Supplemental information

Males with a mother living in their community have higher paternity success in bonobos but not chimpanzees

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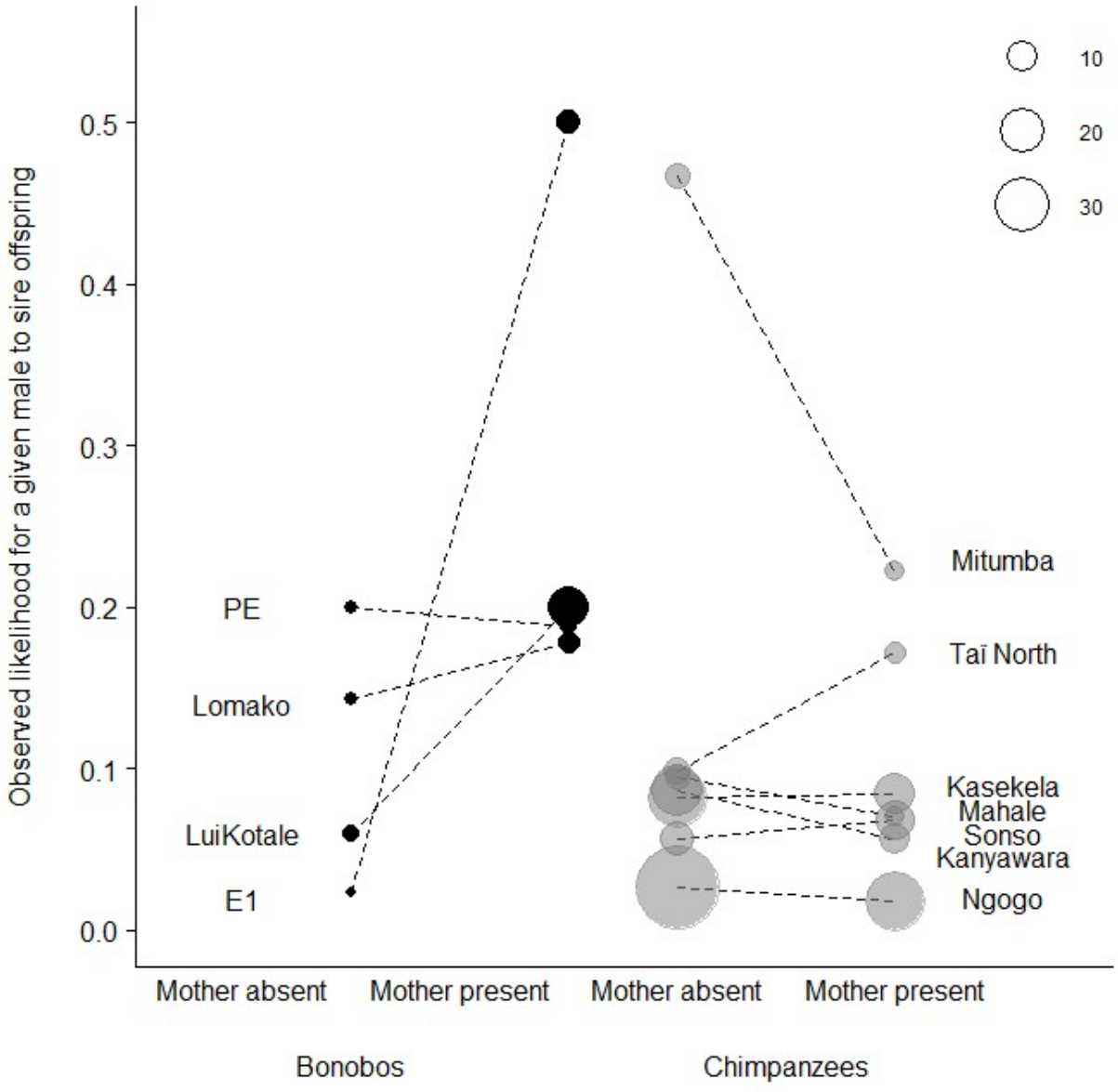

Figure S1. Average likelihood of a male to sire offspring in the presence and absence of their mothers in chimpanzees and bonobo communities.

Bonobos are represented in black and chimpanzees in grey. Circle sizes represent the number of offspring.

