

# SUCCESSFUL MOTHER- AND GROUP-REARING OF A NEWBORN CAPUCHIN MONKEY (*CEBUS CAPUCINUS*) FOLLOWING EMERGENCY MAJOR SURGERY

J R Anderson<sup>1†</sup>, E André<sup>2</sup> and P Wolf<sup>3</sup>

<sup>1</sup> Laboratoire de Psychophysiologie, Université Louis Pasteur (CNRS URA 1295), 67000 Strasbourg, France

<sup>2</sup> Centre de Primatologie, Université Louis Pasteur, 67207 Niederhausbergen, France

<sup>3</sup> Fondation Transplantation, 67000 Strasbourg, France

† Contact for correspondence and requests for reprints: Department of Psychology, University of Stirling, FK9 4LA, Scotland

## Abstract

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*During capture, in order to separate him from a possessive adult female and return him to his mother, a newborn male in a laboratory group of Cebus capucinus monkeys was found to have a seriously infected compound fracture of the humerus associated with a deep and extensive slash wound. Amputation of the affected limb was deemed necessary. Shortly after surgery the newborn was returned to his mother, in isolation from the group, with periodic removal for post-surgical care. Three weeks later the mother-newborn pair was returned to the social group and no further intervention occurred. Regular observations revealed mutual behavioural adjustments to the handicap by the mother and newborn. Compared to a normal age-mate, the amputee received more positive social attention from the mother and other group-members. Despite his showing delays in locomotor and manipulatory activities, the handicapped infant showed good behavioural progress. Early resocialization thus appears feasible following emergency surgery in newborn primates.*

**Keywords:** *animal welfare, behaviour, development, maternal behaviour, rearing, surgery*

## Introduction

Early veterinary intervention is sometimes essential for the survival of captive newborn primates. Cases of an injured offspring being reunited with the mother after early treatment include an infant gorilla with a broken arm (after three months, Nadler & Green 1975), and a newborn lion-tailed macaque treated for an eye infection (after five months, Meyer & Wilcox 1982). However, with the exception of supplementary feeding techniques (Chamove & Anderson 1982; Fontaine 1979), early intervention usually involves separation of the newborn from the mother and subsequent hand-rearing.

It has become widely recognized that all possible efforts should be made to achieve species-appropriate social rearing for captive non-human primates (International Primatological Society 1988; Visalberghi & Anderson 1993). Furthermore, it is recommended that non-human primates should be returned to their companions as soon as possible following surgery (Sainsbury 1991). Here we describe a case of emergency, major surgical intervention (amputation of an arm) on an injured newborn capuchin monkey, followed by the early return to his mother and subsequent mother- and group-rearing. Although he showed

delayed motor development, the infant showed steady social and non-social behavioural progress, indicating that even radical veterinary treatment of newborn primates need not necessitate long-term social separation.

## Methods and Results

### *Case history*

The subject 'Ambi' was born into a captive group of *Cebus capucinus*. The four adult males and three adult females of the group were all wild-born and wild-reared and had been established as a captive group at the Centre de Primatologie in Strasbourg for two years. The group also contained a juvenile female, born in captivity to the dominant adult female. The monkeys were housed in a spacious indoor/outdoor structure consisting of three interconnecting enclosures with numerous elevated ledges and runways, and a variety of inanimate objects. During the winter, ie for most of the duration of the observations reported here, the group was confined to a heated, two-roomed indoor area of approximately 60m<sup>2</sup>. Food (commercial primate pellets) and water were available *ad libitum*, and fresh fruits and vegetables were given twice weekly.

