Supplementary information

Title: Social influence under uncertainty in interaction with peers, robots and computers

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In the Supplementary information, we report the details of the models ran in the present work. For mixed-effects models**,** the intercept was allowed to vary across participants including random effects on the intercept at the subject level. In every model equation, β expresses coefficients of fixed effects, while u indicates random effects. In the fixed-effect results, B express unstandardized regression coefficients, whereas β indicates standardized regression coefficients. In model 3, we treated the influence variable as both a proportion and a percentage, in order to facilitate the interpretation of the results. In this case, we report regression coefficients as B and B%, respectively. Categorical factors (e.g., experimental group, 3 levels) have been treated as dummy variables.

Social influence task

Model 1. Effect of experimental condition on participants' influence

We tested the effect of experimental condition (Computer, Robot, Human) on participants' influence, which was computed as the distance between the participants' final and initial response divided by the distance between the two agents' initial estimates. We used the following mixed-effects model:

$$I = \beta_0 + \beta_1 c + u_0 + \varepsilon$$

I is the participant's influence and c is the experimental condition. The Robot condition is the reference category in the model output.

Results:

Influence	B (β)	Std. Err.	z	p	95% Conf. Inter.	
Condition						
Computer – Robot	- 0.084 (- 0.338)	0.040	- 2.12	0.034	- 0.162	- 0.006
Human – Robot	- 0.118 (- 0.473)	0.040	- 2.97	0.003	- 0.196	- 0.040
N. obs	4950					
N. clusters	75					

There was no difference between the Human and the Computer conditions (Human – Computer, B = - 0.034 (-0.135), SE = 0.040, z = - 0.85, p = 0.397, 95 % CI = [- 0.111, 0.044]).

Model 2. Effect of experimental condition on participants' influence, controlling for estimation error

We ran the previous model (1) adding participants' estimation error (distance between participant's response and correct response (cm) / stimulus length (cm)), as control variable. We used the following mixed-effects model:

$$I = \beta_0 + \beta_1 c + \beta_2 e + u_0 + \varepsilon$$

I is the participant's influence, *c* is the experimental condition and *e* the estimation error. The Robot condition is the reference category in the model output.

Results:

Influence	B (β)	Std. Err.	z	p	95% Conf. Inter.	
Condition						
Computer – Robot	- 0.083 (- 0.332)	0.039	- 2.10	0.036	- 0.160	- 0.006
Human – Robot	- 0.115 (- 0.464)	0.039	- 2.94	0.003	- 0.192	- 0.038
Estimation error	- 0.161 (- 0.100)	0.020	- 7.89	< 0.001	- 0.201	- 0.121
N. obs	4950					
N. clusters	75					

There was no difference between the Human and the Computer conditions (Human – Computer, B = - 0.033 (-0.132), SE = 0.039, z = - 0.83, p = 0.404, 95 % CI = [- 0.110, 0.044]).

Model 3. Effect of trial and experimental condition on participants' influence

We tested the temporal evolution of influence by running the following mixed-effects linear model:

$$I = \beta_0 + \beta_1 c + \beta_2 t + \beta_3 c * t + u_0 + \varepsilon$$

I is the participant's influence, c is the experimental condition and t is the progressive number of the current trial (from 1 to 66). The Robot condition is the reference category in the model output. Standardized regression coefficients (β) are not reported since the standardization of the trial variable would lead to a completely different interpretation of the results, since the output would not refer at the effect at "time zero" but rather to the effect at the mean of the trial variable (central trial of the task). However, we report B%, consisting of the regression coefficient when treating the influence variable as a percentage.

Results:

Influence	B (B%)	Std. Err.	z	p	95% Conf. Inter.	
Condition (at trial 0)						
Computer – Robot	- 0.113 (- 11.30)	0.042	- 2.72	0.007	- 0.194	- 0.032
Human – Robot	- 0.146 (+ 14.60)	0.042	- 3.52	< 0.001	- 0.227	- 0.065
Trial (Robot)	- 0.000 (- 0.03)	0.000	- 1.09	0.276	- 0.001	0.000
Condition*Trial						
Computer - Robot	0.001 (+ 0.09)	0.000	2.35	0.019	0.000	0.002
Human – Robot	0.001 (+ 0.08)	0.000	2.30	0.021	0.000	0.002
N. obs	4950					
N. clusters	75					

Results show a positive effect of trial in Computer and Human conditions: (Computer: B = 0.001, B% = + 0.06%, SE = 0.000, z = 2.23, p = 0.026, 95 % CI = [0.000, 0.001]; Human: B = 0.001, B% = + 0.06%, SE = 0.000, z = 2.17, p = 0.030, 95 % CI = [0.000, 0.001]). There is no interaction between Human and Computer conditions (Human - Computer, B = - 0.000, B% = - 0.00%, SE = 0.000, z = - 0.04, p = 0.966, 95 % CI = [- 0.001, 0.001]).

Model 4. Effect of response distance and experimental condition on participants' influence

We tested the effect of the distance between the participant's estimate and the partner's one on trial-by-trial influence, depending on the experimental condition (Computer, Robot, Human). We used the following mixed-effects linear model:

$$I = \beta_0 + \beta_1 c + \beta_2 d + \beta_3 c * d + u_0 + \varepsilon$$

I is the participant's influence, c is the experimental condition and d is the normalized distance between the two partner' responses (response distance (cm) / stimulus length (cm)). The Computer condition is the reference category in the model output.

Results:

Influence	B (β)	Std. Err.	z	p	95% Conf. Inter.	
Condition						
Robot – Computer	0.047 (0.321)	0.040	1.16	0.244	- 0.032	0.127
Human – Computer	- 0.125 (- 0.140)	0.041	- 3.08	0.002	- 0.204	- 0.045
Distance (Computer)	- 0.435 (- 0.291)	0.034	- 12.86	< 0.001	- 0.502	- 0.369
Condition*Distance						
Robot - Computer	0.136 (0.091)	0.046	2.99	0.003	0.047	0.226
Human – Computer	0.377 (0.252)	0.045	8.40	< 0.001	0.289	0.465
N. obs	4950					
N. clusters	75					

Results show a negative effect of distance also in Robot and Human conditions: (Robot: B = - 0.299 (0.200), SE = 0.031, z = - 9.76, $p < 0.001$, 95 % CI = [- 0.359, - 0.239]; Human: B = - 0.058 (- 0.039), SE = 0.029, z = - 1.98, p = 0.048, 95 % CI = [- 0.116, - 0.001]). Moreover, the effect of distance was stronger in the Robot than in the Human condition (Human - Robot, B = 0.241 (0.161), SE = 0.042, z = 5.66, $p < 0.001$, 95 % CI = [- 0.157, 0.324]).