

Changing patterns of behaviour during the early stages of bonnet monkey *Macaca radiata*

MEWA SINGH, P PRAKASH and RAGHUBIR SINGH PIRTA*

Department of Psychology, University of Mysore, Manasagangotri, Mysore 570 006, India

*Department of Psychology, Utkal University, Bhubaneswar, India

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Abstract. The behaviour of forty infants in five free-living groups of bonnet monkeys (*Macaca radiata*), was studied from birth to fifteen months of age. The total age period was divided into seven age-levels. The percentage of 20-sec intervals for each category and pattern of behaviour is reported for each age-level. With the growing up of the infant, the environment-oriented behaviours increased, whereas interactions with the mother decreased.

Keywords. Adaptive behaviour; fitness ; one-zero sampling ; socialization ; social play ; sociobiology.

1. Introduction

The growth of a monkey infant in a natural group has been studied in a number of species, and the details of these studies have been presented in books on primate socialization (Poirier 1972; Chevalier-Skolnikoff and Poirier 1977). Because of the complexity of social behaviour in higher primates, experience at younger age-levels is considered to be important for studying adult behaviour. Many behaviours or behaviour patterns of the adults may not be related to the direct action of the gene, but the adaptive value of such behaviours may always be evident. The knowledge of such behaviour is passed on by the social group to the infant during the latter's process of socialization. Poirier (1972) remarked: "Socialization ensures that adaptive behaviour will not have to be 'rediscovered' anew in each generation".

Although the development of bonnet monkey infant (*Macaca radiata*) in natural groups has been documented by Simonds (1965, 1974), the precise quantification of specific actions at different age-levels has not been studied. Because of the rapid physiological growth, marked changes take place in the behaviour of the infant monkey in short periods of time. It is therefore better to divide the total growth period into different stages, and then record systematically the activities at each stage. In the present paper, the growth of the infant in natural groups of bonnet macaques is reported and discussed.

2. Methods

Forty infants were studied in 5 free-living groups of bonnet monkeys. In 4 groups the observations were made from the time of birth and thereafter. Detailed records of birth dates of the infants, their kinship relations, growth for 4 years, and the total activities of the group, were maintained for the fifth group (Herb garden group) (Singh and Sachdeva 1977; Singh and Pirta 1978; Singh 1978). These groups inhabited either the semi-urban areas of Mysore city or the highways. The size of the groups ranged from 20 to 40 individuals. All groups lived in areas with thick vegetation mainly of banyan trees (*Ficus bengalensis* and *Ficus religiosa*).

Quantitative observations on the activities of the infants were taken from the time of birth to the age of 15 months. A 20-sec interval data sheet was used, employing the one-zero sampling method (Altmann 1974). Observations on the Herb Garden group were made from October 1974 to January 1978. The infants in the rest of the 4 groups were observed after the breeding seasons of 1977 and 1978.

On the basis of their physical and behavioural characteristics, 15 months of the infant were divided into 7 age-levels. Table 1 presents information on the total number and distribution of hours spent on the sample. According to the one-zero sampling method, each behaviour is recorded not more than once, and each behaviour can also occur once at each 20-sec interval. Therefore, the percentage for each category of behaviour was computed against the total number of 20-sec intervals.

3. Results

During observations, data were collected for all the behaviours of the infant, but the time spent was subjected to analysis only for those manifestly marked behaviour changes at different stages of development.

Table 1. Age classification and distribution of hours of observation on bonnet monkey.

Age classification	Quantitative observations		Qualitative observations
	Hours	20-sec intervals	Hours
0-2 weeks	15	2700	30
2-4 weeks	13	2340	25
1-3 months	13	2340	25
3-6 months	15	2700	28
6-9 months	10	1800	14
9-12 months	10	1800	25
12-15 months	20	3600	40
Total	96	17280	187

Total number of hours—283

3.1. Nipple contact and body contact with mother

Figure 1 shows the percentages of 20-sec intervals for nipple and other body contact with the mother at 7 age-levels. During the first 2 weeks, the infant spent almost all its time in such physical contact. After 2 weeks, the frequency of nipple contact dropped to about half that of the first 2 weeks. At later age-levels, the number of physical contact with the mother was considerably greater, but the frequency of nipple contact was almost nil.

