

# PART II Psychology, Neuroscience and Behaviour

2019 - 2020

## COURSE GUIDE

This handbook contains important information on the course:  
please take the time to read it and keep it for reference throughout the year.

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These pages are also found on the [Faculty of Biology](#) website:

## GENERAL INTRODUCTION

Neuroscience spans across a broad range of processes and associated experimental approaches. It may actually be the most challenging field in life sciences and perhaps in Science in general so much can the gap be between molecular and cognitive neuroscience. In fact, it is often the case that two neuroscientists simply cannot understand each other, let's say if one is a psychologist working on the metacognitive processes involved in judgement and the other one is interested in imprinting or the nature of neural network in the spinal cord that mediate locomotion in the lamprey. Yet, they are both interested in the same organ, namely the central nervous system.

Whether cellular neuroscience, or genes and behaviour, or Psychology are more appealing to you, Psychology, Neuroscience and Behaviour (PNB) offers a unique opportunity to venture in the breadth of what neuroscience is about: a multi-level investigation of the brain that ranges from Psychology, to behaviour, neural systems, cellular and molecular mechanisms, down to genes and how they relate back to each of these other levers of integration. This interdepartmental course is therefore a unique opportunity for you to tailor your Part II experience and training, sampling knowledge and approaches from complimentary modules offered by the departments of Psychology, Zoology and Physiology, Development and Neuroscience (PDN), which you would not find in each of these departments otherwise.

PNB offers you that unique opportunity to be able to understand the brain from each level of integration and to get an insight into how these levels interact with each other to support the emerging properties of the brain that are emotion, motivation, decision-making, and associated disorders. For example, 'How do we perform an action?', 'How is that motor programme stored in our genetic code and influenced by epigenetic mechanisms?', 'Why would we want to perform that action?' and 'How do we remember it?' are key contemporary questions in neuroscience that pertain to the understanding of what goes wrong in the brain, at the molecular, cellular and neural levels in neurodegenerative disorders such as Parkinson's Disease.

There is nothing more exciting than starting to understand the relationships between neurons and behaviour, behaviour and cognition and the underlying cellular and genetic mechanisms! So we hope you'll enjoy it!

This course provides an integrated treatment of the neurosciences and is built around lectures and a research project.

Lectures are organised in modules of 24 lectures drawn from existing Part II modules offered by Psychology, PDN and Zoology, sometimes with additional input from other Departments. Each module will be delivered within a single term (either Michaelmas or Lent) at a rate of three lectures per week. Students must attend four modules in total. There are no restrictions on choice of modules because they will be timetabled to ensure no clashes between them.

In addition, students complete a two-term experimental project in the laboratory of an individual supervisor based in one of the contributing departments or elsewhere in the Cambridge Neuroscience Community. Please note: not all modules are able to offer accompanying projects.

The course is best suited for students who have studied some neurobiology in Part IB, either in MVST or in NST, but others will be able to take it if they are prepared to do some background reading.

You will be encouraged to choose no more than three modules offered by the same department in order to maximise this inter-disciplinary experience that PNB will provide you on your final year.

# AIMS, OBJECTIVES & LEARNING OUTCOMES

## Our Aims

- The Departments of Psychology, Physiology Development & Neuroscience (PDN) and Zoology aim to bring together experts from all over Cambridge to provide a multidisciplinary course in Psychology, Neuroscience and Behaviour.
- We aim to train students in a wide range of skills that provide the learning base for future careers in psychology, zoology and neuroscience research, medicine, veterinary medicine, related disciplines such as the pharmaceutical industry and the emerging biotechnologies.

## How we expect to achieve our aims

- By offering a modular course of lectures and a laboratory-based research project, supported by supervisions where appropriate.
- By providing training in practical and conceptual tools in sub-disciplines ranging from cognitive and behavioural neuroscience, molecular, cellular and integrative neurobiology, evolution of behaviour to the clinical application of psychology, neuroscience and behaviour.
- By providing you the opportunity to hone your critical analysis skills over the course of the year during weekly journal club sessions.
- By providing constructive feedback on your progress throughout the year on your project work and written work for supervisions.
- By offering you the opportunity to present a poster of your research at a PNB symposium in Lent Term (**Monday 2 March**)

## At the end of the course you should be able to:

- Think and write critically and creatively about what you have read, learned and discovered.
- Analyse, interpret and present data collected during a research project.
- Use available resources, including computer searches, to find relevant literature and then evaluate it critically.
- Assess and implement the practical techniques necessary to solve a particular research problem.

## NST Part II: Psychology, Behaviour and Neuroscience (Single subject)

All single subject students must offer a Research Project, which must not exceed 8,000 words, excluding appendices, footnotes, and bibliography (see page 1715). Students can also choose to offer an optional dissertation on any topic that particularly interests them in order to further their knowledge of a particular topic of the course. The student will benefit from supervisions pertaining to the topic and the writing of this optional dissertation, but this dissertation will not be examined.

## NST Part II BBS: Psychology, Behaviour and Neuroscience (Major subject)

If you are studying PNB within the BBS Part II, you do not submit a research project. You do, however, have to submit a dissertation on a topic of your choice. Your dissertation can either be on a topic in an area of psychology, neuroscience and behaviour or a topic in your Minor subject. The arrangements for doing a dissertation on a topic in PNB are as follows: You may propose the dissertation topic, or take it from a list of possible titles that will be published at the start of the Michaelmas Term. You should approach a potential supervisor and gain their agreement to supervise you.

You must obtain approval from the Course Organiser, Dr Belin, of the proposed title and subject of your dissertation *by 4.00 pm Friday 8 November*. From the NST Part II Biological and Biomedical Sciences 2019-2020 Moodle site, you must download and print the PDF Dissertation Title Notification Form, have it signed by your supervisor, and hand in the form to the Psychology Teaching Office *by 4.00 pm Friday 8 November*. You must also fill in an electronic copy of the form, minus the supervisor signature, and upload this to the Dissertation Title Notification Dropbox on the same Moodle page *by 4.00 pm on Saturday 9 November*. Plenty of useful information about the dissertation is also available on the BBS website and Moodle site. The dissertation should not exceed 6,000 words in length.

BBS students may attend any of the PNB modules, although they should note that two modules, PNB 9 and PNB 10 are offered as BBS Minor subjects in PDN (as modules N5 and N6, respectively). BBS students therefore cannot take PNB 9 or 10 as part of their Major subject if these modules are taken as Minors. Please note there may be timetable clashes between some modules and certain Minor subjects, and students should check the timetables carefully. The BBS website contains a [list of compatible combinations of BBS Major and Minor subjects](#).

## ADAPTING TO PART II

At Part II the aim is not just to learn facts, but to understand how experiments are done and what are the limitations and uncertainties of research. You will be exploring the limits of knowledge about the brain, cognition and behaviour. Lecturers' handouts may consist largely of reference lists and much of your reading will be of original research papers. Some will be of general importance, others on topics that you want to concentrate on.

Note that given the need to consider environmental issues and given increasing use of electronic devices by students, it has been decided that lecture handouts will no longer be printed. Module organisers should ensure that lecturers are aware that lecture handouts will need to be posted online well in advance of the lectures.

You have to take more responsibility for your own learning than in Part I. You should organise your learning constructively. Try to integrate knowledge from different courses and modules. But also, follow up your own interests in depth – you will be told several times that there is no right way of learning.

### Accessing research papers:

Most recent papers are available online from within the cam.ac.uk domain. Others will be in departmental libraries or the Central Science Library. You should also learn to make your own literature searches online using databases such as Web of Science (WOS). The Psychology and Zoology librarians will help anyone needing assistance to get started.

### Supervisions and essays:

Because of the specialised nature of this third-year course, the lecturers themselves are often the principal providers of supervisions or will provide you with a list of suitably qualified supervisors.

Lecturers are also asked to provide specimen essay titles, and supervisors should be willing to read your essays. It is your responsibility to approach individual lecturers/supervisors; preferably organise yourselves into groups for the purpose, and use email to set up a meeting (supervisors should reply to requests, but with the best will in the world, an email that arrives at a busy time may be forgotten - don't be afraid to write again if you have not got a reply to your enquiry). It may not be possible for all lecturers/supervisors to meet all requests, because of the numbers taking the modules and because some are external. So, for additional assistance:

If a supervisor has difficulty scheduling supervisions for you, either they or the module organiser should be able to suggest someone else who could do it.

Your college Director of Studies should be willing to arrange a 'generic' supervision, to check whether you are writing essays in appropriate Part II style.

We recommend that you do a minimum of 6 essays and/or supervisions during the year; but many more will be helpful.

### Course advisers:

In case of problems or questions, in the first instance you should contact the relevant lecturer or organiser. In addition to this, please feel free to approach the course organiser, David Belin, for general advice or help if you feel that you have any problems within the course.

