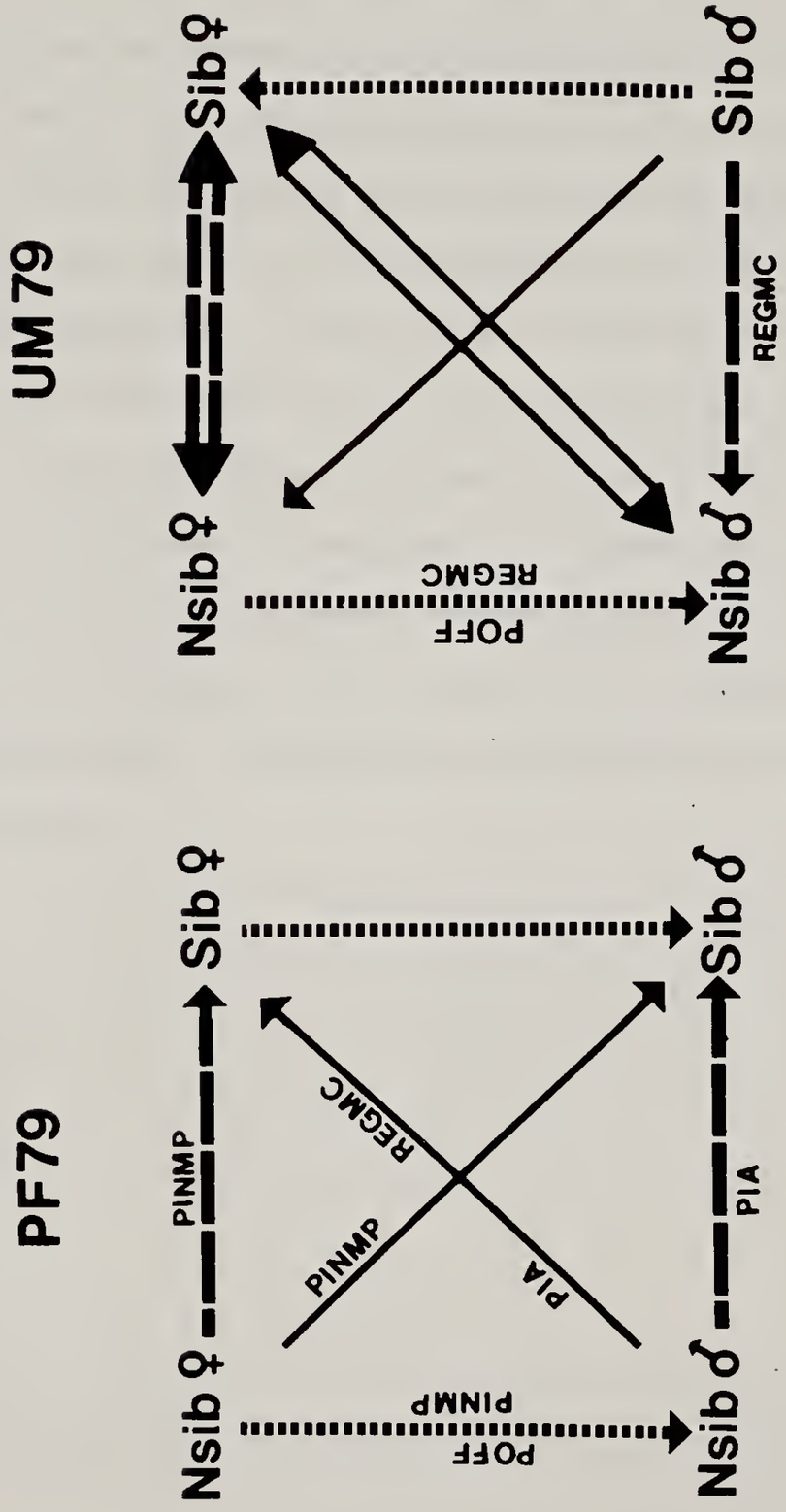

UM 79
Sib ♀
Sib ♂
Nsib ♀
Nsib ♂
REGMC
POFF
REGMC
PF79
Sib ♀
Sib ♂
Nsib ♀
Nsib ♂
PINMP
PIA
REGMC
PINMP
PIA
POFF
PINMP

Fig. 23

ranked higher than the non-sibling male on all behaviors except POFF and REGMC. Cross-matrilineal comparisons show that: (1) the sibling male affected the mother-infant relationship more than either the non-sibling male or the non-sibling female; and (2) the sibling female's affect on this relationship was not demonstrably different from either the non-sibling female or the non-sibling male (symbolized by the open, bidirectional arrows). Of the animals examined, the removal of the sibling male had the greatest impact on the mother-infant dyad, while removal of the non-sibling male had the least affect of this pair.

On the basis of these data, it appears that of the 4 juveniles removed from the social group, there was one central figure, other than the mother, that had an affect on the mother-infant relationship: the non-sibling female, UF76 and the sibling male UM77 for PF79 and UM79, respectively.

