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Consistency and Change in the Behavior of Rhesus Macaque Abusive Mothers with Successive Infants

Received 9 March 1998; accepted 28 May 1998

ABSTRACT: This study investigated the abusive behavior and parenting styles of 7 rhesus macaque mothers with infants born in 2 consecutive years. All subjects lived in captive social groups and were observed during the first 12 weeks of infant life. With the exception of 1 individual, mothers were generally consistent in the frequency with which they abused their successive infants. Similarities were also found in the temporal course of infant abuse, the use of the most common pattern of abuse, and some measures of parenting style, notably those reflecting maternal protectiveness. The findings of this study are discussed in relation to different hypothesized relationships between infant abuse and parenting style in macaques.
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Keywords: infant abuse; parenting style; nonhuman primates

In Old World monkeys such as macaques (genus *Macaca*), baboons (genus *Papio*), and vervet monkeys (*Cercopithecus aethiops*), the development of the mother–infant relationship in the first months of infant life is qualitatively similar across different individuals and environments (Higley & Suomi, 1986; Nash & Wheeler, 1982). Monkey mothers belonging to the same species and social group, however, differ quantitatively from one another in interaction with their infants (e.g., Hinde & Spencer-Booth, 1971). Several studies of maternal behavior conducted with factor analysis have shown that most variability in maternal behavior occurs along the two orthogonal dimensions

of Protectiveness and Rejection (Fairbanks & McGuire, 1987; Maestripieri, 1998a; Schino, D'Amato, & Troisi, 1995; Simpson & Howe, 1980; Tanaka, 1989). In other words, maternal behaviors reflecting protection and control over the infant's behavior tend to be correlated with each other and to vary independently from behaviors such as breaking contact, increasing distance, and rejecting the infant's attempts to make contact and nurse. Variation along the two dimensions of Protectiveness and Rejection can result in four different types of parenting styles: Controlling (high in both Protectiveness and Rejection), Protective (high in Protectiveness and low in Rejection), Rejecting (low in Protectiveness and high in Rejection), and Laissez-Faire (low in both Protectiveness and Rejection).

Individual differences in parenting styles may be associated with characteristics of mothers (e.g., tem-

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Contract grant sponsor: H. F. Guggenheim Foundation
Contract grant number: RR 00165
Contract grant sponsor: NIH
Contract grant number: R01-MH57249

perament, age, parity, or dominance rank), infants (e.g., sex), or the environment (availability of social support from relatives or stressful circumstances) (Fairbanks, 1996; Maestripieri, 1993). Although parenting styles can be adjusted in relation to maternal experience and environmental contingencies, they are also remarkably consistent across infants and generations. Thus, the parenting styles of young females tend to resemble those of their mothers, probably as a result of learning during infancy or adolescence (Berman, 1990; Fairbanks, 1989).

Consistency in mother–infant interactions across infants and generations may also include infant abuse. In group-living macaques, infant abuse consists of violent behaviors such as infant dragging, crushing, throwing, stepping or sitting on, and abusive mothers typically alternate short bouts of abuse with long periods of appropriate caregiving behavior (Maestripieri, 1994, 1998b; Troisi & D'Amato, 1984). Recent epidemiological studies of infant abuse over a period of 30 years indicated that 2–10% of all infants born in three large populations of Old World monkeys were at risk of abuse, that abuse was concentrated in some matrilines and among closely related females, and that abusive mothers maltreated most, if not all, of their infants (Maestripieri & Carroll, 1998a; Maestripieri, Wallen, & Carroll, 1997a, 1997b). Observational studies of infant abuse in three species of macaques (*Macaca fuscata*, *M. mulatta*, and *M. nemestrina*) also showed that the parenting styles of abusive mothers tend to differ from those of controls and that the former score higher in measures of maternal Protective-ness and Rejection (Maestripieri, 1998b; Maestripieri & Carroll, 1998b; Troisi D'Amato, 1984). These observations have led to the hypotheses that there may be a causal relationship between the parenting style and the maltreating behavior of abusive macaque mothers (Troisi & D'Amato, 1994) and that the inter-generational transmission of infant abuse may be mediated by consistency in the personality traits of abusive mothers or by learning mechanisms similar to those involved in the transmission of parenting styles (Maestripieri & Carroll, 1998c, 1998d). Although the evidence linking parenting styles and infant abuse in monkeys is mostly correlational, one study of Japanese macaques showed that the reduction of maternal protectiveness with an anxiolytic drug also reduced the rate of infant abuse (Troisi & D'Amato, 1991).

