

**THE CHINESE UNIVERSITY OF HONG KONG**  
**BRAIN AND MIND INSTITUTE**  
**fNIRS Hyperscanning Shared Facility (fHSF)**  
**Policy for Research Users**

**Background**

Supported by Research Grants Council - Collaborative Research Fund (CRF) and CUHK, the fNIRS Hyperscanning Shared Facility (fHSF) was established in 2023. The fHSF will enable local researchers and their collaborators to address next-generation questions about the human mind that go beyond one or two brains. fHSF will host a wireless, 10-person functional near-infrared spectroscopy (fNIRS) system for studies that require measurements of brain activities of up to 10 people simultaneously. The fNIRS system is housed in Brain and Mind Institute (BMI), 4/F, Hui Yeung Shing Building, CUHK.

Researchers will conduct research in four areas to deepen our understanding of the human mind beyond our behavioral and single-person/two-person neuroimaging research. These 4 areas are:

Area 1 - Group Communication and Relationships

Area 2 - Learning and Musical Performance in Group Settings

Area 3 - Family Systems

Area 4 - Communication Disorders

**fHSF Committee**

The fNIRS Hyperscanning Shared Facility committee will oversee the operation and usage application of the equipment. The Committee will determine the usage guidelines of the facility.

Chair of fHSF Committee:

Prof. Florrie Ng (Professor, Department of Educational Psychology)

Members of fHSF Committee:

Prof. Patrick Wong (Professor, Department of Linguistics and Modern Languages)

Prof. Gangyi Feng (Associate Professor, Department of Linguistics and Modern Languages)

Prof. Xin Zhou (Research Assistant Professor, Brain and Mind Institute)

**Usage priority**

1. Projects funded by the University Grants Committee (UGC) have the highest priority, followed by projects funded by other competitive grants, then CUHK funding, donation/industrial/commercial funding, and finally, projects with no funding support.
2. For projects funded by the same types of grants, projects involving more subjects have higher priorities. Whenever there are conflicts in bookings, projects with higher priorities will be prioritized.
3. Projects that can utilize the device at BMI will have higher priority than those that require borrowing the device off-site.
4. Projects involving more than 5-person hyperscanning can book the facility 6 weeks in advance; rescheduling is allowed but should be confirmed no later than 1 week in advance.
5. Projects with less than 4-person hyperscanning can book the facility 3 weeks in advance.
6. Reserved time slots that are no longer needed should be released as soon as possible.
7. The devices should be returned to BMI by the agreed-upon time.

## **Booking Policy**

1. For the first three years (1 Jun 2023 – 31 May 2026), the facility can only be used by Co-PIs of the CRF project with no service charge. However, Co-PIs are responsible for the costs of any repairs and replacement of broken or missing parts. Co-PIs are also expected to provide their own computer for data collection and buy their own caps and accessories (grommets and stabilizers) as much as possible.
2. During the application process, Co-PIs should complete an application form and submit an ethics approval letter as well as participants' consent form (refer to Appendix 1 for the sample statements) for review. They should acknowledge that they have read the fHSF policy and are aware of the safety issues involved in performing experiments, such as ensuring that study sessions are shorter than 45 minutes for adults and 15 minutes for toddlers. They should also inform participants about the potential discomfort of participating in the experiment.
3. Experimenters need to complete research ethics training and CRMO SOP training (see Appendix 2) and fNIRS online self-training (see Appendix 3) before receiving hands-on training on the devices and performing experiments. Experimenters should submit their research ethics training certificates and CRMO SOP training log to the BMI admin (Ms. Eliz Wong) in order to access the Google calendar for booking the facility.
4. When booking the facility in the Google calendar, experimenters should indicate the following information:
  - Experimenter's name and contact number
  - Number of devices they will use and the box numbers of the devices
  - Location of the experiment
  - Time of the experiment
  - Time of borrowing and returning the devices.
5. Each project team should use the same devices across different sessions of data collection as much as possible.
6. Project teams can borrow the devices one day before the experiment and should return them the day after the experiment is finished. If the experiments are running on consecutive days, and no other team has booked the same devices, the project team can keep the devices. However, if there are no experiments for more than 3 consecutive weekdays, the project team should return the devices.
7. If any team will be running a project with more than 9 subjects, all the devices must be returned to the BMI no later than a day before the testing session.
8. Before checking out the devices, the experimenters who are in charge of data acquisition in the study need to do a demo with Prof. Xin Zhou to ensure that they know how to use the devices.
9. Before checking out the devices for any team for the first time, Prof. Zhou will run an equipment check (dark noise test) to ensure the devices function normally.
10. At least once a month, each team should run a dark noise test for the devices that they are using and send the results (a photo) to Prof. Zhou. Each team should also report any suspected damage, missing parts, or other issues as soon as possible.
11. A photo for packing a NIRXsport carry box is provided in every carry box. Experimenters should follow the photo and return every accessory borrowed in order. If caps are borrowed (for piloting or tutoring), they should be washed with soap and dried properly before return.

