The influence of familiarity during rearing on subsequent partner preferences in squirrel monkeys*

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Laboratory-born adolescent squirrel monkeys, drawn from four separate rearing groups, were placed together. Strong consistent preferences for interacting with others of the same rearing group were observed in 6 weeks of initial observation and persisted in follow-up observations 14 months later. Play was the major type of interaction between strangers and may serve as the primary mechanism through which social integration occurs.

A number of studies have indicated the effects of early social experience on subsequent behavior in primates (Mason, 1963). More recent research has indicated the role of particular social partners in influencing behavior in a given situation. In addition to the obvious role played by the mother, whether genetic, adopted, or artificial (e.g., Hansen, 1966; Rosenblum & Kaufman, 1967), other specific individuals or groups of individuals in the social environment play an important role in regulating the behavior of given individuals. Thus, Fady (1969), for example, studying *Macaca irus*, has indicated the preference of Ss for interaction with agemates, with infants of mothers holding approximately the same hierarchical status as their own mothers, and with siblings. Similarly, Rosenblum (1970) has indicated the preference for interaction with siblings in pigtail macaques. Mere familiarity with a partner during rearing can also influence subsequent social responding in macaques. Hansen et al (1966) studying adolescent rhesus monkeys, described strikingly different behavior directed towards familiar and strange peers.

Relatively limited data are available regarding the factors influencing social behavior in New World primates, although Ploog and his colleagues (e.g., Ploog, 1967) and work in our own laboratory (e.g., Rosenblum, 1968) have elucidated some aspects of social organization and development in squirrel monkeys (*Saimiri sciureus*). With regard to the role of specific partners, Castell & Ploog (1967) have shown for adult squirrel monkeys that preferences for interaction between familiar Ss of a group are maintained following the integration of groups. Much of the continued integrity of the

separate groups after they were placed together related to the hierarchical conflicts between members of the opposing groups. Work in our own laboratory on territoriality and group integration in squirrel monkeys has been in general agreement with the Castell and Ploog findings. The purpose of the current study on *Saimiri* was to determine the effect of early experience with specific peers in influencing social behavior within a large group containing these familiar peers as well as strangers.

SUBJECTS

The Ss were 15 laboratory-born squirrel monkeys (*Saimiri sciureus*; parents' origin: Iquitos, Peru). These included eight males and seven females. Ss comprised four subgroups, containing five, four, four, and two Ss, respectively. The members of each subgroup had been reared together by their mothers. At the start of the study, the Ss ranged in age from 11-15 months, with a mean age of 12.2 months. All Ss had been removed from their mothers prior to these observations.

APPARATUS

The Ss were housed and observed in a pen 1.2 x 1.2 x 2.5 m high. The front wall contained a one-way observation screen, 0.6 x 1.2 m. Affixed at the center of the back wall were six metal chambers in three rows of two each. Each chamber had opaque sides, top, and back and a mesh floor and open front. Each measured 46 cm wide, 15 cm deep, and 21 cm high. Additional climbing and perching sites were provided by handles affixed to each side wall and by the mesh ceiling of the pen.

PROCEDURE

The four subgroups were kept isolated from one another prior to their simultaneous introduction to the group pen. Each S wore a color-coded numbered tag around the neck to allow rapid identification. Observations were made on 24 days, spread across the 6 weeks following

creation of the total group. On each observation day, each individual in the group, in random order, was observed for five consecutive 30-sec intervals, using a standard checksheet procedure described previously (Rosenblum et al, 1968). O recorded the occurrence or nonoccurrence of each of a series of behaviors during the 30-sec interval and noted the partners involved. The following behaviors were considered: (1) High activity—The movement of a S from one level of the pen to another during the 30-sec interval, i.e., S moves from the floor to the chambers or from there to the ceiling or the reverse. (2) Social play—Any form or combination of contact or chasing play, as described previously (Rosenblum, 1968). (3) Agonistic behavior—Instances of: physical aggression, involving biting or manual clasp-pulling; displacement, in which an animal forces another to relinquish a given location by simply moving towards it rapidly or by pushing it aside; or genital display, involving spreading of the hind limbs and exposure of the genital area towards the face of the partner (Ploog et al, 1963). In addition to the checksheets, an additional method was utilized for obtaining data on the overall distribution of the Ss in the pen. Five times each day, i.e., after each of the three Ss had been individually observed, 2 min were taken to complete a location diagram of the pen indicating (1) which Ss, if any, were in each of the metal chambers; (2) resting contact between specific Ss at each location; and (3) the total composition of any multi-S huddles, i.e., a series of Ss in contiguous contact. The data from the checksheets and diagrams was tabulated in terms of the frequency of occurrence of each behavior and the proportion of behaviors in which S engaged which involved Ss of the same rearing subgroup and those involving interactions across such subgroups.