C H A P T E R I V

DISCUSSION

Changes in the mother-infant dyads resulting from the removal process were unanticipated. By the end of the acclimation period (see Chapter II, Habituation Phase), behavioral indices suggested that the colony members had adjusted to this process. However, the findings demonstrated that a systematic restructuring of the mother-infant relationship occurred during these removals. Willott and Daniels (1974) found that stereotypic behaviors, locomotion and distress behaviors increased when rhesus monkeys were exposed to a cue which signalled impending separations. Therefore, even the threat of separation produced emotional disturbance. Although removals affected mother-infant interactions, the nature and extent of this effect depended on the class of individual removed.

Research on the nature of social interactions among rhesus macaques shows that behavioral interchanges between an infant and sibling differs from the interchanges between an infant and non-sibling. Many argue that, because of these differences, siblings play a greater role in an infant's socialization.

Siblings shape an infant's social development by influencing the interactions within a mother-infant dyad. Although little is known about the dynamics of this process, siblings may facilitate mother-infant separation by engaging the infant socially and by creating an

environment safe for infant exploration. If this is the case, then an infant should spend less time in social activities and more time with its mother when a sibling, rather than a non-sibling, is removed from the social group.

The findings of this study were not in accord with these predictions. Surprisingly, mother-infant proximity and contact occurred more often during the removal of non-siblings from the social group. This was particularly true for PF79: of the behaviors examined, only the percentage of intervals spent alone were in the predicted range. The differences in mother-infant response between the removal of siblings and non-siblings were not as great for UM79 as for PF79. Furthermore, not all UM79's behaviors were similarly influenced by non-sibling removals (Proximity Index, PINMP, AND PIA were in the predicted range).

The data show that removal of non-siblings affected the mother-infant relationship by increasing the occurrance of attachment behaviors. However, sibling's contribution to infant socialization, by effecting change in the mother-infant relationship, should not be discounted on the basis of this study. Each infant responded differently to sibling and non-sibling removals, suggesting that kinship was not the sole mediator of the changes observed within the mother-infant dyads. Undoubtedly, sample size, age of infant and peer, and maternal rank influenced the results obtained.

Of the factors examined in this study, however, gender of the individual removed relative to the infant's gender consistently affected the behavioral interchanges between a mother-infant pair.

Adjustments in the mother-infant relationship were identical for PF79 when females were removed and for UM79 when males were removed from the social group. In the absence of same-sex peers, an infant spent more time with its mother and less time engaged with the social environment than in the absence of opposite-sex peers. Changes in the mother-infant relationship were attributed to modification of the infant's, and not the mother's, behavior. The data suggest that an infant is more likely to separate from its mother and engage in non-maternal social activities in the presence of same-sex peers. Quality of the mother-infant relationship and an infant's social experience is therefore determined by the composition of the social group. These findings have implications for infant social development.

Differences in the early social experiences of male and female infants contribute substantially to the development of gender-related behaviors. Simonds (1974) reported that in the absence of same-sex peers, juvenile bonnet macaques (M. radiata) failed to develop appropriate gender roles. Female rhesus macaques raised in iso-sexual groups exhibited the double foot clasp mount more often than did females raised in heterosexual groups (Goldfoot and Wallen, 1978). The mechanisms by which an infant acquires the experiences necessary for the development of appropriate sex-role behaviors may be related to the constellation of behaviors elicited from the infant in response to the availability of same-sex peers. These behaviors, in turn, influence the exchanges between a mother and her infant.

Although this study suggests that infant availability for social interactions increases in the presence of gender-like peers, the

data only show that less time is spent with the mother, it does not show with whom the infant interacts. However, other studies have shown that interactions are more frequent among same-sex peers. Hanby (1980b) found that males spent more time with males than females did with members of either sex. When male-reared infants were compared with female-reared infants, Redican (1975) observed that females tended to play with females while males played with males. Parental care was directed more often toward same-sex rather than opposite-sex individuals (Breuggeman, 1973). The data show, therefore, that infants were not only more available for social exchange in the presence of same sex peers, but interacted with them more often than with opposite-sex peers. Gender-related behavior may have, as its origin, the interplay of these behavioral patterns. Gender of the individual removed relative to an infant's gender systematically affected the mother-infant relationship. It is reasonable to assume however, that both the gender and kinship of a peer act in concert to shape the behavioral interchanges within a mother-infant dyad. When the joint effect of these factors were examined, striking differences emerged between the mother-infant relationships. Although examining the effect that each individual's absence had on the mother-infant pair aids in our understanding of the dynamics of the social group under study, whether the conclusions drawn from this inquiry are applicable to other social groups is purely speculative. The following discussion should therefore be read in this light.