On 19 January 1992 the dominant female gave birth to a female 'Eprou'. Ambi was born to the second-ranking female two days later. This adult female had not previously given birth in captivity, but we are unable to say whether she had done so in the wild. On 22 January the dominant female was observed to carry both offspring. Ambi's mother remained near the dominant female but made no concerted attempt to recover her newborn. On the following day the dominant female was captured using a net. Ambi was taken from her, found to be in good health, and returned to his mother in the group. The dominant female and her infant remained separated from the group for four days and were then returned. The reunion took place without notable incident. One week later, however, the dominant female was again carrying both offspring. After two days she was captured again and Ambi was removed with a view to returning him to his mother. During examination this time, however, Ambi was found to be injured: he had a compound, irregular fracture of the proximal left humerus, associated with what appeared to be an infected bite wound. The wound was so extensive that the arm was almost half-severed. The extent of the injury and infection, and Ambi's generally weak state indicated immediate amputation of the arm as the only possible means of saving his life.

### *Surgery*

Ambi was semi-comatose and weighed 260g. Surgery (performed by PW on 8 February) was carried out under ketamine anaesthesia (20mg kg<sup>-1</sup>), and consisted of sub-epiphysial removal of the remaining connecting tissue of the affected limb, with excision of surrounding muscle until vascularized tissue was obtained. The bone, already irregularly severed at the time of the injury, was evened and smoothed with a xyster and cleaned with antiseptic solution. The wound was sutured using nylon 2/0 sutures (Vicryl). Amoxicilline was administered as a prophylactic antibiotic.

### *Intensive care and return to the mother*

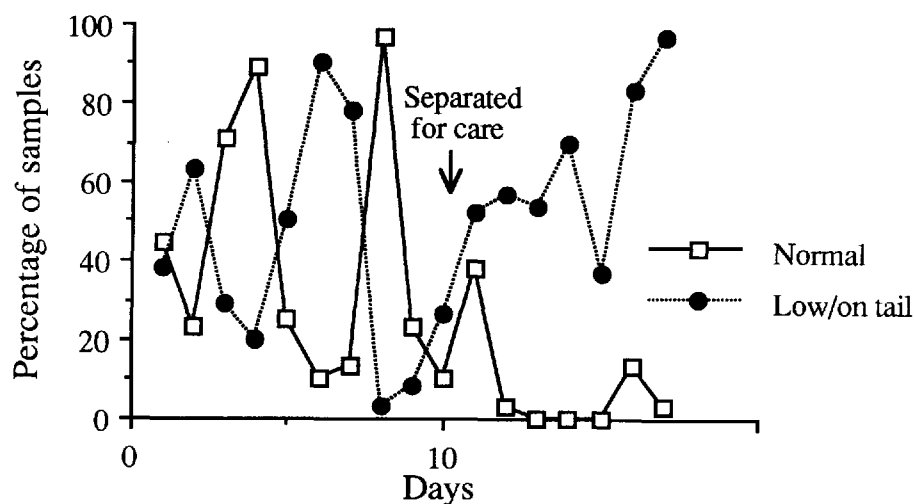
For three days following surgery, Ambi was kept in an incubator at 30°C and 70–80 per cent humidity, and fed 5–8ml of milk for human neonates ('Guigoz 1er âge') from a syringe every

three hours. On February 10 at 1600h he was returned to his mother in an individual cage in the indoor area, near to and in full view of the rest of the group. Every 2–3 days until 21 February, the mother was lightly anaesthetized (ketamine, 10mg kg<sup>-1</sup> intramuscular) and Ambi was removed for 4–5 hours for weighing, supplementary feeding with multivitamin-enriched milk containing an amoxicillin and clavulanic acid antibiotic. The stump wound was treated topically with a neomycin sulphate spray ('Stol 5', Rhône Mérieux, Lyon).

#### *Behavioural observations during intensive care*

Observations on Ambi were conducted on 17 days between 11 February and 3 March, while he was with the mother in the individual cage. Observations lasted between 30 and 90min and took place before the mother was anaesthetized on treatment days (see above). At the end of every minute, Ambi's position (eg normal position high up on the mother's back, abnormally low down on her back, on her abdomen) and the number of one-minute intervals during which Ambi was seen to suckle, or the mother was seen to dispense care to Ambi was recorded.

