

# Checklist for BUCNI Operator Training

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Please ensure that at the end of your training, you are familiar with all the following equipment, procedures and information. Please refer to the [essential guidelines on the BUCNI website](#) for a [detailed overview of BUCNI rules and regulations](#).

## 1. Summary of BUCNI rules and regulations

- **Only BUCNI qualified scan operators are allowed to run the scanner. This means that operators are the ONLY ones who touch the buttons on the scanner, or on the console.**
- Normal operating hours are Monday to Friday, 9am to 6pm. During these hours, healthy adult participants can be scanned by a single qualified operator. Outside these hours, a second, safety-trained person must also be present when scanning. When scanning children (16 and under), patients, or other special populations there must be one qualified scan operator and a BUCNI-approved safety-trained person.
- No participants can be scanned without prior, written ethical approval. Phantom scanning does not require ethical approval. The only exceptions to this are pilot scanning with prior emailed approval from Fred Dick.
- All participants must have completed a consent form prior to entering the scanner (with the exception of the pre-approved pilot mentioned above).
- All participants must have filled out an **MRI Pre-Screening Form** before entering the scanner environment. These must be filed in the box labelled Form1 in the control room. (BUCNI core staff can keep one on record and sign it every time they enter after checking).
- When scanning a participant, the BUCNI logbook must be filled in. This is where their Patient ID is found.
- Operators must be up-to-date on the MRI Safety Training (every 18 months). Failure to do this will result in having operator status suspended until the safety refresher can be attended.
- Operators must do a refresher course (every 18 months). Failure to do this will result in having operator status suspended until the refresher can be attended.

## 2. Scanner environment

- **IMPORTANT:** Keep scanner door FULLY CLOSED at all times when someone is not entering/exiting (to prevent unexpected entrances)
  - Always lock the Prisma scanner door when the operator leaves the scanner or console rooms. The scanner door key can be found in the cabinet in the console room.
- Know the placement of coils and other equipment in scanner room
  - Wires, projectors, mirrors, etc. (know what they are, and what their default position is)
  - Put paddings in the box labelled "Used" after use and notify BUCNI if there is something that needs to be cleaned.
- Keep the room clean and tidy (put back equipment, remove paper towels, clean surfaces, etc.)
- Check chiller temperature gauge (should be below 10C)
  - i. Will alternate between two chillers, sometimes around 12C, which is fine.
- Equipment room - know that it exists.

### 3. Participant & phantom set-up

- a. Participant head placement in coil and use of landmark laser
  - i. align participants carefully in head coil
  - ii. laser should align just above participant's eyebrows (except if specifically changed for a non-brain study)
  - iii. top of head should be as close to back of coil as possible while still allowing participant to see through eye coils
  - iv. place cushions carefully and snugly around head.
  - v. use oblong neck cushion whenever possible
  - vi. Use the paper towel provided to wrap the cushions and cover the scanner bed
- b. Placement of participant using HAROLD (currently available for 30/32-channel, soon for 64- and 20-channel)
  - i. Make sure participant wears a hair cap
  - ii. Place HAROLD inside the posterior coil
  - iii. Deflate all cushions (open vent and press air out of cushions, then close vent again)
  - iv. Close top
  - v. Carefully inflate cushions and check with participant if they are comfortable while still not being able to move much
    - i. Only open one valve at once!!!
  - vi. When done using HAROLD, open vent and deflate all cushions at once
- c. Headcoil plugs - be careful and gentle with them
- d. Use vitamin E tablets to mark laterality (optional)
- e. Scanner bed operation
  - i. avoid injury due to pinch points
  - ii. check that cables are not getting trapped (they are expensive and delicate!)
  - iii. emergency operation – manual bed removal
    - i. only show this, don't demonstrate by pulling handle and removing bed because it can upset the scanner
  - iv. stopping & restarting
- f. Ensure participant not crossing limbs or linked hands
- g. Set up participant and move into bore
- h. Alert bulb check
  - i. For Prisma – best to test in the scanner room, as can be turned off using small jogger dial
  - ii. For Avanto – go back to the console and once there, ask the participant to squeeze the alert bulb. (This order eliminates the need to run between the scanner room and the console to turn the alarm off and to leave the door open at this point)

