

PRACTICAL GUIDE TO EEG MEASUREMENTS

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Outline

- Before EEG measurement
 - Experimental design
 - Ethical issues
 - General issues concerning working in the lab
- During EEG measurement
 - Applying the electrodes (impedances, bridging)
 - Experiment and design related issues
 - Data quality

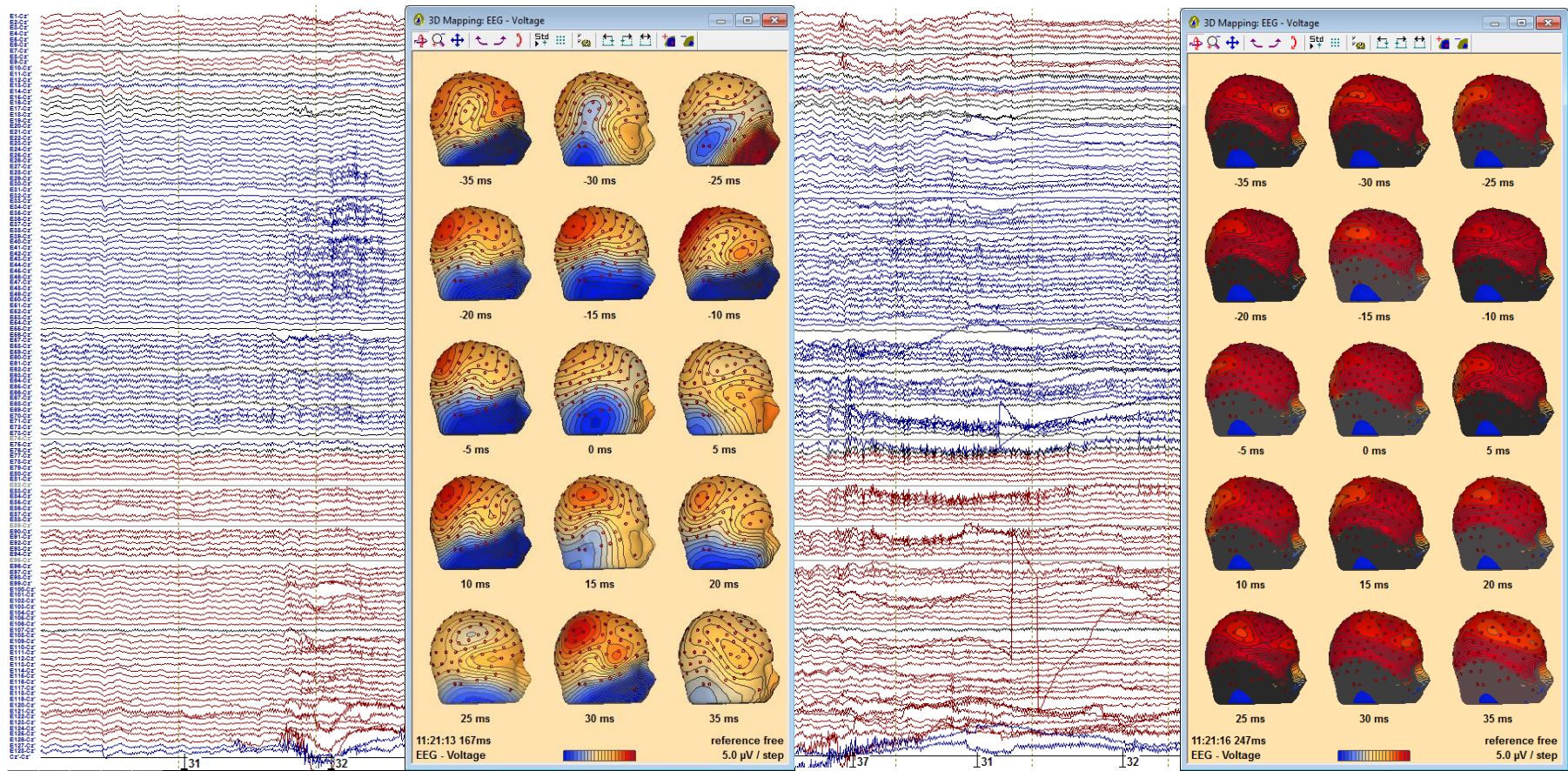
Things to consider when planning your M/EEG experiment

- What do you want to measure from the brain?
- What kind of cognitive processes are needed in your experiment?
 - Split the task into elementary processes
 - E.g. speech perception: Can you hear which syllable was stressed?