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**Statements for Participant Consent Form**

The PIs are required to obtain participants' consent regarding Risks and Discomforts. Sample statements below are for PIs' adaptation and modification as deemed appropriate, and subject to ethics approval from CREC.

**Risks and Discomforts 潛在危險和不適**

The fNIRS imaging is non-invasive, and there are no expected side effects from this study. However, participation may involve more than minimal risk. The risks include finding the cap mildly uncomfortable (being a bit tight), having some red markers, or feeling warm on the skin with limited hair. Wearing a snug-fit cap ensures that the optodes mounted on the cap will have good contact with your skin (hair). Please let our researchers know if you are feeling uncomfortable, and our researchers will adjust the pressure from the optodes or change to a cap that fits you better. You may withdraw at any time you so desire without any consequence.

功能近紅外光譜成像本質是安全，沒有侵入性，無輻射的；這項研究預計不會產生任何副作用。然而，參與此研究可能會出現一些低風險的情況，包括：覺得帽子稍微有點緊不舒服，皮膚上可能會有一些紅印或頭部皮膚感到微溫。這是因為我們為了讓帽子上的光學探頭能與您的皮膚有良好接觸。如果您感到不舒服，請務必即時告訴我們的工作人員，我們會調整光學探頭的壓力或更換更合適的帽子。您可以隨時決定退出研究，不會有任何後果。

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**Research ethics training and CRMO SOP training**

All experimenters are required to complete the following online research ethics training and CRMO SOPs training before booking the facility:

<https://www.research-ethics.cuhk.edu.hk/orktsResearch/Web/Domains>

- o Human Subject Ethics
- o Survey and Behavioral Ethics
- o Publication Ethics

[https://intranet.crmo.med.cuhk.edu.hk/CRMCAApps/CRMO\\_SOPs\\_Training.aspx](https://intranet.crmo.med.cuhk.edu.hk/CRMCAApps/CRMO_SOPs_Training.aspx)

Three modules for the CRMO SOPs training:

- Study Document Filing, Retention and Storage (CRMO-SOP-006)
- Reviewing and Obtaining Informed Consent (CRMO-SOP-011)
- Case Report Form (CRF) Completion (CRMO-SOP-014)

Non-Faculty of Medicine staff who want to join the online training/examination can register here:

<https://intranet.crmo.med.cuhk.edu.hk/CRMCAApps/OnlineGCPTestRegistration.aspx>

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**Recommendations for fNIRS data acquisition and Training**

1. Thoughtful experimental design

**Q1. Will fNIRS measures be able to answer the research question?**

**fNIRS has limited spatial and temporal resolution.** When designing a new study, we need to keep in mind that fNIRS measures reveal the slow hemoglobin changes in the cerebral blood flow in the superficial brain tissues. Rapid changes in neural activity or from deep brain regions are not accessible for fNIRS.

**Q2. Will there be reasonable differences between experimental conditions?**

**fNIRS signals are very noisy.** Besides task-related neuronal activity that is of interest, fNIRS also measures task-related and non-task related changes in systemic responses, and physical noises. For a discussion about all noise components, please see Tachtsidis and Scholkmann (2016). Experimental manipulations with large effect sizes are appreciated to reveal the differences in fNIRS responses across conditions.

Again, due to the noisy fNIRS measures, it is always recommended to compare fNIRS measures between experimental conditions, rather than comparing task-related responses versus non-task baselines.

**Q3. How long is the data collection planned to be?**

fNIRS optodes that are used for data acquisition are not comfortable. The optodes hurt people especially those with thin or no hair, and the weight of the cables makes it worse. It is generally recommended each study session **shorter than 45 mins for adults, and shorter than 15 mins for toddlers.** When the planned data collection is long, please consider splitting it into multiple visits.

It is always helpful to pilot a few subjects, and get feedback about the general experimental procedure, and the comfort level after each session, before running formal sessions.

2. Familiarity with the equipment and accessories for NIRSPort2

**Q4. You may want to register an account with NIRX website?**

NIRX has a great support team. On NIRX website <https://nirx.net/technical-support>, you can download the software, read some documents to familiarize with the equipment, watch video demos to train yourself, and ask questions in this channel <https://support.nirx.de/archives/services/faq>.

You will need to know the serial number of any NIRX device, please contact [xinzhou@cuhk.edu.hk](mailto:xinzhou@cuhk.edu.hk) for this information.

**Q5. Are you familiar with the data acquisition hardware?**

The devices that we are using at the Brain and Mind Institute (CUHK) include 10 NIRSPort2 systems. To understand what each component of the hardware is, please go to the menu <https://nirx.sharefile.com/share/view/s81375ee4c524a909>.

**Q6. Are you familiar with the data acquisition software?**

Currently, we are using Aurora for data acquisition. To download this software, click <https://nirx.sharefile.com/share/view/s831a2599bcea41248cb4ebd73ac8c9b8/fo7c10bc-cddd-4b0e-a749-bd1dcd87cb88>.

NIRx company has a demo video available about running Aurora

<https://support.nirx.de/nirx-video-gallery/page/2>.