The patterning of behaviors within mother-infant dyads was most affected during the removal of the non-sibling female (UF76) and the

sibling male (UM77) from the social group for PF79 and UM79 respectively. Similar findings were obtained by Berman (1978), studying the effects of yearling rhesus siblings on mother-infant interactions. Berman divided similarly ranked moather-infant dyads into four groups according to infant and sibling gender. Data were collected on these dyads for the first 28 weeks of life, using the same measures employed in the present study. Infants with same-sex siblings spent more time off and at a distance from their mother than did infant's with opposite-sex siblings. That is, an infant approached its mother less and solicited fewer maternal contacts in the presence of same-sex siblings. In the present study, the infant spent more time with its mother in the absence of same-sex peers. The greater effect that UF76's removal had on PF79 and her mother, when compared to the effect that PF77's removal had on this mother-infant dyad, is discussed below. However, in both these studies the effects of same-sex siblings on the mother-infant relationship were strongest for males. This may be due to the nature of the bonds formed by male and female rhesus macaques.

Ontogeny of social bonds between male rhesus siblings is rooted in their early social experience. Miller, Kling and Dicks (1973), studying the pattern of social interaction in rhesus monkeys, found that males joined and groomed their brothers more frequently than they joined and groomed their sisters. This affiliative behavior was attributed to the development of play between male siblings. The cohesive force of playbonds among male siblings is perhaps one reason why removal of UM79's brother was most influential in shaping mother-infant interactional patterns.

The relationship that develops between a male sibling and infant not only impacts on the infant's early social experiences but structures its social environment as an adult. Boelkins & Wilson (1972) and Sade (1968) found that male siblings left their natal group together; moreover, immigration into non-natal social groups was facilitated by sibling relationships. The findings of this study reflect the importance of male-sibling bonds and suggest some mechanisms underlying their development.

Male and female bonding patterns differ because of their respective roles in the social group. Stability of the social group depends on the network of relationships between the adult females (Hanby, 1980b). These relationships develop through the interchanges females have with individuals within, as well as outside of, their matriline. Kaplan (1977) observed that adult females were more likely to defend kin. When aiding unrelated individuals, beneficiaries were usually other adult females, suggesting that females used interference as they did grooming: to establish their network of attachments within the group (Kaplan, 1978). A female's propensity to cultivate multiple social bonds is suggested by PF79's response to the removal of group members. Patterning of behavior between PF79 and mother was somewhat affected by the brief separations of the non-sibling male and the sibling female. But of all the animals removed, absence of the non-sibling female had the greatest impact on the mother-infant relationship. The relationship between PF79 and the juvenile females may underlie the difference their removal had on the mother-infant pair.

Juvenile females of high ranking mothers often have disruptive

effects on the social group (Hanby, 1980b). They tease and 'bait' adults, partake in agonistic encounter, and interfere in peer-play. PF77's relationship with PF79's was no exception. PF77 often disrupted PF79's interactions with peers, engaged her in rough play bouts, and carried her awkwardly through the cage. These interactions became so frequent that PF79 retreated to her mother in response to PF77's advances. UF76, however, was extremely solicitous of PF79: grooming, cuddling and social contact characterized their interactions. It is not surprising therefore, that the behavior least affected by UF76's absence was play. The quality of the relationship between UF76 and PF79 was partially due to UF76's age and rank in the group. Spencer-Booth (1968) found that three year old nulliparous females frequently directed parental behavior toward the infant, and Hrdy (1976) noted that caged rhesus monkeys were more likely to allow their infants to interact with subordinate females.

One final comment concerns the relative lack of effect PM76's removal had on both mother-infant dyads. Koford (1963) found that by 3 years of age, juvenile males begin to leave their natal group. In many respects, PM76's behavior resembled that of a peripheral male; social interactions were limited to a few males in the colony.

The data show that the infant-peer relationships were shaped by the interplay of gender, kinship and temperment of the individuals involved. The infant-peer relationship, in turn, influenced the patterning of behavior within the mother and infant dyad. An infant's network of relationships affects its experiences and insodoing promotes the socialization process.

Mechanisms underlying social development in rhesus macaques were examined by monitoring mother-infant interactions during brief separations of peers from the social group. The influence their presence had on the mother-infant dyads was inferred from the influence their absence had on the dyads. In general, same-sex peers fostered behaviors resulting in greater mother-infant distance and increased infant involvement with the social environment. The findings contribute to our understanding of the infant's integration into its social group by indicating: (1) who is influential in structuring an infant's social environment; (2) the mechanisms by which this is accomplished; and (3) the nature of this experience. An infant's early social experiences influences the development of gender-related behaviors and adult social relationships.

The limitations of this study must be noted before generalizations can be made. The conclusions drawn were based on detailed observations of two mother-infant dyads. Undoubtedly, factors other than those studied influenced the pattern of results obtained. Moreover, removal of group members produced perturbations throughout the social group, making it necessary for all relationships to re-equilibrate in response to the disturbance. Changes in mother-infant interactions therefore, may reflect restructuring of the social networks existing among the infant's peers. However, regularities in the behavioral shifts between a mother-infant during peer removal and the data's consistency with findings of other studies lend support to the validity of these conclusions.

These findings suggest that peers influenced an infant's social

development by effecting change in the mother-infant relationship. The nature of a peer's contribution was related to its gender, kinship and temperment. Further study of the socialization process should involve a detailed examination of the ontogeny of peer relations and how these interindividual relationships affect the mother-infant pair and the infant's social experience.