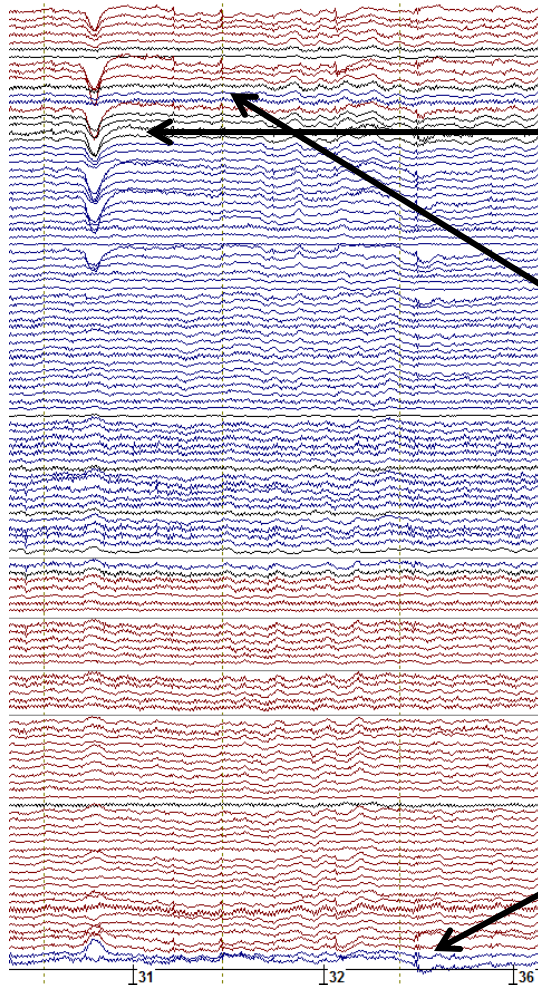
Things to consider when planning your M/EEG experiment

- Movement artifacts are difficult to handle afterwards
 - Try to design an experiment with as little movement as possible
- Eye blinks and eye movements contaminate the M/EEG signal and prevent intake of visual stimuli
 - If possible instruct the participant to blink only during certain time periods
 - Use eye-tracking to confirm that the participant is actually looking at the stimulus
 - Check that color and luminance contrasts are pleasant
 - Sound volume at comfortable level

Movement artifacts



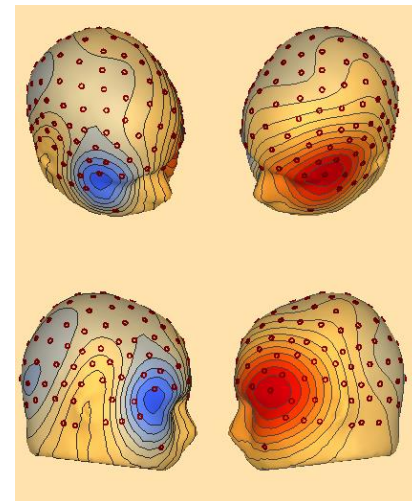
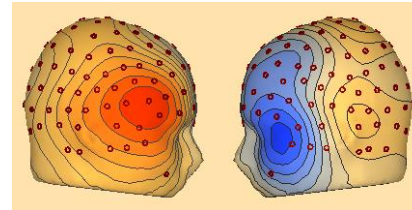
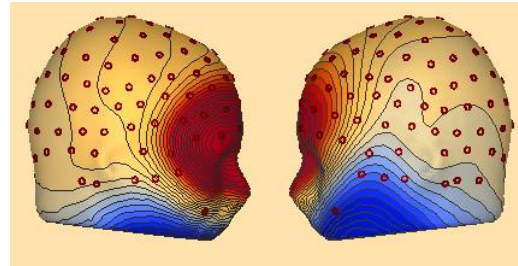
Artifacts from eyes

