Supplementary Information (SI) for:

Do dogs form reputations of humans? No effect of age after indirect and direct experience in a food-giving situation

Animal Cognition

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Table S1 Individual characteristics of dogs that participated in the study

Name	Sex	Breed	Age (years)	Age group	Condition group	First condition	Previous experience in other experiments
Dunni	F	Miniature Pinscher	1	Young	Eavesdropping	Eavesdropping	Yes
Gandalf	M	Andalusian Hound	1			Eavesdropping	Yes
Crash	M	Australian Shepherd	2			Direct	Yes
Daytona	F	Australian Shepherd	2			Direct	No
Holly	F	Rottweiler	2			Direct	No
Ravenna	F	American Staffordshire Terrier	3			Eavesdropping	Yes
Ajani	F	Mixed breed	4	Adult		Eavesdropping	Yes
Cody	M	Siberian Husky	4			Eavesdropping	No
Chivas	M	Siberian Husky	5			Direct	Yes
Lilu	F	Mixed breed	5			Eavesdropping	No
Lenny	M	Canarian Warren Hound	6			Eavesdropping	Yes

Name	Sex	Breed	Age	Age Group	Group	Method	Response
Bailey	F	Pitbull Terrier	7			Direct	Yes
Capper	M	Andalusian Hound	7			Eavesdropping	Yes
Aaron	M	Labrador	8	Senior		Direct	Yes
Helena	F	Poodle	9			Eavesdropping	Yes
Sally	F	Mixed breed	9			Direct	No
Snoopy1	M	Shih Tzu	10			Eavesdropping	No
Amy	F	Border Collie	11			Direct	Yes
Monty	M	Border Collie	11			Direct	Yes
Snoopy2	M	Beagle	12			Direct	Yes
Jazzie	F	Labrador	1	Young	Control	Direct	No
Spaiky	M	Cane Corso	1			Direct	No
Franzi	F	Rottweiler	2			Direct	Yes
Timo	M	Mixed breed	2			Control	Yes

Zazu	F	Miniature Pinscher	2			Control	No
Asha	F	Rhodesian Ridgeback	4	Adult		Control	Yes
Sixtus	M	Petit Brabançon	4			Control	Yes
Django	M	American Staffordshire Terrier	5			Direct	Yes
Ellis	F	Portuguese Water Dog	5			Direct	No
Kiki	F	Mixed breed	6			Direct	Yes
Ozzy	M	Labrador	6			Control	No
Aidan	M	Irish Setter	6			Direct	Yes
Rusty	M	Mixed breed	7			Control	No
Lilly	F	Miniature Pinscher	8	Senior		Direct	Yes
Alois	M	Mixed breed	9			Direct	Yes
Fiona	F	Rhodesian Ridgeback	9			Control	Yes
Shari	F	Rottweiler	9			Direct	No

Jolie	F	Mixed breed	10			Control	Yes
Mozart	M	Labrador	11			Control	No
Ultimo	M	Border Collie	11			Control	Yes

Table S2 Results of the binomial GLM predicting partner choice in the baseline

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	0.527	0.735	-0.908	2.053	0.107	0.815			
Condition (Experimental)[2]	-1.331	0.693	2.767	-0.017	-1.464	-1.099	3.942	1	.047[4]
Age group (Adult)[3]	-0.360	0.851	-2.077	1.316	-0.661	-0.016	2.140	2	.343
Age group (Senior)	0.791	0.868	-0.895	2.566	0.452	1.094			

[1]Some p values are not indicated due to their limited interpretation
[2]Reference level for Condition = Control
[3]Reference level for Age group = Young
[4]Although this p value is significant, the full-null comparison was not. Therefore, the estimate should not be interpreted as significant but as a likely false positive due to multiple testing within the model

Table S3 Results of the binomial GLMM predicting partner choice after the observation phase in the eavesdropping vs control condition

