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Social Cohesion Among Captive Squirrel Monkeys (*Saimiri sciureus*)

F.F. Strayer* and P.J. Harris

Département de Psychologie, Université du Québec à Montréal, Montréal, C.P. 8888, Québec, H3C 3P8, Canada

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Summary. 1. Descriptions of primate group structure emphasize both dispersive and cohesive activities as primary aspects of social organization. Among captive squirrel monkeys, laboratory studies of dominance relations are relatively abundant. However, a comprehensive behavioral analysis of *Saimiri* cohesive relations has not been completed. The present investigation provides such an analysis by focusing upon play, sexual, and affiliative activities in stable *Saimiri* groups.

2. Social interactions were observed among two captive groups containing three males and five females. Daily observations during a four-week period were conducted to examine dyadic patterns of social interaction. Three intercorrelated clusters of cohesive behavior were identified. These clusters were used to provide converging indices of play, sexual, and affiliative bonds.

3. Sociographic representation of social preference and social contacts indicated that social organization in both groups closely paralleled that reported for feral and semiferal *Saimiri*. Results are discussed in terms of their implications for assessing primate social bonds, as well as developmental changes in social cohesion as members of a social unit mature.

Introduction

The stability and organization of any primate troop depends upon the delicate balance struck between social activities promoting group cohesion and those leading to social dispersion. The emergence of group dominance structures which formalize social conflict can be conceptualized as a regulating system which minimizes the impact of aggressive forces that drive animals apart and keep them separate. In contrast, activities which promote group cohesion can be conceptualized as independent factors that attract individuals to one another and maintain them in a coordinated social unit. Primate dominance relations

* To whom reprint requests should be sent

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have long been the focus of extensive analyses in both field and laboratory settings (Bernstein, 1970; Richards, 1974; Smith et al., 1977). By comparison, comprehensive analyses of the factors promoting group cohesion have been fewer in number and more limited in scope.

By emphasizing single classes of behavior as primary cohesive agents, many researchers have provided information which alone is insufficient to explain group affinity. However, a more complete multidimensional approach to group cohesion requires information on diverse activities that are characteristic of all age-sex classes. At least three major types of social relationships can be identified which function to integrate primate troops. Affiliative bonds, generally regarded as derivatives of parental attachment (Anthoney, 1968; Rosenblum and Kaufman, 1968), are usually assessed through measures of spatial proximity and contact behaviors such as allogrooming. Sexual bonds are probably the least stable social relations, but still provide a major source of adult attraction (Chance, 1963; Jolly, 1972). Finally, social play serves as the most important context for primate socialization. Relations with playmates endure into adulthood, and directly influence subsequent social activities ranging from dominance to reproductive behaviors (Dolhinow and Bishop, 1972; Poirer and Smith, 1974).

Given the obvious importance of these three general classes of social activity, they should be essential parameters in laboratory analyses of social cohesion in primate groups. For most species, laboratory assessments of social play, sexual interaction, and affiliation have been guided by descriptive information available from naturalistic studies. However, with arboreal species, relevant field research has been limited due to the inaccessibility of feral groups. Such is especially the case with the New World squirrel monkey (*Saimiri sciureus*). Information from the few field studies that are available has provided, at best, only preliminary descriptions of the *Saimiri* social repertoire and the behavioral ecology of the stable *Saimiri* group (Baldwin and Baldwin, 1972, 1973; Thorington, 1968). However, when augmented by information obtained for semiferal groups (Baldwin, 1968, 1969, 1971; DuMond, 1968), a general outline of *Saimiri* social structure can be developed.

The unique feature of feral and semiferal *Saimiri* social organization is the tight cluster of adult females and young at the center of the social unit. Unlike many terrestrial species, *Saimiri* adult males appear spatially peripheral to the main body of the troop, apparently dispersed there by the collective attacks of adult females. Juveniles are usually found in play groups of varying sizes, and remain fairly close to the central cluster.

Studies of social bonding within captive *Saimiri* groups have provided less consistent findings. Mason (1971, 1974) compared social preferences of both *Saimiri* and *Callicebus (C. moloch)*. His findings indicated that *Callicebus* affiliated with members of the opposite sex while, among the *Saimiri*, females preferred members of the same sex and males showed preference only for females. These are preliminary results which conform with expectations derived from research on feral affiliative patterns. In contrast, a number of researchers (Hopf, 1972; Latta et al., 1967; Ploog, 1967; Ploog et al., 1963; Strayer and Bovenkerk, 1963) have found that heterosexually housed animals affiliated most often with members of the opposite sex. More recent research indicates that age-sex ratios

are important determinants of social organization. Fairbanks (1974) found female affiliative clusters in a captive group where the sex ratio was three females to each male. By manipulating group composition, Strayer et al. (1975b) were able to produce sex differences in social affiliation which resembled same-sex feral preferences or atypical opposite-sex preferences.