Figure 1 shows that Ambi's position on his mother's back alternated between 'normal' and 'abnormally low' across the first 10 days of the intensive care period. Both Ambi and his mother were responsible for his correct re-positioning whenever he slipped from her back on to her left flank because of his missing arm. Clinging to the mother's side or haunch occurred on 17 per cent of point samples during this period. The mother usually used her elbow to lever him back into a more normal position, but Ambi also frequently pulled himself back up. Occasionally he almost fell off the mother during sleep, and she would push him back into position. She also pushed his head up when it drooped over her left shoulder.



**Figure 1** Position of the operated newborn on the mother's back during the intensive care period.

Ventro-ventral contact without nursing accounted for 2.5 per cent of samples. Although infrequent, touching and grooming of Ambi by the mother was observed from the first day,

with occasional attention being given to his sutured arm-stump (touching, licking). She also occasionally supported him with one hand when she moved and during nursing. Nursing bouts were generally very short and frequently interrupted by the mother, who was clearly agitated by her separation from the social group. She frequently pushed Ambi away from the nipple or started to move just after he had transferred from her back on to her abdomen. However, when sitting she also sometimes pulled him from her back on to her abdomen and spread her arms to facilitate suckling. Observations of videotapes indicated that Ambi fed more frequently in the absence of the observer, but quantitative data were not collected.

The 'separated for care' arrow in Figure 1 refers to 22 February, when Ambi was discovered at 0915h lying on the floor of the cage, cold and distressed, the mother making no attempts to retrieve him. He was removed to an incubator where he received vitamin-enriched milk and antibiotic. Appearing more vigorous, he was replaced with the mother at 1100h, but removed again at 1300h after falling to the floor of the cage without being retrieved by the mother. After several more feeds, at 1800h a final reunion with the mother was attempted; this time she accepted him. When observed at 2200h the mother was cradling Ambi, who was suckling. The reason for Ambi's weak condition on this day remains unknown, but it may be related to the fact that on 21 February he suckled during 67 per cent of observation intervals, compared to an average of only 8 per cent during the previous nine days.

It was decided to stop the separations for treatment because Ambi's wound appeared to be healing steadily and because the mother's caretaking appeared compromised by the stresses of separation from the group, confinement in a small cage and periodic anaesthesia followed by separation then reunion with her offspring.

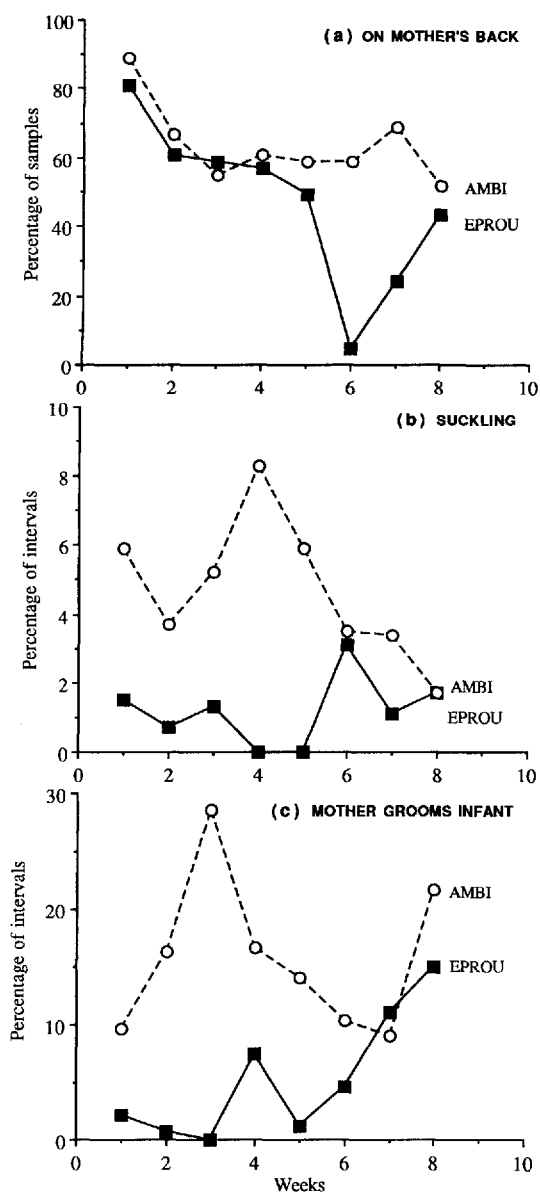
Observations between 23 February and 3 March revealed a steady improvement in Ambi's general condition, in the absence of any further human intervention. Although nursing was observed in only 2–3 per cent of one-minute intervals, videotapes showed that the real frequency was considerably higher. During this period the position 'Low/on tail' predominated (Figure 1). This reflects a mutual behavioural adjustment by Ambi and the mother whereby the former straddled the base of the mother's tail while she maintained the tail in an arched position. Overall, the mother's caretaking appeared competent but her general behaviour continued to deteriorate, with stereotyped locomotion, hair-plucking and eating, and non-ingestive food mouthing becoming increasingly frequent. For these reasons it was decided to return Ambi and the mother to the group.