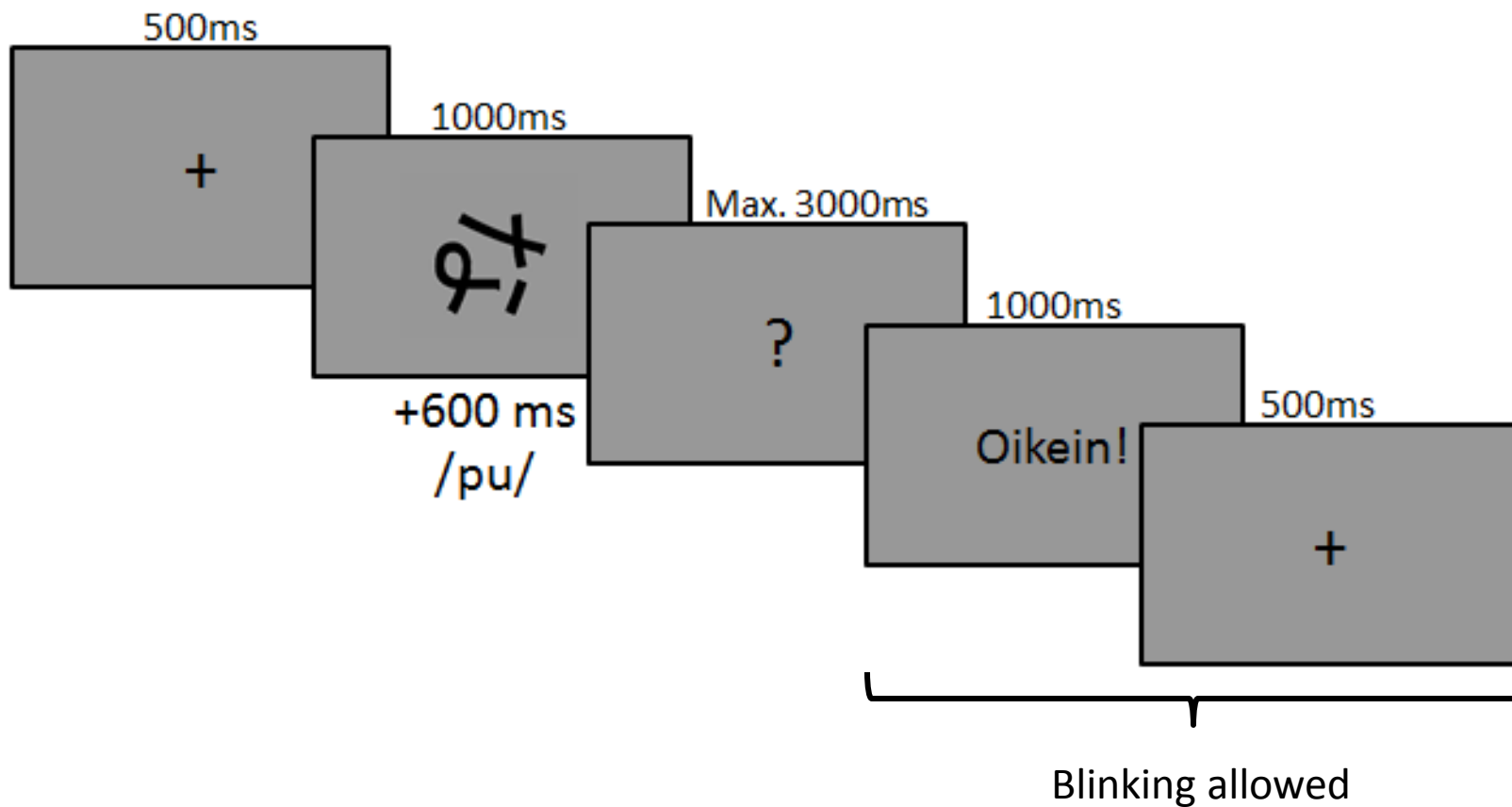


Blink

Small eye
movement
(saccade)