3.2. Play

Figure 2 presents the changes in self-play, play with other infants and juveniles at different periods of development. This activity was almost non-existent for the first 2 weeks. In the first and the second months of age, there was a marked rise in self-play either at the mother's lap or in the proximity. Self-play dropped at the later age-levels, but it gave way to a considerable increase in social play.

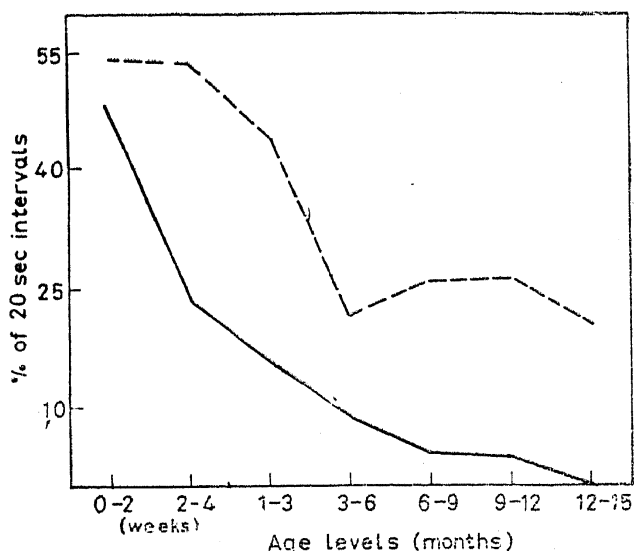


Figure 1. Percentages of 20-sec intervals for physical contact with the mother at different age-levels. Broken line indicates Body contact, Solid line indicates Nipple contact.

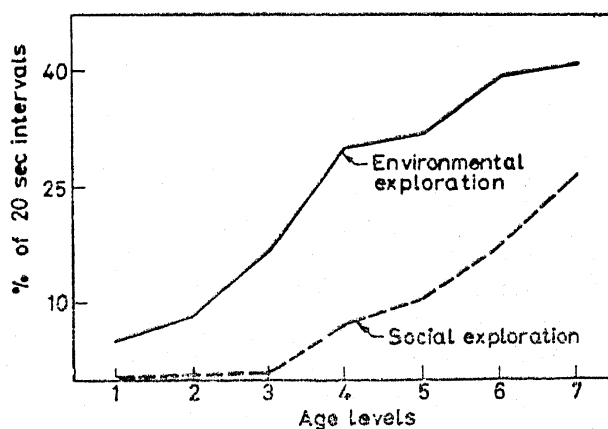


Figure 2. Percentages of 20-sec intervals for social and environmental exploration at different age-levels.

3.3. Environmental and social exploration

Figure 3 presents the percentages of 20-sec intervals spent on explorations at the 7 age-levels. Environmental exploration refers to manipulation and visual exploration of the objects around. Such activity mostly occurs when searching for food, but it may also include explorations to acquaint with the environment. Social exploration refers to friendly interactions, excluding social play, with other animals. A slow rise in the frequency of exploration was observed till 3 months. Thereafter, there was a marked increase in the percentage of 20-sec intervals devoted to the environmental and social exploration.

3.4. Behaviour of the mother

Figure 4 shows the changes in the behaviour of the mother toward the infant at its different age-levels. The mother played with the infant for the first 2 weeks to

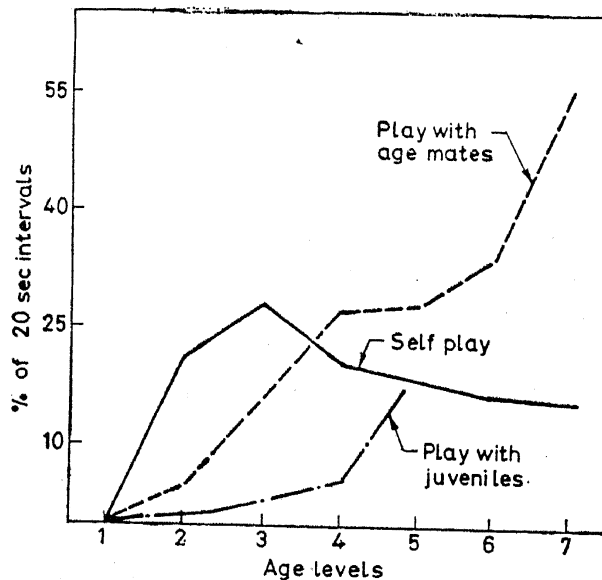


Figure 3. Percentages of 20-sec intervals for play at different age-levels.

