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Mother-Infant Separation in the Java Monkey (Macaca Irus).

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MOTHER-INFANT SEPARATION IN THE

JAVA MONKEY (MACACA IRUS)

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
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August, 1970

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ABSTRACT

Twelve mother-infant pairs of _Macaca_ _irus_ monkeys were
divided into 6 groups of 2 mother-infant pairs each. During a 3-week
separation period, infants in 2 groups received substitute mothering
while infants in another 2 groups did not. Infants in the remaining
2 groups were separated and immediately reunited with mothers.
During reunion, mothers in half of the groups were returned to their
original home cages, and mothers in the remaining half were returned
to identical but spatially reoriented home cages.

During separation, infant playing and related behavior de-
creased. The effects could not be attributed to the traumatic
process of forceful removal of mothers since separation and imme-
diate return of mothers had a minimal effect on infant behavior.
During reunion, infants responded differentially to their own
mothers regardless of location of return. Although most behaviors
returned to pre-separation levels, there was an indication of
prolonged disturbance in the form of an intensified mother-infant
relationship for 3-week separated animals. Substitute mothering,
although it did not alleviate the debilitating effects of separa-
tion, did facilitate recovery in reunion. Species differences in
the reaction to maternal separation were discussed.

INTRODUCTION

Bowlby (1958a) states that the child's tie to its mother is the result of a number of component instinctual responses such as sucking, clinging, following, crying, and smiling which produce a reciprocal reaction from its mother. These component instincts are believed to have arisen in evolution and are necessary for survival since the human neonate is completely helpless and dependent upon its mother to fulfill its physiological needs. When the young child is separated or otherwise deprived of its mother or permanent mother-figure as in the case of death, hospitalization, or repeated rejection, a severe emotional reaction occurs (Bowlby, 1952; 1960a, b; 1961a, b). The initial reaction is that of protest characterized by separation anxiety, which is believed to be the immediate consequence of activation of instinctive response systems without termination. If separation continues, the child goes through a stage of despair characterized by grief and mourning. Eventually, a detachment stage may occur in which the child tries to defend against anxiety. These responses are believed to be biologically basic and no different from the response of adults to loss of love object. If maternal separation occurs when a child is between the ages of six months and five or six years, and is sufficiently prolonged or severe, it is believed to predispose him to delinquent, depressive, or other psychiatric disorders in later years.

In attempting to test Bowlby's theories, some investigators

have found that maternal separation is indeed stressful to the young

child and that, following reunion with the mother, separated children

often behave negatively and aggressively (Robertson, 1955; Heinicke,

1956). Other investigators, however, have questioned whether such

results are due indeed to maternal separation or whether they are

due to environmental deprivation characteristic of many institutional

settings (Wooton, 1966; O'Connor, 1956). Stott (1956) maintains

that it is not separation per se that is the crucial variable, but

the lack of maternal loyalty. Others have questioned the wisdom of

using a single variable, such as the loss of mother or permanent

mother-figure, to explain the diversity in nature of the adverse

effects and the variability in degree of damage (Prugh and Harlow,

1966; Andry, 1966). Equally detrimental to Bowlby's views is the

finding that intelligence test scores, which decrease during

separation, may recover following the mother's return, thus ques-

tioning the degree of permanence of adverse effects (Clarke and

Clarke, 1959). Furthermore, it is becoming increasingly apparent

that maternal separation may not predispose a child to delinquency

in later years (Naess, 1959; Lewis, 1959; Andry, 1966; and Bowlby,

Ainsworth, Boston, and Rosenbluth, 1956).

Such findings have not, however, led Bowlby and his followers

to change their position in any material way. The relationship

between antecedent and consequent conditions is indeed complex, and

the effects of maternal separation depend upon many other factors

as well, such as the length of separation, the age of the child at

separation, the nature of the mother-child relationship prior to separation, and so forth (Ainsworth, 1966). However, maternal separation theorists now state that the adverse effects may be more readily reversible than previously thought, and they no longer maintain that children who experience maternal separation commonly develop psychopathic and affectionless characters later in life (Bowlby et al., 1956; Bowlby, 1958b; Ainsworth, 1966). It has also been pointed out that there are enormous problems in conducting research on human children in this area, and the importance of combining clinical, psychometric, and experimental approaches to the problem has been emphasized (Bowlby, 1952).

The variables affecting the mother-infant tie (Harlow and Zimmerman, 1959; Bowlby, 1961a) and the overt response to loss of love object (Bowlby, 1961b) are believed to be similar in humans and other primates, and several investigators have studied the effects of maternal separation in monkeys. Using an apparatus in which mother-infant pairs of rhesus monkeys (Macaca mulatta) were housed on opposite ends of a play area in which only infants were allowed access, Seay, Hansen, and Harlow (1962) and Seay and Harlow (1965) found that maternal separation is extremely stressful to rhesus infants. When their mothers were not available, there was much crying (cooing vocalization) and a reduction in many complex social behaviors such as infant playing. Mothers reacted violently to being separated from their infants and attempted to maintain

physical contact with them. When the mothers were returned, there was an initial but temporary increase in infant-mother and mother-infant positive behaviors.

Basically similar results were obtained by Spencer-Booth and Hinde (1967), also using the rhesus macaque, and by Kaufman and Rosenblum (1967), using the pigtail (Macaca nemestrina). The monkeys in these studies were maintained in a complex group situation, and removal of mothers did not involve separation from other monkeys. Some of the infants in these investigations showed signs of pro-longed disturbance even after several months following the mother's return in contrast to the studies of Seay and Harlow (1965) and Seay et al., (1962).

Rosenblum and Kaufman (1968) found that bonnet macaque (Macaca radiata) infants living in a group situation do not show the severe disturbance following maternal separation that seems to characterize the reactions of rhesus and pigtail monkeys. When their mothers were removed, the infants appeared agitated initially, but quickly recovered. They showed only slight decreases in complex social behaviors such as social playing. The investigators attri-buted their failure to show debilitating effects to the permissive behavior of bonnet mothers who frequently allow other adults to ex-plore and manipulate newborn infants almost immediately after birth. As a result, these infants become autonomous early and establish social relationships with adults other than their natural mother.

However, pilot work conducted by these investigators indicates that either bonnet or pigtail infants, when placed with strange adults, may barely survive a single day of exposure.

In the present investigation, an attempt was made to determine the generality of the effects of maternal separation in a different species of macaque, the Java monkey (Macaca irus). Results were compared with the rhesus data obtained in previous studies conducted by Seay et al., (1962) and Seay and Harlow (1965) using a similar apparatus and procedure. Comparisons were also made with data recently obtained by Preston, Baker, and Seay, (in press) on the patas monkey (Erythrocebus patas). These investigators, who also used a similar apparatus and procedure, found that patas infants show the usual decline in play behavior during separation. In reunion, however, there was an increase in infant peer interaction rather than an intensification of the mother-infant relationship as observed in macaques.

In addition, it was felt that the consequences of placing Java infants with unfamiliar adult females of the same species would not be fatal, and the present investigation attempted to determine whether differential effects are produced by providing infants with substitute mothers during the separation period. A third objective was to determine whether the adverse effects of maternal separation are due to the absence of the mother or whether such effects are due to the process of forceful separation itself. A fourth and final

objective of the present investigation was to determine whether Java infants are able to discriminate and respond differentially to their own mothers following a three-week separation period if the mothers are returned to identical but spatially reoriented home cages. Infant-mother and mother-infant specificity had previously been observed by Jensen and Tolman (1962) in $\underline{M}$. $\underline{nemestrina}$ following brief separations (up to one hour), and an early study by Spence (1937) indicated that chimpanzee mothers could recognize and respond differentially to their own infants even after separations of six months or more.

METHOD

Subjects.--Twelve mother-infant pairs of $\underline{M}$. $\underline{irus}$ monkeys were divided into six groups of two mother-infant pairs each according to time of birth of infants. At the time of separation, infant ages ranged from 208 to 255 days. The mean within-group age difference was 25 days with the maximum for any group being 38. Of the six groups employed, two contained a female-female infant pair (Groups A_1 and SM_1), two contained a male-male infant pair (Groups SM_2 and C_2), and two a male-female infant pair (Groups A_2 and C_1). All infants were laboratory born and all mothers were feral animals.

