Summer Placement Projects

MRC Cognition and Brain Sciences Unit
Undergraduate Summer Placement Scheme 2023

Monday 3 July – Friday 11 August 2023

Project A. Can we forget to fear? Investigating the role of active memory suppression during Pavlovian fear extinction

Supervisor: Molly Rowlands

Scientific problem to be addressed

This study tests a novel theory in psychology: do we actively forget fear memories to update emotional responses? When a cue no longer predicts threat, we update our fear responses. This process, Pavlovian fear extinction, is traditionally assumed to be automatic - not requiring complex cognition. In contrast, the recent retrieval stopping model of extinction argues that active memory suppression mechanisms may be involved during extinction, whereby fear memories are suppressed to update emotional responses. This project tests this model, putting its key predictions to the test.

Type of activity the placement student is involved in

To address these questions, the student will 1) assess a number of older control participants on cognitive tests, 2) use the data to derive a formula from which we can estimate how much fluid intelligence has declined in patients, and 3) apply the formula to a set of existing patient data. The student's contribution will feed into the broader aim of this project, which is to look at whether damage to different brain networks predicts fluid intelligence decrement.

Methods used/skills to be acquired

Deliver a behavioural fear conditioning study collecting self-reports of fear and threat anticipation, statistical analyses (optional), psychological and qualitative questionnaire delivery, data collection and maintenance, presenting and reporting results in research lab group meetings.

Key References

- Anderson & Floresco. 2021. Prefrontal-hippocampal interactions supporting the extinction of emotional memories: the retrieval stopping model.
- Hulbert, et al. 2016. Inducing amnesia through systemic suppression.
- Anderson & Hulbert. 2021. Active Forgetting: Adaptation of Memory by Prefrontal Control

Project B. How is the Third Thumb represented?

Supervisors: Clara Gallay, Tamar Makin, Lucy Dowdall, Maria Molina

Scientific problem to be addressed

Augmentative technologies are no longer science fiction – engineers are designing robotic fingers and even entire arms to augment our own. These innovative devices introduce various theoretical and practical challenges. In this project, we work with supernumerary robotic fingers, designed to allow the user to single-handedly perform typically bimanual tasks. We train participants to use the robotic finger for a week, to then investigate the neural correlates of hand augmentation using a series of behavioural and fMRI training measures.

Type of activity the placement student is involved in

The main role of the student during the summer placement will be training participants to use the robotic finger over a week, as well as helping us run fMRI tasks. Excellent organization and people skills are vital, and previous data collection experience is desirable. We are looking for hard-working and motivated students with a keen interest in sensorimotor neuroscience to take part in this ambitious project.

Methods used/skills to be acquired

In return, students will learn about how to run a longitudinal study requiring substantial technological and programming setup, and gain experience running a variety of different behavioural and fMRI measures. They will also receive excellent experience interacting with participants, as well as a unique insight into the upcoming field of augmentation technology.

Key References

- Kieliba P, Clode D, Maimon-Mor RO, Makin TR. Robotic hand augmentation drives changes in neural body representation. Sci Robot. 2021 May 19;6(54):eabd7935. doi: 10.1126/scirobotics.abd7935. PMID: 34043536; PMCID: PMC7612043.
- https://www.daniclodedesign.com/
- Makin TR, Flor H. Brain (re)organisation following amputation: Implications for phantom limb pain. Neuroimage. 2020 Sep;218:116943. doi: 10.1016/j.neuroimage.2020.116943. Epub 2020 May 16. PMID: 32428706; PMCID: PMC7422832.
- Amoruso E, Dowdall L, Kollamkulam MT, Ukaegbu O, Kieliba P, Ng T, Dempsey-Jones H, Clode D, Makin TR. Intrinsic somatosensory feedback supports motor control and learning to operate artificial body parts. J Neural Eng. 2022 Jan 24;19(1). doi: 10.1088/1741-2552/ac47d9. PMID: 34983040.

Project C. Which brain networks contribute to fluid intelligence?

