UCD School of Psychology

MSc in Behavioural Neuroscience

Student Manual 2025-26

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1 Welcome

Welcome to the programme on behalf of all colleagues involved in teaching and research supervision on the MSc in Behavioural Neuroscience in 2025-2026. Welcome also to the School of Psychology, your academic home this year. We are very happy you chose to study with us at UCD.

The primary purpose of this manual is to provide details on the programme structure, with a particular emphasis on core modules that are designed to offer training in specific research skills and analysis (Behavioural Neuroscience Labs 1 & 2, Behavioural Neuroscience Research Project, Advanced Research Methods and Statistics), to encourage a critical approach to theory, ideas and research (Recent Papers in Behavioural Neuroscience), and to develop writing and research presentation skills (Knowledge Transfer, Recent Papers in Behavioural Neuroscience). We also offer advice on choosing option modules to complement your undergraduate training (be it in Psychology, Neuroscience or a related discipline). Also included below is information on the various student supports and facilities available on campus.

As programme directors, we are on hand to help; feel free to email either of us to ask a question or to arrange a meeting to chat in person (nuala.brady@ucd.ie, s.cooney@ucd.ie). For organisational and administrative matters related to the programme, please contact Mary Boyle (mary.boyle@ucd.ie).

For queries relating to specific modules, please contact the module coordinator.

Nuala Brady & Sarah Cooney
Programme Directors, MSc Behavioural Neuroscience

Nuala Brady

Sarah Cooney

Please note that details provided in this handbook are subject to change.

2 Some Useful Links

This booklet is designed to provide students on the MSc in Behavioural Neuroscience with information that they need to successfully complete the programme. There is also lots of information about the University, its community, facilities, and regulations available on the main UCD website.

UNIVERSITY COLLEGE DUBLIN

University College Dublin (UCD) is Ireland's largest university with an expansive campus which boasts some lovely woodland walks: **https://www.ucd.ie/healthyucd/t4media/UCDWoodlandWalkMap_and_Guide.pdf**

UCD is a community of students and staff where scholarship and personal development are fostered, leadership cultivated, innovation encouraged, and social conscience developed. Our University provides a very broad and exciting range of opportunities for students from all backgrounds, and staff and students have a responsibility to engage, participate and respect the services and facilities provided. Central to the aims and values of our University is respect and fairness, and every member of our community is required to uphold these values in all dealings with each other. You can find the Student Charter at:
http://www.ucd.ie/studentcharter/

Psychology is based in the College of Social Sciences & Law. Keep an eye out for interesting seminars and news
https://www.ucd.ie/socscilaw/

UCD CONWAY INSTITUTE

UCD Conway Institute is home to our colleagues in Neuroscience, see **www.ucd.ie/conway/research/diseasefocusedresearch/neuroscience** for information, including on seminars and events.

STUDENT CENTRE:

UCD Student Centre is the home for Clubs and Societies, as well as housing many of the essential services students interact with on a daily basis. The Centre houses a theatre, cinema, debating chamber and bar. Also housed in the Student Centre are a wide range of shops and restaurants, a pool room, the student health service, and the multifunctional Astra Hall that across the year plays hosts to a range of events including concerts, musicals, and guest speakers. The Student Centre is also home to the UCD Students' Union (**www.ucdsu.ie**)

Find out more at: **www.ucd.ie/studentcentre**

STUDENT WELFARE:

Your student advisor is here to help you make your time at UCD as fulfilling and enjoyable as possible. Student advisors work with chaplains, the Student Health Service, and academic and administrative staff to ensure the best outcomes for you. You can contact your student advisor in relation to any personal, social, or practical issues you are having. Your student advisors are Holly Dignam (holly.dignam@ucd.ie) and Kieran Moloney(kieran.moloney@ucd.ie)

You can read about the confidential support service provided by Student Advisers at
www.ucd.ie/studentadvisers

UCD ACCESS AND LIFELONG LEARNING

https://www.ucd.ie/all/

INTERNATIONAL STUDENTS

https://www.ucdisc.com/

UCD CAREERS

Thinking ahead to your next step, see (**www.ucd.ie/careers**)

LIBRARY RESOURCES

The UCD Library has a virtual tour which a lot of students find useful in navigating their way around the library:
http://libguides.ucd.ie/newstudents.

Susan Boyle is the Social Science and Law liaison librarian who can provide support in navigating the library:
https://www.ucd.ie/socscilaw/undergraduateandgraduatesocialsciencesstudents/studentsupports/collegeliaisonlibrarian/

Detailed information on using the library is available here:
https://www.ucd.ie/library/use/

REGULATIONS

The MSc in Behavioural Neuroscience is governed by the general Academic Regulations of the University. The regulations also govern the grades that are awarded. Academic Regulations are updated annually and the most recent version can be found at:
https://www.ucd.ie/students/exams/assessinggraduateresearchtheses/regulationsandpolicy/.

The expectations regarding student conduct can be found at:
https://www.ucd.ie/secca/studentconduct/

ACADEMIC INTEGRITY

All students on the MSc in Behavioural Neuroscience are expected to adhere to the University's policy on academic integrity. Before submitting any work, therefore, it is important that you familiarise yourself with the university's Student Academic Integrity Policy which can be found under the 'Avoiding Academic Misconduct' section of this site:
https://www.ucd.ie/secca/studentconduct/

UCD POLICY ON LATE SUBMISSION OF COURSEWORK

If you believe that you are not going to be able to submit a piece of coursework on time then the most important person to contact first is the module coordinator who will be able to offer you advice. You can also find the University's policy on the late submission of coursework here:
https://www.ucd.ie/socscilaw/undergraduateandgraduatesocialsciencesstudents/studentandacademicinformation/latesubmissionofcoursework/

ASSESSMENT APPEALS PROCEDURE

UCD appeals procedures are described at:
https://www.ucd.ie/appeals/

STUDENT COMPLAINT PROCEDURE

Details of student complaint and policy procedures are available at:
www.ucd.ie/complaints/

PRACTICAL ISSUES ON ASSESSMENT

Our University is committed to sustainable development and works toward achieving a 'green campus' (**https://ucdestates.ie/about/sustainability/**). As a little step in helping this big endeavour, we run the MSc in Behavioural Neuroscience as a 'paperless programme' and have dispensed with the usual requirement that students submit hardcopies of assignments. All assessments should be submitted online via Brightspace. Please acquaint yourself with UCD's policy on late work submission, and note that forms can be completed electronically and emailed rather than printed and signed. Always use your ucdconnect address when communicating with module coordinators/academic staff (**https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=GD-DOCLAND&ID=137**)

More generally, UCD's regulations and policy documents are available at the Governance Document Library (**www.ucd.ie/governance/documentlibrary**). This is a vast place, so we recommend you Search by Theme: Student if you need to consult the regulations or view any of the policies. Of particular note is UCD's Student Plagiarism Policy which outlines the standards of academic integrity to which all students in the university are expected to adhere (**https://hub.ucd.ie/usis/W_HU_MENU.P_DOWNLOAD_FILE?p_filename=Student%20Plagiarism%20Policy.pdf&p_par**), and which describes the procedures for investigating breaches of these standards and the associated penalties. Our library provides an excellent guide to avoiding plagiarism, with definitions, examples, and tips on rigorous citations, quotations, and so on (**https://libguides.ucd.ie/academicintegrity**). Our library also provides online tutorials and guides (including subject-specific guides) on resources, collections, searching, interlibrary loans, etc, and our dedicated librarian for Social Sciences is Vanessa Buckley (vanessa.r.buckley@ucd.ie).

