MSc Behavioural Neuroscience

Student Manual 2023-2024

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WELCOME

On behalf of all colleagues involved in teaching and research supervision on the MSc in Behavioural Neuroscience in 2023-2024, welcome to the programme. Welcome also to the School of Psychology which will be your academic home for this year. We are very happy that you have chosen 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 some advice on choosing option modules to complement your undergraduate training (be in 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 drop either of us an email at any time to ask a question or to arrange a meeting to chat in person (nuala.brady@ucd.ie, s.cooney@ucd.ie). For organizational and administrative matters related to the programme, please contact Mary Boyle (mary.boyle@ucd.ie).

Nuala Brady & Sarah Cooney

Programme Directors, MSc Behavioural Neuroscience

SOME USEFUL LINKS

- Psychology is based in the College of Social Sciences & Law. Keep an eye out for interesting seminars and news (https://www.ucd.ie/socscilaw/) and note that we have two Student Advisers, Kieran Maloney (kieran.moloney@ucd.ie) and Holly Dignam (holly.dignam@ucd.ie) who are on hand to help. You can read about the confidential support service provided by Student Advisers at https://www.ucd.ie/studentadvisers/
- UCD Conway Institute is home to our colleagues in Neuroscience, see https://www.ucd.ie/conway/research/diseasefocusedresearch/neuroscience/ for information, including on seminars and events.
- The UCD Student Centre (https://www.ucd.ie/studentcentre/services/) links to information on clubs, societies, sports, dining, health services, the Student's Union (https://www.ucdsu.ie/)
- UCD Access and Lifelong Learning (https://www.ucd.ie/all/)
- Information for international students (https://www.ucdisc.com/)
- Thinking ahead to your next step, see UCD Careers (https://www.ucd.ie/careers/)
- 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)

SOME 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 dispense 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 (https://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 citation, quotation etc (https://libguides.ucd.ie/academicintegrity). Our library also provides online tutorial 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).

HOW THE PROGRAMME IS STRUCTURED

The MSc Behavioural Neuroscience is a 90-credit Level 9 full-time programme which runs over 1 year. At UCD the academic year is divided into 3 trimesters (T1, T2 and T3, aka Autumn, Spring, Summer) and UCD publishes the dates associated with these trimesters, notes bank holidays, examination and study periods. Please see: https://www.ucd.ie/students/t4media/AcademicYear_2324.pdf. Note that the 12-week Spring trimester is split into an initial 7 week and later 5 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 1 week Study period in the Autumn trimester so that the formal teaching time is reduced to 11 weeks. At the graduate level, this is at the discretion of module coordinators.

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			
Trimester	**Module ID**	**Module Name**	**Credits**
Autumn	**PSY40760**	Adv Research Methods & Stats	**5**
Autumn	**PSY40840**	Behav Neuroscience Labs 1	**7.5**
Autumn	**PSY40900**	Recent Papers in Behav Neuroscience	**5**
Spring	**PSY40850**	Behav Neuroscience Labs 2	**7.5**
Summer	**PSY40770**	Knowledge Transfer	**5**
Year Long	**PSY40780**	Behav Neuroscience Research	**30: 2.5-T1, 2.5- T2, 25-T3**
Total Core Credits = 60			

Option Modules			
Trimester	**Module ID**	**Module Name**	**Credits**
Autumn	**PSY40910**	Embodied & Social Cognitive Neuroscience	**10**
Autumn	**PSY40820**	Fundamentals of Neuropsych	**10**
Autumn	**PSY40830**	Advanced Cognitive Psych	**10**
Autumn	**PSY40640**	Advanced Disabilities Studies	**10**
Spring	**NEUR40110**	Sensory Neuroscience	**10**
Spring	**NEUR40120**	Principles of Neuroscience	**10**
Spring	**NEUR40130**	Higher Cortical Function	**10**
Spring	**PSY40790**	Clinical Cases in Neuropsych	**10**
Spring	**PSY40860**	Topics in Psychological Sci	**10**
Spring	**PSY40930**	Neurodevelopmental Disorders	**10**