Fig. 1. The changes in social-play and agonism following formation of the total group.

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In addition to the initial 6 weeks of observation following group formation, follow-up observations of the remaining members of this group were made 14 months later. Unfortunately, due to a breakdown in the laboratory watering system, five Ss, two each from two subgroups and one from a third subgroup, died prior to the follow-up observations.

RESULTS

Upon introduction of the four subgroups to the pen, all Ss showed a great deal of high activity, which was sustained during the first week of group formation but abated thereafter. Males and females showed comparable scores for high activity in 64.4% and 59.4% of the intervals, respectively, during the first week. These levels dropped significantly by the second week to an overall mean of 35.6% ($p < .002$ sign test; Siegel, 1956). As indicated in Fig. 1, the initial formation period was also characterized by relatively high levels of agonistic behavior. Males and females engaged about equally in these behaviors, contributing 54% and 46% of the total agonistic responses, respectively, across the 6 weeks. Similarly, agonistic responses were not restricted to encounters between subgroups. Even in the first week of observation, agonistic behavior within subgroups averaged 43% of the total behavior of this type, and across the 6 weeks averaged 44.4% of all agonistic behaviors observed. Agonism in general declined significantly after the first week, dropping to less than a third the original value by Week 2 ($p < .05$, Friedman test).

In general terms, as the high activity and agonistic encounters waned, play and huddling increased. As Fig. 1 illustrates, social play showed a fivefold increase during the observation period ($p < .05$, Friedman test), and play was scored in a mean of 24% of the 30-sec intervals by the last week of observations. Males and females showed comparable levels of play throughout the initial study. Huddle contacts were at their lowest levels in the first week ($\bar{X}/S/\text{day} = 1.71$) and more than doubled by the second week (4.73). With continued increases in play, however, huddle contacts decreased somewhat, averaging only 2.60 contacts per S per day in the last 3 weeks of testing.

Data from the diagrams were analyzed in terms of the composition of huddling groups, the juxtaposition of Ss making contact within the huddles, and the identity of Ss occupying the same chamber.

Almost immediately following the group formation, the subgroup containing two Ss fused with one

subgroup of four. Little overt antagonism characterized the interaction of these two subgroups. By the end of the first day, huddling and contact between these six Ss showed little differentiation in terms of their original subgroup designation. They quickly behaved as one subgroup of six, interacting frequently between themselves and avoiding interaction with members of the other two subgroups.

Thus, by the end of the first day of observations, three discernible subgroups were evident. Two of these, containing four and five members, respectively, remained intact in terms of original rearing conditions; the third subgroup arose de novo by the almost immediate combination of two previously separate rearing groups whose original identities were rapidly submerged within the new subgrouping. All observations indicated that the three subgroups functioned quite equivalently during the course of the study, despite the somewhat different origin of the one subgroup. Hence, all subgroup analyses focused upon these three functioning subgroups, treating the new grouping of six Ss in the same fashion as the two intact subgroups of four and five.

As reflected in Fig. 2, the members of each of these subgroups initially showed exclusive preference for making contact with others of their own subgroup. Although the strict contact preference declined significantly during the study ($p < .05$, Friedman test), even in the sixth week the three subgroups averaged 87.0% of their contacts within their own subgroup. Furthermore, precise

Fig. 2. Preferences for interaction between members of the same rearing subgroup for each of the major behavior categories. Scores are percentages of total engagement in each type of behavior.

preferences for contacting specific partners within the subgroup were maintained throughout the study. To assess the consistency of these preferences each week, the contact scores of each S with each partner in the subgroup were tabulated and ranked. The data indicated that each S in each group had one partner who ranked first or second in contacts with it in at least 5 of the 6 weeks of observations. To test the null hypothesis that the sets of preference scores obtained in each subgroup did not differ from a population of preference scores that were completely consistent from week to week, chisquares were performed on the data from each subgroup totaled across the 6 weeks. Values reflecting hypothesized perfectly consistent weekly preferences, i.e., one partner most preferred each week, another the second preference each week, etc., were used as the expected values for each cell in the matrix. The p values associated with the three chisquares obtained were .80, .50, and .20, indicating that for each subgroup the null hypothesis could not be rejected. Thus, it may be concluded that not only were there consistent first preferences for contact with specific partners, but that the entire ordering of interindividual preferences within the subgroups remained quite consistent across the 6 weeks.

