

Maintenance of cooperative life in forest and urban rhesus monkeys (*Macaca mulatta*)

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Abstract. Four rhesus groups, two forest and two urban, were observed to collect data on cooperative attack, cooperative defence and assuaging behaviour. Adult females were prominent as help giver in forest as well as urban area; however, cooperative attack was more among the latter. During cooperative defence, females tried to escape from attacks of males with the cooperation of males and females. This pattern was common in urban and forest monkeys. In both areas, females assuage infants when they sought contact, needed reassurance or were threatened.

Keywords. Cooperative attack; cooperative defence; assuaging behaviour; *Macaca mulatta*.

1. Introduction

Rhesus monkeys live in groups, each group having its own home range. Members of a group seek help from one another for food, movement, and to attack and defend themselves from predators (Pirta 1982). These exigencies could lead to the genesis of cooperative behaviour patterns classified under interspecies and intraspecies cooperation, cooperative foraging, cooperative movement, communal attack and communal defence. The coherence of a group requires development of strong interpersonal attachments (Harlow and Harlow 1965). These affectional bonds develop in groups of rhesus monkeys through social grooming, social play, coalition relations and consort relations (Pirta 1983). The selfish interests of individual monkeys, however, frequently disrupt day-to-day life of rhesus group. To avoid this, rhesus monkeys display some behaviours as a result of which peace prevails in group. Three classes of such behaviours are described here.

2. Methods

The details of study areas, groups observed and other information have been given elsewhere (Pirta 1981). In brief, two forest groups, comprising 27 and 38 individuals, and two urban (temple) groups comprising 68 and 129 individuals, were observed from August 1977 to 1978. The study areas were, Chakia Forest and temples (urban) located in the Varanasi district of Uttar Pradesh. A total of 425 and 465 observational hr were spent on the forest and urban monkeys respectively. The *ad libitum* and sequence sampling were employed to collect data. Three types of behaviours are discussed in this paper. (i) Cooperative attack: A joint attack by two or more individuals on the member(s) of the same group. (ii) Cooperative defence: A joint defence by two or more individuals against the threats of the same group members. (iii) Assuaging behaviour.

An interaction between two or more individuals of a group in which one is care solicitor and the other(s) responds to it by giving care.

3. Observations

3.1 *Cooperative attack*

During these interactions either the attacker or the attackee was joined by other group member(s), respectively, for enhancing the attack or for chasing away the attacker (rescuing). Most of the cooperative attacks involved rescuing of attacked monkey (table 1), and females played a prominent role as help givers (table 2). In all, 20 and 168 episodes of cooperative attack were observed in forest and urban areas respectively (figure 1a).

A cooperative attack interaction includes at least three monkeys: the attacker, the attackee and the cooperator. Sometimes the interactions are complex and might involve a whole group.

3.2 *Cooperative defence*

All these interactions involved defence of an individual from attack of one or more members of the same group. The attacked monkey was: (i) carried away by the helping monkey, or (ii) given shelter by the helper by allowing him to stand in proximity or contact, or (iii) allowed to escape as the helper stood in the way of the attacking monkey. Help seekers were adult females and attackers were mainly adult males (table 3), however, help givers were both adult males and females (table 4). A total of 33 and 57 episodes of cooperative defence were observed in forest and urban areas respectively (figure 1b).

3.3 *Assuaging behaviour*

One monkey sought help of another monkey for social contact, reassurance and to avoid threatful situation. In forest area, social contact keeping was the main problem, whereas, avoidance of social threat was the main problem in urban areas (table 5). In most of the cases care solicitors were infants (table 6). In all 27 and 106 episodes were analysed respectively from forest and urban groups (figure 1c).