### 4. Using the console

#### Turning scanner on, off and troubleshooting

- a. Scanner needs to be turned on first thing in the morning, turned off at night. Check [Calpendo calendar](#) to make sure you're the last person scanning.
- b. How to turn on scanner:
  - i. Hit "System on" [top right on the wall]. You will hear a click (if you don't hear it, make sure that the key is turned to "unlocked" and then hit "System on" again). The console computer will just turn on.

- ii. Takes 10 minutes. Wait until you hear the 'clank' from the scanner before moving the patient bed or doing anything on the console. There should also not be any yellow or red diagonal lines on the FID or head icons on the bottom of screen.
  - i. if there are red or yellow lines that don't go away, check what they are, record it by writing down or taking photo. Then contact BUCNI staff.
- iii. On rebooting, a few seconds after hitting "Power On", you should hear the fans on the Console PC under the desk temporarily run up to full blast for a few seconds. This is normal. In fact, if it \*doesn't\* occur, wait 5 minutes (to make sure the boot didn't already start and maybe you just didn't notice the fans), hit "System Off", and start over, with "System On".
- iv. Check that the system is ready for scanning (i.e., no errors showing on the bottom bar at the end of the booting process)
- c. Know how to warm up a cold scanner
  - i. Run a phantom scan for 10 minutes or so using EPI.
  - ii. No need to record a phantom run on the BUCNI log book.
- d. Know how to shutdown (and restart) scanner
  - i. Unplug head coil.
  - ii. Move bed to home position (i.e., outside, same height as scanner)
  - iii. On console, go to System Menu > End Session > Shut Down System. Error messages may pop up, ignore them.
  - iv. This takes ~5 minutes, then says "It's ok to switch computer down."
  - v. Once the 'OK to switch off' message comes up, hit the 'System Off' button on the round control box on the wall to the upper right of the console. → ***This is NOT the quench button!!!!***
- e. Know how to interpret error messages on the console (these are at the bottom of the screen):
  - i. If there is a wave crossed with yellow line: minor annoyance, on the Avanto, this is often the door sensor not working properly.
  - ii. If there is a head profile crossed with red line and/or wave crossed with red line, you can't run the scanner. Depending on the message, sometimes you just need wait. Try running another sequence (e.g., a structural).
    - i. If that fails, try quitting the patient and re-registering
    - ii. Try rebooting the image reconstruction computer
    - iii. If that doesn't work, move bed into home position, re-landmark (laser) subject and reregister.
    - iv. If console doesn't allow you to do this, or bed is not functioning, get patient out and shut down the scanner then restart after 30s-1min.
    - v. If after 2 reboots there is still a red line call BUCNI team.
- f. Know how to reboot the image reconstruction computer
  - i. On console, go to System > Control > Recon tab > Reboot
- g. Know how to reboot the scanner, if necessary
  - i. Note patient has to come out and coil has to be unplugged, with bed in home position for a good restart.
  - ii. Click System, then End Session and confirm
  - iii. It takes 5 minutes to shutdown, wait 30-60sec, then restart.
  - iv. Do not touch the tower computer.

#### Registration of participants and communication

- a. Correctly registering participants & phantom scans (NOTE: new QR code system, researchers need to meet with BUCNI staff before scanning to set up a project code)
  - i. Register the participant before putting them in the scanner