A general problem in comparing social cohesion across laboratory groups arises from the use of varied techniques which emphasize different forms of social activity. Such assessments of cohesion often do not require sufficiently detailed definitions of behavior patterns. Furthermore, few researchers have demonstrated convergence among the behavioral indices purported to assess cohesion. Our own research has placed greater emphasis upon this latter point. Strayer et al. (1975a) found high intercorrelations among three patterns of *Saimiri* dyadic affiliation. By using a more complete catalog of cohesive behaviors in an extension of this analytic procedure, the present research was designed to provide a more comprehensive description of social bonds within captive squirrel monkey groups.

Materials and Methods

Subjects. Sixteen squirrel monkeys (*S. sciureus*) were used as subjects. The first group contained three adult males (U, J, and P, estimated age 5–6 years) and five adult females (W, Z, R, E, and K, estimated age 5–6 years). These animals were all of the Gothic arch variety (Rosenblum and Cooper, 1968). Members of the second group were all of the Roman arch variety. This latter group contained two adult males (A and B, estimated 5–8 years), one juvenile male (V, age 18 months), four adult females (S, F, H, and L, estimated age 5–6 years) and one juvenile female (O, age 15 months). Both groups were formed five months prior to data collection. Housing consisted of two identical wire compounds measuring $4 \times 3 \times 3$ m. Each compound was equipped with a variety of perches and swings. Lighting was automatically controlled with a 12-h light-dark cycle. Throughout the study, all animals had continual access to food and water.

Procedure. Prior to data collection, a list of 16 affiliative, play, and sexual behaviors was compiled from casual observation and a search of the literature. Specific descriptions were adapted from three major sources: Hopf et al. (1974). Latta et al. (1967), and Strayer et al. (1975a). After preliminary training, interobserver reliability using this inventory was evaluated weekly by coding video records of *Saimiri* social interaction. Using the standard percent agreement formula (number of agreements divided by the sum of agreements plus disagreements), interobserver reliability averaged 96% over all patterns. The complete behavioral inventory consisted of:

Affiliative Behaviors

1. *Touch-head:* the initiator brings hands or mouth in contact with the head of another animal who shows no evidence of fear or withdrawal.

2. *Touch-body:* the initiator brings hands or mouth in contact with the body of another animal who shows no evidence of fear or withdrawal.

3. *Touch-tail:* the initiator brings hands or mouth in contact with the tail of another animal who shows no evidence of fear or withdrawal.

4. *Approach:* the initiator approaches and stops within 15 cm of another animal, but does not touch.

5. *Open-huddle:* the initiator achieves lateral contact with another animal in a semicrouch position with head raised.

6. *Closed-huddle:* the initiator achieves lateral contact with another animal with chin lowered and tucked toward the body.

Play Behaviors

7. *Play-pull:* the initiator grabs, or pulls at, any portion of another animal's body, but fails to elicit signs of fear or withdrawal on the part of the target.

8. *Play-hop:* the initiator approaches and jumps onto the back of another animal, leaping off quickly.

9. *Play-chase:* the initiator runs after another animal, usually while engaging in rough-and-tumble play. This behavior is characterized by rapid reversal of roles, as in a game of tag, with no evidence of fear or withdrawal.

10. *Rough-and-Tumble Play:* mutual grasping, pulling, and pushing with another animal which occurs with no evidence of fear or withdrawal.

Sexual Behaviors

The following patterns are generally initiated by adult males, although similar behaviors have been also observed for both adult females and juveniles.

11. *Neck-chirp:* the initiator nuzzles the neck and head area of another animal. This pattern is usually accompanied by purring and chirplike vocalizations.

12. *Genital-sniff:* the initiator nuzzles the genital region of another animal.

13. *Sex-chase:* the initiator pursues another animal while engaging in a series of sexual behaviors.

14. *Hip-grasp:* the initiator grabs the hips or waist of another animal with both hands, approaching from the rear.

15. *Mount:* the initiator grasps another animal by the waist with both hands, and the ankles or calves with both feet.

16. *Thrust:* this pattern generally follows mounting, and is characterized by swift or slow thrusting movements of the pelvis.

Using this inventory, both groups were observed five days per week for four weeks. Observations were divided into three 40-min sessions which occurred during the morning, afternoon, and evening of each day. A total of 40 h of data were obtained for each group. The two observers watched through one-way viewing windows, alternating groups after every session. Observations were recorded on audio tape and later transcribed onto data sheets. Each interaction was scored only once, noting both the initiator of the interaction and the target animal. If either animal could not be identified clearly, the event was not scored.