Apparatus.--The apparatus is shown in Figure 1 and was constructed of galvanized, flattened, expanded metal on an angle-iron frame. It consisted of two 36 x 27 x 42 in. home cages attached on opposite ends of a 60 x 27 x 42 in. play area. The play area was further subdivided by a removable panel, and access to it was provided for infants only by 3.5 sq. in. openings. Each home cage was equipped with a feeder, water bottle, wall-size front door and transport door. The apparatus stood on legs 30 in. above the floor.

Procedure.--Data collection was divided into three, 3-week periods. The first 3 weeks were the same for all groups, and consisted of baseline observation of mothers and infants. In order to test the generality of the effects of maternal separation in the Java monkey, the second 3-week period for Groups A_1 and A_2 consisted of

REMOVABLE PANEL

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┌────────────────┬──────────────┬──────────────┬────────────────┐
│                │              ┊              │                │
│  HOME CAGE     │  PLAY        ┊  PLAY        │  HOME  CAGE    │
│                │              ┊              │                │
│                │  AREA        ┊  AREA        │                │
│                │              ┊              │                │
└────────────────┴──────────────┴──────────────┴────────────────┘
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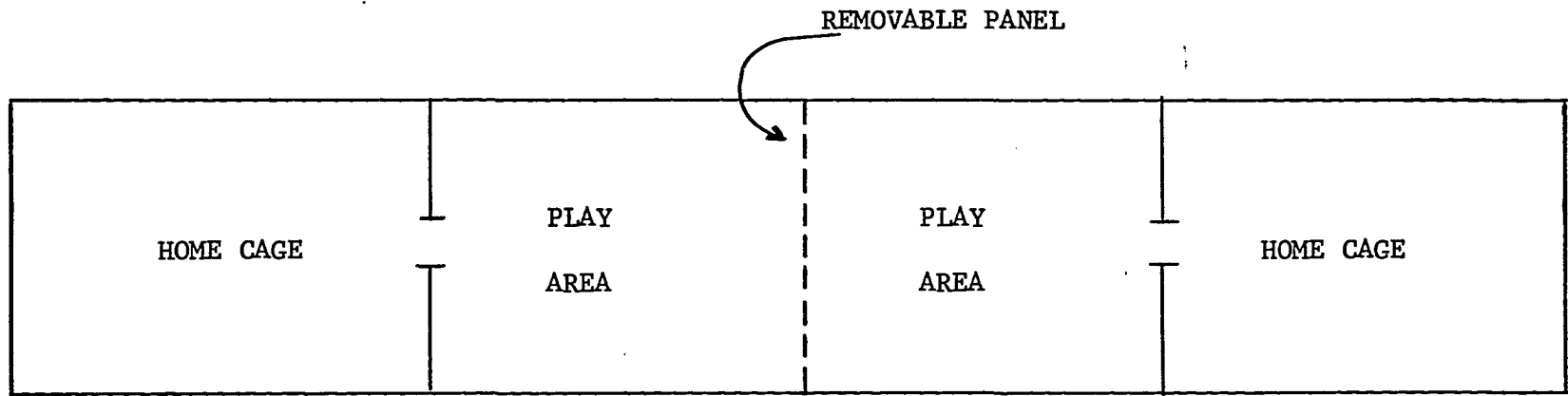
Fig. 1. Apparatus (top view).

observation of infants whose mothers had been removed to another part of the building. For Groups SM_1 and SM_2, the second 3-week period consisted of observation of infants with unfamiliar adult females following removal of real mothers to determine whether differential effects are produced by providing infants with substitute mothers during separation. For Groups C_1 and C_2, the second 3-week period consisted of observation of infants and real mothers, following the removal and immediate return of the real mothers, to determine whether the adverse effects of maternal separation are due to absence of the mother or to the process of forceful separation itself.

The third 3-week period consisted of observation of mothers and infants following return of the mothers (Groups A_1 and A_2), removal of substitute mothers and return of real mothers (Groups SM_1 and SM_2), or removal and immediate return of mother-infant pairs (Groups C_1 and C_2). Mothers in half of the groups (Groups A_1, SM_1, and C_1) were returned to their original home cages, and mothers in the remaining groups (Groups A_2, SM_2, and C_2) were returned to cages identical to their own but previously occupied by the other mother-infant pair of the same group in order to determine whether infants are able to recognize and respond differentially to their own mothers following a 3-week separation period.

The separation procedure involved the simultaneous placement of metal plates by two investigators between each home cage and the play area in such a way as to prevent infants from running to their

mothers. A small transport cage was then placed on the edge of each home cage, and guillotine doors were raised to allow mothers to enter. The metal plates blocking the infants' access to home cages were then removed. The introduction of substitute mothers and the return of real mothers to home cages were also done by means of transport cages. Mothers were simultaneously released by two investigators while their infants were in the play area and the panel removed.

The panel subdividing the play area was removed for approximately one-half hour per day, 4 days per week, during which time data collection was undertaken. Data collection consisted of eight, 15 min. sessions per week on each mother-infant pair throughout the 9-week period. A modification of the symbol checklist developed by Hansen (1966) at the University of Wisconsin Primate Laboratory was used for this purpose. Symbols representing many different behaviors were recorded on 8.5 x 11 in. data sheets consisting of two columns of ten rows each. Each row was further subdivided with the upper half being used to record the behavior of mothers and the bottom half the behavior of infants. Mother and infant behavior was scored simultaneously as it has previously been shown that one observer is able to score two animals at the same time reliably and efficiently (Thorne, Schlottmann, and Seay, 1969). A tape recorded voice counted from zero to 60 with 15 sec. intervals between each number to indicate when entries were to be made on the next row. The maximum score for each behavior occurring in a 15 sec. interval was one. Therefore, the maximum score for a behavior category in the 15 min.

session was 60. In recording data, observers were seated on stools approximately 4 ft. from the test apparatus and in full view of the Ss. Data sheets were held in place by means of a clipboard. The actor and recipient animal were indicated by a system of color coding and position of score on the data sheet.

The following is a list of behaviors scored and their definitions. Two observers participated in data collection and estimates of interobserver reliability obtained by means of Pearson product-moment correlation coefficients are listed after each definition. In one instance, no correlation coefficient is given since the behavior occurred very infrequently during reliability sessions. All reliability coefficients are based on sessions conducted by the two observers during acquisition of developmental data for another project prior to initiation of the present study.

<u>Infant-infant behaviors</u>

Approach	Oriented movement of 1 ft. or more toward another infant (.781).
Withdraw	Oriented movement of 1 ft. or more away from another infant (.825).
Non-contact play	Highly active, oriented movement toward or away from another infant involving two or more directional turns. Also includes bee-line mock attack of three or more body lengths and rapid bouncing in place with orientation toward the other infant (.853).

Contact play	Wrestling or biting with rapid changes in location, or biting with head shaking, directed toward another infant (.954).
Oral exploration	Any mouthing, sucking, or licking on another infant (--).
Ear-flip threat	Flipping the ears with orientation toward another infant (.751).
Jaw-drop threat	Dropping the jaw with orientation toward another infant (.824).
Clasp-pull	Clasping and jerking the hair or skin of another infant (.873).
Bite	Biting another infant (.887).
Cuff	Striking or hitting another infant (.899).
Non-specific contact	Brushing against or touching another infant which is not included in any other score (.979).
Cling	Grasping or clutching the hair of another infant in such a way as to maintain contact (.987).
Ventral contact	Gross body contact with the ventral surface of another infant (.742).
Gross body contact	Gross contact with any surface of another infant's body except ventral (.954).

Infant non-social behaviors

Vocal screech	High-pitched screaming (.937).

Vocal coo   Tonal vocalization resulting in ooo-ooh sound (.894).

Vocal yip   Short, abrupt, high-pitched sound (.696).

Self-mouthing   Any mouthing or oral manipulation of infant's own body (.930).

Oral exploration   Mouthing or licking cage or other inanimate object (.894).

Manual manipu-
         lation   Manipulating or exploring the cage or other inanimate object with the hand (.774).

Self-play   Any behavior meeting the activity criterion of non-contact play, but without social orientation (.747).

