# The Young And The Restless: Male-Female Relationships In A Group Of Captive Lion-Tailed Macaques, Macaca Silenus

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*This study looked at a captive group of lion-tailed macaques, a male dispersed species, in which sexually mature related males were housed with related females in order to assess the effect on male-female relationships. Data were collected via focal sampling on females for all occurrences of event behaviors (ignore, facial threat, physical rebuke, and sexual reception) and focal sampling on males for grooming bouts. Results showed high frequencies of aggression between unrelated dyads (N=37) compared to related dyads (N=24) as well as higher frequencies of affiliate grooming behavior between unrelated dyads compared to related dyads (N=24 versus N=10). A possible link between aggression and age class exists, but many other factors influence this specific troop that should be considered in interpretation of the results, especially captivity stress.*

While much previous research on primate groups has focused on behavior common among same-sex dyads or groups, there is a dearth of data collected on the behavior found between males and females, outside of breeding seasons and general mating tactics (Maestripieri & Wallen 1997, Massen et. al. 2012). The few studies that have attempted to understand male-female relationship benefits outside of the scope of mating and reproduction focus mostly on wild troops (Perry 1997). Studying groups in captivity provides a unique opportunity for researchers to thoroughly assess these interactions due to increased troop visibility and

better recognition of individuals. These are more difficult to accomplish in natural environments where troops can move large distances and must be tracked down over terrain, as well as contending with weather restrictions or dense foliage. Such an advantage was employed in this study done on the male-female relationships of the lion-tailed macaque, *Macaca silenus*.

Studying the captive behaviors of this species is especially pertinent because it is highly endangered. Extinction levels are mostly attributed to anthropogenic habitat restriction and destruction (Krishnamurthy & Kiester 1998, ICUN 2012). A growing number of lion-tailed macaques are held in captivity for species preservation and protection against habitat loss and imminent extinction (Lindburg et. al. 1989). If this current norm continues, it can be expected that the majority of lion-tailed macaques will be housed in captivity, and an understanding of their specific care needs will become even more vital. Such needs extend into the understanding of group dynamics, and how unnatural group settings can affect the relationships that form among troop members. In the wild, although males and females of this species live in close proximity, they are not immediately related. In captivity, this may not be the case. For breeding and population growth purposes, an understanding of the male-female dynamic is essential (Lindburg et. al. 1989).

The lion-tailed macaque is an endangered monkey indigenous to India. Like most primates, the lion-tailed macaque employs a specific strategy to avoid incestuous mating, single-sex dispersal. This is a common strategy found in multi-male, multi-female troops (Lehmann & Perrin 2003). Single-sex dispersal is accomplished by either the males or females of a group leaving their natal group upon reaching sexual maturity. The dispersed sex does not return to the original group. In this species of macaque, males are the dispersed sex (Singh et al. 2011). In addition to this behavior, male to male aggression is high, and dispersed males maintain their distance from the same sex (Singh et al. 2011). They prefer to interact with only a female troop.

In captivity, unless accomplished via keeper intervention, males do not have the option to disperse. Males born in captivity stay with related

males and females in simulated imitation troops. This arrangement augments aggression between individuals as it disrupts the natural tendencies. This also places restrictions on potential mating partners. Siblings and parents remain in troops together reducing genetic diversity and disrupting animal culture. Females will meet any continued presence of a related male with hostility because females do not want to mate with closely related males (Manson & Perry 1993). Missed mating opportunities and constantly limited potential for reproductive success could have a negative impact on relationships between males and females, especially related males and females.

The question remains with so many individuals housed in captivity and in unnatural group settings, are there distinct behavioral trends among related individuals kept together into adulthood? This study compares the levels of aggression and affiliation in relationships between male and female *Macaca silenus* bred and housed in artificial troops in captivity. It is hypothesized that levels of aggression would be higher between related males and females, and lower among non-related males and females. This hypothesis follows the idea that female lion-tailed macaques expect related males to leave the troop. Predictions were that among related dyads, females would exhibit higher levels of aggression and less affiliate behaviors.

