

Supplementary Materials for

Article title:

Effects of indirect reputation and type of rearing on food choices in chimpanzees (*Pan troglodytes*)

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Fig. S1 The antisocial experimenter hits the victim.



Fig. S2 The prosocial experimenter squats next to the victim and semi-hugs her after having interrupted the fight.



Fig. S3 Both experimenters enter in the room and offer food to the ape twice (Phase 2: antisocial+4 vs. prosocial+1; Phase 3: antisocial+2 vs. prosocial+2)



Table S1. Subject's participation in a previous similar experiment

Subject	Participated in Russell et al, 2008	
	Yes	No
Alex	x	
Alexandra	x	
Annett	x	
Daza		x
Dorien	x	
Frederike		x
Frodo	x	
Jahaga	x	
Kara		x
Kofi		x
Lobo		x
Lome		x
Natascha	x	
Riet	x	
Robert	x	
Sandra	x	
Tai		x
Ulla	x	

Exclusion criteria:

We excluded infants (N=2, Azibo and Bangolo, less than 7 years-old); the mother of the youngest, because they were together all the time and she was excluded from testing during lactation and rearing (N=1, Swela); two female adults that did not show interest in participating (N=3, Corrie, Fraukje and Jeudi, they did not come to the testing room when they were called by their names) and some chimpanzees that had just arrived to the zoo and they were in their integration phase / medicalized or in quarantine in cages apart (N=4, Maja, Zira, Hope, Bambari).

Information about facilities, housing and diet:

All the subjects were housed in large outdoor (Group A: 4.000m²; Group B: 1.400m²) or indoor enclosures (Group A: 430m²; Group B: 175m²) depending on the weather conditions. Both enclosures contained a variety of vegetation (trees, shrubs, grass) as well as materials and structures for climbing, foraging and resting. There are also some enrichment structures (eg. termitarium-like apparatuses). During the test we used two testing rooms, one for each social group. The room for Group A was approximately 5x3x5m while the room for Group B was a bit longer and wider. To test the chimps, we/zookeepers called them by their names and waited until they came into the testing room. During the experiment, the subjects could get access to the offered food through a decision window allocated in the respective sides.

Chimpanzees were regularly fed three times per day with a variety of vegetables (eg. celery, carrots, lettuce), leaves, fruits (eg. apple, bananas) and occasionally meat, eggs, insects, juice and enrichment products (eg. paper rolls with seeds inside). The food used during the testing was adapted to their diets and therefore respectful to their nutritional needs, allergies and weight control approved by vets. Water was present *ad libitum*, both in the enclosures and in the testing rooms.

Demographics:

Subject	Information about participants at the time of the study (2016)			
	Group	Sex	Age	Chimp info
Alex	B	M	15	Human-reared, castrated, hybrid species, only male in B group
Alexandra	B	F	17	Human-reared
Annett	B	F	17	Human-reared
Daza	B	F	30	Mother-reared
Dorien	A	F	36	Half human-reared
Frederike	B	F	42	Mother-reared
Frodo	A	M	23	Alpha male at that moment, being disputed with Lome
Jahaga	B	F	23	Mother-reared
Kara	A	F	11	Mother-reared
Kofi	A	M	11	Mother-reared
Lobo	A	M	12	Mother-reared
Lome	A	M	15	Mother-reared
Natascha	A	F	36	Hormone chip, Half human-reared
Riet	A	F	39	Sterilized, Hormone chip, Half human-reared, big mouth non-painful tumor
Robert	A	M	41	Half human-reared
Sandra	A	F	23	Hormone chip, Sterilized
Tai	A	F	14	Hormone chip
Ulla	A	F	39	Hormone chip, Half human-reared

Table S2. Individual choices in Phases 1 to 3 (see datasheet attached for more info)

