2016-2017 PS4071: Behavioural Neuroscience
Reward, motivation and adaptive behaviour

Meeting times: 11 AM – 1 PM, Thursdays, Seminar room 1.00
School of Psychology & Neuroscience

Assessment: Continuous assessment 25%; 2-hour examination 75%

Credits: 15

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Office hours: 4-5 PM Mondays or by arrangement

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Please note that in past years there has been a modest correlation between the marks given on the essay and the marks given on the examination. This is because the two forms of assessment measure different aspects of learning. The essay measures how well you analyse a single piece of work and fit it into the existing literature. The examination measures how well you have discovered, read, and understood multiple research articles across a broad topic.

Feedback will be provided on both the continuous assessment and the examination. Individual feedback on the continuous assessment essay will be provided in electronic form (either using the Track changes feature of MS Word, or using ‘text bubbles’ in PDF documents as appropriate). Additionally, generic feedback will be given for both the essay and the examination, in part to guide the external examiners, but also to provide the students with an overview of how well the class performed.

Individual feedback on the examination can be arranged by contacting me, but typically it is counted as summative (more for evaluation purposes than formative purposes).
If you are considering taking the module but are undecided...

How do we learn to change our behaviour in order to obtain reward? This module focuses on the brain systems that determine the actions of people and animals seeking reward. Much of the module will be devoted *reinforcement learning*, which is a basic form of learning in which actions become associated with consequent rewards. However, we will also discuss how organisms look to the future, weighing the risk, costs, and benefits of pursuing a given goal, and this will lead us away from simple learning more complex processes such as motivation, decision-making, selective attention, and social/economic interaction. Much of the material in the module is basic science, but we will apply that basic science to addiction and other disorders of behavioural dysregulation. Inevitably the research we will discuss will touch on the issue of whether addicts and other people who take seemingly self-destructive actions have a choice.

Overview

Behavioural neuroscience is a huge field, with thousands of researchers producing scientific reports each year. Therefore, the purpose of this module is not to make you an expert on all areas of behavioural neuroscience. Instead, we will take three examples of adaptive (and maladaptive) behaviour – reinforcement learning, goal-directed decision-making and addiction – and see how behavioural neuroscientists and psychologists apply various approaches to study them.

Adaptive behaviour is a vital process in most animals and people. It allows flexibility of behaviour in response to changing environmental conditions and physiological needs. Some of the adaptations are due to simple mechanisms, such as motor fatigue or sensory habituation. However, when animals and people learn to adapt their actions to a specific environmental context, *associative learning* is said to occur between the context and the behavioural response. In this module we will explore examples of learning mechanisms that operate during and after associative learning, focusing specifically on instances in which sensory events and actions are followed by reward. This process seems to be largely automatic and is thought to be crucial for the formation of habits. We will also study adaptive behaviour based on goal-directed deliberation in which an organism must weigh the relative risks, costs and benefits of pursuing a given goal. Psychologists have theorised that goal-directed action is based on motivation and a ‘mental map’ of how actions result in rewarding outcomes. At the applied level, we will compare our knowledge of these mechanisms to those of addiction, which can be viewed as a form of pharmacologically induced learning. We will also examine whether the neural mechanisms involved in reward and learning play a role in decision-making in social and economic contexts.
We will approach the question by looking at mechanisms for adaptive behaviour across six different learning situations:

1. classical (Pavlovian) conditioning, in which sensory events are associated with rewards
2. operant (instrumental) conditioning, in which behaviours are reinforced or punished based on their outcomes
3. drug addiction, in which chemicals activate and change the brain circuits involved in operant conditioning
4. acquired ‘compulsive’ behaviours, such as pathological gambling, video game playing, and overeating
5. brain stimulation reward, in which a given behaviour is rewarded by pairing it with stimulation of a specific brain region
6. adaptive decision-making in social and economic contexts

The module can be divided into three sections. The first section will provide a background on the terminology and methods used to study adaptive behaviour. The second section will cover some of the major findings in regard to how the brain learns to obtain reward. In this second section we will spend ~20 minutes in lectures 2-7 discussing a research paper, rather like a journal club. This will give you practice in extracting the essential information from a paper and evaluating its quality. The last section will be comprised of guided debates. Each student will present a summary of a research article and use its data to argue for or against a selected proposition. In order to prepare for this presentation, all students should discuss with me their selection of the relevant paper and the details of the presentation.

**Module aims**

1. To provide basic knowledge required for evaluating research reports in the behavioural neuroscience of adaptive behaviour
2. To give an overview of behavioural, anatomical & physiological methods used to study reinforcement learning
3. To provide exposure to the process of developing formal models of adaptive behaviour
4. To promote an awareness of addictive behaviour from the viewpoint of a behavioural neuroscientist