## Materials and Methods:

Data were collected at the Reid Park Zoo in Tucson, Arizona from a group of five lion-tailed macaques that were housed in a caged environment. The environment was outfitted with several trees for climbing, natural substrates, a small pond for drinking, and access to a night house, which is closed off during the day. The troop was composed of two adult males, and three adult females. Of the adults, there were three young adults, one male and two females, and two older adults, one male and one female. All were bred in captivity (Reid Park Zoo records). The older male was the sire to two of the young adults, the male and one female. The older female was the mother of the young male. The remaining young female

was unrelated to any of the members, but was born at the Reid Park Zoo (Figure 1). The two young females sexually cycled regularly, with visible perennial skin swellings typical of this species. The two males, although both still of capable breeding age, were genetically represented in the Association of Zoos and Aquariums' studbooks enough that the old male was vasectomized, and the young male was castrated, preventing them from further unwanted breeding.

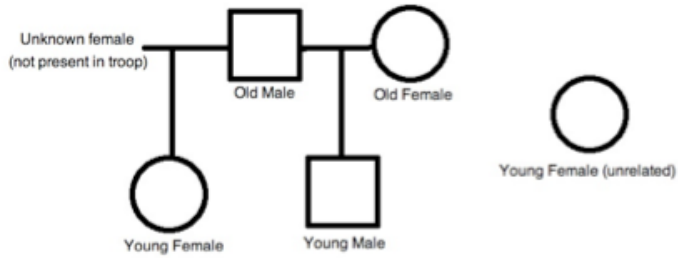


*Figure 1: Macaque troop membership and pedigree*

The troop was studied over the course of two months, March and April of 2012, with a total of twenty hours of observation. Studies started in the mornings, typically at nine or ten in the morning. Weather conditions were sunny, with average temperatures ranging from 70 to 85 degrees, Fahrenheit. Dates of observation were March 11, 20, 22, 27, and April 10, 12, 14, and 15 of 2012.

In order to assess the relationships between males and females of the group, each male and female were paired as separate dyads, and labeled as related or non-related. The young male is part of three dyads, one unrelated, and two related. The old male is also part of three dyads, two unrelated, and one related. According to the predictions made, the young male would experience more aggressive behaviors directed from the females, and the old male less, because the young male is related to two of the females, and the old male is only related to one.

Prior to the start of the study, an ethogram (a list of observed

behaviors for a specific troop) and individual identification sheets were developed for the members of the group (Table 1). Once recognized, all behaviors were categorized as aggressive, sexual, or affiliate behaviors. All other observed behaviors were ignored. Each aggressive behavior was assigned a number on a scale from 1 to 3, 1 being no behavior, 2 being facial threats, and 3 being physical interaction. All sexual behaviors were numbered as 4. The numbers aided in differentiation between types of behavior when quantifying totals of each kind of aggression in a table. Affiliate grooming behaviors were recorded based only on the occurrence of grooming between a dyad. Sexual encounters were recorded on the basis of allowances by the female, and not on attempts by the male (i.e. if a male attempted to inspect a female, and she walked away or physically rebuked the male, the ignore/aggression was recorded and not the sexual interaction).

| Behavior | Code | Description |
|---|---|---|
| Groom | GR | One or more individual(s) uses feet, teeth, or hands to run through fur of a different individual, picking out insects or debris. |
| Cuff | CUFF | One individual forcefully strikes another with hand or foot. |
| Bite | BITE | One individual grabs the hair or flesh of another using teeth and jaw force. |
| Chase | CHS | One or more individuals rapidly follow another individual. Distinct from following by its rapid pace, and is often a play or aggressive action. |
| Displace | DIS | One subject moves another out of its occupied area/seat involving no violent behavior. |
| Tongue Flick | TF | Intermittent poking and retraction of the tongue between the teeth and lips. |
| Present | PRE | One individual stands adjacent to another with rear extended, and sends intermittent glances. |
| Mount | MT | Grasping another from behind while bent at the waist. |
| Thrust | THR | Pelvic motion created by shoving the hips back and forth. |
| Grimace | GM | Pulling back of the lips to reveal the teeth and part or all of the gums. Often directed at another individual. |
| Lip Smack | LSK | Repeated popping of the lips by pressing them together and releasing them in a quick motion. Often directed at another individual. |
| Eyebrow Raise | ER | A quick, repetitive, flickering of the eyebrows, aimed in the direction of another individual. |
| Inspect | INS | One individual lifts the tail of another to inspect rear end (usually male to female) |

