Supplemental Online Materials for:

Human psychophysiology is influenced by physical touch with a “breathing” robot

Follow-up manipulation check analyses:

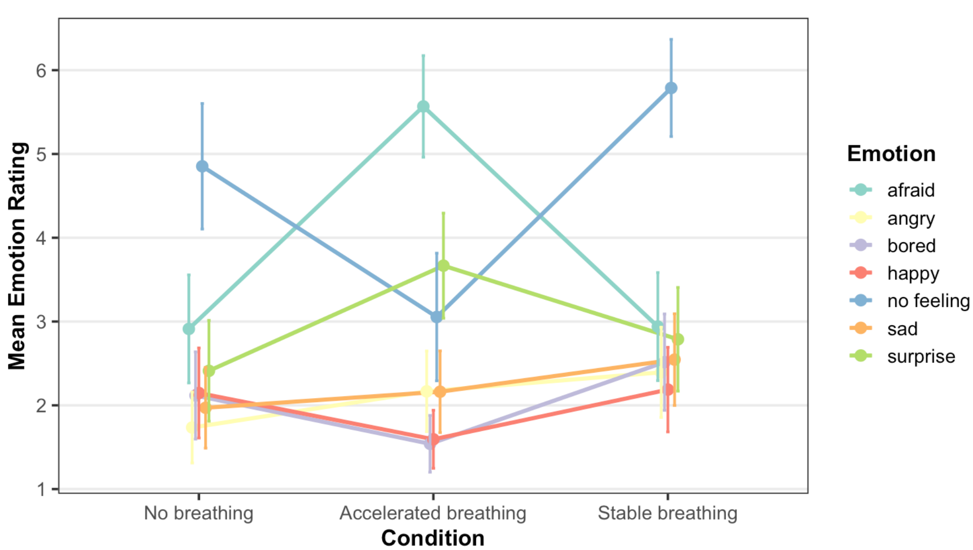
As reported in the main text, participants retrospectively rated the extent to which they perceived the robot to be feeling “Afraid”, “Angry”, “Bored”, “Happy”, “Sad”, “Surprised”, and neutral (“The robot did not feel anything”). Participants provided responses characterizing the robot’s feelings using a 5-point rating scale ranging from 1 (Not at all) to 5 (Completely). Mean emotion ratings for all emotion labels and for each robot breathing conditions are presented in Table S1 and Figure S1.

Table 1
Participant Perceptions of the Robot’s Emotion, by Breathing Condition.

Perceived Emotion	No Breathing *M (SD)*	Accelerated Breathing *M (SD)*	Stable Breathing *M (SD)*
Afraid	2.91^{b} (1.85)	5.57^{a} (1.82)	2.94^{b} (1.82)
Angry	1.74^{a} (1.21)	2.17^{a} (1.44)	2.39^{a} (1.52)
Bored	2.12^{ab} (1.49)	1.54^{b} (1.02)	2.52^{a} (1.62)
Happy	2.15^{a} (1.54)	1.59^{a} (1.04)	2.19^{a} (1.42)
Neutral	4.85^{a} (2.15)	3.05^{b} (2.28)	5.79^{a} (1.63)
Sad	1.97^{a} (1.38)	2.16^{a} (1.46)	2.55^{a} (1.54)
Surprise	2.41^{b} (1.73)	3.67^{a} (1.88)	2.79^{ab} (1.75)

Note: Means that do not share a superscript differ significantly across breathing conditions, after a Bonferroni correction for multiple comparisons.

Figure 1. *Participant Perceptions of the Robot’s Emotion by Breathing Condition*



Follow-up tests of primary hypotheses:

To test the robustness of our results, we conducted several follow-up analyses. First, we replicated the model reported in the main manuscript, this time including gender as a covariate. Results from this model paralleled our findings reported in the paper; participants in the accelerated -breathing condition experienced an increase in their HR between pre- and post-elicitation ($\beta = .31$, $t(5494) = 9.02$, $p < .001$**)**, whereas those in the no-breathing condition experienced only a small change in HR, ($\beta = .09$, $t(5493) = 2.52$, $p = .012$), which was significantly smaller than the change observed in the accelerated-breathing condition, ($\beta = -.22$, $t(5494) = 4.32$, $p < .001$). Finally, participants in the stable-breathing condition demonstrated no significant change in HR between pre- and post-elicitation ($\beta = .07$, t(5492) = 1.89, $p = .058$).

Second, we removed any participants who recognized the movie scene used in the fear-elicitation stimulus ($N_{final} = 79$), and replicated the model reported in the main manuscript. Results from this model paralleled our findings reported in the paper; participants in the accelerated-breathing condition experienced an increase in their HR between pre- and post-elicitation ($\beta = .40$, $t(4200) = 2.04$, $p < .001$**)**, whereas those in the no-breathing condition experienced only a small change in HR, ($\beta = .09$, $t(4200) = 2.52$, $p = .041$), which was significantly smaller than the change observed in the accelerated-breathing condition, ($\beta = -.31$, $t(4100) = 5.10$, $p < .001$). Finally, participants in the stable-breathing condition demonstrated no significant change in HR between pre- and post-elicitation ($\beta = .04$, t(4200) = 1.07, $p = .28$).

Finally, we centered HR around participants' personal baseline (with baseline defined by the average HR during the first 10 seconds of black screen preceding fear-elicitation stimulus). Using participant-centered HR, we constructed two additional models – one including participant baseline HR as a covariate, and one without it included. In both models, the results paralleled our findings reported in the paper.

Specifically, in the first model, which did not include participants' baseline HR as a covariate, participants in the accelerated-breathing condition experienced an increase in their HR between pre- and post-elicitation ($\beta = .35$, $t(5499) = 9.08$, $p < .001$), whereas those in the no-breathing condition experienced only a marginally significant change in HR, ($\beta = .08$, $t(5494) = 1.91$, $p = .056$), which was significantly smaller than the change observed in the accelerated-breathing condition, ($\beta = -.27$, $t(5497) = 4.79$, $p < .001$). Finally, participants in the stable-breathing condition demonstrated no significant change in HR between pre- and post-elicitation ($\beta = .08$, $\mathrm{t}(5495) = 1.91$, $p = .056$).

In the final model, which included participants' baseline HR as a covariate, participants in the accelerated-breathing condition experienced an increase in their HR between pre- and post-elicitation ($\beta = .35$, $t(5500) = 9.09$, $p < .001$), whereas those in the no-breathing condition experienced only a small change in HR, $\beta = .10$, $t(5496) = 2.55$, $p = .01$, which was significantly smaller than the change observed in the accelerated-breathing condition, $\beta = -.24$, $t(5498) = 4.36$, $p < .001$. Finally, participants in the stable-breathing condition demonstrated no significant change in HR between pre- and post-elicitation ($\beta = .08$, $\mathrm{t}(4200) = 1.90$, $p = .057$).

Based on valuable feedback from a reviewer, we constructed an additional linear mixed effects model predicting heart rate (HR) directly following the fear-elicitation video, including the experimental condition as a dummy-coded predictor, pre-trial HR as a covariate, and random effects for participants. The results are consistent with those reported in the main manuscript: After controlling for HR during the black screen, HR in the accelerated-breathing condition ($M = 87.31$, SE = .31) was significantly higher than in the stable ($M = 84.63$, SE = .14) and no-breathing ($M = 83.95$, SE = .13) conditions, ts ≥ 14.49, ps $< .001$. HR in the stable- and no-breathing conditions were also significantly different form each other, $t = 3.43$, $p = .002$.