**Q7. Troubleshooting for the optodes**

Before checking out the devices (or monthly), please check whether the optodes function normally by running a quality test using the static phantom, which simulates the most optimal testing environment for the optodes. For step-by-step trouble shooting with the static phantom, please see the menu below.

[https://support.nirx.de/wp-content/uploads/2019/07/GettingStarted-\\_NIRSport2\\_-\\_Phantom\\_Test.pdf](https://support.nirx.de/wp-content/uploads/2019/07/GettingStarted-_NIRSport2_-_Phantom_Test.pdf)

**3. Experimental montage and cap setup**

**Q8. Are you familiar with the montage setting software?**

A montage refers to the connections between the NIRx light sources and light detectors, based on which fNIRS data will be recorded. NIRx has development the software NIRSite to help us design and visualize the montage. For step-by-step montage design in NIRSite, please see the video [https://support.nirx.de/nirx-video-gallery?filter\\_tag=montage-design](https://support.nirx.de/nirx-video-gallery?filter_tag=montage-design).

**Q9. Do you know how to set up a cap according to your montage?**

NIRScaps use coordinates from the EEG 10-5 system, and come naked. Once the montage is ready, you will need to set up the caps ready, by putting the optode holders and rings (grommets) to the naked caps. For step-by-step cap setup, please see the menu <https://nirx.sharefile.com/share/view/s832f984296140a69>. Please pay attention to the common mistakes that people make and may potentially cause problem with data acquisition.

- Choose the cap sizes based on the head size of each participant.
- **Size up** for better comfort of participants: if your participant has a head size of 56.5 cm, then choose a 58-cm cap, not a 56-cm one, the latter will be too tight.

**Q10. Are you aware of the short-channel bundles?**

Short channels with a distance of 8 mm, are designed to only measure the systemic responses from the extracerebral tissue, which are later used to help reduce the noise in regular fNIRS channels (30-mm long). For adults, short channels are very helpful and critical. Please see the video demo about cooperating short channels in NIRx system for data acquisition [https://support.nirx.de/nirx-video-gallery?filter\\_tag=short-channel](https://support.nirx.de/nirx-video-gallery?filter_tag=short-channel) Whereas short channels have NOT been implemented in the infant population so far for two reasons. First, infants have thinner tissues than adults, much shorter than 8 mm channels are needed to only measure responses from the extracerebral tissue (Brigadoi & Cooper, 2015). However, such short channels have not been developed yet. On the other hand, due to the thin tissue and limited hair infants, fNIRS has better spatial resolution and better data quality in infants than in adults.

**4. A few recommendations for testing subjects**

**C1. Be open to the subjects with the drawbacks of fNIRS**

Inform subjects of the non-invasiveness but discomfort from the optodes of fNIRS during the consent process; let them know that participation is voluntary, and withdrawal is acceptable with no consequence.

Explain to the subjects how they can report their complaints to the PI if they wish.

**C2. Reject subjects with terrible hair artifacts**

fNIRS suffers from hair artefacts. Subjects with dense and black hair are not optimal for fNIRS studies. Spending 15 mins or longer to simply deal with hair during preparation is not worth it, as subjects may already feel uncomfortable or fatigued before data

collection, or unable to complete the session. It is reasonable to include a ‘hair-screening’ step and reject subjects who fail to provide signal of good quality before data collection. For those rejected, explain to them the reason (and reimburse them for their travel or time spent).

#### C3 Pre-prepare the caps and optodes

Ask adult subjects or the parents of child/infant subjects to measure their head circumferences ahead of time. Based on these measures, select a cap that will be snug-fit and connect the optodes to the cap based on the montage, before the subject arrives. This will largely shorten subject’s waiting time and speed up the process.

#### C4 Keep booth clean and air circulated

Make sure the booth is clean and necessary items are in place on the day of testing. Make sure the air conditioning is running, and the room is cool and comfy. As the session runs, the booth can get fluffy. It is always good to offer subjects breaks and open the door to better circulate the air.

#### C5. Don’t keep the room dark

It is okay to have some luminance in the room, just avoid over-head light shining on the optodes. A cover plastic cap is recommended to block the light. Otherwise, subjects might get sleepy soon or uncomfortable in the dark.

#### C6. Cleaning and packing

**Wash the caps, sanitize the optodes and accessories, and the tables, chairs, and response devices (keyboard, mouse and et al) after each data acquisition session.**

**Put all the accessories back into the carry boxes.** Please pack everything in the way that was shown in the photo inside of the suitcase, which will save you a lot of time for your next session.

### References

- Brigadoi, S., & Cooper, R. J. (2015). How short is short? Optimum source–detector distance for short-separation channels in functional near-infrared spectroscopy. *Neurophotonics*, 2(2), 025005-025005.
- Tachtsidis, I., & Scholkmann, F. (2016). Erratum: Publisher's note: False positives and false negatives in functional near-infrared spectroscopy: issues, challenges, and the way forward. *Neurophotonics*, 3(3), 039801. doi:10.1117/1.NPh.3.3.039801