Results

1. Patterns of Social Behavior

A total of 8,817 behavioral interactions defined in the present inventory were recorded during the four weeks of observation. Of these, 76% (6,698) were scored in the affiliative category, 9% (817) in the sexual category, and 15% (1,305) in the play category. A summary of observations for each group is provided in Table 1. It is evident that there were large differences between

Table 1. Summary of observed cohesive activities for the two groups

No./Behavior	Gothic		Roman	
	Total frequency	Average rate per hour	Total frequency	Average rate per hour
1. Touch-head	46	1.15	102	2.55
2. Touch-body	395	9.88	922	23.05
3. Touch-tail	25	0.63	206	5.15
4. Approach	1115	27.88	2046	51.15
5. Open-huddle	843	21.08	428	10.70
6. Closed-huddle	343	8.58	227	5.68
Affiliation total	2767	69.18	3931	98.28
7. Play-pull	161	4.03	489	12.23
8. Play-hop	3	0.08	444	11.10
9. Play-chase	3	0.08	106	2.65
10. Rough-and tumble play	0	0.00	99	2.48
Play total	167	4.18	1138	28.45
11. Neck-chirp	82	2.05	40	1.00
12. Genital-sniff	242	6.05	87	2.18
13. Sex-chase	37	0.93	13	0.33
14. Hip-g rasp	102	2.55	29	0.73
15. Mount	108	2.70	2	0.05
16. Thrust	71	1.78	1	0.03
Sex total	642	16.05	172	4.30
Total behavior	3576	89.41	5241	131.03

groups in the absolute rate of social behaviors. In general, members of the Roman group initiated almost 50% more social activity. However, in both groups the cumulative frequency of the six affiliative patterns accounted for over 75% of the total social behavior. Three affiliative patterns – touch-body, approach, and open-huddle – were observed most often. Although the relative frequency of these three patterns differed in the two groups, in both cases they constituted approx. 85% of observed affiliative activity. More extreme between-group differences were evident in the occurrence of the four play patterns. A total of 1,138 play behaviors were observed in the Roman group, a cumulative frequency nearly six times that found in the Gothics. The play-pull pattern accounted for the greatest number of play interactions in both groups, although the Roman frequency exceeded the Gothic total threefold. The remaining three patterns occurred with a relatively high frequency in the Roman group, but were seldom observed among the Gothics. In contrast to the comparative predominance of play in the Romans, the members of the Gothic group engaged in substantially more sexual interaction. Between-group differences in

total frequency were apparent in all sexual patterns. However, genital-sniff proved to be the most frequently occurring sexual pattern in both groups, accounting for over 38% of sexual interactions.

2. *Dyadic Social Interaction*

The preceding summary of observed social behavior gives a general overview of the types of cohesive activity within each group. However, this preliminary description provides little information about social coordination among group members, or the nature of cohesive bonds within each social unit. These latter questions require a consideration both of the specific forms and of the social direction of behavioral activity. Thus, in the following analyses, the 28 dyads within each group were treated as 56 *directional dyads*; that is, each dyad A–B was conceptualized as two directional dyads A→B and B→A. The basic question in these dyadic analyses entailed assessing the degree to which different forms of behavior covaried for the 56 directional dyads in each group. Since some of the behavioral patterns occurred infrequently, only those activities with an average rate of occurrence greater than twice per hour during each of the four observational weeks were included in the analyses. For the Roman group these patterns consisted of touch-body, touch-tail, approach, open-huddle, closed-huddle, play-pull, play-hop, play-chase, and genital-sniff. For the Gothic group the patterns included in the dyadic analyses were touch-body, approach, open-huddle, closed-huddle, play-pull, genital-sniff, hip-grasp, and mount. Finally, in order to normalize the distribution of dyadic rates of interaction, a root transformation was conducted on all scores prior to correlational analysis.

Dyadic intercorrelations between rates of initiated activity for the Gothic

Table 2. Correlations for initiated dyadic interaction observed in the Gothic group

No./Behavior	Affiliation				Play	Sex		
	2.	4.	5.	6.	7.	12.	14.	15.
2. Touch-body	1.00							
4. Approach	0.51[a]	1.00						
5. Open-huddle	0.63[a]	0.60[a]	1.00					
6. Closed-huddle	0.56[a]	0.69[a]	0.87[a]	1.00				
7. Play-pull	0.64[a]	0.37[a]	0.63[a]	0.48[a]	1.00			
12. Genital-sniff	0.77[a]	0.32	0.33	0.32	0.29	1.00		
14. Hip-grasp	0.73[a]	0.27	0.24	0.23	0.27	0.91[a]	1.00	
15. Mount	0.62[a]	0.24	0.30	0.28	0.30	0.76[a]	0.73[a]	1.00

[a] $P < 0.01$, $df = 54$, two-tailed test

Note. Correlations were calculated only for patterns which occurred more than an average of twice per hour in each observational week

group are shown in Table 2. Two expected clusters of significant correlations are evident in this matrix. The first is comprised of the four frequently occurring affiliative patterns – touch-body, approach, open-huddle, and closed-huddle. The strongest relations within this affiliative cluster were evident among the latter three patterns. The second cluster of significantly related behaviors included the three frequent forms of sexual activity – genital-sniff, hip-grasp, and mount. Finally, some significant correlations were also evident between behavioral patterns from different categories of cohesive activity. The dyadic rate of play-pull correlated strongly with the rate of three affiliative patterns, and touch-body correlated strongly with the three sexual patterns.

