

Author(s)

Ruud Hortensius (Bangor University) - ruud.hortensius@glasgow.ac.uk
Emily Cross (University of Glasgow) - emily.cross@glasgow.ac.uk

Created: 03/16/2018 01:26 AM (PT)**Public:** 11/30/2018 01:23 AM (PT)**1) Have any data been collected for this study already?**

It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

2) What's the main question being asked or hypothesis being tested in this study?

This study tests the impact of a 5-day interaction with a social robot on brain activation within the pain matrix network when participant observe a human or robotic agent experiencing pain or pleasure. It is hypothesized that repetition suppression for agents (robot and human), but not for emotions (pain and pleasure), will increase after a 5-day interaction compared to before the interaction.

3) Describe the key dependent variable(s) specifying how they will be measured.

Pre-post change in repetition suppression: suppression of the blood oxygen level-dependent response per region of the pain matrix (core regions: anterior middle cingulate cortex, anterior insula, secondary sensory cortex, postcentral gyrus) after the repeated presentation of the same stimulus condition pre-interaction minus suppression of the blood oxygen level-dependent response per region of the pain matrix after the repeated presentation of the same stimulus condition post-interaction.

4) How many and which conditions will participants be assigned to?

There are 8 conditions in total: each session has a 2 x 2 factorial design with novel or repeated agents and emotions (novel agent, novel emotion; repeated agent, repeated emotion; novel agent, repeated emotion; repeated agent, novel emotion), and session has two levels (pre-interaction; post-interaction).

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

Incorporating a subject-specific fROI analysis (Fedorenko et al., 2010, Journal of Neurophysiology), a repeated measures analysis of variance (ANOVA) with agent (2) and emotion (2) as within-factors will be conducted on pre-post change in repetition suppression.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

a) Not enough interaction: participants with <2 hours interaction time in total will be removed from data analyses; b) Movement during fMRI tasks: volumes with spikes > 1 voxel will be removed; c) Attention check responses during fMRI tasks: participants with less than 32 (responses out of 40 per session) to attention check questions will be removed from data analyses.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.

We will collect data for 28 participants.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

Note on this pre-registration: Data collection started on Monday 12 March. So far, only pre-interaction data have been collected for 7 participants. As the main question and hypothesis of this study deal with a post- versus pre-interaction comparison of repetition suppression, this pre-registration can still be viewed as valid. That is, our pre-registration is pre post-interaction data collection and pre analyses.

a) Secondary analyses: A whole-brain random-effects analysis will be used to test a main effect of agent (novel > repeated), a main effect of emotion (novel > repeated). and agent by emotion interaction across the brain (initial single voxel threshold set at $p < .001$, with the minimal cluster size threshold applied to the final statistical map corresponding to a cluster-level false-positive rate of 5%); b) Variables collected for control analyses: Participants will rate each video after completion of the two fMRI task. They will be asked to rate each video on a scale from -5 (pain) to +5 (pleasure). We will run a 2 (agent: human, robot) by 2 (emotion: pain, pleasure) by 2 (session: pre-interaction, post-interaction) repeated measures ANOVA to test potential differences in perceived pain and pleasure between agents and sessions. For every human-robot interaction session, the software logs the social behaviour of the robot, as well establishes the amount, duration and type of the interactions between the robot and the human. These log files will be read out to establish the quantity (number of games, duration of the interaction per day) and quality of the interaction (positive and negative emotions of the robot, ratio of self-initiation of the robot) between the human and the robot; c) Variables collected for exploratory purposes: Participants will complete a selection of questionnaires related to empathy (Interpersonal Reactivity Index (IRI), Davis, 1980), attitudes to and perception of robots (Negative Attitudes towards Robots Scale (NARS), Nomura et al., 2008; Godspeed questionnaires, Bartneck et al., 2009; agency in robots questionnaire, Kahn et al., 2012), anthropomorphism (Ruijten et al., 2014; Waytz et al., 2010), daily exposure to robots (Riek et al., 2011), self-other overlap (Inclusion of the Other in the Self (Aron et al., 1991), as well as several single item ratings and open questions related to the interaction (engagement, authenticity, emotional content, perceived difficulty, subjective experienced quality and quantity of the interaction).