- The 90-credits comprise 60 credits from core modules that are compulsory on the programme and 30 credits from optional modules.
- The 60 cores include 30 credits for **PSY40770 Behavioural Neuroscience Research Project** (aka 'Project') which is split as 2.5 credits in T1, 2.5 credits in T2, and 25 credits in T3.
- **PSY40840** and **PSY40840 (**Labs 1 and Labs 2 in Trimester 1 and 2 respectively) are 7.5 credit core modules
- In T1 (Autumn) you take Project (2.5) plus Labs 1 (7.5) plus Adv Research Methods & Stats (5) and Recent Papers in Behav Neuroscience (5) for 20 core credits. You should take one option for a total of 30 credits

- In T2 (Spring) you take Project (2.5) plus Labs 2 (7.5) for 10 core credits, so should take 2 options for a total of 30 credits.
- In T3 (Summer) you take Project (25) plus Knowledge Transfer (5) for 30 core 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.
- Professor Klaus Kessler joined the UCD School of Psychology in 2021 as Full Professor of Affective, Behavioural and Cognitive Neuroscience and is offering a module in T1, **PSY40910 Embodied & Social Cognitive Neuroscience**.
- 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)

ADVANCED RESEARCH METHODS & STATISTICS PSY**40760**

Module Co-ordinator: Dr Sarah Cooney

This module is designed for postgraduate students completing the Masters in Behavioural Neuroscience, and aims to support them to develop their quantitative research skills to an advanced level. The focus of the module will be on acquiring the methodological and analytical skills necessary to complete a research project of publishable quality. The topics covered include quantitative design analysis techniques. Teaching methods will include classroom seminars and advanced methodology laboratories, and students will be expected to complete set tasks and reading in between sessions. This year we are introducing workshops in R programming to give students hands-on experience in developing programming skills for data management, visualization and analysis.

The module includes both lectures (morning session) and hands-on lab activities (afternoon session). The lab activities focus on task based learning in pairs/groups. Students are also encouraged to reflect on the nature of debates in research design and consider how they might apply to their previous experience and planned research activity.

Coffee breaks and lunchbreaks are provided during the sessions.

Core Texts

Jhangiani, R.S., Chiang, I.A., Cuttler, C., & Leighton, D.C. (2019). Research Methods in Psychology, 4th Edition. **Free to download** at https://kpu.pressbooks.pub/psychmethods4e/

Herzog, M., Francis, G. & Springer, C. (2019). Understanding statistics and experimental design: How not to lie with statistics. Springer. https://www.springer.com/gp/book/9783030034986 **Free / Open Access (50 pages**)

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**

RECENT PAPERS IN BEHAVIOURAL NEUROSCIENCE PSY40900

Module Coordinator: Sarah Cooney

This module introduces students to recent scientific findings and trends in Behavioural Neuroscience via a series of research seminars delivered by academics in the field, and by critical analysis of 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 that are currently being asked in areas such as neuropsychology, cognition and perception?
2. What methodologies and experimental techniques are currently being 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 presentation and empirical research papers?

Module Schedule

Date	Structure	Speaker	Affiliation
13/09/2023	**seminar**	Dr Ciara Egan	NUIG
27/09/2023	**seminar**	Assoc. Professor Michelle Downes	UCD
04/10/2023	**seminar**	Dr Sarah Cooney	UCD
11/10/23 (tbc)	**seminar**	Dr Helen O'Shea	UL
25/10/2023		TBC	TBC

BEHAVIOURAL NEUROSCIENCE LABS

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 Patricia Gough 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 follow below

EYE TRACKING LAB

Lab Instructor: Ciara Greene
Lab Demonstrators: TBA

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.

