Engineering and Physical Sciences Research Council Doctoral Landscape Award

PROJECT TITLE: Neuro technology causes and cures for fatigability

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Project details: Background: Fatigue is a manifesting symptom across numerous neurodegenerative, neurologic, musculoskeletal, immunologic, endocrinologic, cardiorespiratory, gastroenterologic, and reproductive conditions and can negatively impact function and quality of life (Razin 2023). Fatigue has been proposed to be reported at 40% of GP visits, and identified as a research priority in most clinical conditions. Of the 157 conditions that have published priorities for future research with the James Lind Alliance, 17 (10%) name fatigue as a 'Top 10' research priority [Homepage | NIHR JLA, accessed May 2024]. Alongside tiredness, it includes a sense of needing to rest, of low energy, or of difficulty in initiating or sustaining voluntary effort. People with medical conditions describe both mental and physical fatigue as "more than ordinary tiredness" with impacts that go beyond the symptom itself[Mayo 2015 Skau 2021]. As such fatigue is both common, serious and transdiagnosis. Commentators have suggested that fatigue appears to be a transdiagnostic phenomenon with similarities in experience and impairment across different conditions[Goërtz 2021; Whitehead 2016]. Fatigability refers to decrements in motor or cognitive performance over time [Mayo 2015 Skau 2021].

Current models of fatigue include biological and psychosocial factors, with increasing interest in the role of altered signalling between the brain and body [Raizin 2023]. Different modes of peripheral stimulation can alter brain-body signalling to effect physiological and psychological perception of fatigue. Transcutaneous electrical stimulation of nerves reduces movement-evoked pain and fatigue in fibromyalgia [Dailey 2020], and focal vibratory stimulus on the tendon [Casale, Ring and Rainoldi, 2009; Lee 2014] and muscle belly [Lee 2014] can induce long- and short-term central changes to motor unit recruitment. Reduction of movement-related pain and fatigue by modulation of afferent inflow therefore provides promising analgesic and therapeutic potential in the clinic. Testing modalities of selective stimulation within the context of different fatigue severities is required for deeper understanding of the clinical contexts and mechanisms at play, and would enable the development of a model for optimal stimulation target and dose.

The research team have recently carried out three program areas of work exploring transdiagnostic fatigue including[Leavis 2025] and in press Davies et al 2025:1) a scoping review and expert consensus of transdiagnostic mechanisms of fatigue 2) a review of clinical effectiveness, cost effectiveness, and qualitative evidence synthesis of interventions for fatigue that takes a transdiagnostic perspective. 3) mechanistic research across multiple conditions.

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The PhD will develop the potential of neuromotor sensing and intervention technologies to understand and manage cognitive and physical fatigability.

PhD program

1. Secondary analysis of existing neuromotor data/data fusion in frequency and time domains [fNIRS, EMG, Motion capture] collected during everyday activities in people with different neurological and neurodegenerative conditions with and without fatigue to develop AI classification for fatigue, no fatigue, fatigue severity, and develop conceptual understanding of heterogeneity across condition, sex, age.
2. Develop prediction model for fatigue and no fatigue and fatigue severity and test model in novel neuromotor data set.
3. Develop logic model for stimulation intervention and dosage
4. Test intervention dosage in proof of concept.

Project specific entry requirements: 2:1 Bsc degree in science subject

Potential PhD programme of study: PhD in Neurotechnology

Department: Health and Community Sciences

Location: College House St Lukes Campus Exeter

Please direct project specific enquiries to: Professors Chris Fox (Christopher.Fox@exeter.ac.uk) or Helen Dawes (H.Dawes@Exeter.ac.uk)

Please ensure you read the entry requirements for the potential programme you are applying for.

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