**Standard operating procedure (SOP) - Oksima**

**Simultaneous measurement of (76 channel) EEG and MEG**

**Equipment**

* 76 channel EEG cap (various sizes)
* 2 electrodes for reference and ground
* Measuring tape for head circumference
* 6 more electrodes for HEOG, VEOG, ECG
  + ECG: snap electrode stickers + cables labelled L(eft) and R(ight)
* Alcohol pads for skin cleaning
* Alcohol and small cup for EEG preparation
* Cotton swabs
* Abrasive electrode gel (Abralyt light – labelled with yellow sticker “non-magnetic”)
  + Prefill syringes with gel
* Paper tissues for cleaning
* Protection cap which comes on to EEG cap to protect MEG against gel
* HPI coils for MEG
* Others
* Towel, shampoo, hairdryer, brush
* Toothbrush for electrode cleaning
* Glasses if vision correction is necessary
* 2x memory foam ear tips
* MEG cushion
* Button response pads
* Insert earphones

**Before arrival of participant - MEG, Hardware, Acquisition Software and Experiments**

* Put MEG into measuring position (68°) and slide the seat into the MEG (at least half an hour before measurement)
* Turn on soundcard, datapixx, Hb7 headphone driver and MEG Trigger Box
* Connect insert earphones to patient audio
* Open the acquisition software on the MEG computer and load settings
* Start the stimulus computer and check the functionality of experiment scripts
* Check soundcard settings (oksima)
* Check / Connect MEG Trigger Box cable to Stimulus Trigger Interface I/O Unit
* Switch on digitization hardware of the MEG
* Check noise level with tuner and tune if necessary
* Emptyroom recording
  + Recording: sub-XX\_task-emptyroom.fif

**Arrival participant**

* Ask the subject to take off and change their shoes, roughly explain MEG and the lab
* If necessary, first check whether the subject's head is not too big for the MEG (plastic helmet) – check in combination with EEG cap
* Have formalities read and signed
* Ask the subject to change the cloths and wear scrubs (smallest size: 2). Also ask them to remove all metal objects, jewelry, piercings, wallets, mobile phones, make-up etc.
* Enter participants codeword into acquisition software
  + Firstname: sub
  + Lastname: codeword

**Procedure**

**Preparation – EEG**

* hair should be freshly washed
* Put on scrubs for MEG, take off magnetized
* Measure head circumference for EEG cap
* Put on EEG cap, check cap size fit and take off the cap
* Prepare (H)EOG, (V)EOG, ECG for artifact monitoring
  + Take care that the electrode positions don’t interfere with EEG-cap
  + EOG: Clean the skin with an alcohol pad. Fill the cup electrode with gel and place the electrodes according to the scheme[[1]](#footnote-1), securing them with tape onto the skin.
  + ECG: Let participant place left and right snap electrode sticker below collarbone and attach cables.[[2]](#footnote-2)
* Fit 76 channel EEG-cap
  + Determine Cz electrode position
    - I.e. with washable marker (e.g. lip liner), measure and halve length from nasion (nose beginning between eyes) to inion (occipital knob), measure and halve length between preauricular points on the ears
  + Optional: Place stickers underneath ear electrodes so that they stick onto skin
  + Place the cap on participants head[[3]](#footnote-3)
* For each electrode
  + Push the hair under the electrodes to the side with alcohol-soaked cotton swabs by circular movements and clean the scalp
  + Inject electrolyte gel into the electrodes with a prefilled syringe, attach to the scalp and then pull it up during pressing
  + Erode skin with circular movement of cotton swab
  + Refill electrodes with gel[[4]](#footnote-4)
* Place Reference (blue) and Ground (black) ring electrode
  + Ref: right noise tip side
  + Gnd: forehead
  + Clean with alcohol, abrade skin, place electrode with sticker.
* Check impedances
  + Connect the three Lemo plugs of the cap one after the other with extension cable to the MEG terminal and start the impedance measurement.
  + Connect Ref and Gnd with extension cables to MEG terminal.
  + Correct impedances of electrodes if necessary[[5]](#footnote-5)
  + HEOG, VEOG, ECG electrodes are checked when participant is inside MEG and the bio channels are connected. Typically, they are alright.
* After digitization put mesh hood onto head to protect MEG helmet from gel.