The demonstration that abusive mothers show some consistency in their abusive behavior and parenting style with successive infants could lend further support to the hypotheses linking abuse and parenting style. The comparison of abusive mothers' behavior with successive infants could also help elucidate whether differences in the frequency or severity of abuse are

associated with differences in infant sex or infant behavior. Unfortunately, although the epidemiological data indicate that infants whose older siblings have been abused are themselves at high risk of abuse (Maestripieri et al., 1997a, 1997b), no quantitative information on the behavior of abusive mothers with successive infants is currently available.

In the present study, we compared the maternal and abusive behavior of rhesus macaque (*Macaca mulatta*) abusive mothers with infants born in 2 successive years. A previous study had shown that these abusive mothers displayed relatively mild levels of infant abuse and Controlling parenting styles when compared to nonabusive mothers (Maestripieri, 1998b). Some of these mothers gave birth again in the following year and, in this study, we assessed whether there were consistencies or changes in the frequency and severity of abuse as well as in their parenting styles with the new infants.

METHOD

Subjects and Procedure

This study was conducted from March to August 1996 and from March to August 1997 at the Field Station of the Yerkes Regional Primate Research Center in Lawrenceville, GA, U.S.A. At the beginning of the 1996 birth season, one of us (D. M.) began ad libitum observations of four rhesus macaque groups housed in adjacent outdoor compounds (35 × 35 m) with attached indoor quarters. Each group consisted of 2–5 adult males and 25–30 adult females with their subadult and juvenile offspring. Food and water were freely available to all animals. The criterion used to identify abusive mothers was the occurrence of one of the following behavior patterns: infant dragging, crushing, throwing, or sitting/stepping on (see below for definitions). These patterns are clearly distinguishable from other behaviors in the maternal and aggressive repertoire, such as those observed during mother–infant weaning conflicts (Gomendio, 1991). Ten abusive mother–infant pairs were identified in three social groups. In 7 mother–infant pairs, the first episode of infant abuse was observed in the first week of infant life. In the other 3 mother–infant pairs, the first infant abuse episode was observed in Weeks 5, 7, and 9, respectively. Focal observations of the mother and her infant began immediately after abuse was first observed and continued until the 12th week of infant life. Each mother–infant pair was observed in four weekly 30-min observation sessions randomly distributed between 0800 and 1900 hr. Observations were made from a platform that provided unrestricted view of the

entire compound and data were collected with a portable computer.

Seven of the 10 abusive mothers observed in 1996 gave birth again in 1997. They still lived in the same social groups as in 1996; five of them belonged to the same group and consisted of one mother with her two adult daughters, and another mother with her daughter. The other two abusive mothers lived in different groups. There were no major changes in group size and composition, the dominance rank of the subjects, or their health condition in 1996 and 1997. Focal observations of the abusive mothers with their new infants began the day after the infants were born and continued until the 12th week of infant life with procedures similar to those used in the previous year. Prior to the onset of data collection, two observers recorded maternal and infant behavior at the same time in several consecutive observation sessions. Interobserver reliability was considered to have been achieved when percent agreement in recording behavior exceeded 90% and Cohen's kappa (Cohen, 1960) exceeded 0.8. The observers were aware that the subjects observed in 1997 had abused their infants in 1996 and that infant abuse was likely to be repeated. The potential influence of the observer's bias on data collection, however, was probably negligible because abusive behavior was recorded with an objective scoring system and the observers had no specific expectation concerning the form or the frequency of infant abuse in the 2nd year.

Data Collection

Data collection included infant abuse and other behavioral interactions between mothers and infants (see also Maestripieri, 1998b; Tomaszycki, Cline, Griffin, Maestripieri, & Hopkins, 1998).