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APPENDIX A

CONSTITUENT BEHAVIORAL DEFINITIONS AND DECISION RULES

Constituent Behavior	Definition
Off Mother	When no physical contact occurs between mother and infant for any portion of the time interval
Completely off mother	When no physical contact occurs between mother and infant for the complete time interval

When there is no physical contact between the mother and infant, then the infant's position relative to the mother's is recorded. Individual responsibility for the spacing is also recorded.

Greater than 60cm	When mother and infant are separated by a distance of at least 60cm
Approaches	When the infant or mother moves from greater than to less than 60cm
Leaves	When the infant or mother moves from less than to greater than 60cm
Mother-infant contact	Any physical contact between mother and infant. Responsibility for contact is recorded by dividing the interaction into initiate and receive behavior

Constituent Behavior	Definition
Mother-infant contact termination	When physical contact between mother and infant was terminated the animal responsible for the termination was recorded
Regulated maternal contact	When a mother allows selective contact by making all but her ventral region accessible to the infant
When infant and mother are not in physical contact, the following behaviors are scored	
Non-maternal play	Any chasing, bouncing, grabbing and/or wrestling between the infant and group members excluding the mother
Alone	When the infant is not in physical contact or engaging in social interactions with other group members

Decision Rules

At the beginning of each data session.

1. If the infant is in physical contact with its mother, then by convention initiate contact (v/v or body) is scored.

2. If the infant is off its mother, the distance between the infant and its mother is noted, but no animal is assigned responsibility for the observed distance.

If in making contact, the infant or mother locomotes more than 60cm., less than 60cm is not scored, since it is assumed that the animal must be within 60cm before contact is made.

A P P E N D I X B

RELIABILITY ESTIMATES

Constituent Behaviors	% Agreement Score
Intervals off mother	95
Complete intervals off mother	99
Intervals mother and infant greater than 60cm apart	94
Approaches initiated by infant	86
Approaches initiated by mother	75
Leaves initiated by infant	77
Leaves initiated by mother	72
Mother-infant contact initiated by infant	95
Mother-infant contact initiated by mother	100 (not observed)
Mother-infant contact terminated by infant	91
Mother-infant contact terminated by mother	84
Regulated maternal contact	100 (not observed)
Intervals infant engaged in non-maternal play	95
Intervals infant alone	98

APPENDIX C

INDIVIDUAL RANK ORDER FOR EACH BEHAVIOR

	Rank							
	PF79				UM79			
Behavior	1	2	3	4	1	2	3	4
Percentage of Intervals Off Mother	PM76	PF77	UF76	UM77	UF76	PM76	PF77	UM77
Percentage of Complete Intervals Off Mother	PM76	PF77	UM76	UF77	UF76	PF77	PM76	UM77
Percentage of Intervals Greater than 60cm from Mother	UF76	UM77	PM76	PF77	UM77	UF76	PM77	PF76
Proximity Index	PM76	PF77	UM76	UF77	PF76	UF76	PF77	UM77
Regulated Maternal Contact	UM77	PM76	UF76	PF77	UM76	PF76	UM77	PM76
Percentage Intervals Non-maternal play	PM76	UF76	PF77	UM77	PM76	UF76	PF77	UM77
Percentage Intervals Alone	UM77	PM76	PF77	UF76	PM76	UF76	PF77	UM77

APPENDIX D

Effect of Removal on Mother-Infant Interactions

Percentage of Complete Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	14338.208	4	3584.552	4.027	.019
BLOCK	2368.125	3	789.375	.887	.469
DAY	11970.083	1	11970.083	13.449	.002
2-WAY INTERACTIONS	4674.750	3	1558.250	1.751	.197
BLOCK DAY	4674.750	3	1558.250	1.751	.197
EXPLAINED	19012.958	7	2716.137	3.052	.031
RESIDUAL	14241.000	16	890.063		
TOTAL	33253.958	23	1445.824		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13046.833	4	3261.708	3.489	.031
BLOCK	9441.500	3	3147.167	3.367	.045
DAY	3605.333	1	3605.333	3.857	.067
2-WAY INTERACTIONS	3148.500	3	1049.500	1.123	.369
BLOCK DAY	3148.500	3	1049.500	1.123	.369
EXPLAINED	16195.333	7	2313.619	2.475	.063
RESIDUAL	14956.500	16	934.781		
TOTAL	31151.833	23	1354.428		

Effect of Removal on Mother-Infant Interactions

Percentage of Complete Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	8449.833	4	2112.458	5.132	.007
BLOCK	2193.500	3	731.167	1.776	.192
DAY	6256.333	1	6256.333	15.199	.001
2-WAY INTERACTIONS	3102.000	3	1034.000	2.512	.095
BLOCK DAY	3102.000	3	1034.000	2.512	.095
EXPLAINED	11551.833	7	1650.262	4.009	.010
RESIDUAL	6586.000	16	411.625		
TOTAL	18137.833	23	788.601		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6900.354	4	1725.089	6.440	.003
BLOCK	5136.167	3	1712.056	6.392	.005
DAY	1764.187	1	1764.187	6.586	.021
2-WAY INTERACTIONS	2716.396	3	905.465	3.380	.044
BLOCK DAY	2716.396	3	905.465	3.380	.044
EXPLAINED	9616.750	7	1373.821	5.129	.003
RESIDUAL	4285.750	16	267.859		
TOTAL	13902.500	23	604.457		