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	-0.931	0.603	-0.183	0.211	-1.176	-0.651			
Condition (Experimental)[2]	0.007	0.491	-0.960	0.975	-0.148	0.143	0.000	1	.989
Age group (Adult)[3]	0.094	0.618	-1.117	1.331	-0.155	0.247	1.208	2	.547
Age group (Senior)	0.627	0.635	-0.603	1.912	0.399	0.777			
Trial (Trial 2)[4]	0.466	0.489	-0.488	1.442	0.355	0.609	0.913	1	.339
z-transformed condition order[5]	-0.340	0.254	-0.851	0.151	-0.410	-0.259	1.833	1	.176
~~Condition*Age group~~[6]							0.135	2	.935

[1]The *p* value of the intercept is not shown due to its limited interpretation
[2]Reference level for Condition = Control
[3]Reference level for Age group = Young
[4]Reference level for Trial = Trial 1
[5]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.500 (0.504)
[6]Removed from the model; the *p* value of the term at the time it was removed from the model is shown

Table S4 Results of the beta GLMM predicting time spent in proximity to the generous partner after the observation phase in the eavesdropping vs control condition

Term	Estimate	*SE*	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	0.387	0.359	-0.328	1.091	0.257	0.488			
Condition (Eavesdropping)[2]	0.024	0.311	-0.587	0.635	-0.054	0.090	0.006	1	.937
Age group (Adult)[3]	-0.050	0.384	-0.806	0.706	-0.168	0.100	2.906	2	.234
Age group (Senior)	-0.603	0.397	-1.387	0.178	-0.751	-0.472			
Trial (Trial 2) [4]	-0.127	0.310	-0.738	0.483	-0.230	-0.038	0.169	1	.681
z-transformed condition order[5]	0.039	0.158	-0.273	0.350	0.011	0.085	0.059	1	.807
~~Condition*Age Group~~[6]							1.110	2	.574

[1]Some *p* values are not indicated due to their limited interpretation. Significant *p* values are in bold
[2]Reference level for Condition = Control
[3]Reference level for Age group = Young
[4]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.506 (0.503)

Table S5 Results of the binomial GLMM predicting partner choice after the experience phase in the direct experience condition

Term	Estimate	SE	95% CI Lower	95% CI Upper	Model stability Min	Model stability Max	χ^2	df	p^1
Intercept	-0.040	0.214	-0.477	0.393	-0.167	0.108			
Age group (Adult)[2]	-0.040	0.285	-0.620	0.537	-0.196	0.096	0.565	2	.972
Age group (Senior)	-0.068	0.288	-0.655	0.512	-0.207	0.066			
z-transformed trial number[3]	-0.042	0.097	-0.232	0.148	-0.071	-0.009	0.185	1	.667
z-transformed condition order[4]	-0.039	0.115	-0.272	0.194	-0.083	0.004	0.117	1	.732
~~z-trasnformed trial number*Age group~~[5]							1.569	2	.456

[1]The *p* value of the intercept is not shown due to its limited interpretation
[2]Reference level for Age group = Young
[3]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 6.477 (3.477)
[4]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.527 (0.500)
[5]Removed from the model; the *p* value of the term at the time it was removed from the model is shown

Table S6 Results of the binomial GLMM predicting time spent with the generous partner after the experience phase in the direct experience condition

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	0.276	0.136	0.007	0.556	0.225	0.312			
Age group (Adult)[2]	0.146	0.179	-0.217	0.507	0.075	0.245	0.663	2	.718
Age group (Senior)	0.097	0.181	-0.270	0.461	0.015	0.182			
z-transformed trial number[3]	0.043	0.069	-0.094	0.179	0.025	0.059	0.376	1	.540
z-transformed condition order[4]	0.260	0.073	0.114	0.410	0.220	0.294	11.210	1	.001
~~z-trasnformed trial number*Age group~~[5]							0.241	2	.887

[1]The *p* value of the intercept is not shown due to its limited interpretation
[2]Reference level for Age group = Young
[3]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 6.258 (3.458)
[4]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.495 (0.501)
[5]Removed from the model; the *p* value of the term at the time it was removed from the model is shown

Table S7 Results of the exact binomial tests for colour and side bias. Significant p values are in bold

