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RESEARCH ARTICLE

The Effects of Infant Births on Male–Female Relationships in *Cebus capucinus*

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Most primates are characterized by cohesive male–female bonds that are maintained year round. While recent studies have addressed the selective pressures influencing the evolution of male–female relationships in primates, we know relatively little about the proximate mechanisms affecting them. It has been demonstrated that newborn white-faced capuchins (*Cebus capucinus*) attract the attention of other group members and this may be an important mechanism influencing male–female relationships. We studied two groups of *C. capucinus* in the Area de Conservación Guanacaste, Costa Rica, between February and July 2007. A total of 348 hr of focal data were collected on all adult males ($n = 6$) residing in each of the study groups. During our study, 13 of the 14 group females were either pregnant or lactating, and 9 infants were born. We calculated an average daily affiliation rate between all group males combined and each adult female four weeks before and four weeks after the birth of her infant. Repeated measures ANOVAs revealed no significant changes in affiliation following infant births ($F = 2.262$, df = 1, $P < 0.176$). Results remained nonsignificant for rank ($F = 1.550$, df = 1, $P < 0.260$) and group membership ($F = 0.729$, df = 1, $P < 0.429$). Infant sex was the only variable with a significant effect on affiliation rates between males and females ($F = 10.020$, df = 1, $P < 0.019$). Adult males increased their affiliation with all adult females that gave birth to male infants ($n = 4$), while their rates decreased with all but one of the adult females with female infants ($n = 4$). While preliminary, these results indicate that the adult males may cultivate relationships with other males at a young age. Am. J. Primatol. 71:380–383, 2009. © 2009 Wiley-Liss, Inc.

Key words: affiliation; parturition; socialization; dispersal

INTRODUCTION

A number of researchers have characterized the patterns of male–female social relationships in *Cebus* [Fedigan, 1993; O'Brien, 1991; Rose and Fedigan, 1995], but we are aware of no study that has explicitly examined how infant births affect these relationships. Newborn white-faced capuchins (*Cebus capucinus*) garner considerable attention from other group members [Manson, 1999]. Adult males take particular interest in new infants, often following the mother in order to groom, nuzzle or carry the new baby [MacKinnon, 2002]. This attraction to the newborn should also affect the male's relationship with new mothers, as the baby serves as a focal point to bring the sexes together. In this article, we examine how rates of affiliation among males and females change with the birth of infants.

The attraction of group males to new infants in primates may function to increase infant survivorship by providing, either directly or indirectly, protection from predators [Janson, 1986], increased access to food [Escobar-Páramo, 1989], protection from intragroup aggression [Escobar-Páramo, 1989; Ferreira et al., 2006; Hector et al., 1989; Kleindorfer and Wasser, 2004; Vessey and Meikle, 1984] and protection from infanticide [Busse and Gordon, 1984; Vogel and Fuentes-Jiménez, 2006]. In some species, adult males also play an important role in infant socialization by encouraging appropriate behaviors, discouraging inappropriate behaviors, and by assisting in the forging of social bonds within the group [Burton, 1972; MacKinnon, 2002; Stein and Stacey, 1981].

The attention that adult males give to infants and their mothers may be dependent on a number of factors. Several studies have noted that, in some species, males are more attracted to male infants than female infants [Ogawa, 1995; Paul et al., 1996; Zhao, 1996]. Female rank may also play a role in the attractiveness of infants. Although adult females typically interact with infants of lower ranking females [O'Brien, 1991; Silk, 1999], in some species

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it has been found that the adult males are more attracted to infants of high-ranking females (e.g. *Macaca sylvanus*: Paul et al., 1996; Small, 1990; and *Papio cynocephalus*: Stein, 1984]). Group composition can also affect patterns of affiliation simply because smaller groups have fewer available partners with whom individuals can form relationships. Males may also associate more with infants they have potentially sired or with females they have mated with in the past [Borries et al., 1999; Martin-Ordas and Colmenares, 2005; Menard et al., 2001].

In this study, we compare male–female affiliation levels for a 1-month period before and after the infant births in two groups of *C. capucinus*. We further examine how infant sex, female rank and group membership may influence changes in affiliation patterns. While we hope to examine the effect of infant paternity on these relationships in the future, genetic data are unavailable at this time.

METHODS

Study Site

We conducted our study in the Santa Rosa Sector of the Area de Conservación Guanacaste, Costa Rica. Santa Rosa encompasses approximately 108 km^2 of tropical dry forest at varying stages of regeneration. The park experiences a distinct wet season from late May to early December, with minimal rainfall during the remainder of the year [Fedigan and Jack, 2001].