3 People

Key Point of Contact (Programme Administrator)

Ms Mary Boyle
mary.boyle@ucd.ie

Programme Directors

Nuala Brady
nuala.brady@ucd.ie

Sarah Cooney
s.cooney@ucd.ie

Key members of staff on the programme belong to Affective Behavioural Cognitive Neuroscience groups - read their profiles in the link **https://www.ucd.ie/psychology/research/affectivebehaviouralcognitiveneuroscience/**

4 Key Academic Dates 2025-26

At UCD, the academic year is divided into three trimesters (T1, T2 and T3, aka Autumn, Spring, and Summer). UCD publishes the dates associated with these trimesters and notes bank holidays, examinations and study periods. Please see **www.ucd.ie/students/t4media/Academic_Calendar2526.pdf**. Note that the 12-week Spring trimester is split into an initial seven-week and later five-week teaching block with a 2-week Fieldwork/Study period in between, during which there are no classes. This is a longstanding tradition at UCD. In recent years, many colleges/schools have introduced a one-week Study period in the Autumn trimester to reduce the formal teaching time to 11 weeks. At the graduate level, this is at the discretion of module coordinators.

Autumn Trimester (Monday, 1 September 2025 – Sunday, 18 January 2026)		
Orientation	Monday, 1 September – Friday, 5 September	No. of days varies depending on course
Teaching term	Monday, 8 September – Friday, 28 November[1]	12 weeks
Revision	Saturday, 29 November – Friday, 5 December	1 week
Exams	Saturday, 6 December – Saturday, 20 December[2]	2 weeks
Spring Trimester (Monday, 19 January 2026 – Sunday, 17 May 2026)		
Teaching term	Monday, 19 January – Friday, 6 March[3]	7 weeks
Fieldwork/Study period	Monday, 9 March – Sunday, 22 March[4]	2 weeks
Teaching term	Monday, 23 March – Friday, 24 April[5]	5 weeks
Revision	Saturday, 25 April – Friday, 1 May[6]	1 week
Exams	Saturday, 2 May – Saturday, 16 May	2 weeks
Summer Trimester (Monday, 18 May 2026 - Sunday, 30 August 2026)		
Teaching term	Monday, 18 May – Friday, 7 August[7]	12 weeks
Revision	Saturday, 8 August – Friday, 14 August	1 week
Exams	Saturday, 15 August – Saturday, 22 August	1 week

[1] October Bank Holiday: Monday, 27 October 2025 [2] Campus closure commences: (see https://www.ucd.ie/hr/a-z/christmasclosuredates/) [3] St Brigid's Day: Monday, 2 February 2026 [4] St. Patrick's Day: Tuesday, 17 March 2026 [5] Good Friday, 3 April 2026; Easter Sunday, 5 April 2026; Easter Monday, 6 April 2026 [6] May Bank Holiday: Monday, 4 May 2026 [7] June Bank Holiday: Monday, 1 June 2026; August Bank Holiday: Monday, 3 August 2026

5 Programme Structure

The MSc Behavioural Neuroscience is a 90-credit Level 9 full-time programme which runs over one year. The 90 credits comprise 60 credits from core modules that are compulsory on the programme and 30 credits from optional modules.

The programme structure is sketched below in its most essential form but is described in full here: **https://hub.ucd.ie/usis/!W_HU_MENU.P_PUBLISH?p_tag=PROG&MAJR=W461**, and you can consult that link when you wish to get an introduction to a specific module, its aims and objectives, learning outcomes, and assessment strategies. When registered to a module, you will have access to Brightspace, where module coordinators/lecturers post syllabi, reading lists, lecture notes and/or recordings, resources, etc; for many modules, assessments are submitted via Brightspace.

Core Modules	Term	Module Code	Module Title	Credits
	Trimester 1	PSY40760	Advanced Data Anaysis and Statistics in R	5
		PSY40840	BN Labs 1: Behavioural Measures	7.5
		PSY40900	Recent Papers in Behavioural Neuroscience	5
	Trimester 2	PSY40850	BN Labs: Physiology	7.5
	Trimester 3	PSY40770	Knowledge Transfer	5
	Year Long	PSY40780	Behavioural Neuroscience Research	30: 2.5-T1, 2.5-T2, 25-T3

*30 credits for PSY40770 Behavioural Neuroscience Research Project (aka 'Project') have been spread across the year as follows: 2.5 credits assigned in Trimester 1, 2.5 credits assigned in Trimester 2 and 25 credits in Trimester 3.

Option Modules	Term	Module Code	Module Title	Credits
	Trimester 1	PSY40820	Fundamentals of Neuropsychology	10
		PSY40830	Advanced Cognitive Psychology	10
		PSY40640	Advanced Disability Studies	10
	Trimester 2	NEUR40110	Sensory Neuroscience	10
		NEUR40120	Principles of Neuroscience	10
		NEUR40130	Higher Cortical Function	10
		PSY40790	Clinical Cases in Neuropsych	10
		PSY40860	Topics in Psychological Sci	10
		PSY40930	Neurodevelopmental Disorders	10
		PSY 40960	MATLAB for Human Behaviou	10

In T1 you take at least one option:

Trimester 1 (Autumn)	Credits
Project	2.5
Labs 1	7.5
Adv Research Methods & Stats	5
Recent Papers in Behavioural Neuroscience	5
Core Modules	**20**
Optional Module x 1	**10**
Trimester 1 Credits	**30**

In T2 (Spring) you should take a number of options to ensure that you have the full component of credits for your programme (90 credits):

Trimester 2 (Spring)	Credits
Project	2.5
Labs 2	7.5
Core Modules	**10**
Optional Modules x 2	**20**
Trimester 2 Credits	**30**

In T3 (Summer) you take Project plus Knowledge Transfer:

Trimester 3 (Summer)	Credits
Project	25
Knowledge Transfer	5
Core Modules	**30**
Trimester 3 Credits	**30**

90 Credits

At UCD a programme structure cannot require a student to take more than 30 credits per trimester and a student cannot take more than 40 credits, and you should bear the latter constraint in mind when choosing options. You cannot exceed 40 credits due to workload considerations.

- Regarding advice to students who have completed their undergraduate degree in Psychology with us at UCD, please consider options other than the graduate variants of undergraduate modules you have taken.
- For students with a specific interest in Neuropsychology we recommend PSY40790 Clinical Cases in Neuropsychology as an option.
- For students with an interest in Decision Making (thinking, planning, rationality, political psychology, nudges) we recommend you look closely at PSY40860 Topics in Psychological Science which is coordinated by Associate Professor Mick O'Connell
- It has been a pleasure to work with our colleagues in Neuroscience to establish this programme and we advise students with a pure psychology background to look to Neuroscience offerings in T2. You can read about these modules by following the programme structure link above:
  - » NEUR40110 Sensory Neuroscience (Professor John O' Connor)
  - » NEUR40120 Principles of Neuroscience (Associate Professor Oliver Blacque)
  - » NEUR40130 Higher Cortical Function (Professor John O'Connor)

AN IMPORTANT NOTE ON TIMETABLING

We have timetabled, so there are no obvious clashes between modules. However, when students register online, they may not be able to register if there is a minor clash, e.g., Students are split into small groups for Labs 2, and it may be the case that attending your practical in one week may mean you have a clash with a Neuroscience lecture for that one week. We encourage you to ignore these minor clashes (lecture notes are available online, and we can try to move your practical group to accommodate you). If this happens during your registration please get in touch with Mary (mary.boyle@ucd.ie) and she will be able to register you to the module manually.

