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Occurrence and frequency of twin-fight in the Common marmoset *(Callithrix jacchus)*

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Abstract

Studied frequency and occurrence of twin-fight in the common marmoset *(Callithrix jacchus)*. Twin-fight is found in 32 of 39 groups and in 27 of 83 litters. 39 twins are heterosexual, 23 isosexual female and 16 isosexual male. Twin-fights are most frequent in isosexual male (50 %) and female (46 %) litters, least frequent in male-female twins (17 %). The age of the combatants at twin-fight is on the average 188,5 days in mm-twins, 241,7 days in ff-twins and 237,1 days in mf-twins. Sibling competition is observed during the whole interbirth-interval of the α-female. Five twin-fights show a temporal relation to the first and second estrus post partum of the α-female. In 6 % of all twin-fights a combatant has to be removed in order to prevent severe injuries. Sibling competition is observed in groups of max. 10 members. A relatively high percentage of twin-fights (ca. 37 %) is noticed in very small groups and in absence of group members of the opposite sex (parents excluded).

Introduction

Agonistic interactions between infantile/juvenile social living mammals are the exception rather than the rule. The siblings of a given litter, for example Suidae, Canidae, Felidae or Cricetidae often quarrell for the access to the nipples of their mother or for food, and also during play sessions they may interact to some extent agonistically. However, all these interactions do not cause injuries to their familiar social partner (see also Sutcliffe and Poole 1984). Poor management conditions (e.g. overcrowding, stimulus deprived environment) often induces increased aggressiveness between littermates which may lead to severe physical consequences, and even to the death of one or the other sibling (e.g. cronism in piglets or hamsters).

All these dissociative interactions are characterized insofar as they are triggered by an actual event, for example the access to food or mother's nipples. Furthermore they do not seem to have negative longterm effects on the relationship of the combatants. On the contrary many authors have stressed the eminently associative character of the interactions between infantile mammals (for a survey see Fagen 1981).

In the behavioural ontogeny of the marmosets however, we can observe a process which does not seem to be promoted by an actual event – at least we could not detect it – which exclusively involves dissociative behaviours, and which often ends in severe physical, and possibly even psychic injuries in the 4–10 months old marmoset twins. This twin-fight (Sutcliffe 1980) or sibling competition (Kleiman 1979) is believed to determine the relative position of the twins in the hierarchy of the group.

According to Sutcliffe and Poole (1984) the twin-fight has longterm consequences on the hierarchical relationship of the siblings, that is, the dominance-subordination-relationship between the twins will not be altered as long as the twins live together in their

Table 1. **Generation of twins and TF-frequency; TF – litter(s) with twin-fight; no TF – litters without twin-fight**

twin constellation		F_1	F_2	F_2^x	F_2/F_3	F_3/F_2	F_3	F_2^x/F_4	F_3/F_4	F_4/F_3	F_5F_4/F_3^x	$F_3^x/F_3^xF_5$	F_3F_5/F_3^x	Σ
mf	no TF	11	4	3		6	1	6	1					32
	TF		3				1	1	1	1				7
ff	no TF	5	3	1			1	3						13
	TF	2			1		2	2	1		1		1	10
mm	no TF	4	1+(1)	3		1								9+(1)
	TF	2	2−(1)				1		1			1		7−(1)
Σ	no TF	20	8+(1)	7		7	2	9	1					54+(1)
Σ	TF	4	5−(1)		1		4	3	3	1	1	1	1	24−(1)

( ) = twin-fight uncertain; x = generation of one parent unkown; handreared and fostered peers are excluded.

Table 2. **Relative and absolute frequencies of litters with and without TF**

twin constellation	no TF	TF	Σ	% TF
mf	32	7	39	18
mf (FM)	1		1	
mf (HR)	1		1	
Σmf	34	7	41	17
ff	13	10	23	44
mmff (HR)		1	1	
Σff	13	11	24	46
mm	9+(1)	7−(1)	16	44 (38)
m + m (FM)		1	1	
mm + mmf (HR)		1	1	
Σmm	9+(1)	9−(1)	18	50 (44)
Σ total	56+(1)	27−(1)	83	33 (31)

FM = peers reared by foster mother; HR = hand-reared; ( ) = TF uncertain.

natal group. Kleiman (1977) does not believe that marmoset families are hierarchically structured (compare however Epple 1975; Rothe 1975, 1979; Stevenson and Poole 1976). On the other hand Kleiman (1979) refers to dominant and subordinate twins in *Leontopithecus rosalia rosalia*.