Infant abuse: The following maternal behavior patterns were included in the infant abuse category: (a) dragging: The mother drags her infant by its tail or leg while walking or running; (b) crushing: The mother pushes her infant on the ground with both hands; (c) throwing: the mother throws her infant a short distance with one hand while standing or walking; (d) hitting: The mother violently slaps her infant with one hand or arm; (e) biting: common definition; (f) stepping or sitting on: The mother steps on her infant with one foot or both feet, or sits on her infant; (g) dangling/dropping: The mother climbs a tree or fence and holds her infant by its tail or leg or drops her infant on the ground; (h) rough grooming: The mother pulls her infant's hair or otherwise roughly grooms it causing distress calls. Infant abuse was scored independently of all the other mother–infant interactions (e.g., rejection). Abuse events did not last more than a few sec-

onds and therefore were recorded only in terms of their frequency. Infant abuse was recorded as two separate events if there was a transition in the pattern of behavior (e.g., from dragging to throwing) or if there was a pause of at least 10 s during the behavior. The number of infant distress vocalizations (screams, coos, and geckers) was also recorded (see Maestripieri, Jovanovic, & Gouzoules, 1998 for definitions).

Mother–infant interactions: The following measures were used: (a) percentage of observation time spent in bodily contact; (b) percentage of contact time in which the mother kept her arms around the infant (% cradling; cradling data were not available for 1 individual because we decided to record this behavior after observations of the first individual had already begun); (c) percentage of contact time in which the mother groomed her infant (% grooming); (d) number of approaches and leaves by mothers and infants. Approaches and leaves were scored in relation to proximity within arm's reach (about 60 cm) and may or may not have involved physical contact; (e) number of maternal restraining episodes: Restraining involved pulling the infant by its tail or leg to prevent it from leaving; (f) number of maternal rejection episodes: Rejection involved turning, running away, or holding the infant at a distance with an arm to prevent it from making contact and nursing.

Data Analysis

Data analysis focused on the 7 abusive mothers who gave birth both in 1996 and 1997. Among these individuals, only infant age periods in which there were data for both years were used. The frequencies and durations of behavior recorded in the four weekly sessions were summed to obtain weekly scores. Comparisons of behavioral frequencies and durations in the 2 years were made using the Student's *t* test for paired samples. Correlations were calculated using the Pearson product-moment coefficient of correlation. The chi-square test was also used when appropriate. All tests were two-tailed. Probabilities ≤ 0.05 were considered statistically significant, and probabilities ≤ 0.1 were considered indicative of statistical tendencies.

RESULTS

Infant Sex, Frequency, Severity, and Temporal Course of Abuse

In 1996, the 7 abusive mothers of this study gave birth to 4 male infants and 3 female infants. In 1997, they gave birth again to 4 male infants and 3 female infants. Three mothers gave birth to infants of the same sex, 2

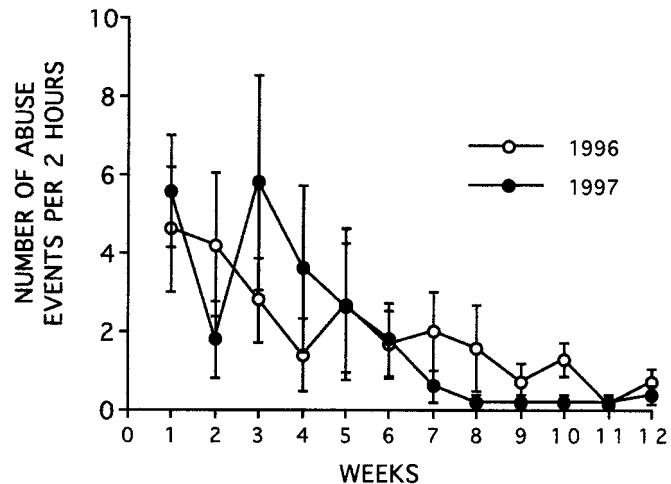


FIGURE 1 Mean number (\pm SEM) of abuse events per individual per week (2 hr) during the first 12 weeks of infant life in 1996 and 1997.

switched from males to females, and 2 from females to males.