- ii. Every subject must be registered using a subject specific QR code and the project code set up by BUCNI staff
- iii. On Prisma, click on QR Code icon on Camera PC
- iv. On Avanto, open the Terminal on Raspberry (NOTE: still in process)
- v. Type “. / bucni\_qrcode *PROJECTNUMBER*” and press Tab (project should start with 20) -> This should generate a QR Code
- vi. Open patient registration window once QR code is generated (don't click anywhere else!)
- vii. Scan QR code (shown on Camera PC monitor) with QR code reader
- viii. Only edit patient ID, sex, height in centimeters (Prisma) meters (Avanto), weight in kg, patient position
- ix. **Don't touch any other fields or change values to non-metric**
- x. Press Exam and proceed with the scan as usual
- xi. Phantom: use 'PHANTOM deleteit' for registration (type PHA and search to find the relevant registration details)
- b. Use the BUCNI log book (this provides Patient ID)
- c. Communication with participant in scanner is important!
  - i. Unless you have discussed with the participant beforehand, talk to them before and after each scan to make sure they are OK and that they know what they are doing and what they should expect
  - ii. Remember to *have the experimenter* tell them what the experimental task is!
- d. Check that coils are on:
  - i. Vertical rectangles on the sides of the top squares should be red surrounding grey and not red surrounding black.
  - ii. If not on, click on the bars to make them become grey with red borders.

### Protocols and sequences

- a. Know how to set up a new protocol
  - i. Ask BUCNI staff (Fred/Joerg) to do this **unless you have been explicitly instructed to set up a protocol by Fred or Joerg!** Register the participant before putting them in the scanner
  - ii. Getting standard protocols from the folder “For General Use” (1.5 T) or “BUCNI Default” (3T)
  - iii. Never change distance factor or TE
  - iv. Don't change orientation for special sequences
  - v. *Don't tick Moco*
  - vi. Only change TR, number of slices, slice thickness, number of BOLD volumes
    - i. For sparse sampling, Delay in TR [BOLD card] = silent gap
    - ii. For all sequences: Top and bottom slices are not good data.
- b. Know how to
  - i. Use localizer scans to do slice positioning (taking care to avoid accidentally turning off coils!)
  - ii. acquire a T1-weighted structural scan
  - iii. acquire T2\*-weighted EPI data
  - iv. acquire a fieldmap (see below)
  - v. acquire a reverse phase encoded EPI (see below)
  - vi. stop a scan in progress (counter-intuitive!)
  - vii. start an interrupted scan again (better to start a new scan)
  - viii. recognize the active scan versus planning for the next scan
  - ix. use (and not misuse) the inline viewing tool (i.e., watch out for the □/▶ button which stops the scan)

- x. use 3D and Neuro3D viewers (Better to use Neuro3D when not scanning, risk of crashing)
- c. How to setup fieldmap:
  - i. Run a normal EPI sequence (or a short EPI sequence), then follow with fieldmap sequence, open fieldmap, right click on EPI sequence, copy parameters > adjust volume, then see green & yellow cubes on the brain image.
  - ii. Then for subsequent EPI sequences, right click on the earlier one, copy “everything” to copy the slices positions.
  - iii. The fieldmap needs to be run after a first test (!) sequence of EPI, to make sure the shimming has been done already (so that all subsequent EPI runs have the same shim).
- d. How to set up a reverse phase encoded EPI
  - i. Ask Fred to set up for you.
- e. How to copy parameters (e.g., position of slices) from one scan to another
  - i. Drag new scan B below scan A
  - ii. Double click on scan B to open it
  - iii. On scan A, right click, copy parameters
  - iv. Select Centre of slice groups & ... or Slices & sat ....
  - v. Click Apply
- f. How to setup Autoalign:
  - i. Search in the register for autoalign, patient name opens up Talairach patient. AAScout (found in General Use sequences), put it after localizer.
  - ii. Open the EPI sequence, position slices, then apply, same for structural.
  - iii. Right click on black background, save as program, then open/register new patient.
  - iv. To use, run the autoalign localizer, then make sure it runs successfully (will tell you if it fails) then use same protocol you’ve set up.
- g. How to setup structural (MPRAGE):
  - i. Don’t rotate slab unless you know what you are doing
  - ii. Make sure that field of view is larger than right-left dimensions of head
  - iii. Watch out for A-P wrap if person has very long/big head (unusual)

## 5. BUCNI equipment

Up-to-date manuals for BUCNI equipment can be found in both the Prisma and Avanto console rooms. These can also be found on the [Facilities page of the BUCNI website](#).