### Research seminars:

Whilst not a requirement of the course, you are strongly encouraged to attend relevant research seminars within the University. Most contributing departments have their own departmental seminars, which are advertised in departments as well as on the Web (see the [Cam Talks website](#)). In addition, seminars deemed of special interest to the course will be advertised by e-mail shots to all students and notices on our coursework website.

**Safety:**

All departments and labs in which you work must have risk assessments and must ensure that everyone works safely. You must be aware of and observe all necessary safety precautions, especially in any workshop or lab project.

## LECTURE MODULES

Twelve lecture modules are offered, 7 in Michaelmas Term and 5 in Lent term. Each module has three lectures per week, giving 24 in all. **You will be examined on four modules in total.** The timetable allows you to attend all of the modules, and you are strongly encouraged to attend more than two at any one time, especially early in the term as this will give you more time to decide which modules to concentrate on. Throughout the year, sitting in on additional lectures (even if you don't do all the associated reading) will broaden your understanding of psychology, neuroscience and behaviour.

You will share these lectures with students from other Part II courses.

### Michaelmas Term Modules:

#### ✓ **PNB Module 1: Brain Mechanisms of Emotional Regulation and Motivation (Psychology)**

Mon 11am, Tues 12am, Wed 12am

Part II Lecture Theatre Department of Plant Sciences

Module organiser: Dr David Belin ([bdb26@cam.ac.uk](mailto:bdb26@cam.ac.uk))

This module takes different approaches to the question of emotion and motivation: what is motivation, what is emotional regulation and what are the psychological and neural mechanisms associated with adaptive and maladaptive motivation. Therefore, this module will explore why we take some actions, avoid taking others; do what we are supposed to do and what is best for us and do things that are clearly harmful. Some behaviours are simply elicited by the environment and others might be thought to serve regulatory needs, but most are too complex to be explained in simple terms. The module provides you with a range of approaches in current psychology, from behavioural neuroscience to abnormal psychology and demonstrates potential applications to real world issues.

The module is structured around 3 blocks of 8 lectures each: 1. Motivation: Emotional and cognitive mechanisms of preparatory and consummatory responses, 2. Advances in research on stress and stress-related disorders, 3. Emotion regulation and aberrant motivation. Together these 24 lectures will offer a historical perspective on our understanding of emotion, emotion regulation and motivation as well as the current, most contemporary state of the art. Drawing on learning theory, and sophisticated behavioural approaches in animals, this module will cover a breadth of Behavioural Neuroscience techniques such as lesioning, electrical and chemical stimulation, electrophysiological recording and in vivo monitoring of transmitter release, chemo- or opto-genetic manipulations of specific neuronal ensembles or circuits and calcium imaging, to provide deep insights into the neural mechanisms of normal and abnormal emotion and motivation. Particular emphasis will be placed on corticostriatal systems, monoamines and the role of stress in adaptive and maladaptive emotion regulation and motivation. The last set of lectures will capitalise on the knowledge accrued over the first half to discuss the psychological and neural basis of post-traumatic stress disorder, Obsessive Compulsive Disorder and drug addiction.

### Recommended Reading:

- Toates, F. (2011). Biological psychology (3rd ed.). Harlow: Prentice Hall.
- Carlson, N.R. (2012). Physiology of behavior (11th ed.). Boston: Pearson.
- Squire, L.R., et al. (Eds.). (2012). Fundamental neuroscience (4th ed.). San Diego: Academic Press. (Earlier versions should be consulted for more detailed chapters by Robbins & Everitt, and Koob.)
- Koob, G.F., & Le Moal, M. (2006). The neurobiology of addiction. Amsterdam: Elsevier.
- Feldman, R.S., Meyer, J.S., & Quenzer, L.F. (1997). Principles of neuropsychopharmacology. Sunderland, Mass.: Sinauer Associates.
- Iversen, L.L., Iversen S., Bloom, F.E., & Roth R.H. (2009). Introduction to neuropsychopharmacology (1st ed.). New York: OUP.
- Craig, A. (2009) How do you feel--now? The anterior insula and human awareness. *Nat Rev Neurosci*, 10, 59-70.
- Eleanor H. Simpson (editor), Peter D. Balsam (editor) (2016- Behavioral Neuroscience of Motivation
- Arnsten AF (2015) Stress weakens prefrontal networks: molecular insights to cognition. *Nat Neurosci*. **18**: 1376-1385
- McEwen B et al (2011) Stress- and allostasis-induced brain plasticity. *Ann Rev Med* **62**: 431-445.
- Miller AH and Raison CL (2015) The role of inflammation in depression: from evolutionary imperative to modern treatment target. *Nat Rev Immunol* **16**: 22-34.

### ✓ PNB Module 2: Evolution and behaviour: Genes and individuals (Zoology ZM5)

Mon, Wed, Fri 2pm

Part II Lecture Theatre, Department of Zoology

Module Organiser: Dr Nick Mundy ([nim21@cam.ac.uk](mailto:nim21@cam.ac.uk))

Individual variation is the raw material for evolution. This course examines the evolution of animal behaviour by focusing on how individual differences in behaviour arise. The first half of the course considers how behaviour develops during a lifetime by focusing particularly on the genetic foundations of behaviour, and the many ways in which genes and the environment interact in behavioural development. The aim here is to consider how these interactions influence the process of adaptive evolution. In the second half of the course, the emphasis is on cognitive, sensory and immune function. We focus particularly on natural populations with the aim of understanding the diverse selection pressures on these aspects of animal physiology, and how these systems themselves can be agents of selection.

### Recommended Reading:

- Carew, T.J. (2000) Behavioural Neurobiology.
- Jiggins C. D. (2017) The Ecology and Evolution of Heliconius Butterflies
- Martin, G. R. (2017) The Sensory Ecology of Birds
- Piersma, T. & van Gils, J. A. (2010) The Flexible Phenotype
- Price, T (2008) Speciation in Birds Chapters 9-13
- Stevens, M (2013) Sensory Ecology, Behaviour and Evolution
- West-Eberhard, M.J. (2003) Developmental Plasticity and Evolution.
- Wynne, C.D.L. (2001) Animal Cognition: The Mental Lives of Animals.
- Essential reading for students NOT from NST (e.g. vets and medics)**
- Bateson, P. and Gluckman, P. (2011) Plasticity, Robustness, Development and Evolution.
- Birkhead, T.R. (2012) Bird Sense: What it's like to be a Bird.

### ✓ PNB Module 3: Neuroethology: The neural basis of adaptive behaviour (Zoology ZM4)

Mon, Wed, Fri 3pm

Part II Lecture Theatre, Department of Zoology

Module Organiser: Dr Berthold Hedwig ([bh202@cam.ac.uk](mailto:bh202@cam.ac.uk))

The course considers a central problem in animal biology: How does the nervous system gather information about the environment, integrate it and then generate appropriate behavioural responses? Emphasis is placed on the behavioural context of neural mechanisms and relating neural organisation, function and circuit design to specific behaviours, i.e. the classical approach of “Neuroethology”. The lectures will cover the following topics:

- Ecology and evolution of brains
- Energy consumption in the nervous system
- Neural circuits and their analysis
- Neural mechanisms of acoustic communication
- Colour vision and visual information processing
- Drosophila courtship behaviour
- Phenotypic plasticity
- Neuromodulation and variability

We will use examples from invertebrates and vertebrate to identify and analyse neural circuits that process sensory signals and generate motor activity underlying simple and complex behaviour.

#### **Recommended Reading:**

Striedter, G.F. (2005). Principles of Brain Evolution.

Sterling P and Laughlin S (2015): Principles of Neural Design

Squire, LR and Kandel, ER (2008) Memory: From Mind to Molecules, 2nd ed (Roberts & Co).

Hedwig B (2014) Insect Hearing and Acoustic Communication

Pollack GS, Mason AC, Popper AN and Fay RR (2016) Insect Hearing

Keith T. Sillar, Laurence D. Picton, William J. Heitler (2016) The Neuroethology of Predation and Escape

#### **Essential reading for students NOT from NST (e.g. vets and medics)**

Simmons and Young, Nerve Cells and Animal Behaviour, Cambridge University Press, 3<sup>rd</sup> Edition

Carew, T.J. (2000) Behavioural Neurobiology.

### ✓ PNB Module 4: Developmental Neurobiology (PDN N1)

Mon 9am, Thurs 9am, Fri 10am

Hodgkin Huxley Seminar Room, Department of PDN

Module organiser: Prof. Clare Baker ([cvhb1@cam.ac.uk](mailto:cvhb1@cam.ac.uk))

Maximum of 80 students

This module addresses how the nervous system is assembled during embryonic development. Although we now understand a considerable amount about the processes involved, many fascinating questions remain.

We begin by discussing the formation of the vertebrate neural tube (future brain and spinal cord), and how this is patterned to generate distinct neuronal and glial cell fates in different regions, including the cerebral cortex. We also consider the formation of the peripheral nervous system from the migratory neural crest and cranial neurogenic placodes.

