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# Infant Care in a Family of Siamangs (*Hylobates syndactylus*) With Twin Offspring at Berlin Zoo

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Infant-carrying in a family group of siamangs with twin offspring was observed during a 2-week period. The twins were about 11 months old at the time of the study. One or both twins were usually carried by their father, but hardly ever by their mother. A considerable amount of infant-carrying was also contributed by the twins' juvenile brother. Helping behavior (defined as the care of offspring by individuals who are not their parents) is not normally known to occur in siamangs or other hylobatids. We suggest that the presence of multiple offspring may have facilitated the occurrence of infant-carrying exhibited by a nonparental family member. This finding may point to one of the mechanisms influencing the occurrence of helping behavior in general.

**Key words:** paternal care, helping behavior; multiple offspring; gibbon

## INTRODUCTION

Gibbons (Hylobatidae) are distributed in Southeast Asian rain forests [Marshall and Sugardjito, 1986]. Field studies, now covering most gibbon species [Chivers, 1984], have revealed that virtually all live in monogamous family groups occupying permanent, physically- and vocally-defended territories. In addition to the adult pair, family groups usually include one to four offspring; the mean group size is about four individuals. The pair produces single offspring with an interbirth interval of about 2–3 years in the wild; the young are thought to leave their natal group at an age of about 7–8 years [Gittins and Raemaekers, 1980; Leighton, 1987].

Among hylobatids, the siamang (*Hylobates syndactylus*) appears to exhibit an exceptional amount of active male participation in infant care: Several siamang fathers, both in the wild and in captivity, have been repeatedly observed to carry their offspring at some time during ontogeny, usually several months after birth and es

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Fig. 1. The female siamang "Siam" with her twin offspring on 8 January 1987, at the age of 25 weeks. Photograph by Mr. Fred Kleinschmidt, © Archiv Zoo Berlin. Printed with permission.

pecially during the second year [Alberts, 1987; Chivers, 1972, 1974]. In contrast, infants of other gibbon species are usually carried by their mothers [Gittins and Raemaekers, 1980], with only sporadic exceptions being known from captive animals [Fischer and Geissmann, 1990].

Paternal care among primates is particularly prominent in some New World primates such as two genera of cebid monkey – owl monkeys (*Aotus*) and titi monkeys (*Callicebus*) [Robinson et al., 1987], and the much smaller callitrichid monkeys [Goldizen, 1987]. The callitrichids are exceptional in yet another aspect of their reproductive behavior: Whereas all other members of the haplorhine primates (Old and New World monkeys, apes, and humans) usually give birth to single offspring [Eisenberg, 1978; Geissmann, 1989, 1990], callitrichids as a rule give birth to twins [Eisenberg, 1978]. In these primates, the father usually has to carry two infants simultaneously, but nonreproductive group members often provide substantial amounts of infant-carrying, too [Goldizen, 1987].

Siamangs, like other gibbons, only rarely give birth to twins [Geissmann, 1989, 1990], and apparently no observations on twins reared in their natal group have been published to date. In 1986, the female siamang at the Berlin Zoo gave birth to male twins (Fig. 1). The infants appeared to be healthy and were left with their family group, consisting of the parents and a juvenile male. This represented a unique

opportunity to observe the amount of infant care provided by the various family members. At least in captivity, some siamang fathers do not appear to participate in carrying their offspring [Fischer and Geissmann, 1990]. The male at the Berlin Zoo, however, is well known for this behavior (B. Blaszkiewicz, U. Hollihn, and R. Opitz, personal communication to T.G.). We wished to establish whether the unusual presence of twin infants would influence the amount of carrying behavior exhibited by the group members.

This brief study attempted to answer the following questions: (1) Do both parents participate in carrying the twin infants, and if so, to what extent? (2) Does the juvenile male in the group participate in carrying its twin siblings?

## **MATERIALS AND METHODS**

### **Animals**

The family group studied had the following composition (age classes for siamangs according to Gittins and Raemaekers [1980, p. 70]):

“Sumo”, adult male, in Berlin since 23 September 1962, an infant on arrival; at least 25 years old at the time of this study.

“Siam”, adult female, born on 22 February 1976 at the Tierpark Hellabrunn in Munich; in Berlin and together with “Sumo” since 27 October 1980; 11.3 years old at the time of this study.