The corresponding dyadic correlations between behavioral patterns for the Roman group are shown in Table 3. This analysis revealed a slightly different constellation of interrelated behavioral patterns. Again, two expected clusters of behavior were evident. The first contained the five frequently occurring affiliative behaviors – touch-body, touch-tail, approach, open-huddle, and closed-huddle. However, in contrast with the Gothic findings, the most strongly related affiliative patterns for the Roman group were the various touch and approach activities. The second expected cluster of behaviors was comprised of the three play patterns – play-pull, play-hop, and play-chase. Once again, significant correlations were also evident between behaviors from each of these two categories. In general, the strongest between-category correlations were for the touch and play activities.

In order to provide a more precise summary of the correlational results shown in Tables 2 and 3, both matrices were factor analyzed using a principal components solution with normal Varimax rotations. The results from these factor analyses are shown in Tables 4 and 5. For the Gothic group, two general factors describing cohesive activities were evident. The first factor related most

Table 3. Correlations for initiated dyadic interaction observed in the Roman group

No./Behavior	Affiliation					Play			Sex
	2.	3.	4.	5.	6.	7.	8.	9.	12.
2. Touch-body	1.00								
3. Touch-tail	0.74[a]	1.00							
4. Approach	0.77[a]	0.74[a]	1.00						
5. Open-huddle	0.52[a]	0.54[a]	0.49[a]	1.00					
6. Closed-huddle	0.14	0.12	0.13	0.71[a]	1.00				
7. Play-pull	0.74[a]	0.80[a]	0.72[a]	0.37[a]	−0.07	1.00			
8. Play-hop	0.67[a]	0.76[a]	0.69[a]	0.36[a]	−0.05	0.80[a]	1.00		
9. Play-chase	0.51[a]	0.53[a]	0.53[a]	0.18	−0.07	0.65[a]	0.72[a]	1.00	
12. Genital-sniff	0.39[a]	0.20	0.27	0.24	0.13	0.03	0.03	0.01	1.00

[a] $P < 0.01$, $df = 54$, two-tailed test

Note. Correlations were calculated only for patterns which occurred more than an average of twice per hour in each week of observation

Table 4. Principal component analysis for the Gothic group

No./Behaviors	Varimax factors	
	Factor 1	Factor 2
2. Touch-body	0.690[b]	0.593[a]
4. Approach	0.179	0.655[b]
5. Open-huddle	0.141	0.934[b]
6. Closed-huddle	0.122	0.892[b]
7. Play-pull	0.241	0.588[b]
12. Genital-sniff	0.928[b]	0.198
14. Hip-grasp	0.890[b]	0.118
15. Mount	0.810[b]	0.206
Eigen value before rotation	4.51	1.76
% Variance before rotation	56.40	22.00
Eigen value after rotation	4.26	1.54
% Variance after rotation	73.50	26.50

[a] Indicates highest loading for each behavior pattern
[b] Indicates high loading on a second factor, with $P < 0.01$, $df = 54$

strongly to sexual activity, while the second included the various forms of affiliative behavior. It is clear in this analysis that touch-body was strongly related to both dimensions of cohesive activity. The corresponding analysis for the Roman group revealed three dimensions of cohesive interaction. The first factor included a combination of play and affiliative behavioral patterns, the second related to the two forms of social huddling, and the third reflected sexual activity. In this latter analysis, touch-body again correlated strongly with the sexual factor. Perhaps more interestingly, the general affiliation factor identified in the Gothic analysis was replaced by two separate factors in the Roman results. This between-group difference suggests that the organization of cohesive bonding within stable groups may vary as a function of age-level composition of the social unit.

3. The Assessment of Social Bonds

The demonstration of significant intercorrelations between the rates of behavioral patterns originally grouped together because of similarities in form and context provides some support for the classes of social behavior in the present observational inventory. However, the results of the factor analyses suggest

Table 5. Principal component analysis for the Roman group

No./Behavior	Varimax factors		
	Factor 1	Factor 2	Factor 3
2. Touch-body	0.739[b]	0.188	0.524[a]
3. Touch-tail	0.816[b]	0.227	0.228
4. Approach	0.756[b]	0.198	0.342
5. Open-huddle	0.345[a]	0.855[b]	0.209
6. Closed-huddle	−0.085	0.849[b]	0.067
7. Play-pull	0.918[b]	0.033	0.056
8. Play-hop	0.923[b]	0.044	−0.028
9. Play-chase	0.727[b]	−0.044	−0.035
12. Genital-sniff	0.036	0.107	0.636[b]
Eigen values before rotation	4.83	1.71	1.00
%Variance before rotation	53.70	19.00	11.10
Eigen values after rotation	4.62	1.47	0.54
%Variance after rotation	69.60	22.20	08.20

[a] Indicates high loading on second factor, with $P<0.01$, $df=54$
[b] Indicates highest loading for each behavior pattern

Table 6. Correlations between categories of dyadic social behavior

Behavior category	1.	2.	3.
Gothic group			
1. Affiliation	1.00		
2. Play	0.58[a]	1.00	
3. Sexual activity	0.43[a]	0.37[a]	1.00
Roman group			
1. Affiliation	1.00		
2. Play	0.72[a]	1.00	
3. Sexual activity	0.26	−0.02	1.00