**Preparation – MEG**

* Digitization
  + Put on glasses
  + Optional: place earmolds with empty vitamin markers in the participant's ears.
  + Digitize anatomical landmarks: nasion, preauricular points left/right or earmold markers.
  + Digitize HPI coils, order not important
  + Digitize reference first, then all 76 channel EEG-cap electrodes
    - Digitize attachment point of ring electrode cable.
  + Digitize additional points (headshape)
  + Remove glasses[[6]](#footnote-6)
* Move participant into MEG
  + Let the test person sit on the front of the chair
  + Connect all cables to the terminal
    - Bio channels (HEOG, VEOG, ECG)[[7]](#footnote-7)
    - Reference, Ground
    - Connect HPI coils
    - 3 Lemos (2 for EEG cap, 1 for ear EEG)
    - Connect insert earphone cable (patient audio)
      * Attach insert earphone transducers to cushion velcros
* Check impedances once more
  + This time, you can also check the bio channels
  + Typically, ECG is inf but still ok.
* Participant slides backwards, pump up chair so that the head is as close as possible to the helmet.
* Insert table, place cushion and button response box onto table.
* Place monitor screen and adjust mirrors for beamer projection.
* Lock the door

**Measurement**

* Check MEG signal quality and update bad-channels
* No cHPI
* Start experiment, 7 recordings in total (emptyroom included).[[8]](#footnote-8)
  + Olsa SRT measurement (training + test list, 2 runs)
  + Recording: sub-XX\_task\_olsa\_run\_X.fif (run=1,2)
  + Recording: sub-XX\_task\_audiobook\_run\_X.fif (run=1,2)
  + Recording: sub-XX\_task\_olsa\_run\_3.fif
  + Recording: sub-XX\_task\_transient\_all.fif

**Wrap-up**

* Only allow the participant to stand up from the MEG seat after removing all cables from terminal. Transfer them back to the wooden chair.
* Remove HPI coils and additional electrodes and EEG-cap.
  + Wrap EEG-connector of cap into towel.
* Let participant wash their hair in locker room.
* Clean EEG cap and electrodes + cables carefully but thoroughly with hot water and toothbrush
  + Attention: Don’t wet the connectors and don’t harm EEG wires.
  + If necessary, carefully blow dry the EEG-cap.
* Put EEG-cables, HPI coils back onto holders and place EEG-cap onto Styrofoam-head.
* Check the MEG for any gel residue and clean if necessary.
* Switch the MEG to helium recovery mode and return the seat to its original position next to the device.
* Get recording data.
* MEG-checkout[[9]](#footnote-9)

**Electrode-placement-sketch**

Ein Bild, das Text, Diagramm, Design enthält.

Automatisch generierte Beschreibung

1. See electrode-placement-sketch [↑](#footnote-ref-1)
2. ECG cables are labelled with L(eft) and R(right) [↑](#footnote-ref-2)
3. Note: Correct placement is not as crucial because all electrode positions are digitized afterwards. [↑](#footnote-ref-3)
4. Be careful with the amount of gel. Don’t bridge the electrodes. [↑](#footnote-ref-4)
5. Impedances should be < 10 kΩ and be in the same order of magnitude [↑](#footnote-ref-5)
6. Take care not to move the cap. [↑](#footnote-ref-6)
7. See electrode-placement-sketch [↑](#footnote-ref-7)
8. Recording names might be updated if two sessions are measured. [↑](#footnote-ref-8)
9. See MEG checkout instructions. [↑](#footnote-ref-9)