Subject	Number of trials	Colour bias		Side bias	
		Number of successes (black)	p	Number of successes (left)	p
Aaron	12	6	1	1	**.006**
Aidan	15	8	1	7	1
Ajani	15	9	.607	6	.607
Alois	12	6	1	2	**.039**
Amy	12	11	**.006**	8	.388
Asha	15	8	1	8	1
Bailey	15	5	.302	5	.302
Capper	15	7	1	6	.607
Chivas	7	4	1	1	.125
Cody	14	4	.180	9	.424
Crash	14	8	.791	3	.057

Daytona	12	8	.388	3	.146
Django	15	7	1	6	.607
Dunni	15	3	**.035**	1	**.001**
Ellis	15	6	.607	4	.119
Fiona	14	8	.791	2	**.013**
Franzi	14	6	.791	4	.180
Gandalf	15	6	.607	8	1
Helena	15	7	1	0	**< .001**
Holly	15	9	.607	10	.302
Jazzie	15	10	.302	3	**.035**
Jolie	15	5	.302	12	**.035**
Kiki	10	8	.109	8	.109
Lenny	15	4	.119	6	.607

Lilly	15	7	1	4	.119
Lilu	15	5	.302	10	.302
Monty	15	6	.607	9	.607
Mozart	11	4	.549	6	1
Ozzy	15	8	1	14	**.001**
Ravenna	15	9	.607	4	.119
Rusty	15	7	1	2	**.007**
Sally	14	7	1	10	.180
Shari	12	6	1	6	1
Sixtus	15	9	.607	2	**.007**
Snoopy1	14	4	.180	3	.057
Snoopy2	13	3	.092	8	.581
Spaiky	14	9	.424	9	.424

Timo	13	3	.092	9	.267
Ultimo	15	9	.607	14	**.001**
Zazu	14	3	.057	5	.424

Supplementary Video 1 Example of the procedure for the baseline and observation phase in the control and eavesdropping conditions. The first clip shows the baseline (single trial). The second clip shows the subject (Django) observing the selfish partner (wearing white) and the generous partner (wearing black) interacting with an invisible dog in the control condition. The third clip shows another subject (Daytona) observing the two partners interacting with the dog demonstrator (Jasper) in the eavesdropping condition

Supplementary Video 2 Example of the procedure for the direct experience condition. The first clip shows the subject (Django) interacting with the generous partner (wearing black) and the selfish partner (wearing white) in the experience phase. The second clip shows two consecutive trials out of 12 in the test phase

Supplementary File 1 Full dataset used for statistical analyses

Supplementary File 2 Statistical analyses with the exclusion of dogs with a side bias

Fifteen dogs (5 young, 3 adult and 7 senior) that had a side bias were excluded from the following analyses. Thus, this subset comprised 25 dogs (6 young, 12 adult and 7 senior). Since the sample size was reduced and the percentage of excluded dogs in each age group was unbalanced (i.e., a greater percentage of senior dogs (50%) showed a side bias compared to young (18%) and adult (40%) dogs), we did not include age as a predictor and only tested the effect of (1) condition (eavesdropping vs control) and (2) trial number (in the direct experience condition only) in the following analyses.

We conducted four Generalized Linear Mixed-Effects Models (GLMM):

1. A binomial GLMM partner choice after the observation phase in the eavesdropping vs control condition;

2. A beta GLMM predicting proportion of time spent in proximity to the generous partner after the observation phase in the eavesdropping vs control condition;

3. A binomial GLMM predicting partner choice after the experience phase in the direct experience condition;

4. A beta GLMM predicting proportion of time spent in proximity to the generous partner after the experience phase in the direct experience condition.

We evaluated the quality of the models following the same steps as the main analyses. There were no issues with model stability, collinearity, overdispersion or best linear unbiased predictors (BLUPs).