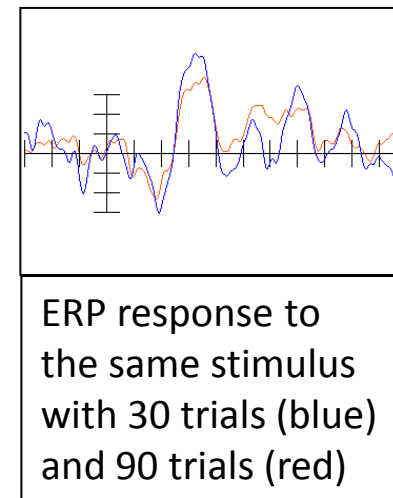
Horizontal eye
movement





Things to consider when planning your M/EEG experiment

- Timing of the stimuli
 - Do you plan to use time-frequency analyses?
 - Is there a possibility of overlapping (sustained) responses?
 - Is there a possibility of expectancy/prediction effects?
- Number of stimuli / length of recording
 - What kind of analysis do you plan to use? (e.g. ICA requires minimum of $20 \times (\text{number of electrodes squared})$ time points)
 - Make sure signal-to-noise ratio is good enough
 - Different numbers of stimulus presentations will lead to differences in SNR between conditions
- Counterbalancing blocks, randomizing stimulus presentation order



Which electrodes to use?

- Disposable
- Single electrodes
- Electrode cap
 - EasyCap, EGI Hydrocel
- How many electrodes
- Active or passive electrodes



Ethical issues

- Good practice to acquire an ethical statement before data collection
- Most journals require a statement from the local ethics committee before publication of the data
- Most EEG and MEG studies are handled by the JYU committee
 - If patients as participants or medical procedures are carried out
→ hospital ethics committee
- The participants have the right to discontinue their participation at any time, even to withdraw their data from the study -> informed consent
- <https://www.jyu.fi/hallinto/toimikunnat/eettinentoimikunta/en>

Recruiting participants

- Exclusion criteria, mention already in the ad
 - Neurological problems, head injuries, hearing problems, extremely irritable skin, handedness, eye-glasses? (MEG: tooth braces, implanted metal, pace makers etc.)
- Inform participants not to use hair products, make-up etc.
 - In MEG measurements, no metal jewelry etc.
- Contacting your participants
 - What, where, how long, who
 - Name of senior researcher (PI) (in all communication)
- Useful background information: handedness, age, sex (e.g., musical expertise, bilingual etc)

Working with the participants

- EEG laboratory is a new experience for most individuals
 - Assume participant knows nothing of EEG/MEG
 - Give enough information in everyday language
 - Explain the length of each experiment phase
 - Leave time for questions
- Working with children
 - Criminal records check (show it to Anna Karhu, Jutta Aalto or Raija Mehto)
 - Children are anxious of new situations
 - Keep track of arousal level (sleepy, hyperactive) and endurance
 - Instructions given to parents beforehand