Once neurons have formed, they extend axons to their targets to 'wire up' the nervous system: the process of axon guidance is considered in detail. We then explore how axons make and refine the synapses that will generate functional neural circuits, and discuss how circuit designs lead to function.

We end by considering nervous system evolution ('evo-devo').

This course is given by researchers in the Departments of PDN, Zoology and Paediatrics, the Gurdon Institute and the MRC Laboratory of Molecular Biology.

It is best suited for students who have studied some neurobiology in Part IB, either in MVST or in NST, but others will be able to take it if they are prepared to do some background reading.

### ✓ **PNB Module 5: Molecular and Cellular Neuroscience (PDN N2)**

Mon 10am, Wed 9am, Fri 9am

Bryan Matthews Seminar Room, Department of PDN

*Module organiser: Dr David Parker ([djp27@cam.ac.uk](mailto:djp27@cam.ac.uk))*

*Maximum 40 students*

While many approaches can be applied to analyses of nervous systems, it is obviously important for any mechanistic understanding to determine the cellular and synaptic properties underlying sensory, motor, and cognitive functions. The voltage-dependent ion channels that determine the resting and active properties of cells form a superfamily of at least 143 genes, with further diversity and functional variability resulting from alternative splicing, posttranslational modifications, and the plasticity of the varying combinations of subunits that form channels. This results in a massive range of potential cellular properties (e.g. adaptation, tonic spiking, bursting, post-inhibitory rebound, plateau potentials). At the synaptic level there is estimated to be in excess of 200 transmitter substances, each of which can differ in the mechanisms of their release and their effects. The independent or co-release of these transmitter substances can also result in interactive effects that cannot be predicted from knowledge of their individual effects in isolation.

This module provides a basis from which you can investigate various aspects of cellular and synaptic function. The lectures will cover voltage-dependent ion channels, oligodendrocytes and glial cells, ionotropic transmitter receptors including NMDA and AMPA-type glutamate receptors, Cys-loop receptors (e.g. nicotinic acetylcholine), G protein-coupled receptors, the influence of pH on neuronal function, the role of calcium in synaptic transmission and plasticity, and mechanisms of transmitter release and activity-dependent and neuromodulator-evoked plasticity. A knowledge of these effects is essential to understanding how signals are processed by the nervous system, and will provide insight that can cross over to other neuroscience modules.

### ✓ **PNB Module 6: Sensory Transduction (PDN N4)**

Mon 12, Wed 10am, Thur 10am

Anatomy Lecture Theatre, Department of PDN

Module organiser: Dr Hugh Matthews ([hmr1@cam.ac.uk](mailto:hmr1@cam.ac.uk))

The process of transduction within individual sensory receptors has consequences for, and imposes limits on, the perception of sensory events. Considerable advances have been made in recent years in elucidating the means by which primary sensory stimuli are transduced and processed. The module begins by examining the molecular mechanisms which enable vertebrate photoreceptors to respond with incredible sensitivity to individual photons of light, yet which also allow the cells to recover rapidly and to respond effectively at high light intensities. This will be followed by consideration of invertebrate phototransduction, which will include the ever-more-widespread roles of TRP channels which were originally discovered in this system. The modality then shifts to the chemical senses, to discuss transduction and coding in olfactory receptors, which share some fascinating features in common with phototransduction, as well as exhibiting some marked differences. The analysis of these chemosensory signals in the olfactory bulb is then explored. The focus then switches to mechanotransduction, especially the encoding of auditory information in both vertebrate and invertebrate species. These special senses will be contrasted with the molecular and cellular mechanisms responsible for the transduction of pain.

### ✓ **PNB Module 7: Neural Circuits and Behaviour (PDN N7)**

Tue, Wed, Fri 11am

Bryan Matthews Seminar Room, Department of PDN

Module organiser: Dr David Parker ([djp27@cam.ac.uk](mailto:djp27@cam.ac.uk))

Maximum of 40 students

Connections between groups of neurons form circuits that generate specific outputs. These outputs have traditionally been related to the properties of the component cells and synapses, but there is growing awareness that other aspects could contribute, including glial cells and extracellular signals. These circuits form the middle ground in approaches to understanding the nervous system: they assemble the molecular and cellular components needed to process sensory inputs, perform cognitive functions, and pattern motor outputs. Insight into the organisation and function of these networks is essential to understanding nervous system function and behaviour. Gaining this understanding is considered to be the major problem facing neuroscience today, as evidenced by the major funding initiatives currently supporting research into this area (the EU Human Brain Project, and the BRAIN initiative in the United States).

This module will examine the principles of neural circuit function. It will use invertebrate, lower vertebrate, and mammalian model systems (cerebellum, hippocampus, and cortex) to illustrate the general principles of circuit function and our current understanding. The module will also introduce the molecular, anatomical, electrophysiological, imaging, and computational techniques used in network analyses.

The central role of neuronal networks means that this module provides general links to other modules that focus on molecular and cellular mechanisms (e.g. how do these properties influence higher functions?), or higher-level aspects of sensory, motor, or cognitive functions (e.g. what mechanisms underlie these effects?).

### **Lent Term Modules:**

### ✓ **PNB Module 8: Memory (Psychology)**

Mon, Tues, Fri 10am

Plant Sciences Lecture Theatre

Module organisers: Prof Jon Simons ([jss30@cam.ac.uk](mailto:jss30@cam.ac.uk)), Dr Amy Milton ([alm46@cam.ac.uk](mailto:alm46@cam.ac.uk)), Dr Paul Bays ([pmb20@cam.ac.uk](mailto:pmb20@cam.ac.uk))

Students will take the three lecture blocks below.

**Computational approaches to Cognition (Dr Paul Bays):** These lectures address the cognitive operations the brain must carry out in order to extract information from the senses, maintain it in memory, evaluate evidence to decide on actions, and send signals to the motor system to carry them out. A central challenge for the brain is randomness, both in the form of unpredictability in the external world and “noise” that corrupts signals in the neural system. Crucial insights have come from considering optimal strategies to cope with this randomness: What is the best way to use ambiguous sensory input to interpret one’s surroundings? How can we make good decisions based on incomplete and unreliable evidence? How should we control our bodies’ imperfect muscular system to best achieve movement goals? Once optimal rules have been identified, we will discuss how neurons might encode the information and carry out the computations needed to implement them. The lectures will cover some basic elements of probability theory that are important for the computational approach, but will not assume previous mathematical knowledge.

### Recommended Reading

A good textbook for reading around this subject is:

O’Reilly, Randall C., and Yuko Munakata. *Computational explorations in cognitive neuroscience: Understanding the mind by simulating the brain*. MIT press, 2000.

**Synaptic Plasticity, Engrams and Memory (Dr Amy Milton):** These lectures consider memory at multiple levels of analysis, with a strong emphasis on cellular-level and circuit-level mechanisms informed by studying memory in animals. We will consider the insights that can be gained by studying memory using cutting-edge techniques in animal models and how these complement studies in humans, before presenting the leading theories of how memories are stored and represented within the brain at the cellular-level. We will discuss how different types of memory are supported by different memory networks and neural structures, and how these may change over extended periods of time through systems-level consolidation. Finally, we will conclude by considering how our understanding of memory can be leveraged to enhance or disrupt memory in neurological and mental health disorders.

This course will be most readily accessible to those who have previously studied NST 1b Neurobiology or MVST 1b Neurobiology and Human/Animal Behaviour. For those who have not, we recommend the preparatory reading suggested below.

### Recommended Reading:

#### Preparatory reading:

Purves et al. (2001) *Neuroscience*, 2nd ed. Sunderland (MA): Sinauer Associates.

Chapters 2-8. **OR** Purves et al. (2004) *Neuroscience*, 3rd ed. Sunderland (MA): Sinauer Associates. Chapters 2-7.

#### Textbooks and background reading:

Kandel, E.R. (2007). *In search of memory: The emergence of a new science of mind*. New York: W.W. Norton.

Ward, J. (2010). *The student's guide to cognitive neuroscience* (2nd ed.). Hove: Psychology Press.

Gazzaniga, M.S., Ivry, R.B., & Mangun, G.R. (2013). *Cognitive neuroscience: The biology of the mind* (4th ed.). New York: W.W. Norton and Company.

Gazzaniga, M.S. (2014). *The cognitive neurosciences* (5th ed.). Cambridge, Mass.: MIT Press (more advanced than Gazzaniga, Ivry & Mangun).

Kandel, E.R., et al. (2013). *Principles of neural science* (5th ed.). New York: McGraw-Hill.

Squire, L.R., et al. (Eds.). (2012). *Fundamental neuroscience* (4th ed.). Amsterdam: Elsevier.

### **Articles:**

Vervliet, B. and Raes, F. (2013) Criteria of validity in experimental psychopathology: application to models of anxiety and depression. *Psychological Medicine* 43: 2241-2244.