Please note also that at UCD, all teaching sessions end at 10 minutes to the hour, so you will have time to walk from one building to the next between classes.

6 Module Overview

PSY40760
Advanced Data Analysis and Statistics in R

Credits	5
Module Coordinator	Dr Sarah Cooney
Lecturers	Assoc Professor Nuala Brady Dr Sarah Cooney

Module Description

This module is for postgraduate students in Psychology and Social Sciences. It is designed for students in the MSc Behavioural Neuroscience programme, and aims to support them in developing their quantitative data analysis skills to an advanced level. The module will focus on acquiring the data analytic and statistical skills necessary to complete a research project of publishable quality.

This module provides an in-depth exploration of advanced statistical techniques essential for psychological research, using R and JASP as the primary tools for analysis. The curriculum emphasises essential data science skills that have been overlooked in traditional teaching approaches, including programming, data visualisation, data wrangling, and reproducible reports. Students will gain a deeper understanding of probability and inference through data simulation and hands-on work with real psychological datasets.

Through a combination of lectures, interactive coding sessions, and applied exercises, students will develop the skills necessary to conduct, interpret, and communicate advanced statistical analyses in psychology using modern, reproducible workflows.

Coffee breaks and lunch breaks are provided during the sessions.

Core and Recommended texts

- Lakens, D (2022). Improving Your Statistical Inferences. Free online. Retrieved from **https://lakens.github.io/statistical_inferences/**.
- Poldrack., R (2019) Statistical Thinking for the 21st Century **https://statsthinking21.github.io/statsthinking21-core-site/** Free online
- Thulin, M. (2021). Modern Statistics with R. Eos Chasma Press. ISBN 9789152701515. R **https://modernstatisticswithr.com/index.html** Free online

PSY40900
Recent Papers in Behavioural Neuroscience

Credits	5
Module Coordinator	Dr Sarah Cooney

Module Description

This module introduces students to recent scientific findings and trends in Behavioural Neuroscience via a series of research seminars delivered by academics and by critically analysing recent papers in leading scientific journals. The seminars will cover recent developments and research trends, and encourage students to think critically about the following:

1. What are the most pressing and pertinent research questions in areas such as neuropsychology, cognition and perception?
2. What methodologies and experimental techniques are currently employed to examine these questions?
3. What are the avenues for future research?
4. How are research outputs best conveyed through different dissemination mediums, including oral presentations and empirical research papers?

Module Schedule

- **September 10th 2025:** Dr Jude Bek
- **September 24th 2025:** Dr Sarah Cooney
- **October 8th 2025:** Dr Aine Ni Choisdelbha
- **October 22nd 2025:** Assoc Prof Keith Gaynor
- **November 5th 2025:** Assoc Prof Ciara Greene

PSY40840 Behavioural Neuroscience Labs 1

PSY40850 Behavioural Neuroscience Labs 2

Module Description

In PSY40840 (Behavioural Neuroscience Labs 1) and PSY40850 (Behavioural Neuroscience Labs 2), students will complete brief rotations in four experimental laboratories in the School of Psychology and gain practical experience of collecting data using common Behavioural Neuroscience methods. Students will develop skills in experimental design, data collection and analysis, using a variety of experimental and statistical approaches. In Labs 1 the methodologies include eye-tracking, virtual reality and neuropsychological assessment, and Labs 2 will focus on electroencephalography (EEG) / event-related potentials (ERP) and will include a theoretical introduction to magnetoencephalography (MEG). Dates, times and room numbers are available in the timetable but as we have recently refurbished laboratory space, there may be last minute changes: all labs will be in the E1 area of the Arts Building and the module coordinators (Ciara Greene in T1 and Klaus Kessler in T2 will advise you of exact locations if there are any changes to the timetable).

PSY40840 Behavioural Neuroscience Labs 1

- **Laboratory 1** Eye Tracking Lab
- **Laboratory 2** Neuropsychological Assessment
- **Laboratory 3** Virtual Reality and Social Cognition Lab

PSY40850 Behavioural Neuroscience Labs 2

- **Laboratory 4** Event-Related Potential (ERP) Lab and Transcranial Magnetic Stimulation (TMS)

Details on the individual labs are below

PSY40840 Behavioural Neuroscience Labs 1

Eye Tracking Lab

Credits	7.50
Lab Instructor	Assoc Professor Ciara Greene

Introduction

Eye tracking is a non-invasive method that uses near-infrared sensors to establish where another person is looking (see Figure 1). Eye tracking has lots of real-world applications: it can be used in market research to establish which parts of a display or advertisement consumers are interested in, or it can be used communication aid by people with physical disabilities. There are many examples of eye tracking methods in psychological research; for example, an attention researcher may wish track the focus of a participant's attention or monitor how quickly they can detect a given stimulus [1, 2] or a sports psychologist may wish to compare the gaze behaviour of novice and expert athletes to understand how performance changes with experience [3]. Some eye tracking studies in psychology include monitoring how quickly participants detect the presence of a stimulus onscreen and how long they choose to spend looking at particular stimuli. Other approaches include examination of saccades and antisaccades, where very brief eye movements towards and away from a salient stimulus are measured, and pupillometry, in which the researcher examines the dilation and contraction of the pupil during cognitive tasks.

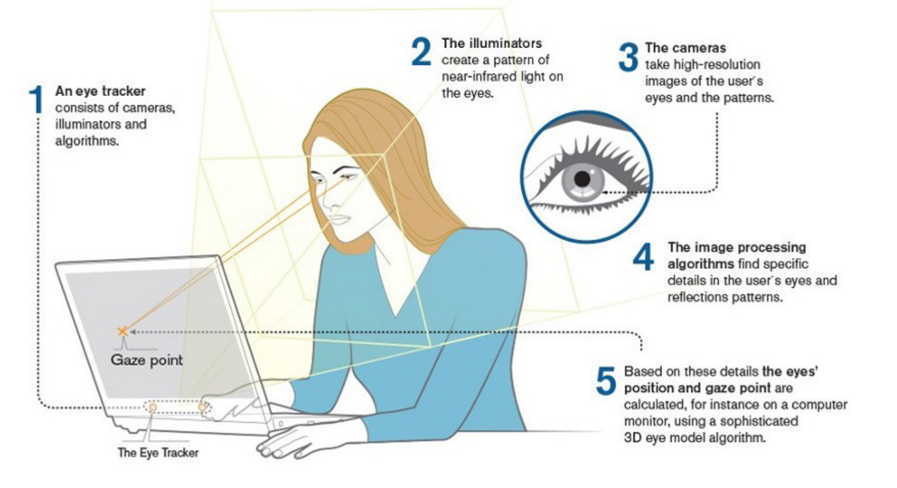

Figure 1. Illustration of the eye tracking process (© Tobiipro.com)

PSY40840 Behavioural Neuroscience Labs

1

Eye Tracking Lab (cont.)

Lab Instructor Assoc Professor Ciara Greene

In general, there are two kinds of eye trackers: fixed or screen-mounted trackers are attached to a computer monitor and are used to assess eye movements in response to stimuli that appear on the screen (Figure 2A). Wearable eye trackers (Figure 2B) are worn on the head near the participant's eyes to track gaze behaviour in the real world – for example, while playing golf or walking around a supermarket. Fixed eye trackers are usually more accurate and record data with higher precision. The School of Psychology has both kinds of eye trackers. Our fixed eye tracker – the Eyelink 1000 Plus – captures up to 2000 eye gaze data points per second.