Working in the lab



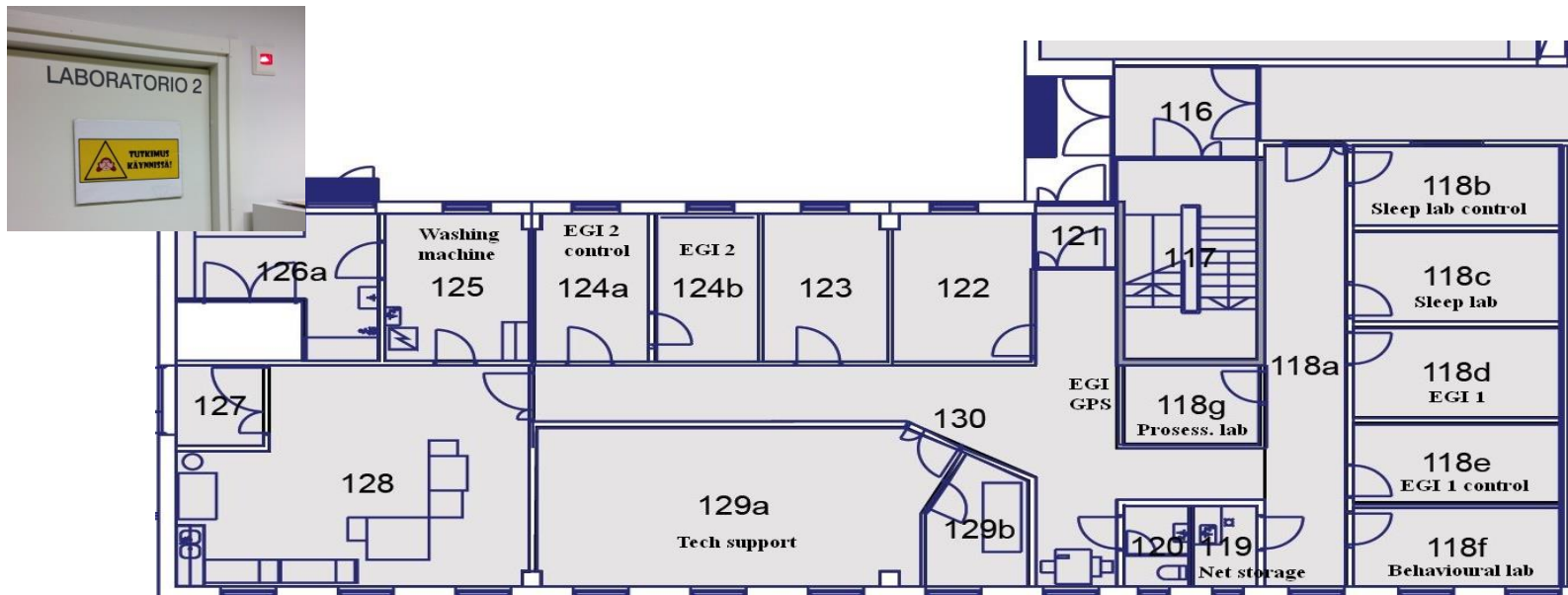
- Be professional
 - There are many participants and visitors to the laboratories
 - Think what you say out loud...
 - Need to keep the facilities clean and orderly: return everything to where they belong and clean any obvious messes
 - Keep the corridors as quiet as possible; respect the silence signs
- Participant confidentiality
 - Professional secrecy (Vaitiolovelvollisuus)
 - Do not leave any papers concerning participants on the tables or other places that are not locked (preferably not in the lab at all)
 - Participant information should be kept in a password protected file on the network server accessible only by the research group
 - Do not talk about the participants in the corridors
- Data management
 - Save your data in your project folder
 - Keep the lab computers clean of unnecessary files
 - Do not connect the laboratory computers to the internet, use external hard drives or equivalent for data transfer



Laboratory facilities



- Use primarily the door from outside (leading to 121)
 - This is to keep the laboratory corridor as quiet as possible
- When running an experiment use the silence sign stands in the corridors and on the doors
- When running an experiment in rooms 118b-118g also use the coffee machine silence sign
- Respect the signs (do not use the coffee machine and avoid talking loudly and walking the corridors when experiment in progress)
- Keep the electrode net storage room (119) door closed



Booking lab time

- Consult your PI on how much lab time has been agreed on
- Use the google calendar to book your times
 - Username: neurolabs.jyu, password: geodesic
 - Book the lab space you need and if necessary the needed equipment (eye-tracker or Neurone amplifier)
 - Book the time using your name, PI name and the name of your project (do not include participant information in the calendar)
- You can use the lab only when you have reserved the time from the calendar
- Remember to cancel your reservations if you cannot use the time slot