*Table 1 Ethogram of lion-tailed macaque.*

Aggressive and sexual behaviors, all considered event behaviors, were sampled and recorded as focal female, all occurrences behavior. Females were watched and behavior was recorded each time a male entered into their space, within four feet of distance. Only the reaction of the female was recorded in response to the male presence in her space. This included instances of no behavior, for this study assumed to be ignoring or tolerance of the male's presence. Totals were made for numbers of occurrences of ignores, facial threats, and physical interactions, and non-aggressive, sexual interactions. The frequencies of each type of behavior were totaled together for related and non-related dyads for comparison between frequencies of tolerance, aggression, and sexual behavior.

Focal sampling (behavior scanning for a single individual at a time) was taken on each male, beginning each time grooming behavior started. Behavior was recorded at regular intervals of 15 seconds, 60 intervals at a time, for a total of fifteen minutes in each sample. Samples were then reviewed for total number of grooming bouts between each related and non-related dyad. Total bout durations and mean duration per bout were calculated for each dyad (Table 2). Mean duration per bout was calculated by dividing the total grooming time by the frequency of grooming bouts. Statistical analysis was not applied to the frequency data or bout duration calculations due to the small sample size and short duration of this study.

## Results:

Total frequency of grooming bouts between related dyads and non-related dyads as well as mean duration per bout for related and nonrelated dyads were compared against total frequencies of tolerances, aggressive actions, and sexual allowances (Table 2). Proximity of male to female at the initiation of female behavior was originally recorded. Once compared to observed behavior, it became clear that proximity did not have any effect on behavior choice (all behaviors occurred at all distances), and was not analyzed further.

| Relationship | Tolerate/Ignore | Aggression | Sexual | Grooming | MD/B |
|---|---|---|---|---|---|
| Related | 43 | 24 | 4 | 10 | 3.45min/B |
| Nonrelated | 14 | 37 | 26 | 24 | 1.86min/B |

*Table 2 Behavior frequencies for related and non-related dyads, and mean duration per bout of grooming behavior*

The data show that higher frequencies of aggression occurred between unrelated males and females than between related males and females, with a 21% increase in frequency among nonrelated subjects (Table 2). Even when counts for facial threats and physical interactions were separated there remained a higher frequency in both types of aggression among unrelated pairs over related pairs. Ignoring and/or tolerating the male's presence were much higher in frequency among related individuals than nonrelated individuals (Table 2). Out of the total fifty-seven occurrences of no behavior between males and females, fourteen non-reactions were attributed to nonrelated pairs, whereas the other forty-three were tolerances of a related male's presence (Table 2).

In sexual behavior allowances, there was an increase in allowances from females toward unrelated males over related males (Table 2). Even though unrelated dyads seem to exhibit high frequencies of aggressive behaviors, females are also much more willing to accept sexual approaches from unrelated males rather than from related males. Only four occurrences total of sexual behavior occurred between related males and females, and all those occurrences were between the same dyad.

Data for grooming frequencies show a much higher frequency of grooming between nonrelated dyads (N=24) than between related dyads (N=10). The mean duration per bout shows that although grooming frequency is higher among nonrelated pairs, bout duration is higher in related dyads (Table 2). Within the twenty hours of observation, 34.5 minutes total were spent on grooming between related pairs, and 44.75 minutes spent among nonrelated pairs.

## Discussion:

The data do not support the idea that lion-tailed macaque females are more aggressive towards related males than nonrelated males. The data in general are contradictory, and an accurate picture of the relationships in the study group is difficult to draw from the results at hand. While this does not imply that this study is a conclusive report on lion-tailed macaques housed in captivity, it does suggest that the male-female relationships present in such groups are more complicated than assumed prior to start of study, and that other factors are influencing the behavior of these animals outside of the original prediction made regarding restricted male dispersal.