In 1996, in no case was abuse as severe as to cause infant death or to require infant removal for medication. In 1997, 1 female infant died from physical trauma caused by abuse and another female infant was permanently removed from her mother because her life was judged to be jeopardized by abuse. Both infant death and removal occurred in the 1st week of infant life and therefore behavioral data for these infants and their mothers were only available for 1 week.

The frequencies of abuse across the 12 weeks were significantly correlated between the 2 years, $r = 0.67$, $n = 12$, $p < 0.05$, as in both cases infant abuse decreased in frequency as a function of infant age (Figure 1). The average frequency of infant abuse per week was higher in 1997 than in 1996 for 4 subjects, while the opposite was true for 3 subjects; thus, the overall frequency of abuse did not differ significantly, $t = -1.01$, $df = 6$, n.s., between 1996 (mean \pm SEM = 2.24 ± 1.04) and 1997 (3.98 ± 2.09). Giving birth to a male or female infant in the 2nd year was not significantly associated with an increase or decrease in the frequency of abuse, $\chi^2 = 1.21$, $df = 1$, n.s.

When all 7 abusive mothers were considered, the individual frequencies of abuse in 1996 and 1997 were not significantly correlated, $r = 0.14$, $n = 7$, n.s. However, if the mother whose infant died and whose rate of abuse in the 1st week changed from 0 to 12 events was excluded from the analysis, there was a significant positive correlation between the individual frequencies of abuse in 1996 and 1997, $r = 0.98$, $n = 6$, $p < 0.01$; Figure 2a. Therefore, with the exception of 1

individual, abusive mothers were highly consistent in the frequency with which they abused their infants in successive years. The exceptional individual (Dwezil) was not observed to abuse her infant for several weeks after parturition in 1996, while in 1997 she displayed

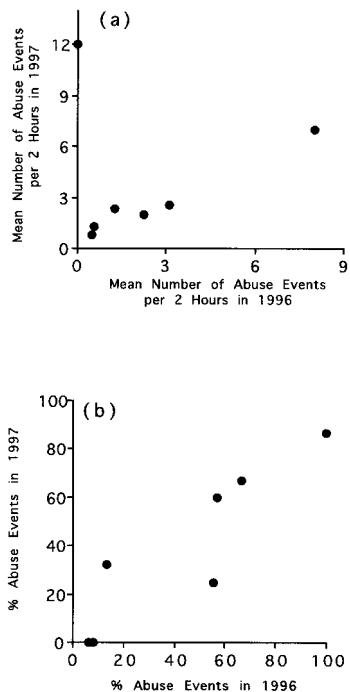


FIGURE 2 (a) Correlation between individual rates of infant abuse in 1996 and 1997. Data are presented in terms of mean weekly rates (2 hr of observations) of abuse for each individual. (b) Correlation between the percentage of abuse events accounted for by infant dragging among individuals in the 2 years.

an initial rate of abuse similar to that of her mother, who also had high rates of abuse in both years and whose 1997 infant had to be removed. Interestingly, in 1996, Dwezil gave birth 6 days before her mother, whereas in 1997, Dwezil gave birth 6 days after her mother. Therefore, in 1997 Dwezil had time to observe her mother severely abuse her infant before she gave birth to her own infant.

In addition to the frequency of abuse, abusive mothers showed some consistency also in their patterns of abusive behavior. Infant dragging was the most common form of abuse in 1996 and the percentage of abuse accounted for by dragging did not change significantly in 1996 (43.81 ± 13.84) and 1997, 38.64 ± 12.69 ; $t = 0.90$, $df = 6$, n.s. Moreover, there was a positive correlation in the percentage of abuse accounted for by dragging among individuals in the 2 years, $r = 0.82$, $n = 7$, $p < 0.05$; Figure 2b. The percentage of abuse accounted for by crushing, however, increased significantly in 1997, 1996 = 25.70 ± 9.29 ; 1997 = 54.12 ± 10.41 ; $t = -3.05$, $df = 6$, $p < 0.05$, while the percentage of other abuse patterns decreased, 1996 = 30.48 ± 10.63 ; 1997 = 7.24 ± 3.25 ; $t = 2.40$, $df = 6$, $p = 0.05$. There were no significant correlations in the % crushing, $r = 0.56$, $n = 7$, n.s., and % other abuse patterns, $r = 0.43$, $n = 7$, n.s., among individuals in the 2 years.