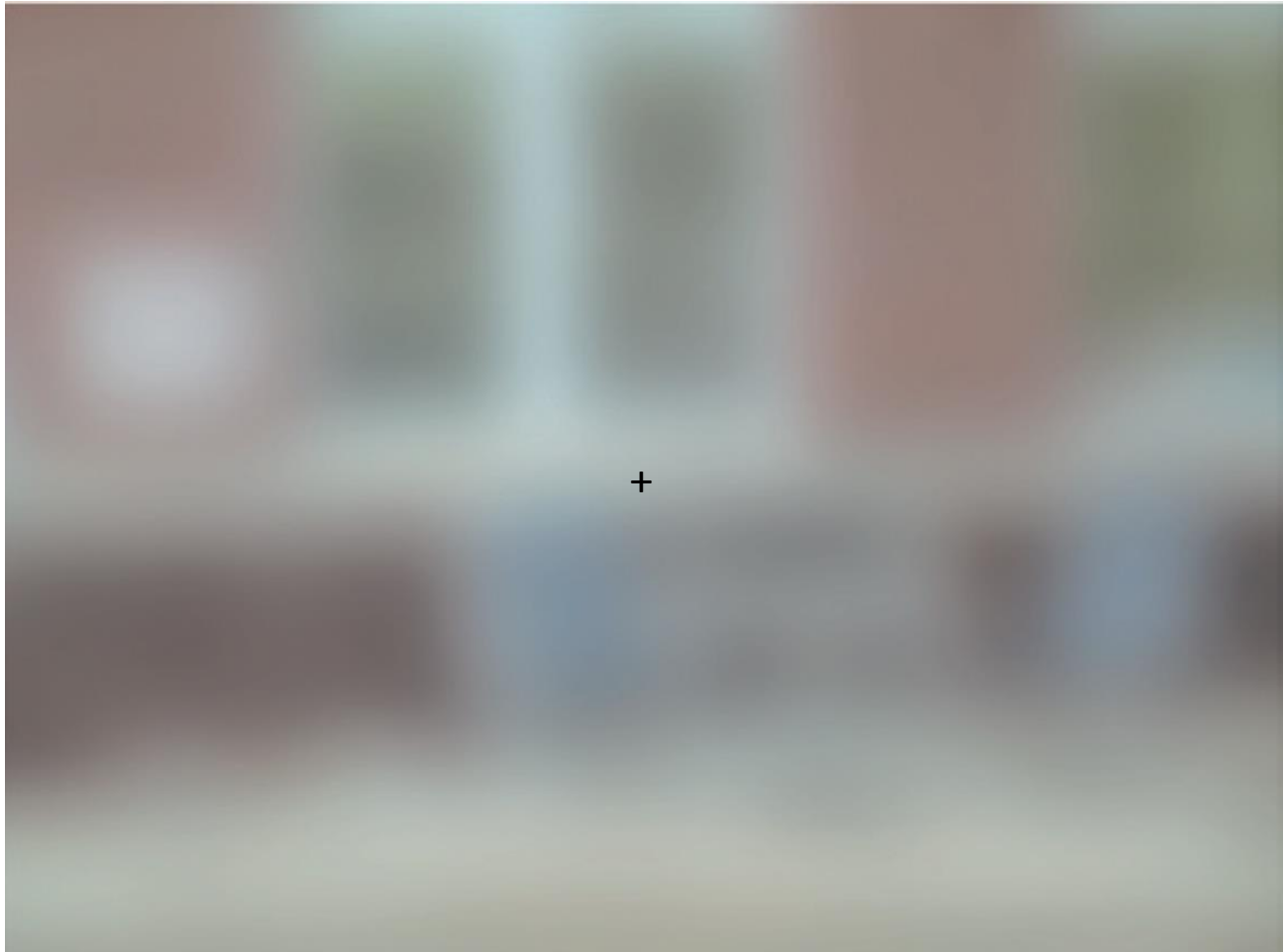
Objective

- good data quality

- Making notes of the EEG recording
 - Systematic (e.g., checklist, procedure sheet)
 - Relevant information (changes to the protocol, special to note)
- Equipment and tools
 - Sufficient expertise of the equipment and software
 - How to deal with problem cases
- Issues related to experimental design
 - Laboratory equipment and software
 - Calibration of sounds, screen luminance, room lighting etc. – try to standardize everything you can
 - Checking the timing of the triggers and stimulation
 - Checking the experimental program; e.g., response buttons work as expected -> test everything beforehand
- Data quality
 - Conclusions possible only when the data has good enough signal-to-noise ratio