In the present paper we give data on the occurrence, frequency and the relationship of twin-fights to group size, sex ratio of the natal group, age at twin-fight, as well as the incidence of twin-fights during the interbirth-interval of the α-female.

Material and methods

83 litters (5 hand- and fostermother-reared peers included, see Table 2) of 32 families of our *Callithrix jacchus* colony could be analysed. In 39 litters the surviving siblings were bisexual, in 23 isosexual female and in 16 isosexual male. The size of the groups (parents and offspring) varied from 4 to 18 members. The generation of the twins/peers was F 1 to F 3F 5/F 3 (Table 1). The data were taken from the diary of our primate laboratory, in which we record all important biological and behavioural events which can be observed during the animals' daily activity (6–18 h).

The groups were housed in cages or rooms of 1.0 m × 2.0 m × 2.5 m to 5.0 m × 7.0 m × 3.0 m in size, each of them being equipped with free-swinging climbing frames, feeding boards and sleeping boxes. The animals usually could not see each other, however occasionally there was some acoustic and olfactory contact.

In addition to daylight artificial lighting was provided by neon tubes on a 12 hour cycle (6–18 h), and the rooms were screened by venetian blinds from 5.00 p.m. to 7.00 a.m. A constant temperature of 26 °C and a humidity of 70 % was maintained by means of an air conditioner. The animals were fed twice daily.

Most of the twin-fights (TF) were not observed directly, that is, we do not know the initiator and the special circumstances which triggered the sibling competition. From the numerous small wounds, which could be detected in the face and in other parts of the twins' bodies as well as from their aggressive interactions it was rather easy to infer, that TF had taken place. We cannot exclude, however, that we have overlooked one or the other TF, especially those which did not cause injuries or which were not accompanied by detectable aggressive interactions between the combatants.

Results

TF were noticed in 22 of the 32 groups (68.68 %) and in 27 of the 83 litters (32.5 %) (Table 2). In 3 groups we observed 2, in one group 3 TF (see also Kleiman 1979 for *Leontopithecus rosalia rosalia*).

Most frequent TF occurred in isosexual male litters (= mm-litters) (n = 9, 50.0 %). Isosexual female twins (= ff-litters) (n = 24) had also a high rate of TF (n = 11, 46 %), whereas male-female twins (mf-litters) (n = 41) had significantly lower TF-ratios (n = 7, 17 %). According to these data TF was observed in about one third of all litters. From these data we can conclude that TF is not a regular event in the ontogeny of the common marmoset infants/juveniles.

In 5 TF the loser was so severely attacked and injured by its sibling that he has to be removed from its family, one of them died 4 days following the TF (see also Kleiman 1979 for *Leontopithecus rosalia rosalia*).

In our *C. jacchus* colony TF was observed when the combatants were 4 to 10 months old. The maximum TF-age is rather identical in the three twin-constellations (see also Sutcliffe and Poole 1984). The age of the combatants at TF was lowest in mm-twins (on the average 188.5 days, range 112–278 days). In ff-twins we find the highest TF-age (on the average 241.7 days, range 167–314 days), closely followed by mf-litters (on the average 237.1 days, range 209–314 days) (Table 3). The low TF-age of the mm-twins is mainly due to 2 TF which were observed when the combatants were only 4 months old.

As is demonstrated in the Figure TF are distributed over the whole interval between 2 births by the α-female of the group. The peak however lies in the first half (= 50–80 days)

Table 3. Age of twins at twin-fight (in days)

twin constellation	mean	range
mf	237.1	209–314
ff	241.7	167–314
mm	188.5	112–278

Table 4. Relationship of mm-TF-frequency to sex ratio of the family; parents and following litter are excluded

m/f	0	1	2	3	4	5	6	7	8	9	10
1											
2	TEX		E	(T)							
3	X	T	Ta	T							
4			T								X
5		X	Eb								
6			X	X							
7											
8			X								
9						2X					

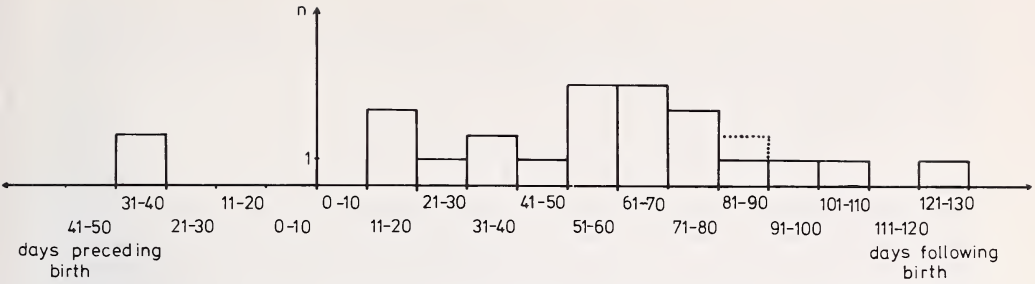
T = twin-fight; E = twin-fight related expulsion/removal; X = no twin-fight; ( ) = twin-fight uncertain; a = reared by foster mother; b = handreared