“Simon”, juvenile male, born on 11 September 1984; 2.7 years old at the time of this study.

“Sakan” and “Sakon”, twin infants, males, born on 17 July 1986; 0.9 years old at the time of this study.

All offspring born to this pair were reared by their parents. The first offspring of the adult pair, a male (“Otto”), was born on 27 June 1982, and was sold on 13 May 1985. After the birth of the twins, the previous offspring “Simon,” still being suckled, was removed from the group in order to relieve the mother. This led to marked restlessness in all animals, and the juvenile male was reintroduced into the group after some hours [Klös, 1987; H. Frädrieh, personal communication to T.F.D.]. It is unknown whether this event affected interactions in the group.

### **Housing**

The family group was kept in an indoor / outdoor cage, each part with a base area of 20 m<sup>2</sup> and a height of about 4 m. Both indoor and outdoor parts had horizontal platforms, ropes, and chains. The ceiling and the front wall of the outdoor cage consisted of wire mesh.

### **Observation Time**

Behavioral observations were carried out by two of us (T.F.D. and E.Z.) between 9 and 20 June 1987. During this period, the animals were observed in the afternoon between 1230 and 1700. Between 13 and 20 June, additional observations were carried out during the morning from 0900 (opening time of the zoo) onwards, in order to cover the siamangs’ activity period more effectively. The individual durations of observation were: “Sumo” = 255 min, “Siam” = 255 min, “Simon” = 285 min, and both twins together = 475 min. The total duration of observation amounted to 21 hr 10 min.

**TABLE 1. Carrying, occurrence in percentage of 30-second point samples**

	Focal animal		
	Adult female	Adult male	Juvenile male
Juv. male	0	0	–
One twin	1.8	10.9	4.7
Both twins	2.0	29.6	0
Total	2.8	40.5	4.7
Number of 30-sec point samples	510	510	570

## Method

The siamang group was observed either by one observer or by two observers simultaneously. All animals were in sight at any given time. Observations were made alternatively on focal animals during 5-min sample periods. The order of observation of group members was altered at random (by drawing lots). Two behavioral variables were recorded: (1) carrying = one individual, while stationary or while moving, providing weight-supporting contact to one or two other animals, and (2) being carried = one individual being carried by another. The behavioral data were collected with the point sampling method (= instantaneous sampling): The two behavioral variables were recorded every 30 sec and their number of occurrence was expressed as percentage of the total number of sample points [Altmann, 1974; Dunbar, 1976; Martin and Bateson, 1986].

Each twin served as focal animal about equally long as the other individuals sampled. Because we were not always able to identify a twin individually during the two weeks of this study, the results for single twins were combined and then divided by two in order to represent the “average” twin. However, it was specifically recorded whether one or two twins were being carried simultaneously by one other group member.

For comparison, C. Weber and I. Willer made their unpublished data later collected on the same siamang group available to us. Their observations were carried out between 27 November and 7 December 1989, about 2.5 years after our own observations. At that time, the siamang group included the breeding pair, the twins (now juveniles of 3.4 years of age) and an infant of 1.1 years (born on 5 November 1988). The animals were observed daily between 1100 and 1530. The infant served as focal animal for a total 300 min. Weber and Willer used the same observation techniques as in our study, but they only recorded the behavioral variable “being carried” (i.e., omitting “carrying”).

## RESULTS

Tables 1 and 2 list numbers of occurrences of each behavioral variable in percentage of 30-sec point samples. These data show that it is the adult male that usually carried the infants, sometimes both together. The mother of the twins, on the other hand, was only rarely observed to carry an infant, and rarely two at the same time. The juvenile male offspring of the pair also participated in carrying its younger siblings, even more frequently than the mother of the twins. The juvenile was, however, not observed to carry both twins at the same time. In addition, the juvenile

**TABLE 2. Being carried, occurrence in percentage of 30-second point samples**

	Focal animal	
	Juvenile male	Twin (mean)
Carrier		
Ad. female	0	7.4
Ad. male	0.4	28.9
Juv. male	–	4.8
Total	0.4	41.2
Number of 30-sec point samples	570	950

was also carried by the adult male, but this occurred only rarely and only in the latter part of the daily observation period (after 1530).

