

The Social Interactions of Juvenile Japanese Monkeys on Koshima Islet

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ABSTRACT. This study reports on the social interactions of juvenile Japanese monkeys (1–5 years old) living in their natural habitat. Juvenile males preferred to associate and play with males of the same age. Male-male interactions initiated by a subordinate of the same age or by an older frequently involved play. Juvenile females tended to interact with younger individuals, and to avoid older males. Older females (4–5 years old) tended to avoid one another. Sibling pairs had high frequencies of interaction, although the occurrences of particular types of interactions varied from pair to pair. Patterns of social relations among adults are discussed in relation to juvenile behavior.

INTRODUCTION

Studies of social relations among juvenile Japanese monkeys have been concerned primarily with playmate relationships (MORI, 1974; KOYAMA, 1977). Although play is one of the most important social interactions among juveniles, they do interact with one another without playing (BALDWIN & BALDWIN, 1973). To understand juvenile social relations, it is necessary to examine peripheral, non-play interactions. This paper provides a quantitative assessment of the age changes and sex differences in the types and frequencies of social interactions among juvenile Japanese monkeys.

MATERIALS AND METHODS

This study was conducted on the Japanese monkey troop of Koshima islet, situated in the southern part of Japan, in Miyazaki Prefecture. This troop has been under observation since it was provisioned by ITANI and TOKUDA in 1952. The genealogical relationships of all animals are known. At the beginning of this study in 1978, there were about 100 monkeys on the islet: a main troop, a small group of females (see MORI, 1979) and solitary males. Table 1 shows the composition of the main troop.

This study was carried out in the 1978 and 1979 non-mating seasons. The study subjects were 18 juvenile monkeys born from 1974 to 1977. The nine juveniles who were born in 1974 and 1975 compose the "old juvenile" group (OJ), and the nine born in 1976 and 1977 compose the "young juvenile" group (YJ). Focal animal sampling method was employed in the forest area away from the feeding site. Table 2 shows the duration of tracing for each individual, totaling 345.9 hr.

During the 1979 study period, proximity data were collected by recording at 1-min intervals all animals within 3 m of the focal animals. Proximity between individuals A and B was calculated by the following formula:

$$\text{Proximity} = \frac{DP(A, B) + DP(B, A)}{DT(A) + DT(B)} \times 100,$$

where $DP(A, B)$ is the total amount of time that B was within 3 m of the focal animal A , and $DT(A)$ is the duration of observation on A . The proximity between various age/sex classes is given by the mean value of the proximity of all possible pairs of monkeys, excluding siblings, from any two classes.

Social interactions occurring within 1.5 m of the focal animal were recorded in detail. Social interactions were divided into 19 bout patterns. A bout was defined as a sequence of social behaviors between two individuals within a distance of 1.5 m, which terminated when both partners stopped moving, when one left away from the other, or when they behaved indifferently to each other. The bout patterns were grouped into the following six categories.

PLAY BOUTS

This category includes five patterns; (1) wrestling; (2) chasing; (3) mixed play in which several behaviors of different types, e.g., wrestling, chasing, mounting, etc., occur without a

Table 1. The composition of the main troop in August 1979.

| | | Birth year | Male | Female |
|--------|------|------------|------|--------|
| Before | 1964 | 2 | 2 | |
| | 1965 | 1 | 2 | |
| | 1966 | 2 | 1 | |
| | 1967 | — | 6 | |
| | 1968 | — | 4 | |
| | 1969 | — | 7 | |
| | 1970 | — | 7 | |
| | 1971 | — | 3 | |
| | 1972 | 1 | 1 | |
| | 1973 | 1 | 0 | |
| | 1974 | 4 | 4 | |
| | 1975 | 1 | 0 | |
| | 1976 | 0 | 2 | |
| | 1977 | 3 | 4 | |
| | 1978 | 6 | 3 | |
| | 1979 | 2 | 2 | |

Table 2. Duration of tracing.

| Target | | Birth year | Duration of tracing (min) | | |
|----------------|-----|------------|---------------------------|------|-------|
| | | | 1978 | 1979 | Total |
| <i>Karasu</i> | (♂) | 1977 | 729 | 832 | 1561 |
| <i>Kochi</i> | (♂) | 1977 | 562 | 653 | 1215 |
| <i>Abi</i> | (♂) | 1977 | 581 | 772 | 1353 |
| <i>Utsugi</i> | (♀) | 1977 | 647 | 793 | 1440 |
| <i>Bara</i> | (♀) | 1977 | 730 | 605 | 1335 |
| <i>Take</i> | (♀) | 1977 | 638 | 423 | 1061 |
| <i>Hie</i> | (♀) | 1977 | 605 | 740 | 1345 |
| <i>Cha</i> | (♀) | 1976 | 521 | 614 | 1135 |
| <i>Soba</i> | (♀) | 1976 | 584 | 635 | 1219 |
| <i>Usagi</i> | (♂) | 1975 | 267 | 604 | 871 |
| <i>Kogera</i> | (♂) | 1974 | 412 | 750 | 1162 |
| <i>Batta</i> | (♂) | 1974 | 432 | 659 | 1091 |
| <i>Risu</i> | (♂) | 1974 | 296 | 642 | 938 |
| <i>Kuma</i> | (♂) | 1974 | 211 | 597 | 808 |
| <i>Chigusa</i> | (♀) | 1974 | 359 | 724 | 1083 |
| <i>Nira</i> | (♀) | 1974 | 416 | 641 | 1057 |
| <i>Ai</i> | (♀) | 1974 | 335 | 619 | 954 |
| <i>Fuki</i> | (♀) | 1974 | 353 | 727 | 1080 |

break; (4) non-vigorous but mutual grasping, touching, pulling, pushing or biting; and (5) interaction in which an animal rapidly approaches another, usually jumping from a tree, and both partners quickly run away.

PROXIMITY BOUTS

Proximity within 1.5 m without positive interactions consists of the following three patterns: (6) interaction in which an animal approaches another, and they behave indifferently within 1.5 m; (7) following; and (8) passing by.

