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Supplementary Materials for

Mandrills use olfaction to socially avoid parasitized conspecifics

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This PDF file includes:

Supplementary Materials

Supplementary Results

Protozoan status

The seven protozoan taxa found in the mandrill population are: *Balantidium coli*, *Entamoeba coli*, *Endolimax nana*, *Entamoeba hartmanni*, *Entamoeba histolytica*/*dispar* "complex", *Pseudolimax butschlii*, and *Coccidia sp*. The *E. histolytica*/*dispar* "complex" corresponds to two morphologically indistinguishable species. In December 2015, we performed Elisa tests (Entamoeba Ag Rapid Test, Creative Diagnostics) on 95 fecal samples parasitized by this complex (all samples were collected between February 2013 and December 2015 and kept at –20°C until analyses). We found that 8.4 % of samples contained the species *E. histolytica*. We therefore considered the complex as a single taxon in our analyses and kept the appellation "*E. histolytica*/*dispar*" throughout the manuscript. From October 2012 to April 2015, the prevalence of each protozoan taxon within the population (proportion of positive samples per individual averaged over the population) was 70.0 % for *B. coli*, 66.8% for *E. coli*, 64.1% for *E. nana*, 58.7% for *E. histolytica/dispar* complex, 25.4% for *E. hartmanni*, 11.7% for *Coccidia sp*., and 5.3% for *P. butschlii*.

SUPPLEMENTARY TABLES

table S1. Results of coprological analyses performed on skin smears, according to the individual's protozoan status. Only five of the seven taxa known to parasitize this population are presented (*P. butschlii* did not parasitize any of the 36 studied individuals and *Coccidia sp*. parasitized only five of them). Fisher tests were performed to compare the proportions of positive skin smears in parasitized *vs*. in non-parasitized individuals and the proportions of positive skin smears when collected from the peri-anal *vs.* from other body parts in parasitized individuals. We did not perform this latter test for *E. hartmanni* because we found only three positive skin smears in parasitized individuals. We adjusted P-values for multiple comparisons using Bonferroni corrections. Non-significant P-values probably rather reflect limited sample sizes than an absence of difference between the two sets of individuals.

	E. histolytica /dispar	*E. nana*	*E. hartmanni*	*E. coli*	*B. coli*
Number of parasitized/non-parasitized individuals	29/7	17/19	13/23	17/19	31/5
Proportion of parasitized individuals with positive skin smears (%)	52.6	41.1	23.1	52.9	64.5
Proportion of non-parasitized individuals with positive skin smears (%)	0	10.5	4.3	10.5	0
Adjusted P-values (Fisher tests)	0.01	>0.1	>0.1	0.05	0.05
Proportion of parasitized individuals with positive skin smears obtained from the peri-anal area (%)	31.0	35.3	23.1	52.3	61.3
Proportion of parasitized individuals with positive skin smears obtained from other parts of the body (%)	3.4	11.8	0	0	3.2
Adjusted P-values (Fisher tests)	0.05	>0.1	-	0.08	<0.01

table S2. Effects of each protozoan taxon on the index of grooming received. For each predictor, we calculated the sum of the Akaike weights of models that included this predictor (importance) and compared this sum to the expected value under the assumption that all tested models have equal Akaike weights (expected ratio) in order to show the plausibility of each predictor. Only *B. coli* (in bold) appears as a plausible predictor (importance > expected ratio). The estimate coefficient associated to each predictor variable and its standard error of the mean (SEM) are reported.

Predictors	Importance	Expected ratio	Estimate	SEM
B. coli	**0.53**	**0.50**	**-0.33**	**0.22**
E. histolytica/dispar	0.49	0.51	-0.21	0.15
E. coli	0.26	0.45	-0.07	0.18
E. hartmanni	0.26	0.45	-0.05	0.15
E. nana	0.35	0.45	-0.18	0.18
P. butschlii	0.45	0.49	-0.58	0.41
Coccidia sp.	0.34	0.45	-0.29	-0.32

table S3. Effects of different predictors on (A) daily degree and (B) daily number of contacts. For each predictor, we calculated the sum of Akaike weights of the models including this predictor (importance) and compared it to the ratio of the number of models including this predictor on the number of models without this predictor (expected ratio). Plausible predictors (in bold) are those with an importance greater than the expected ratio. The estimate coefficient associated with each predictor and its standard error of the mean (SEM) are reported.

