Social bonds affect anti-predator behaviour in a tolerant species of macaque, *Macaca nigra*

Electronic Supplementary Material

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1. **Additional figures, table and videos:**

**Figure S1.** Spectrograms showing three alarm calls produced by two different individuals in a call sequence (created with SASLab Pro 5.1.20; sampling rate: 16 kHz; FFT length = 1024 points; window=Hamming; frame size=100%; overlap=96.87%).

**Figure S2.** Reticulated python model presented to females crested macaques to elicit alarm calling.
Figure S3. Set up for the playback experiments. A) Bird’s-eye view of the experimental set up showing the position of and approximate distances between the two experimenters (E1 and E2), the subject (S) and the group. B) An experimenter was facing the target female to videotape its reaction to the stimulus, while a second experimenter carrying the speaker was hiding at a location roughly perpendicular to the group’s direction of travel, and located 10-15m away from the isolated target female. C) When the alarm call sequence was played back, the subject female produced an obvious head movement toward the speaker. If the female approached the speaker (dashed arrow), she had to deviate from the group’s travel direction, thus allowing the observer to conclude that the subject female was going towards the
speaker and not merely intended to join the rest of the group. We considered the subject female to orient towards/approach the speaker when the looking/walking direction was at ground level and within 22.5° of each side of the speaker.

**Table S1.** Descriptive statistics for the acoustic parameters used to analyze alarm call structure and data transformation applied to the raw data prior to statistical analysis.

<table>
<thead>
<tr>
<th>Parameter (unit)</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Coefficient of Variation</th>
<th>Transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise (%)</td>
<td>0.90/0.88</td>
<td>0.12/0.15</td>
<td>0.37/.027</td>
<td>1/1</td>
<td>0.116/0.128</td>
<td>arcsine</td>
</tr>
<tr>
<td>DFA2 (Hz)</td>
<td>2211/2488</td>
<td>369/395</td>
<td>1534/1746</td>
<td>3977/3789</td>
<td>0.137/0.113</td>
<td>log</td>
</tr>
<tr>
<td>DFB1 (Hz)</td>
<td>1030/1074</td>
<td>265/232</td>
<td>517/548</td>
<td>1613/1487</td>
<td>0.187/0.204</td>
<td>---</td>
</tr>
<tr>
<td>PF (Hz)</td>
<td>1576/1712</td>
<td>346/591</td>
<td>673/485</td>
<td>3350/3569</td>
<td>0.175/0.256</td>
<td>log</td>
</tr>
<tr>
<td>FR (Hz)</td>
<td>4709/5058</td>
<td>1323/1387</td>
<td>1440/2505</td>
<td>7139/7593</td>
<td>0.252/0.233</td>
<td>---</td>
</tr>
<tr>
<td>Duration (msec)</td>
<td>283/341</td>
<td>101/163</td>
<td>134/108</td>
<td>744/820</td>
<td>0.183/0.270</td>
<td>log</td>
</tr>
</tbody>
</table>

Values are presented by group in the form of R1/PB. The coefficients of variations presented are the mean individual coefficients of variation for a given parameter.

Noise: proportion of time segments in a given call that did not reveal a tonal structure;
DFA2: median of the frequencies at which in each time segment the median value of the energy distribution was reached; DFB1: first dominant frequency band; PF: overall peak frequency; FR: frequency range.

**Video S1** A video recording of a female crested macaque discovering a python and producing alarm calls. The rest of the group subsequently gather and start mobbing. The python finally flees up into a tree.
**Video S2** A video recording of a playback trial in the “affiliate” condition. The female looks towards the speaker as soon as the alarm call sequence starts, then she approaches the speaker.

**Video S3** A video recording of a playback trial in the “non-affiliate” condition. The female looks towards the speaker as soon as the alarm call sequence starts, but she does not approach the speaker.

2. **Additional methods regarding the DFA:**

Before conducting the linear discriminant function analysis, we verified that univariate distributions were symmetric by visually inspecting histograms. Here, we identified two potential outlier cases (one call in each group) and removed them from the data set. We then transformed raw data where necessary (see table S1 for information which transformation was applied to each call parameter). Whether results were based on analyses including or excluding the outliers did not affect our interpretation but we only report results where the cases were removed. After transformation, all acoustic parameters were standardized to mean=0 and SD=1 [1].

Next, we ensured that standardized acoustic parameters were not inter-correlated. The maximum Spearman correlation coefficient out of the 30 possible correlation (15 pairs of parameters x 2 groups) was 0.68 (mean = 0.21). We therefore concluded that the acoustic parameters were sufficiently independent of each other to allow entering them in a linear discriminant function analysis. We then visually checked for homogeneity of residuals conducting multivariate analysis of variance (function “manova” in R 15.0 [2]) and plotting fitted values against residuals and
creating histograms of the model residuals. Residuals were approximately normal and homogeneously distributed.

In order to assess the stability of the results obtained with the discriminant function analysis results (i.e. Wilk’s lambda) we programmed a bootstrap. Per group, we created 1 000 random data sets by randomly selecting calls with replacements (i.e. calls could occur more than once in a given data set) and then calculated Wilk’s lambda. The size of each data set matched the original number of calls recorded in the respective group. Overall results remained stable (R1: mean lambda = 0.095, max = 0.127; PB: mean lambda = 0.084, max = 0.126).

Additionally, using a jack-knife approach using a data set with all calls but one (similar to the leave-one-out procedure) indicated that no case had any leverage on the results (R1: mean lambda = 0.107, max = 0.108; PB: mean lambda = 0.090, max = 0.091).

REFERENCES
