Training procedure – iCub @Boggiano Pico

The training activities will consist of a visuospatial game with the iCub robot. Activities will comprise several training sessions that are embedded in the standard therapy sessions. All the activities will be supervised by an experimenter to grant the safety of the environment and to control the robot. However, the training per sè will be carried out by healthcare professionals (either a logopedist, a psychomotricist, or a psychotherapist) of Provincia Religiosa Don Orione. Therefore, before the start of the activities, healthcare professionals will be trained by the experimenters to be fully autonomous during the training procedure.

Each training session will consist of ten *turns*, lasting approximately fifteen minutes in total. During each *turn*, the robot and the child will be facing each other, and the training session will take place on the setup developed to grant a safe interaction between the iCub and the child (https://osf.io/vk5cm/ for details). Two identical six-sided polyurethane[1] dices (8 cm x 8 cm x 8 cm) will be positioned next to the child. Two (or more) target stimuli (for ex., a green triangle, and a red circle) will be attached to the two opposite sides of each dice. The first dice will be given to the child, that will be able to rotate it and explore all its sides freely. During this phase, the robot will only gaze at the child and the dice. After the child explores the dice, the therapist will ask him/her to take the second cube, make sure that it is identical to the first one, and then pass it to the robot, placing it in the drawer[2]. Then, the robot will need to gaze at the object, grasp it from the drawer, lift it, rotate it, and look at it. The child will be asked to report which side is the iCub looking at, and the robot will provide feedback based on the correctness of the child's

[1] Either polyurethane or another soft material that the robot can grasp

[2] For "drawer" we intend any solution that allows moving an object from one side of the setup to the other side

answer (happy reaction for correct answer, confused/sad reaction for incorrect answer). As further feedback, at the end of each trial, the therapist will show the robot perspective on a portable device, streaming the visual information collected from the cameras of the robot. Eventually, the robot will return the object to the child, placing it into the drawer[3].

The game will consist of several levels of difficulty, depending on the features of the target (from simple shapes to faces of dolls) and the number of distractors attached to the cube (from zero to four). During the first session, the child will explore the first level of complexity of the game. If he/she answers correctly to ¾ of the trials, he/she will be allowed to pass to the subsequent level during the following session (and so forth).

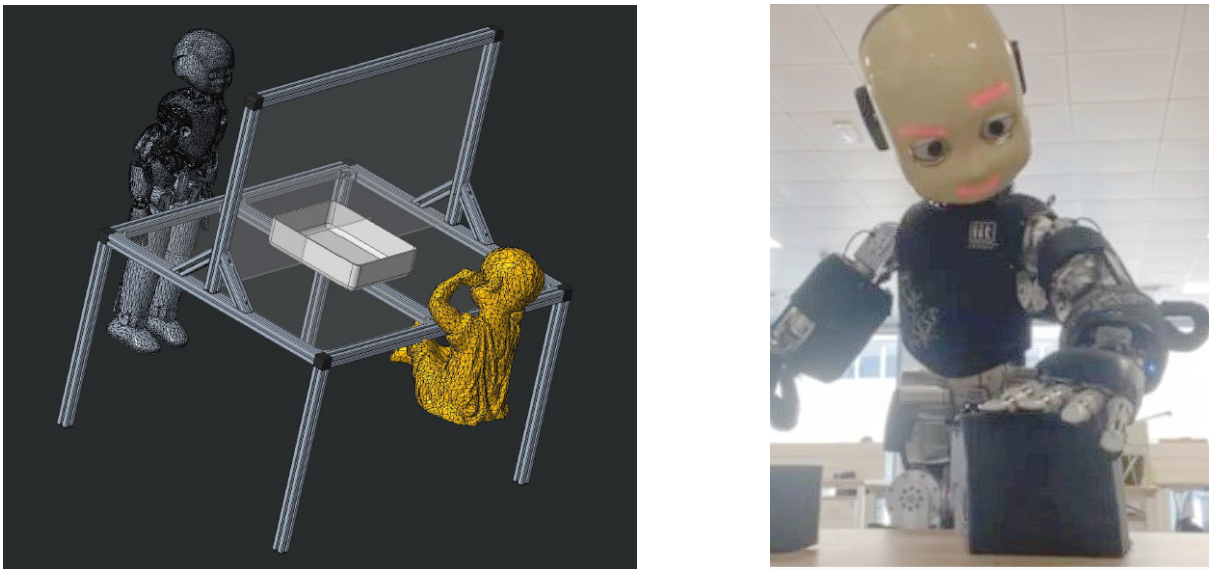

Figure 1 – Setup solution proposed for the activities (on the left) and iCub grasping an 8x8x8 polyurethane dice (on the right)

[3] The best solution would be that the robot moves the drawer, either by pressing a button or pushing it towards the kid