PARA-PLAY BOUTS

This type of interaction ceases soon after it is initiated, because one animal does not respond, or moves away: (9) interaction in which an animal initiates interaction, but the partner moves away; (10) interaction in which an animal initiates interaction and grasps or bites the partner, but the partner remains inactive; (11) interaction in which an animal approaches another, but the approacher soon moves away. This pattern usually includes physical contact by the partner, so it is different from passing by; and (12) interaction in which an animal approaches a partner, and the partner grasps or bites the approacher who remains inactive. Patterns (9) and (10), in which the initiator is active, are called "initiator-positive para-play" bouts, while Patterns (11) and (12), in which the partner is active, are called "initiator-negative para-play" bouts.

AGGRESSIVE BOUTS

(13) This pattern involves aggressive behaviors, i.e., threat, aggressive chasing, biting, etc. Although cases in which wrestling ended in aggression were sometimes observed, they were included as play bout patterns. Submissive or defensive behaviors were not considered as criteria for aggressive bouts because these behaviors were often involved in other bout patterns.

AFFINITIVE BOUTS

(14) Grooming; (15) parental patterns such as carrying an infant under the belly or on the back, preventing an infant from moving away, etc; and (16) embracing and touching while sitting.

OTHERS

(17) Mounting; (18) mouth-to-mouth contact; and (19) other patterns involving physical contact. For example, an animal walks bipedally with his hands on the back of a partner walking in front.

RESULTS

PROXIMITY TO OTHER INDIVIDUALS

Proximity results are shown for YJ group (Figs. 1a & b) and for OJ group (Figs. 1c & d).

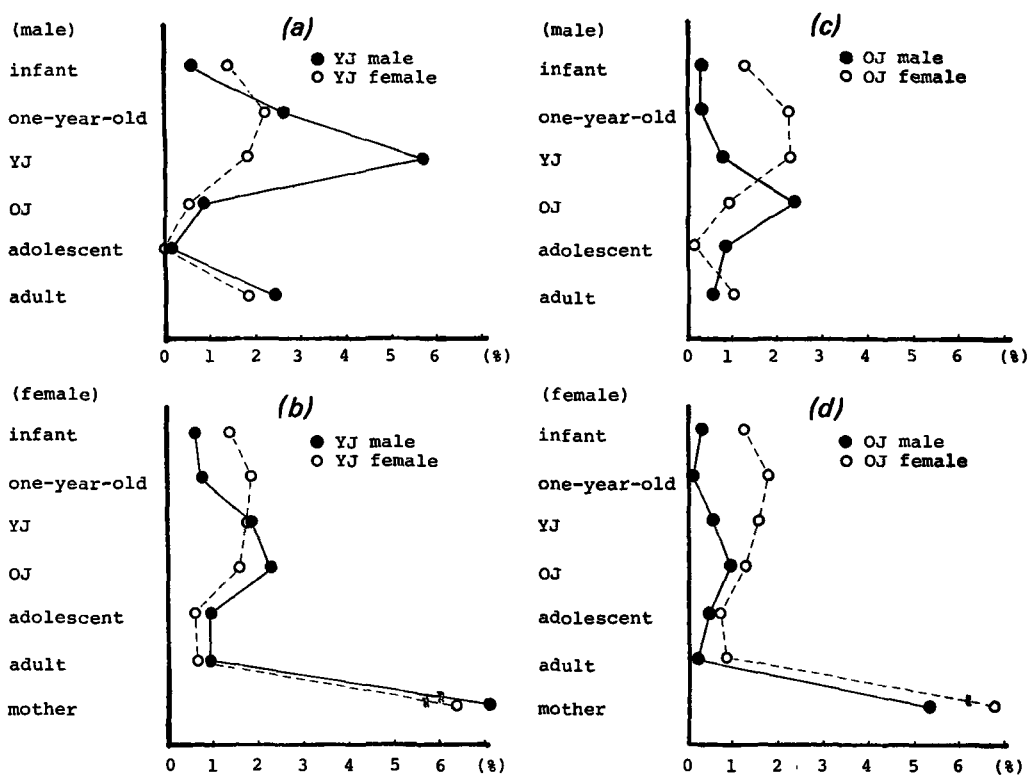


Fig. 1. Proximity within 3 m. a. Between YJ group and male partners. b. Between YJ group and female partners. c. Between OJ group and male partners. d. Between OJ group and female partners. Each point indicates mean frequency of duration of proximity between a traced animal and a member of each class for 100 min.

In the 1979 study period, the juvenile monkeys associated frequently with their mothers, other juveniles, and adult males. The age and sex of juveniles influenced their associations, as follows.

Proximity to Individuals Other Than Juveniles

Younger juveniles showed a strong tendency to associate with their mothers. YJ males spent 36% of the observation time in proximity to their mothers, and YJ females spent 26%. Proximity to mothers decreased in the OJ group, especially among OJ males (Kruskal-Wallis Test, $p < .05$). OJ males associated with adolescent males most frequently ($p < .05$), and least with adult females ($p < .05$). This pattern is probably related to male peripheralization.

Young juveniles tended to associate with adult males (Kruskal-Wallis Test, $p < .01$). Infants and young juveniles were often observed to aggregate near and to follow adult males, and also to be followed by adult males. These interactions are thought to influence patterns of troop movement (MORI, MORI & IWAMOTO, 1977). Juvenile females tended to stay near infants, although infants were largely inactive.

Proximity to Other Juveniles

Juveniles tended to remain near other juveniles, and young males frequently aggregated

together. Proximity among males of the same age was the highest both in YJ group and in OJ group. While juvenile males tended to spend time with males of the same age, juvenile females were inclined to associate with younger individuals. OJ females spent more time than OJ males with young juveniles and 1-year-olds (Kruskal-Wallis Test, $p < .01$, in both cases). However, YJ males associated frequently with 1-year-old males, resulting in no significant sex difference in proximity of YJ group to 1-year-olds. This association will be considered in the next section.

INTERACTIONS AMONG JUVENILES

In order to estimate the influence of age, sex and kin relationship on the frequencies and types of interactions, the mean frequency per 1 hr and the occurrence of each category of interaction between juveniles of all combinations of age/sex classes were calculated (Tables 3 & 4). The mean frequencies were calculated by a formula similar to that for proximity, using the total amount of bouts instead of the total amount of time, and changing the frequency per 100 min to that per 1 hr.