Name	Phase 1. Reward Baseline		Phase 2. Reward vs. Reputation		Phase 3. Reputation		
	1 piece	4 pieces	Pros+1	Ant+4	Pros	Ant	First
* Alex	1	5	0	2	1	1	A
* Alexandra	0	2	0	2	2	0	P
* Annett	3	5	1	1	1	1	P
Daza	4	6	0	2	1	1	A
+ Dorien	0	2	0	2	1	1	P
Frederike	0	2	0	2	1	1	P
Frodo	1	5	0	2	1	1	P
Jahaga	1	5	0	2	1	1	A
Kara	1	5	0	2	1	1	A
Kofi	0	2	0	2	0	2	A
Lobo	0	2	0	2	0	2	A
Lome	0	2	0	2	0	2	A
+ Natascha	2	6	0	2	2	0	P
+ Riet	1	5	0	2	2	0	P
+ Robert	0	2	1	1	1	1	A
Sandra	0	6	0	2	1	1	P
Tai	5	9	0	2	1	1	P
+ Ulla	0	2	0	2	-	-	-
Trials (total)	19	73	2	34	17	17	52%

* Individuals with an asterisk before their names were full-time hand-reared by humans. This entailed being baby-sitted during human working hours (they were daily hugged and fed by humans who regularly played with them).

+ Individuals with a plus sign before their names were raised in a peer-group and the intervention of humans shortly after they were born only consisted of providing them with food and giving sporadic individual care.

Table S3. Individual emotional arousal during fight and consolation (Fight 1 and Consolation 1 belong to Phase 2 and Fight 2 and Consolation 2 belong to Phase 3) (see datasheet attached for more info)

Subject	Fight 1	Fight 2	Consolation 1	Consolation 2
Alex	Bi, Ba, P, V	Bi, Er, H, M, P, V	L	L, M
Alexandra	H, J, M, V	Ba, H, J, V	NR	A, L
Annette	J, K, V	A, J, M	L	A, L
Daza	J, L, V	J	NR	NR
Dorien	M, P, V	NR	L	NR
Frederike	H, J, V	L	A, L	L
Frodo	NR	Ba	NR	L
Jahaga	Bi, L, M	NR	NR	NR
Kara	H, J, M,	Bi, H, K, V	L, E, H	L, Sc
Kofi	Bi	Ba, Bi, H, P	A, L	L
Lobo	Ba, H, J, L, P	Bi, H, J, P, V	E, H, L	NR
Lome	NR	Ba	E	A
Natascha	Bi, M, P	Bi, P	L	H, L
Riet	L, V	NR	L	NR
Robert	Ba, N	J	E	L
Sandra	M	L	M	L
Tai	H, V	H, M, V	NR	L
Ulla	NR	-	NR	-

Legend: A=approach/physical proximity, Ba= repeatedly rocking and balancing from right to left while four-hands or seated, Bi= bipedal walking or standing up for at least 1 second, E= enter hand or fingers through hole, Er= genital erection, H=hit panels or walls, K= kick floor or walls, J=jump, L=still and look, M=move around, N=prompt movements of head, similar to nodding, NR=no reaction, P=piloerection, Sc=scratches himself, V=vocalization (barking, screaming or crying).

In the main text, the behaviors A, E and L and NR were not eventually counted. This is because A and L could be confounded with attentional signs or behaviors to obtain information (thus they did not provide information about the emotional arousal we were interested in to assess). Regarding E, we were not sure whether it could account for distress (passive arousal), urge to intervene in the course of action (active arousal) or attention-getter (begging). NR did not show any arousal, therefore we preferred to exclude it from the analysis as well.

Ethogram:

Excluded → **Approach/physical proximity (A):** the chimpanzee gets closer to where the action between the experimenters (fight or consolation) occurs, faces them and remains watching. If the chimpanzee gets closer through jumping, then only Approach is coded. As the decision windows are not in front of where the action occurs, then Approach is coded when the chimpanzee is facing the experimenters and Entering is coded when the chimpanzee is facing the decision windows.