Mother–Infant Interactions

The comparison of mother–infant interactions in 1996 and 1997 only involved 6 mother–infant pairs. For the infant that died in 1997, no behavioral information was

Table 1. Maternal and Infant Behavior Scores in 1996 and 1997

| Behavioral Measures | Years | |
|----------------------|------------------|------------------|
| | 1996 | 1997 |
| % Time in contact | 69.33 ± 3.51 | 62.05 ± 2.12 |
| % Cradling | 25.01 ± 5.55 | 24.66 ± 5.38 |
| % Grooming | 4.27 ± 1.19 | 4.76 ± 1.73 |
| Approaches made by M | 9.87 ± 2.45 | 6.32 ± 0.99 |
| Approaches made by I | 22.89 ± 4.99 | 23.12 ± 5.22 |
| Leaves by M | 14.44 ± 2.03 | 10.49 ± 2.91 |
| Leaves by I | 20.06 ± 4.63 | 18.33 ± 4.51 |
| Restraining | 5.38 ± 2.47 | 2.04 ± 1.08 |
| Rejection | 4.14 ± 1.74 | 2.04 ± 0.62 |
| Infant Calls | 8.56 ± 2.86 | 7.33 ± 1.68 |

Data are presented in terms of mean values ($\pm SEM$) per individual per week calculated across the 12 weeks of infant life. Differences are not statistically significant for any of the measures.

M = mother; I = infant.

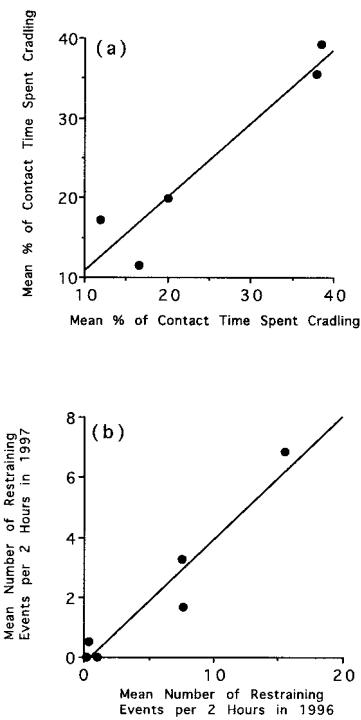


FIGURE 3 (a) Correlations between individual cradling scores in 1996 and 1997. (b) Correlation between individual restraining scores in the 2 years.

available for the 1st week of life in 1996 other than the infant was not abused by its mother in that week.

The percentage of time spent in mother–infant contact was not significantly different in 1996 and 1997, $t = 2.07$, $df = 5$, n.s.; Table 1. The number of approaches and leaves made by infants did not differ significantly in 1996 and 1997, approaches: $t = -0.12$, $df = 5$, n.s.; leaves: $t = 1.15$, $df = 5$, n.s.; Table 1. Likewise, the number of infant distress vocalizations was similar, $t = 0.84$, $df = 5$, n.s.; Table 1. Therefore, infants had comparable levels of activities in the 2 years, at least in the interactions with their mothers. Maternal interactions with successive infants did not differ significantly in any of the measures considered, including percentage cradling, $t = 0.20$, $df = 5$, n.s., % grooming, $t = -0.32$, $df = 5$, n.s., number of approaches made by mothers, $t = 2.0$, $df = 5$, n.s., number of leaves, $t = 1.47$, $df = 5$, n.s., restraining, $t = 2.28$, $df = 5$, n.s., and rejection, $t = 1.56$, $df = 5$, n.s. Individual differences in % cradling, $r = 0.95$, $n = 5$, $p < 0.05$; Figure 3a, and restraining were highly consistent with successive infants, $r = 0.93$, $n = 6$, $p < 0.01$; Figure 3b, and there was a tendency for mothers to be consistent also for rejection, $r = 0.74$, $n = 6$, $p < 0.1$, and number of approaches, $r = 0.79$, $n = 6$, $p < 0.1$, but not for number of leaves,

$r = 0.46, n = 6$, n.s. or % grooming, $r = 0.49, n = 6$, n.s.