Interactions of Pairs of the Same Age Group

The age changes and sex differences in the frequencies of interactions of pairs of the same age group are shown in Figure 2.

Interactions among males occurred most frequently in all age groups except YJ-O group. At less than 1 year of age, female-female interactions were most frequent, but at 1 year, male-male interactions increased and became more frequent than female-female interactions. After this age the frequencies of interaction among males were always higher than among females, although frequencies decreased for both sexes. Juvenile males showed a consistent tendency to interact with males of the same age.

The occurrence of play bout patterns was consistently high (36–58%) in male-male interactions (Table 4a), while OJ females seldom played with one another (4–7%). Older males probably maintain peer relationships among males through play, while older females begin to avoid one another. Although the frequency of male-female interactions was low, the occurrence of play was not (20–40%).

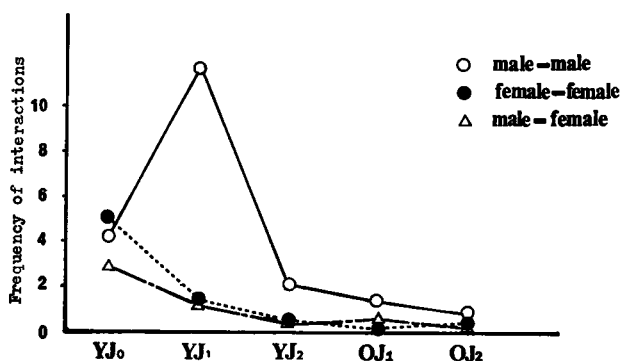


Fig. 2. Frequency of interactions in pairs of the same age group. Data for YJ-0 were obtained in April 1978 from juveniles born in 1977 (0 year of age). Data for YJ-1 and OJ-1 were obtained from the YJ group and OJ group in the 1978 non-mating season, and those for YJ-2 and OJ-2 in the 1979 season. These data are arranged according to their age.

Table 3. Frequencies of interactions between pairs of each age/sex class.*

| | | YJ-male | YJ-female | OJ-male | OJ-female |
|------|-------------------|---------|--------------------|--------------------|--------------------|
| 1978 | YJ-male | 11.68 | 1.19 | 1.26 ¹⁾ | 1.02 ¹⁾ |
| | YJ-female | | 1.23 | 0.31 ¹⁾ | 0.38 ¹⁾ |
| | OJ-male | | | 1.39 | 0.54 |
| | OJ-female | | | | 0.21 |
| 1979 | 1-year-old male | 0.91 | 0.47 | 0.07 | 0.57 |
| | 1-year-old female | 0.11 | 0.68 ¹⁾ | 0.01 | 0.67 ¹⁾ |
| | YJ-male | 2.12 | 0.51 | 0.28 ¹⁾ | 0.74 ¹⁾ |
| | YJ-female | | 0.44 | 0.12 ¹⁾ | 0.53 ¹⁾ |
| | OJ-male | | | 0.89 | 0.27 |
| | OJ-female | | | | 0.41 |

*The number in each cell is the mean frequency of interaction between a traced individual and a member of each class for 1 hr. 1) Pairs of siblings are excluded.

Table 4. Observed frequencies (%) of interactions among juveniles, excluding sibling pairs.

| (a) Between pairs of the same age group | | Play | Proximity | Para-play | Aggression | Affinitive | Others | Total |
|---|--------------|-------------|------------|------------|------------|------------|-----------|-------|
| 1978 | YJ♂ & YJ♂ | 236 (58.3%) | 52 (12.8%) | 98 (24.2%) | 1 (0.2%) | 3 (0.7%) | 15 (3.7%) | 405 |
| | YJ♂ & YJ♀ | 88 (34.4) | 78 (30.5) | 61 (23.8) | 1 (0.4) | 6 (2.3) | 22 (8.6) | 256 |
| | YJ♀ & YJ♀ | 67 (29.9) | 69 (30.8) | 71 (31.7) | 1 (0.4) | 14 (6.3) | 2 (0.9) | 224 |
| | OJ♂ & OJ♂ | 77 (51.7) | 31 (20.8) | 36 (24.2) | 0 (—) | 1 (0.7) | 4 (2.7) | 149 |
| | OJ♂ & OJ♀ | 55 (39.6) | 28 (20.1) | 50 (36.0) | 0 (—) | 1 (0.7) | 5 (3.6) | 139 |
| | OJ♀ & OJ♀ | 1 (6.7) | 3 (20.0) | 10 (66.7) | 0 (—) | 1 (6.7) | 0 (—) | 15 |
| 1979 | YJ♂ & YJ♂ | 57 (35.6) | 47 (29.4) | 28 (17.5) | 3 (1.9) | 17 (10.6) | 8 (5.0) | 160 |
| | YJ♂ & YJ♀ | 43 (20.2) | 88 (41.3) | 53 (24.9) | 2 (0.9) | 10 (4.7) | 17 (8.0) | 213 |
| | YJ♀ & YJ♀ | 52 (34.4) | 65 (43.0) | 24 (15.9) | 1 (0.7) | 4 (2.6) | 5 (3.3) | 151 |
| | OJ♂ & OJ♂ | 77 (39.9) | 56 (29.0) | 35 (18.1) | 2 (1.0) | 15 (7.8) | 8 (4.1) | 193 |
| | OJ♂ & OJ♀ | 37 (30.6) | 40 (33.1) | 28 (23.1) | 4 (3.3) | 0 (—) | 12 (9.9) | 121 |
| | OJ♀ & OJ♀ | 2 (3.8) | 27 (50.9) | 18 (34.0) | 0 (—) | 6 (11.3) | 0 (—) | 53 |
| (b) Between pairs of different age groups | | Play | Proximity | Para-play | Aggression | Affinitive | Others | Total |
| 1978 | YJ♂ & OJ♂ | 124 (53.4%) | 43 (18.5%) | 56 (24.1%) | 0 (—) | 2 (0.9%) | 7 (3.0%) | 232 |
| | YJ♂ & OJ♀ | 48 (35.8) | 37 (27.8) | 35 (26.3) | 0 (—) | 14 (10.5) | 0 (—) | 134 |
| | YJ♀ & OJ♂ | 40 (38.1) | 27 (25.7) | 34 (32.4) | 0 (—) | 1 (1.0) | 3 (2.9) | 105 |
| | YJ♀ & OJ♀ | 45 (43.3) | 10 (9.6) | 36 (34.6) | 0 (—) | 13 (12.5) | 0 (—) | 104 |
| 1979 | YJ♂ & OJ♂ | 26 (27.4) | 32 (33.7) | 19 (20.0) | 4 (4.2) | 0 (—) | 14 (14.7) | 95 |
| | YJ♂ & OJ♀ | 36 (18.9) | 78 (41.1) | 43 (22.6) | 10 (5.3) | 18 (9.5) | 5 (2.6) | 190 |
| | YJ♀ & OJ♂ | 21 (29.2) | 25 (34.7) | 16 (22.2) | 4 (5.6) | 2 (2.8) | 4 (5.6) | 72 |
| | YJ♀ & OJ♀ | 93 (33.8) | 90 (32.7) | 71 (25.8) | 5 (1.8) | 7 (2.5) | 9 (3.3) | 275 |
| | 1 yr-♂ & YJ♂ | 70 (35.9) | 68 (34.9) | 46 (23.6) | 1 (0.5) | 4 (2.1) | 6 (3.1) | 195 |
| | 1 yr-♂ & YJ♀ | 34 (18.4) | 102 (55.1) | 36 (19.5) | 2 (1.1) | 6 (3.2) | 5 (2.7) | 185 |
| | 1 yr-♀ & YJ♂ | 0 | 6 | 6 | 0 | 0 | 0 | 12 |
| | 1 yr-♀ & YJ♀ | 44 (31.2) | 50 (35.5) | 36 (25.5) | 2 (1.4) | 5 (3.5) | 4 (2.8) | 141 |
| | 1 yr-♂ & OJ♂ | 12 (48.0) | 9 (36.0) | 2 (8.0) | 1 (4.0) | 0 (—) | 1 (4.0) | 25 |
| | 1 yr-♂ & OJ♀ | 34 (21.5) | 68 (43.0) | 36 (22.8) | 1 (0.6) | 17 (10.8) | 2 (1.3) | 158 |
| | 1 yr-♀ & OJ♂ | 0 | 0 | 0 | 2 | 0 | 0 | 2 |
| | 1 yr-♀ & OJ♀ | 27 (31.8) | 30 (35.3) | 17 (20.0) | 1 (1.2) | 8 (9.4) | 2 (2.4) | 85 |