Belzung, C. and Lemoine, M. (2011) Criteria of validity for animal models of psychiatric disorders: focus on anxiety disorders and depression. *Biology of mood and anxiety disorders* 1: 9.

Schmidt, M.V. (2011) Animal models for depression and the mismatch hypothesis of disease. *Psychoneuroendocrinology* 36: 330-338.

Steimer, T. (2011) Animal models of anxiety disorders in rats and mice: some conceptual issues. *Dialogues in Clinical Neuroscience* 13(4): 495-506.

### **Human Memory: Cognitive, Neural and Clinical Perspectives (Prof Jon Simons):**

This set of lectures will consider evidence relating to a number of theoretical distinctions that have been proposed within human memory, focusing in particular on long-term episodic and semantic memory. In each case, evidence from a variety of sources will be discussed, including cognitive experiments involving healthy individuals, neuropsychological studies of patients with brain lesions, and functional neuroimaging investigations. The objective will be to achieve an understanding of the cognitive and neural mechanisms responsible for different aspects of remembering. We will also consider human memory from a clinical perspective: how well do the patterns of difficulties and strengths exhibited by patients in the memory clinic map onto the theoretical distinctions described? How do models of memory inform assessments and help make diagnoses, and can we try to help people to cope with their memory difficulties?

### **Main Readings:**

Baddeley, A. (1997). *Human Memory: Theory & Practice*. Psychology Press.

Eysenck, M. & Keane, M. (2015). *Cognitive Psychology: A Student's Handbook*. Psychology Press.

Hodges, J. R. (2007). *Cognitive Assessment for Clinicians*. Oxford University Press.

Ward, J. (2015). *The Student's Guide to Cognitive Neuroscience*. Psychology Press.

### **✓ PNB Module 9: Neural Degeneration and Regeneration (PDN N5)**

Mon, Wed, Thur 9am

Plant Sciences Lecture Theatre

Module organiser: Prof. Jenny Morton ([ajm41@cam.ac.uk](mailto:ajm41@cam.ac.uk))

Many diseases and injuries of the human brain and spinal cord are tragically resistant to treatment. This lecture module investigates the cellular and molecular causes of these

conditions, the reasons why regeneration does not take place, and the research now under way to permit regeneration therapies in the future. We first consider how neural damage occurs due to acute ischaemic injury (stroke), a complex process that has implications for other forms of neural degeneration. We then look at chronic neurodegenerative diseases, including Alzheimer's, Huntington's and Pick's diseases, examining their origins in genetic and/or biochemical anomalies. Progress has also been made recently in revealing the molecular genetics underlying some forms of intellectual disability, including autistic spectrum diseases, and this topic is covered next. A subsequent course covers the rapidly developing field of neural stem cells, considering both the presence of stem cells able to generate new neurons in some parts of the adult brain, and the potential of stem cells from other sources. Serious lifelong disability can be caused by an injury that interrupts axon pathways, most prominently spinal cord injury. We look at the physiological and clinical aspects, why axon regeneration fails to occur, and how re-wiring can be promoted experimentally. Returning to neurodegenerative diseases, we look at the possibility of treatment by cellular grafting or other novel approaches, particularly in Parkinson's and Huntington's diseases. Glial cells are also vital, and are the focus of demyelinating diseases such as multiple sclerosis; so finally, we look at the degeneration and possible regeneration of glial cells.

The lecturers will all discuss research which could lead to new therapies, including development of molecular inhibitors, gene therapy, neural grafting, stem cells, and remyelination. This course is mostly given by researchers from the Clinical School, Vet School, Brain Repair Centre, and Stem Cell Institute.

✓ **PNB Module 10: Central Mechanisms of Reward, Punishment and Emotion (PDN N6)**

Mon 12pm, Tues 11am, Thurs 10am

Hodgkin Huxley Seminar Room, Department of PDN

Module organiser: Prof. Angela Roberts ([acr4@cam.ac.uk](mailto:acr4@cam.ac.uk))

Maximum of 80 students

How does the brain process reward and punishment and how does this help us understand emotions and their dysregulation? Wolfram Schultz will discuss the varied functions of reward including learning, approach, positive emotion and economic decision making and how these functions are instantiated in neural circuits including dopamine, the striatum, amygdala, orbitofrontal and lateral prefrontal cortex. Further discussion on positive emotion by Jane Garrison will include the concept of anhedonia and the pathological mechanisms underlying a loss of pleasure. Fabian Grabenhorst will then consider whether this same reward circuitry underlies social behaviour and social cognition. Following on from this, Angela Roberts will describe the limbic and cortical mechanisms by which punishing stimuli impact on our motivations and emotions and inform our decision making. The range of strategies at our disposal for regulating our negative emotions will also be considered and how those strategies are implemented within interacting brain circuits. How, when and why these circuits become dysregulated in psychiatric disorders will be discussed by Hannah Clarke and the importance of understanding body-brain interactions in health and psychiatric disease considered by Golam Khandaker. Finally, Fionnuala Murphy will explore the interplay between cognition and emotion. By the end of the course you should have a better sense of one of the most exciting and active areas of brain research in this decade, that is at the heart of what the brain is all about.

## ✓ PNB Module 11: Neuronal Plasticity, Modulation and Behaviour (PDN N9)

Mon 11am, Wed 10am, Fri 9am  
Bryan Matthews Seminar Room, Department of PDN  
Module organiser: Dr Sue Jones ([sj251@cam.ac.uk](mailto:sj251@cam.ac.uk))  
Maximum of 40 students

A fascinating feature of the nervous system is neuronal plasticity: the ability for neurons and their connections to be modified in response to an ever-changing external or internal environment. Alongside neuronal plasticity, the modulatory effects of neurochemicals provide additional flexibility in the response repertoire of neurons. In the mature mammalian brain, neuronal plasticity and modulation enables complex neural networks to remain dynamic and adaptive.

Two key questions in modern neuroscience are: what are the mechanisms of neuronal plasticity, and how do neuronal plasticity and modulation contribute to behaviour? This module will focus on the second question, and will explore examples of plasticity and modulation in defined neuronal systems, ranging from endocrine modulation of hypothalamic circuits in the context of sexual maturation and behaviour, to the plasticity of neurons in brain reward pathways and how this is hijacked by drugs of abuse, and the developmental plasticity of cortical networks, with reference to developmental disorders. Contemporary as well as traditional research methods for investigating neuronal plasticity and modulation will be considered, including opto- and chemogenetic approaches, imaging and electrophysiology. As part of this module, students will work in small groups to prepare a short critical review and a powerpoint presentation of a research paper.

This module would work very well in combination with any of Modules N2, N4, N6 and N7, although none are essential. The first lecture will include an introduction to different forms of cellular and synaptic plasticity and modulation.

## ✓ PNB Module 12: Evolution and Behaviour: Populations and Societies (Zoology ZL3)

Mon, Wed, Thurs 4pm  
Part II Lecture Theatre, Department of Zoology  
Module Organiser: Professor Rufus Johnstone ([raj1003@cam.ac.uk](mailto:raj1003@cam.ac.uk))

**Please note:** it will not be possible to take a project associated with this module

This course aims to provide a functional interpretation of variation in animal life histories and social behaviour. The underlying theme is that individuals will behave in ways that promote their genetic contribution to future generations. The ways in which they do so are constrained by their ecology and by social interactions with members of their own and other species.

Lecture blocks deal with communication, family life, group living and collective behaviour, individual personalities, coevolution (from mutualism to parasitism) and selfish genes.

### Recommended Reading:

Danchin, E., Giraldeau, L.-A. & Cezilly, F. (2007) Behavioural ecology.  
Davies, NB, Krebs, JR and West, SA (2012) An Introduction to Behavioural Ecology (4th Edn.) Wiley-Blackwell  
Dawkins, R. (1976/1989) 'The selfish gene', O.U.P.  
Krebs, J.R. & Davies, N.B., eds. (1997). 'Behavioural ecology: an evolutionary approach'. Blackwell Scientific Publications. (more detailed chapters on specific topics)  
Maynard Smith, J. (1982). Evolution and the theory of games. Cambridge, UK: Cambridge University Press.

Williams, G.C. (1966). *Adaptation and Natural Selection: A Critique of some Current Evolutionary Thought*. Princeton, N.J.: Princeton University Press.

**Essential reading for students NOT from NST (e.g. vets and medics):**

Chapters 1-3 in Davies, NB, Krebs, JR and West, SA (2012) *An Introduction to Behavioural Ecology* (4th Edn.) Wiley-Blackwell

**Lecture times.**

Lecture times are available on the University online timetable - [www.timetable.cam.ac.uk](http://www.timetable.cam.ac.uk). You will be notified by e-mail of any timetable changes. **Please address timetable queries to the relevant module organiser.**

**Handouts and Slides.**

Wherever possible, lecturers' slides and handouts will be placed on the Part II PNB Moodle websites. You will be able to access these using your Raven password.