All operators should be familiar with and able to set up, use and trouble shoot the following equipment:

- a. Ear plugs
  - i. Make sure to show participant how to roll in finger and insert into ear while holding in place with thumb
- b. Projectors
  - i. Front projector Avanto
  - ii. Back projector Prisma (including details on screens, neutral density filter)
- c. Button boxes
  - i. Turn on button box console, make sure it is connected and recording button presses to the relevant PC for the experiment
  - ii. Use alcohol wipes to clean NATA button boxes after use (Prisma)
- d. Confon headphones including the microphone (AVANTO ONLY)

- e. Sensimetric headphones
  - ii. Put the grey sleeve tips (different sizes, should feel snug) on the blue or red ends (1.5 turn screw).
  - iii. Bring the earbud leads into the scanner room, and attach to the main leads that are hung above the front projector door the room by the front projector doors  
Place arrow on arrow, red on red, red tip should be in the right ear.
  - iv. Note that you have to be careful with putting people into the head coil with these, as they cannot be too tight.
  - v. The leads should not be coiled or entangled, just straight along the body
  - vi. The same goes for the long grey wire, which should not be looped, in particular within the scanner high field red circle marked on the floor.
  - vii. Sensimetrics are OK with DTI, EPI, T1 structural, but **NOT high RF sequences like T2 structural (clinical typically), they heat up.**
  - viii. The grey sleeve tips can be compressed due to suction if the outer ear shape or eardrum tension changes. If this happens ask the participant to open and close their jaw. Also make sure participants can hear out of both ears.
  - ix. After use, make SURE to put them in the 'dirty' bin for cleaning with the ultrasonic cleaner
- f. Audio amplifier (below front projector, 1.5 T; cabinet to the right of the console computer, 3T)
  - i. ALWAYS check volume and make sure that it is low before putting earbuds or earphones on; then raise to the appropriate level while checking with participant  
CONNECTIONS:
    - ii. Black optical wire on desk for Mac from Topping D10
    - iii. Stimulus PC already setup but make sure that the correct audio output is selected (Topping D10)
- g. FOMRI microphone
  - i. Turn on microphone console, adjust volume and noise cancellation
  - ii. Connect either USB or analogue cable to PC/laptop
  - iii. Be careful with the cables, they are very delicate and should not be bent too much
  - iv. Use cable binders, nanotape, Velcro to attach to coil
  - v. Mount pop filter onto microphone and put it in the 'dirty' bag after use
  - vi. Microphone should be positioned as closely as possible to the mouth
    - i. Angle might need to be adjusted to prevent interference from breathing
  - vii. Test if microphone works and volume is okay
- h. In-bore camera (see Marty notes on monitor, 1.5T; Monitor to the left of the console computer, 3T)
  - i. Illuminator Prisma
    - i. Know how to switch on/off in cabinet
- j. Laptop connections
  - i. Plug trigger before starting Matlab.