Interactions of Pairs of Different Age Groups

Interactions between YJ group and OJ group were observed both in 1978 and in 1979, and the interactions of YJ group and OJ group with 1-year-olds were observed in 1979. Frequencies of interactions in these four combinations showed following tendencies (Table 3): (1) Young-

er males interacted with older juveniles more than younger females did, with no significant relation to the sex of the older juveniles (between YJ group and OJ group in 1978, $\chi^2 = 272.3$, $df = 3$, $p < .001$); (2) Older females interacted with younger individuals more than older males did, with no significant relation to the sex of the younger individuals (between YJ group and OJ group in 1979, $\chi^2 = 233.0$, $df = 3$, $p < .001$; between 1-year-olds and OJ group, $\chi^2 = 228.9$, $df = 3$, $p < .001$); and (3) The frequency of interaction between pairs of the same sex was higher than that between male-female pairs (between 1-year-olds and YJ group, $\chi^2 = 91.63$, $df = 3$, $p < .001$).

These results have only one point in common; the interactions between younger females and older males were infrequent. Although frequencies of interactions in these combinations show different tendencies, the interactions should be interpreted with respect to the following facts.

There were conspicuous individual differences among OJ males in the frequency of their interactions with YJ males in 1978; *Kogera* and *Batta* interacted with YJ males frequently, while *Risu*, *Kuma* and *Usagi* rarely did so (Table 5). In 1979, all of the OJ males interacted infrequently with YJ males except for two dyads, *Kogera-Kochi* and *Kogera-Karasu*. This change may have been due to the following factors: (1) In 1978, *Kogera* and *Batta* tended to stay in the central part of the troop, while the other OJ males were on periphery. In 1979, *Kogera* and *Batta* began to spend much time in the peripheral part, and their interactions with YJ males decreased; (2) The combination of OJ males and YJ males included a pair of siblings (*Kochi* & *Kogera*). The high frequency of interaction between this pair may have affected the frequencies between other pairs through the peer relationships among males of the same age in 1978; and (3) Although there were few male partners for YJ males in 1978, 1-year-old males became available as partners in 1979. It is important to take the age difference between pairs into account. Although OJ males were 2 or 3 years older than YJ males, YJ males were only 1 year older than 1-year-old males. Thus, in 1979, interactions between YJ males and OJ males, which were frequent in 1978, decreased and YJ males interacted frequently with 1-year-old males instead of OJ males. It is possible that juvenile males might have interacted with much older males if there had been fewer male partners of the same age or a close age available. The high occurrence of play among males of all combinations of different ages (Table 4b) supports this suggestion. It is likely that juvenile males easily form social relationships with other males.

As among males, the occurrence of play among females of different ages was consistently high. Older females tended to interact with younger individuals. However, the relationship between older females and younger females was different from that between older females and younger males. For example, there were many cases of mere proximity between older females and younger males.

In conclusion, the effects of age and sex on the frequencies and types of interactions among juveniles are summarized as follows: (1) Males tended to interact with males of the same or

Table 5. Individual differences among OJ-males in frequencies of interactions with YJ-males.*

| | <i>Usagi</i> | <i>Kogera</i> | <i>Batta</i> | <i>Risu</i> | <i>Kuma</i> |
|------|--------------|---------------|--------------|-------------|-------------|
| 1978 | 0.04 | 5.86 (10.0) | 1.83 | 0.09 | 0 |
| 1979 | 0.08 | 0.93 (1.95) | 0.37 | 0.15 | 0.08 |

*The figures indicate the mean frequencies of interaction between each OJ-male and YJ-males for 1 hr (in parentheses, including sibling relationship—*Kogera* and *Kochi*).

a close age, and the occurrence of play was consistently high; (2) Females rarely interacted with older males; (3) Females tended to interact with younger individuals. Play between younger and older females was frequent, while females and younger males mostly engaged in proximity only; and (4) Older females tended to avoid one another.