Figure 2. Images of the fixed (left) and wearable (right) eye trackers used in the School of Psychology. The eye tracker in panel A is the Eyelink 1000 Plus. In the lower panel, the Eyelink 1000 Plus is fixed to the table in front of a computer monitor while the participant performs a task. He uses a chin rest to restrict his movement and improve the accuracy of the eyetracking. Panel B depicts a headmounted eyetracker, the Eyelink II; in the lower panel, a participant wears a similar headmounted eyetracker while practicing golf.

Gaze behaviour and emotional faces

Previous research indicates that gaze patterns tend to vary depending on the emotion expressed on a face. Positive emotions may be expressed more on the lower half of the face, while negative emotions are primarily expressed in the upper half of the face [4]. As a result, people typically spend more time looking at the mouth when processing happy faces compared to fearful faces, and more time looking at the eyes when processing fearful faces compared with happy faces [5].

In this lab, we will use a fixed eye tracker to record gaze behaviour during passive viewing of emotional faces. This lab will use video stimuli described in a recent paper [6]. These videos show a woman expressing happiness, fear and no particular emotion (neutral condition; see Figure 3). We will test the hypotheses 1) that people spend more time looking at the eyes in the fearful condition relative to the happy condition, and 2) that people spend more time looking at the mouth in the happy condition relative to the fearful condition. We will also look at other eye tracking metrics, including the location of the participant's first fixation and time to first fixation on a given region.

Lab Details

- Students will act as both experimenter and participant in an eye tracking task
- You will learn how to set up the experiment and calibrate the eye tracker for a new participant
- You will learn how to define dynamic areas of interest (AOIs) that track moving features in the videos, and extract eye movement data from each AOI.
- You will conduct a group analysis of data recorded from all students in the lab group (N = 10), and test the hypotheses listed above.

PSY40840 Behavioural Neuroscience Labs

1

Eye Tracking Lab (cont.)

Lab Instructor	Assoc Professor Ciara Greene

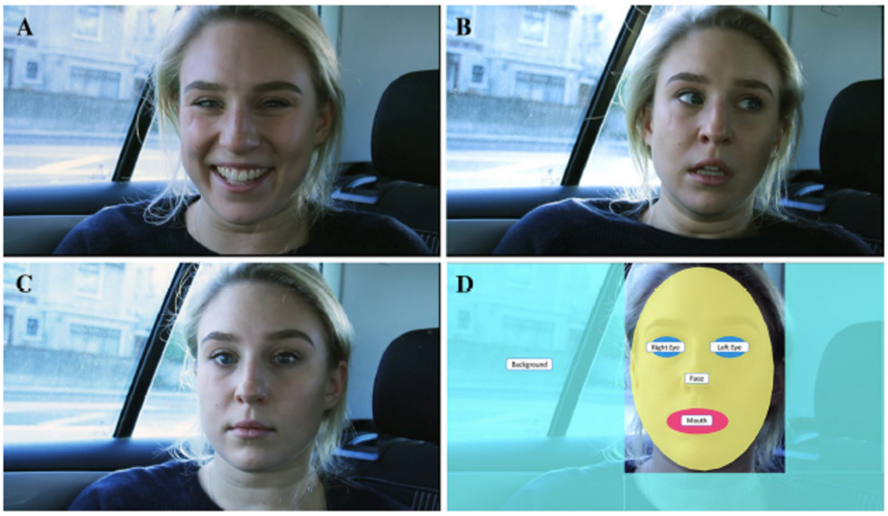

Figure 3. Screenshots from the (A) happy, (B) fearful and (C) neutral video clips, taken from Greene, Suess and Kelly (2020) [6]. Panel D indicates AOIs over the eyes, mouth, whole face and background.

Research Skills

- Running an eye tracking experiment using the Eyelink 1000 Plus eyetracker
- Conducting eye tracking data analysis using Eyelink Data Viewer software, including visualisation of eye tracking metrics
- Writing a lab report based on eye tracking data

References

1. Barnhart, A.S. and Goldinger, S.D. (2014). Blinded by magic: Eye-movements reveal the misdirection of attention. *Frontiers in Psychology,* 5: 1461.
2. Chen, N.T.M., Clarke, P.J.F., Watson, T.L., MacLeod, C., and Guastella, A.J. (2015). Attentional bias modification facilitates attentional control mechanisms: Evidence from eye tracking. *Biological Psychology*, 104: 139-146. https://doi.org/10.1016/j.biopsycho.2014.12.002
3. Campbell, M.J. and Moran, A.P. (2014). There is more to green reading than meets the eye! Exploring the gaze behaviours of expert golfers on a virtual golf putting task. *Cognitive processing*, 15(3): 363-372.
4. Dimberg, U. and Petterson, M. (2000). Facial reactions to happy and angry facial expressions: Evidence for right hemisphere dominance. *Psychophysiology*, 37(5): 693-696.
5. Wagner, J.B., Hirsch, S.B., Vogel-Farley, V.K., Redcay, E., and Nelson, C.A. (2013). Eye-tracking, autonomic, and electrophysiological correlates of emotional face processing in adolescents with autism spectrum disorder. *Journal of autism and developmental disorders*, 43(1): 188-199.
6. Greene, C.M., Suess, E., and Kelly, Y. (2020). Autistic traits do not affect emotional face processing in a general population sample. *Journal of autism and developmental disorders*: 1-12.

Useful background resources:

Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & Van de Weijer, J. (2011). *Eye tracking: A comprehensive guide to methods and measures.* OUP Oxford [Most of this book is available in e-book format through Google books]

Andrychowicz-Trojanowska, A. (2018). Basic terminology of eye-tracking research. *Applied Linguistics Papers*, (25/2), 123-132

PSY40840 Behavioural Neuroscience Labs

1

Neuropsychology Testing Lab

Lab Instructor	Jessica Bramham

Please note that Professor Bramham may change the details of the lab this year.

Introduction

Dementia is a term used to describe a series of symptoms affecting cognitive (e.g., memory, attention), behavioural (e.g. depression, anxiety, agitation) and social abilities, which impair a person's daily functioning. Neuropsychological assessment is a performance based method to observe and measure cognitive function and mental status and one of its core purposes is to help detect the presence of cognitive impairment and/or behavioural changes and the possible relationship with an underlying brain pathology and dysfunction. A neuropsychological evaluation is often essential in the diagnosis of neurological illnesses and different types of dementia such as dementia due to Alzheimer's disease.

Most cognitive tests used in clinical neuropsychological evaluations yield a single overall achievement score in order to determine the presence of cognitive impairment. However, the use of a single-score method for quantifying performance masks the multifactorial nature of the cognitive functions that are required for successful performance on most tests. Thus, an impaired score on any given cognitive test might be attributable to a range of underling cognitive deficits, the nature of which is hidden within a single score and fails to provide information regarding the primary neurocognitive mechanism responsible for defective performance. Exclusively relying on this quantitative method of neuropsychological evaluation may lead to erroneous clinical interpretations. For example, two patients with very different underlying brain pathology/dementia type may achieve the same total score by way of relying on different spared cognitive processes or because of different cognitive deficits.

In order to circumvent these shortcomings, neuropsychological interpretation of test performance can be complemented with a process-based approach methodology, which emphasizes the importance of the finer analysis of the cognitive strategies favoured by a patient in the course of solving the test –whether it is passed or failed –as well as the qualitative analysis of the errors made. A process-based approach can help draw a more reliable neuropsychological profile of patients as well as identifying their cognitive strengths and the difficulties they face when dealing with challenges in the real world, helping family members better understand their loved ones behaviour and inform a rehabilitation plan and make decisions regarding power of attorney etc.