Infant-mother behaviors

Ventral contact   Gross body contact with the ventral surface of the mother (.997).

Cling   Grasping or clutching the hair of the mother in such a way as to maintain contact (.992).

Nipple contact   Mouthing, sucking, or holding the nipple of the mother in the mouth (.979).

Non-specific
         contact   Brushing against or touching the mother which is not included in any other score (.969).

Approach   Oriented movement of 1 ft. or more toward the mother (.784).

Gross body   Gross contact with any surface of the

    contact   mother's body except ventral (.917).

Infant-other mother behaviors

Non-specific   As above, but directed or oriented toward

    contact   adult female other than infant's own

           mother (.864).

Withdraw   As above, but movement is away from adult

           female other than infant's own mother

           (.548).

Mother-infant behaviors

Groom   Spreading and picking at fur of infant

           (.973).

Embrace   Encircling or partly encircling the body

           of infant with one or both arms (.970).

Mother-other infant behaviors

Jaw-drop threat   As above, but directed by adult female

           toward infant other than her own (.938).

Approach   As above, but movement is by adult female

           toward infant other than her own (.901).

Mother non-social behaviors

Lipsmack   Smacking the lips rapidly with orientation

           toward the observer or without apparent

           orientation (.972).

Jaw-drop threat   As above, but directed toward observer (.990).

Statistical analysis.--The mean score per session in each of
the three experimental periods was calculated for each infant for
each category of infant-infant and infant non-social behavior. Since
mothers were not present for A groups during period two, the mean
score per session for mother and mother-related behaviors was calcu-
lated for periods one and three. These data were then analyzed
using repeated measures analysis of variance and relevant comparisons
were made using orthogonal coefficients. In assessing the immediate
effects of separation, data from the last session of period one and
the first session of period two were used instead of the mean score
per session for each period. Similarly, data from the last session
of period one and the first session of period three were used in
assessing the immediate effects of reunion.

The behavior of and toward substitute mothers in SM groups
was compared to the behavior of and toward real mothers in C groups
during period two. The mean score per session for each category of
mother and mother-related behaviors was calculated and analyzed by
means of t tests. The .05 level of significance was used in all of
the above tests.

RESULTS

Immediate effects of separation.--Inspection of the data on

initial changes in which scores for single sessions rather than

period-wide means were used revealed that most behaviors did not

occur frequently enough to warrant analysis. It was therefore

decided to combine the data into broader categories by adding the

scores for each S across several behaviors that logically seemed to

be related. The resulting combination categories and their components

are shown in Table 1. Infant-infant non-specific contact was also

analyzed due to the high frequency of occurrence of this behavior.

The initial reaction of infants to separation was charac-

terized by a significant decrease in active and passive interaction

over all groups (Figure 2). There was a tendency for infant dis-

tress vocalization to increase, but the effect was not statistically

significant. Non-specific contact (Figure 3) and non-social object-

directed behavior (Figure 4) decreased sharply in the SM groups while

showing only slight changes in the A groups, and the differential

effects were statistically significant in both cases.

Period-wide effects of separation.--Analysis of period-wide

effects of separation revealed that the brief separation experi-

enced by infants in the C groups produced virtually no change in

behavior other than a significant increase in infant-infant contact

play. In contrast, infants in the experimental groups (A and SM

TABLE 1

COMBINATION CATEGORIES USED IN ASSESSING IMMEDIATE
EFFECTS OF SEPARATION AND REUNION

| Combination Category	Specific Behaviors Combined
Inf-inf active interaction	Non-contact play, approach, contact play, ear-flip threat, jaw-drop threat, clasp-pull, bite, cuff
Inf-inf passive interaction	Cling, ventral contact, gross body contact
Inf distress vocalization	Vocal screech, vocal coo
Inf non-soc object-directed behavior	Oral exploration, manual manipulation
Inf-mot positive behavior	Ventral contact, cling, nipple contact, non-specific contact, approach, gross body contact
Mot-inf positive behavior	Groom, embrace
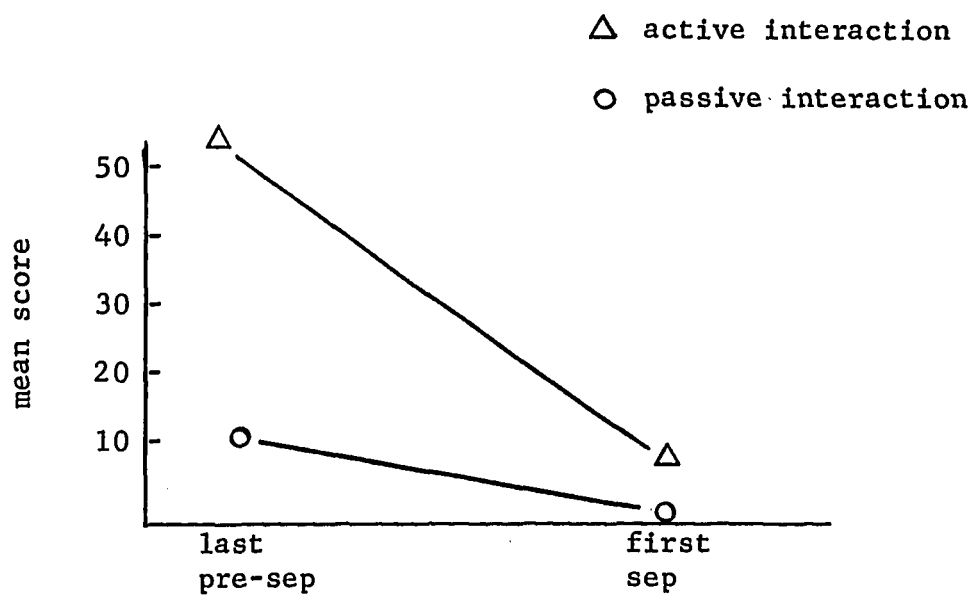
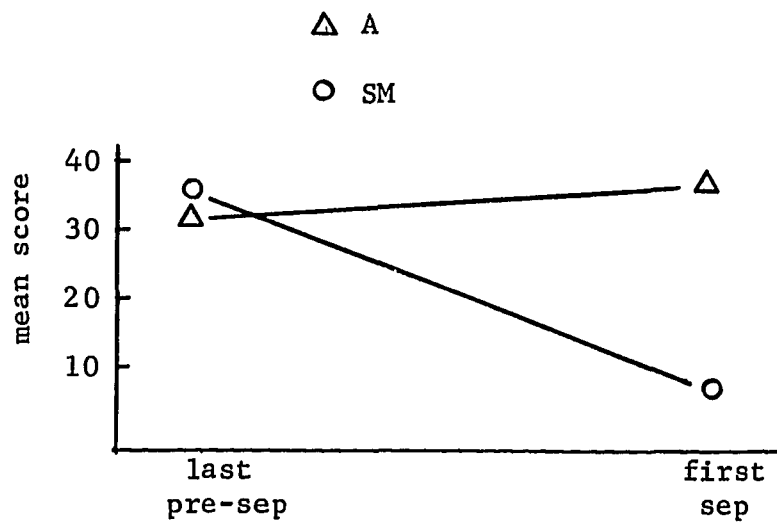Fig. 2. Infant-infant interaction. Immediate overall effects of separation.

Fig. 3. Infant-infant non-specific contact.
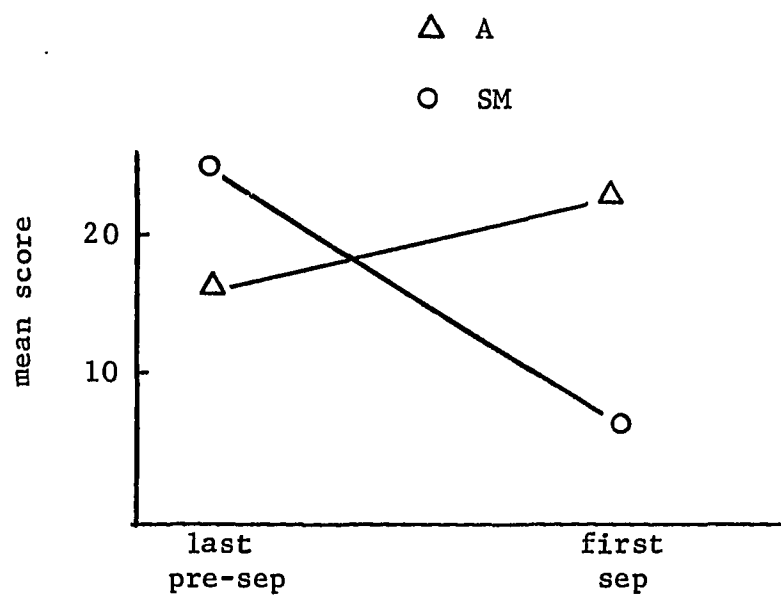Immediate effect of separation.