Species	Community (Location)	Reference to published data	Number offspring	Percentage of offspring sired in the presence of the sire's mother
Bonobo	Bompusa (LuiKotale)	[S1]	20	85%
Bonobo	Eyengo (Lomako)	[S2]	7	71%
Bonobo	E1 (Wamba)	[S3]	7	86%
Bonobo	PE (Wamba)	[S3]	5	60%
Chimpanzees	North group (Taï)	[S4]	13	38%
Chimpanzees	M group (Mahale)	[S5S,6]	11	36%
Chimpanzees	Kasekela (Gombe)	[S7,S8]	53	32%
Chimpanzees	Mitumba (Gombe)	[S8]	11	36%
Chimpanzees	Ngogo (Kibale)	[S1,S9]	109	33%
Chimpanzees	Kanyawara (Kibale)		38	26%
Chimpanzees	Sonso (Budongo)	[S10,S11]	28	57%

Table S1. Overview over included published data, sample size and percentage of sire's mothers present during conceptions.

Supplemental Experimental Procedures

Study sites

We combined genetic and demographic data from four bonobo and six chimpanzee communities (Table S1).

Data preparation

The conception date was estimated by subtracting 230 days, the mean gestation length in captive bonobos and chimpanzees ([S12,S13]), from the offspring's estimated birthdate. In the bonobo communities some conceptions occurred up to four years before the exact community composition was known (Eyengo, 6 of 7 infants with a single possible father [S2]; Bompusa, 7 of 20 infants with known within-group sire). For these cases, we assumed that the males and females identified when the community composition was first established were also present during these earlier conceptions. This assumption may have misclassified some males as having no mother living in the community at the time of a conception if their mothers died before they were individually identified. However, such misclassification is unlikely, as mothers with adult sons are older females, who are typically among the first individuals to be identified during the habituation process due to their central positions in bonobo society and distinctive physical appearances.

Statistical analysis

We used a Generalized Linear Mixed Model with a binomial error structure and logit link function [S14] to determine how the effect of having a mother living in the community at the time of a conception affected a male's probability of siring an offspring in bonobos compared to chimpanzees. For each offspring, we determined the males who were present in the group and of reproductive age (≥ 10 years) at the time of conception, and set the identity of the sire (yes/no) as the response variable. As the test predictor, we included the 2-way interaction between species (bonobo/chimpanzee) and whether a given male had a living mother at the time of conception (yes/no). As previous research in *Pan* [S1] and other group-living primates [S15] indicates that the number of competing males present at each conception influences the distribution of paternities, we controlled for the number of males present by incorporating the inverse of the number of males log-transformed as an offset term into the model. In order to exclude the possibility that a species difference in the distribution of male ages at reproduction results in a different likelihood of the mother being present, we controlled for the age of all males at conception by including it as a fixed effect. We also included group ID, male ID, offspring ID, and ID of the offspring's mother as random effects. To

keep type 1 error rates at the nominal rate of 0.05 we included random slopes of mother presence within group, mother presence within offspring, and mother presence within mother ID of offspring [S16]. The model was fitted in R (R Core Team 2015) using the lmer function of the R-package lme4 [S17].

We checked for model stability by excluding levels of community, male ID, offspring ID and mother ID of offspring one at a time from the data and comparing the model estimates derived from those data with those for the full dataset. This indicated no influential levels of them to exist (for example, results not driven by a single bonobo male siring all the offspring). Collinearity was not an issue in the model as indicated by variance inflation factors close to 1 estimated from a standard linear model (without random effects; [S18]). The p value for the two-way interaction between species and mother presence at the time of conception is based on likelihood ratio tests comparing the full model with a reduced model without the interaction [S19]. The Null vs. Full model comparison revealed significance ($\chi 2$=10.02, df=3, p=0.02).

In summary, the full model revealed the following estimates and standard errors: Intercept: -1.54±0.5; Mother presence: 1.55±0.53 (p<0.01); Species: 0.89±0.45 (p=0.05); Potential sire age 0.02±0.01 (p=0.02); Mother presence * Species -1.63±0.55 (p<0.01).

Author Contributions

M.S. analysed the data and together with L.V. and K.L. drafted the manuscript. M.S., K.L., G.H., L.V., C.B., B.F., R.W., K.Z., T.F., M.M., T.S., N.T., S.I., A.P., E.W., K.W., C.C., M.E.T. and Z.M. were involved with study design, interpretation of results or acquisition of data. All authors gave final approval for publication.

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