**University of Leicester**

**BBSRC MIBTP Studentship Project 2025-6 entry.**

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**Section 2 – *Project Information***

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| **Project Title** | Cognition across the lifespan, the influence of sleep and exercise on sustained attention and proactive control in young, middle-age and older adults. |
| **Project Summary** | |
| *Background:* There is a growing awareness of the impact of lifestyle factors on mental health and cognition across the adult lifespan.  Modifiable behaviours such as sleep duration, levels of physical activity and sedentary time have been associated with variability in cognitive health in young, middle age and older adults1,2.  Cognitive abilities are mediated by the structure and functional capacity of the brain. Adequate sleep and engagement in regular physical activity are thought to improve cognitive health and neural processes, such as neuroplasticity, through molecular upregulation of cellular processes3, synchronised neural firing4 and increased cerebral blood flow5.  Much of the evidence for links between lifestyle factors and cognitive health comes from studies that have focussed on clinical groups or outcomes in response to prescribed diets, physical activity programmes or sleep deprivation. Few studies, however, have investigated the combined influence of sleep and different physical activity modalities on neuroplasticity and its influence on specific measures of sustained attention, which are though to mediate the ability to prioritise and respond flexibly to changes in the physical and social environment 6,7.  *Objective:* The project will investigate the way that sleep, sedentary time and different forms of physical activity (i.e., aerobic and resistance) interact to influence neural function via changes in the speed of sensory processing and individual’s capacity to sustain attentional control.  To do this, the study will use cutting-edge statistical methods to model interactions between self-report measures of sleep, physical activity and different types of exercise, and their impact on sensory processing and sustained attention using behavioural, eye tracking and electrophysiological measures.  To assess these interactions at different stages of the adult lifespan, the study will recruit cohorts of young, middle-aged and older adults who have recently enrolled in a gym or fitness class.  The aims of the project are:   1. Identify and recruit a cohort of inactive young (< 25 years), middle-aged and older adults (> 65 years) who intend to, or have recently joined a gym or fitness class with the aim of improving their physical fitness 2. Use a mixture of diary-based and accelerometer-acquired data to conduct a compositional data analysis to quantify the allocation of time to sleep, physical activity engagement and sedentary time in each cohort during a twelve-week period following enrolment to a gym or fitness class 3. Evaluate the sensitivity of recently developed measures of sustained attention using cue-related changes in the modulation of the pupil light response and the accuracy of smooth pursuit eye movements during short-periods of ongoing cognitive activity 4. Integrate the tasks above in a cognitive test battery to measure variability in individuals’ speed of processing, sustained attention and inhibitory control using behavioural, eye movement and steady state evoked visual potentials 5. Model variability in cognitive performance and psychological outcomes in young, middle-aged and older adults prior to and after the uptake of their gym membership as a function of sleep patterns and the allocation of different forms of physical activity and sedentary behaviour during a twelve-week period   The project will be supervised by a multidisciplinary team with expertise in developing lifestyle interventions and measuring mental health outcomes, experimental design, and eye movement and electrophysiological measures of sustained attention. The student will combine self-report, behavioural, and physiological measures of physical health and cognitive performance to investigate the impact of lifestyle choices on each cohort’s cognitive ability.  The results will provide new insights into the link between different forms of physical activity and the maintenance of core cognitive abilities in response to modifiable lifestyle behaviours at different stages of the adult lifespan.  Techniques that will be undertaken during the project   1. Diary and accelerometer-acquired time series data on sleep and movement patterns 2. Visual psychophysics 3. Eye movement recording and pupil frequency tagging 4. Human electrophysiology 5. Compositional and multivariate statistical analyses | |
| **References** | |
| 1. Sewell, K. R., Erickson, K. I., Rainey-Smith, S. R., Peiffer, J. J., Sohrabi, H. R., & Brown, B. M. (2021). Relationships between physical activity, sleep and cognitive function: A narrative review. *Neuroscience & Biobehavioral Reviews*, *130*, 369-378. 2. Festa, F., Medori, S., & Macrì, M. (2023). Move your body, boost your brain: the positive impact of physical activity on cognition across all age groups. *Biomedicines*, *11*(6), 1765. 3. El-Sayes, J., Harasym, D., Turco, C. V., Locke, M. B., & Nelson, A. J. (2019). Exercise-induced neuroplasticity: a mechanistic model and prospects for promoting plasticity. *The Neuroscientist*, *25*(1), 65-85. 4. Wilckens, K. A., Erickson, K. I., & Wheeler, M. E. (2018). Physical activity and cognition: a mediating role of efficient sleep. *Behavioral sleep medicine*, *16*(6), 569-586. 5. Kleinloog, J. P., Mensink, R. P., Ivanov, D., Adam, J. J., Uludağ, K., & Joris, P. J. (2019). Aerobic exercise training improves cerebral blood flow and executive function: a randomized, controlled cross-over trial in sedentary older men. *Frontiers in Aging Neuroscience*, *11*, 333. 6. Pickersgill, J. W., Turco, C. V., Ramdeo, K., Rehsi, R. S., Foglia, S. D., & Nelson, A. J. (2022). The combined influences of exercise, diet and sleep on neuroplasticity. *Frontiers in psychology*, *13*, 831819. 7. Stillman, C. M., Esteban-Cornejo, I., Brown, B., Bender, C. M., & Erickson, K. I. (2020). Effects of exercise on brain and cognition across age groups and health states. *Trends in neurosciences*, *43*(7), 533-543. | |