

# MEG Guide

## Study design considerations

### **Do we have the equipment you need?**

Before making grand plans, you should check that what you want to do is feasible. If you need anything not mentioned below, please discuss this with MEG physicist Sven Braeutigam: [sven.braeutigam@psych.ox.ac.uk](mailto:sven.braeutigam@psych.ox.ac.uk)

**Visual:** Will the projector be suitable for your visual stimuli? Can we give you the viewing distance and field of view you need? Do you want to present stereo stimuli? If so, you will probably need to use red/green rather than shutter glasses.

**Audio:** Will our amplifiers and audio-tubes be suitable?

**Responses:** We have a variety of different ways to signal responses, either for simple logging or to feedback into the stimulus program. Equipment can record button presses, grip-force and joystick movements. Eye movements can also be used to signal responses.

**Software:** We have Presentation, PsychToolBox, PsychoPy and Matlab installed on the stimulus computer. Please check that we have the software and toolboxes you need.

**Other:** Are you planning on bringing your own equipment? Please discuss this as soon as possible with Sven as all equipment taken into the shielded room must be MEG compatible.

### **How will you get ethics approval?**

Before starting your MEG study, you need to apply for ethics approval from either CUREC or the NHS. This procedure is covered in detail on the ethics website.

If you have any questions regarding your ethics, contact MEG/EEG lab manager Anna: [anna.camera@psych.ox.ac.uk](mailto:anna.camera@psych.ox.ac.uk) and don't forget to send Sven your full application before sending it to CUREC.

### **How long will a scan take?**

The maximum session time per participant is two hours (unless you have an exceptional study design), and this is generally far more than required. If you are doing a sleep study then you may need your participant to be in the scanner for much longer and it is possible to use a bed instead of the chair. Currently, the bed is restricted to scans with non-visual tasks.

Assuming you want your participant to be alert throughout the scan, you need the sessions to be as short as possible whilst also collecting enough trials. The length of time before your participant gets drowsy or fidgety will depend on the nature of the task, and the compliance of your participants (children and patients will often need shorter sessions). As a guideline, one hour is around the maximum time you can expect someone to stay in the scanner – and that's if you have an interesting task.

Due to the large size of raw MEG datasets it is recommended to stop recording and save the data every twenty minutes or less. Once file sizes exceed 2GB - which is shortly after twenty minutes at 1000 Hz - the acquisition program will split your data into several files, which might cause issues during analysis. You should design your task to allow for these breaks.

A significant portion of your session time may be spent acclimatising your participant to the scanner environment, preparing them with electrodes and coils, and maybe doing some training tasks. If your participant has not been in the scanner before then they may be anxious and it is important to allow them plenty of time to ask questions and decide if they want to take part. Ideally, participants should be checked for artefacts before fitting with electrodes but this will not be possible if the MEG system is already in use. In this case you can proceed to prepare your participants if you are confident they are metal-free, else you will need to wait for the scanner.

### **How are you going to recruit and remind participants?**

Do you expect particular difficulties recruiting the participants you need?

Are there any particular conditions, medications or other things you need to screen for?

Are you worried about your participants not showing up or dropping out of the study?

What are you going to do to remind your participants? Phone calls, texting and emails could be used.

### ***A typical protocol might be:***

- Participant contacts researcher. Researcher summarises the project, explains the exclusion criteria and what the study would involve. If the participant is still interested they are sent (by either e-mail or post) the participant information sheet. This sheet includes full information on exclusion criteria. Participant contacts researcher if they are interested in taking part. Researcher confirms they are suitable in terms of metal, eyesight and other criteria. Researcher books a suitable scanning slot.
- Artefact tests can be done in the MEG, without cost, in advance of the real scan for participants with metal in their body. These should be booked via OHBA support staff so that Calpendo sessions for a project are not used.
- The day before the scan, the researcher calls or emails the participant to confirm the scan and check the participant is well to take part.
- If required, the researcher emails, texts or phones the participant on the day of the scan to remind them.

You must take reasonable steps prior to the scanning session to ensure participants are suitable for scanning, and reminded to attend the scanning session. Scans that are cancelled with less than 24 hours' notice may be charged for.

### **How are you going to correct eye-sight?**

If you're doing a visual experiment then you need to consider whether you want participants that need optical correction to wear contact lenses or glasses.

Normally, participants cannot wear their own glasses in the MEG unless the frames are metal free, i.e. no metal screws.

**Contact lenses:** These are only an option if they have their own. An advantage is that you know their eyesight will be properly corrected (certainly better corrected than you could achieve with the plastic glasses); they may be more comfortable than the frames. A disadvantage is that your participant may blink more; the eyetracker may not work as well for detecting micro-saccades.

**Glasses:** We have plastic frames and lenses from -8.0 to +8.0 dioptres (0.5 dioptre step). The lenses and frames are not suitable for everyone. Also, the frames and lenses can sometimes obstruct the eyetracker – this seems to vary between participants.

