OIST ECSU

Equipment Information

This information sheet provides general information about the equipment used in the studies conducted by the OIST Embodied Cognitive Science Unit. The equipment mentioned here includes physiological recordings instruments as well as human-computer interaction interfaces. The use of this equipment is required in order to obtain a more detailed understanding of the processing done by human minds, brains and bodies.

Please read this information carefully if you consider participating in one of our studies and the specific study you are considering includes explicit mention of these tools.

EEG

Part of the processing in the central nervous system occurs through electrical activity of the nerve cells. This minimal, continuous electrical activity of the brain can be measured and recorded by using electrodes. The result of such a measurement is called an electroencephalogram (EEG).

The EEG measurement requires some amount of preparation, both by yourself at home and in the lab before the experiment. It might also seem strange to have to wear a cap with electrodes attached to it. However, the procedure is safe and the electrical recording itself will not be noticeable for you.

Preparation at home

To make the EEG-measurement run more smoothly, you should:

- Wash and dry your hair. Do not use hair conditioner, gel, hairspray, etc.
- Do not use face cream or make-up.
- Wear clothes that you don't mind getting dirty if some electrode gel gets on them

Preparation in the lab

A cap (sort of bathing cap) will be put on to your head. In this cap a large amount of measuring electrodes will be attached. Your eyes, nose, mouth and the underside of your face will remain free. The cables will be held together with Velcro straps, so they do not get in the way of your movement.

To obtain good signals it is important that the resistance of the skin is not too high. To that end, a small amount of conductive gel (0.2 to 0.3 ml) will be inserted in between the electrode and the skin on your scalp. Testing of the resistance and inserting the gel is done with a syringe with a blunted needle. You might feel the contact with the needle, but it will not pierce the skin.

The preparation will take about 15 minutes.

After the experiment

After the completion of the experiment, the experimenter will remove the cap with the electrodes. If you want, you can rinse out your hair, wash and dry it in a shower room adjacent to the experimental lab. Please bring your own shampoo, a towel, a hair dryer and a comb if you wish to make use of this facility.

EMG

Contraction of muscles produces electrical activity that can be detected by an electromyogram (EMG). In clinical settings this procedure requires inserting needle electrodes into the muscle. However, in psychological studies, surface EMG is used, in which recording electrodes are placed on the skin over the target muscle group and the signals are amplified through additional apparatus.

Before the electrodes are placed, your skin will be cleaned with alcohol. The researcher will measure your area of interest (e.g. forearm, forehead) to determine the best placement for the electrodes and then apply some conductive gel to the skin. The electrodes will then be attached to your skin with a double-sided adhesive tape. The researcher will make sure the electrical properties of the setup are both safe for you and sensitive enough to capture the muscle activity.

ECG

The heart is an organ that pumps blood through the body through contractions. These contractions can be felt, heard through a stethoscope and recorded with an electrocardiograph (ECG), which measures electrical currents produced by the heart and detectable on the body surface.

Electrodes can be placed on different parts of the body depending on the experiment. Typically, wrists or ankles are used but when the experiment requires you to use your hands, a placement on the torso is preferable to minimize the effect of movement on the recorded activity.

EDA

Just like brain and muscles, skin has electrical properties that can be recorded as electrodermal activity (EDA). These properties vary as a function of sweating activity, which, in turn, can be affected by such non-psychological factors as ambient temperature and humidity but also by emotions. EDA is not under conscious control, which has motivated its use in psychological research and as part of lie detection systems.

The most typical way to record EDA is by placing 2 electrodes on the index and middle finger. However, other parts of your palm could also be used, depending on the experimental setup. Before the experiment, you will be asked to gently wash your hands with water and dry them thoroughly. The experimenter will make sure that your hands are warm. Then an electroconductive gel will be applied and the electrodes attached to your hand with adhesive rings. Typically, a non-dominant hand will be used.

You will not feel any pain or discomfort as recording is made. However, it is theoretically possible for the electrodes and cables to heat up. In extremely rare cases skin irritation might develop. You are encouraged to stop the experiment and signal to the experimenter should anything unexpected occur. You will then be medically examined and will receive appropriate care.

Respiration belt

One of the less obvious variables that can tell us something about psychological processing is respiration. In clinical settings the volume of gasses exchanged during inhalation and exhalation can be precisely measured with a device called spirometer. This measure would be quite inconvenient in psychological studies and so less invasive methods are used such as a respiration belt. Typically, two belts are used that can be worn around the chest and abdomen. The belts contain a stretch-responsive sensor. The breathing movements stretch the device enabling the researcher to estimate the amount of air inhaled and record the breathing rhythm.

The belt is worn over the clothing and no special preparation is required. However, in order to prevent the signals from being distorted, cell phones must be left at the far end of the experimental room.

Torobo Robot Arm

Torobo is a simple robot arm that consists of 7 segments connected with joints that can rotate in different directions. The arm is connected to a power supply, a device that processes commands issued to the arm, a PC which issues the commands and an emergency button.

The Arm has been developed for research purposes such as testing robot operation (e.g. in industrial settings), investigating different algorithms responsible for motion control and exploring collaboration between robots and humans. Being around the robot is generally safe but it is a powerful device that can generate significant forces. There is never a perfect guarantee that nothing will go wrong during its operation. However, we take the following measures to minimize any risks involved:

- before carrying out any study, robot operation is tested extensively
- during the experiment, the researcher remains in the same room and supervises robot operation
- emergency button can be pressed at any time, which will immediately cut off power supply from the robot and stop its operation

Before the experiment you will have the chance to examine the arm and confirm your willingness to interact with it. You can anyway always decide to stop the experiment without needing to provide any reason to do so.

Enactive Torch

Enactive Torch is a simple sensory substitution device. Devices of this type translate information that is normally available to one sensory modality (for example vision) into another sensory modality (for example touch or hearing). You can think of a blind person's cane as an example of an analog sensory substitution device which allows a person to "see" through the sensations conveyed by the cane to their hand. Enactive Torch realizes a similar mapping. It is equipped with a distance sensor that detects the distance to the first-encountered surface and a motor that produces vibration that is inversely proportional to the distance. That is, detection of a smaller distance produces vibration of higher intensity while detection of a larger distances produces a less intense vibration. The sensor also has a limit such that pointing the Torch at a large empty room will not produce any noticeable vibration.

Previous studies show that using Enactive Torch is intuitive and people can learn to use to distinguish a variety of objects and perform many tasks. There is no risk associated with this device.

Eye Tracker

Eye trackers use the reflection of infrared light to record eye movements. These eye movements can be based on conscious decisions, such as gaze positions, or subconscious processes like pupil dilation. Using an Eye tracker therefore opens a window into different psychophysiological and psychological processes.

In eye tracker experiments it is necessary to put a small sticker on the participant's forehead to make the gaze tracking reliable. It is therefore necessary for the participant to have a clear forehead surface with no hair or headwear hiding it. Furthermore, to ensure usable data, it is necessary that no mascara is worn during the experiment.