DISCUSSION

This study showed that rhesus macaque mothers who abused their infants in 1 year, abused their new infants again the following year. With exception of 1 individual, abusive mothers were generally consistent in their rate of abuse, in their use of the most common pattern of abuse, and in the temporal course of abuse in relation to infant age. Abusive mothers were also generally consistent in their parenting styles. The individual scores of cradling and restraining were positively correlated in the 2 years, and to a lesser extent, this was true also for maternal rejection and the number of maternal approaches to the infant. These findings indicate that mothers who were highly protective of their infant in 1 year also showed high levels of protectiveness with the next infant, whereas maternal rejection appeared to be more variable than protectiveness.

Although this study was conducted with a relatively small sample size, it provides the first evidence that the abusive behavior and the parenting styles of maltreating mothers are generally consistent with successive infants. These findings are in agreement with previous research showing consistency in the parenting styles of nonabusive mothers (Berman, 1990; Fairbanks, 1989) as well as with epidemiological studies of infant abuse showing that abuse is likely to be repeated with siblings (Maestripieri et al., 1997a, 1997b). Therefore, although both parenting styles and infant abuse can be sensitive to environmental contingencies such as stressful social events (Fairbanks & McGuire, 1987; Maestripieri, 1994; Maestripieri & Carroll, 1998b), quantitative differences among individuals in both parenting style and abusive behavior are generally maintained over time, and probably also across generations.

The sex ratio of the infants born to the abusive mothers was the same in the 2 years and infants had similar levels of activity as well. Thus, the lack of significant differences in infant characteristics in the 2 years may have contributed to the observed consistency in abusive behavior and parenting style. Infant sex and activity levels, however, appear to have a negligible role in determining variability in macaque parenting styles (at least in the 1st months of infant life) when compared to maternal characteristics (Fairbanks, 1996). Therefore, it is unlikely that the observed similarities in abusive behavior and parenting style with

successive infants are entirely accounted for by lack of significant differences in infant characteristics.

The findings of this study lend support to the hypothesis that parenting style and maternal abusive behavior are mutually linked, although they provide no specific information as to the nature of the relationship between these two variables. Although it is possible that extremely controlling parenting styles can increase the probability of occurrence of abuse (Maestripieri, 1998b), it cannot be ruled out that parenting style and abusive behavior are independently correlated with a third variable, e.g., the mother's temperament. It is also possible that abusive behavior, including the specific pattern of maltreatment, is transmitted from mothers to daughters along with the parenting style through experience and learning. Indeed, the behavior of 1 abusive mother in this study might suggest that the observation of her own mother's abusive behavior may have played an important role in the occurrence of abuse.

This abusive mother increased dramatically her rate of abuse during the 1st week after parturition relative to the previous year, and her abusive behavior was fatal to her infant. This subject's mother displayed high rates of abuse as well, although her abuse rates were similar in the 2 years. While in the 1st year the daughter gave birth several days before her mother, in the 2nd year the reverse occurred. Therefore, it is possible that the observation of the mother's abusive behavior prior to giving birth may have triggered an early onset of severe abuse in her daughter through a process of social facilitation or imitation.

Exposure to violent behavior in the family environment during childhood and direct experience of abuse appear to play an important role in the intergenerational transmission of child maltreatment in humans (Egeland, Jacobvitz, & Papatola, 1987; Widom, 1989). The extent to which the perpetuation of child abuse is accompanied by consistency in parenting style and the relative role of learning versus biological mechanisms in this process have not been systematically investigated in humans. In nonhuman primates, the relative role of experiential versus biological processes in the intergenerational transmission of infant abuse can be experimentally investigated in studies in which female infants are cross-fostered at birth between abusive and nonabusive mothers and then observed when they give birth to their own infants. Such experiments would obviously be difficult or impossible to perform with humans. Therefore, research with nonhuman primates could complement human research and make an important contribution to understanding the mechanisms responsible for the maintenance and transmission of

infant abuse in the population (Carroll & Maestripieri, 1998; Maestripieri & Carroll, 1998c).

NOTES

The Yerkes Center is fully accredited by the American Association for Accreditation of Laboratory Animal Care.

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