LF302-15 Translational Neuroscience

26/27

Department
Life Sciences
Level
Undergraduate Level 3
Module leader
Ian Edwards
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The aim of the module is to introduce the students to the specific aspects of working translationally, to provide an understanding of the main differences between basic and translational (including clinical) neuroscience, and to teach basics of best-practice translational strategies.

The module will aid student preparation for a Y3 and/or subsequent Master project. It complements the content taught in Y3 modules of the Neuroscience degree programme, for instance BS374 (Modern approaches to human disease); and BS362 (Integrative Neuroscience).

The module will also contain two interactive seminars (2.0h each). In the first workshop, we will introduce a paper to them that has clear strengths and weaknesses from a translational point of view. We would discuss the papers content and explain the peer review process. This would take 2.0h (including some time to read the paper beforehand).
For the second workshop, students will be split into groups to work on a reviewer's report on another paper (considering the paper is an unpublished manuscript) until the next workshop. Each group will give a presentation of their suggestions to improve the paper. We will then discuss together. Performance in this part will be assessed based on students participation as well as the quality of the suggestions for paper improvement.

Module aims

This module will cover modern approaches and strategies to transform basic neuroscience findings into novel applications, technologies, therapies and diagnostic approaches. It will provide insight into required steps and challenges related to such transformation. This will be done on exemplary real-world problems and nervous system diseases requiring translational neuroscience solutions or causal therapies.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Introduction

1. History of translational neuroscience and translational pathways
   Brief introduction to the course, historical examples of translational neuroscience, explaining translational pathways from basic to clinical research and public health impact

The translational neuroscience toolbox
2. Neuronal function and electrophysiology
Focus on electrophysiological methods (e.g. Ca2+ imaging, voltage-sensitive dyes) and how they are used to decipher neuronal function in health and disease

1. Advanced in vitro and in vivo models in translational neuroscience
   Focus on cell culture, organoid and animal models of important neurological diseases, explaining advantages and disadvantages of each approach

2. Structural and functional brain imaging
   Focus on the basics of brain imaging technologies (CT, MRI, PET) and what can be investigate with these technologies

3. Optogenetics and their role in basic research and therapeutic applications
   Focus on techniques and applications based on optogenetics including therapeutic intervention and approaches in humans

High quality translational neuroscience research
6. Internal and external study validity
7. An integrated translational pipeline for diagnostic and therapeutic research in Parkinson’s disease

Recent breakthroughs in translational neuroscience
8. Adult neurogenesis and brain plasticity
Focus on the discovery of adult neurogenesis in mammals and its impact for memory formation and brain plasticity, including for therapeutic implications

1. Central nervous system and immune system interactions
   Focus on immune surveillance of the CNS in health and disease, interaction between the

peripheral immune system and the CNS in health and disease

2. The gut-brain axis
   Focus on the gut-brain axis and recent findings how the microbiome affects central nervous system function

3. Novel diagnostics and biomarkers for CNS diseases
   Focus on novel diagnostic tests for CNS disorders and their working principles. Explanation of specificity, sensitivity, and ROC curve analysis.

Therapeutic research in translational neuroscience
12. Advanced drug delivery to the central nervous system
Focus on the blood-brain barrier and ways to overcome it including viral vectors and imaging-based precision approaches

1. Cell replacement and nervous system regeneration
   Focus on cell-based approaches to regenerate the central nervous system including biomaterial-based ones. Discussion of challenges related the approach

2. Pain sensation and pain management
   Focus on how translational neuroscience shaped modern approaches to understand and modulate pain sensation, as well as to develop novel strategies for pain management

Neuroengineering and in silico approaches
15. Computer-brain interfaces and neuroprosthetics
Focus on interdisciplinary work on computer-brain interfaces and areas of application, in particular neuroprosthetics

1. Computational neuroscience
   Focus on computer-based approaches for the simulation of neuronal and brain function

Learning outcomes

By the end of the module, students should be able to:

- Explain contemporary in silico, in vitro and in vivo approaches in translational neuroscience including their respective advantages and disadvantages
- Identify good methodological practice in translational neuroscience approaches and provide suggestions to improve approaches not meeting it
- Explain recent translational neuroscience contributions to the understanding of brain function and system (patho-)biology
- Plan and design experiments investigating specific questions in translational neuroscience, considering an appropriate methodological approach and ethical aspects

Subject specific skills

Students will obtain detailed knowledge on key aspects of translational neuroscience.
Experimental designs are usually more complex in translational settings as they need to consider

real-world aspects (e.g. comorbidities) often neglected in basic science exploratory research. Students will gain the ability to conceptualise, design and manage such advanced experimental setting, to prioritise translationally relevant aspects with respect of the precise research question, and will develop a deeper understanding on critical processes during the advancement of research findings into practical applications. These skills are relevant for employment both in translational research in an academic environment as well as in industrial R&D.

Transferable skills

Most of the content taught, though presented in the specific framework of neuroscience, is valid and relevant also in other areas. For instance, the concepts of internal and external study validity are important in all areas of experimental medicine and biomedical science, and knowledge on those is important for any activity in application-oriented R&D and feeds into transferrable skills such as analytical reasoning, critical thinking, adaptability, and project management. Detailed introduction to cutting-edge models and techniques increases students' technical literacy.

Study

Study time

Type	Required
Lectures	16 sessions of 1 hour (11%)
Other activity	6 hours (4%)
Private study	111 hours 30 minutes (74%)
Assessment	16 hours 30 minutes (11%)
Total	150 hours

Private study description

Students are expected to spend non-timetabled time on self-directed learning, including reading research papers and background material to prepare for the assessments

Other activity description

This is the 2x 3 hour workshop on reviewing neuroscience papers.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D

	Weighting	Study time	Eligible for self-certification
Group presentation	30%	15 hours	No

The students will be asked to provide a peer review-like critique of a paper that will be created as a team activity. There will also be a presentation of the critique and a joint discussion.

Closed-book examination	70%	1 hour 30 minutes	No

In-person locally-timetabled closed-book examination

Students will have to write a mini-essay to answer a specific question of appropriate complexity. Students will have a choice of 1 out of 3 questions. Mini-essays will be typed on a computer in a dedicated space (e.g., ICL suite) in a time-tabled assessment. No access to additional resources (e.g., internet, note-sheets) is granted. Mini-essays do not need to be fully referenced.

Assessment group R2

	Weighting	Study time	Eligible for self-certification
Closed-book examination	100%		No

In-person locally-timetabled closed-book examination.

Students will have to write a mini-essay to answer a specific question of appropriate complexity. Students will have a choice of 1 out of 3 questions. Mini-essays will be typed on a computer in a dedicated space (e.g., ICL suite) in a time-tabled assessment. No access to additional resources (e.g., internet, note-sheets) is granted. Mini-essays do not need to be fully referenced.

Feedback on assessment

Individual written feedback

Past exam papers for LF302

Availability

Courses

This module is Core for:

- Year 3 of ULFA-B140 Undergraduate Neuroscience (BSc)
- Year 3 of ULFA-B142 Undergraduate Neuroscience (MBio)

- Year 3 of ULFA-B143 Undergraduate Neuroscience (with Industrial Placement) (MBio)
- Year 4 of ULFA-B141 Undergraduate Neuroscience (with Placement Year) (BSc)