Strong and Consistent Social Bonds Enhance the Longevity of Female Baboons

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Summary

Longevity is a major component of variation in fitness in long-lived iteroparous species [1–4]. Among female baboons, variation in breeding lifespan accounts for approximately 50% of the variation in lifetime fitness [5, 6]. However, we know little about the causes of variation in longevity in primates or other long-lived mammals. Savannah baboons form strong, equitable, and enduring relationships with specific female partners, particularly with close relatives and agemates [7–10]. The quality of females’ social relationships influences their ability to cope with stressful events [11–13] and is associated with variation in female reproductive success [9, 14]. Here we show that dominance rank and the quality of close social bonds have independent effects on the longevity of female chacma baboons (Papio hamadryas ursinus). High-ranking females live longer than lower-ranking females. In addition, females who form stronger and more stable social bonds with other females live significantly longer than females who form weaker and less stable relationships. These data extend our understanding of the adaptive value of social bonds in baboons and complement a growing body of evidence that indicates that social bonds have adaptive value in a range of taxa, from mice to humans [9, 14–19].

Results and Discussion

The analyses focus on a group of free-ranging baboons in the Moremi Game Reserve in the Okavango Delta of Botswana studied continuously over a 16 year period [6, 20]. Previous analyses indicate that infants and juveniles suffer the highest rates of age-specific mortality, whereas adults experience relatively low mortality [6]. Predation is the major source of mortality for adults in this population [6].

Behavioral measures were derived from focal observations of adult females conducted regularly using a common protocol over a 7 year period, from 2001 to 2007. The number of adult females (≥ 5 years of age) in the group during this period varied from 23 to 32, with an average of 27.4. Only females who were present in the group for at least 2 years were included in these analyses (n = 44).

All approaches, vocalizations, and affiliative and aggressive interactions involving the focal female were recorded on a continuous basis. The onset and termination of all grooming bouts were recorded, producing information about grooming initiations and the duration of grooming bouts.

We constructed a composite sociality index (CSI) to characterize the strength of affiliative relationships among females when they did not have young infants and to identify females’ top three partners in each year [9, 10]. The CSI was constructed as follows: \( A_i / A_{\text{ave}} + P_i / P_{\text{ave}} + G_i / G_{\text{ave}} + D_i / D_{\text{ave}} / 4 \). The first term represents the hourly rate of approaches for dyad \( ij \) divided by the average hourly rate of approaches for all dyads, the second term represents grooming, the third represents grooming durations, and the last represents grooming duration. These values are summed and divided by 4. The CSI measures the extent to which each dyad deviates from other dyads in a given year. The mean of the CSI is defined as 1, but the values can range from 0 to infinity. High values of the CSI represent dyads that had stronger social bonds than the average female dyad in the group in a given year, and low values of the sociality index represent dyads that had weaker social bonds. We used CSI scores to identify each female’s top three partners in each year.

To assess the consistency of females’ relationships with their top three partners, we used the following procedure. For each female, we tabulated the number of different females that were among her top three partners across years. This value, \( U \), could range from 3 to 3\( Y \), where \( Y \) is the number of years that the female was present (range 2–7). We assessed the consistency of females’ relationships as \( C = (3Y - U) / (3Y - 3) \). The possible values of \( C \) range from 1 for females who had the same three partners across years to 0 for females who had three different partners each year.

Females varied considerably in the strength and consistency of their relationships with their top partners, and this variation contributed significantly to variation in longevity. The value of the CSI for females’ top three partners averaged 7.30 ± 0.56 (range: 1.38–14.41). Although females in this group show strong preferences for closely related females [9, 10], some females established strong bonds with unrelated individuals. Thus, there was a trend for females with more relatives in the group to have stronger social bonds with their top partners (Table 1). Female dominance rank had no effect on the strength of females’ relationships with their top three partners (Table 1).

There was also considerable variation in the consistency of females’ relationships with their top partners from year to year (mean = 0.37 ± 0.03, range 0–0.67). The consistency of females’ relationships was positively related to the number
Figures and Tables

**Figure 1. Females with Strong and Consistent Stable Bonds Live Longer than Females with Weaker and Less Consistent Social Bonds**

For the purposes of the illustration, females were divided into three groups based on relationship quality. The solid line represents females in the top third, the dashed line represents females in the middle third, and the dotted-dashed line represents females in the bottom third.

**Table 1. Sources of Variation in the Strength and Consistency of Relationships**

<table>
<thead>
<tr>
<th></th>
<th>Strength</th>
<th>Consistency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β</td>
<td>Standard Error</td>
</tr>
<tr>
<td>Mothers and daughters present</td>
<td>1.7880</td>
<td>0.9378</td>
</tr>
<tr>
<td>Dominance rank</td>
<td>0.0867</td>
<td>2.0972</td>
</tr>
</tbody>
</table>

a Regression with robust standard errors: $F_{2,41} = 1.87, p = 0.169, R^2 = 0.07$.

b $F_{2,41} = 9.29, p = 0.0005, R^2 = 0.18$.

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