

Project Details	
Project Code	MRC22NMHBa Stothart
Title	Using mobile electroencephalography (EEG) and computational modelling to understand the role of sleep in disease progression in amnesic mild cognitive impairment
Research Theme	Neuroscience & Mental Health
Summary	Disruption to sleep causes dementia pathology and symptoms. New mobile technology now makes it possible to measure brain activity during sleep remotely, in patients' natural home environments. The project will harness this new technology to understand the role of sleep in early dementia, bringing together clinical neurologists, neuroscientists, biomedical mathematicians and an industrial partner to provide a unique, ambitious and interdisciplinary studentship.
Description	<p>1. Research The disruption of slow wave sleep (SWS) is implicated in the pathogenesis and functional consequences of dementia. SWS is critical for clearing toxic dementia-linked proteins, and plays an essential role in memory consolidation. Amnesic Mild Cognitive Impairment (aMCI) is the earliest identifiable stage of dementia, with the majority of patients progressing to Alzheimer's disease. Sleep quality is altered in aMCI, and linked to subsequent waking cognitive performance, however, study samples have been small and lacking EEG measures of sleep. Consequently, the link between SWS, aMCI and disease progression is unknown. Identifying SWS changes in aMCI could provide a significant therapeutic target for both disease-modification and symptom management. Historically sleep has been measured using polysomnography, requiring participants to stay overnight in sleep clinics, wearing sleep disruptive equipment. This project will be the first of its kind to harness cutting edge mobile, wearable EEG technology to revolutionise the clinical assessment of sleep in the home environment, with no experimenter present. Dreem™ are market leader and project partner The aims are to: 1. Characterise changes to sleep in aMCI using remote, home-based EEG data collection. 2. Examine the relationship between SWS and waking cognitive performance 3. Develop mathematical models using sleep EEG and predict the conversion of MCI to dementia Methods: 100 aMCI patients will be recruited from Dr Coulthard's ReMemBr Memory Clinic volunteer database of 1500 patients, over 2 years. They will complete standardised tests of cognition and sleep (ACE-III, PSQI), and be provided with a Dreem EEG headset and laptop. The experimenter will provide instructions to the patient and partner/carer via an online video call each night, for 1 acclimatisation + 7 test nights. Patients will also complete a novel EEG test battery (also via Dreem EEG), developed by Dr Stothart to assess attention, memory and language function. Patients' clinical outcome, e.g. conversion to dementia, will be updated at 6 monthly intervals. Computational models will be developed using the spectral characteristics of sleep EEG to understand network dysfunction and predict conversion to dementia. 2. Training and interdisciplinary working The student will have immersive interdisciplinary training including:</p> <ul style="list-style-type: none"> • Gaining invaluable clinical experience as part of Dr Coulthard's team and completing the Introductions to Diagnostic Research and Statistics short courses (Bristol). • Training in

	<p>experimental design and advanced signal processing techniques with Drs Stothart and Petrini and completing postgraduate software skills training in Python and R (Bath) • Training to study and fit models of the brain to data with Dr Goodfellow, and completing courses in Mathematical Modelling in Biology and Medicine and nonlinear dynamical systems at the Living Systems Institute (Exeter). 3. Added value features The student will complete two invaluable secondments to a world leading sleep laboratory at the University of California, hosted by Dr Bryce Mander, and will work directly with our industrial partner, Dreem, see Identification of Project-Specific Training Needs section for full details. 4. Knowledge transfer and maximising impact Testing protocols will be developed in collaboration with Dr Coulthard's established Patient and Public Involvement group, who have already indicated a preference for home testing. New links will be established through a secondment to leading neuro tech industrial partner (Dreem), who will provide technical consultation throughout. This will provide a platform for further GW4-Dreem industrial partnerships, and an invaluable student experience of knowledge transfer between academia and industry. The student will coordinate, in partnership with Dr. Mander's lab, a sleep research symposium as part of Alzheimer's Research UK's annual conference.</p>
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