### ***Return to the group***

The pair was returned to their group on 3 March. Observations were conducted almost daily, with the experimenter sitting passively either inside the larger room of the indoor area from where he could see into both rooms, or else outside on sunny days. Starting on 4 March, over an eight-week period both Ambi and the normal age-mate Eprou were observed as focal animals, using a combination of instantaneous and one-zero sampling for up to 90min per day, divided equally between the two subjects. Each observation period lasted between 10 and 30min, and was immediately followed by an observation of identical duration on the other subject. Observations were approximately equally distributed across the morning and afternoon. Behavioural categories included infant posture, manipulation and locomotion. The identity of other group-members interacting with the infants was recorded.

**Mother-infant relationship**

The stereotypies previously shown by Ambi's mother during confinement to the small cage throughout the intensive care period, ceased totally upon her reunion with the group and her maternal performance was excellent. Figure 2 shows the incidence of three behaviours reflecting the mother-infant relationship during the eight-week observation period.



**Figure 2** Comparison of mother-related behaviours in the operated and the control infant.

Both infants spent progressively less time on their mother's back, but the overall rate of decline was lower for Ambi than for Eprou (Figure 2a). Ambi also continued to ride low down the mother's back on the base of her tail but this position, always extremely rare in Eprou, had ceased by the end of the eight weeks. Occasionally Ambi almost fell off when the mother moved suddenly, but she would support him with one hand and he would right himself. The mother also continued to push his head up if it drooped too low across her shoulder while he slept.

There were no consistent differences between the two infants in the time spent clinging to the mother's abdomen without suckling. However, Ambi suckled considerably more frequently than Eprou, although the difference diminished towards the end of the eight-week period (Figure 2b). A similar pattern was observed for infant-directed grooming by the mother (Figure 2c).

### ***Behavioural development***

Ambi was clearly retarded in terms of manipulatory and motor activities, and in some active social behaviours. Table 1 gives the mean weekly scores for four behavioural categories in these domains. Reaching towards and contacting other individuals in the group (behaviour 'Social Touch' in Table 1) appeared later in Ambi than in Eprou, and at generally lower frequencies. In later weeks, such overtures as did occur sometimes resulted in brief bouts of play (see below).

Manipulation of inanimate objects appeared less affected (behaviour 'Object Manip.' in Table 1); in both subjects this activity was infrequent during the first four weeks of observation, but then increased markedly. At the end of the observations, however, Ambi's environmental manipulation score was only a quarter of that of Eprou.

**Table 1** Comparison of four behavioural categories reflecting manipulatory and locomotor development in the operated and the control infant.