Balancing (Ba): the chimpanzee changes its behavior from still to repeatedly rocking and balancing from right to left while four-hands or seated and stays in the same place.

Bipedal (Bi): the chimpanzee changes its behavior from sitting down or quadrupedal posture to standing up and bipedal walking or standing up and remaining bipedal for at least 1 second

Excluded → **Enter fingers (E):** the chimpanzee passes any of its hands or fingers (palm up or down) through the hole in the decision window so that part of the hand/finger is inside the cage and part is outside, in the experimenters' zone. If the hand or fingers are moved away and entered again, that counts as a second E. However, if once the hands and fingers are entered through the hole and the chimpanzee shakes them, then it still counts as one entering.

Erection (Er): the chimpanzee's penis is fully or partially erected.

Hit (H): the chimpanzee uses any part of its body (eg. foot and hand palms) to hit the plexiglass panels or the cage walls. A series of repeated hits with no pauses in between the hits is only counted as one H. Two series of hits, when there is at least 2 seconds of pause between the hits, is counted as two H.

Kick (K): the chimpanzee uses its feet to hit the floor or the walls. In the floor the kick is a strong stomp movement and the chimpanzee keeps in the same place. The intensity of the stomp must be higher than if walking because it produces a splash sound. In the wall it is done while quadrupedal (therefore one leg remains on the floor while the other hits the wall with the foot palm). A series of repeated kicks with no pauses in between the hits is only counted as one H. Two series of kicks, when there is at least 2 seconds of pause between the kicks, is counted as two H.

Jump (J): the chimpanzee moves from one place to another with an impulse of its hands or legs. If by jumping the chimpanzee gets close to where the action between the experimenters occurs, then only Approach is coded.

Excluded → **Look (L):** the chimpanzee stays still with its eyes directed to the actions performed by the experimenters.

Move around (M): the chimpanzee walks from one side to the cage to other. It is a constant movement that involves quadrupedal locomotion. It is usually performed as a returning movement (going to one place and return to the original place).

Nodding (N): the chimpanzee moves the head or neck up and down in a repeated movement.

No reaction (NR): the chimpanzee does not produce any behavior during the action or ignores the action (eg. does not look, remains turning back/seated/entertained with any object the whole time of the action...).

Piloerection (P): the chimpanzee’s hair (especially shoulders, arms and neck) is erected for at least 1 second.

Scratching (Sc): the chimpanzee repeatedly rubs a part of its body with its fingernails, producing an audible sound. It is not counted when the chimpanzee does the movement slightly or without sound.

Vocalization (V): the chimpanzee barks (short dog-like sound, low intensity), screams (high-pitch sounds) or cries.

GLMM analysis for chimpanzees’ choices

Tables S4 and S5. GLMM (chimpanzees’ choices) results. Note: Random effects: Subject

Fixed Effect Omnibus tests

	X ²	df	p
Condition	13.888	1.00	<.001
Rearing	4.418	1.00	0.036
Sex	1.542	1.00	0.214
Age	0.436	1.00	0.509

Fixed Effects Parameter Estimates

Names	Estimate	SE	z	p
(Intercept)	-1.6618	0.4667	-3.560	<.001
Condition	3.4217	0.9182	3.727	<.001
Rearing	1.6286	0.7748	2.102	0.036
Sex	0.9441	0.7603	1.242	0.214
Age	0.0223	0.0338	0.660	0.509

We ran a logistic GLMM with choice (prosocial or antisocial experimenter) as the dependent variable; condition (phases 2 or 3), rearing (mother or human reared) and sex (male or female) as factors; age as a covariate and subject as a random effect (intercept). We excluded the double interaction of rearing and condition because the descriptive data showed that in Phase 2 only two subjects out of eighteen responded differently from the rest, so we did not want to pollute the analysis or produce any spurious results.