Sibling Relations

Five pairs of juvenile siblings were observed in 1978, and seven pairs in 1979. All pairs of siblings interacted more frequently than would be expected were they not siblings (Table 6). What types of interactions increase or decrease in siblings? Table 7 shows the frequency of each category of interaction for six pairs of siblings who interacted with high frequency. Para-play occurred less than was expected in every pair, demonstrating that siblings seldom respond negatively to each other. On the other hand, the occurrence of the other bout patterns varied from pair to pair. Play occupied a larger proportion of the interactions between *Kochi* and *Kogera* and between *Bara* and *Batta*, while affiliative bouts occurred more frequently between *Abi* and *Ai*, and proximity bouts between *Cha* and *Chigusa*. Although siblings have many opportunities to interact with each other, the type of interaction seems to vary from pair to pair, perhaps because of their ages, sexes and personalities.

Table 6. Frequencies of interactions between siblings.*

| Pair of siblings | 1978 | 1979 |
|---|--------------|-------------|
| <i>Kochi</i> (YJ ♂)- <i>Kogera</i> (OJ ♂) | 18.28 (1.26) | 3.98 (0.28) |
| <i>Abi</i> (YJ ♂)- <i>Ai</i> (OJ ♀) | 5.10 (1.02) | 7.59 (0.74) |
| <i>Utsugi</i> (YJ ♀)- <i>Usagi</i> (OJ ♂) | 2.37 (0.31) | 0.17 (0.12) |
| <i>Bara</i> (YJ ♀)- <i>Batta</i> (OJ ♂) | 1.47 (0.31) | 4.03 (0.12) |
| <i>Cha</i> (YJ ♀)- <i>Chigusa</i> (OJ ♀) | 1.40 (0.38) | 4.26 (0.53) |
| <i>Nigana</i> (1 yr- ♀)- <i>Nira</i> (OJ ♀) | — | 4.16 (0.67) |
| <i>Soyogo</i> (1 yr- ♀)- <i>Soba</i> (YJ ♀) | — | 5.99 (0.68) |

*For comparison, the mean frequency of each age/sex class to which each pair belongs is given in parentheses.

Table 7. Interactions between pairs of siblings.*

| | Play | Proximity | Para-play | Aggression | Affinitive | Others | Total |
|--------------------------|-------------|-----------|-----------|------------|------------|----------|-------|
| 1978 <i>Kochi-Kogera</i> | 132 (115.4) | 37 (40.0) | 42 (52.1) | 2 (0) | 1 (1.9) | 2 (6.5) | 216 |
| <i>Abi-Ai</i> | 4 (20.8) | 25 (16.0) | 10 (15.1) | 1 (0) | 14 (6.1) | 4 (0) | 58 |
| 1979 <i>Kochi-Kogera</i> | 62 (25.5) | 9 (31.3) | 16 (18.6) | 4 (3.9) | 0 (0) | 2 (13.7) | 93 |
| <i>Abi-Ai</i> | 36 (33.3) | 80 (72.3) | 15 (39.8) | 0 (9.3) | 38 (16.7) | 7 (4.6) | 176 |
| <i>Bara-Batta</i> | 43 (24.8) | 28 (29.5) | 12 (18.9) | 0 (4.7) | 1 (2.4) | 1 (4.7) | 85 |
| <i>Cha-Chigusa</i> | 20 (32.1) | 47 (31.1) | 24 (24.5) | 1 (1.7) | 3 (2.4) | 0 (3.1) | 95 |

*In parentheses are given the expected values calculated from the occurrence of each category of interaction of each age/sex combination to which each sibling pair belongs.

RELATIONSHIPS BETWEEN INDIVIDUALS

Initiation of Interactions

The initiator of a bout of social interaction was defined as the individuals who approached the partner or began the interaction. Animals were sometimes invited to approach and to interact. Following invitations were observed: (1) stare; (2) look through legs; (3) look over

the shoulder, then run away; (4) roll onto back; (5) rear onto hind legs and stare with play face; (6) run away, holding an object; and (7) vocalize “kuu, kku, guu, ggu.” Some initiations occurred after these invitations.

Age and sex differences

The initiator of a bout could not be always determined. 1,976 initiations were observed in 1978, and 2,322 in 1979. Figure 3 shows the initiations of bouts between pairs of different age/sex classes. For male-male pairs, older males initiated more interactions than younger males in all combinations of age classes. For female-female pairs, no constant patterns appear. Interactions between OJ females and 1-year-old females were initiated mostly by OJ females, while interactions between OJ females and YJ females were initiated mostly by YJ females. For male-female pairs, the combinations of age/sex classes totaled 12. Between pairs of the same age class, initiations were more frequently made by males than by females. However, females initiated more interactions than males between pairs of different age classes.