Fig. 4. Infant non-social object-directed behavior. Immediate effect of separation.

groups combined) showed very pronounced decreases during the separation period in infant playing and related behaviors. Statistically significant decreases were found in infant-infant approaches, withdraws, contact and non-contact plays, ear-flip and jaw-drop threats, clasp-pulls, bites, cuffs, and non-specific contacts (see Figure 5). The decrease in non-specific contact was significantly greater for infants in the SM group than for infants in the A groups (Figure 6).

Infants in the experimental groups also showed significant changes during separation in some non-social behaviors as well. Self-playing decreased significantly while manual manipulation and vocal coo increased (Figure 7). Significantly different reactions to separation between the A and SM groups were found for self-mouthing and non-social oral exploration. Infants in the A groups showed a decrease in self-mouthing and an increase in non-social oral exploration during separation, while infants in the SM groups showed only slight changes in these behaviors (Figure 8). Vocal yip showed a significant decrease during separation only when the data over all groups was included.

Some additional significant effects during separation (and also during reunion) resulted from differences in the sexual composition of groups. Sex differences resulted in pre-separation differences between groups for some behaviors. Corresponding differential changes from one period to another were found in some instances since the lower limit of zero prevented a group with a low frequency of occurrence for a particular behavior from showing a marked decrease in
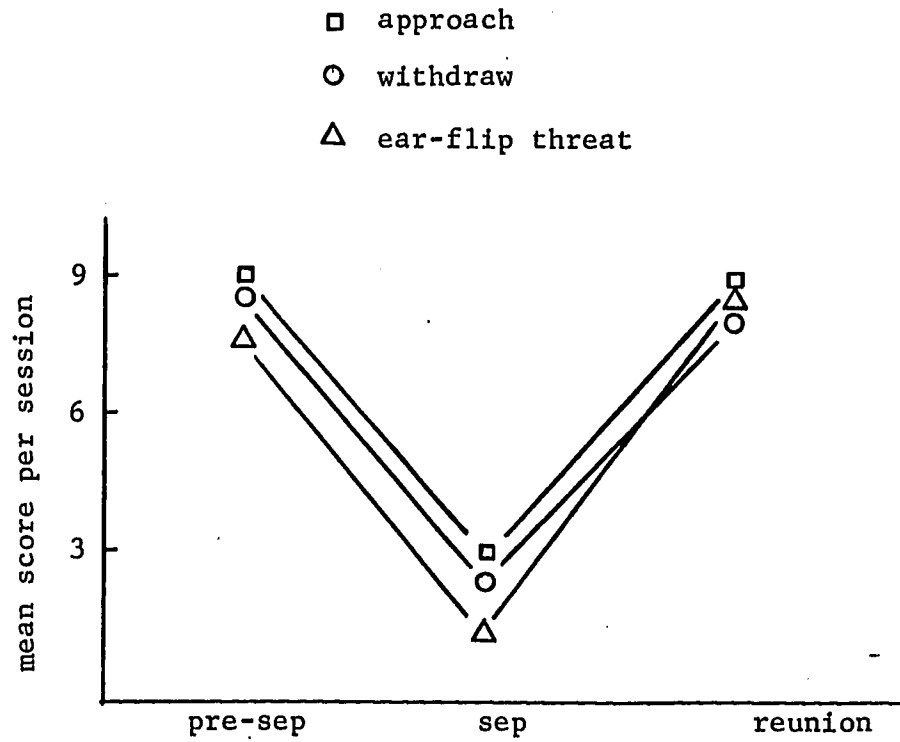
Fig. 5. Infant-infant approach, withdraw, and ear-flip threat for A and SM groups combined. Period-wide effects.
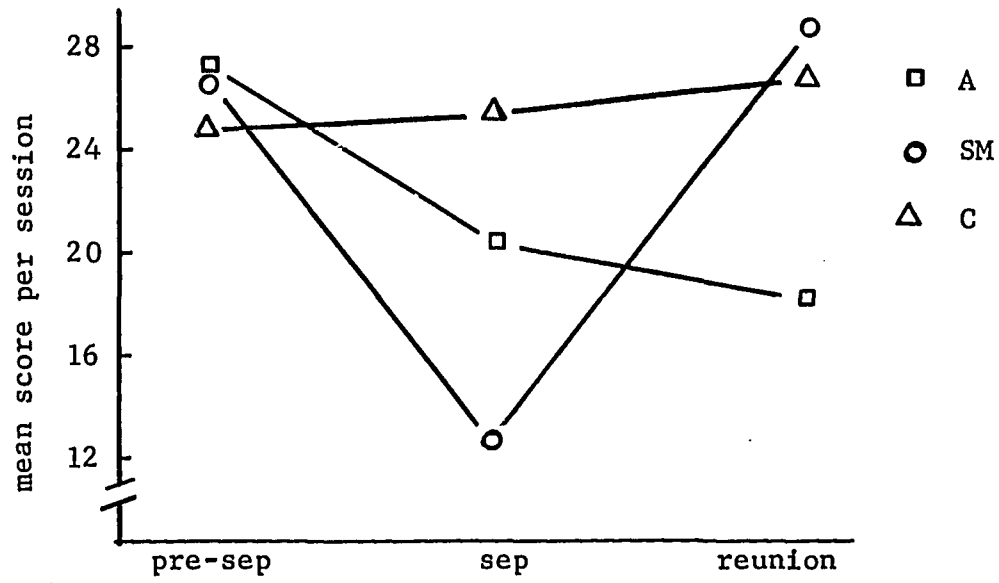
Fig. 6.   Infant-infant non-specific contact.
Period-wide effects.