4. Discussion

The social environment of a group puts individuals in a sort of competition with each other. As a result dominant-submissive relationship among the members emerge. Even then peace is not maintained in a group because dominant individuals intimidate the submissives. We observe, however, that to check such coercion two or more individuals help each other in attacking, in defending and by assuaging. Mainly the fight interference behaviours (cooperative attack and defence) play an important role in control of aggression in groups of free living macaques and baboons. Some investigators have reported fight interference by high ranking males (Bernstein and Sharpe 1966; Kummer 1967; Tokuda and Jensen 1968; Van Hoof and De Waal 1975; Oswald and Erwin 1976; Packer 1977) whereas others emphasize on females (Kaplan 1977; Kurland 1977; Massey 1977). Rowell (1971) pointed out that ecological factors

Table 1. Episodes of cooperative attack in forest (F) and urban (U) monkeys.

Context	Duration (min)		Number of monkeys			Total	
	0-1	1+	2-5	5-10	10+		
1. To rescue monkeys from							
Male	F	6(100)	0	5(83.3)	1(16.7)	0	6(50)
	U	53(82.8)	11(17.2)	37(57.8)	23(35.9)	4(6.3)	64(62.1)
Female	F	2(66.7)	1(33.3)	1(33.3)	2(66.7)	0	3(25)
	U	25(96.2)	1(3.8)	20(76.9)	5(19.2)	1(3.9)	26(25.2)
Immature	F	2(66.7)	1(33.3)	2(66.7)	1(33.3)	0	3(25)
	U	13(100)	0	10(76.9)	3(23.1)	0	13(12.6)
2. To avoid other monkeys							
Male	F	4(80)	1(20)	3(60)	2(40)	0	5(62.5)
	U	28(82.4)	6(17.6)	22(64.7)	10(29.4)	2(5.9)	34(54)
Female	F	0	0	0	0	0	0
	U	20(90.9)	2(9.1)	13(59.1)	9(40.9)	0	22(34.9)
Immature	F	3(100)	0	2(66.7)	1(33.3)	0	3(37.5)
	U	7(100)	0	5(71.4)	2(28.6)	0	7(11.1)
3. Other	F	0	0	0	0	0	0
	U	1(50)	1(50)	2(100)	0	0	2(100)
Total	F	17(85)	3(15)	13(65)	7(35)	0	20
	U	147(87.5)	21(12.5)	109(64.9)	52(31)	7(4.2)	168

Numerical values denote number of episodes and its percentage (in parenthesis) for all tables.

Table 2. Episodes of cooperative attack in forest and urban areas: Signal giver and cooperator.

Signal giver		Cooperator				Total
		Male	Female	Juvenile	Infant	
Male	Forest	0	0	0	0	0
	Urban	12(80)	8(53.3)	2(13.3)	0	15(8.9)
Female	Forest	1(100)	0	0	0	1(5)
	Urban	28(46.7)	43(71.7)	15(25)	6(10)	60(35.7)
Juvenile	Forest	1(9.1)	8(72.7)	5(45.5)	0	11(55)
	Urban	11(31.4)	29(82.9)	16(45.7)	0	35(20.8)
Infant	Forest	3(100)	3(100)	2(66.6)	1(33.3)	3(15)
	Urban	5(23.8)	16(76.2)	5(23.8)	1(4.8)	21(12.5)
Unidentified	Forest	4(80)	3(60)	0	0	5(25)
	Urban	13(35.1)	19(51.4)	15(40.5)	4(10.8)	37(22)
Total	Forest	9(45)	14(70)	7(35)	1(5)	20
	Urban	69(41.1)	115(68.5)	53(31.5)	11(6.5)	168