## **PNB-SPECIFIC WORKSHOPS**

Besides your lectures and supervisions, you will benefit from PNB-specific workshops on paper reading and essay writing. These 2-hour long workshops aim to help you acquire better skills in efficiently reading scientific publications and writing essays. They are a unique opportunity for you to hone these skills that will prove very helpful for your research projects and dissertations as well as for the exam. They will be carried out as follows:

**PNB Journal Club – Dr David Belin**

Fridays 12.30-14.00

Nick Mackintosh Room: 11, 25 Oct 2019; 8, 15, 22, 29 Nov 2019; 17, 24, 31 Jan 2020; 7, 14, 21, 28 Feb 2020, 6 Mar 2020

**Craik Marshall Seminar Room: 18 Oct, 1 Nov 2019**

**Essay Writing and Critical Thinking (two sessions, each for the whole cohort)**

Session 1: 15 Oct 2019, 13.00-15.00, Hodgkin Huxley Seminar Room – Dr David Parker

Session 2: 15 Oct 2019, 16.00-18.00, Hodgkin Huxley Seminar Room – Dr David Parker

**Statistical Design and Testing (half the cohort in each session)**

Session 1: 17 Oct 2019, 11.00-13.00, Nick Mackintosh Room – Dr David Belin

Session 2: 18 Oct 2019, 13.30-15.30, Nick Mackintosh Room – Dr David Belin

**How to read a paper (half the cohort in each session)**

Session 1: 17 Oct 2019, 16.00-18.00, Nick Mackintosh Room – Dr David Belin

Session 2: 22 Oct 2019, 16.00-18.00, Nick Mackintosh Room – Dr David Belin

# LECTURE TIMETABLES 2019-2020

## MICHAELMAS TERM

	9-10	10-11	11-12	12-1	2-3	3-4
<b>Monday Michaelmas</b>	<b>PNB 4</b> Developmental Neurobiology	<b>PNB 5</b> Molecular and Cellular Neuroscience	<b>PNB 1</b> Motivation and Emotion Regulation	<b>PNB 6</b> Sensory Transduction	<b>PNB 2</b> Evolution and Behaviour: Genes & Individuals	<b>PNB 3</b> Neuroethology
<b>Tuesday Michaelmas</b>			<b>PNB 7</b> Neural Circuits	<b>PNB 1</b> Motivation and Emotion Regulation		
<b>Wednesday Michaelmas</b>	<b>PNB 5</b> Molecular and Cellular Neuroscience	<b>PNB 6</b> Sensory Transduction	<b>PNB 7</b> Neural Circuits	<b>PNB 1</b> Motivation and Emotion Regulation	<b>PNB 2</b> Evolution and Behaviour: Genes & Individuals	<b>PNB 3</b> Neuroethology
<b>Thursday Michaelmas</b>	<b>PNB 4</b> Developmental Neurobiology	<b>PNB 6</b> Sensory Transduction				
<b>Friday Michaelmas</b>	<b>PNB 5</b> Molecular and Cellular Neuroscience	<b>PNB 4</b> Developmental Neurobiology	<b>PNB 7</b> Neural Circuits		<b>PNB 2</b> Evolution and Behaviour: G&I <b>PNB 6</b> <i>Sensory Transduction some workshops</i>	<b>PNB 3</b> Neuroethology <b>PNB 6</b> <i>Sensory Transduction some workshops</i>

## LENT TERM

	9-10	10-11	11-12	12-1		2-3	3-4	4-5
<b>Monday Lent</b>	<b>PNB 9</b> Neural Degen/Regen	<b>PNB 8</b> Memory	<b>PNB 11</b> Neuronal Plasticity	<b>PNB 10</b> Central Mechanisms				<b>PNB 12</b> Evolution and Behaviour: Populations & Societies
<b>Tuesday Lent</b>		<b>PNB 8</b> Memory	<b>PNB 10</b> Central Mechanisms					
<b>Wednesday Lent</b>	<b>PNB 9</b> Neural Degen/Regen	<b>PNB 11</b> Neuronal Plasticity						<b>PNB 12</b> Evolution and Behaviour: Populations & Societies
<b>Thursday Lent</b>	<b>PNB 9</b> Neural Degen/Regen	<b>PNB 10</b> Central Mechanisms						<b>PNB 12</b> Evolution and Behaviour: Populations & Societies
<b>Friday Lent</b>	<b>PNB 11</b> Neuronal Plasticity	<b>PNB 8</b> Memory						

# RESEARCH PROJECTS

## Organisation

Project will be allocated by the beginning of Michaelmas Term, with every attempt being made to meet the wishes that you express.

## During the project

**Note:** Although your day-to-day supervisor in the lab may be a PhD student or a postdoc, your actual supervisor is the academic staff member/head of the lab. All references to "supervisor" mean the lab head, not your day-to-day lab supervisor (where these are different people).

On being allocated a project, you should arrange to meet your supervisor so that you are in a position to start collecting data as soon as possible.

Your supervisor will help you formulate the plan of experiments and arrange for you to be trained in techniques and in working safely. The research project is expected to occupy you for anywhere between 120-180 hours altogether. This is a very rough guideline and students can exceed it, but should not be put under pressure to do so.

Your supervisor will also give you advice on writing up, but of course the actual writing must be your own. The supervisor will read and comment on one full draft of the report; the final version will be your responsibility.

You should also use the opportunity of the PNB symposium, which will take place on the last day of Lent term (**Monday 2 March**) to receive informal feedback from the neuroscience community. Thus, during the PNB symposium you will present a poster of your project or dissertation (hypothesis, experimental design, methods, and results) to your peers and the general neuroscience community. This will not only offer you a unique opportunity to learn how to prepare a poster presentation and share your data in a conference-like setting.

If you have a problem during your project that cannot be resolved with your supervisor (for instance, if you feel you are expected to spend unreasonably long hours on the project), don't hesitate to discuss it with the course co-ordinator.

We recommend that you read the following papers before starting your project:

Cumming, G., Fidler, F., Vaux, D.L., 2007. Error bars in experimental biology. *J. Cell Biol.* 177, 7-11.

Vaux, D.L., Fidler, F., Cumming, G., 2012. Replicates and repeats - what is the difference and is it significant? A brief discussion of statistics and experimental design. *EMBO Rep.* 13, 291-296.

Lazic, S.E., 2010. The problem of pseudoreplication in neuroscientific studies: is it affecting your analysis? *BMC Neurosci.* 11, 5.

## Guidelines on writing up your project

Your project will be judged on the report. You will not be penalised if, for reasons beyond your control, the project fails to produce clear (or any) results. Roughly equal weight will be given to the Introduction, Results and Discussion. The examiners may also take note of your supervisor's opinion of your performance.

**Format:** Your report should be no longer than 8,000 words (excluding the 500 word abstract, figures, figure legends bibliography and appendices: you must give the word count on the title page). It should be written in the style of a scientific paper. The detailed format is up to you as long as it conforms to the style of a typical research paper.

However, we suggest you use the following features:

2.5 cm margins, Arial 12 font, 1.5 line spacing, APA reference style. Of course, these are only recommendations and there are no specific restrictions on line spacing, column format etc,

however, please ensure that figure labels are clearly legible. Students in the past have had last-minute printing problems with reports prepared in 2 columns: we strongly recommend using a single column format (as in this handbook).

- **Please do not use font size smaller than 12 in your write-up.**

You are strongly advised to look at journals dealing with similar material (e.g. *Journal of Cognitive Neuroscience*, *Neuron*, etc.).

Research journals typically have a similar layout, as follows:

- **Title.**
- **Summary.** This should be not more than 500 words. Give a concise summary of the main results.
- **Introduction.** Explain the significance and underlying interest of the questions you asked and relate them to the published literature.
- **Materials and Methods.** Describe the techniques you have used.
- **Results.** This section is often easier to write (and read!) if you arrange the results in a logical sequence to show how each set of experiments or observations leads to the next set. Divide the text up into sections, each with its own sub-heading. Refer to summaries of the data in the form of numbered Tables and Figures, each of which should have explanatory legends which enable readers to understand them without detailed reference to the text. When preparing your Figures, we recommend that you consult standard guidelines on image manipulation, such as [those from Nature](#). Ask your supervisor (lab head) for advice if you are unsure how to present your data. Statistical analysis can often be given in the legends or in the tables. Do not provide huge amounts of raw data in the tables - these should be summaries of the analysis which provide quantitative data to test your ideas. If necessary the raw data can be provided in an Appendix. Do not be afraid to include details of experiments which produced negative or inconclusive results.
- **Discussion.** This gives you the opportunity to discuss the interpretation of your results with reference to the scientific literature, and to suggest ideas for further work or "what might have been" if you'd had more time, more animals, more cells etc.
- **References.** Use a consistent style of citation. Any standard journal format is acceptable, but preferably cite references in the text in the form: Smith (1983), Bloggs et al. (1992) - rather than using numbers. Though you will not be penalised for this, it is easier for the reader (in particular the examiner!) to follow.
- **Acknowledgements.** You must acknowledge any significant contribution made by others, particularly whether materials were provided or any procedures done by others - including your supervisor and any collaborators or co-workers. In particular each figure legend should contain an acknowledgment. For most or all figures this should be "This figure was produced by the candidate", or in some cases by 2 students jointly, or by the candidate and supervisor. But it may be someone else in the lab, or a published work. **Never include your initials in figure legends or figure titles.**

Below is a list of key points that an examiner may look for in a project write-up (you should not expect a model outline for this, the approach can depend on the type of project and method you have followed).