1. **Results of the binomial GLMM predicting partner choice after the observation phase in the eavesdropping vs control condition**

After discarding the trials in which dogs did not choose either partner (5 trials), the data for this model comprised 45 trials from 24 dogs. At a group level, we found that the full model including condition was not better than the null model lacking condition (full-null model comparison, $\chi^2 = 0.368$, $df = 1$, $p = .544$; Table SI1). Fig. S1 shows that all model estimates and confidence intervals include the chance level of 50%, thus dogs did not choose the generous partner above chance level.
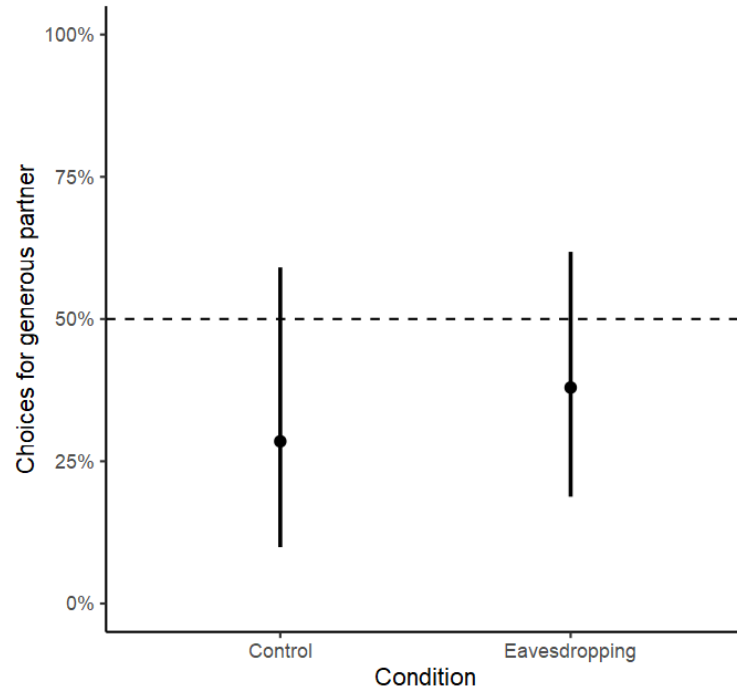
Fig. S1 Estimates (circles) and confidence intervals (lines) indicating the percentage of choices for the generous partner by condition (model 1).

The horizontal dotted line represents the chance level (50%)

Table SI1 Results of the binomial GLMM predicting partner choice after the observation phase in the eavesdropping vs control condition

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	-0.920	0.657	-2.333	0.306	-1.222	-0.646			
Condition (Experimental) [2]	0.428	0.714	-0.936	1.918	0.124	0.648	0.368	1	.544
Trial (Trial 2)[3]	-0.142	0.638	-1.415	1.114	-0.376	0.067	0.050	1	.824
z-transformed condition order[4]	-0.901	0.328	-0.738	0.562	-0.262	-0.006	0.076	1	.783

[1]The *p* value of the intercept is not shown due to its limited interpretation
[2]Reference level for Condition = Control
[3]Reference level for Trial = Trial 1
[4]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.578 (0.499)

2. **Results of the beta GLMM predicting proportion of time spent in proximity to the generous partner after the observation phase in the eavesdropping vs control condition**

After discarding trials in which the subject did not spend any time in proximity to either partner (32 trials), the data for this model consisted of 43 trials from 24 dogs. This model was slightly overderdispersed (dispersion parameter = 1.236), which can lead to less conservative estimates. The amount of time that dogs spent in proximity to the generous partner was not influenced by condition (full-null model comparison, $\chi^2 = 0.428$, $df = 1$, $p = .513$; Table SI2). Fig. S2 shows that all model estimates and confidence intervals include the chance level of 50%, thus dogs did not spend more time with the generous partner above chance level.
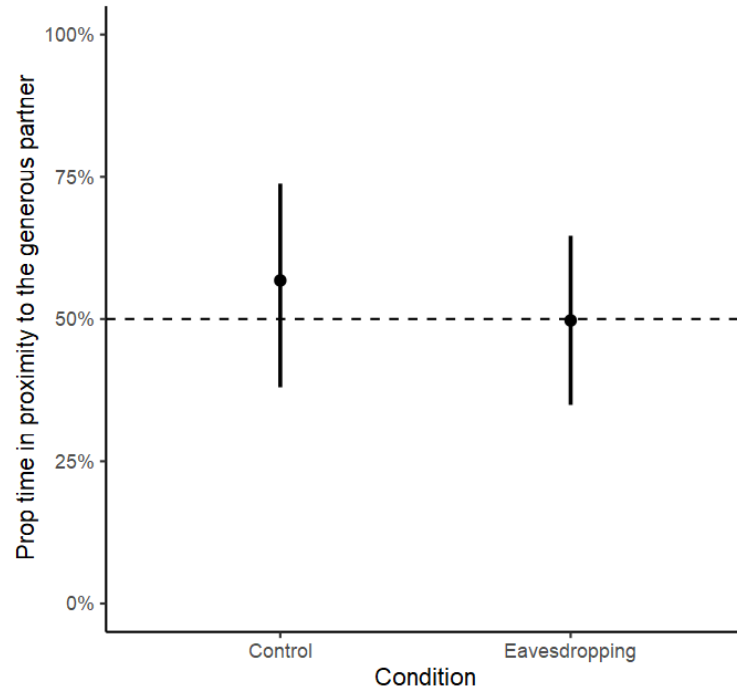
Fig. S2 Estimates (circles) and confidence intervals (lines) indicating the proportion of time spent in proximity to the generous partner by condition (model 2). The horizontal dotted line represents the chance level (50%)

