

This is part of the additional material of the RA-L paper:

*“Interact with me: an Exploratory Study on Interaction Factors for Active Physical Human-Robot Interaction”, Yue Hu, Mehdi Benallegue, Gentiane Venture, Eiichi Yoshida*

## **pHRI experiment protocol and instructions**

The experiment is divided into three stages, please read carefully the explanations of each stage and ask questions, if any.

In the following, the terminology will be as follows:

- The subject, the person who is taking part in the experiment (you).
- The instructor, the person who is guiding the experiment.
- The robot, the robot which is part of the experiment (Sawyer).

### **Stage 1 - Preparation**

The subject has to be equipped with the following sensors:

- Motion capture markers, placed on the head, the torso, the back, both arms, both hands, and both feet. All the markers are placed on wearable clothes, so they will not be directly placed on the skin of the subject.
- Galvanic Skin Resistance (GSR) sensor, placed on the back of the subject. The GSR is measured via two single-use gel-type electrodes, placed on the back of the neck of the subject.
- Heart Rate Monitor (HRM, measured as photoplethysmogram - PPG), which is the same sensor as the GSR. The HRM is measured via an ear-clip, clipped on the left earlobe.
- Eye-tracking glasses, worn as normal glasses on the eyes of the subject. A piece of tape will be placed on the front to fix the position of the glasses. A band-aid will be placed on the top part of the left cheek for comfort reasons.

The preparation stage proceeds as follows:

1. The subject's height and weight are measured and recorded.
2. The subject fills in the preliminary questionnaire and the personality test.
3. The subject remove their shoes and any accessory as per the instructor's request.
4. The subject can keep their own clothing.
5. The subject is equipped with the motion capture set.
6. The subject is equipped with the GSR + HRM sensor.
7. The subject is equipped with the eye-tracking glasses.
8. The subject is asked to rest in a calm and mindless state for 5-10 minutes, sitting in the waiting room. During this time, recordings with the GSR + HRM sensor are performed.

## **Stage 2 - Experiment**

The experiment stage is divided into three steps.

### Step 1. Eye-tracking calibration

1. The subject stands in the middle of the room, in front of the screen, with face centered on the screen.
2. The instructor checks the positioning of the glasses, small adjustments might be necessary.
3. During the calibration, the subject must move only the eyes, and not the head nor the body. It is fine to blink during the calibration procedure, but please do not close the eyes for long times.
4. On the screen a round marker appears at the center, the subject must look at the marker until it changes location. The subject must follow the marker with their eyes until the marker disappears from the screen.
5. The subject is asked to look at each corner of the screen.

The procedure might have to be repeated according to the quality of the calibration.

### Step 2. Interaction trial

The experiment consists of playing a puzzle game by using the arm of the robot as a joystick.

The goal of the game is to match the blue piece into the red one.

The subject has the possibility of trying the experiment up to two times, before the actual experiment.

### *Instructions for the game*

Please watch the instructional video.

### *Trial procedure*

Each trial proceeds as follows:

1. The subject stands outside of the red rectangular area, facing the robot, without moving.
2. The instructor will say "Start", the subject walks inside the red rectangular area and can start interacting with the robot, and play the game.
3. The subject must keep playing the game (restarting if necessary) until the instructor says otherwise.
4. For the whole duration of the trial, please stand inside the red rectangular area.
5. The instructor will say "Stop", the subject will stop playing (regardless of the status of the game) and go back to the initial position outside of the red rectangular area.
6. The instructor will say "Ok, finished", which will end the trial.

Each trial lasts about 2-3 minutes. The subject can perform the trial maximum twice.

### Step 3. Interaction experiment

After the trial, the actual experiment is carried out.

The experiment proceeds with the same procedure as the trial procedure.

Three consecutive experiments are performed.

At any time, if the subject feels uneasy or wants to pause/stop the experiment, please let the instructor know immediately.

### **Stage 3 - Questionnaires**

After the experiment, the subject is moved to the waiting room.

All the sensors are taken off and the subject can put on their own clothing and accessories.

The subject is asked to fill in two questionnaires related to the experiment.

1. The first one contains 33 statements, the subject has to rate how much they agree with the statement from 1 to 7, where 1 is strongly disagree, and 7 is strongly agree.
2. The second one contains couples of opposite adjectives/descriptions. The subject has to rate to which adjective they relate.