- (i) Your Introduction should give a clear description of the background to your project, including its potential relevance: why is it interesting and important?

- (ii) The Methods need to be clearly and properly explained. Could someone repeat what you have done by reading your Methods section?
- (iii) Consider how well the data are presented in the Results. For example, are the figures clear and informative, are they properly described (the format will depend on the specifics of the data, graphs, images, electrophysiological traces etc....), and do they properly represent the effect you are claiming. The use of quantification and statistics also needs to be appropriate, but this will again depend on the nature of your project.
- (iv) The Discussion needs to place the results into perspective, for example by relating them to the background in your Introduction. You also need to consider caveats to your methods, results, and conclusions. An important consideration here that shows you have understood your project is to consider how you could do things differently to address obvious caveats, as well as future work that could build on what you have done.

Supervisors will be available for you to discuss **your ideas** about the structure and content of your project report before you write it up and provide guidance where needed. The format should be roughly that of a typical research paper in Psychology or Neuroscience. The supervisor is permitted to read and comment on only **one draft** of the project. Students are discouraged from soliciting advice on their drafts from other individuals.

## Project submission:

You must submit **two bound hard copies** to the Part II Teaching Office, PDN, and an **electronic version** via *Assignments* on the main PNB Moodle site (see below for details), by the **deadline of 2.30pm on 24 April 2019 (the first Friday of Full Easter Term)**. This deadline must be strictly observed. Marks may be deducted for late submission.

**Hard copies:** these must be bound, each with a title page which includes the title of the project, **your candidate number**, the supervisor's name, the date and a word count (**ensure you leave enough time before the deadline for this, for example to allow for last minute glitches with printing etc...**). Reports should be handed in to the Part II Office, PDN. **Please make sure your candidate number is never apparent on any pictures you may take when submitting your project report. Candidate numbers are to remain absolutely confidential and you should not share them, even on social media.** You should obtain your candidate number from your college.

**You must also include a cover sheet (that will be available on Moodle in due course) and a signed statement separate from the report that it is your own work**, unaided except as may be specified in the statement, and that it does not contain material that has already been used to any substantial extent for a comparable purpose; if two or more candidates have undertaken work in collaboration, they will each be required to indicate the extent of their contribution.

**Electronic version:** You must submit a **PDF version** that is the exact match to the hard copies and the **final electronic version** (all tracked changes accepted; all comments deleted!), in Microsoft Word\*, via *Assignments* on the main PNB Moodle site. The electronic copy may be used to verify the word count and will be scanned with software for detection of plagiarism (the file size limit for the Word submission is 20MB as this is the Turnitin restriction. If your file size exceeds this, try removing the images).

*\*If you do not use Microsoft Word, your application should offer the choice of "Save As: .rtf or .txt". This will be sufficient to confirm the word count and check for plagiarism.*

## Plagiarism

The following advice is relevant for students taking single-subject PNB **and** students taking BBS PNB.

***As in all examinations, plagiarism is not acceptable.***

Students are responsible for ensuring they have read and understood both the University's Statement on Plagiarism, and the [Faculty of Biology Plagiarism Guidance](#).

The Faculty of Biology uses Turnitin UK to screen student work. Screening is carried out via blanket screening of all work in Moodle. All work screened will be reviewed by the Academic Integrity Officer to determine whether further action may be necessary. Use of Turnitin UK complies with UK Copyright and Data Protection Laws. Submission to Turnitin does not affect your ownership of the work; the copyright and intellectual property of all work remains with the original owner (normally the student, with the exception of some sponsored research projects). No personal or sensitive data will be transmitted. Work screened by Turnitin UK will be retained in the Turnitin database for comparison with future submissions; if matches are identified, the full text is not accessible to other institutions, only the matching text. You may request that your work is removed from the Turnitin UK database at the conclusion of the examination process, but this must be done separately for each piece of submitted work. Retaining your work on the database will help to ensure that your work remains protected from future attempts to plagiarise it, will help maintain the integrity of the University's qualifications, and will maximise the effectiveness of the software.

Full details about Turnitin UK and your rights and responsibilities can be found on the University's website, <http://www.admin.cam.ac.uk/univ/plagiarism/>. Queries about plagiarism or the Faculty's use of Turnitin UK should be addressed in the first instance to your Director of Studies or College Tutor.

Your dissertation will automatically be submitted to Turnitin UK at the time of submission. Note that Turnitin will always find some level of similarity to text in the database; 10% similarity is common and is generally not a problem. Problems areas to look out for are unattributed whole sentences or paragraphs. Full details will be given in the General Module session on Writing your Dissertation. The Departmental Turnitin Policy is available on the Part II Moodle site.

The golden rule for avoiding plagiarism is: **NEVER COPY TEXT** (unless you actually want to give a direct quotation, in which case the copied text must be in quotation marks, as well as giving the source). Instead, make the point in your own words, as well as giving the source of your information. A good source of information on plagiarism, and how to avoid it, can be found here: [https://writing.wisc.edu/Handbook/QPA\\_plagiarism.html](https://writing.wisc.edu/Handbook/QPA_plagiarism.html)

In general, plagiarism can be defined as: **The unacknowledged use of the work of others as if this were your own original work.**

In the context of an examination, this amounts to: **Passing off the work of others as your own to gain unfair advantage.**

Such use of unfair means will not be tolerated by the University; if detected, the penalty may be severe and may lead to disciplinary proceedings being taken against you.

### **The scope of plagiarism**

Plagiarism is defined as submitting as one's own work, irrespective of intent to deceive, that which derives in part or in its entirety from the work of others without due acknowledgement. It is both poor scholarship and a breach of academic integrity.

Examples of plagiarism include **copying** (using another person's language and/or ideas as if they are a candidate's own), by:

- **quoting verbatim** another person's work without due acknowledgement of the source;
- **paraphrasing** another person's work by changing some of the words, or the order of the words, without due acknowledgement of the source;
- **using ideas** taken from someone else without reference to the originator;
- **cutting and pasting** from the Internet to make a pastiche of online sources;
- **submitting someone else's work** as part of a candidate's own without identifying clearly who did the work. For example, buying or commissioning work via professional agencies such as 'essay banks' or 'paper mills', or not attributing research contributed by others to a joint project.

Plagiarism might also arise from **colluding** with another person, including another candidate, other than as permitted for joint project work (i.e. where collaboration is concealed or has been forbidden). A candidate should include a general acknowledgement where he or she has received substantial help, for example with the language and style of a piece of written work. Plagiarism can occur in respect to all types of sources and media:

- text, illustrations, musical quotations, mathematical derivations, computer code, etc;
- material downloaded from websites or drawn from manuscripts or other media;
- published and unpublished material, including lecture handouts and other students' work.

Acceptable means of acknowledging the work of others (by referencing, in footnotes, or otherwise) vary according to the subject matter and mode of assessment. Faculties or Departments should issue written guidance on the relevant scholarly conventions for submitted work, and also make it clear to candidates what level of acknowledgement might be expected in written examinations. Candidates are required to familiarize themselves with this guidance, to follow it in all work submitted for assessment, and may be required to sign a declaration to that effect. If a candidate has any outstanding queries, clarification should be sought from her or his Director of Studies, Course Director or Supervisor as appropriate.

Failure to conform to the expected standards of scholarship (e.g. by not referencing sources) in examinations may affect the mark given to the candidate's work. In addition, suspected cases of the use of unfair means (of which plagiarism is one form) will be investigated and may be brought to one of the University's Courts. The Courts have wide powers to discipline those found guilty of using unfair means in an examination, including depriving such persons of membership of the University, and deprivation of a degree.

# EXAMINATION MATTERS

## Overview

Students reading Part II PNB and BBS PNB take four papers and a research project.

### ✓ Written Papers

There will be one written paper per Module. Each paper will draw questions from the lectures within the module and most written papers require candidates to answer three questions on each paper.

### ✓ Research Projects

Students taking Part II Psychology, Neuroscience and Behaviour must submit three copies of an independent report on their project. The project report will contribute roughly twice that of each written paper to the total mark.

### ✓ BBS Dissertations

Part II BBS candidates will not offer a project. The dissertation is an intrinsic component of their exams and can be offered either within Part II Psychology, Neuroscience and Behaviour or within their minor subject.