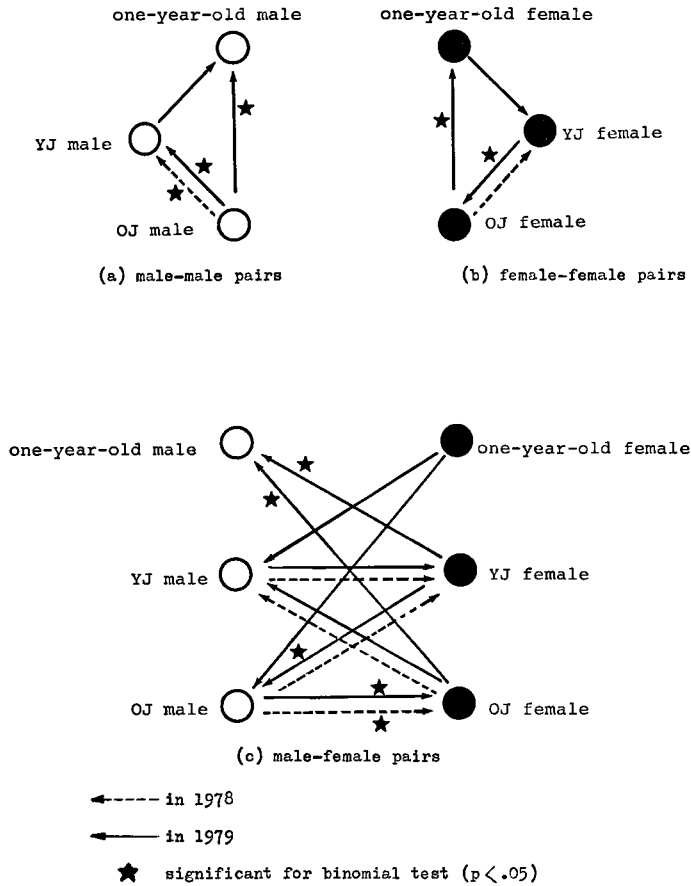


Fig. 3. Initiations of interactions between each pairs of age/sex class. More initiations occurred in the direction of the arrow in each combination of age/sex class.

Dominance relations

Before 1 year of age, dominance relations among juveniles are determined according to their mothers' dominance rank (NORIKOSHI, 1974). The dominance relations among juveniles born in 1977 were determined on the basis of observations of dyadic aggression in the study period (Fig. 4). Their dominance rankings corresponded to those of their mothers, with the exception of *Hie* and *Take*. Although *Take*'s mother was the lowest-ranking female, *Hie* ranked below *Take* perhaps because *Hie* was smaller. *Take* was sometimes observed to make "appeal aggression" (DE WAAL, VAN HOFF & NETTO, 1976) to some individuals, with dominant individuals behind. Furthermore, there was an example of a triangular dominance relationship among *Abi*, *Bara* and *Take*.

There were 21 possible pairings of the seven 1977-born juveniles, all of which were considered. Of 942 observed initiations, 620 (65.8%) were begun by the dominant animal. And for 19 of the 21 pairs, the dominant animal initiated more interactions, and for two pairs, the subordinate initiated more interactions (Table 8). It is thought that dominants initiate interactions more easily than subordinates do.

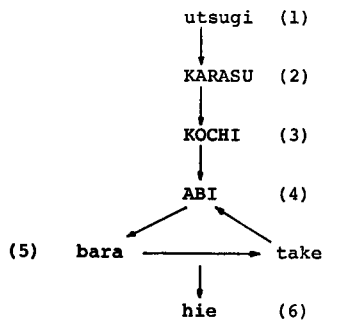


Fig. 4. The dominance relations based on dyadic aggression among juveniles born in 1977. The numbering assigned indicates the dominance order of their mothers. Males are indicated by capital letters.

Table 8. Initiations and dominance relationship.

| | <i>Utsugi</i> | <i>Karasu</i> | <i>Kochi</i> | <i>Bara</i> | <i>Take</i> | <i>Abi</i> | <i>Hie</i> |
|---------------|---------------|---------------|---------------------|-------------|-------------|---------------------|-------------------|
| <i>Utsugi</i> | — | 46/33 | 24/41 ¹⁾ | 24/10 | 19/17 | 13/5 | 31/10 |
| <i>Karasu</i> | | | 149/90 | 11/7 | 9/1 | 81/34 | 0/2 ¹⁾ |
| <i>Kochi</i> | | | | 12/1 | 5/2 | 74/25 | 11/4 |
| <i>Bara</i> | | | | | 13/7 | 10/16 ²⁾ | 14/5 |
| <i>Take</i> | | | | | | 31/3 | 25/11 |
| <i>Abi</i> | | | | | | | 12/4 |

1) Pairs in which the subordinate initiated interactions more often than the dominant; 2) triangular relationship (*Bara-Take-Abi*, see Fig. 4).

CORRELATION BETWEEN INITIATOR AND TYPES OF BOUT PATTERNS

Between individuals of different ages

Figure 5 shows the occurrence of each category of interaction for each initiator between individuals of different ages. Between males of different ages, the occurrences of play and initiator-positive para-play were higher when the older males were the initiators, and proximity bouts occurred frequently when initiated by younger males ($\chi^2 = 22.80$, $df = 4$, $p < .001$).

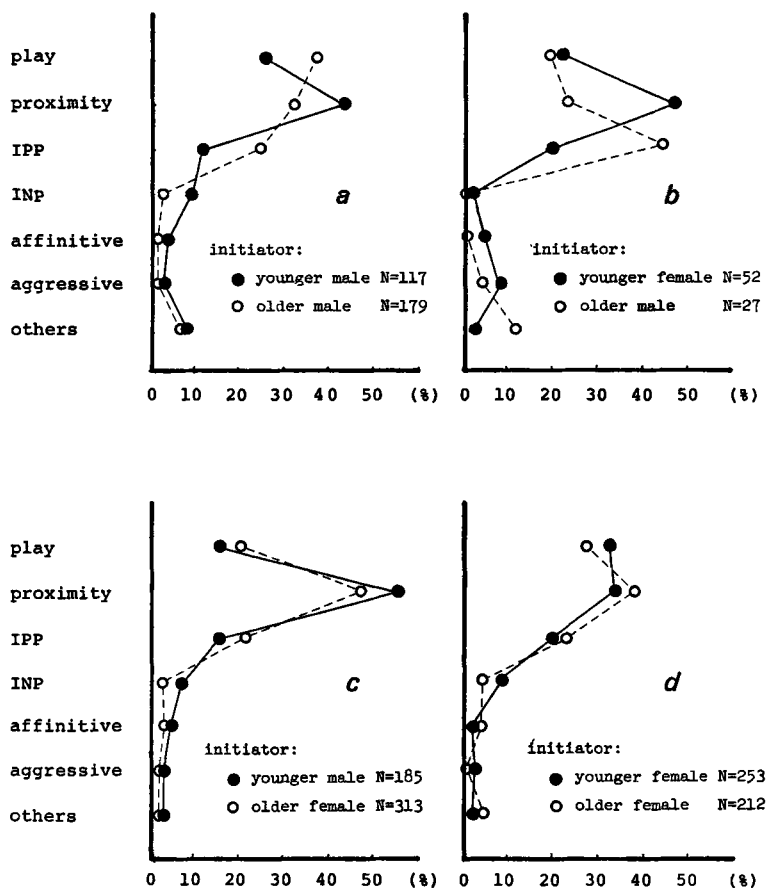


Fig. 5. Incidence pattern of different interactions with respect to the age and sex of the initiator. a. Between males of different ages. b. Between younger females and older males. c. Between younger males and older females. d. Between females of different ages. Each point indicates the percentage of each interaction for total initiations of each initiator.