Effect of Removal on Mother-Infant Interactions

Percentage of Intervals Greater Than 60 cm

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	4742.854	4	1185.714	1.146	.371
BLOCK	1781.833	3	593.944	.574	.640
DAY	2961.021	1	2961.021	2.862	.110
2-WAY INTERACTIONS	2130.229	3	710.076	.686	.573
BLOCK DAY	2130.229	3	710.076	.686	.573
EXPLAINED	6873.083	7	981.869	.949	.498
RESIDUAL	16554.750	16	1034.672		
TOTAL	23427.833	23	1018.601		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	4650.354	4	1162.589	1.682	.203
BLOCK	3874.333	3	1291.444	1.868	.176
DAY	776.021	1	776.021	1.123	.305
2-WAY INTERACTIONS	2698.229	3	899.410	1.301	.308
BLOCK DAY	2698.229	3	899.410	1.301	.308
EXPLAINED	7348.583	7	1049.798	1.519	.230
RESIDUAL	11058.750	16	691.172		
TOTAL	18407.333	23	800.319		

Effect of Removal on Mother-Infant Interactions

Mother-Infant Responsibility for Proximity

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	16392.750	4	4098.187	1.439	.267
BLOCK	1902.000	3	634.000	.223	.879
DAY	14490.750	1	14490.750	5.089	.038
2-WAY INTERACTIONS	11400.750	3	3800.250	1.335	.298
BLOCK DAY	11400.750	3	3800.250	1.335	.298
EXPLAINED	27793.500	7	3970.500	1.394	.274
RESIDUAL	45556.500	16	2847.281		
TOTAL	73350.000	23	3189.130		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7188.583	4	1797.146	2.128	.124
BLOCK	6641.833	3	2213.944	2.622	.086
DAY	546.750	1	546.750	.648	.433
2-WAY INTERACTIONS	1424.417	3	474.806	.562	.648
BLOCK DAY	1424.417	3	474.806	.562	.648
EXPLAINED	8613.000	7	1230.429	1.457	.251
RESIDUAL	13509.500	16	844.344		
TOTAL	22122.500	23	961.848		

Effect of Removal on Mother-Infant Interactions

Mother-Infant Responsibility for Contact

PF79

SOURCE OF VARIATION	SQUARES	DF	SQUARE	F	OF F
MAIN EFFECTS	6946.000	4	1736.500	1.511	.246
BLOCK	3744.667	3	1248.222	1.086	.383
DAY	3201.333	1	3201.333	2.785	.115
2-WAY INTERACTIONS	1192.333	3	397.444	.346	.793
BLOCK DAY	1192.333	3	397.444	.346	.793
EXPLAINED	8138.333	7	1162.619	1.011	.459
RESIDUAL	18391.000	16	1149.438		
TOTAL	26529.333	23	1153.449		

UM79

SOURCE OF VARIATION	SQUARES	DF	SQUARE	F	OF F
MAIN EFFECTS	5815.458	4	1453.865	1.037	.418
BLOCK	4914.125	3	1638.042	1.169	.352
DAY	901.333	1	901.333	.643	.434
2-WAY INTERACTIONS	1075.500	3	358.500	.256	.856
BLOCK DAY	1075.500	3	358.500	.256	.856
EXPLAINED	6890.958	7	984.423	.702	.670
RESIDUAL	22423.000	16	1401.438		
TOTAL	29313.958	23	1274.520		

Effect of Removal on Mother-Infant Interactions

Percentage of Regulated Maternal Contacts

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	825.979	4	206.495	1.053	.411
BLOCK	800.458	3	266.819	1.360	.291
DAY	25.521	1	25.521	.130	.723
2-WAY INTERACTIONS	334.729	3	111.576	.569	.644
BLOCK DAY	334.729	3	111.576	.569	.644
EXPLAINED	1160.708	7	165.815	.845	.567
RESIDUAL	3138.250	16	196.141		
TOTAL	4298.958	23	186.911		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	374.146	4	93.536	.751	.572
BLOCK	244.125	3	81.375	.654	.592
DAY	130.021	1	130.021	1.044	.322
2-WAY INTERACTIONS	259.562	3	86.521	.695	.569
BLOCK DAY	259.562	3	86.521	.695	.569
EXPLAINED	633.708	7	90.530	.727	.652
RESIDUAL	1992.250	16	124.516		
TOTAL	2625.958	23	114.172		