- ii. Yellow plug on the left, black on the right. Check cable is connected to stimulus PC or laptop as appropriate
- k. MR compatible glasses
  - i. Watch out they are a tight fit with the 32 channel coil.
  - ii. If needed can put ear plugs in between the top and bottom of the head coil (coil has to be plugged in but doesn't need to have the top all the way down).
  - iii. For people with flat faces, glasses can steam up and impair vision, can put ear plugs between the cheeks and glasses to elevate them a bit and avoid steam building up.
- l. Phantoms (handling, leaks, and when to use them)
- m. Able to play music or videos to participants in scanner (Avanto)
  - i. If using the Stimulus PC to play a video or music, on the intercom press the middle button (with music note) so participants can hear the speaker.
- n. HAROLD (See 3.b)
  - i. Check which cap size fits the participant best and put used caps into dirty bags
- o. Periscope
  - i. Don't touch mirrors in periscope, only touch bottom wooden part when handling
  - ii. Know where to put screen. By default, the back of the screen (labelled) is positioned on black dotted line inside scanner bore
  - iii. If screen is too bright, check if neutral density filter is on projector lens. Put it on projector using the handle, don't touch the lens, camera, or anything else!
- p. Eye-tracker
  - i. Turn on illuminator before turning on eyetracker PC
  - ii. Know how to handle mirrors. Mirror for eyetracking must not be touched, only touch plastic handles. If it needs to be cleaned please contact Oliver or Joerg
  - iii. Eyetracker platform must be as far as possible from the screen in the scanner
  - iv. Know how to adjust camera and illuminator
  - v. On PC, go to settings and select appropriate configuration settings
  - vi. Know how to use TRACK software on stimulus PC for calibration (use same light settings for setting up as for study, e.g. calibrate with lights off if lights are off during study as well)
  - vii. Turn off eyetracker PC by clicking 'Shutting Down Host' and then turn off illuminator
- q. Physio measures
  - i. Make sure physio amplifiers are always in charging mode (i.e. pushed down in the socket)
  - ii. Know where the physio console is and how to switch on/off in case data will be recorded and saved
  - iii. Know how to put on physio belt and pulse oximeter
  - iv. Know how to check if physio data are being recorded with the sequence and are in the correct format (i.e., 'file') in the sequence settings
  - v. Know how to visualise physio measurements on the scanner PC



## 6. Safety issues

- a. No one enters the control room without the operator's approval. This includes both the participant(s) and the experimenters.
- b. You have the right to ask anyone to leave the control room at any time and for any reason.
- c. Do not allow cleaners, technicians, visitors or anyone else into the control room. If someone requests access but you are uncertain, get a member of BUCNI staff to help them.
  - i. One exception: our cleaner Inga who comes every day has clearance for the console room as well as the scanner rooms themselves
- d. Everyone who goes into the magnet room must be safety screened and metal checked including, the participant, the experimenter, and yourself. If there is any doubt about the safety of entering the magnetic field, the person may not go in. If participants indicate on the pre-screening form that they have something on their body, the [implant form](#) needs to be filled out and sent to Joerg for approval well before the participant comes in.
  - i. When safety screening, model checking from hair to feet for any headpins (put hands through hair), earrings, necklaces etc. all the way down (participant mirrors the operator).
  - ii. Make sure everything has been taken out of pockets.
- e. Tattoos:
  - i. Make participants aware they might warm up or tingle and they should tell you if it happens. If you are running subjects who might be less able to do this (e.g., brain damaged patients), you need to have confirmation from them, their family and/or clinician.
- f. Don't be persuaded by "expert subjects" – just because something was safe elsewhere or previously does not override BUCNI safety procedures
- g. Be sure that participants do not have: damp clothing, eye makeup such as mascara, eyeliner, or eyeshadow, or excessive hair gel. All of these can result in contact burns.
- h. Anyone entering the control room or magnet room is your responsibility.
- i. *Keep scanner door closed and latched pretty much all the time to avoid people barging into the magnet room.*
- j. When people go into the control room or magnet room, the operator should follow them to make sure they haven't picked up something they shouldn't have.
- k. No external equipment is allowed in the magnet room without prior approval from Joerg. All approved devices will have accompanying documentation from an MRI Device Compatibility Form. If uncertain, the equipment may not enter the magnet room.
- l. When a participant is in the scanner, the scan operator may not leave the control room unless another BUCNI qualified scan operator (i.e. not a certified user) agrees to take over and replace them in the control room
- m. Always try to set-up all equipment before the participant arrives and take it down after the last one leaves. This minimizes risk to the participant.

## 7. Emergency procedures and unexpected events.

**All operators should know the emergency number at UCL (222) and the procedures for dealing with emergencies.**

- a. When calling 222 operator/safety trained person should stay on the phone to describe location etc. until emergency people have arrived.