Table 5. Relationship of ff-twin-fight-frequency to sex ratio of the family
(See legend of Table 4)

m/f	1	2	3	4	5	6	7	8	9	10	11
0		7TEX	2X	X							
1			TX	TX							
2											
3			Eb		X				X		X
4			2X			X					
5											
6											
7											
8					X						

Table 6. Relationship of mf-twin-fight frequency to sex ratio of the family
See also legend of Table 4

m/f	0	1	2	3	4	5	6	7	8
0									
1		2T8X		3X		X			
2		2T	TX	Xa	2TX		X		
3		2X		X		X	X		
4		X		Xb			2X		
5					X	X		X	
6			X						
7									
8				X					X
9				X			X	X	



Incidence of TF in relation to preceding/following birth in the family group. n = frequency of TF; – – – TF uncertain

of the α-female's pregnancy. The TF in the three twin-constellations are rather similar distributed over the interbirth-interval. Five TF however showed a temporal relation to the first and second estrus post partum of the α-female (days 11–37), the twins being 167 to 314 days old at that time.

TF which required the removal of a combatant occurred only in isosexual litters [n = 5; 3 twins, 2 handreared peers (male and female)]. If we exclude the handreared peers, then 12.5 % of all expulsions/removals of a group member followed a TF, and in only 6 % of all TF (n = 83) we had to remove a sibling in order to prevent severe injuries or even the death of the inferior twin.

Six from 9 TF of mm-twins and -peers were observed when the sex ratio of the group was in favour of males, 2 when the sex ratio was balanced, and only 1 when the females were in surplus. TF independent expulsions of group members could only be noticed when males were in surplus (see Table 4).

We obtain the same results for ff-siblings. Ten of 11 TF were seen when the sex ratio was in favour of females, only 1 when the group had a balanced sex ratio. Most of the TF were observed in groups with 6 to 10 members. It must be stressed however, that we did not see any TF in groups with extremely unbalanced sex ratio. Wether this depends on the unbalanced sex ratio or on the group size or on both, cannot be answered (see Table 5).

TF in mf-siblings could nearly exclusively be observed in groups with rather balanced sex ratio and with less than 10 group members (see Table 6).

In summing up we get the following results. In our *C. jacchus* colony we observed TF in groups of max. 10 group members. A relatively high percentage (approx. 37 %, n = 10, 8 in ff-twins) of TF was noticed in very small groups and in the absence of group members

Table 7. **Relationship of twin-fight frequency to sex ratio of the family**
Summary of Table 4–6

m/f	0	1	2	3	4	5	6	7	8	9	10	11
0			7TEX	2X	X							
1		2T8X		T4X	TX	X						
2	TEX	2T	TEX	TX	2TX		X					
3	X	T2X	T	TEX		2X	X			X		X
4		X	T	3X			3X				X	
5		X	E		X	X		X				
6			2X	X								
7												
8			X	X		X			X			
9				X		2X	X	X				

of the opposite sex (parents excluded). In that situation TF often led to the removal of a combatant. Between these two extreme situations it seems to give a stable group size with neither TF nor expulsions/removals (see Table 7).

Discussion

According to the data of our *C. jacchus* colony sibling competition is not a regular event in the relationship between young common marmosets. Even if we assume that many TF could not be observed, there still remained a large number of litters in which TF did not occur. The infants of wildcaught parents showed the least TF. With increasing number of generation the frequency of TF rises, but not continuously. It might be, however, that with increasing length of the existence of the colony in our laboratory a better monitoring of the animals was realized so that more TF could be detected compared to the first years of colony existence.

Sutcliffe and Poole (1984) argue that TF have a longterm effect of the relative hierarchy between the combatants. We cannot confirm this view, since TF are not seldomly repeated and the rank position may be changed (see also König, in prep.; Kleiman 1979 for *Leontopithecus rosalia rosalia*). TF-related expulsions are rather seldom. Since the age at TF is relatively low (see also Sutcliffe and Poole 1984; Kleiman 1979 for *Leontopithecus* [10–12 months]; Wolters, pers. communication for *Saguinus oedipus oedipus* [8–12 months]), this means, that the animals are far from being adult (see Abbott and Hearn 1978) it seems biologically meaningful to prevent expulsions in order not to reduce too drastically life expectancy and/or reproductive success of the infantile/juvenile loser. According to Sutcliffe and Poole (1984) TF must take place at an age when the permanent dentition has not yet developed to avoid dangerous injuries. In most TF which were noticed in our colony only minor wounds indeed occurred, but in some TF also severe injuries could be observed in both combatants (see also Kleiman 1979 for *Leontopithecus rosalia rosalia*). As yet we have no idea on the psychic effects/consequences of TF which might also be, even more important, than any physical wound.