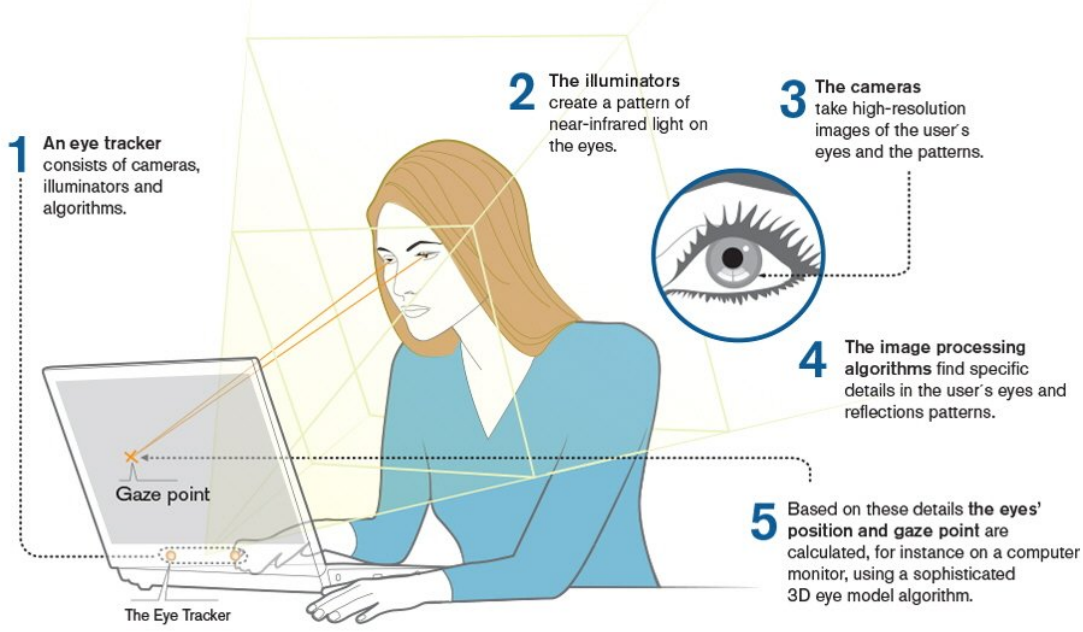

Figure 1. Illustration of the eye tracking process (© Tobiipro.com)

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) usually look like glasses and are worn 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 Tobii X3 120 – captures 120 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 Tobii X3 120. In the lower panel, the X3 120 is attached to the bottom of the computer monitor as a participant performs a task. Panel B depicts the Tobii Glasses 2; in the lower panel, a participant wears the glasses 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 class (N = 10), and test the hypotheses listed above.

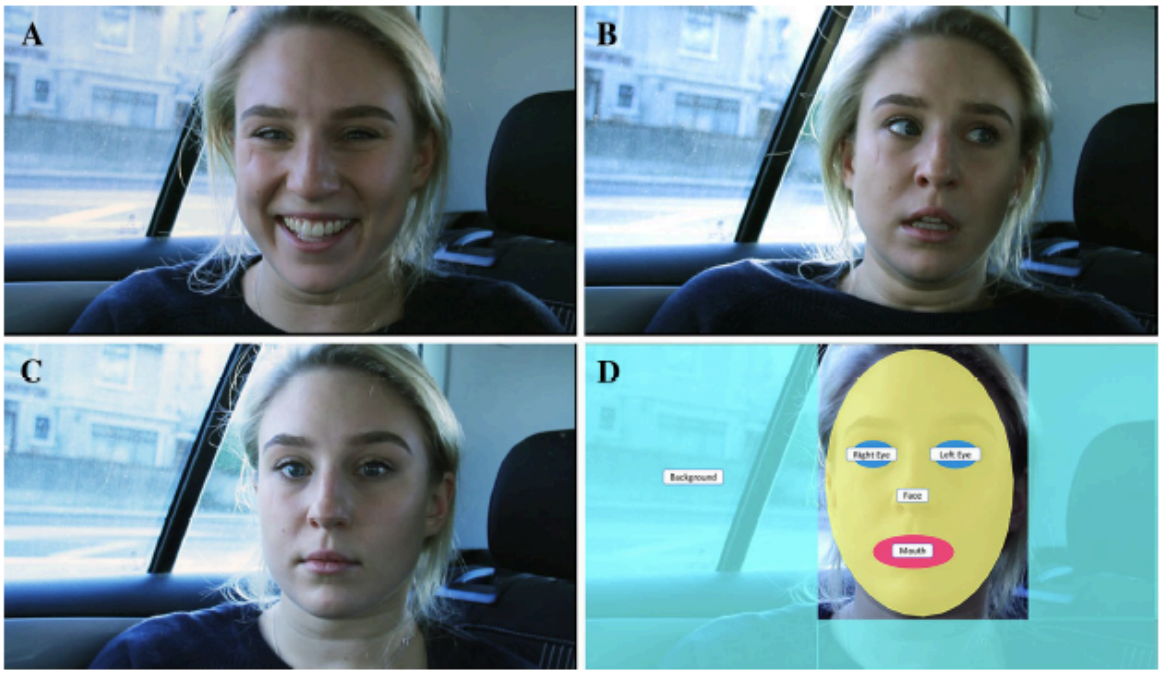

Figure 3. Screenshots from the (A) happy, (B) fearful and (C) neutral video clips, taken from Greene, Suess and Kelly (2020) [6]. Panel D indicates AOIs over the eyes, mouth, whole face and background.