Common misconceptions surrounding a diagnosis of dementia, e.g. dementia is a normal part of ageing, or that there is no value in pursing treatment, may lead to delayed diagnosis, limiting the potential for early intervention (Glynn, et al., 2017). Research has identified several modifiable lifestyle risk factors which, if controlled, may help delay the onset of symptoms of dementia (Livingston et al., 2017; 2020).

In this lab, we will first build upon our understanding of the different types of dementia, the clinical implications of current research findings and the value of the process-based approach to neuropsychological evaluation in order to make a differential diagnosis and rehabilitation plan, before moving on to discuss a case study (see below).

We will then practice the administration and neuropsychological interpretation of some cognitive tests.

There are a number of factors a clinician must take into consideration when choosing an appropriate neuropsychological assessment during the diagnosis process. For example, due to the nature of the condition, short cognitive screening measures, such as the Mini Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA), may be recommended rather than longer assessment batteries, always taking into consideration appropriate demographically corrected norms and culturally appropriate measures.

In the lab we will discuss the application of the process-based approach with a range of commonly used cognitive tests in clinical practice. Special attention will be given to the MoCA and its process based approach version (MoCA-PA) and the EirPrVLT-12, a list learning tests that was culturally adapted for an Irish population (Corboy et al., 2020), which is a version of the California Verbal Learning Test (CVLT) and provides a granular insight into distinct learning and memory processes.

PSY40840 Behavioural Neuroscience Labs

1

Neuropsychology Testing Lab (cont.)

Lab Instructor	Jessica Bramham

Lab details

- Background of the neuropathology of dementia and the 'current state of play' in dementia research - treatment, diagnosis & misconceptions
- Introduction to a range of neuropsychological tests used in dementia diagnosis • Introduction to the process-based approach to neuropsychological evaluation • Introduction of the MoCA-PA and EirPRVLT
- Case study of a person with impaired cognitive function (see below)
- Students will act as both the clinician and patient partaking in a neuropsychological assessment

Case study

A 56-year-old, right-handed, married man was referred to the memory clinic with a history of progressive cognitive impairment, with predominant word finding difficulties and visuospatial alterations. He had a past medical history significant for ischemic heart disease with coronary artery stenting 2 years previously. Medications included aspirin and atorvastatin. He consumed alcohol in moderation and was a non-smoker. He had recently stopped working as a taxi driver because of his cognitive impairment. Subjectively he described difficulty judging distances noting that he often hit door handles when reaching for them. Previously an avid reader of crime novels he described difficulties keeping his attention on the line "jumping from line to line" and he had trouble remembering what he had read. He reported difficulty with mental calculations but described his day to day memory as "not too bad." His wife gave a 2-year history of cognitive difficulties of gradual onset and progressive deterioration. Initially noticing difficulties retrieving words noting that he often "comes out with the wrong word." She felt that over time his driving had become erratic, reporting that he "didn't keep to his own lane." She described him as "clumsier" noting that "if there was a glass he'd knock it over." She also noted a functional decline with difficulties using kitchen appliances and limited use of his mobile phone. She felt that his memory was poor; he did not "retain much" and that he frequently forgot to carry out intended activities. Formal neuropsychological evaluation, MRI brain scan and Cerebrospinal Fluid biomarkers were conducted.

Prescribed reading (& watching) in advance of lab:

Blanco-Campal. A., Diaz-Orueta, U., Navarro-Prados., Burke, T., Libon, D., & Lamar, M. Features and psychometric properties of the Montreal Cognitive Assessment: Rapid review and proposal of a process based approach version (MoCA-PA). Applied Neuropsychology: doi.org/10.1080/23279095.2019.1681996

Corboy, H., Blanco-Campal, A., Bates, R., Bramham, J., Libon, D. J. & Greene, C. (2020). The development, validation and normative data study of the English in Ireland adaption of the Philadelphia repeatable Verbal learning Test (EirPrVLT-12) for use in an older adult population. Clinical Neuropsychology, 34 (sup1): 83-109

Diaz-Orueta, U., Blanco-Campal, A., Lamar, M., Lion, D.J., & Burke, T. Marrying Past and Present Neuropsychology: Is the future of the process-based approach technology based? Frontiers in Psychology, Vol 11: Article 361. doi:10.3389/fpsyg.2020.00361

Diaz-Orueta, U., Blanco-Campal, A., & Burke. T. Rapid review of cognitive screening instruments in MCI: Proposal for a process based approach modification of overlapping cognitive tasks between instruments to enhance clinical detection. International Psychogeriatrics (2018), 30:5, 663–672

Fitzpatrick, D., Blanco-Campal., & Kyne, L. "A case of overlapping posterior cortical atrophy and logopenic syndrome". Neurologist (2019) Mar; 24(2):62-65

Livingston, G. Sommerlad, A., Orgeta, V., Costafreda, S. G., Huntley, J., Ames, D., ...Mukadam, N. (2017). Dementia prevention, intervention, and care. The Lancet Commissions, 390, 2673-2734. **https://dx.doi.org/10.1016/S0140-6736(1)31363-**

Livingston, G., Huntley, J., Sommerlad, A., Ames, D, Ballard, C., Banerjee, S., …, Mukadam, N. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commisson. The Lancet Commissons, 396, 413-416.

Milberg, W.P., Hebben, N., & Kaplan, E. (2009). The Boston Process Approach to Neuropsychological Assessment. In Grant, I., & Adams, K.M. Neuropsychological Assessment of Neuropsychiatric Disorders.

Youtube – 'Barbara's story' - Perspective of living with dementia (NHS short video): **https://youtu.be/VFXirEnjfTI**

PSY40840 Behavioural Neuroscience Labs

1

Neuropsychology Testing Lab (cont.)

Lab Instructor	Jessica Bramham

References

Glynn, R. W., Shelley, E., & Lawlor, B. (2017). Public knowledge and understanding of dementia: evidence from a national survey in Ireland. Age and Ageing, 46, 865-869.

Harvey, P. (2012). Clinical applications of neuropsychological assessment. Dialogues – Clinical Neuroscience 14, 91- 99.

Pink, J., O'Brien, J., Robinson, L., Longson, D. (2018). Dementia: assessment, management and support: summary of updated NICE guidance. BMJ, 361, 1-6.

PSY40840 Behavioural Neuroscience Labs

1

Virtual Reality and Social Cognition Lab

Lab Instructor	Dr Brendan Rooney

Introduction

Social cognition refers to the neurological and cognitive processes underlying our engagement with social information (e.g. discerning mental states from facial expressions, conveying subtle intentions in language, predicting behaviours of individuals in different contexts, etc.). For the most part, humans are very skilled at processing social information. Deficits in social cognition have been identified in people with various types of dementia, Autism (Baron-Cohen et al., 1997), schizophrenia (Brüne, 2005; Harrington et al., 2005) and borderline personality disorder (Bateman & Fonagy, 2010). To identify and treat these conditions, health professionals rely heavily on standardised neuropsychological assessments. For example, the Reading the Mind in the Eyes test (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997) assesses recognition of mental states from facial features using cropped photos of faces to show only the eyes (see Figure 1 and additional details are further below).