[a] $P<0.01$, $df=54$, two-tailed test

that certain behaviors may also be functionally related to patterns listed in other categories of cohesive activity. In order to directly examine the interrelationships between the three general categories of cohesive activity, category sums were derived, based on all those behavior patterns which occurred more than twice per observational hour in either group. Thus an 'affiliation score'

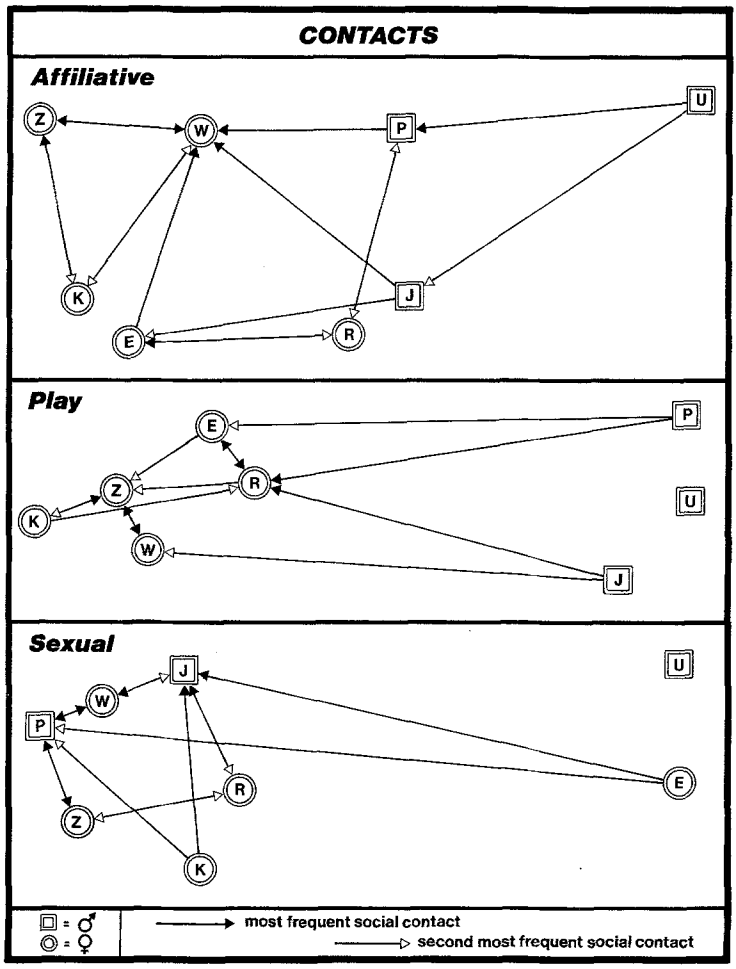

Fig. 1. Cohesive contacts within the Gothic group (length of lines is inversely proportional to the frequency of dyadic exchange)

was obtained for each directional dyad by adding the frequencies of the five affiliative patterns retained in the initial Roman analysis. Similarly, a 'play score' was defined as the total frequency of the three play patterns used in the Roman analysis. Finally, a 'sexual activity score' was obtained by summing the three forms of sexual behavior identified in the Gothic analysis.

Table 6 shows the dyadic intercorrelations between these category scores for each group. In both analyses, the strongest relationship was evident between affiliative and play activities. For the Roman group these two general categories of activity did not relate strongly to the category of sexual activity. However, for the Gothic group all three types of cohesive activity showed a positive and significant degree of interrelationship.