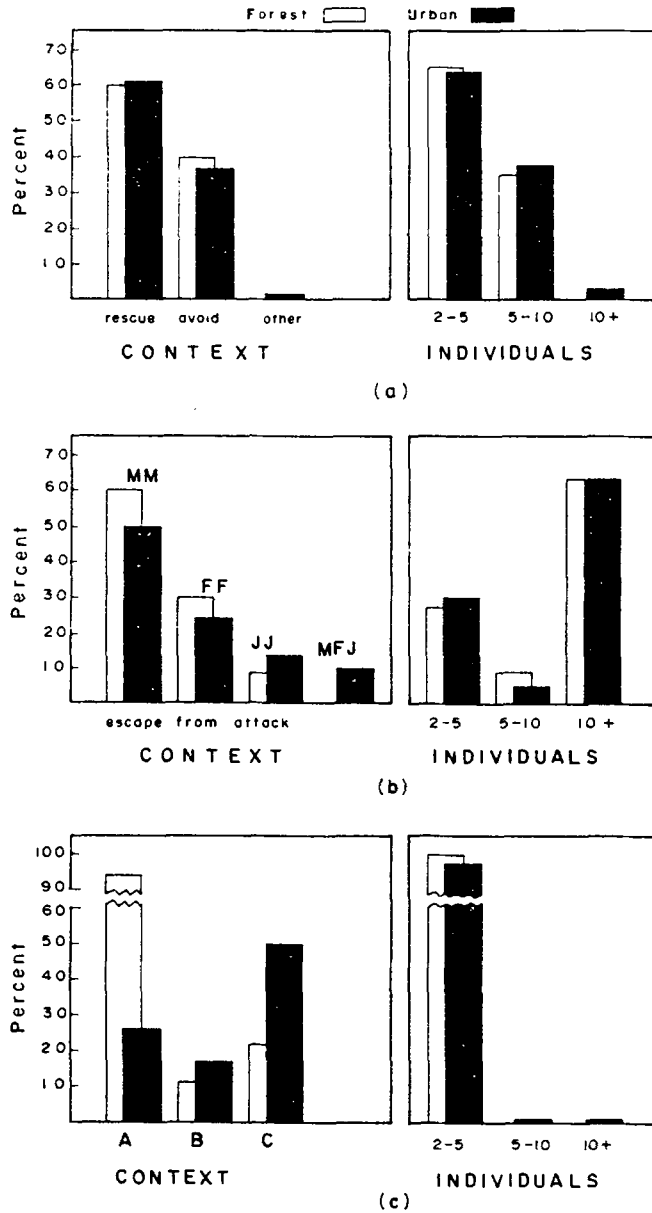


Figure 1. Context and individuals participating in episodes of (a) Cooperative attack, (b) Cooperative defence; MM = males, FF = females, JJ = juveniles, MFJ = joint, (c) Assuaging behaviour; A = contact seeking, B = reassurance, C = threatening situation; the broken bars indicate that the actual length of the bars has been reduced.

probably bring differences in fight interference behaviour. Her speculation is partially supported in the present study on urban and forest macaques, however, more controlled observations are needed.

The twelve classes of cooperative behaviours observed in urban and forest rhesus monkeys seem essential for *genesis, development and maintenance* of group (Pirta 1982

Table 3. Episodes of cooperative defence in forest (F) and urban (U) areas: Context, duration and number of monkeys.

Context (to escape from)		Duration (min)		Number of monkeys			Total
		0-1	1 +	2-5	5-10	10 +	
Male	F	18(90)	2(10)	3(15)	2(10)	15(75)	20(60.6)
	U	24(82.8)	5(17.2)	4(13.8)	2(6.9)	23(79.3)	29(50.9)
Female	F	8(80)	2(20)	3(30)	1(10)	6(60)	10(30.3)
	U	10(71.4)	4(28.6)	7(50)	0	7(50)	14(24.6)
Juvenile	F	3(100)	0	3(100)	0	0	3(9.1)
	U	5(62.5)	3(37.5)	7(87.5)	0	1(12.5)	8(14)
Joint	F	0	0	0	0	0	0
	U	3(50)	3(50)	0	1(16.7)	5(83.3)	6(10.5)
Total	F	29(87.9)	4(12.1)	9(27.3)	3(9.1)	21(63.6)	33
	U	42(73.7)	15(26.3)	18(31.6)	3(5.3)	36(63.2)	57

Table 4. Episodes of cooperative defence in forest and urban areas: Signal giver and cooperator.