Behaviour	Subject	Weeks							
		1	2	3	4	5	6	7	8
<i>Social</i> <sup>1</sup> <i>Touch</i>	Ambi	0.7	4.4	3.9	2.5	9.4	12.1	4.5	11.7
	Eprou	5.9	11.1	0.0	4.2	7.1	0.0	14.4	15.0
<i>Object</i> <sup>1</sup> <i>Manip.</i>	Ambi	0.0	1.5	2.6	10.8	9.4	10.3	20.2	6.7
	Eprou	1.5	0.7	1.3	12.5	7.1	0.0	22.2	28.3
<i>Off</i> <sup>2</sup> <i>Contact</i>	Ambi	0.0	0.0	0.0	0.0	1.2	6.9	4.5	3.3
	Eprou	2.2	12.6	1.3	12.5	1.2	0.0	12.2	8.3
<i>Off</i> <sup>2</sup>	Ambi	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.0
	Eprou	1.5	3.0	2.5	4.2	2.4	0.0	31.1	35.0

<sup>1</sup> Percentage of intervals, one-zero sampling

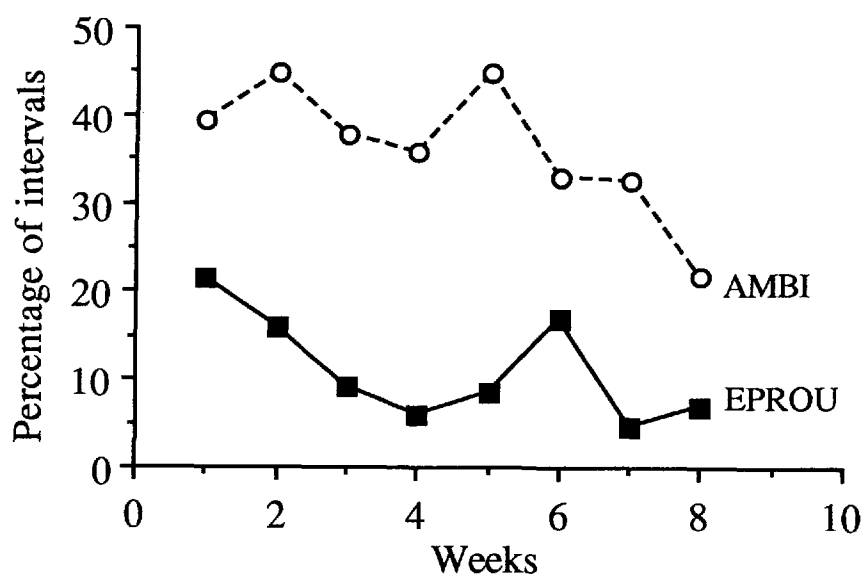
<sup>2</sup> Percentage of point samples, instantaneous sampling

From the first week of observations, Eprou frequently clambered around on her mother, often raising herself into a bipedal position or walking unsteadily on her mother's back while her mother was sitting still or lying down. The onset of this behaviour was delayed by one week in Ambi.

Table 1 also shows that Eprou was relatively advanced in exploration of the environment while maintaining contact with her mother (behaviour 'Off/Contact'), which was also observed from the first week of observations. In contrast, Ambi did not leave the mother even partially until the fifth week, and the behaviour generally remained less frequent than in Eprou. The differences between the infants in time spent fully off the mother were dramatic. Eprou was recorded off the mother from the earliest observations, and was off her for about one third of the time in the final two weeks. In contrast, Ambi remained in contact with his mother until the seventh week and even after it first appeared, time spent off the mother was minimal.