- b. Know how to deal with the following issues:
  - i. Fire
  - ii. Fire alarms
  - iii. Police (e.g., unruly participant or other)
  - iv. Removal of unconscious participant from scanner bed
- c. Equipment alarms:
  - i. Chiller alarms (next to small box with red LED to left of scanner door)
    - i. if alarm sounds, stop scanning, and contact BUCNI team. (Do not stop attempting to contact until you get through to someone)
  - ii. Oxygen monitor (round disk panel to left of scanner door)
    - i. If alarm sounds
      - 1. open scanner door and keep open
      - 2. get participant out immediately
      - 3. then close scanner door
      - 4. Inform BUCNI team.
  - iii. Air conditioner alarms (larger beige box with two aircon controllers and two temperature displays above them)
    - i. If alarm sounds, stop scanning
      - 1. Contact BUCNI team. (Do not stop attempting to contact until you get through to someone)
      - 2. If temperature is going up a lot (>30C) may indicate a fire, please be careful
      - 3. if there is a fire, leave with participant, and press fire alarm on way out, making sure that everyone is out of the scanner suite

## 8. Incidental findings

- a. On safety form, make sure that participant has checked and initialled screening form for " Would you like to be informed yourself if something unusual was found in your brain scan?" and "I acknowledge that these scans are not optimized for detection of clinical abnormalities."
  - i. If these are not checked and initialled, don't scan.
- b. If you DO spot something unusual:
  - i. Don't say anything to the participants (or parents); just continue as normal.
  - ii. Transfer data normally, and write down BUCNI code and participant number.
  - iii. Email this information to Fred. They will follow up with you. Put the relevant data into the 'ForFred-DontRemove' directory and make sure you include the directory name in your email to Fred.

## 9. Participants' comfort

- a. Do not try to persuade participants to stay in if they are uncomfortable, check the participant is ok to continue regularly
- b. Peripheral nerve stimulation
  - i. Usually happens with structural or DTI scans
  - ii. Tell participant to move their body a little bit to change the orientation of the nerves/muscles
  - iii. If it continues, stop scanning
  - iv. Fill the peripheral nerve stimulation form and leave on the main reception desk

## 10. Transferring and saving data (Avanto and Prisma):

- a. Make sure to hit refresh on the patient browser before starting transfer, and then select the whole participant directory (not just one scan).
- b. Bottom of the screen, check for Accepted and the Success of transfer. Transfer data after each subject (too many in a row doesn't work well).
- c. Data must be transferred via *mridatasort*
- d. Prisma: Physiological data acquired with multiband will be transferred automatically to the same folder as the MRI data
- e. Avanto: Contact Oliver for transfer of physio data
- f. Know how to retrieve data from buc02 in reception (but this is now the responsibility of the researcher)
- g. On BUC02 Terminal, you can convert the Dicom files using dcm2niix. That function is installed on Buc02
- h. Please note: A backup DVD backup is not supported anymore. The backup responsibility will fall to the project group!

### Troubleshooting

#### Prisma

- i. If transfer via *mridatasort* is not working, transfer data via buc13
  - i. b. On BUC13, open the terminal and access the folder where DCM files are stored: `cd /dicom`.
  - ii. Copy data from /Dicom to Buc02 (computer in the main reception room):
  - iii. `cp -r [NAME OF DATASET]/ meduser@buc02.psychol.ucl.ac.uk:~/fmri-data`

#### Avanto

- j. If transfer via *mridatasort* is not working, transfer data via Leonardo
  - i. On Leo, export to H:\TEMP\YYYYMMDDII.
  - ii. If job aborted, export again and save to a different name YYYYMMDDII2.
  - iii. To transfer onto the mac, use WinSCP (remember to refresh regularly).
  - iv. Then once on the mac, get rid of the extra "2", making sure there isn't a double on the mac. Files are backed up only if named correctly and in the right folder: `fmridata`.
  - v. Use `ima2brik` for checking data
  - vi. Open terminal window (green window)
  - vii. Go into your participant's directory (... \fmri-data\YYYYMMDD)
  - viii. Run `ima2brik -list` to make sure all the data has transferred before burning