### ✓ Allocation of marks

Written Papers 64% (16% per Paper); Research project 36%

## Written examination

Each Module provides a separate 3-hour written paper. You are required to sit 4 of the total of 11 available. Sample papers will be made available in due course on the Moodle site.

## Research projects

See previous pages for details. The Research Project counts for 36% of the overall examination mark. Each student must submit a write-up on their research project, no longer than 8,000 words, excluding the 500 word abstract, figures, figure legends bibliography and appendices, written in the style of a scientific paper (as discussed previously in this document). **Roughly equal weight will be given to the Introduction, Results and Discussion. You will not be penalised if, for reasons beyond your control, the project fails to produce clear results.**

**You must submit two electronic versions via Assignments on the main PNB Moodle site that will be scanned with Turnitin as well as two hard bound copies to the Part II Office, PDN, by the deadline of 2.30pm on 24 April 2019 (the first Friday of Full Easter Term). Failure to hand your report in on time may lead to deduction of marks.**

The assessment of your dissertation will focus on:

1. the quality of the logical structure of the introduction
2. the presentation of the hypothesis
3. the appropriateness and design of the methods deployed to address the hypothesis
4. the quality and appropriateness of the presentation of the results (NOT THEIR CONTENT: You will not be penalised if, for reasons beyond your control, the project fails to produce clear results. You are not expected to produce a publishable dataset, but instead to demonstrate you have understood the process of refining an hypothesis, design appropriate, flawless experiments, carrying out experiments and discuss the results)
5. the intellectual content of the discussion

The examiners also take note of your supervisor's opinion of your performance

## Some advice about Part II essay questions

Students often ask for general advice about approaching essay questions in the final exams. Although we do not want you to focus on exam technique to the detriment of enjoying your modules, we hope that the following notes will be helpful.

The best answers in Part II exams present not just facts, but evidence that you understand the subject and can think about it. Many questions are not best answered by simply regurgitating a lecture course verbatim: questions instead can be quite general and invite you to present the opinions that you have formed on a topic from the lectures, your reading around the subject, seminars etc.... To produce a considered, comprehensive answer, you may need to select or rearrange information from lectures, perhaps from more than one lecturer and module, make connections between lectures and modules, and include details from papers or book chapters that you have read.

"Not answering the question" is a surprisingly common mistake which will inevitably cost you marks: so read the question carefully and spend time thinking about it before you start writing. An introductory paragraph giving an overview of your answer may help to show that you have a balanced view of the subject (referring to the question, e.g. paraphrasing it, will ensure that you have read it properly and will focus on it in your answer; it is good to return to the title of the question in the final paragraph).

Of course, you get more marks for more detail (if it is relevant and correct); but examiners want to see that you have understood a subject, not just memorised it. They are also happy to read your own thoughts, preferably with rational arguments for them! Examiners like to see evidence that you have read original research papers (and would be especially impressed if these went beyond the lecturer's list of most important ones). You can cite important ones by the principal authors' name(s), and you may be able to give your own assessments of the evidence in some of them. If you describe technical details (e.g. diagrams or equations), remember to explain enough to show that you understand them.

Finally, of course, your handwriting must be legible!

### **A note on the use of citations in essays**

This is an issue that comes up repeatedly. Examiners **do not** count citations to decide on the mark for an exam essay. Citations *are* useful when discussing a specific scientific paper or lending support for an argument you are making or to an argument that someone else has proposed. Citations of course are also a good way of indicating that you have included material from outside of the lecture. If you include a citation, give the author(s) and year in the text (multiple authors can be dealt with using et al, or for a general overview you can say as "xx and colleagues have shown...". If you can't remember a name but remember the concept, then put this in anyway rather than spending a long time trying to remember names or leaving out the detail – you could still get credit for this and the name may come back to you later.

## Criteria applied when marking Part II Tripos answers (Faculty of Biology)

These are the official University's Guidelines on marking answers in Part II Tripos exams, which are available on the [Faculty of Biology's website](#).

### **First:**

Work, which is excellent both in the range and command of the material covered and in the argument and analysis. Work that is excellent in its understanding of the subject; that has engaged closely with the question; that has shown some originality and treated the evidence critically; that brings in relevant material from an appropriate range of sources; and that is well-planned and complete.

A first class mark may be awarded on more than one set of criteria: there may be a great deal of relevant information, displaying substantial knowledge and understanding; the arguments and presentation may be stylish; the approach may be original, critical or unorthodox. An upper first would be an outstanding performance, meeting all, or virtually all, of these criteria. A low first would meet at least some of these criteria.

**Upper Second:** Work that shows a good broad-based knowledge of the topic and the lecture material; that is presented in an organised way; and clearly argued and focused on the set question. Answers at the top end of this class would often include material from outside the taught material and where relevant, from different lecture courses and would include some attempt to treat the evidence critically and to synthesise arguments. Answers at the lower end of this class would be competent, accurate in reproducing lecture material and show evidence of reading of the principal sources of published work on the subject.

**Lower Second:** Work that overall shows a reasonable competence in the understanding and presentation of the relevant material. Answers at the top end of this class would show competent understanding of the basic lecture material or reasonable organisation and focus; an answer at the lower end would show gaps in understanding and coverage together with poor organisation and focus. Certain types of uneven work would fall into this class; detailed factually correct work that did not relate a broad knowledge of the topic to the specific question asked, or work with clear organisation and some insight but with serious omissions of factual knowledge

**Third:** At the upper end of the class work that just shows competent knowledge of the basic, core material. At the lower end of the class, work that shows some knowledge of the material but with serious deficiencies in understanding, coverage and organisation. This will include work that is unduly brief or largely misses the point of the question.

**Fail:** Work that is irrelevant, shows a considerable degree of ignorance or is short and superficial. Where the question is barely attempted.

*For* **Criteria applied when marking Part II Dissertations (Faculty of Biology)** see:

<https://www.biology.cam.ac.uk/undergrads/exams/marketing-part-ii-dissertations/marketing-diss>

## ELECTRONIC RESOURCES

*Part II Psychology, Neuroscience and Behaviour* IT facilities are available in the Department in which you take your project and details can be found in the section “Departmental Resources”.

### Email

Announcements about the course will routinely be made by email. You should check your e-mail at least every morning and evening.

### Moodle

All course material for Part II PNB and the Modules will be available online in the Moodle system. You will each be assigned membership of the main [Part II PNB site](#) plus membership of the sites for your four Modules. You will also be registered to access material for the other Modules as an Observer. You will need to log in using your [Raven password](#).

#### *Moodle functions*

Moodle has a large repertoire of tools to aid the support of teaching and promote online access and collaboration. The most important components will be:

- *resources* to download materials from your lectures
- *assignments* tool for you to submit written materials
- *announcements* to draw your attention to changes
- *Quickmail* you can send e-mails to the group directly from this page. This will be the primary route by which we will contact you, for instance for time-table changes.

#### ***Be sure to check your e-mails or the site frequently.***

Inside Moodle you will see tabs for each of your worksites. These will include:

- **My Workspace:** a personal space where you can store your own files and notes. The schedule here contains the merged schedules of all your Modules as well as general course events.
- **NST Part II PNB:** the main course site. This site will contain links to the Course Handbook. There will be *announcements* from time-to-time - you can even send announcements yourself.
- **NST Part II Subject Modules:** each Module has its own site. This contains a series of resources for each lecture (the lecture handout, and/or the lecturer's Powerpoint slides – not available for every lecturer). There may be announcements specific for that Module, along with its own e-mail archive. Some Module organisers may choose to add other features such as discussions or assignments for problem sessions or journal clubs during the course.

### Online Journals

The University of Cambridge pays for you to have access to most journals online. If you are using a computer in the .cam domain you will have automatic access. Outside the University network (e.g. from home during vacations) you will need your Raven password to log in. Search for both online and printed journals in [iDiscover](#).

The tool bar along the top of the page contains a link to ejournals A-Z where you can search by journal title. If you know the article title it is quicker to search in iDiscover by title. If a simple search doesn't give you the result you need click through to [advanced search](#), located to the right of the search box, and add more search terms and filters.

Simply search for the journal title and if the journal is available online via subscription, the full text coverage for that title is given, along with any 'off campus' login information. If the journal does not appear then it is not available online and you will have to locate a print copy of it in Cambridge (see below).

To access journals from outside the University network (e.g. from home during vacations) just do your search on the A-Z list as usual and when you click on the link for the journal title you will

automatically be prompted for your Raven password. You should only need to enter this once per session. N.B. it is strongly recommended to check the 'off campus' availability of the online journals you think you will need away from Cambridge BEFORE leaving for vacations etc. It will state this next to the title information for a journal on the A-Z list.

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### **Finding printed journals in Cambridge libraries:**

If you need a print copy of a journal, you can find out where it resides in Cambridge from [Library Search](#).

*Library Search* allows you to look for printed books and journals held in all the libraries in the University of Cambridge. To find a journal or book, simply search for it here. If an electronic version of the book or journal is available, you will be able to click on a link that will take you directly to it. If you are searching from 'off campus', you will be prompted for your Raven password.