In keeping with the contact data, huddle composition initially was restricted to members of the same subgroups. However, as Fig. 2 indicates, Ss of each subgroup showed somewhat greater tolerance for inclusion of outgroup Ss in the huddles as weeks progressed ($p < .05$, Friedman test), although clear preferences within subgroups were maintained. Thus, by the sixth week, 82% of huddling scores were still between members of the same subgroups.

In addition to their preferences regarding contact and huddle composition, the subgroup members initially were quite restrictive regarding the presence of outgroup Ss in the same chamber with them. Indeed, much of the initial agonism concerned attempts to dislodge outgroup Ss from a given chamber or to prevent them from entering a chamber already occupied. However, as Fig. 2 illustrates, chamber occupancy rapidly became less exclusive regarding subgroup membership. Although initially 92.5% of same-chamber scores were within subgroups, these scores declined significantly ($p < .02$, Friedman test) and by the sixth week only 58.8% of same-chamber scores were between members of the same subgroup.

Unlike contact and huddling patterns, from the outset play was not restricted to interactions between members of the same subgroups. Although play scores, particularly initially, were rather low (about one-third of the Ss failed to play in any given week), even in the first week 26% of the play scores were between members of different subgroups. Although subgroup preferences in play declined somewhat further during the study, no significant decrease was recorded ($p > .10$, Friedman test).

Follow-up observations of the remainder of the group more than a year later, when Ss were more than 2 years old, indicated that although strong subgroup preferences remained, sexual factors had begun to emerge. Unfortunately, only three females, one from each subgroup, remained alive at follow-up: two of these females showed a decided preference for contacting one another. Furthermore, unlike the initial observations, females now showed significantly less play than males ($p < .02$, Mann-Whitney U) and hence little could be determined regarding female partner preferences in play.

At follow-up, two subgroups containing three males each were still available. For these male Ss, 84.3% of their contacts were still within their respective subgroups. As in the original observations, however, play in male Ss often involved members of different subgroups; only 57.6% of the play observed in the follow-up was between members of the same subgroups.

DISCUSSION

The current study indicates that infant squirrel monkeys reared together develop strong, enduring, and quite specific preferences for interaction with one another, often to the relative exclusion of strangers. In early adolescents, i.e., 1-year-olds, these preferences show no sex differences and are particularly evident in the sustained resting behaviors in which Ss huddle together. The integrity of these rearing groups is apparently maintained, despite agonistic behavior within them, and well after agonistic encounters

between subgroups have abated. After a period of time, Ss show an increased readiness to share an enclosed space with relative strangers, but it is only in terms of play behavior that any sustained interactions between the unfamiliar peers can be observed. Even in play, however, some preference for more familiar peers is maintained for long periods. After more than a year of living together, original preferences, in terms of contact patterns, remain quite strong, and in males at least, even some residual preferences in play are maintained. However, from both the initial and follow-up observations, it seems likely that it is social play that serves as the most important mechanism for bringing together disparate members of larger groups and for providing the means through which strangers and their offspring can be integrated into the social structure. Thus, in addition to the adaptive significance attributed to play for individual development, we may add the hypothesis that play serves an adaptive function for the group as a whole.

Some questions are raised by the current study which suggest the operation of additional factors in organizing preadult social behavior in squirrel monkeys. It seems likely, for example, that even prior to puberty sexual differentiation in behavior may exert an influence upon peer preferences. Thus, in the follow-up study, the absence of other females in the subgroup resulted in females moving towards each other across subgroup lines. It seems likely, from descriptions of free-ranging squirrel monkeys (Dumond, 1968), that these homosexual preferences for some behaviors become even more pronounced with puberty.

Another factor we cannot explain at present is the immediate fusion of the one subgroup containing two males with the other larger group containing two males and two females. One can speculate that a subgroup of two is unable to establish and maintain a resting huddle or area protection on their own and are motivated to join a larger group. Even if this hypothesis

were correct, we must still explain the apparent acceptance of these two Ss by the larger subgroup. These questions of critical group size regarding group integration and fractionation are of major concern to field workers on many species, and the use of nuclear rearing groups in the laboratory may offer some significant insights into the dynamics of group behavior in primates.

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