□ self-play

○ manual manipulation
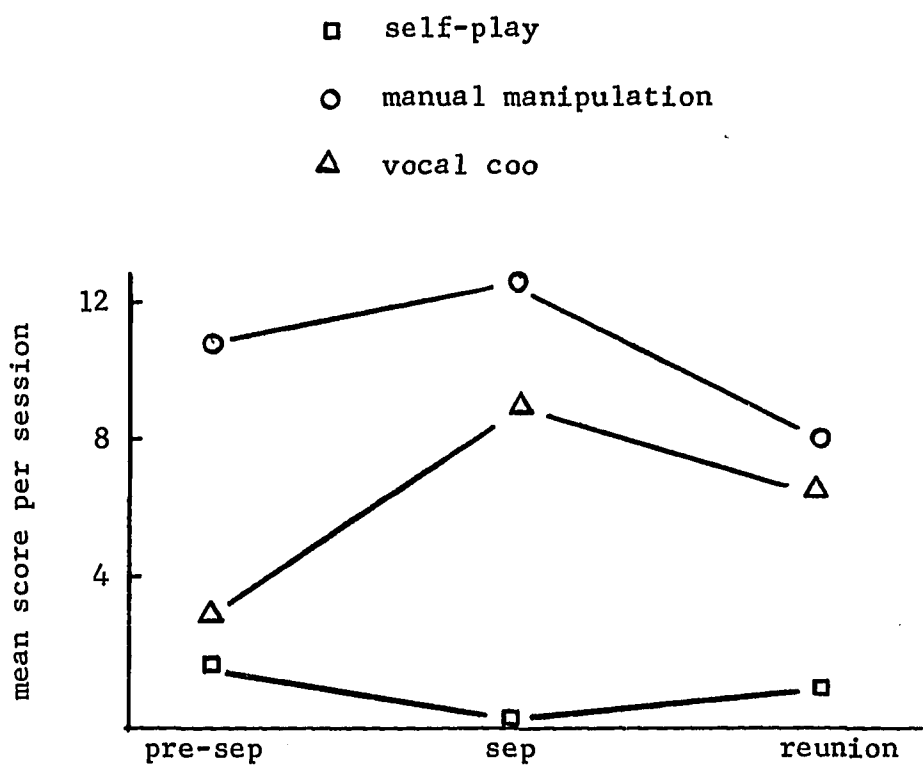
△ vocal coo

Fig. 7. Infant non-social self-play, manual manipulation, and vocal coo for A and SM groups combined. Period-wide effects.
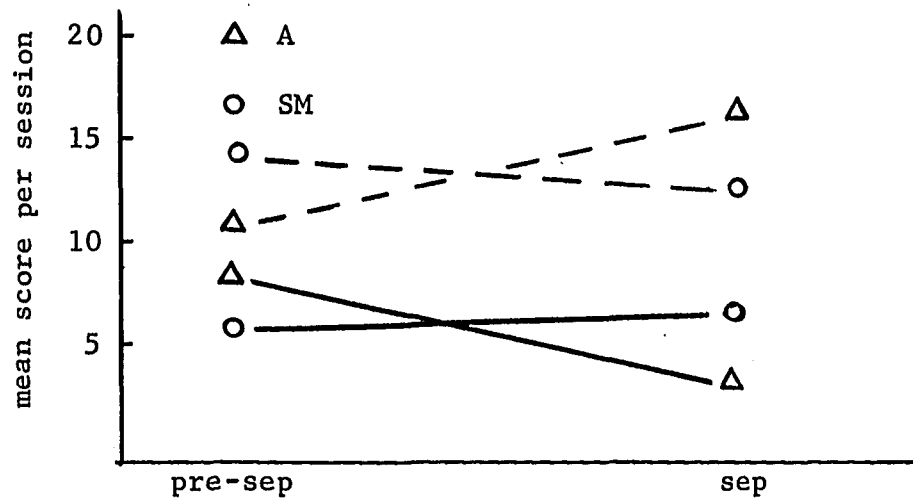
Fig. 8. Infant self-mouthing (solid lines) and
non-social oral exploration (broken lines). Period-wide
effects of separation.

that behavior. Therefore, effects due to sex differences between groups had to be taken into consideration in the interpretation of statistically significant results.

Immediate effects of reunion.--Compared to the last pre-separation session, the immediate reaction to reunion was characterized by a pronounced increase in mother-infant interactions and a pronounced decrease in infant peer-directed behaviors. Significant overall initial increases were found for mother-infant and infant-mother positive behavior. Conversely, significant overall initial decreases were found for infant-infant active interaction, non-specific contact, and non-social object-directed behavior (Figure 9). The initial decrease in infant-infant non-specific contact was significantly greater for infants in the experimental groups (Figure 10). For infant-infant passive interaction, a statistically significant differential reaction was found between the A and SM groups. Compared to the last pre-separation session, infants in the A groups showed an initial increase in this behavior during reunion, while infants in the SM groups showed an initial decrease (Figure 11).

Period-wide effects of reunion.--Few period-wide differences in infant-infant and infant non-social behavior were found during reunion between the groups as the behavior of infants in the experimental groups tended to return to pre-separation levels (see Figure 5). There was a significant difference in reunion between the
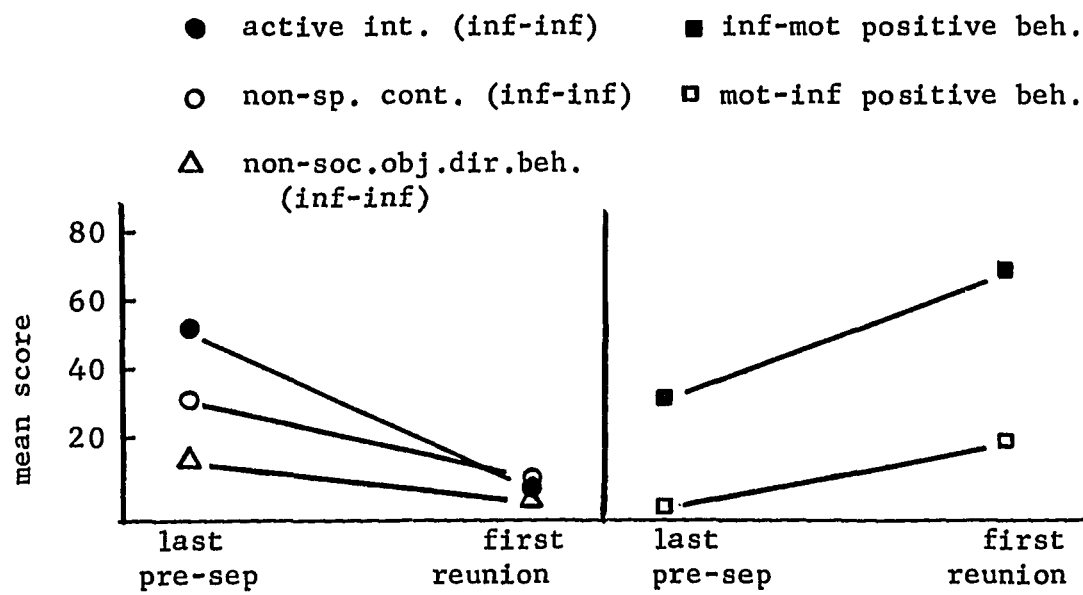
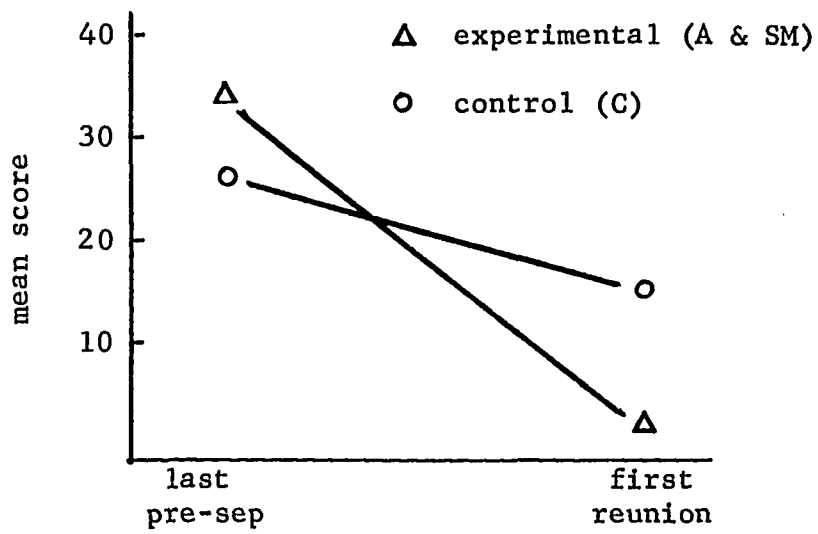Fig. 9. Immediate overall effects of reunion.

Fig. 10. Infant-infant non-specific contact.
Immediate effect of reunion.
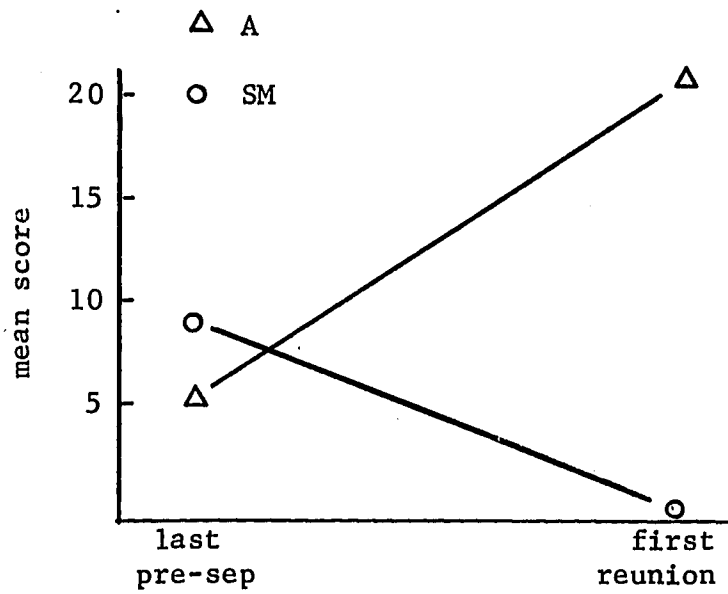
Fig. 11. Infant-infant passive interaction.
Immediate effect of reunion.

experimental and control groups in infant-infant clasp-pull, a behavior which increased slightly in reunion but did not return to its pre-separation level (Figure 12). There was also a significant difference in reunion between the A and SM groups for infant-infant non-specific contact. This behavior returned to its pre-separation level for the SM groups, but continued to decrease in reunion for the A groups (Figure 6).