Signal giver		Cooperator				Total
		Male	Female	Juvenile	Infant	
Male	Forest	2(100)	2(100)	2(100)	0	2(6.1)
	Urban	2(66.7)	3(100)	2(66.7)	0	3(5.3)
Female	Forest	12(70.6)	10(58.8)	5(29.4)	1(5.9)	17(51.5)
	Urban	37(100)	27(73)	20(54.1)	5(13.5)	37(64.9)
Juvenile	Forest	5(45.5)	5(45.5)	7(63.6)	0	11(33.3)
	Urban	6(60)	7(70)	4(40)	0	10(17.5)
Infant	Forest	1(33.3)	2(66.7)	0	0	3(9.1)
	Urban	4(57.1)	5(71.4)	3(42.9)	0	7(12.3)
Total	Forest	20(60.6)	19(57.6)	12(36.4)	1(3)	33
	Urban	49(86)	42(73.7)	29(50.9)	5(8.8)	57

1983 and present study). These categories of cooperative behaviour have been defined as altruistic behaviours (that too in pure genetic terms) in current literature on primates. At first, it appears easy to explain the evolution of such altruistic behaviours in genetical terms by applying the theory of kin selection (Hamilton 1964). After the analysis is complete, some part of the data is explained (altruistic acts toward relatives) whereas a considerable part remain unexplained (altruistic acts toward non-relatives). Unbiased examination of models of kin selection (Williams 1981; Maynard Smith 1982; Michod 1982; Richard and Schulman 1982), and conclusions drawn by other investigators (Kaplan 1978; Altmann 1979; Quiatt 1979; Bekoff 1979; Boehm 1981; Wolfe 1981), suggest two important points. (i) These so-called altruistic behaviours might not be examples of pure genetical altruism, probably psychological altruism is also involved in it. (ii) Both genetic and social selfishness might be associated with these seemingly altruistic behaviours. Therefore it might not be correct to treat such behaviours as

Table 5. Episodes of assuaging behaviour in forest and urban areas: Context and duration.

Context		Duration (min)			Total
		0-1	1-5	5+	
Contact seeking	Forest	6(33.3)	5(27.8)	7(38.9)	18(66.7)
	Urban	11(39.3)	9(32.1)	8(28.6)	28(26.4)
Reassurances	Forest	1(33.3)	1(33.3)	1(33.3)	3(11.1)
	Urban	5(26.3)	11(57.9)	3(15.8)	19(17.9)
Threatful situation	Forest	3(50)	2(33.3)	1(16.7)	6(22.2)
	Urban	51(86.4)	8(13.6)	0	59(55.7)
Total	Forest	10(37)	8(29.6)	9(33.4)	27
	Urban	67(63.2)	28(26.4)	11(10.4)	106

Table 6. Episodes of assuaging behaviour in forest and urban areas: Care solicitor and care giver.

Care solicitor		Care giver				Total
		Male	Female	Juvenile	Infant	
Male	Forest	0	0	0	0	0
	Urban	1(100)	0	0	0	1(0.9)
Female	Forest	0	0	0	1(100)	1(3.4)
	Urban	6(66.7)	3(33.3)	0	0	9(8.5)
Juvenile	Forest	0	1(100)	0	0	1(3.4)
	Urban	7(24.1)	16(55.2)	6(20.7)	0	29(27.4)
Infant	Forest	2(8)	21(84)	2(8)	0	25(92.6)
	Urban	8(11.9)	50(74.6)	6(9)	3(4.5)	67(63.2)
Total	Forest	2(7.4)	22(81.9)	2(7.4)	1(3.7)	27
	Urban	22(20.8)	69(65.1)	12(11.3)	3(2.8)	106

altruistic. They are rather instances of mutual aid or cooperation and should be considered as products of genetical and social evolutionary forces acting in the same direction.

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