Table SI2 Results of the beta GLMM predicting proportion of time spent in proximity to the generous partner after the observation phase in the eavesdropping vs control condition

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	0.273	0.389	-0.503	1.044	0.145	0.393			
Condition (Experimental)[2]	-0.283	0.433	-1.143	0.569	-0.362	-0.189	0.428	1	.513
Trial (Trial 2)[3]	0.317	0.398	-0.469	1.101	0.184	0.506	0.633	1	.426
z-transformed condition order[4]	-0.087	0.203	-0.488	0.312	-0.134	-0.015	0.186	1	.666

[1]Some *p* values are not indicated due to their limited interpretation
[2]Reference level for Condition = Control
[3]Reference level for Trial = Trial 1
[4]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.581 (0.499)

3. Results of the binomial GLMM predicting partner choice after the experience phase in the direct experience condition

After discarding the trials in which dogs did not choose either partner (29 trials), the data for this model comprised 271 trials from 25 dogs. At a group level, we found that the full model including trial number was not better than the null model lacking this variable (full-null model comparison, $\chi^2 = 0.668$, $df = 1$, $p = .414$; Table SI3). Fig. S3 shows that all model estimates and confidence intervals include the chance level of 50%, thus dogs did not choose the generous partner above chance level.
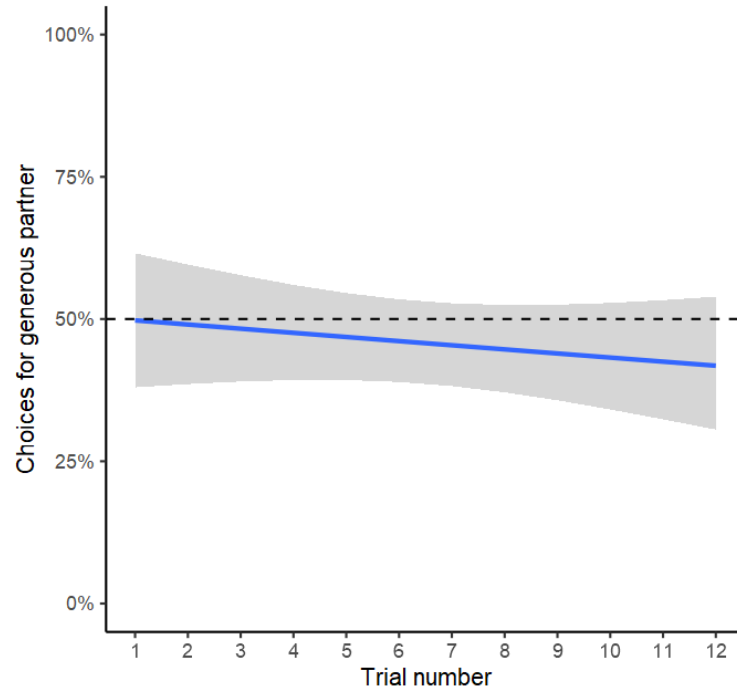
Fig. S3 Estimates (lines) and confidence intervals (shaded area) indicating the percentage of choices for the generous partner by trial (model 3).