We observed two groups of white-faced capuchins from February through July of 2007. Guanacaste (GC) was comprised of 21 members: 3 adult males, 9 adult females, 7 juveniles, 2 independent infants, and 5 infants that were born during the study. Los Valles (LV) was comprised of 15 members: 3 adult males, 5 adult females, 6 juveniles, 1 independent infant and 4 infants that were born over the course of the study. All infants were born during the dry season, between late March and early June 2007. All females who gave birth during the study period were pregnant when observations began. One LV infant died within days of its birth and its mother was excluded from analysis. At the time of this study, all males had maintained residence in their respective study groups for a minimum of one year.

Data Analysis

Groups were observed for the majority of daylight hours spanning from 6:00 to 18:00, two to three times per week. A total of 348 hr of focal animal data were collected on adult males ($\geq$10 years) ($n = 6$) during 10 min focal animal follows [Altmann, 1974]. This study complied with protocols approved by Tulane University's IACUC and the legal requirements of Costa Rica.

All durational, affiliative behaviors (including grooming, contact behaviors, and proximity behaviors within 2 m) were combined into a single affiliation category. Only those females who gave birth during the study period were included in the analysis. For each male–female dyad in the two study groups ($n = 23$), we calculated an average daily affiliation rate for 4 weeks preceding (the ''before'' category) and 4 weeks following (the ''after'' category) the infant's birth. We also combined the average daily affiliation rates of all males residing in each group for each group female and examined how these changed after infant births. It should be noted that one male–female dyad (BB-MZ) from the LV group was not considered in our analyses. Data collection on MZ did not begin until he was elevated to full adult status on March 19. The female BB gave birth to her infant before March 19 and as such there is no ''before'' data available. This second data set was examined using a repeated measures ANOVA in SPSS to test whether the birth of an infant lead to any significant changes in affiliation patterns. We used the same test to examine the influence of female rank on affiliation patterns after the birth of an infant. In this case, we compared the affiliation rates in the alpha-female/all-male category (see Table I) with the rates from the other females/all-male category within the same group. Females were assigned a rank of either alpha or beta based on ad libitum observation of female feeding priority and instances of agonism and submission within each group. Our rank assignments were supported by concurrently collected data on females by other researchers (Mackenzie Bergstrom, personal communication). Next, we used a repeated measures ANOVA to determine if group membership had an effect on male–female affiliation rates after the infant births. We did this by comparing the mean affiliation rates of the female/all-male category in GC with those of LV, before and after infant births. Finally, we used the same test to determine if infant sex affected the male–female affiliation rates. This was done by comparing means of affiliation rates for the female/all-male categories of females with male infants with those of females with female infants, before and after births.

RESULTS

Dyadic affiliation rates ranged from a low of 0.1% to a high of 11% during the before period and 0.4% and 14.1% during the after period. Fourteen of 23 male–female dyads displayed an increase in daily average affiliation, eight displayed a decrease and one displayed no change after the birth of an infant (Table I). Combining all group male affiliation data with each group female showed that the affiliation rates increased during the ''after'' period for five of the eight females, while they decreased for three of the females. The change in affiliation patterns before

TABLE I. Comparative Affiliation Rates (%) for Male-Female Dyads ($n = 23$) Before and After Infant Births

Group	Dyad	Before	After	Change
GC	FL-BG*	0.1	3.2	+3.1
GC	FL-AD	1.1	0.9	−0.3
GC	FL-MM	3.1	8.3	+5.2
GC	FL-ALL MALES	1.5	3.8	+2.3
GC	LL-BG*	1.8	5.4	+3.6
GC	LL-AD	3.3	4.6	+1.3
GC	LL-MM	1.9	6.7	+4.7
GC	LL-ALL MALES	2.4	5.7	+3.3
GC	MV-BG*	3.3	4.1	+0.8
GC	MV-AD	2.7	13.8	+11.1
GC	MV-MM	0.5	6.0	+5.4
GC	MV-ALL MALES	2.3	8.1	+5.8
GC	**MX-BG*	9.3	14.1	+4.8
GC	**MX-AD	10.2	4.3	−5.9
GC	**MX-MM	2.7	1.0	−1.7
GC	**MX-ALL MALES	7.0	6.9	−0.2
GC	RM-BG*	7.2	4.4	−2.9
GC	RM-AD	0.7	7.9	+7.2
GC	RM-MM	1.8	3.8	+2.1
GC	RM-ALL MALES	3.1	5.2	+2.1
LV	BB-CY*	1.2	6.0	+4.9
LV	BB-WW	0.9	9.0	+8.1
LV	BB-ALL MALES	1.1	7.5	+6.4
LV	**KL-CY*	8.1	3.7	−4.4
LV	**KL-WW	3.4	3.0	−0.4
LV	**KL-MZ	3.9	5.1	+1.3
LV	**KL-ALL MALES	5.3	4.1	−1.2
LV	DL-CY*	11.0	4.6	−6.4
LV	DL-WW	5.4	0.4	−5.0
LV	DL-MZ	3.0	3.0	0.0
LV	DL-ALL MALES	6.5	2.7	−3.8