Research Skills

- Running an eye tracking experiment using Tobii Pro Lab software
- Conducting eye tracking data analysis using Tobii Studio software, including visualisation of eye tracking metrics (heat maps, fixation counts etc.)
- 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:

Tobii Studio User's Manual https://www.tobiipro.com/siteassets/tobii-pro/user-manuals/tobii-pro-studio-user-manual.pdf

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

NEUROPSYCHOLOGY ASSESSMENT LAB

Lab Instructor: Jessica Bramham
Lab Demonstrator: TBA

Introduction

Neurocognitive disorder (also known as dementia) is a condition that involves 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 neurocognitive disorder 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 underlying cognitive deficits, the nature of which is hidden within a single score and fails to provide information regarding the primary neurocognitive mechanism responsible for difficulties in 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 neurocognitive disorder, e.g. memory loss 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 neurocognitive disorder, 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.

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)31363-6

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

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.

VIRTUAL REALITY AND SOCIAL COGNITION LAB

Lab Instructor: Brendan Rooney
Lab Demonstrator: TBA

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).

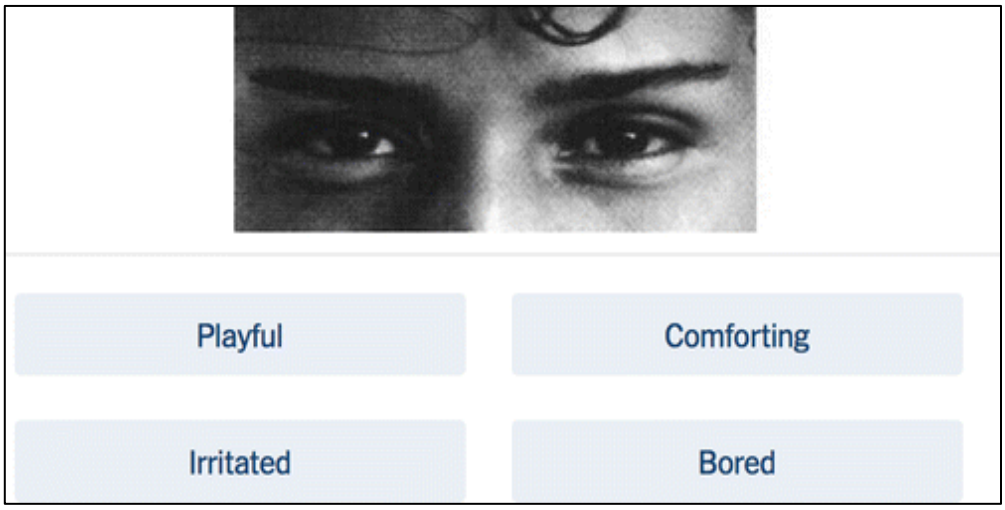

Figure 1. Example trial from the RMET test. Participants are required to select one of four possible mental states that the person in the picture is expressing.

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*.

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).

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.

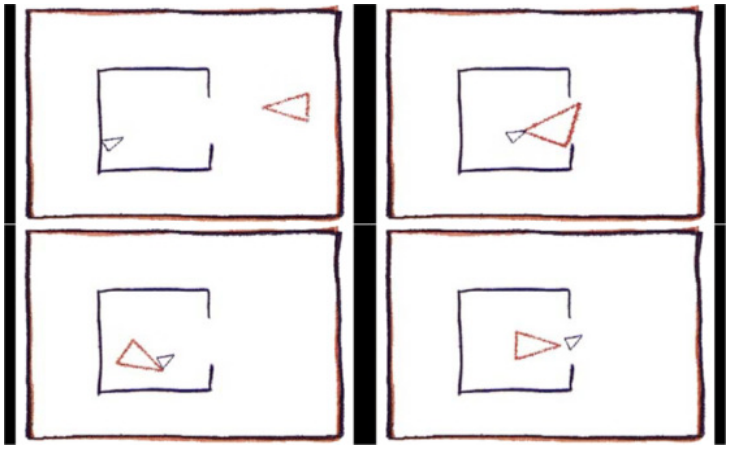

Figure 3. Images from the Animations Task showing two triangles moving around a space to give the illusion of social interaction.