Make sure you've read the information on using the lenses and have checked before your participant arrives that the glasses will be suitable. This information is available in the MEG Lab and Technical Guide.

### **Will you use participants with metal in their body?**

Ideally of course your participants would be completely free of metal. In reality, many participants will have some metal, and your judgement may be influenced by how difficult it is to recruit your participants.

Remember that your participant is never in any danger if they enter the scanner with metal in their body (unlike with an MRI scanner), but the data may be unusable.

Participants who have had wires, pins, screws or plates fitted to repair bone fractures will normally not know what metal was used. According to Taljanovic et al., 'The majority of internal fixation implants are currently made of stainless steel. Occasionally, less strong but biologically superior and more elastic titanium implants are favoured' (RadioGraphics, 2003, 23: 1569-1590). Stainless steel will contain a small amount of ferrous material and so can produce magnetic noise.

An important consideration is where in the body the metal is. Metal in legs or arms (so long as they are not being moved) may be fine. Anything on the chest that will move with breathing, such as lung staples (used after a collapsed lung) will likely be problematic. Similarly, heart pacemakers create a lot of noise.

Generally, metal (other than normal dental fillings) around the head area will make the participant unusable (e.g. pins in fractured jaws, aneurism clips, cochlear implants). Dental braces can be fine or terrible depending on the metal used. Removable hearing aids will need to be removed for the scan.

Ultimately, it is not possible to know for certain whether your participant will be usable until they go in the MEG. You should arrange for a free artefact scan of your participant prior to booking a real scan. If your participant cannot come in for this, and you still want to scan them, then have another participant on stand-by to avoid wasting the scanning session.

### **Are you going to be present for your MEG scans?**

A researcher from your study, and named on your ethical approval, **MUST** be present throughout all scans. This applies even if an approved MEG user is supervising the scanning. In some cases it can be useful to have a researcher sat in the MSR with the participant during the scan, for example, if your participants are particularly anxious or are children. If you do this then you will need to arrange for another researcher from your project to be present.

### **How can you become an approved MEG user?**

To become an approved MEG user you need to take part in the MEG course given at OHBA. This course consists of 6 theory sessions and lab sessions (of about 90 minutes each).

Once you have taken the course, a member of MEG supporting staff will be present while you scan subjects and will allow you to take the lead in the scanning session, while supervising you until you are ready to scan on your own. Once you become an approved MEG user you will be allowed to have MEG scans after working hours and on weekends, as well as help those who are not yet approved users with their scanning sessions if required. If you would like more information on the MEG course please contact: [anna.camera@psych.ox.ac.uk](mailto:anna.camera@psych.ox.ac.uk)

### **Do you have the funding?**

Current scanning charges are 550.00 £/hour.

### **Make sure you know your settings**

Once your study has been approved (ethically, financially and scientifically) you will be keen to get started. You should email MEG support staff (Anna or Sven) and request a pilot session to run through your experimental set-up. This session should not be used for programming your stimuli so make sure you have these programs running first.

There is a blank copy of the Experimental set-up form on the intranet (see the Forms and SOPs page). You will need to know all of these settings so that your experiment can be easily and accurately reproduced each time. During your first pilot scan you will be shown how these settings relate to your study.

You will then be offered a second pilot scan to try running your experiment on a person. For this session you should bring along a volunteer to be scanned, but is important to realise that this session is for testing the procedure and training you. The session will take significantly longer than a normal scan and the data may not be usable for your study. For this reason you should not bring a real study participant for the pilot session.

### **Checklist for using the MEG lab**

On the intranet you will find the checklist for using the MEG lab. Print this document and bring it with you to the lab when starting to pilot. It will help you to remember all the different steps you need to take in the lab before, during and after you are done with testing.

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## Recruitment considerations

### During recruitment – before your participant comes to the centre

Make sure participants have been given all of the information sheets in advance as described in your ethics approval.

### How to get to OHBA

- Make sure participants know where you want them to come to; this is normally directly to OHBA. You must tell OHBA reception who you are expecting and when by emailing: [reception@ohba.ox.ac.uk](mailto:reception@ohba.ox.ac.uk)
- Make sure you have sent participants maps, directions, and bus information if needed.

### Screening

- Depending on your study requirements, screen for medication, particular diagnoses, and mental health. See the MEG screening template for help in selecting your questions. You can arrange a free artefact scan in advance, or have a reserve participant ready to fill the scanning slot if required. To book a free artefact test ask a member of MEG support staff to make the booking for you so you don't use your session allowance.
- Check whether your participant needs eyesight correction. If they need correction, and if you want to use the plastic frames (see MEG study design considerations), then obtain their prescription in advance and check that the lenses can make the prescription (see Plastic frames and lenses guide).

### What to wear/bring

Mobile phones cannot be taken into the scanner room. Tell participants they will be asked to switch them off or put into flight safe mode.

Warn participants that they should not wear clothes or accessories containing metal. Tell them that they will be given scrubs and that a changing room and lockers are available.