Between younger females and older males, initiator-positive para-play occurred frequently when initiated by older males, and proximity bouts occurred frequently after initiations by younger females ($\chi^2 = 6.82$, $df = 3$, $p < .01$). These results indicate that younger juveniles responded to older males' initiations. Younger males tended to respond positively, i.e., playfully, although younger females responded negatively. Older males, however, could remain indifferent and ignore the initiations of younger juveniles. There were no significant difference either between females of different ages or between younger males and older females. Younger juveniles seemed to pay attention to older males rather than to older females.

Between individuals of the same age

The influence of dominance relationships between individuals of the same age was analyzed (Fig. 6). In male-male interactions, play occurred with a much higher frequency (67.8%) when the subordinate initiated the interaction. When the dominant males initiated, initiator-positive para-play occurred more frequently but the occurrence of play was not low (32.7%).

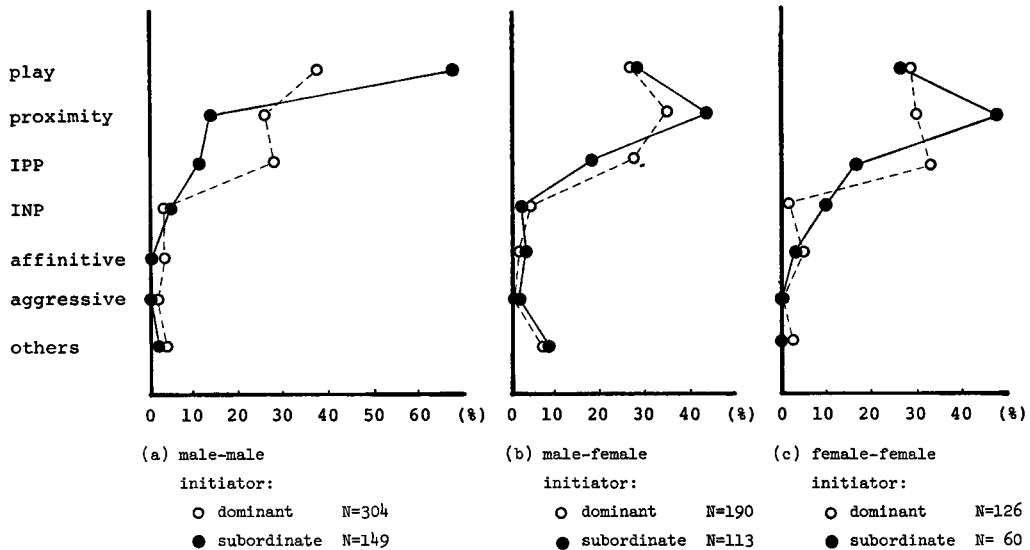


Fig. 6. Incidence pattern of different interactions with respect to the dominance of the initiator.

In contrast with responses of males of different ages, dominant males usually responded playfully to initiations by a subordinate male of the same age ($\chi^2 = 40.59$, $df = 4$, $p < .001$).

There were no significant differences in male-female interactions, although initiator-positive para-play occurred more frequently and proximity bouts occurred less frequently when the dominant animal was the initiator ($\chi^2 = 5.51$, $df = 4$, $p < .2$). This result may be biased because male-female dominance relations were not as stable, e.g., the triangular relation of *Abi*, *Bara* and *Take*, as those of males or of females. The interactions between dominant males and subordinate females seemed to differ from those between dominant females and subordinate males (Table 9). In the former combination, subordinate females not only seldom initiated interactions but tended to reject initiations by dominant males. Play seldom occurred, while proximity bouts were common. On the other hand, play occurred more frequently between dominant females and subordinate males. The frequency of initiations and the occurrence of each bout were similar between dominant females and subordinate males. These tendencies accord with those observed in male-female pairs of different ages.

In female-female interactions, initiator-positive para-play occurred more frequently when the dominant initiated the interactions, and proximity bouts occurred more frequently when the subordinate was the initiator ($\chi^2 = 7.28$, $df = 3$, $p < .05$). This pattern is similar to that between younger females and older males.

Table 9. Influence of initiations on the types of interaction between male-female pair of the same age (observed in 1979).

| | Play | Proximity | IPP ¹⁾ | INP ¹⁾ | Aggression | Affinitive | Others | Total |
|-----|-------|-----------|-------------------|-------------------|------------|------------|--------|-------|
| (a) | 4/0 | 20/7 | 12/0 | 1/1 | 0/1 | 0/0 | 4/0 | 41/9 |
| (b) | 14/10 | 12/12 | 17/9 | 1/0 | 0/1 | 1/1 | 3/2 | 49/35 |

(a) Initiations by dominant male/subordinate female; (b) initiations by dominant female/subordinate male. 1) IPP indicates initiator-positive para-play, and INP indicates initiator-negative para-play (see MATERIALS AND METHODS).

DISCUSSION

Japanese monkey males seem to acquire a strong preference for partners of the same age and sex at 1 year of age. After this stage, the frequencies of interaction decrease, while the preference for males is maintained. Male-male interactions are characterized by play, and juvenile males tend to play more than females in many primate species (e.g., *Macaca mulatta*: SYMONS, 1978; *M. fascicularis*: FADY, 1969; *Papio anubis*: OWENS, 1975). As MORI (1974) notes, in the infant stage females engage in rough-and-tumble play more often than males, while the opposite is true in the juvenile stage. In this study, play groups observed in the peripheral part of the troop consisted almost entirely of males aged 3–6 years, while play groups in the central part consisted mainly of younger individuals of both sexes. Peer play is probably more important for males (POIRIER, BELLISARI & HAINES, 1978).

