Electronic Supplementary Material S1

Food sharing in vampire bats: reciprocal help predicts donations more than relatedness or harassment

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Supplement to Methods

We carried out our study in accordance with the Animal Behavior Society Guidelines for the Use of Animals in Research [1], and the Organization for Bat Conservation (Bloomfield Hills, MI, USA).

Microsatellite analysis

We used the web program PRIMER 3 (http://frodo.wi.mit.edu/) to design primers for 12 Desmodus rotundus DNA sequences with repeats [2] in GenBank, and added 1 additional published microsatellite marker, Tsil3Ca2 [3]. For these 13 microsatellite loci [4], we compared the frequency, and observed and expected heterozygosities from the 25 bats genotyped in our population with 16 free-ranging adult common vampire bats netted in Trinidad, West Indies. We failed to find a significant difference in heterozygosities between observed and expected values (paired t=1.85, n=13, p>0.05) or between the two populations (paired t=1.2, n=13, p>0.05). We used the programs ML–RELATE [5] and MICROCHECKER [6] to check and account for potential scoring errors and null alleles.

Sequential analyses

To determine if individual food donations were exchanged in a reciprocal manner over time, we examined the sequence of sharing events across trials. For this analysis we only analysed trials where donors were previously subjects. We also only included mouth-licking bouts longer than 15 s to remove instances of begging. We then tested (1) if the donation size from bat B to bat A in a trial was predicted by the size of the most recent previous donation from A to B, and (2) if the percentage of B’s contribution to the total food received by A in a trial was predicted by the percentage of A’s contribution to the total food received by B in the most recent previous donation from A to B.

Consistency analysis

To test for evidence of symmetrical and consistent dyadic relationships over time, we examined the amount (food donated/chances to give) and the presence or absence of food sharing for dyads that had multiple chances to donate. We used Mantel and randomization tests to assess similarity of (1) presence and amounts of food sharing in subsequent fasting rounds, (2) presence and amounts of food sharing six months apart, (3) allogrooming given and received within dyads, and (4) the food-sharing matrix with its transpose, using bats that both served as subjects and were available as donors in every round (67% of the total possible food-sharing dyads).

Supplement to Results

Pattern of food sharing

We induced food sharing on 48 out of 52 days over a period of 780 days. Overall patterns of food sharing are shown in Figure S2. Female adults and juveniles (4–8 months old) were always fed by at least one other bat, while 4 of 9 adult males were never fed. After controlling for chances to give and receive, adult females donated 78% and received 57% of the total amount of food donated, while juveniles provided and received an additional 13% and 15% respectively. We observed no food sharing between adult males. However, we did observe two unrelated adult males feeding a male juvenile, and sharing between two unrelated 8 month–old males. Sixty-three of the 98 dyads that shared food had relatedness estimates less than 0.05 (Figure S2). This percentage (64%) is close to the number expected if partners were chosen at random with respect to relatedness because 208 of 312 possible food-sharing dyads (67%) were related by less than 0.05.

Recipients were fed by an average of 3.9 donors in a trial (range=1–7). The median food donated
from a donor to recipient in a trial was 191 s (N=204 donations, mean=339 s, range=5-3315 s). When scaling by chances to give, female donors gave food to recipients for an average of 256 s (S.E.=45), and male donors gave for an average of 164 s (S.E.=89). One feeding donation lasting 3315 s from an adult female to a highly related two-year old male was an extreme outlier (Figure S1). The total amount of food received from all donors during the 2 h period was typically about 5% of an adult recipient’s mass, which restored ~20% of mass lost during 24 h of fasting. The donation during a trial consisted of several mouth-licking bouts, and the median length of a mouth-licking bout was 40 s (mean=79.9, S.D.=131.6 s).

Predictors of food sharing across dyads
Food received (p<0.0002), donor sex (p<0.0002), and allogrooming received (p=0.0056), but not relatedness (p=0.2896), predicted the presence of food sharing among the 312 dyads where food sharing could have occurred (Figure S4, S5). However, within the subset of 98 dyads that shared food, food donation size was predicted by relatedness ($R^2=0.063$, p=0.0032) and food received ($R^2=0.049$, p=0.0324) in separate univariate analyses. We found no significant predictors when these factors were considered simultaneously. The effect of relatedness was driven largely by extended maternal care. Mothers feeding their pups or putative subadult offspring (ages 4–31 months) constitute four of the largest donations (Figure S6, three largest outliers in Figure S1). If these dyads are removed, relatedness is no longer a significant predictor (p=0.4).

Supplementary Figures

Figure S1. Distribution of mean mouth-licking times before and after log transformation. Mouth-licking time was used to estimate food donated to the subject. Box shows the distance of the interquartile range, the whiskers extend that range 1.5 times, and the line within the box is the median.
Figure S2. Food donated values shown as a sociomatrix. Columns are donors and rows are fasted subjects. Blank squares have zero values and black squares are dyads that did not have an opportunity to donate or receive food. Dyads are colored according to estimates of pairwise relatedness (r): white for r estimates 0—0.05, light green for r estimates between 0.05—0.25, and blue for r estimates >0.25. Numbers are mean seconds of food sharing per trial. Unit for age is months.
Figure S3. Box plot showing food donated by donor sex. Box shows the distance of the interquartile range, the whiskers extend that range 1.5 times, and the line within the box is the median.

Figure S4. Logistic regression plot. The effect of log food received and relatedness on the presence of food sharing is shown.
Figure S5. Frequency histograms showing proportion of dyads that shared food across values of food received and relatedness. Grey bars show dyads that could have shared food in both directions and black bars show dyads that did share food. Length of bars above horizontal line is reduced by 95% to fit graph (length is equally reduced above line for both histograms).

Figure S6. Relationship between relatedness and food donated. Values for mothers feeding juvenile or putative adult offspring are shown as open circles.

References