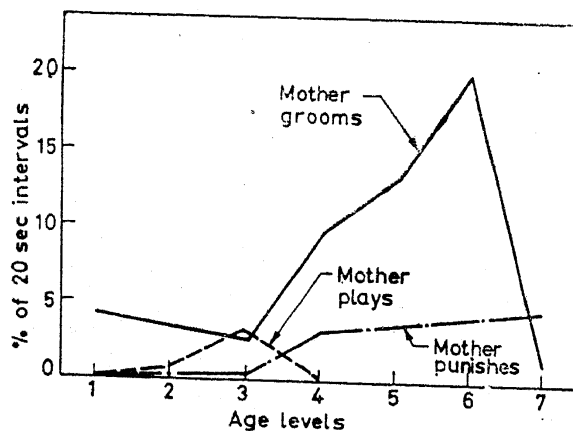


Figure 4. Percentages of 20-sec intervals for mother's behaviour towards the infant at different age-levels.

one month of the infant and thereafter completely stopped this activity. The frequency of the mother grooming the infant, and her punishing the infant was maximum at the age-level of one year. This was when the mother had a newborn infant with her. The old infant attempted to make nipple contact or a ventral-ventral contact with the mother. The mother threatened and sometimes even bit the old infant, but she also groomed the infant for a considerable duration.

3.5. Interaction with mother and environment-directed behaviours

Interactions with mother includes any kind of physical contact, e.g. nipple contact, non-specific contact, play with the mother, retrieval or grooming by the mother, etc. Behaviours such as social play, environmental exploration, interactions with peers, spending time away from the mother, distance between infant and the mother, etc. constitute environment-oriented behaviours. Figure 5 shows the mean percentages of 20-sec intervals for the behaviours involving interactions with mother, and environment-oriented behaviours. It is seen that with increasing age, interaction with the mother decreases, whereas the frequency for environment-oriented behaviours increases.

3.6. Pre-weaning and post-weaning

Table 2 presents the mean percentages of 20-sec intervals and the significance of difference for some behaviour patterns during the pre-weaning (0-6 months) and the post-weaning (after 6 months) periods. A test of equal probability hypothesis applied to the mean frequencies for the 3 behaviour patterns, i.e. contact with mother, social play and hand use in manipulations, showed a highly significant difference between the pre-weaning and the post-weaning periods.

4. Discussion

Social behaviour of non-human primates is a complex process as it consists of complex behavioural acts displayed in a variety of situations. For a non-human primate infant, the social group living in its natural habitat is the ideal situation.

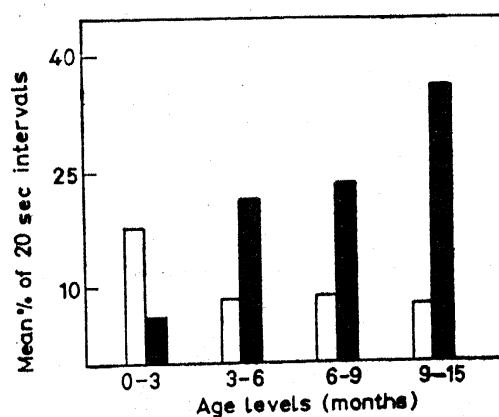


Figure 5. Interaction with the mother (non-shaded area) and environment-oriented behaviours (shaded area) at different age-levels.

Table 2. Significance of difference between pre-weaning and post-weaning behaviours in bonnet monkey.

Behaviour patterns	Pre-weaning %	Post-weaning %	X^2	P
Contact with mother	33.8	10.1	12.8	.001
Social play	12.2	39.6	14.4	.001
Hand use in manipulations	8.5	27.8	10.2	.01

The natural environment provides a complexity or a full range of stimuli to elicit the biologically programmed actions, and the social group provides an opportunity for testing the adaptivity of such actions. Because of their organismic complexity the non-human primates possess a capacity to display a number of behaviours in each situation. A behavioural phenotype, which serves to enhance the survival, is then favoured by natural selection, and becomes an environment-specific characteristic of the species. In primate sociobiology, socialization, therefore, refers to (i) experimentation by a young animal displaying a variety of behavioural acts in specific environmental conditions, and (ii) the selection of the phenotypes which would enhance the fitness of an individual as an adult, as well as that of the social group.