#### *Interactions with other group-members*

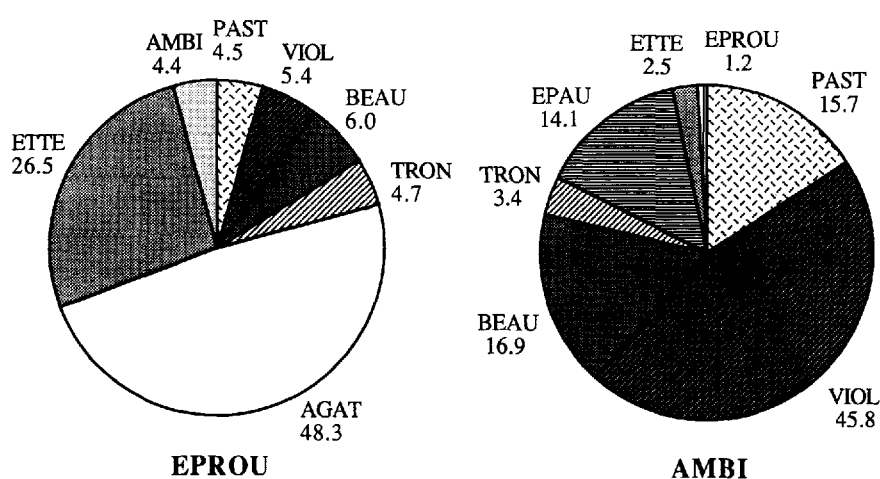
The most striking differences between the two infants concerned social behaviours directed towards them by members of the group other than their mother. Infant-directed behaviours included close visual inspection, sniffing, gentle mouthing, licking and manipulation, and especially grooming. As can be seen in Figure 3, Ambi received much more non-maternal social behaviour than Eprou. In both infants the amount of social behaviour received declined over time but the decline was less marked in Ambi. Much of the grooming he received occurred while his mother was lying down, a behaviour which she engaged in frequently presumably because of fatigue due to carrying her growing but developmentally delayed infant for unusually long periods of time.



**Figure 3** Comparison of the total amount of positive, non-maternal social behaviour received by the operated and the control infant.



Not only the total amount of social behaviour received, but also its distribution differed for the two infants. For example almost all grooming of Eprou, other than by the mother, was performed by the mother of Ambi. In contrast, Ambi was groomed by most other group-members throughout the eight-week study period. Figure 4 illustrates the percentage of positive social behaviour directed towards the infants by individuals in the group other than the mother. Eprou interacted especially with 'Agat', the mother of Ambi and with her juvenile sister 'Ette'. Ambi's principal social partner, in contrast, was the second-ranking adult male of the group 'Viol'. Eprou's mother 'Epau', and two other adult males each directed 14–17 per cent of all positive social responses towards the handicapped infant.



**Figure 4** Pie charts showing the percentages of total social responses directed towards the operated and the control infant by group members other than the mother. Key to individuals: Agat – second-ranking adult female, Ambi's mother; Ambi – the handicapped male infant; Beau – adult male; Epau – dominant adult female, Eprou's mother; Ette – juvenile female, Eprou's sister; Past – dominant adult male; Tron – adult male; Viol – second-ranking adult male.

Ambi showed less social play than Eprou, although there was no difference during the final week. Also, whereas Eprou sometimes clambered on to another individual from the first week of observations and was occasionally carried by them for brief periods, such social clambering was not observed in Ambi. Indeed it was not until the seventh week that he was seen being carried briefly by another individual, first by the dominant male, then by the second-ranking male (in week eight).

### Discussion

This case study shows that it is feasible to return a newborn monkey for rearing by its mother and then return the mother-infant pair to their social group following a major surgical intervention on the newborn. If successful, such an early re-socialization would appear



beneficial for the animal's subsequent development. Indeed, the difficulties encountered during the intensive care period illustrate this point. The mother was highly stressed by her separation from the group, and her maternal behaviour appeared to be further adversely affected by regular light anaesthesia and removal of the newborn for post-surgical treatment. Furthermore, informal observations of videotapes indicated that her maternal performance was less affected when humans were absent (Candland *et al* 1972). We cannot say whether the newborn would have survived if he and the mother had been returned to the group much sooner, but this seems doubtful given his weak state and the possibility of his sustaining further injury in the group.