A.

Predictors	Importance	Expected ratio	Estimate	SEM
Sex	**0.79**	**0.25**		
- female			**16.11**	**3.96**
- male			**17.17**	**4.80**
Age	**0.65**	**0.51**	**-0.1e-2**	**-0.7e-3**
Protozoan richness	0.28	0.5	-0.06	0.28
Rank*Sex	0.20	0.25		
- high rank*female			15.77	3.44
- low rank*female			13.85	4.54
- low rank*male			14.41	5.38
- middle rank*female			16.55	4.95
- middle rank*male			17.57	4.79

B.

Predictors	Importance	Expected ratio	Estimate	SEM
Age	**0.63**	**0.5**	**-0.4e-3**	**0.2e-3**
Rank*sex	**0.53**	**0.25**		
- high rank*female			**4.73**	**0.83**
- low rank*female			**3.76**	**1.10**
- low rank*male			**3.13**	**1.31**
- middle rank*female			**4.13**	**1.10**
- middle rank*male			**5.05**	**1.18**
Sex	**0.47**	**0.25**		
- female			**5.60**	**1.23**
- male			**5.67**	**1.52**
Protozoan richness	0.35	0.5	0.06	0.06

table S4. Effects of different predictors on the chemical similarity between pairs of fecal samples. Degrees of freedom ("df"), F-statistics, R^2 and *P* values are provided and are based on permutation analyses (5000) with pseudo-F ratios (VEGAN package, adonis procedure). We adjusted *P* values for multiple comparisons using Bonferroni corrections. Significant predictors are in bold.

Model	Predictors	df	F-statistic	R^2	*P* value
Model with protozoan status	**Season**	**3**	**36.73**	**0.59**	**< 0.001**
	Sex	**1**	**12.91**	**0.07**	**< 0.01**
	Protozoan status	**1**	**0.10**	**0.11**	**< 0.01**
Models with each protozoan taxon	***B. coli***	**1**	**13.3**	**0.07**	**< 0.01**
	E. coli	**1**	**21.4**	**0.10**	**< 0.001**
	E. histolytica/dispar	**1**	**9.2**	**0.05**	**0.01**
	E. hartmanni	1	0.6	0.004	0.3
	E. nana	1	0.3	0.002	0.5
	Coccidia sp	1	0.8	0.005	0.2

table S5. Major volatile compounds (*n* = 75) found in the analyzed fecal samples and their chemical family. Volatile compounds were extracted from 59 fecal samples, using a solid-phase micro-extraction method and analyzed on a gas-chromatograph coupled with a mass-spectrometer.

Volatile compound	Chemical family
3-ethyl-2-methyl-hepta-1,3-diene	Alkene
(E)-2-methyl-but-2-enal	Alkene
(Z)-3,7-dimethyl-oct-2-ene	Alkene
(E)-eicos-5-ene	Alkene
Hexadec-7-ene	Alkene
2-methyl-butanal	Alkene
3,7-Dimethyl-2,4-octadiene	Alkene
3,7-dimethyl-1,6-octadiene	Alkene
Dodecan-1-ol	Simple alcohol
Heptadecan-1-ol	Simple alcohol
Heptan-1-ol	Simple alcohol
Hexan-1-ol	Simple alcohol
Pentan-1-ol	Simple alcohol
Tridecan-1-ol	Simple alcohol
Heptan-2-ol	Simple alcohol
2-methyl-butan-1-ol	Simple alcohol
3-methyl-butan-1-ol	Simple alcohol
3-hydroxy-butan-2-one	Ketone
Heptan-2-one	Ketone
Hexan-2-one	Ketone
Nonan-2-one	Ketone
Octan-2-one	Ketone
Pentan-2-one	Ketone
6-methyl-hept-5-en-2-one	Ketone
Butanoic acid	Carboxylic acid and ester
2-methyl-butanoic acid	Carboxylic acid and ester
3-methyl-butanoic acid	Carboxylic acid and ester
Ethylbutanoate	Carboxylic acid and ester
Methylbutanoate	Carboxylic acid and ester
Heptanoic acid	Carboxylic acid and ester
Ethylheptanoate	Carboxylic acid and ester
Hexanoic acid	Carboxylic acid and ester
Butylhexanoate	Carboxylic acid and ester
Ethylhexanoate	Carboxylic acid and ester
Methylhexanoate	Carboxylic acid and ester
Propylhexanoate	Carboxylic acid and ester
Pentanoic acid	Carboxylic acid and ester
2-hydroxy-4-methyl-methylpentanoate	Carboxylic acid and ester
Methylpentanoate	Carboxylic acid and ester
Pentylpentanoate	Carboxylic acid and ester
Propanoic acid	Carboxylic acid and ester

