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About

Dr Steve Mayhew conducts a lot of simultaneous EEG-fMRI experiments in an effort to better understand the coupling between single-trial variability in electrophysiological and haemodynamic measurements of brain responses, and how interactions between ongoing brain processes and external events are intrinsic to the function of the brain.

Qualifications

MPhys (hons) University of Bath

DPhil University of Oxford

Biography

Dr Steve Mayhew studied Physics at the University of Bath and initially wanted to be a space scientist but then decided that biological systems were more interesting, and became particularly fascinated by the challenge of understanding the functions of the brain. Steve moved to the University of Oxford Life Science Interface Doctoral Training Centre (LSI DTC) where he began the research that he continues to this day, applying physical techniques to problems in neuroscience. He completed a PhD in neuroimaging at Oxford, using simultaneous recording of electroencephalography (EEG) during functional magnetic resonance imaging (FMRI), before moving to the University of Birmingham for post-doctoral research positions with Professor Zoe Kourtzi and **Dr Andrew Bagshaw (/staff/profiles/psychology/bagshaw-andrew.aspx)** . Steve is now an independent researcher supported by an EPSRC post-doctoral research fellowship and a Birmingham Fellowship.

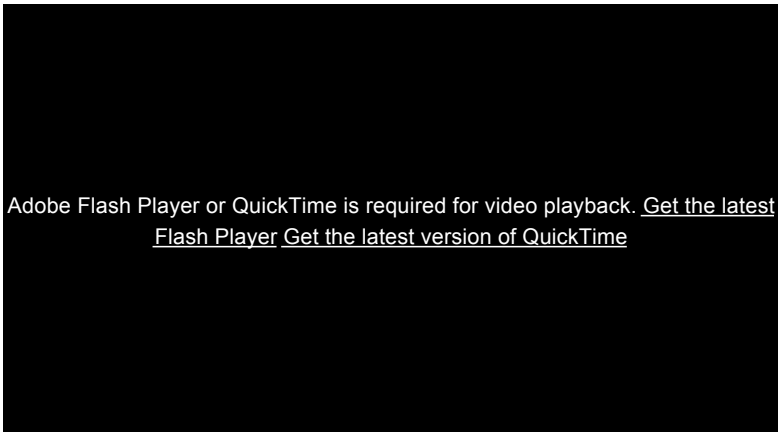
Research

Dr Mayhew's research is focused on using simultaneous EEG-fMRI recordings in humans to gain a better understanding of the empirical coupling between electrophysiological and haemodynamic measurements of brain activity. BOLD fMRI is currently the best available technique for non-invasively assessing the function of the healthy, diseased or aging human brain because it can accurately localise the regions of the brain that are active when we experience sensations and feelings, or during the performance of a particular task. However, BOLD is limited in that it measures only relative changes in blood oxygenation and blood flow that are induced by the metabolic demands of neuronal activity. The combination of EEG with fMRI creates a multi-modal imaging technique that provides much richer data sets which allow the dynamics brain's response to internal or external stimulation to be probed in greater spatiotemporal detail.

His research investigates:

- The coupling between both evoked and induced oscillatory EEG responses to sensory stimulation and the amplitude and shape of the BOLD HRF.
- The importance of dynamic, distributed networks of brain regions in supporting function.
- The relationship between ongoing brain activity (EEG oscillations and fMRI networks) and the magnitude of the brains response to stimulation.
- Combining EEG-fMRI with measurements of cerebral blood flow (CBF) obtained with arterial-spin labelling to investigate neurovascular coupling and the negative BOLD response. CBF is potentially better localised to neuronal activity than BOLD and provides additional information on brain physiology and a very complementary measurement to combine with BOLD to provide a more complete characterisation of the complex haemodynamic changes that are a consequence of neural activity.
- Mathematical modelling of EEG and fMRI response to investigate neurovascular coupling mechanisms.

'Adventures in Neurological Space': Stephen Mayhew on his research



Publications

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