Effect of Removal on Mother-Infant Interactions

Percentage of Intervals Engaged in Non-maternal Play

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1686.167	4	421.542	1.394	.280
BLOCK	980.833	3	326.944	1.081	.385
DAY	705.333	1	705.333	2.333	.146
2-WAY INTERACTIONS	501.667	3	167.222	.553	.653
BLOCK DAY	501.667	3	167.222	.553	.653
EXPLAINED	2187.833	7	312.548	1.034	.446
RESIDUAL	4838.000	16	302.375		
TOTAL	7025.833	23	305.471		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2449.979	4	612.495	3.796	.024
BLOCK	685.792	3	228.597	1.417	.275
DAY	1764.187	1	1764.187	10.933	.004
2-WAY INTERACTIONS	1272.896	3	424.299	2.630	.086
BLOCK DAY	1272.896	3	424.299	2.630	.086
EXPLAINED	3722.875	7	531.839	3.296	.023
RESIDUAL	2581.750	16	161.359		
TOTAL	6304.625	23	274.114		

Effect of Removal on Mother-Infant Interactions

Percentage of Intervals Alone

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6707.312	4	1676.828	.895	.489
BLOCK	2908.792	3	969.597	.518	.676
DAY	3798.521	1	3798.521	2.028	.174
2-WAY INTERACTIONS	1336.396	3	445.465	.238	.869
BLOCK DAY	1336.396	3	445.465	.238	.869
EXPLAINED	8043.708	7	1149.101	.614	.737
RESIDUAL	29965.250	16	1872.828		
TOTAL	38008.958	23	1652.563		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13769.208	4	3442.302	6.442	.003
BLOCK	8602.458	3	2867.486	5.367	.009
DAY	5166.750	1	5166.750	9.670	.007
2-WAY INTERACTIONS	9140.417	3	3046.806	5.702	.007
BLOCK DAY	9140.417	3	3046.806	5.702	.007
EXPLAINED	22909.625	7	3272.804	6.125	.001
RESIDUAL	8549.000	16	534.313		
TOTAL	31458.625	23	1367.766		

Effect of Kniship of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	16500.458	5	3300.092	3.790	.027
Block	2368.125	3	789.375	.907	.467
Kinship	14132.333	2	7066.167	8.116	.006
2-WAY INTERACTIONS	6306.000	6	1051.000	1.207	.367
Block Kinship	6306.000	6	1051.000	1.207	.367
EXPLAINED	22806.458	11	2073.314	2.381	.076
RESIDUAL	10447.500	12	870.625		
TOTAL	33253.958	23	1445.824		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6952.917	5	1390.583	4.662	.013
Block	5136.167	3	1712.056	5.740	.011
Kinship	1816.750	2	908.375	3.046	.085
2-WAY INTERACTIONS	3370.583	6	561.764	1.884	.165
Block Kinship	3370.583	6	561.764	1.884	.165
EXPLAINED	10323.500	11	938.500	3.147	.030
RESIDUAL	3579.000	12	298.250		
TOTAL	13902.500	23	604.457		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Percentage of Complete Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	9206.083	5	1841.217	4.452	.016
Block	2193.500	3	731.167	1.768	.207
Kinship	7012.583	2	3506.292	8.478	.005
2-WAY INTERACTIONS	3968.750	6	661.458	1.599	.230
Block Kinship	3968.750	6	661.458	1.599	.230
EXPLAINED	13174.833	11	1197.712	2.896	.040
RESIDUAL	4963.000	12	413.583		
TOTAL	18137.833	23	788.601		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13179.083	5	2635.817	2.458	.034
Block	9441.500	3	3147.167	2.935	.077
Kinship	3737.583	2	1868.792	1.743	.217
2-WAY INTERACTIONS	5103.750	6	850.625	.793	.593
Block Kinship	5103.750	6	850.625	.793	.593
EXPLAINED	18282.833	11	1662.075	1.550	.231
RESIDUAL	12869.000	12	1072.417		
TOTAL	31151.833	23	1354.428		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Greater Than .60 cm

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6485.917	5	1297.183	1.546	.248
Block	1781.833	3	593.944	.708	.566
Kinship	4704.083	2	2352.042	2.804	.100
2-WAY INTERACTIONS	6874.917	6	1145.819	1.366	.303
Block Kinship	6874.917	6	1145.819	1.366	.303
EXPLAINED	13360.833	11	1214.621	1.448	.267
RESIDUAL	10067.000	12	838.917		
TOTAL	23427.833	23	1018.601		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7026.917	5	1405.383	5.031	.010
Block	3874.333	3	1291.444	4.630	.023
Kinship	3152.583	2	1576.292	5.651	.019
2-WAY INTERACTIONS	8033.417	6	1338.903	4.800	.010
Block Kinship	8033.417	6	1338.903	4.800	.010
EXPLAINED	15060.333	11	1369.121	4.909	.005
RESIDUAL	3347.000	12	278.917		
TOTAL	18407.333	23	800.319		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Responsibility for Mother-Infant Proximity