The frequencies in carrying either one or both infants (unspecified), just one infant, or definitely two infants, were compared separately with Chi-square tests. The adult male was more frequently observed to carry infants (all three specifications defined above) than either the adult female or the juvenile male; the differences are significant for both comparisons ( $P < 0.001$ ). The juvenile male, too, was more frequently observed to carry infants than the adult female ( $P \leq 0.05$ ), except for the frequency of carrying two infants simultaneously. The juvenile was never observed to carry two infants, but the adult female was recorded to do so; the difference between the animals is statistically significant ( $P < 0.001$ ).

If the data collected from 0900 to 1530 and those from 1530 to 1700 are analysed separately, it becomes clear that *all* infant-carrying by the adult female was observed after 1530, except one instance (one 30-sec point sample) where the female was found to carry one of the twins. Infant carrying by the mother increased from 1530 to 1700 (i.e. at the end of the simangs' activity period), probably because the animals then began to assume the grouping pattern for sleeping (see below). Before 1530, infant-carrying (all three specifications defined above) was observed most frequently in the adult male, *less* frequently in the juvenile male, and *least* frequently in the adult female. All pairwise comparisons between these three animals revealed statistically significant differences (point sampling:  $P < 0.001$ ), except for "carrying two infants": This frequency was zero in both the juvenile male and the adult female ( $P > 0.05$ ).

Only rarely was it observed that an infant went to the mother to be suckled during the activity period. It should be noted, however, that after 1700 – i.e. after the end of the simangs' activity period and outside of the actual observation time – it was the mother that took the twins, whereas the father would then assume a position with his arms around the juvenile. Although no observations were made at night, it is likely that this was the grouping the animals maintained while sleeping.

In addition, our data recorded before 1530 can be compared with the unpublished data collected by Weber and Willer about 2.5 years after our own observations (see Material and Methods). During the 300 min the single infant served as the focal animal, it was carried by its father in 29.3% of the 30-sec point samples. In contrast, the infant was not observed being carried by the mother or by one of the juvenile twins. (Only once, while the infant was *not* serving as focal animal, was it observed

being carried by one of the twins.) The frequency of being carried by the mother did not differ significantly from our own data (Chi-square test,  $P > 0.1$ ). The frequency of being carried by the father may have been higher than in our study, but the difference was not statistically significant ( $P > 0.05$ ). On the other hand, infant-carrying by a juvenile was observed much less frequently by Weber and Willer than in our study. The difference was statistically significant ( $P < 0.001$ ).

## DISCUSSION

The frequently-quoted observation that siamang fathers tend to carry their infant offspring was confirmed for the captive family group studied here. The adult male carried one or both of his offspring during about 50% of the point samples in which he was the focal animal. Previous observations on captive siamangs indicate that infants are regularly suckled by their mother until about 15 – 19 months of age [Fox, 1977]. The twin infants of the present study, although barely one year old, were only rarely observed being suckled during the activity period. Casual observations made after the end of the siamangs' activity period (i.e. after 17:00h) suggest, however, that the twins probably slept with their mother, while the juvenile male slept with its father.

A remarkable finding of this study was the observation that the juvenile male also repeatedly carried its younger siblings (during about 9% of the point samples). Moreover, the juvenile male was more frequently observed to carry an infant than the mother herself (about 5% of the point samples). The observers gained the impression that the juvenile male and its father were at times actually competing for access to the twins. The juvenile, however, never succeeded in getting both infants simultaneously.

Among primates, helping behavior (defined as the care of offspring by individuals who are not their parents) is especially prominent in callitrichid monkeys [Goldizen, 1987], but appears to be an uncommon behavior in gibbons. Only a few comparable findings have been observed (but not quantified) with gibbons: Chivers and Raemaekers [1980] reported on an adult (about 8 years old) male wild siamang that had been seen carrying its six-month-old sister. The infant had been born five months *after* its father had disappeared (and presumably died) and after its adult brother had assumed the father's role in the family group. Fox [1972, 1977, p. 538], on the basis of a long-term study on a group of captive siamangs, reported that a subadult female (aged about 7 1/2 years), and (later) a subadult male (of about 6 years) both repeatedly carried their respective infant brother. No such behavior was reported, however, for any of the several juvenile animals in the same group. The present observation appears to be the first report on helping behavior displayed by a juvenile hylobatid in an intact family group. The juvenile male of this study was less than 3 years old; and, in further contrast to earlier observations on possible helping behavior in siamangs, this helper was still occasionally carried by his father. The question of whether those earlier observations and the current one have something in common will be considered below.