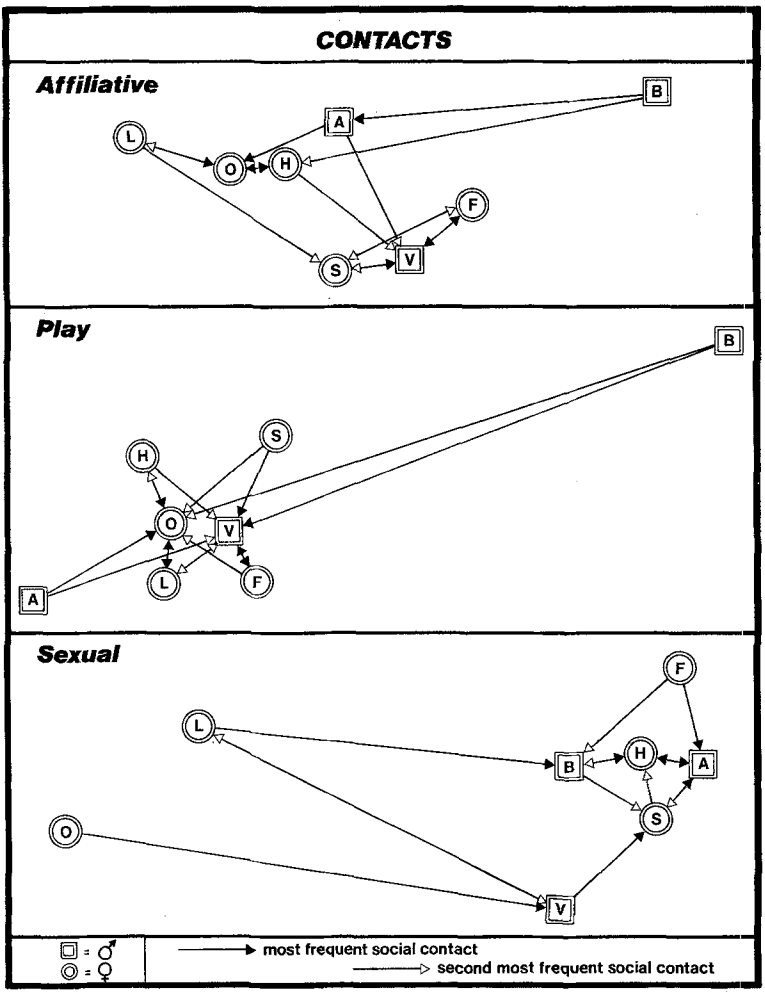

Fig. 2. Cohesive contacts within the Roman group (length of lines is inversely proportional to the frequency of dyadic exchange)

A comparison of these general category scores also permitted sociometric representations of cohesive bonds within each group. Two types of sociograms were constructed. The first set was designed to graphically represent the most frequent social contacts for members of each group. Figs. 1 and 2 show the two most frequent affiliative, play, and sexual partners for individual animals within each group. These sociograms are based upon the total interaction for the dyad without regard to the initiating or receiving roles of the two animals. The distance between dyad members is directly proportional to the reciprocal of the total frequency of dyadic activity. Thus, animals connected by a shorter line interacted more often than those placed farther apart in the sociograms. Figs. 3 and 4 show individual preference patterns for animals in each group.

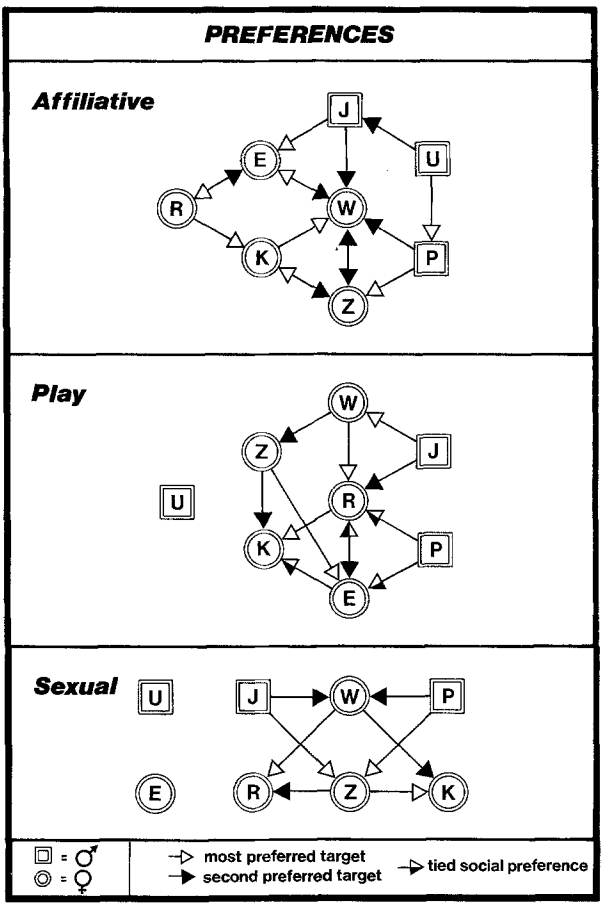

Fig. 3. Social preferences within the Gothic group

This second type of sociogram shows the two most frequent recipients for each category of initiated activity by each group member. Lines in these latter sociograms have not been scaled to reflect the frequency of directed actions, but simply denote each group member's first and second most frequent target for each type of activity.

The sociogram depicting Gothic affiliative contacts (Fig. 1) reveals a relatively close and interconnected cluster of adult females (Z, K, W, E, and R), with the three adult males (P, J, and U) somewhat peripheral to the center of the group. This isolation was especially exaggerated for the adult male U, who appears at the extreme edge of the sociogram. Figure 3 shows that female affiliative preferences were exclusively directed toward other females, while only one of the three males (U) exhibited a same-sex affiliative preference. Finally, one dyad (W–K) showed a reciprocated first affiliative preference, and for three other female dyads (K–Z, R–E, and E–W) reciprocity was present to the extent that one member was a first preference and the other a second. In the affiliative

