Standing up to threats: Understanding the neural mechanisms underpinning threat-related changes in balance control

Supervisory team:
Main supervisor: Dr Jennifer Davies (Cardiff University)
Second supervisor: Prof Jonathan Marsden (University of Plymouth)
Prof Kate Button (Cardiff University), Dr Toby Ellmers (Imperial College London)

Host institution: Cardiff University

Project description:
Fear of falling is common, particularly among older individuals and clinical populations, such as people with arthritis, osteoporosis or Parkinson's disease. It is linked to increased physical decline, frailty and deconditioning . Being fearful of falling changes the way that a person controls their balance when they are standing still and when they are moving. Paradoxically, some of these changes (e.g., increased movement variability) can increase the risk of falling. Understanding how and why these changes in movement occur will enable us to design ways to prevent unhelpful movement strategies and reduce the number of falls. Specifically, this studentship seeks to understand how fear of falling alters the neural and sensorimotor control of balance.

Virtual reality (VR) technology can be used create a simulated environment in which to induce threat and fear in a safe and controlled environment. We (Ellmers) have shown that a novel VR environment that simulates the experience of standing on an elevated surface reliably induces postural threat and fear of falling, and associated changes in behaviour.

The successful applicant will combine this VR environment with a bespoke toolbox of cutting-edge neurophysiology equipment that allows them to probe the sensorimotor control of balance at multiple levels of the nervous system. They will have the opportunity to use transcranial magnetic stimulation (TMS), a type of non-invasive brain stimulation, to probe the connection between brain and muscles. We (Davies) have developed a highly novel system, unique in the UK, to deliver TMS during standing and walking, allowing study of how the brain is involved in controlling muscle activity during dynamic, full-body activities. In addition, peripheral nerve stimulation allows study of the transmission of information through networks of neurones in the spinal cord, and high-density surface electromyography allows study of the firing of individual spinal motor neurones that project to muscles involved in the control of balance. These techniques will provide the first thorough neurophysiological exploration of the mechanisms driving fear-related changes in balance.

The successful applicant will be supported to codevelop their own research questions to apply these highly novel, internationally unique capabilities to probe the neural mechanisms that contribute to threat-related changes in balance control during standing and walking. This work will advance our understanding of how the human sensorimotor system functions, particularly the interaction between psychological and physiological variables.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.