Analysis of period-wide effects of reunion also revealed that the initial overall intensification of the mother-infant relationship continued throughout reunion for the $\underline{S}$s in the experimental groups. Infant-mother ventral contact, cling, and nipple contact showed a significantly greater increase in reunion for the experimental than for the control groups. Also, infants in the A groups showed significantly greater increases in these behaviors than infants in the SM groups (Figure 13). The experimental groups combined also showed a significant differential change in mother-infant grooming during reunion (Figure 14). Compared to pre-separation levels, mothers in the experimental groups groomed their infants more during reunion while mothers in the control groups groomed their infants less.

The return of mothers to reversed home cage locations resulted in a significant overall increase in infant-mother ventral contact, cling, and nipple contact (Figure 15). When only the data from the experimental groups was considered, the effect was significant only for infant-mother ventral contact and cling.
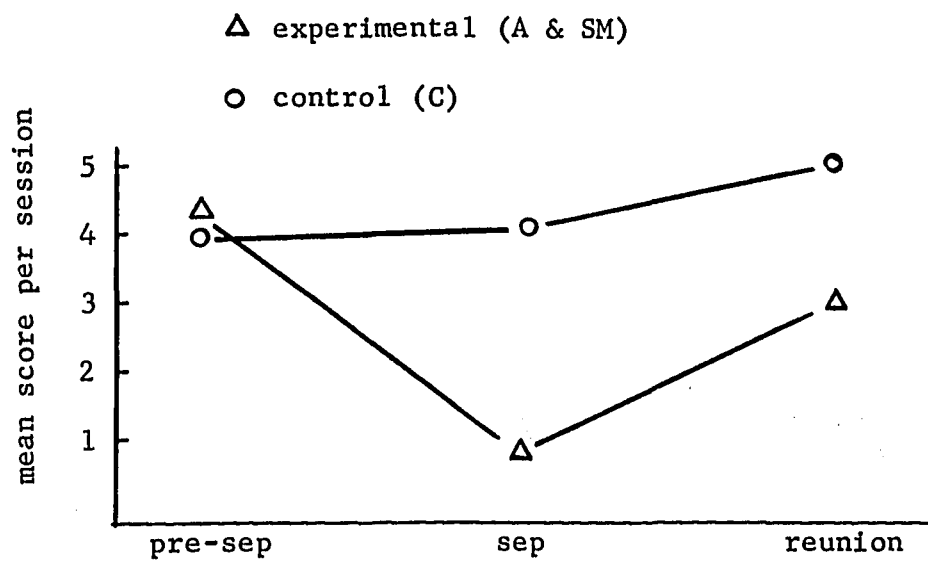
Fig. 12. Infant-infant clasp-pull. Period-wide effects.
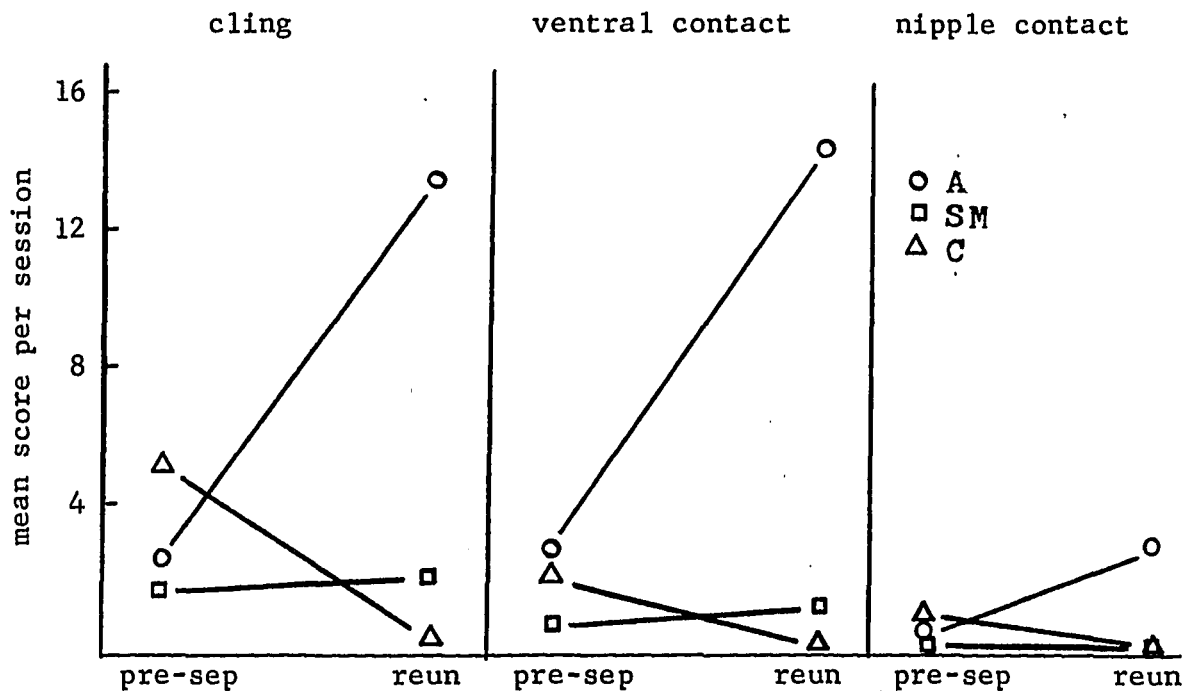
Fig. 13. Infant-mother cling, ventral contact, and nipple contact. Period-wide effects of reunion.
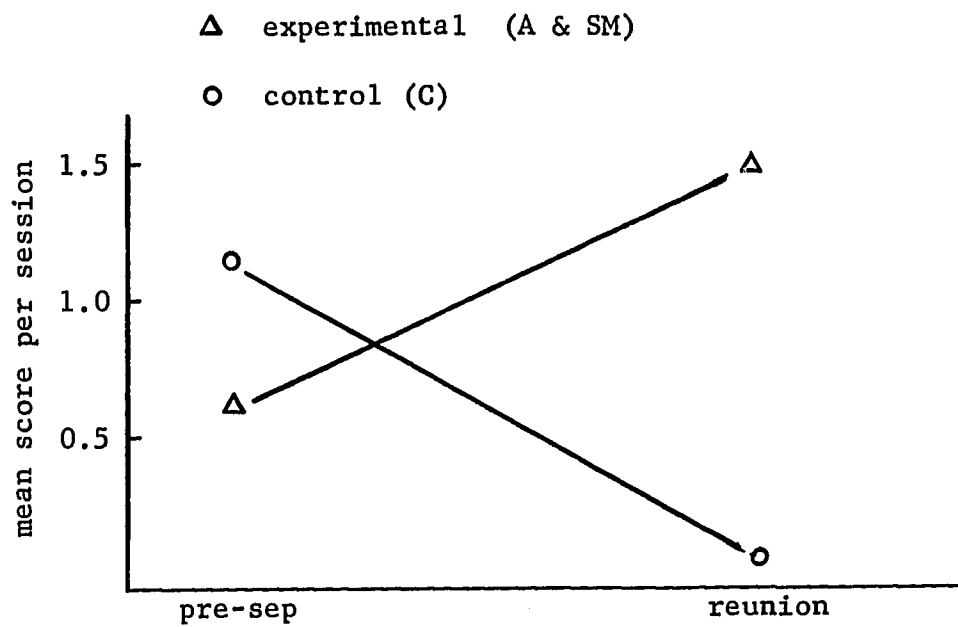
Fig. 14. Mother-infant grooming. Period-wide effects of reunion.
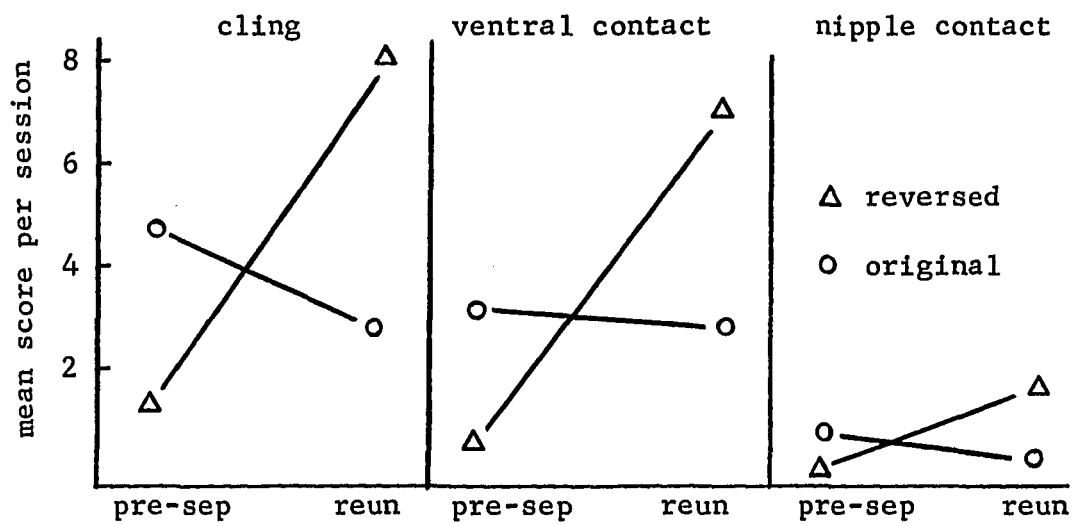
Fig. 15. Infant-mother cling, ventral contact, and nipple contact. Period-wide effects of original vs. reversed home cage return of mothers.