Most remarkable is the sudden appearance – at least for the human observer – of TF. The initiating event was not observed in most cases. Sutcliffe and Poole (1984) believe that the increase of intolerant behaviour of older group members towards the twins could stimulate the siblings to TF. Kleiman (1979) mentions as possible releaser for TF in *Leontopithecus rosalia rosalia* the first transfer of the youngest family members (= 2 weeks old) from the mother to the father. For both assumptions we do not have any indication from *C. jacchus*. Without further information on the initiating event it is somewhat difficult to understand that aggressiveness toward the twins should trigger more or less suddenly aggressiveness between them. We urgently need more data on this aspect.

According to Abbott (1978) *C. jacchus* already show from the sixth month of age considerable changes in the estradiol (female) and testosterone (male) levels. These data fit relatively well to the TF-age. Therefore it might not be unrealistic to assume that the endocrine status of the twins could influence, and may be the primary cause for TF. If this is the case then TF would be a regular event in the development of common marmosets and we had overlooked a considerable number of TF in our colony. It may be, however, that many TF proceed less spectacularly, i.e. in a strong ritualized, non-fighting manner, so that they are hardly to detect.

Our data show that TF are influenced by the size and the sex ratio of the family. It is most striking, that TF very often occur in small groups, that is in groups in which besides the parents no other or only very few adult members live. According to our observations these groups are only scarcely hierarchically structured. The probability to collide with an adult brother or sister is essentially lower in small than in large groups in which TF

typically occur seldom or not at all. This result does not fit to SUTCLIFFE and POOLES (1984) hypothesis on the initiating event/animal of TF.

At least some TF seem to be triggered by the estrus of the α-female, especially by the post-conception-estrus in mid-pregnancy. KLEIMAN (1979) also observed in *Leontopithecus rosalia rosalia* estrus related TF and parent-offspring-conflicts during mid-pregnancy (mid-pregnancy false estrus sensu KLEIMAN and MACK 1977).

As a whole there exists only a small bulk of data on TF in Callitrichidae and no information on the question whether we are right in assuming that siblings are even-ranking up to TF. ENGEL (1986) has shown that twins already reveal remarkable differences as to their social competence in early infancy. We do not know as yet however which event(s) or process(es) may be responsible for these differences in the relative position of the twins in the group hierarchy. This would mean that TF must have other and/or different function(s) as was hitherto believed. Up to now the published data on TF in marmosets and tamarins are too small for a sufficient explanation of the functional aspect of this behavioural phenomenon.

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Zusammenfassung

Auftreten und Häufigkeit von Zwillingskämpfen beim Weißbüscheläffchen (Callithrix jacchus)

Zwillingskampf wurde in 32 von 39 Gruppen und in 27 von 83 Würfen des Weißbüscheläffchens *Callithrix jacchus* beobachtet. 39 Würfe waren heterosexuell, 23 isosexuell weiblich und 16 isosexuell männlich. Am häufigsten waren Zwillingskämpfe in reinen Männchen- (50 %) und isosexuellen Weibchenwürfen (46 %), am seltensten (17 %) unter heterosexuellen Wurfgeschwistern. Das Zwillingskampf-Alter betrug bei männlichen Wurfgeschwistern im Durchschnitt 188.5 Tage, bei weiblichen 241.7 Tage und bei heterosexuellen 237.1 Tage. Zwillingskämpfe waren über den gesamten Intergeburtenabstand des α-Weibchens verteilt, fünf zeigten eine zeitliche Beziehung zum 1. bzw. 2. postpartum-Östrus der Mutter. In 6 % aller Zwillingskämpfe mußte ein beteiligtes Tier aus der Gruppe entfernt werden, um schwere Verletzungen zu vermeiden.

Zwillingskämpfe konnten nur in Gruppen mit max. zehn Mitgliedern beobachtet werden, wobei ein relativ hoher Prozentsatz (37 %) in sehr kleinen Gruppen und in Abwesenheit gegengeschlechtlicher Gruppenmitglieder (Eltern ausgenommen) zu verzeichnen war.

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