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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EVENT RELATED POTENTIAL (ERP) LAB AND TRANSCRANIAL MAGNETIC STIMULATION (TMS)

Lab Instructor: Patricia Gough
Lab Demonstrator: TBA

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.

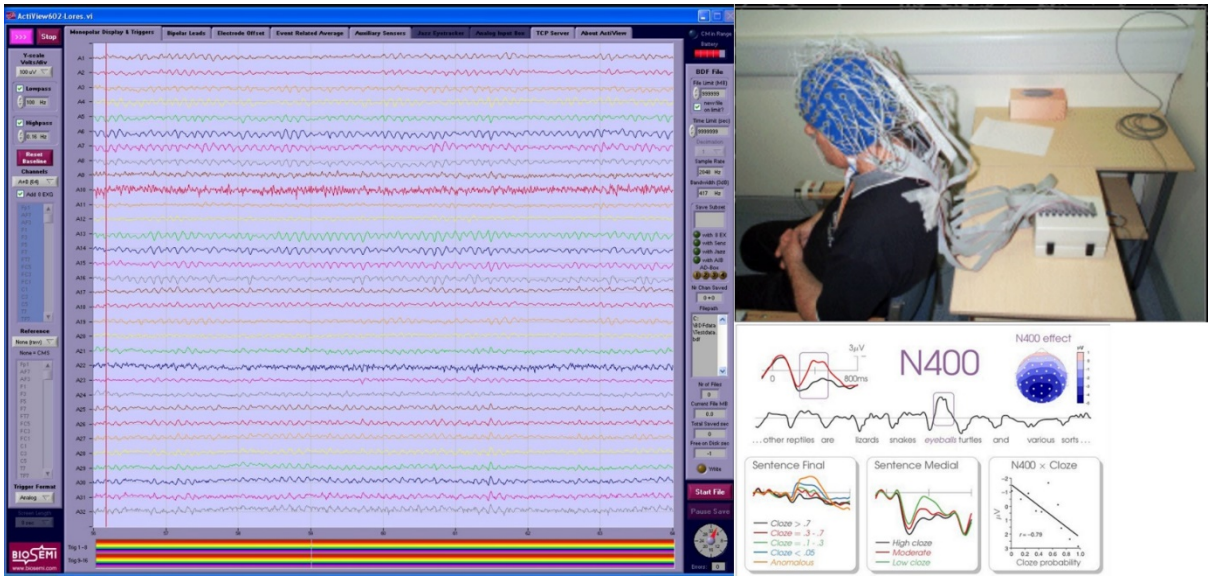

Figure 1: (Clockwise) Screen showing visualisation of EEG data during acquisition using ActiView software; A participant following set up of the EEG cap for recording (Biosemi EEG system); A depiction of the classic N400 ERP component.

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.

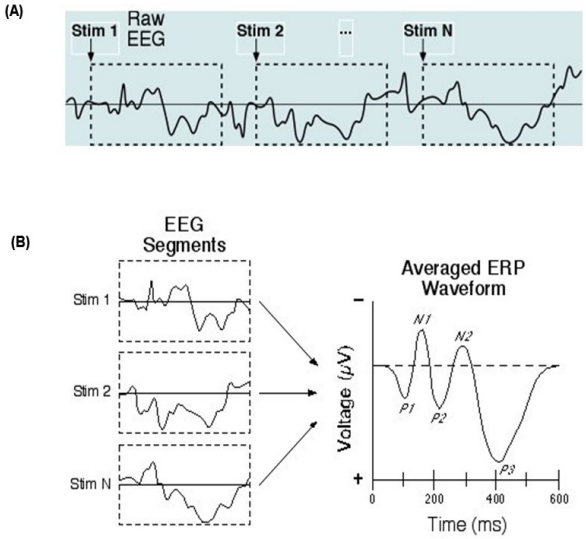

Figure 2: An illustration of the method for creation of an ERP. The continuous EEG data (A) is epoched and segments from the same condition are averaged together (B).

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.

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.

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(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.

Useful background resources

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

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PSY40780 BEHAVIOURAL NEUROSCIENCE RESEARCH

Module Coordinator: Nuala Brady

Short Description: 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.

Projects offered in 2023-2024 are described in the Projects document which includes a concise description of each project and suggested background readings. The majority of projects on offer are from members of staff in the Affective, Behavioural and Cognitive Neuroscience (ABC) research group, with some from staff in other research groups. A number of 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.