Behavior of and toward substitute mothers.--Infants in the

SM groups withdrew less from the adult female in the adjacent home

cage during separation than did infants in the C groups whose real

mothers were present in period two. Although no other significant

differences were found, there was a tendency for real mothers to

lipsmack more at $\underline{0}$ and to jaw-drop more at the other infant. There

was also a non-significant tendency for infants to touch and make

nipple contact more with real mothers. In fact, not a single

instance of nipple contact with substitute mothers was observed.

DISCUSSION

Results of the present study indicate that maternal separation
is indeed stressful to Java infants. The behavior of infants during
the separation period was characterized by the almost total obliteration
of complex infant social behaviors such as playing and related
component behaviors of the infant play pattern. Infant crying (vocal
coo) increased and self-mouthing decreased during separation, but
behaviors related to more sedentary forms of infant interaction showed
only an initial, transient effect. Although a basically similar
reaction during separation was seen in the rhesus (Seay et al., 1962;
Seay and Harlow, 1965; Spencer-Booth and Hinde, 1967), in the
pigtail (Kaufman and Rosenblum, 1967), and in the patas (Preston et
al., in press), some species-specific differences exist. Patas
infants show a significant increase in contact play during separa-
tion despite the usual decreases in non-contact and self-play.
Preston et al., (in press) interpreted the difference between patas
and macaque reactions to separation in terms of the relationship
between maternal roles and peer interaction. Patas mothers are more
protective than their Java counterparts and threaten the other
infant more during close-quarters play. Separation, therefore,
permitted behaviors which previously evoked threat reactions from
the mother.

Species differences in the reaction to separation were also
evident in the Rosenblum and Kaufman (1968) study. Bonnet macaques

fail to show a severe reactions to separation if familiar substitutes are provided since their social structure facilitates attachment behavior between infants and adult females other than the mother. It is difficult to make comparisons between the present study and the bonnet data, however, because of differences in apparatus and procedures.

In accord with Bowlby's (1952) views, the reaction of the infants in the present study to separation was due primarily to loss of the specific mother to whom the infants had become attached. Although the presence of an unfamiliar substitute mother in the separation period facilitated recovery during reunion, the effects of separation were nevertheless considerable. In addition, the effects observed during the separation period could not be attributed to the seemingly traumatic nature of the separation procedure, since infants who were separated and immediately reunited with mothers were minimally affected.

Although there were no significant differences in the behavior of substitutes and the specific mothers to whom infants had already become attached, substitutes appeared to be more indifferent toward infants. They seldom threatened the other infant and their attempts to punish infants housed with them, although infrequent, appeared to be more severe. However, it also appeared that there were large individual differences in the behavior of substitutes. One of the substitutes used in Group SM_2 frequently embraced the infant housed with her and appeared quite maternal. The infant

involved appeared to recover somewhat from the effects of separation, and several times attempted to play with the other infant in the group. These attempts resulted in the other infant screeching, fear-grimacing, and withdrawing. But evidence obtained in other studies suggests that even highly maternal substitutes could not override the effects of maternal separation. The presence of already familiar (and presumably more maternal) substitute mothers in the Spencer-Booth and Hinde (1967) study did not alleviate the severe reaction of rhesus infants to separation. The effects would probably be similar in Java monkeys since laboratory studies by Seay (1967) have shown a similar pattern of maternal and filial behavior for the two species.

Although some temporary hesitation and disorientation resulted when mothers were returned to reversed home cage locations, all infants were able to recognize and respond differentially to their own mothers after several minutes at most. As in the Seay et al., (1962) and Seay and Harlow (1965) studies, the initial response to reunion was characterized by an intensification of the mother-infant relationship. A similar effect was reported by Ainsworth and Bell (1970) who noted an increase in proximity-seeking and contact-maintaining behavior in young children during reunion following brief separations. It is apparent that, as Ainsworth and Bell (1970) pointed out, the attachment between a specific mother-infant pair is not diminished by separation even though attachment behavior had been prevented by the mother's absence.

In the present study, infant playing and most related

behaviors returned to pre-separation levels shortly after the mother's

return. However, intensification of the mother-infant relationship

was evident throughout the 3-week reunion period, especially for those

infants who had not been provided with substitute mothers during

separation. The fact that substitute mothering facilitated recovery

in reunion seems contradictory to the rhesus data of Seay et al.,

(1962) and Seay and Harlow (1965) as compared to that of Spencer-Booth

and Hinde (1967). In the Seay studies, all infants were without

substitute mothers during the separation period, and the increase in

infant-mother and mother-infant positive behaviors in reunion was

ephemeral. In the Spencer-Booth and Hinde study, infants remained in

contact with already familiar adults. Yet, there was a prolonged

intensification of the mother-infant relationship in reunion. A

possible explanation is that the sheer complexity of the group

situation in the Spencer-Booth and Hinde study may have exacerbated

the effects of separation and hindered recovery in reunion. Kaufman

and Rosenblum (1967), using the pigtail macaque, also employed a

group situation and obtained results similar to Spencer-Booth and

Hinde.

As in all the other studies of maternal separation using

monkeys, none of the infants in the present study appeared to reach

Bowlby's detachment stage. Neither was there any indication of an

increase in contact-resisting or contact-avoiding behaviors as

recently reported by Ainsworth and Bell (1970) following brief

separations of one-year-old human children from their mothers. The

appearance of a detachment stage in children may very well represent a species difference between monkeys and humans. The data of Preston et al., (in press) indicates that species differences during reunion exist even among monkeys. Their patas infants showed an increase in peer interaction during reunion rather than an intensification of the mother-infant relationship as seen in macaques. Another possibility, however, is that detachment results when other stressful factors are present in combination with the separation variable. Such confounding factors, such as illness and removal from the home, have been characteristic of studies of maternal separation with human children (Yarrow, 1961). The importance of a change in the physical environment, for example, was also noted in the present study in that the return of mothers to reversed home cages required infants to adapt to a new home cage location. There was virtually no effect of this procedure on Ss in the control groups, but there was an exacerbation of the already intensified mother-infant relationship for Ss in the experimental groups who had just undergone a stressful separation experience.

