SCHOOL OF SOCIAL SCIENCES

M.Sc. Functional Neuroimaging

Module Outlines

These brief outlines are for general information only and are intended to provide a broad indication of the nature of the course and the type of topics it covers. The actual modules taught in any year are subject to variation. Detailed reading lists with related essay and seminar topics will be available on registration for the course.

Credit Structure: 4 modules of 30 credits each + Dissertation 60 credits.

Attendance: Course commences September/October each year.
Full-time: 2 days a week - Thursday and Friday
Part-time: 1 day a week - 1st year Thursday 2nd year Friday
Approximately 26 weeks attendance required for teaching between October and April.

Duration: Full-time: 1 year. Part-time: 2 years.

Entry criteria: Normally a good Honours degree in Psychology, Neuroscience, Computer Science or other relevant scientific or engineering discipline from a UK institution; an equivalent overseas qualification; or an equivalent professional qualification. Students whose first language is not English must have IELTS of at least 6.5 or equivalent.

Course Convenor: Dr. Adrian Williams

Web Site: www.ccni.co.uk www.brunel.ac.uk/about/acad/sss/postgraduate/psychology

COGNITIVE NEUROSCIENCE

Course Convenor: Prof. David Bunce

Main Aims of the Module:
- To review the neuroimaging literature on major topics within the cognitive neurosciences with emphasis on the research interest of the course participants.
- To investigate neuroimaging techniques, findings and prospects with respect to cognitive science

Main Learning Outcomes:
- Acquire knowledge of the functional anatomy of cognitive and related processes of the human brain.
- Gain an understanding of the techniques used to determine the functional anatomy of cognitive and motor processes.
- Critical analysis and assessment of a wide body of literature on cognitive neuroscience and neuroscience in general in the context of neuroimaging.
- Evaluate and Devise cutting edge research projects in neuroimaging based on their understanding and extrapolation of existing data.
Main Topics of Study:
The module will focus on fundamental issues within cognitive neuroscience, and the way in which neuroimaging in combination with neuropsychology has advanced our understanding. Topics covered will include:

- Learning and Memory
- Language and the Brain
- Cerebral Lateralization and Specialization
- The Control of Action
- Executive Functions and Frontal Lobes
- Emotional Mechanisms
- Aging, Development and Plasticity

Assessment: 2 x 3000 word essays


**VISUAL NEUROSCIENCE**

Course Convenor: Dr. Andrew Parton

Main Aims of the Module:

- Provide students with a detailed insight into the study of visual neuroscience
- Equip students with a strong theoretical understanding of the utility and application of neuroimaging techniques in furthering our understanding of the functioning of the visual brain.
- Expose students to the wide range of research methods and applications expected to be found in the knowledge base of a professional vision scientist.

Main Learning Outcomes:

- Understanding of the functional anatomy of the ‘visual brain’
- Knowledge of the techniques used to determine the functional anatomy of the visual brain with a clear emphasis on Neuroimaging, but with reference to other methods in a historical and comparative context.
- Analyse and assess a wide body of literature on visual neuroscience and neuroscience in general.
- Evaluate the strengths of weaknesses of different Neuroimaging methods in terms of their utility in furthering understanding of visual and other sensory processing in the human brain

Main Topics of Study:
The module will cover core issues in visual neuroscience, covering much of the cross-disciplinary research contributing to this field. Topics will include:

- Visual Pathways
- Visual Motion and the Dorsal Stream
- Biological Motion
- Object recognition and the Ventral Stream
- Face recognition
- Disorders of vision
- Visual Development
- Visual Imagery
- Visual Awareness
- Synaesthesia
- Visual Attention
- Neuroaesthetics
Assessment: 2 x 3000 word essays


PRACTICAL NEUROIMAGING

Convenor: Dr. Justin O’Brien

Main Aims of the Module:
This module provides students with the opportunity to learn how Neuroimaging studies are designed, with reference to the wide range of Neuroimaging methods in use today, and the varied experiments to which they are applied. Students will learn how experimental methods are applied in Neuroimaging, with particular reference to the EEG and fMRI methods with which they can get hands on experience, but also regarding other contemporary methods. A large part of the module is devoted to the analysis of the data obtained in Neuroimaging studies, with worked examples in a variety of imaging modalities, and including data of varied complexity.

Main Learning Outcomes:
- The advantages and disadvantages of different functional neuroimaging techniques
- The design, implementation and analysis of neuroimaging experiments
- A general understanding of what has been discovered about human brain function using Neuroimaging techniques
- Analyse neuroimaging data using various statistical techniques
- Reflect on their analyses and relate them to the structure and function of the human brain
- Critically evaluate different Neuroimaging techniques, in order to understand not only their relative strengths in different application, but also their epistemological implications for neuroscience and psychology.

Main Topics of Study:
- Experimental Design, with particular reference to EEG, PET and fMRI
- Operating an MRI scanner, using Siemens SYNGO software
- Using EEG equipment.
- Data Preprocessing
- Statistical Analysis of functional Neuroimaging datasets
- Analysis of structural MRI data
- Statistical inference
- Data presentation
- Project planning and management
- Safety in Neuroimaging practice
- Ethical issues in neuroimaging

Assessment: 2 x 3000 word essays

PRINCIPLES OF NEUROIMAGING

Convenor: Dr. Adrian Williams

Main Aims of the Module:
- Inform students of the principles of neuroimaging technologies for determining the functional and structural anatomy of the human brain, and how they may be applied to different areas of experimental psychology and neuroscience.
- Introduce students to the physical principles that underlie the signals generated by MRI scanners and their interpretation.
- Teach the principles underlying the operation of other imaging technologies including electroencephalography, magnetoencephalography, positron emission tomography, trans-cranial magnetic stimulation and near infra-red spectroscopy.

Main Learning Outcomes:
- Understand the principles underlying different neuroimaging techniques, particularly MRI.
- In depth knowledge of scanner operating principles and associated safety measures.
- Apply knowledge derived from the module to devise successful MRI experiment paradigms.
- Demonstrate the relationship between measured neuroimaging responses and brain activity.

Main Topics of Study:
- Overview of functional neuroimaging techniques (including MRI, EEG, MEG, PET TMS)
- The course will focus on individual imaging modalities and cover topics such as:
  - Historical perspectives, principles of operation, and safety
  - Signal generation and image formation
  - Neuroimaging signals and brain activity
  - Spatial and temporal properties of signals, and noise.
- Comparisons between neuroimaging techniques
- Combined used of neuroimaging techniques (e.g. simultaneous fMRI and EEG)

The course will be mainly theoretical in nature, although practical examples and demonstrations will be employed where possible.

Assessment: 1 x 3000 word essay 1 x unseen examination (90 minutes; comprising multiple choice questions, and short answer questions)


DISSERTATION IN FUNCTIONAL NEUROIMAGING (Journal Length Article or Dissertation)

Main Aims of the Module:
The dissertation module provides students with the opportunity to demonstrate their ability to integrate conceptual, theoretical and practical issues within their chosen subject. It allows students to undertake in-depth study and investigation of their own functional neuroimaging design in an area relevant to them.

Main Topics of Study:
Students select a relevant research question appropriate to their discipline during the writing of their research proposal. This will typically be (a) an original functional MRI study, (b) an original EEG study, or (c) a novel analysis of existing FMRI and/or EEG data.