### The day before

Contact your participant to confirm they are feeling well and are able to make the appointment. Run through the procedure with them and ensure they have all the information as above.

For participants that need eyesight correction, make sure your participant knows whether you want them to arrive wearing contact lenses or glasses.

The day before your participant is due, email [reception@ohba.ox.ac.uk](mailto:reception@ohba.ox.ac.uk) and inform them of your visitor's name, expected arrival time, your name and contact number (the MEG lab is 01865 283811).

Remember to bring any refreshments you want to provide for your participants.

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## Screening MEG participant's template

This is just an example of something you may find useful to adapt into a screening form. It is meant as an aid for reminding your participants - and not something they need to fill in - so it shouldn't need extra ethics approval. Most of the things here will be mentioned in your Participant Information Sheet, but time and again participants turn up who have not informed researchers in advance of potential problems. You could send your adapted sheet out or go over it on the phone.

You should adjust this for your own study depending on your own criteria. A lot of the points below may not be relevant to you, pick the points that you've mentioned in your inclusion/exclusion criteria on your ethics application.

With a lot of the metal-in-body questions the only way to see if they are scan-able is by doing an artefact test (book through a member of MEG staff). You will need to weigh up whether this is worth it if your participant needs to travel a long way. Note that you cannot presume that because someone has had an MRI scan that they are suitable for MEG.

- **Are you aged between x and x years?**
- **Is your first language English?** *If this is relevant to your study.*
- **Are you right/left handed?** *If this is relevant to your study.*
- **Do you have a heart pacemaker fitted?** *Will not be suitable for scanning.*
- **Do you have a cochlear implant?** *Will not be suitable for scanning.*
- **Have you had brain surgery?** *May not be suitable for scanning.*
- **Do you have surgical staples in your body, e.g. lung staples?** *These could be titanium or surgical steel, only an artefact test will show.*
- **Have you any metal plates or screws in your body, e.g. from a broken bone?** *If yes then consider where the metal is, may be ok on the lower body.*
- **Do you have tattoos on your head?** *These \*may\* contain metallic inks. If they are not on the head they are unlikely to cause problems.*
- **Do you have dental work other than normal fillings?** *Crowns and fixed braces cause the most problems.*
- **Have you ever been diagnosed with a neurological disorder?**
- **Have you been diagnosed with <insert other medical conditions>?** *Anything that's relevant to your study.*

- **Are you taking any medication?** *If yes then you may need to get a medical opinion as to whether this is likely to affect brain function.*
- **Did you have an eye squint as a child or does one eye not see clearly even when corrected by an optician?** *Most people won't recognise the word amblyopia, if binocular function is really important to you then you may want to test this.*
- **Do you wear glasses or contact lenses?** *If yes, make sure you have considered whether you want them to wear contact lenses. If wearing glasses, make sure you have checked their prescription is correctable as described on the OHBA website.*
- **Do you wear a hearing aid?** *If yes, this will need to be removed for the scan. Check they are happy to do this and consider whether you need to adapt your procedure to communicate during the scan.*
- **Can you hear well with both ears?** *If this is relevant to your study.*
- **Do you have any walking difficulties?** *If so you may need to use the ramp or move the seat out-and-up when your participant arrives.*

#### **For when you come for the scan:**

There is a changing room at OHBA for you to remove metal objects in private. There are lockers for storing your belongings. Please confirm you are happy with the following:

- Are you willing to remove metal jewellery? You usually do not need to remove wedding rings as they are normally non-magnetic and are far enough away from your head to be fine.
- Are you willing to remove metal piercings which are above the waist for the duration of the study? Piercings below the waist are normally fine. If they have plastic piercings or plugs then they should be fine too.
- Some make-up and hair spray /gels can produce magnetic noise. Ideally, do not wear make-up or hair spray/gel for the scan. In the unlikely event of make-up producing noise you may be asked to wash it off. You may want to bring make-up with you to reapply afterwards.
- Metal in bras are a huge problem. Even if a bra is not underwired they often have metal clasps (which may be coated with plastic) at the back. An elasticated crop top style sports bra without fastenings should be fine. Alternatively, you can remove your bra in the changing area and where the scrubs given to you.

#### **Things to note during a MEG scan**

Exactly what one wants to note during a scan will depend on one's study. It is worth thinking carefully before your study starts about all the variables you may want to note down. Having a form, or a standard list, to fill out will help make sure you don't forget anything important.

You should always bring your lab book with you to every scan. Please make sure your lab book has your name clearly marked on the outside or inside of the front cover.

Notes from scans should NEVER be jotted on scrap bits of paper. Bits of paper left lying around the lab will be thrown away.

You may also want a checklist to remind you to confirm that settings are correct. For example, checking viewing distance/ screen resolution/ screen size/ response values/ trigger values. If you record personal details of your participant, then make sure all documentation is stored securely in accordance with the Data Protection Act.