Supervisors: Nadene Dermody and Alexandra Woolgar

Scientific problem to be addressed

Fluid intelligence – the ability to solve novel problems independent of acquired knowledge – is a core feature of human cognition. What are the neural processes or brain systems that underpin it? One way to investigate this is to see how intelligence changes after part of the brain is damaged by stroke or tumour. However, the patients we recruit for such studies are usually only tested after they have sustained brain damage. How do we know what their cognition was like beforehand? How can we work out how much their cognition has changed?

Type of activity the placement student is involved in

This summer placement project will address these questions by 1) assessing a number of older control participants on cognitive tests, 2) using the data to derive a formula from which we can estimate how much fluid intelligence has declined in patients, and 3) applying the formula to a set of existing patient data. This will feed into the broader aim of this project, which is to look at whether damage to different brain networks predicts fluid intelligence decrement.

Methods used/skills to be acquired

The student will gain experience with administering neuropsychological tests and developing a regression algorithm that we will use to understand how brain damage affects cognition.

Key References

- Duncan, J. (2010). The multiple-demand (MD) system of the primate brain: Mental programs for intelligent behaviour. Trends in Cognitive Sciences, 14(4), 172–179. https://doi.org/10.1016/j.tics.2010.01.004
- Duncan, J. (2010). How Intelligence Happens. Yale University Press.
- Gläscher, J., Rudrauf, D., Colom, R., Paul, L. K., Tranel, D., Damasio, H., & Adolphs, R. (2010). Distributed neural system for general intelligence revealed by lesion mapping. Proceedings of the National Academy of Sciences of the United States of America, 107(10), 4705–4709. https://doi.org/10.1073/PNAS.0910397107
- Woolgar, A., Duncan, J., Manes, F., & Fedorenko, E. (2018). Fluid intelligence is supported by the multiple-demand system not the language system. Nature Human Behaviour, 2(3), 200–204. https://doi.org/10.1038/s41562-017-0282-3
- Woolgar, A., Parr, A., Cusack, R., Thompson, R., Nimmo-Smith, I., Torralva, T., Roca, M., Antoun, N., Manes, F., & Duncan, J. (2010). Fluid intelligence loss linked to restricted regions of damage within frontal and parietal cortex. Proceedings of the National Academy of Sciences of the United States of America, 107(33), 14899–14902. https://doi.org/10.1073/pnas.1007928107

Project D. Can selective restudying reset recall of forgotten information?

Supervisors: Petar Raykov and Rik Henson

Scientific problem to be addressed

Recent work (Trißl & Bäuml, 2022) has suggested that selective re-studying of some words can have memory benefits for not re-studied words that were initially presented in the same context as the re-studied words. An everyday example of this effect may be that re-studying chapter 2 of a psychology textbook may help one's memory for chapter 1, if they were initially learned in the same context. However, this remains to be tested. In this project, we will try and replicate the memory benefits of selective re-study and examine the boundary conditions for this effect. We will use list learning tasks. We will manipulate whether the words were initially learned in the same or in different contexts and test whether this interferes with the re-study effect. This question has both theoretical and practical implications for memory research.

Type of activity the placement student is involved in

The student will be involved in designing and coding online experiments to replicate and test the re-study memory effect. The student will also be involved in running statistical analyses (e.g., power calculations, ANOVAs).

Methods used/skills to be acquired

The student will gain experience with coding and running online experiments. The student will gain experience with experimental design and common statistical analyses using R.

Key References

- Trißl, L., & Bäuml, K. H. T. (2022). Selective restudy can reset recall of forgotten information. Psychonomic Bulletin & Review, 1-9.
- Antony, J. W., Ferreira, C. S., Norman, K. A., & Wimber, M. (2017). Retrieval as a fast route to memory consolidation. Trends in cognitive sciences, 21(8), 573-576.
- Antony, J. W., Romero, A., Vierra, A. H., Luenser, R. S., Hawkins, R. D., & Bennion, K. A. (2022). Semantic relatedness retroactively boosts memory and promotes memory interdependence across episodes. ELife, 11, e72519.
- DuBrow, S., Rouhani, N., Niv, Y., & Norman, K. A. (2017). Does mental context drift or shift? Current opinion in behavioral sciences, 17, 141-146.