Alpha male indicated by "*", alpha female by "**", an increase in affiliation by "+", and a decrease in affiliation by "−".

and after the birth of an infant was nonsignificant ($F = 2.262$, df = 1, $P < 0.176$). Next, we examined if group composition, female rank and infant sex had any effect on the changes in affiliation patterns after the infant births. Results remained nonsignificant with respect to group composition ($F = 0.729$, df = 1, $P < 0.429$) and female rank ($F = 1.550$, df = 1, $P < 0.260$), but infant sex had a significant effect on the affiliation rates between males and females ($F = 10.020$, df = 1, $P < 0.019$). Group males increased their affiliation with females that gave birth to male infants ($n = 4$), and decreased their affiliation with three out of four females that gave birth to female infants (Fig. 1). Each of the females who gave birth to the first infant in their group, both of which were male infants, experienced the most pronounced increase in affiliation rates with group males.

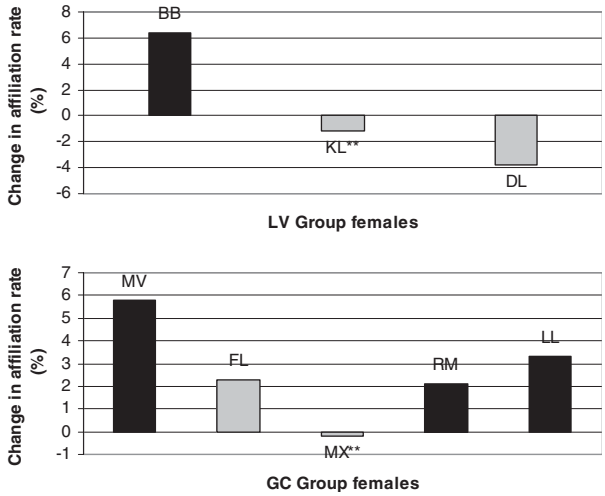

Fig. 1. Changes in affiliation rates (%) between adult females and all adult males after the birth of an infant in each group. Alpha female is indicated by "**", females with male infants are denoted by black bars, and females with female infants are shown by gray bars. Females are listed left to right in the order in which they gave birth. For example, in GC group, MV was the first to give birth, then FL, then MX, and so on.

DISCUSSION

Our study did not support the idea that, overall, the birth of an infant significantly alters male and female affiliative interactions. Roughly, half of the male–female dyads displayed an increase in affiliation after the birth of an infant while the other half displayed a decrease. Neither the rank of the mother nor group membership significantly influenced the attention that males gave to a female and her new infant. However, our finding that adult males were significantly more interested in females with male infants supports the findings from other species [*M. sylvanus*: Paul et al., 1996; *M. thibetana*: Ogawa, 1995; Zhao, 1996]. It is possible that birth order may explain this increase in affiliation because the first infants born into each study group were male and their mothers experienced the greatest increase in their affiliation rates. However, upon examination of the pattern of change in affiliation (see Fig. 1) for our largest study group (GC), birth order does not appear to be playing a role. It will be necessary to explore this possible effect with a larger data set. While our results are still preliminary, it is possible that the interest adult males have in male infants serves as an important start in their socialization process. In white-faced capuchins, the formation of cooperative bonds among males is important for group defense and establishing and maintaining group membership [Perry, 1998; Jack, 2003]. Jack and Fedigan [2004a,b] suggest that in this species, the formation and maintenance of cooperative bonds among group males are possible because of the high frequency of parallel dispersal (dispersing with group mates or into groups containing familiar individuals). Male white-faced capuchins emigrate from their natal group at four years of age on average, but have been documented to disperse as early as 20 months. This primary dispersal is often triggered by

the departure of adult males from the group, i.e. young males will follow older males when they disperse [Jack and Fedigan, 2004a]. Given that the average tenure length for adult males is four years [Jack and Fedigan, 2004b], it is possible that the infant to whom an adult male has bonded may indeed become a future dispersal partner. These males may either disperse together or the maturing natal male may later immigrate into the group containing the familiar older male. The results presented here provide the first tantalizing evidence that the formation of bonds between males and potential future dispersal partners may begin at a very young age.

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