The horizontal dotted line represents the chance level (50%)

Table SI3 Results of the binomial GLMM predicting partner choice after the experience phase in the direct experience condition

| Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	-0.169	0.149	-0.485	0.133	-0.232	-0.092			
z-transformed trial number[2]	-0.102	0.125	-0.349	0.142	-0.140	-0.051	0.668	1	.414
z-transformed condition order[3]	0.001	0.149	-0.309	0.311	-0.064	0.068	0.000	1	.997

[1]The p value of the intercept is not shown due to its limited interpretation
[2]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 6.454 (3.487)
[3]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.472 (0.500)

4. **Results of the beta GLMM predicting proportion of time spent in proximity after the experience phase in the direct experience condition**

After discarding trials in which the subject did not spend any time in proximity to either partner (69 trials), the data for this model consisted of 231 trials from 25 dogs. The amount of time that dogs spent in proximity to the generous partner was not influenced by trial number (full-null model comparison, $\chi^2 = 1.289$, $df = 1$, $p = .256$; Table SI4). Fig. S4 shows that model estimates and confidence intervals initially include the chance level of 50%, but this is not the case in later trials. This pattern suggests an improvement in dogs' time spent in proximity to the generous partner over the course of the trials. However, the statistical analyses do not support this interpretation, as trial number is not a significant predictor in the model – this indicates that the observed improvement was not robust enough to reach statistical significance.
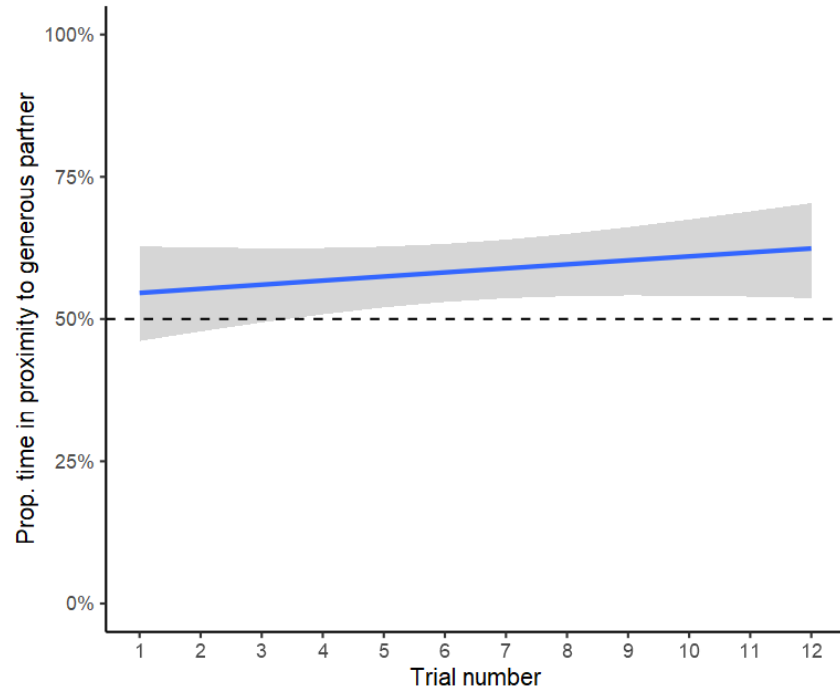
Fig. S4 Estimates (lines) and confidence intervals (shaded area) indicating the percentage of time spent in proximity to the generous partner by trial (model 4). The horizontal dotted line represents the chance level (50%)

Table SI4 Results of the beta GLMM predicting proportion of time spent in proximity to the generous partner after the experience phase in the direct experience condition

Term	Estimate	SE	95% CI		Model stability		χ^2	df	p^1
			Lower	Upper	Min	Max			
Intercept	0.338	0.107	0.127	0.564	0.289	0.383			
z-transformed trial number[2]	0.101	0.089	-0.074	0.276	0.074	0.124	1.289	1	.256
z-transformed condition order[3]	0.209	0.106	-0.004	0.428	0.163	0.255	3.700	1	.054

[1]The p value of the intercept is not shown due to its limited interpretation
[2]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 6.264 (3.447)
[3]z-transformed to a mean of 0 and a standard deviation of 1; original mean (*SD*): 1.450 (0.499)