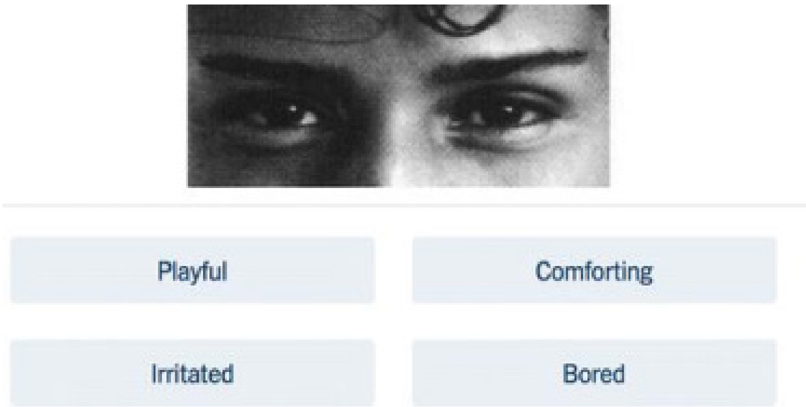

Figure 1. Example trial from the RMET test. Participants are required to select one of four possible mental states that the person in the picture is expressing.

Indeed such cognitive and neuropsychological assessment tests are fundamental to understanding, diagnosis and treatment of neuroscientific processes and psychological problems. Tests like this have been used for decades with large populations, so any individual's score can be compared to a norm; Traditional standardised tests are useful to researchers and practitioners in their relative precision, control and objectivity.

Despite the benefits to using traditional standardised assessments, previous researchers have argued that traditional tests are limited because they do not tap into real-life functions and behaviours (Goldstein, 1998; T. Parsons, 2016). Researchers argue that existing neuropsychological procedures using text descriptions or simple static images, are built around relatively abstract, context-free scenarios that assess what are called "cold" cognitive processes. They do not assess real-life, adaptive cognitive function on tasks that are emotionally laden. For this reason, researchers have called for more naturalistic methods of assessing social cognition (e.g. Zaki & Ochsner, 2009). Researchers and practitioners argue for the development of "function-led" neuropsychological assessments that are based on directly observable everyday behaviours (e.g. Parsons et al., 2015). Rather than assessing how much someone can differentiate between a positive or negative emotional expression from a picture, a clinician might prefer to ask, for example, whether the patient can interact as part of a team with colleagues in a new job. In behavioural sciences, this "realism" is referred to as ecological validity.

PSY40840 Behavioural Neuroscience Labs 1

Virtual Reality and Social Cognition Lab (cont.)

Lab Instructor	Dr Brendan Rooney

While meaningful, using real-world activities in assessment can be problematic. Aside from the fact that, observing a patient in a new job is time-consuming, it does not provide a consistent measure of their ability. On any particular day the work demands might be higher than normal, or a team member might be replaced by a different person who is more or less friendly, making it difficult to benchmark performance. Hence there is often a trade-off between the precision or control of a measure and its realism or ecological validity. It should also be noted that even when naturalistic tasks are designed in an ad-hoc fashion for specific research purposes, researchers often need to compare findings with more traditional standardised tests to comment on the validity of those findings.

One possible way to address this issue is by using media entertainment technology (movies, video games and virtual reality). Media entertainment scenarios and stories are highly designed experiences that can be adapted and carefully controlled to move emotion and capture attention with precision. Yet they also offer high levels of "natural" complexity, sophisticated social interactions and emotional realism. Virtual Reality (VR) is one such technology that may offer an exciting solution to the problems above by allowing for the presentation and control of dynamic simulated real-world situations that can be used for assessment of neurocognitive and affective processing. Using VR, researchers and clinicians can assess people on more realistic tasks, while maintain control over how they are presented.

Lab Details

- You will learn how to set up the VR system and calibrate the scenario to suit the room.
- You will demo some VR scenarios.
- You will act as both experimenter and participant in a VR-based social cognition assessment – although your data will not be used for the analysis.
- You will complete and score a number of "traditional" social cognition assessments.
- You will select variables from a larger pool of previously collected data to answer a research question that you develop yourself.
- You will draft a skeleton rationale/hypothesis, and an analysis plan with associated documentation (with analysis code/syntax).

Research Skills

- Setting up and calibrating a VR system.
- Running a VR-based assessment of participants' social cognition.
- Drafting a rationale and hypotheses that can be tested.
- Scoring various tests and measures of social cognition.
- Preparing documentation including an analysis plan and summary findings with analysis code/syntax.

Additional details on social cognition assessments

Virtual Environment Café (VEC) and Human Emotion Attribution

This assessment includes (i) a VR environment as the stimulus and (ii) a response measure, described separately below.

i. ***Stimulus: Virtual Environment Café (VEC; See Rooney et al., 2018).***
The VEC is a virtual environment depicting a café scene where the participant sits opposite another character at a table (see Figure 2). The environment consists of generic visuals and sounds associated with a small coffee shop (i.e., barista, customers, and ambient chatter). The virtual human seated across from the participant initially makes eye contact after a period of approximately 20-30 seconds with "a probe gaze". The probe gaze would last for approximately 1 second, followed by a longer gaze. This is always followed by a 30 second neutral period where no eye contact would take place. Participants spend approximately 2 minutes viewing the scene.

Note: within this scenario it is possible to change the apparent gender of the character and the avatar (user-body). It is also possible to manipulate whether or not the character makes eye contact with the participant or if they make no eye-contact (averting their gaze).

Lab Instructor Dr Brendan Rooney

Figure 2. Images of the Virtual Environment Café from the user perspective. User sits opposite either female or male character.

ii. ***Measure: Human Emotion Attribution (Demoulin et al., 2004).***

A key feature of social cognition is the extent to which a person recognizes and understands the mental states of others. This has been referred to as "Theory of Mind" but also using terms such as mental state attribution (e.g. Bálint et al., 2020), mentalizing (e.g. Frith & Frith, 2003), mental state inference or mind-mindedness (e.g. Meins et al., 2014).

This test assesses whether people "humanise" or dehumanise the target character in the VR café by measuring the extent to which people attribute basic or more complex emotions to the character. Various emotions are considered to be "uniquely human" while others are considered to be shared with other non-human animals (Demoulin et al., 2004). This test requires participants to indicate on a five-point scale, how frequently they believed the target character experiences a list of various emotions. These are then classified into primary emotions (e.g. pleasure, disgust) or secondary emotions (e.g. compassion, contempt).

Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 1997).

This test is one of the most widely used tests of social cognition. The RMET assesses recognition of mental states from facial features. Specifically, it uses 36 photographs of pairs of human eyes each surrounded with 4 mental state terms (See Figure 1). The participant must choose the word that best describes what the individual in the picture is thinking or feeling based on the cropped image depicting only the region around the eyes.

Animations Task (Abell et al., 2000; Castelli et al., 2000; White et al., 2011).

This is a visual test assesses the extent to which people make mental attribution to inanimate objects. The task comprises 12 short (35–45s) videoclips (plus a few practice clips) that feature pairs of animated geometric stimuli (i.e., red and blue triangle shapes). There are four trials within each of three conditions: random (e.g., drifting movement of the triangles), simple goal-directed movement (e.g., the triangles bounce off each other as if fighting), complex interaction, or ToM type (e.g., one triangle appears to push and coax another repeatedly out of a central box, each triangle reacting in a varied way to the other's movements). When adapted for use in fMRI studies, participants are required to categorize each video-clip as containing (a) no interaction/random (b) simple interaction/goal directed movement, or (c) mental-state-related/complex social interaction.