Things to consider when measuring EEG

- Keep the participant happy
 - Data quality will be better when only little movement and muscle tension, also concentration on task will be better
 - Inform what the experiment is about
 - Always tell the participant if you intend to touch them and tell what you are going to do and why
- When giving the instructions for the task, be precise; misunderstood instruction can ruin the experiment
 - Before the experiment show the participant how eye blinks, tense muscles etc. affect the EEG
- Important to get the EEG sensors in their correct positions and well placed
 - If the electrodes have poor skin contact then the EEG is of poor quality and there is no point in collecting the data
- Monitor the EEG quality during measurement: no point in collecting poor quality data



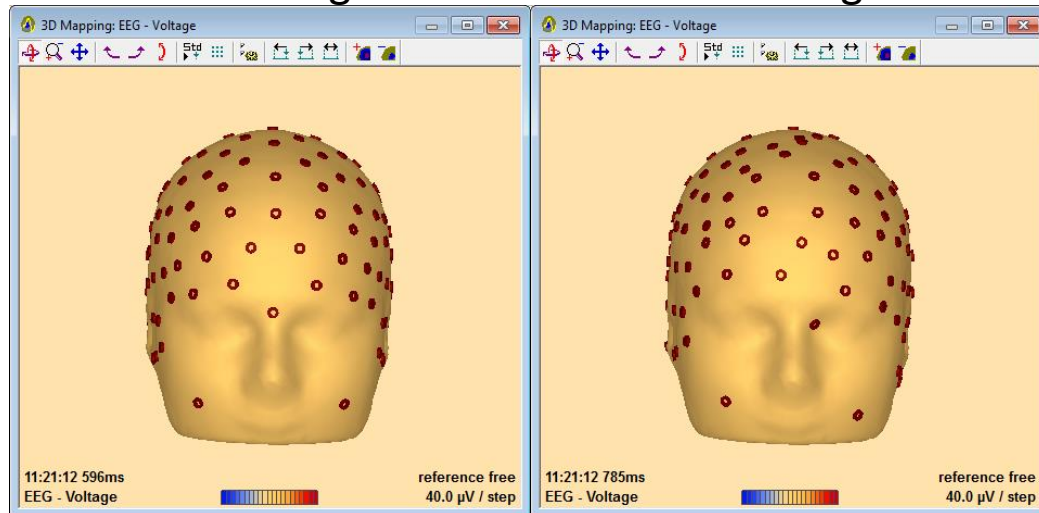
Placing the EEG electrodes on the head

- Electrode locations have to be comparable between participants for group level analyses (recording the electrode coordinates using Polhemus)
- Even more important when the same participants are tested several times
- Impedances (Ω) to be kept below certain limit (depends on the system)
 - Describes how well electricity flows between the electrode and skin, the lower the number the better the contact
- Bridging
 - Electrolyte can cause bridges between electrodes
 - Seen as identical signal from the electrodes connected by the electrolyte bridge
 - Avoid using excessive amounts of electrolyte to prevent this
 - Use tissues to wipe excess electrolyte if bridging observed
- Reference and ground electrodes
 - Make sure the reference and ground electrodes have good contact, this affects quality of EEG measured from all other electrodes