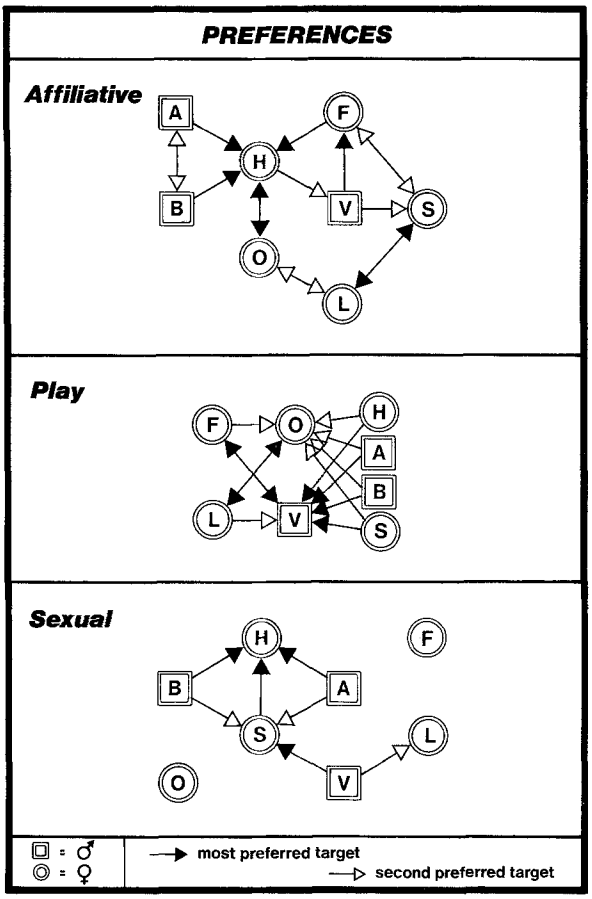

Fig. 4. Social preferences within the Roman group

contact sociogram for the Roman group (Fig. 2), the presence of a juvenile male (V) only slightly altered the central-female/peripheral-male organization. Examination of the affiliative preference sociogram (Fig. 4) showed that, without exception, adult female affiliative choices were directed toward other females or juveniles. In addition, all reciprocal first and second preferences were once again evident only for female dyads (O–H, L–O, L–S, and S–F).

The play contact sociogram for the Roman group also revealed a spatially close cluster of adult females and juveniles, with the adult males again essentially peripheral to the rest of the group. However, unlike the diversity of dyadic preferences found in affiliative relations, the majority of play preferences were directed toward the two juveniles, O and V. One juvenile in particular, V, received a high proportion of first play preferences. Reciprocal play preferences were fewer in number than in affiliative relations, involving only the juvenile dyad (O–V), and two juvenile-adult female dyads (V–F and O–L).

Play preferences in the Gothic group were somewhat less animal specific,

with every adult female being preferred by at least one other member of the group. Gothic play contacts resembled the Roman group arrangement in that two of the three adult males (P and J) were located some distance away from the majority of individuals. The remaining male (U) did not engage in play interaction and could not be placed in the sociogram. Reciprocal play preferences, like reciprocal affiliative preferences, were few in number and restricted to one female dyad (R–E).

Quite different patterns of social bonding were evident in the contact and preference sociograms for sexual activity. Strong affiliative and play bonds between adult females in the Gothics, and adult females and juveniles in the Romans, were largely replaced by associations involving the adult males. Peripheral animals in the Gothic group included both an adult female (E) and an adult male (U), while an adult female (L) and the juveniles (O and V) were found to be spatially distant in the Romans. As with other social relations, dyadic preference patterns within adult male-female dyads remained nonreciprocal. Where adult female sexual preferences are indicated, they are directed toward other females (S–H and Z–R).

Discussion

The major focus of the present research concerned the assessment of cohesive social relations within captive *Saimiri* groups. This objective required initial confidence in the categories of behavior to be used as potential indices of social relations. Analysis of dyadic initiation validated the preliminary organization of the behavioral inventory, and indicated specific clusters of behavior which could be used to assess play, sexual, and affiliative relations. These analyses also showed that categories of cohesive behavior were not independent, but rather interrelated in group-specific ways. Sociographic representation of play, sexual attraction, and affiliative relations within the present groups provided a visually comprehensible illustration of the cohesive aspects of *Saimiri* social organization, and this in turn facilitates comparison of cohesive social structures among other captive, feral, and semiferal groups.

1. Cohesive Factors in Saimiri Social Organization

Among the researchers who have observed captive squirrel monkeys, there has been a good deal of variation in reported accounts of social behavior and group structure. Frequently such laboratory findings have been discrepant with field reports. However, to a great extent the social preference patterns revealed in the Roman and Gothic affiliative sociograms closely correspond to descriptions both of feral and semiferal group organizations. Field studies strongly emphasize the adult female's attraction to members of her own sex (DuMond, 1968; Baldwin, 1971). These reports suggest that such attraction develops due to experience in play groups and aunt–mother relationships. Some laboratory research has also emphasized the gregariousness of the adult female as an

important determinant of social organization (Mason, 1971, 1974; Strayer et al., 1975b). The adult female's preference for interaction with members of the same sex may not only provide a cohesive core within the natural troop, but may have further biological value by guaranteeing that adult females capable of giving collective care to infants aggregate in a relatively close physical area.