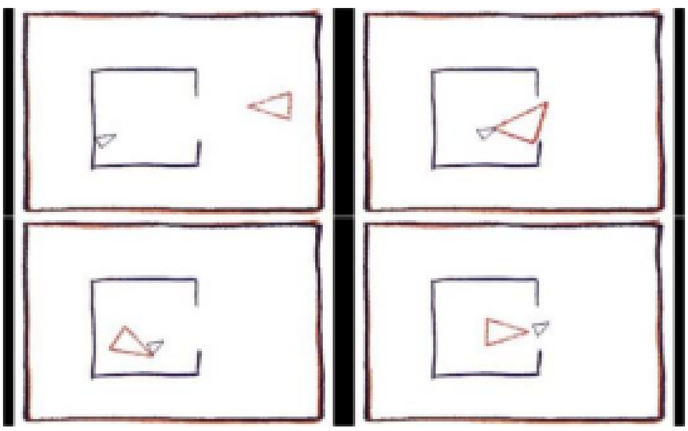

Figure 3. Images from the Animations Task showing two triangles moving around a space to give the illusion of social interaction.

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Virtual Reality and Social Cognition Lab (cont.)

Lab Instructor	Dr Brendan Rooney

Autism-Spectrum Quotient-Short (Hoekstra et al., 2011).

Autism, or autism spectrum disorder (ASD), refers to a broad range of conditions characterized by lower scores in measures of social cognition (in addition to other related skills and behaviours). Autism spectrum conditions are commonly conceptualized as dimensional, representing the extreme end of one or more continuously distributed traits in the general population (Constantino & Todd, 2003). The Autism Spectrum Quotient-Short (ASQ-S; Hoekstra et al., 2011) assesses participants' level of ASD traits. Participants self-rate their agreement with 28 items relating to social skills, attention switching, imagination and attention to detail. Higher scores indicate greater ASD traits. The measure has good psychometric properties in both ASD and non-ASD samples, with reliability scores ranging from 0.77 to 0.86 (Hoekstra et al., 2011).

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Frith, U., & Frith, C. D. (2003). Development and neurophysiology of mentalizing. Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences., 358(1431), 459–473. Goldstein, G. (1998). Functional considerations in neuropsychology. In Ecological validity of neuropsychological testing (pp. 75–89). Gr Press/St Lucie Press, Inc.

Harrington, L., Siegert, R., & McClure, J. (2005). Theory of mind in schizophrenia: A critical review. Cognitive Neuropsychiatry, 10(4), 249–286. https://doi.org/10.1080/13546800444000056 Hoekstra, R. A., Vinkhuyzen, A. A. E., Wheelwright, S., Bartels, M., Boomsma, D. I., Baron-Cohen, S., Posthuma, D., & Van Der Sluis, S. (2011). The construction and validation of an abridged version of the autism-spectrum quotient (AQ-short). Journal of Autism and Developmental Disorders, 41(5). https://doi.org/10.1007/s10803-010-1073-0

Meins, E., Fernyhough, C., & Harris-Waller, J. (2014). Is mind-mindedness trait-like or a quality of close relationships? Evidence from descriptions of significant others, famous people, and works of art. Cognition, 130(3), 417–427. https://doi.org/10.1016/j.cognition.2013.11.009

Parsons, T. (2016). Ecological Validity. In Clinical Neuropsychology and Technology (pp. 11–27). Springer, Cham.

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Virtual Reality and Social Cognition Lab (cont.)

Lab Instructor	Dr Brendan Rooney

function in experimental and clinical neuropsychology. Neuropsychological Rehabilitation, 1–31. https://doi.org/10.1080/09602011.2015.1109524

Rooney, B., Burke, C., Balint, K., O'leary, T., Parsons, T., Lee, C. T., & Mantei, C. (2018). Virtual reality, presence and social cognition: The effect of eye-gaze and narrativity on character engagement. Proceedings of the 2017 23rd International Conference on Virtual Systems and Multimedia, VSMM 2017. https://doi.org/10.1109/VSMM.2017.8346272

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PSY40850 Behavioural Neuroscience Labs 2

Event Related Potential (ERP) Lab and Transcranial Magnetic Stimulation (TMS)

Credits	7.50
Module Co-ordinator	Professor Klaus Kessler

Introduction

EEG is a non-invasive technique for measuring activity in the brain. The technique measures voltage changes across time through the application of conductive electrodes to the scalp. The voltage at each active electrode is measured relative to a reference electrode. In order to simplify the task of placing electrodes, and to ensure the correct spacing of electrodes, participants wear an EEG cap to which electrodes are attached (See Figure 1. Some systems use a net rather than a cap). A good connection (between the scalp and the electrodes) is maintained through the use of conductive electrode gel. It is possible to record EEG with few electrodes, however, some of the standard number of electrodes used are 32, 64, 128, 256 electrodes. Once the cap has been placed correctly and gel has been applied to aid the connection between the scalp and electrodes, a check is made for the quality of data at each electrode. Any electrode showing high levels of noise will be worked on (e.g. application of more gel). Visualisation of the signal being picked up at each electrode continues through the experimental session. EEG detects voltage changes in the order of micro-volts. As these changes are extremely small, the EEG system uses an amplifier to amplify the signal. Depending on the system used, amplification can occur at the electrode or at a separate amplifier. The small voltage changes mean that the control of any noise in the testing environment is particularly important. EEG has high temporal specificity as it picks up voltage changes in milliseconds across time. As this is happening for every electrode across time, EEG generates a lot of data.

EEG data can be recorded when people are in a different state or when they are performing a task. It is possible to use EEG in two main ways: to analyse the EEG data itself, looking at, for example, the different frequency bands present under different conditions e.g. alpha activity (low frequency) is associated with a relaxed state. The other main way is to use the EEG data to create ERP data. As the name suggests ERPs are potentials related to particular events in an experimental paradigm. Some classical ERPs have been identified in the literature and have been repeatedly demonstrated e.g. the P100 and N100 (1) are associated with activation of the visual cortex on presentation of a visual stimulus, the N170 (2) is associated with the presentation of face stimuli, and the N400 (which we will look at in this lab (3)) is associated with meaning and context.

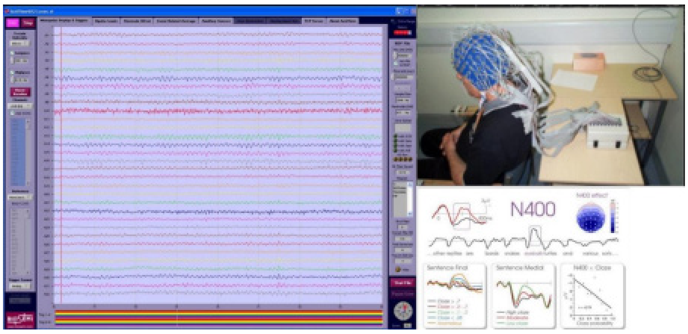


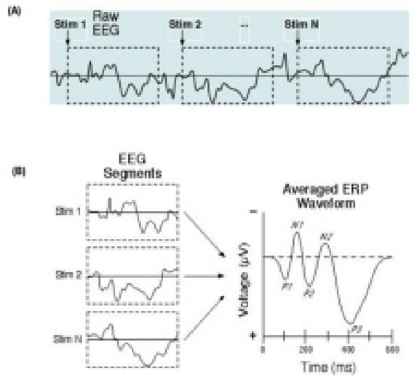
Figure 1: (Clockwise) Screen showing visualisation of EEG data during acquisition using ActiView software; A participant following set up of the EEG cap for recording (Biosemi EEG system); A depiction of the classic N400 ERP component.

PSY40850 Behavioural Neuroscience Labs 2

Event Related Potential (ERP) Lab and Transcranial Magnetic Stimulation (TMS) (cont.)