Juvenile males seemed to take considerable interest in older males, including both adolescent and adult males. They often approached and presented to older males with vocalizing “guiui” (A6 sounds; ITANI, 1963). Younger males apparently use play behavior to maintain interactions with older males. Although younger males were often ignored when they initiated interactions with older males, they were able to interact with older males by responding playfully to their initiations. Thus, play occurred frequently when initiated by older males. Play with older males who tend to stay in the peripheral part of the troop may facilitate the peripheralization of a juvenile male.

Play among males of the same age seems to enhance their cohesion. In contrast to pairs of different ages, play among males of the same age tended to occur more frequently when subordinate males initiated the interactions. Dominant males seldom ignore initiation attempts by subordinate males, implying close ties between them. These ties might be maintained as male-bonds (SUGAWARA, 1975) that might facilitate entry into another troop which peers had already entered (KOYAMA, 1977).

Juvenile females tended to interact with younger individuals, and proximity bouts occurred frequently between them. Older females and younger individuals seemed to tolerate each other. The frequent interactions of this combination at the juvenile stage may help females when they later bring up their offspring, although typical maternal behaviors did not occur frequently.

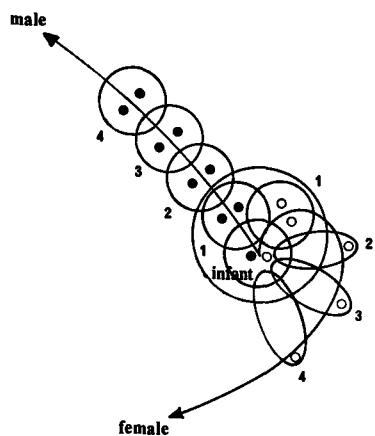


Fig. 7. The hypothetical schema of social relations among juveniles. Infants tend to aggregate together, and have little sex differences. They begin to prefer partners of the same sex at 1 year old (1); especially juvenile males tend to play with males of the same age or a close age. This preference of males continues (male, 1–4). However, older juvenile females become to avoid one another, preferring younger individuals (female, 2–4).

There is one more interesting characteristic of juvenile females. Although juvenile males maintain close ties through play, older juvenile females tend to avoid one another. The process of social development in males and females is clearly different (Fig. 7). Considering the function of play for social integration, it seems paradoxical that females, who will stay in their natal troop, should stop playing together earlier than males who will leave their natal troop. This pattern is probably related to an "avoiding mechanism" among troop members, as suggested by MORI (1977), for females to keep "optimal inter-individual distances." Further studies are required on the relations among non-blood-related females.

Social relation patterns among adult monkeys are probably based on these behavior patterns among juveniles.

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REFERENCES

- BALDWIN, J. D. & J. I. BALDWIN, 1973. The role of play in social organization: comparative observations of squirrel monkeys (*Saimiri*). *Primates*, 14: 369–381.
- DE WAAL, F. B. M., J. A. R. A. M. VAN HOOFF & W. J. NETTO, 1976. An ethological analysis of types of agonistic interaction in a captive group of Java-monkeys (*Macaca fascicularis*). *Primates*, 17: 257–290.
- FADY, J.-C., 1969. Les jeux sociaux: Le compagnon de jeux chez les jeunes. Observations chez *Macaca irus*. *Folia Primatol.*, 11: 134–143. ["Social play: the choice of playmate observed in the young of the Crab-eating macaque." In: *Play—Its Role in Development and Evolution*, J. S. BRUNER, A. JOLLY & K. SYLVA (eds.), 1976. Penguin Books, New York.]
- FEDIGAN, L., 1972. Social and solitary play in a colony of vervet monkeys (*Cercopithecus aethiops*). *Primates*, 13: 347–364.
- ITANI, J., 1963. Vocal communication of the wild Japanese monkey. *Primates*, 4(2): 11–66.
- KOYAMA, N., 1977. Social structure of Japanese monkeys. In: *Jinruigaku-koza*, 2. *Reichorui (Anthropology, Vol. 2, Primates)*, J. ITANI (ed.), Yuzankaku-shuppan, Tokyo, pp. 225–276. (in Japanese)
- MORI, A., 1977. Intra-troop spacing mechanism of the wild Japanese monkeys of the Koshima troop. *Primates*, 18: 331–357.
- , 1979. The role of sex as a centripetal factor in a Japanese monkey troop. In: *Biosociological Studies on the Role of Sex in the Japanese Monkey Society*, Primate Research Institute, Kyoto Univ., Inuyama, pp. 41–49. (in Japanese)
- , U. MORI & T. IWAMOTO, 1977. Changes in social rank among female Japanese monkeys living on Koshima islet. In: *Keishitsu, Shinka, Reichorui (Morphology, Evolution and Primates)*, T. KATO, S. NAKAO & T. UMESAO (eds.), Chuokoron-sha, Tokyo, pp. 311–334. (in Japanese)
- MORI, U., 1974. The inter-individual relationships observed in social play of the young Japanese monkeys of the natural troop in Koshima Islet. *J. Anthropol. Soc. Nippon*, 82(4): 303–318. (in Japanese)
- NORIKOSHI, K., 1974. The development of peer-mate relationships in Japanese macaque infants. *Primates*, 15: 39–46.
- OWENS, N. W., 1975. Social play behavior in free-living baboons, *Papio anubis*. *Anim. Behav.*, 23: 387–408.
- POIRIER, F. E., A. BELLISARI & L. HAINES, 1978. Functions of primate play behavior. In: *Social Play in Primates*, E. O. SMITH (ed.), Academic Press, New York, pp. 143–168.

- SUGAWARA, K., 1975. Analysis of the social relations among adolescent males of Japanese monkeys (*Macaca fuscata fuscata*) at Koshima Islet. *J. Anthropol. Soc. Nippon*, 83(4): 330–354. (in Japanese)
- SYMONS, D., 1978. *Play and Aggression: A Study of Rhesus Monkeys*. Columbia Univ. Press, New York.

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