Returning the post-surgical newborn for mother- and group-rearing is clearly not without potential risks, including medical complication or infection as well as further stress or injury if recapture proves necessary. Also, if the newborn has received injurious abuse in the group then the possibility exists of further maltreatment; repeated abuse of the same infant following medical treatment has been reported in macaques (Erwin 1983). In fact two new, though superficial wounds, appeared on the newborn in the two weeks following return to the group: one on the neck, the other on the scalp. However, as no aggression towards the infant was ever seen, and the mother kept the wounds clean by grooming (contributing in part to the high mother-infant grooming score), the social reintegration was pursued with success.

In situations such as the one described in the present report, the following management decision has to be made: should a newborn be separated from its mother and the group for (possibly long-term) treatment while the mother remains in the group, or should early intervention by isolating the mother-infant pair be attempted, with the aim of subsequent social housing? The latter course of action may be highly stressful for the mother, leading to compromised maternal performance. It is even possible that the odour from antiseptic/antibiotic agents used on the newborn may induce rejection by the mother (Haigh 1978). On the other hand, separating the injured newborn from the mother and the group is also likely to be stressful for the mother, at least temporarily, and the likelihood of deleterious behavioural effects due to social deprivation in the newborn increase. It is clear that, as with other types of husbandry decisions in which the social environment is involved (Visalberghi & Anderson 1993), the case for attempting social rearing of recently operated newborns will vary across circumstances; our view is that, where possible, the attempt should be made.

In addition to its implications for primate husbandry, the present case study contributes useful data on behavioural development. Although some information is available for the congeneric species *C. apella* and *C. olivaceus* (Welker *et al* 1987; Escobar-Paramo 1989a, b; Fragaszy 1990; O'Brien & Robinson 1991), virtually no information exists regarding social and nonsocial development in *C. capucinus*. Thus, we can now affirm that infant-carrying by individuals other than the mother exists in this species as in other capuchin species, but it appears to be more common in adult male *C. capucinus* than in other male capuchins. Also, judging from the behaviour of the normal female infant studied here, dismounting from the mother may occur earlier in *C. capucinus* (at around six weeks) than in *C. apella* (eight to nine weeks) (Fragaszy 1990; Fragaszy *et al* 1991).

The present case study also illustrates compensatory responding by a non-human primate mother to her handicapped offspring, complementing descriptions in macaque monkeys (Berkson 1977; Fedigan & Fedigan 1977). In particular, Ambi's mother adjusted her posture so that the newborn could securely straddle the base of her tail; in normal *C. capucinus* such

tail-base riding usually appears later (Oppenheimer 1973). She also frequently repositioned him (or his head) after he slipped into an abnormal position and groomed her infant more than did the mother of the normal infant, but this was at least partly due to the appearance of new wounds, as in capuchin monkeys, like other primates, wounds attract grooming (Ritchie & Fragaszy 1988; Dittus & Ratnayeke 1989).

Finally, the increased social attention received by the handicapped infant is interesting from the perspective of current theorizing about the evolutionary origins of caretaking behaviour towards injured individuals (Dettwyler 1991; Silk 1992). We cannot be sure about the precise motivations underlying the particular attention paid to the handicapped infant by his mother and other group-members. For example although the mother frequently adjusted her posture and behaviour to accommodate her offspring's reduced ability to maintain a normal position, this may be interpreted as a self-centred attempt to reduce discomfort rather than a compassionate response to facilitate the infant's posture. Also, more data are required to clarify whether normal male infants are more likely than female infants to be carried by other group-members, or whether the responses observed here are indeed examples of special compensatory care. The answer to this question may become clearer once the handicapped infant eventually starts to show independent locomotion, with its associated risks of falls and of being stranded.

#### *Animal welfare implications*

One advantage of captivity is that life-threatening illnesses and injuries can be treated promptly and the animal's life therefore preserved. In the case of non-human primates, however, major veterinary treatment may be seen to be incompatible with subsequent social housing and thus the individual's long-term welfare may be compromised. The successful outcome of the emergency intervention described here indicates that the objective of social rearing may be attainable even when a major procedure such as limb amputation is required.

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