It is possible that the presence of twins enhanced the occurrence of helping behavior in the present study group: Because siamangs, as a rule, give birth only to single offspring, siamang parents may be predisposed to carry only one offspring at a time. In addition, continually carrying two infants may represent a considerably

physical stress for these animals. Therefore, the parents of twins may be more inclined to be temporarily free of at least one infant than parents of single offspring. Even if the parents are reluctant to let a juvenile member carry an infant, a juvenile could more easily get hold of a twin infant, because the parents may find it more difficult to constantly keep track of two infants simultaneously.

The review presented above revealed two earlier reports on possible helping behavior in siamangs. Those reports and the current one apparently have one context in common: in each family group the breeding male for some reason was not able or not willing to constantly carry the infants: In the first report, the breeding male had disappeared and presumably died [Chivers and Raemaekers, 1980]. The breeding male of the second group did not engage in infant carrying behavior on a regular basis; he was observed to do so in exceptional situations only [Fox, 1972, 1977, pp. 145, 561]. In the present study on a family group with twin infants, the breeding male may have been unable or unwilling at times to carry *two* infants. In all three reports, infants were more frequently “available” to their older siblings for being carried.

On a broader scale, the finding presented above may be relevant to our understanding of helping behavior in general. In the first place, it would appear that carriage of the offspring by individuals other than the mother in siamang is a facultative response. The loading of the mother (e.g., through an additional offspring) may eventually turn out to be one of the mechanisms influencing the occurrence, and possibly the evolution, of helping behavior.

It is conceivable that the natural environment, as compared with the captive context, might constrain helping behavior by juveniles: Presumably there is more danger of injury or death due to animals falling, and the greater time spent in travel in the tree tops could possibly make it less likely that juveniles would perform as much infant carrying in the wild.

As an alternative interpretation, the rarity of helping behavior in the literature on siamangs could be due to the relative scarcity of detailed behavioral data on these animals and/or the difficulty of field observations. On the other hand, the tentative hypothesis presented above is further supported by unpublished observations made by Weber and Willer on the same siamang group, about 2.5 years after our own observations. In addition to the breeding pair, the siamang group then included two juveniles (the twins) and one infant. Thus, the juvenile-infant ratio in the group was exactly inverse to that in our study. During the 300 min the infant served as focal animal, it was carried by its parents at about the same frequency as in our study. Although *two* juveniles were present in the siamang group in 1989, “being carried” by a juvenile was not observed at all. This observation represents a contrast to our study, where only one juvenile was present. This finding appears to support our hypothesis that the presence of two infants in a group may facilitate the occurrence of helping behavior in siamangs. We hope that future twin births in siamangs may stimulate additional observations in order to test our hypothesis.

## CONCLUSIONS

1. A family group of siamangs with twin offspring (of an age of about 11 months) was observed during a 2-week period. One or both twins were usually carried by their father, but hardly ever by their mother. The evidence presented here is

consistent with the notion that the siamang (*Hylobates syndactylus*) appears to exhibit an exceptional amount of active male participation in infant care.

2. A considerable amount of infant-carrying was also contributed by the twins' juvenile brother. Helping behavior (defined as the care of offspring by individuals who are not their parents) is not normally known to occur in siamangs or other hylobatids. The presence of multiple offspring may have facilitated the occurrence of infant-carrying exhibited by a non-parental family member.

3. Loading of the mother may be one of the mechanisms influencing the occurrence (and possibly the evolution) of helping behavior in general.