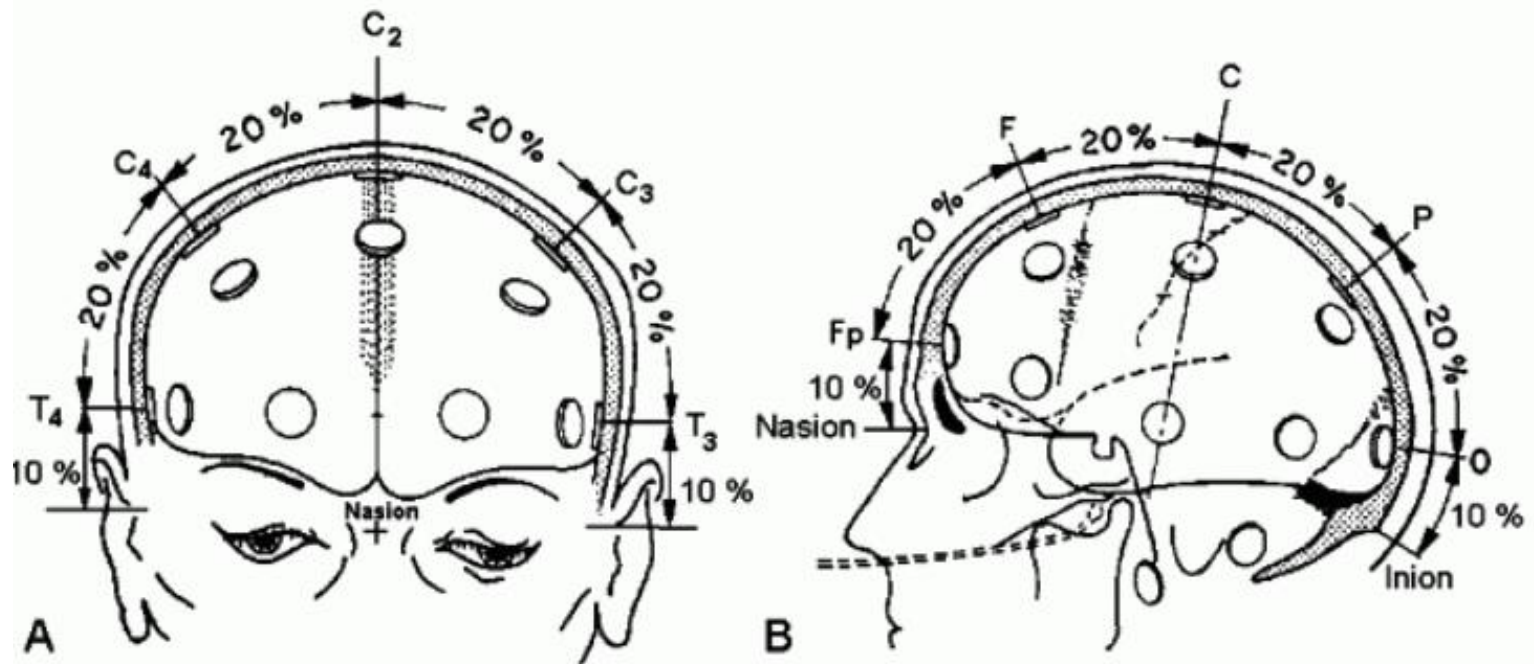
Electrode locations

Recording 1

Recording 2



Placing the EEG electrodes



After the EEG measurement

- Leave time for questions by the participant
- Debriefing if the real purpose of the experiment was not explicit
- Make sure the participant has all their belongings
- Clean/disinfect the electrodes used
 - Be gentle when handling the electrodes
 - If disinfecting needed, remember to set an alarm for yourself; extended periods of submerging in the disinfectant can be harmful to the electrodes
- Tidy up the laboratory facilities
- Do not leave any participant information in the labs

In problem cases...

- Technical problems
 - Try to figure out what is wrong
 - Contact the tech support
 - Technical assistant Petri Kinnunen
 - Research technician Lauri Viljanto
 - University researcher Jarno Mikkonen
 - Always inform the tech support if the problem will affect general lab usage
- Problems in experimental design
 - Contact your PI
- General major problems with the facilities
 - Contact Prof. Paavo Leppänen