Anomalies in the data point out the aforementioned complicated interactions. One such occurrence took place between the young unrelated female and the older male. Following a physical fight between the two males, the young female mounted the older male and displayed thrusting actions. Such interactions are common among primates, but are not well understood (Wundram 1979). While it was certainly a recorded male-female occurrence, it was ambiguous as to whether such a behavior was aggressive, socio-sexual, or fulfilled some other purpose. Because it could not be appropriately labeled for the purposes of this study it was not included in the final frequency results.

There also remained a difficulty in interpreting the data for frequency of ignoring and tolerating behaviors. Related males were ignored by females more often than nonrelated males. This observation makes sense if the females are truly indifferent to the presence of kin. However, it is difficult to accurately assess motive behind no behavior. It could be tolerance, or it could be ignoring, and in both cases less aggression between related males is still viable. Assigning motive to instances of no behavior is difficult, however, and requires speculation outside the scope of observable phenomena.

Grooming behavior also led to struggles in analysis. While a higher frequency of bouts of grooming is present between nonrelated dyads, the time spent in each bout is almost half as much for each bout between a related pair. With an approximate ten-minute increase in total time spent

grooming between related pairs versus nonrelated pairs, grooming behavior does not provide enough of a measurable difference between each relationship type to create an accurate portrayal of affiliation or non-affiliation among troop members (Table 2). When such interactions were assessed in the Japanese macaque, higher instances of grooming among males and females led to higher instances of mating (Soltis 1999). This does appear to be true in our study group because while there were sexual behaviors, no instances of mating behavior occurred (Table 2).

Originally measured to provide a more dynamic interpretation of relationships between captive animals, these data do not expand upon the understanding of this troop. The frequency and mean duration per bout are somewhat inconclusive on their own, but compared to aggressive frequencies, the data are even more inconclusive. With higher aggressive frequencies among nonrelated males and females, a high frequency in grooming among the same individuals does not expound upon the aggressive frequency data because it indicates that the nonrelated dyads simply interact more than related dyads, and not that they are more aggressive with each other (Table 2). However, because the exact opposite is true among related individuals (low frequency of aggression and low frequency of grooming), it may indicate that females tend to avoid related kin overall (Table 2).

Among each analyzed type of behavior there appeared a distinct difference between the young male and the females versus the older male and the females. When age was included in the interpretation, frequencies of ignore behaviors, facial threats, and physical encounters were higher in interactions between the females and the young male (Figure 2). Such differences indicate a possible link between relation and aggression. The younger male is related to more females than the older male, which may support the original hypothesis that the females are more aggressive towards related males, if age class is accounted for in this troop. Although age was not originally included as a contributing factor in the predictions, it does reveal this pattern of aggressive interactions.

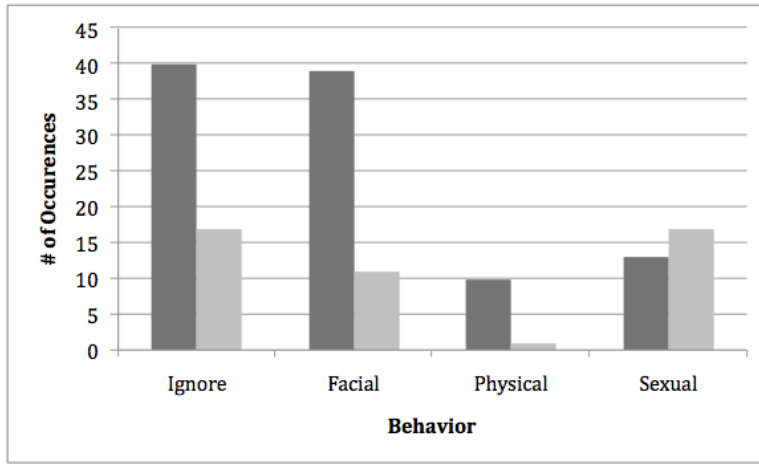


*Figure 2 – Frequencies of behavior between females and the younger male in dark grey versus females and the older male in light grey.*