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	17353.750	5	3470.750	1.129	.397
Block	1902.000	3	634.000	.206	.890
Kinship	15451.750	2	7725.875	2.512	.123
2-WAY INTERACTIONS	19093.250	6	3182.208	1.035	.450
Block Kinship	19093.250	6	3182.208	1.035	.450
EXPLAINED	36447.000	11	3313.364	1.077	.447
RESIDUAL	36903.000	12	3075.250		
TOTAL	73350.000	23	3189.130		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	8244.833	5	1648.967	2.284	.111
Block	6641.833	3	2213.944	3.073	.069
Kinship	1603.000	2	801.500	1.113	.360
2-WAY INTERACTIONS	5233.667	6	872.278	1.211	.365
Block Kinship	5233.667	6	872.278	1.211	.365
EXPLAINED	13478.500	11	1225.318	1.701	.197
RESIDUAL	8644.000	12	720.333		
TOTAL	22122.500	23	961.848		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Responsibility for Mother-Infant Contact

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7970.000	5	1594.000	1.604	.232
Block	3744.667	3	1248.222	1.256	.333
Kinship	4225.333	2	2112.667	2.126	.162
2-WAY INTERACTIONS	6637.333	6	1106.222	1.113	.410
Block Kinship	6637.333	6	1106.222	1.113	.410
EXPLAINED	14607.333	11	1327.939	1.337	.312

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7496.458	5	1499.292	1.589	.237
Block	4914.125	3	1638.042	1.736	.213
Kinship	2582.333	2	1291.167	1.368	.292
2-WAY INTERACTIONS	10493.000	6	1748.833	1.853	.171
Block Kinship	10493.000	6	1748.833	1.853	.171
EXPLAINED	17989.458	11	1635.405	1.733	.179
RESIDUAL	11324.500	12	943.708		
TOTAL	29313.958	23	1274.520		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Engaged in Non-maternal Play

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2336.417	5	467.283	1.664	.217
Block	980.833	3	326.944	1.165	.364
Kinship	1355.583	2	677.792	2.414	.131
2-WAY INTERACTIONS	1320.417	6	220.069	.784	.599
Block Kinship	1320.417	6	220.069	.784	.599
EXPLAINED	3656.833	11	332.439	1.184	.386
RESIDUAL	3360.000	12	280.750		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2455.042	5	491.008	2.326	.107
Block	685.792	3	228.597	1.083	.393
Kinship	1769.250	2	884.625	4.190	.042
2-WAY INTERACTIONS	1316.083	6	219.347	1.039	.447
Block Kinship	1316.083	6	219.347	1.039	.447
EXPLAINED	3771.125	11	342.830	1.624	.209
RESIDUAL	2533.500	12	211.125		
TOTAL	6304.625	23	274.114		

Effect of Kinship of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Alone

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7295.375	5	1459.075	.769	.590
Block	2908.792	3	969.597	.511	.682
Kinship	4386.583	2	2193.292	1.156	.347
2-WAY INTERACTIONS	7944.083	6	1324.014	.698	.657
Block Kinship	7944.083	6	1324.014	.698	.657
EXPLAINED	15239.458	11	1385.405	.730	.695
RESIDUAL	22769.500	12	1897.458		
TOTAL	38008.958	23	1652.563		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13781.458	5	2756.292	5.751	.006
Block	8602.458	3	2867.486	5.983	.010
Kinship	5179.000	2	2589.500	5.403	.021
2-WAY INTERACTIONS	11925.667	6	1987.611	4.147	.017
Block Kinship	11925.667	6	1987.611	4.147	.017
EXPLAINED	25707.125	11	2337.011	4.875	.006
RESIDUAL	5751.500	12	479.292		
TOTAL	31458.625	23	1367.765		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	14448.458	5	2889.692	3.049	.053
Block	2358.125	3	789.375	.833	.501
Gender	12080.333	2	6040.167	6.373	.013
2-WAY INTERACTIONS	7433.000	6	1238.833	1.307	.325
Block Gender	7433.000	6	1238.833	1.307	.325
EXPLAINED	21881.458	11	1989.223	2.099	.109
RESIDUAL	11372.500	12	947.708		
TOTAL	33253.958	23	1445.824		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13530.833	5	2706.167	3.457	.036
Block	9441.500	3	3147.167	4.032	.034
Gender	4089.333	2	2044.667	2.620	.114
2-WAY INTERACTIONS	8255.000	6	1375.833	1.763	.190
Block Gender	8255.000	6	1375.833	1.763	.190
EXPLAINED	21785.833	11	1980.530	2.538	.062
RESIDUAL	9366.000	12	780.500		
TOTAL	31151.833	23	1354.428		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Complete Intervals Off Mother

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	8660.083	5	1732.017	4.118	.021
Block	2193.500	3	731.167	1.738	.212
Gender	6466.583	2	3233.292	7.685	.007
2-WAY INTERACTIONS	4430.750	6	738.458	1.756	.191
Block Gender	4430.750	6	738.458	1.756	.191
EXPLAINED	13090.833	11	1190.076	2.830	.044
RESIDUAL	5047.000	12	420.583		
TOTAL	18137.833	23	788.001		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6968.417	5	1393.683	6.152	.005
Block	5136.167	3	1712.056	7.570	.004
Gender	1832.250	2	916.125	4.051	.045
2-WAY INTERACTIONS	4220.083	6	703.347	3.110	.045
Block Gender	4220.083	6	703.347	3.110	.045
EXPLAINED	11188.500	11	1017.136	4.497	.008
RESIDUAL	2714.000	12	226.167		
TOTAL	13902.500	23	604.457		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Greater Than 60 cm