2-methyl-propanoic acid	Carboxylic acid and ester
Ethylpropanoate	Carboxylic acid and ester
Hexylacetate	Carboxylic acid and ester
(+)-4-Carene	Monoterpene
2-Carene	Monoterpene
(1R)-(-)-Myrtenal	Monoterpene
α-phellandrene	Monoterpene
β-cymene	Monoterpene
(+)-(S)-linalool	Monoterpene
Trans-β-ocimene	Monoterpene
Carane	Monoterpene
L-*trans*-Pinocarveol	Monoterpene
Pinocarvone	Monoterpene
(R)-(-)-*p*-menth-1-en-4-ol	Monoterpene
p-menth-1-en-8-ol	Monoterpene
(R)-(+)-*m*-mentha-6,8-diene	Monoterpene
(+)-Cycloisosativene	Sesquiterpene
α-farnesene	Sesquiterpene
α-bergamotene	Sesquiterpene
α-caryophyllene	Sesquiterpene
α-cubebene	Sesquiterpene
α-guaiene	Sesquiterpene
(-)-β-elemene	Sesquiterpene
α-copaene	Sesquiterpene
δ-guaiene	Sesquiterpene
(-)-γ-elemene	Sesquiterpene
Germacrene D	Sesquiterpene
Humula-1,6-dien-3-ol	Sesquiterpene
2-phenylacetaldehyde	Phenylpropanoid
Phenylethyl Alcohol	Phenylpropanoid
Gamma-valerolactone	Lactone
3-methyl-1H-indole	Alkaloid
Indole	Alkaloid
Cresol	Phenol derivative

Supplementary Figure

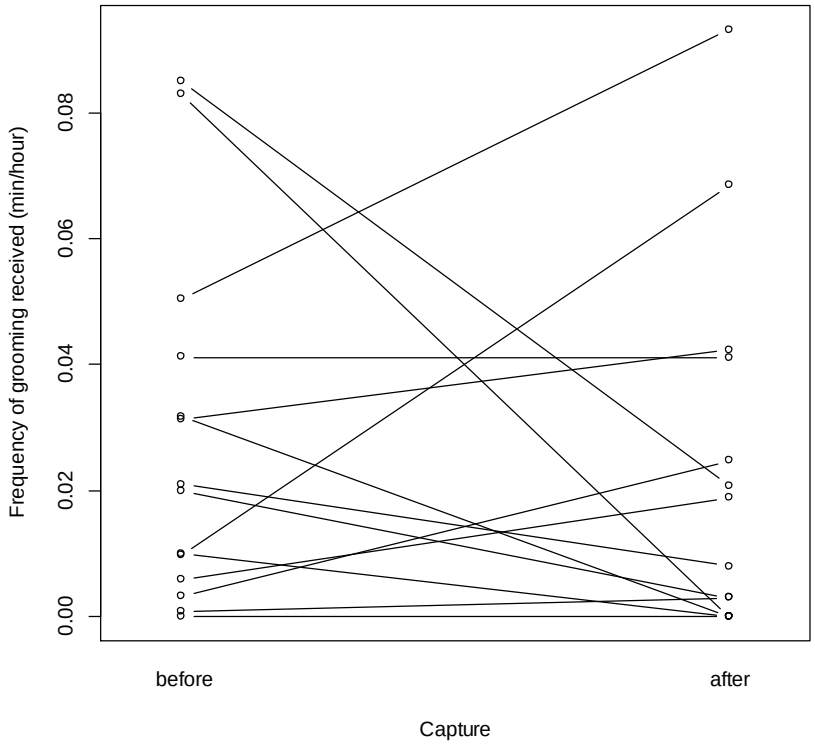

fig. S1. Effect of the capture (without medical treatment) on the frequency of grooming received. Frequencies of grooming received were retrieved from a six-week period extending from three weeks before capture ("before") to three weeks after capture ("after"). Each line represents one of the nine captured individuals that was not deparasitized.