GLMM Analysis for emotional arousal

Tables S6 and S7. GLMM (emotional arousal) results. Note: Random effects: Subject

Fixed Effect Omnibus tests

	X ²	df	p
Condition	0.0150	1.00	0.903
Event	31.2021	1.00	< .001
Rearing	0.0658	1.00	0.798
Condition * Event	0.0355	1.00	0.851
Event * Rearing	0.4099	1.00	0.522

Fixed Effects Parameter Estimates

Names	Estimate	SE	z	p
(Intercept)	-0.6977	0.268	-2.608	0.009
Condition	-0.0521	0.426	-0.122	0.903
Event	2.5102	0.449	5.586	< .001
Rearing	-0.1326	0.517	-0.257	0.798
Condition * Event	-0.1603	0.851	-0.188	0.851
Event * Rearing	0.5754	0.899	0.640	0.522

We ran a Poisson GLMM with emotional arousal (the sum of behaviors and vocalizations) as the dependent variable; condition (phases 2 or 3), event (fight or consolation), rearing (mother or human reared) and the double interactions of condition*event and event*rearing, keeping subject as a random effect (intercept).

Analysis of vocalizations

As it is explained in the main text, we did not run a GLMM to analyse vocalizations due to very few instances of vocalizations we registered (N=12) and its distribution across events (fight=11 and consolation=1).

Analysis of behaviors (GLMM with behaviors, vocalizations excluded, as DV)

In the main text, we ran a Poisson GLMM with behaviors plus vocalizations as the DV, however in the SM we provide a Poisson GLMM with behaviors as the dependent variable, condition (phases 2 or 3), event (fight or consolation), rearing (mother or human reared) and the double way interactions between condition and event and event and rearing as factors and subject as a random effect (intercept).

The model was significant compared to the null model (likelihood ratio test: $\chi^2=49,354$, $df=5$, $p<0.001$). Adding event ($\chi^2=48.898$, $df=1$, $p=0.001$) improved model fit, while adding condition ($\chi^2=0.01$, $df=1$, $p=0.92$), rearing ($\chi^2=0.05$, $df=1$, $p=0.82$) and the double-

way interactions between condition and event ($\chi^2=0.006$, $df=1$, $p=0.93$) and between event and rearing ($\chi^2=0.39$, $df=1$, $p=0.53$) did not (see below). In other words, chimpanzees reacted very similarly regardless of their rearing in both phases and events. Also, as the whole fight and consolation interaction was repeated the same across phases, it is a sign of consistency that we did not find any effect of condition on the chimpanzees' emotional arousal. However, we found a significant effect of event ($\chi^2=26,37791$, $df=1$, $p=0.001$). Post hoc tests revealed that chimpanzees produced more behaviors during the fight event than during the consolation event ($z=-5.14$, $p<0.001$).

Tables S8, S9, S10. GLMM (only behaviors) results. Note: Random effects: Subject

Fixed Effect Omnibus tests

	X ²	df	p
Condition	4.94e-8	1.00	1.000
Event	26.37791	1.00	< .001
Rearing	0.07487	1.00	0.784
Condition * Event	0.00450	1.00	0.947
Event * Rearing	0.37412	1.00	0.541

Fixed Effects Parameter Estimates

Names	Estimate	SE	z	p
(Intercept)	-0.8058	0.277	-2.9131	0.004
Condition	9.54e-5	0.429	2.22e-4	1.000
Event	2.3246	0.453	5.1359	< .001
Rearing	-0.1446	0.529	-0.2736	0.784
Condition * Event	-0.0576	0.858	-0.0671	0.947
Event * Rearing	0.5538	0.905	0.6117	0.541

Post Hoc Comparisons - Event

Comparison		exp(B)	SE	z	p _{bonferroni}
Fight	Consolation				
"consolation"	- "fight"	0.0978	0.0443	-5.14	< .001

References for the analysis:

The jamovi project (2020). *jamovi*. (Version 1.2) [Computer Software]. Retrieved from <https://www.jamovi.org>.

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