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	4847.917	5	969.583	.885	.520
Block	1781.833	3	593.944	.543	.662
Gender	3066.083	2	1533.042	1.401	.284
2-WAY INTERACTIONS	5444.917	6	907.486	.829	.569
Block Gender	5444.917	6	907.486	.829	.569
EXPLAINED	10292.833	11	935.712	.855	.599
RESIDUAL	13135.000	12	1094.583		
TOTAL	23427.833	23	1018.601		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	4947.917	5	989.583	1.177	.375
BLOCK	3874.333	3	1291.444	1.537	.256
SEXANR	1073.583	2	536.792	.639	.545
2-WAY INTERACTIONS	3373.417	6	562.236	.669	.677
Block Gender	3373.417	6	562.236	.669	.677
EXPLAINED	8321.333	11	756.485	.900	.566
RESIDUAL	10086.000	12	840.500		
TOTAL	18407.333	23	800.319		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Responsibility for Mother-Infant Proximity

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	16699.000	5	3339.800	.991	.463
Block	1902.000	3	634.000	.188	.902
Gender	14797.000	2	7398.500	2.195	.154
2-WAY INTERACTIONS	16228.000	5	2704.667	.803	.586
Block Gender	16228.000	5	2704.667	.803	.586
EXPLAINED	32927.000	11	2993.364	.889	.574
RESIDUAL	40423.000	12	3368.583		
TOTAL	73350.000	23	3189.130		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	7650.833	5	1530.167	1.574	.240
Block	6641.833	3	2213.944	2.277	.132
Gender	1009.000	2	504.500	.519	.608
2-WAY INTERACTIONS	2803.667	6	467.278	.481	.811
Block Gender	2803.667	6	467.278	.481	.811
EXPLAINED	10454.500	11	950.409	.977	.512
RESIDUAL	11668.000	12	972.333		
TOTAL	22122.500	23	961.848		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Regulated Maternal Contacts

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1568.542	5	313.708	1.986	.153
Block	800.458	3	266.819	1.689	.222
Gender	768.083	2	384.042	2.431	.130
2-WAY INTERACTIONS	834.917	6	139.153	.881	.537
Block Gender	834.917	6	139.153	.881	.537
EXPLAINED	2403.458	11	218.496	1.383	.292
RESIDUAL	1895.500	12	157.958		
TOTAL	4298.958	23	186.911		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	549.708	5	109.942	1.001	.458
Block	244.125	3	81.375	.741	.548
Gender	305.583	2	152.792	1.391	.286
2-WAY INTERACTIONS	757.750	6	126.292	1.149	.393
Block Gender	757.750	6	126.292	1.149	.393
EXPLAINED	1307.458	11	118.860	1.082	.445
RESIDUAL	1318.500	12	109.875		
TOTAL	2625.958	23	114.172		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Engaged in Non-maternal Play

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1992.417	5	398.483	1.419	.286
Block	930.833	3	326.944	1.165	.364
Gender	1011.583	2	505.792	1.802	.207
2-WAY INTERACTIONS	1664.417	6	277.403	.988	.475
Block Gender	1664.417	6	277.403	.988	.475
EXPLAINED	3656.833	11	332.439	1.184	.386
RESIDUAL	3369.000	12	280.750		
TOTAL	7025.833	23	305.471		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2464.042	5	492.808	2.607	.081
Block	685.792	3	228.597	1.209	.348
Gender	1778.250	2	889.125	4.703	.031
2-WAY INTERACTIONS	1572.083	6	262.014	1.386	.296
Block Gender	1572.083	6	262.014	1.386	.296
EXPLAINED	4036.125	11	366.920	1.941	.135
RESIDUAL	2268.500	12	189.042		
TOTAL	6304.625	23	274.114		

Effect of Gender of Animal Removed

on Mother-Infant Interactions

Percentage of Intervals Alone

PF79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	9132.875	5	1826.575	.849	.541
Block	2908.792	3	969.597	.451	.721
Gender	6224.083	2	3112.042	1.447	.273
2-WAY INTERACTIONS	3072.583	5	512.097	.238	.935
Block Gender	3072.583	5	512.097	.238	.935
EXPLAINED	12205.458	11	1109.587	.516	.858
RESIDUAL	25803.500	12	2150.292		
TOTAL	38008.958	23	1652.563		

UM79

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	13789.458	5	2757.892	2.691	.006
Block	8602.458	3	2867.486	2.797	.010
Gender	5187.000	2	2593.500	5.352	.022
2-WAY INTERACTIONS	11853.667	6	1975.611	4.077	.018
Block Gender	11853.667	6	1975.611	4.077	.018
EXPLAINED	25643.125	11	2331.193	4.810	.006
RESIDUAL	5815.500	12	484.625		
TOTAL	31458.625	23	1367.766		