The effects of captivity on the animals could also be a factor in the ambiguous and contradictory behaviors. Although all of these animals were born and raised in captivity, enclosed environments with unchanging components such as substrates and fauna can create stress and boredom in the housed individuals (Mallapur et. al. 2005). This is especially significant for lion-tailed macaques, which show a high propensity for exploratory behavior and spontaneous environmental interaction (Westergaard & Lindquist 1986). Evidence of boredom was observed in these macaques in noticeable bald spots on each primate, and most individuals favoring one spot on their bodies that he or she continually picked at, exacerbating the balding. Boredom behaviors are common, and as such most zoos implement enrichment for the animals to provide alternate ways of spending time and provide mental stimulation, which in the closely related stump tail macaque has been shown to reduce aggression and other undesirable behaviors (Márquez-Arias et. al. 2010). Enrichment for primates can include the introduction of toys, unfamiliar objects and substrates, and sometimes box puzzles that the animals can solve to receive food awards.

While observers were originally told that these macaques received enrichment four times daily, the reality of observed enrichment items were seen only one to three times per week. The enrichment items were usually ignored by the troop members, most likely due to disinterest after remaining in the environment for more than a day. In addition, the macaques only receive food once a day (Wallach 1972). Unfortunately, this feeding schedule can negatively affect zoo animals by limiting the number of times an environment change is experienced, increasing aggression, boredom, and undesirable behaviors associated with these emotions (Wallach 1972). With lack of continuing enrichment, boredom is likely a key factor in the aggressive behaviors viewed in this troop.

Extenuating factors to captivity stress are the addition of zoo visitors and general zoo noise density. While there is a separation between the visitors and the macaques, the exhibit is made mostly of large glass panels, and only one tree in the environment provides enough cover for the primates to escape from viewing. Other options include high branches of a faux tree built in the enclosure, but this tree does not provide canopy cover, and the macaques remain in full view. The lion-tailed macaque inhabits tropical forest in nature, with a large amount of canopy cover and protection from view (Kumara & Singh 2008). Wild macaques are also described as naturally shy primates that do not like loud noises and attempt to avoid areas of excessive noise and activity created by other animals (Easa et. al. 1996). Although these individuals who were bred in captivity may be more used to the human presence than wild macaques, zoo visitation can still have a stressful impact, especially if not enough secluded shelter is available to escape from view.

In addition to noise and viewing factors present from zoo visitors, overhead noise was commonly experienced from test runs of several jets and other military aircraft from the nearby Davis Monthan Air Force Base. The aircraft that flew overhead were present nearly every day that observation occurred, and the noise level was fierce enough to cause physical discomfort. The macaques were observed to crouch and jump when an

aircraft flew nearby, and the young male would often run to the entrance to the night-house. These observations further extend the evidence for stress from noise factors.

Males in this group could be experiencing stress due to the control exerted over their reproductive ability. While the older male is only vasectomized, the young male is completely castrated. Castrations in male marmosets have been shown to increase aggressive behavior between males and females, and lower intromission success rates (Dixson 1993). This supports the differences in aggressive behavior observed between the young male and the older male. Castration in rhesus macaques has also been linked to decreased interest in sexual activity, and lower success rates of intromission (Zumpe et. al. 1992). While the younger male did accomplish mounting of the unrelated female subject, it was unclear whether intromission took place.

From this study it can be concluded that age and captivity stress, exacerbated by a lack of enrichment, contribute to the behavior and interactions of these animals, but further study is needed to confirm these patterns in observation. Future studies should sample from more captive groups and increase total observation hours. This could help reduce the variance evident in this data set. Collecting similar data on troops where related males are not present would also be beneficial for behavior comparison in order to confirm if the presence of a related male has any influence on the behavior of the females. A method of testing for stress levels present among troop members without relying on behavioral evidence would also provide good comparative data, in order to assert more concrete reasoning behind aggression (Davey 2007).

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