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## REFERENCES

- Alberts, S. Parental care in captive siamangs (*Hylobates syndactylus*). *ZOO BIOLOGY* 6: 401–406, 1987.
- Altmann, J. Observational study of behavior: Sampling methods. *BEHAVIOUR* 49:227–267, 1974.
- Chivers, D.J. The siamang and the gibbon in the Malay peninsula. Pp. 103–135 in *GIBBON AND SIAMANG, VOL. 1*. Rumbaugh, D.M., ed., Basel, Karger, 1972.
- Chivers, D.J. The siamang in Malaya: A field study of a primate in tropical rain forest. *CONTRIBUTIONS TO PRIMATOLOGY*, Vol 4. Basel, Karger, 1974.
- Chivers, D.J. Feeding and ranging in gibbons: a summary. Pp. 267–281 in *THE LESSER APES. EVOLUTIONARY AND BEHAVIOURAL BIOLOGY*. Preuschoft, H., Chivers, D.J., Brockelman, W.Y., Creel, N., eds. Edinburgh, Edinburgh University Press, 1984.
- Chivers, D.J., Raemaekers J.J. Long-term changes in behaviour. Pp. 209–269 in *MALAYAN FOREST PRIMATES: TEN YEARS' STUDY IN TROPICAL RAIN FOREST*. Chivers, D.J., ed., New York and London, Plenum Press, 1980.
- Dunbar, R.I.M. Some aspects of research design and their implications in the observational study of behaviour. *BEHAVIOUR* 58:78–98, 1976.
- Eisenberg, J.F. Comparative ecology and reproduction of New World monkeys. Pp. 13–22 in *THE BIOLOGY AND CONSERVATION OF THE CALLITRICHIDAE*. Kleiman, D.G., ed., Washington, D.C., Smithsonian Institution Press, 1978.
- Fischer, J.O., Geissmann, T. Group harmony in gibbons: Comparison between white-handed gibbon (*Hylobates lar*) and siamang (*H. syndactylus*). *PRIMATES* 31: 481–494, 1990.
- Fox, G.J. Some comparisons between siamang and gibbon behaviour. *FOLIA PRIMATOLOGICA* 18: 122–139, 1972.
- Fox, G.J. *SOCIAL DYNAMICS IN SIAMANG*. Ph.D. Dissertation, University of Wisconsin, Milwaukee, 1977.
- Geissmann, T. *MULTIPLE BIRTHS IN CATARRHINE MONKEYS AND APES – A REVIEW*. Firenze, Editrice "Il Sedicesimo", 1989.
- Geissmann, T.: Twinning frequency in catarrhine primates. *HUMAN EVOLUTION* 5: 387–396, 1990.
- Gittins, S.P., Raemaekers, J.J. Siamang, lar and agile gibbons. Pp. 63–105 in *MALAYAN FOREST PRIMATES: TEN YEARS' STUDY IN TROPICAL RAIN FOREST*. Chivers, D.J., ed., New York and London, Plenum Press, 1980.
- Goldizen, A. Wilson. Tamarins and marmosets: Communal care of offspring. Pp. 34–43 in *PRIMATE SOCIETIES*. Smuts, B.B., Cheney, D.L.,



- Seyfarth, R.M., Wrangham, R.W., Struhsaker, T.T., eds., Chicago and London, University of Chicago Press, 1987.
- Klös, H.-G. Jahresbericht des Zoo Berlin für das Jahr 1986. *BONGO* 12:129–212, 1987.
- Leighton, D.R. Gibbons: Territoriality and monogamy. Pp. 135–145 in *PRIMATE SOCIETIES*. Smuts, B.B., Cheney, D.L., Seyfarth, R.M., Wrangham, R.W., Struhsaker, T.T., eds., Chicago and London, University of Chicago Press, 1987.
- Marshall, J.T., Sugardjito, J. Gibbon systematics. Pp. 137–185 in *COMPARATIVE PRIMATE BIOLOGY, VOL 1: SYSTEMATICS, EVOLUTION, AND ANATOMY*. Swindler, D.R., Erwin, J., eds., New York, Alan R. Liss, 1986.
- Martin, P., Bateson, P. *MEASURING BEHAVIOUR. AN INTRODUCTORY GUIDE*. Cambridge, Cambridge University Press, 1986.
- Robinson, J.G., Wright P.C., Kinzey W.G. Monogamous cebids and their relatives: Intergroup calls and spacing. Pp. 44–53 in *PRIMATE SOCIETIES*. Smuts, B.B., Cheney, D.L., Seyfarth, R.M., Wrangham, R.W., Struhsaker, T.T., eds., Chicago and London, University of Chicago Press, 1987.