Lab Instructor TBA

ERP data is retrieved by epoching the EEG data (see Figure 2). Let us use a simple example to explain how this is done. Imagine we have a very simple experiment where we present participants with houses and faces and we want to see how the ERP response differs in each condition. For this example, let us suppose we use 32 electrodes. The task/stimuli are presented on a task/stimulus computer and the software handling this sends a code to the EEG recording software every time a stimulus (house or face) is presented. Our continuous EEG signal, for each participant, has labels on it, showing in time when the stimuli appeared (a different code is used for different conditions). Once the EEG recording is complete the continuous signal for every electrode (32 in this example) can be sliced into epochs surrounding each event. This involves slicing from e.g. 100ms before the event (baseline) to e.g. 500ms after the event. Following some standard checks and corrections (to be discussed in our lab) all slices of data associated with house stimuli at each electrode can be averaged together to form an ERP. The same is then done for the face stimuli. The ERP is thought to represent true changes related to the given event because by averaging together lots of face events we get rid of any noise in the signal that occurs by chance on any trial. The same is then done for all our participants data and we can then compare our ERP data for the two conditions across participants. We can also visualise our group ERP data by looking at a "grand average" which is the average ERP at each electrode per condition across participants. For our hypothetical experiment here, we might expect that our analysis would show a significant difference in the ERP signal so that for the face condition there would be an increased negative-going part of the wave at around 170ms (N170 referred to above). N and P refer to the polarity of the component (i.e. positive or negative), and the number following refers to the latency of the response in ms i.e. how long after the event the deflection occurs.



A - an example of raw EEG data from a single electrode channel.

B - an example of epoching raw EEG data and averaging to create an ERP.

Figure 2: An illustration of the method for creation of an ERP. The continuous EEG data (A) is epoched and segments from the same condition are averaged together (B).

In our lab we will be looking at a semantic (meaning) task and the classic N400 component. The task will involve participants making a judgement on every trial about whether a pair of words are related in meaning or not. ERP analyses will compare responses to the condition where there is a semantic (meaning) relationship versus the condition where there is none.

Lab Details

- Students will act as both experimenter and participant in an EEG/ERP experiment with a parallel behavioural task.
- You will learn how to set up an EEG cap and record data.
- You will run a behavioural task using Presentation software in parallel with EEG recording and you will learn how the presentation of task stimuli is linked with your EEG data. You will take part in an analysis session to analyse data based on 40 participants (4) You will analyse performance on the behavioural task.
- You will learn how to clean and epoch individual data in order to create individual ERPs for each condition.
- You will perform a group analysis of the ERP data and be able to present that visually.

PSY40850 Behavioural Neuroscience Labs 2

Event Related Potential (ERP) Lab and Transcranial Magnetic Stimulation (TMS) (cont.)

Lab Instructor TBA

Research Skills

- Running a behavioural task in Presentation (https://www.neurobs.com/) EEG data collection using a Biosemi system and ActiView software (https://www.biosemi.com/)
- Analysis of EEG data using EEGLAB/ERPLAB Toolbox (ERPLAB Toolbox — ERP Info) (5) Creating figures to present your ERP results as part of your lab report.

References

(1) Luck, S.J. (1995) Multiple mechanisms of visual-spatial attention: recent evidence from human electrophysiology. Behavioural Brain Research, 71, 113-123

(2) Amihai, I., Deouell, L.Y., and Bentin, S. (2011). Neural adaptation is related to face repetition irrespective of identity: a reappraisal of the N170 effect. Experimental Brain Research, 209, 193-204

(3) Kutas, M., and Federmeier, K.D. (2011) Thirty Years and Counting: Finding Meaning in the N400 Component of the Event-Related Brain Potential (ERP). Annual Review of Psychology, 62, 621-647

(4) Kappenman, E. S., Farrens, J. L., Zhang, W., Stewart, A. X., & Luck, S. J. (2020). ERP CORE: An open resource for human event-related potential research. NeuroImage. https://doi.org/10.1016/j.neuroimage.2020.117465

(5) Lopez-Calderon, J., & Luck, S. J. (2014). ERPLAB: An open-source toolbox for the analysis of event-related potentials. Frontiers in human neuroscience, 8, 213. [Click here for free access]

Useful background resources:

Luck, S.J. (2014). An Introduction to the Event-Related Potential Technique (2nd Edition). MIT Press. (ProQuest Ebook Central - Detail page)

Luck, S. J., & Kappenman, E.S. (Eds.). (2012). The Oxford Handbook of Event-Related Potential Components. New York: Oxford University Press.

For lots of free resources including explanatory videos see ERP Info from Steve Luck and Emily Kappenman at UC Davis.

Transcranial Magnetic Stimulation (TMS)

Following the ERP lab described above, you will take part in a session on Transcranial Magnetic Stimulation (TMS). This will include a theoretical introduction as well as a demonstration of the TMS and neuronavigation equipment in the School. Following the TMS session, it is expected that you should have an appreciation of the theory behind TMS and how it compares to EEG and other Cognitive Neuroscience techniques, that you should understand the strengths and weaknesses of TMS, and that you should understand the basic elements of a TMS set up and be able to assist in a practical session. In order to measure this understanding, you will be required to submit answers to a set of questions provided to you at the TMS session.

PSY40850 Behavioural Neuroscience Labs 2

Event Related Potential (ERP) Lab and Transcranial Magnetic Stimulation (TMS) (cont.)

Lab Instructor	TBA

Useful background resources

Hartwigsen, G., & Silvanto, J. (2022). Noninvasive brain stimulation: Multiple effects on cognition. The Neuroscientist, 10738584221113806.

Rossi S, Hallett M, Rossini PM, Pascual-Leone A and The Safety of TMS Consensus Group. (2009) Safety, ethical considerations, and application guidelines for the use of transcranial magnetic stimulation in clinical practice and research. Clinical Neurophysiology 120, 2008–2039

Siebner, H. R., Funke, K., Aberra, A. S., Antal, A., Bestmann, S., Chen, R., ... & Ugawa, Y. (2022). Transcranial magnetic stimulation of the brain: What is stimulated?–a consensus and critical position paper. Clinical Neurophysiology, 140, 59-97.

Walsh, V., & Cowey, A. (2000). Transcranial magnetic stimulation and cognitive neuroscience. Nature Reviews Neuroscience, 1(1), 73-80

PSY40780 Behavioural Neuroscience Research

Level	
Credits	
Module Coordinator	Nuala Brady
Lecturers	

Each student will work with a member of academic staff in the School of Psychology to complete a research project that is part of ongoing research in the school. The purpose is to enable students gain hands-on experience in conducting research under close supervision where they will have the opportunity to engage in aspects of research such as (a) reviewing the research literature, (b) considering ethical issues associated with the research with reference to ethical guidelines, (c) collecting data using specialised research equipment or standardised assessments, (d) accessing pre-existing data, (e) managing, visualising and analysing data using a statistical package and (f) writing a research article in the recommended publication style of an academic journal chosen in consultation with the supervisor.

The Projects document describes the projects offered in 2025-2026 and will be distributed to stduents by Mary Boyle. It includes a concise description of each project and suggested background readings. Most projects are from staff members in the Affective, Behavioural, and Cognitive Neuroscience (ABC) research group, with some from staff in other research groups. Several projects are collaborative, offering students an opportunity to work with more than one member of staff. Details of project submission deadlines are given on Brightspace.

Assessment includes a literature review in T2, and the submission of your final research thesis is written up as a journal article submission in T3.

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