Studies of human children have also reported the appearance of aggressive behavior toward the mother during reunion (Robertson, 1955; Heinicke, 1956). Although aggression directed toward the mother has not been reported in any of the studies of maternal separation using monkeys, peer-directed aggression has been seen during the separation and reunion periods (Seay and Harlow, 1965; Preston et al., in press). In the present study, 32 instances of

peer-directed aggression were noted among six of the 12 infants, but
it did not appear to be related to the separation experience. Of the
32 instances, 12 occurred during the pre-separation period, 11 during
separation, and 9 during reunion. Furthermore, one of the infants in
the present study also exhibited tantrums in which it began screeching
loudly and jerking convulsively for no apparent reason. Tantrums had
previously been reported by Spencer-Booth and Hinde (1967) during
reunion, but in the present study the infant involved exhibited the
behavior during the pre-separation period as well. These data suggest
that tantrums, like aggression, are unrelated to the separation
experience in Java infants.

Although no indication of detachment or negativism was seen,
the results of the present study are generally in accord with the
views of Bowlby (1952; 1958a,b; 1960a,b; 1961a,b). Loss and return
of the specific mother to whom an infant had become attached were
the primary factors responsible for the infants' behavior in separa-
tion and reunion respectively. However, Bowlby's Component Instinc-
tual Response theory also assumes there is a genetic bias toward
becoming attached and attributes the debilitating effects of
separation to the activation of instinctive response systems without
termination. An alternative to Bowlby's viewpoint is that of Cairns
(1966). Cairns proposed that attachment in mammals is the result of
the length of association with an object in a given context and the
relative cue weight of the object. Accordingly, an object can become
a significant component in the stimulus pattern supporting $\underline{S}$s

behavior if there is a continguous association between that object and other environmental or internal events. Attachments to non-social objects can result, but animals are more capable of providing reciprocal stimulation and are more likely to become conditioned. An infant's mother is not only a salient object, but one that is also relevant to the infant's activities and attachment occurs. When the object is removed as in the case of an infant deprived of its mother, associative chains are disrupted and atypical behavior occurs. As pointed out by Seay, Schlottmann, and Thorne (1970), the instinct concept is thus unnecessary and variations within and between species in attachment behavior and in reactions to maternal separation can more readily and more parsimoniously be explained.

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APPENDICES

Code:

A = treatment during period two

A_1 = infants alone following removal of real mothers

A_2 = infants with unfamiliar substitute mothers following removal of real mothers

A_3 = infants with real mothers following removal and immediate return of latter

B = treatment during period three

B_1 = mothers returned to original home cage locations

B_2 = mothers returned to reversed home cage locations

C = periods

C_1 = pre-separation (period one)

C_2 = separation (period two)

C_3 = reunion (period three)

APPENDIX I

Orthogonal Coefficients Used in

Analysis of Period-Wide Effects of Separation and Reunion

on Infant-Infant and Infant Non-Social Behavior

C Summary Table

c_1	c_2	c_3
+1	-1	0

AC Summary Table

	C_1	C_2	C_3
A_1	a	b	c
A_2	d	e	f
A_3	g	h	i

a	b	c	d	e	f	g	h	i
+1	-1	0	+1	-1	0	-2	+2	0
+1	-1	0	-1	+1	0	0	0	0
0	0	+1	0	0	+1	0	0	-2
0	0	+1	0	0	-1	0	0	0

BC Summary Table

	C_1	C_2	C_3
B_1	a	b	c
B_2	d	e	f

a	b	c	d	e	f
0	+1	-1	0	-1	+1
+1	0	0	-1	0	0

ABC Summary Table

		C_1	C_2	C_3
	A_1	a	b	c
B_1	A_2	d	e	f
	A_3	g	h	i
	A_1	j	k	l
B_2	A_2	m	n	o
	A_3	p	q	r

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
0	+1	-1	0	+1	-1	0	0	0	0	-1	+1	0	-1	+1	0	0	0
+1	-1	0	+1	-1	0	0	0	0	+1	-1	0	+1	-1	0	0	0	0
0	0	0	0	0	0	+1	-1	0	0	0	0	0	0	0	+1	-1	0
0	0	0	0	0	0	0	+1	-1	0	0	0	0	0	0	0	-1	+1

APPENDIX II

Orthogonal Coefficients Used

in Analysis of Immediate Effects of Separation

on Infant-Infant and Infant Non-Social Behavior

C Summary Table

Last C_1 First C_2

+1   -1

AC Summary Table

	Last C$_1$		First C$_2$
A$_1$	a		b
A$_2$	c		d
A$_3$	e		f

a	b	c	d	e	f
+1	-1	+1	-1	-2	+2
+1	-1	-1	+1	0	0

APPENDIX III

Orthogonal Coefficients Used

in Analysis of Immediate Effects of Reunion

on all behaviors

and in Analysis of Period-Wide Effects of Reunion

on Mother and Mother-Related Behaviors

C Summary Table

Last C_1 First C_3

+1   -1

AC Summary Table

	Last C_1	First C_3
A_1	a	b
A_2	c	d
A_3	e	f

a	b	c	d	e	f
+1	-1	+1	-1	-2	+2
+1	-1	-1	+1	0	0

BC Summary Table

	Last C_1		First C_3
B_1	a		b
B_2	c		d

a	b	c	d
+1	-1	-1	+1

ABC Summary Table

		Last C_1	First C_3
	A_1	a	b
B_1	A_2	c	d
	A_3	e	f
	A_1	g	h
B_2	A_2	i	j
	A_3	k	l

a	b	c	d	e	f	g	h	i	j	k	l
+1	-1	+1	-1	0	0	-1	+1	-1	+1	0	0
0	0	0	0	+1	-1	0	0	0	0	-1	+1

VITA

Robert Stanislaus Schlottmann was born in New Orleans, Louisiana on October 22, 1937. He graduated from De La Salle High School in New Orleans in 1955. He was employed for several years before attending Louisiana State University in New Orleans where he majored in psychology and received his bachelor's degree in 1962. After working with mentally retarded children for a year, he attended Tulane University and received his master's degree in psychology in 1965. He continued his graduate work at LSU's main campus in Baton Rouge in clinical psychology and completed his internship at the University of Texas' Southwestern Medical School at Dallas. While a student at LSU, he worked with Dr. Bill Seay as a research assistant in the LSU Primate Laboratory. He is married to the former Miss Carol Hellbach and has one child, Robert Brien, eleven months old.
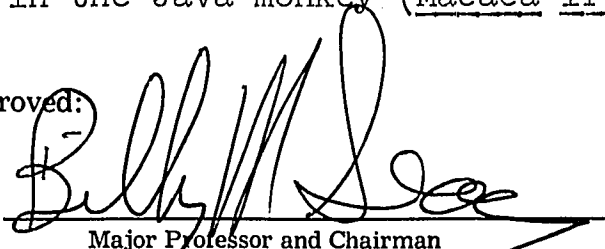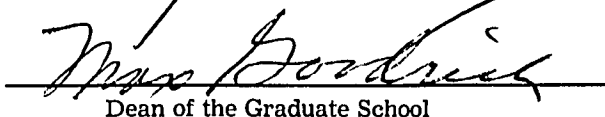
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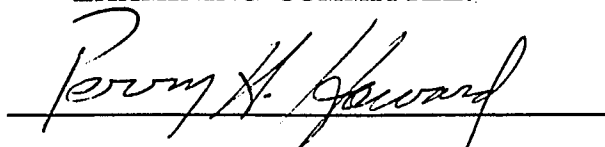Candidate: Robert Stanislaus Schlottmann

Major Field: Psychology

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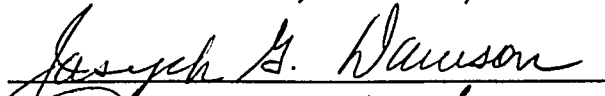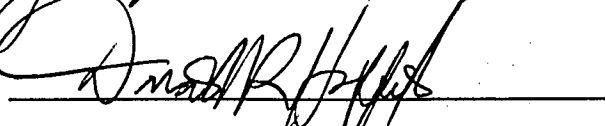
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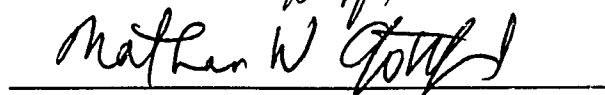
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