**BBSRC MIBTP Studentship Project**

**September 2023**

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| **First Supervisor** | Dr David Souto |
| **School/Department** | Psychology & Vision Sciences |
| **Email**  | ds572@leicester.ac.uk  |

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| **Second Supervisor** | Dr Douglas Barrett |
| **School/Department** | Psychology & Vision Sciences |
| **Email**  | djkb1@leicester.ac.uk  |

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| **Additional Supervisor** | N/A |

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| **Project Title** | Inferring attentional states from gaze and pupil size during free viewing |
| **Project Summary**  |
| Our ability to pay attention fluctuates from moment-to-moment. For instance, we can only give our full attention in a lecture for short bouts of time. In this project we seek to model and empirically test fluctuations in attention by recording participants gaze as they explore visual scenes. Aside from addressing a poorly understood neurocognitive process, cognitive fluctuation is thought to change over the life span, and is characteristic of clinical conditions, such as dementia. Yet objective measures of those fluctuations is lacking.  Fluctuations in attention could be understood within an information-theoretic framework as a shift in the balance between exploitative and exploratory modes of information processing (Esterman, Rothlein, 2019). In the former, eye movements are used to scrutinise a small part of the scene. In the latter, eye movements are used to explore parts of the scene that have not been sampled. As the informational reward diminishes during exploitation the expected value of exploration increases, creating a naturally oscillatory state. The above theory generates clear predictions about the duration of attentional cycles if the informational value during exploitation is known. The goal of the project will be to validate this model by using eye movements during visual tasks in which the reward structure is well-known, and free-viewing tasks where fluctuations between attentional states will be inferred using gaze patterns, pupillometry and cortical electrophysiology (EEG).  More specifically, longer fixations and shorter changes in gaze have been associated with an exploitative state, whereas shorter fixations and larger changes in gaze, have been associated with an exploratory state (Unema et al., 2005; Krejtz et al., 2016). One objective of the study will be to validate this distinction by comparing the classification of these states using multiple indices, including the speed and accuracy of recall (Bylinskii, et al., 2015), blink rate, pupil size and eye movement dynamics as indicators of arousal, and EEG micro-states as indicators of the activity of attentional networks (Michel & Koenig, 2018). The project will be supervised by a multidisciplinary team with expertise in experimental psychology, eye-tracking, psychophysics, neuroimaging, and computational modelling. The project will also follow best practice in open science, by pre-registering research plans and publishing data, code and outputs using open access methods. The project will develop a broad range of research skills and competencies, and we will seek to submit pre-registered reports to relevant journals. Techniques that will be undertaken during the project:* Eye-tracking
* Pupillometry
* Computational modelling (information and signal theoretic)
* Statistical computing using linear mixed-effects models and the R programming environment
* EEG co-registration, analysis of fixation-related potentials

BBSRC Strategic Research Priority: Understanding the Rules of Life - Neuroscience and behaviourIntegrated Understanding of Health - Ageing |
| **References** |
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