Juvenile offspring in the Roman group also appear to be preferred by adult females. This finding may seem to contradict Baldwin's (1971) observation that semiferal adult females tend to avoid individuals of other age-sex classes except their own young infants. According to Baldwin, the closest contacts between juveniles and females were during prolonged rest periods, where the younger animals were seen no closer than 2 feet away from sleeping adults. Since the Roman juveniles were relatively older than infants described by Baldwin, and tended to affiliate actively through contact and proximity behaviors, it may well be that the affiliative relations between these two age classes are slightly altered by the conditions imposed due to captivity. Continued affiliative interaction of juveniles with adult females may also provide some explanation for the lack of affiliation between the two juveniles. Feral juveniles seldom interact outside their peer group, preferring to travel, rest, and play together, yet both Roman juveniles rarely interacted in an affiliative fashion, again suggesting some modification of feral organization as a function of captivity.

To some extent Baldwin's (1969) discussion anticipates this possibility. In his short comparison of *Saimiri* social ontogeny in semiferal and laboratory environments, Baldwin noted that laboratory females interacted with their offspring several months longer than semiferal females. He attributed this difference to the fact that semiferal adults and infants had many more contemporaries with whom to interact. Thus, once an infant play group has formed, the young interact primarily within this group. Semiferal females, in turn, resume fairly complex adult-adult interactions. With fewer social alternatives in the laboratory, young monkeys do not experience intense peer group socialization. This fact, acting in conjunction with the confined space, may have an effect in prolonging the adult–offspring relationship.

A final point concerning affiliative relations involves the association between adult males and females. Although attracted to adult females, the adult males' peripheral positions in both groups stress the weak affiliative bonds between these two sex classes. This peripheral affiliative position has been reported in all field studies. Furthermore, these peripheral positions were maintained without the frequent collective attacks of adult females, suggesting possible mechanisms beyond overt female aggression for enforcing social distance.

To a large extent, affiliative peripheralization may result from hormonal factors, although there is considerable confusion over the exact nature of the role which gonadal hormones might play. DuMond and Hutchinson (1967) and Baldwin (1968) have noted that nonspermatogenic males are relatively passive, maintaining large distances between themselves and the troop females. With an increase in spermatogenesis, there is a corresponding rise in both the frequency and persistence of the males' approaches to females. Such approaches are either tolerated or rebuffed depending on the receptivity of the female. In a more controlled situation, Alvarez (1968) found that castration

produced dramatic alteration of *Saimiri* affiliative patterns. Prior to surgery, animals had maintained the characteristic close–adult-female/peripheral–adult-male social organization. However, following gonadectomies, these patterns were abolished, with animals of both sexes maintaining close affiliative relations even after hormonal replacement. Thus, while it may be too early to assess the exact role of hormones, it is apparent that there are important sex-related variables which control species specific affiliative patterns.

Whereas between-sex affiliative associations were weak in both groups, sexual interaction appeared as the strongest cohesive social relation binding the adult males to the central cluster of females. Affiliatively peripheral males were sexually central, forming associations with the majority of females. These relationships were somewhat analogous to the sexual bonds found among feral animals during the breeding season. Since sexual relations were the primary type of social contact between adults of different sexes, it seems plausible that Zuckerman's (1932) original thesis concerning the cohesive effect of sexuality may have some limited application to explain the lack of dispersion for peripheral males in feral *Saimiri* groups.

2. Developmental Implications

The analysis of Roman play relations provides further information on *Saimiri* sex differences in behavior. For the most part, play interaction was primarily directed toward and between the two juveniles, O and V. The young male appeared to be the most preferred play partner by five of the seven group members. Such play preferences may provide a developmental basis for sex-role differentiation within the adult group. Studies on social ontogeny have noted that after the first year of life, *Saimiri* males engage in substantially longer and rougher bouts of play than juvenile females (Ploog et al., 1967; Baldwin, 1969). Baldwin (1969) indicated that as the juveniles mature, females gradually withdraw from play activity and maintain closer associations with the adult females. Males, on the other hand, continue to associate with other young males, venturing farther away from the central female cluster. Because of activity level differences, adult females become increasingly less tolerant of juvenile males, often threatening their approach, much as they would the approach of fully adult males.

A more detailed inspection of the juveniles' play preferences reveal that O's first preference is directed toward her mother (L). In contrast, V's preference is directed toward his behavioral 'aunt' (F). Coupled with the apparent spatial distance separating V and his mother (S), these results suggest the beginning of possible peripheralization of the young male. It is also interesting to note differences in V's affiliative relations in comparison with O's. Both juveniles choose their mother and 'aunt' as primary affiliative partners. However, in V's case, these two females do not reciprocate his preferences, again providing some indication of V's social peripheralization.

The behavior of both the Roman juveniles conforms with expectations derived from information on the socialization process in feral groups. O, by main-

taining her familial contacts, should eventually decrease her play activity with the young male, V, in order to develop more adultlike female affiliative bonds. As his associations with adult females disintegrates even further, V should be destined to a more peripheral role in his social group, a role that may very well include a period of social isolation, depending on the tolerance of the other already peripheral adult males.

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Erratum

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On pages 147–149: (1) The graph in Fig. 4 belongs with the Fig. 5 caption; (2) the graph in Fig. 5 belongs with the Fig. 6 caption; (3) the graph in Fig. 6 belongs with the Fig. 4 caption.