### **Electronic Databases**

The University subscribes to 866 databases. [The A-Z list is here](#).

[The Department of Psychology Lib Guide](#) provides links to databases most relevant to your studies.

[Science Citation Index Expanded](#) via Web of Science indexes the international journal literature of science, medicine, agriculture, technology and the behavioural sciences. It provides titles and abstracts but not full text. It enables you to search for papers that have references a known paper, which is useful for following up a topic. Dates of coverage 1900 to present. [Video guides are available here](#).

### **MEDLINE/ PUBMED**

Produced by the US National Library of Medicine it provides 27 million citations for biomedical literature from MEDLINE and life science journals.

[Google Scholar](#) You can sign up for email alerts for specific topics of interest by clicking the envelope icon in the sidebar of search results page.

### **Other Useful Libraries:**

The [Libraries Directory](#) contains information about all the other libraries associated with the University.

[University Library](#) (UL)

[Medical Library](#)

[Moore Library](#)

### **Online databases to use for finding and downloading scientific literature:**

See the [eresources@cambridge website](#).

For access to databases such as *Scopus* and the *Web of Science*, that you can use to search for articles written on certain topics by certain authors. Many other useful databases are available via this link.

*LibrarySearch+* covers all content in Library Search and allows you to search the full text of journal articles (Justor, Science Direct etc) as well as the full text of many ebooks, newspaper content, major citation databases (inc. Web of Knowledge), and more, over 200 million records. Access from the [Library Search page](#). Alternatively, here are the links to [Scopus](#) and [WoS](#):

## DEPARTMENTAL FACILITIES

Three departments contribute to the Part II PNB course. You are welcome to use the facilities (e.g. library, tea room) of the Department where you undertake your project. You will also receive key/swipe cards for out of hours access to the Department where you undertake your project. BBS students will be allocated a home Department.

### Department of Psychology

Downing Site.

Departmental academic representative: Dr David Belin ([bdb26@cam.ac.uk](mailto:bdb26@cam.ac.uk))

Departmental administrative contact: Teaching Administrator, Ms Josephine Simmonds ([teaching@psychol.cam.ac.uk](mailto:teaching@psychol.cam.ac.uk)).

Access: University Card-keys (usually only for project students), see either Mr James Glasberg or Mr David Webb, Ground Floor of the Main Building on the Downing Site.

Library: 9.00am-5.00pm Mon-Fri (or 24 hours with University card key). Librarian: Daniele Campello Dos Santos (3)33554 ([library@psychol.cam.ac.uk](mailto:library@psychol.cam.ac.uk)). The Library offers a quiet and comfortable place to work and stocks the reading material recommended in this guide and in lecture hand-outs. Most of the Library's books are available for loan. Books should be borrowed using the self-issue machine or loans register. There is a drop-box for book return. Laptops may be used throughout the Library, which has wireless Internet access. Drinks may be consumed in the Library.

The [Psychology Library website](#) gives further information about the Library and the services it offers, and provides links to teaching resources and to electronic resources.

Photocopying: the Department of Psychology holds a Gold Green Impact award and is committed to reducing its impact on the environment by saving energy and minimizing waste. Please use electronic copies of material wherever possible and avoid the use of paper copying.

You will see throughout the Department a number of recycling bins provided for paper, cardboard, plastic, cans and tins and would encourage all students to use these and to be considerate of switching off lights, reducing waste etc.

Student Computer Room: Computers are available for your use in the Student Computer Room, which is situated next door to the Library. You will be provided with registration details from the Computer Officer (room 105) for an account, which will give you 2Gb file space, will allow you to use the printer and will give you access to a wired Internet connection.

The IBM SPSS statistics package is installed on four of the machines and the R statistics program is installed on the other four. All eight computers also have MATLAB and Microsoft Office. The computers are labelled to indicate which software package is available on each machine. Requests for other packages can be forwarded to the Computer Officer ([computingrequests@psychol.cam.ac.uk](mailto:computingrequests@psychol.cam.ac.uk)).

You must not make copies of software on these machines, nor introduce copies of programs on to them.

Psych Sanctuary: Located next door to the Library, the Student Common Room is a great place to relax. There is a microwave, kettle, fridge and cutlery and crockery for your use. The room also contains machines for hot and cold drinks and snacks. Lockers can be hired for a £10 deposit, refundable on return of the locker key.

### Department of Zoology

New Museums Site.

Departmental Representative: Dr Berthold Hedwig [bh202@cam.ac.uk](mailto:bh202@cam.ac.uk) Departmental administrative contact: Teaching Administrator, Georgina Rutherford, Room F13 ([gr367@cam.ac.uk](mailto:gr367@cam.ac.uk), 01223 336647 [teaching@zoo.cam.ac.uk](mailto:teaching@zoo.cam.ac.uk)).

Departmental Access: Your University Card will give you access to the Department of Zoology including the library and common room. If you have any issues with card access, please contact Emma Francis ([ef384@cam.ac.uk](mailto:ef384@cam.ac.uk))

Library: 1<sup>st</sup> floor, normal opening hours 08.30-17.00 Mon-Thurs, 08.30-16.30 Fri (and Saturdays 09.15-12.30 in full-term).

Librarian: Jane Acred, Tel. 36648. Web site:

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[Zoology Library Website](#), email [library@zoo.cam.ac.uk](mailto:library@zoo.cam.ac.uk). See also the guide to the Balfour Library available on Moodle, inviting you to register your University Card with the Senior Library Assistant so you can borrow books, attend a tour, and credit your printing account.

Printing and Photocopying: In Library during normal opening hours via a multi-function device (MFD). Another MFD is also available 24/7 in Part II Computer Suite, as below. The Zoology Department uses the University Information Services' DS Print service. You can pre-pay for printing online using a debit or credit card. The charges for printing and photocopying are:

A4 black and white sheet (both single and double sided): 5p

A4 Colour sheet (both single and double sided): 30p

Scanning: An A3 flatbed scanner is in the library 24/7. The MFDs can also be used to scan from printed materials into PDF. This service is free. All scans are in colour. Ask library staff for more information.

Tea Room: 2nd floor (above Library) 10.00—11.15am & 2.45—4.15 pm.

*Part II Computer Suite*, 2nd floor. There are computers available for the use of Part II Students (shared with Zoology) which have a range of software installed on them including: IE, Microsoft Office, Corel Draw, Photoshop, Adobe Acrobat Professional, R, Minitab, GenStat. There is a multi-function device for printing, photocopying and scanning (see above).

The **University Wireless Service** is also available throughout a large part of the department, including the Computer Suite, the Library and the Tearoom.

## Department of Physiology, Development & Neuroscience (PDN)

Downing Site.

Departmental Representative: Dr David Parker ([djp27@cam.ac.uk](mailto:djp27@cam.ac.uk)).

Departmental Administrative Contact: **TBC**

Access: Your university swipe card needs to be validated separately for the two buildings: Physiology Building: for library access, and project students: see Reception (33899).

Anatomy Building: only for project students: see principal technician: Phil Garrett (33764)

Library: Physiology C floor. Open all hours. Information about the library can be found on the [PDN website](#). The library is wireless enabled so that you can use your laptops.

### Reference materials provided by lecturers

At the beginning of each year all your lecturers are encouraged to deposit, with the PDN Part II Administrator, a paper copy of any references on their list which might be difficult to obtain in Cambridge. These copies will be kept in a filing cabinet in the Part II Computer Room. They may not be removed from the area as one copy is provided for all to use. In the past this facility has been abused: **At the first sign of this happening again this material will be withdrawn.**

Photocopying: In the entrance to the library. Cards can be purchased from the Physiology Reception: 8p per sheet. It is also possible to scan documents and send them to a USB key or to any University e-mail account, free of charge and without needing a photocopying card  
Tea Room: Physiology Floor C.

## FEEDBACK

As throughout your time in Cambridge, you will be periodically asked to provide feedback on all aspects of the course. This feedback is very important for us to continue to develop the course and is always taken seriously. We will welcome your reaction to the course as a whole, and individual lecturers will do their best to accommodate sensible criticism and suggestions.

**You should feel free to approach any of the module organisers with specific concerns as and when they arise, the course organiser or the teaching administrators.** We will do our best to sort out problems quickly. For any problems with lecture schedules, first contact the module organiser; for any problems with departmental access, first contact the departmental rep. In case of more general problems, feel free to approach your nominated course advisor for advice.

We collect the feedback for each module via Qualtrics. Obviously, we are limited by the amount and quality of the feedback we receive, and opinions based on only a few returns are unlikely to be representative. So please fill out the online forms as soon as possible. The system is simple and fast, and the information you provide is valuable.

In addition, you will elect two representatives who will attend staff-student meetings in the Michaelmas and Lent terms. You should inform them of any concerns you want raised, so that they can represent your views at these meetings