Because of the extended duration of growth, a newborn infant monkey spends most of its time in some physical contact with its mother. Figures 1 to 5 clearly reveal the change from the simple, mother-oriented behaviours during early infancy to the increasingly complex social behaviours at later age-levels. The 4th age-level (i.e. the age of 6 months) requires a specific mention as most of the behaviours undergo a distinctive quantitative change at that stage of the infant's development (figures 1 to 4). When the infant is about 6 months old, the mother again comes into estrous and is frequently consorted by the males. Trivers (1974) explained that at this stage of development, there is usually a conflict between the mother and the offspring. The continued dependence upon mother would still contribute to the fitness of the infant. But from the mother's viewpoint, the energy which can be invested in one more infant becomes more than the benefit, i.e. addition to the fitness of present infant. If the bonnet infant, after weaning, attempted to make a nipple contact, or wanted to be carried ventrally, it was usually discouraged, rejected and even sometimes punished by the mother. However, the mother continued care of the infant in ways which do not cost her much, e.g., the frequency of grooming the infant increased after weaning, and it reached its maximum just before the birth of new infant. It was reported in another study (Singh and Sachdeva 1977) that the bonnet juvenile is not hostile towards its newborn sibling because, by this time, the juvenile is engaged completely in other complex social activities and hardly has any more interactions with the mother.

In bonnet infants, after the age of 3 months, there is a marked increase in the environment-oriented activities including the manipulation of environment and

increased interactions with other group members. Through exploration the infant learns about the new objects and the strange parts of its environment. The use of hand in exploring and manipulating the objects in environment was significantly more between 6 and 20 months than at any other age-level. It was observed that the adult bonnet macaques usually explore their surroundings visually whereas the juveniles would approach the objects such as leaves, stones, etc., and would turn them upside down. "When exploratory behaviour leads one or a few animals to a breakthrough enhancing survival and reproduction, the capacity for that kind of exploratory behaviour and the imitation of the successful act are favoured by natural selection" (Wilson 1975).

The observations indicated social play to be another prominent activity of bonnet infants. Not only the time devoted but also the form of play changed according to age. The activity started with a simpler, non-mutual play with the mother, gradually changed to a solitary play, and then advanced to a highly complex form of social play with peers, juveniles and subadults. The bonnet play is characterised by rocking gait, chasing and mounting each other, and chewing a leaf, which actually do not result in aggression, copulation or feeding. The adult patterns of social stimulation, dominance hierarchy and leadership are clearly visible in the complex social play of juveniles.

Although due to different ecological pressures and adaptations, the rate of change in behaviours during the early social development varies among different primate species (Eimerl and DeVore 1965; Rowell *et al* 1968; Chalmers 1972), an overview of these studies and that of the data reported in the present paper indicates a common pattern of change. Most adult behaviours such as hierarchial system, sexual behaviour, environmental exploration, aggression, intragroup social bonding, etc. are displayed by infants and juveniles during their play and exploratory activities. It is important here to emphasize the roles that learning and natural selection have played in the evolution of social behaviour. The fact that a primate infant in its natural groups learns 'right' and extinguishes 'bad' behaviours implies that there is a built-in mechanism in the organism which directs learning towards survival value by creating a maximum adaptivity and economy of behaviour. "What evolves is the directedness of learning—the relative ease with which certain associations are made and acts are learned, and others by-passed even in the face of strong reinforcement" (Wilson 1975).

The above view is further evidenced by the experimental studies on rhesus monkey (*Macaca mulatta*) infants (Singh and Pirta 1977, 1979; Pirta and Singh 1978). It was reported that the infants raised in peer groups in the natural habitat, which exposed them to all kinds of selection pressures, developed the normal patterns of spatial use, time-activity budgets, dominance hierarchies, intra- and inter-specific relations, feeding habits, etc., identical to, but in absence of, their adult conspecifics. The natural environment provides that complexity which is required for the development of complex and intricate social behaviours.

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