**Studentship Form**

The Precision Imaging Beacon wishes to promote cross-disciplinary interaction between Schools, with an expectation of at least two supervisors.

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| First Supervisors name | Maddie Groom (50%) | School Addresses | School of Medicine, Division of Psychiatry & Applied Psychology, IMH |
| Co Supervisors name | Lucy Cragg (25%) | School Addresses | School of Psychology |
| Co Supervisors name | Claudia Danielmeier (25%) | School Addresses | School of Psychology |
| Co Supervisors name | Nic Blockley  | School Addresses | School of Life Sciences |
| Start date  | Sept 2019 | Duration  | 3.5 years |
| Student  | TBC following selection process |
| Project Title | Establishing autonomic and electrophysiological markers of arousal regulation and attention in children with ADHD |
| Project Abstract | ADHD is a prevalent, lifelong and disabling condition that is primarily treated with medication. Medications for ADHD have limited efficacy/tolerability in many children and are selected via trial-and-error; it can take several months to find the right medication for an individual child. This situation would improve significantly with accurate, reliable prognostic markers of medication response. The most effective medications for ADHD target brain systems involved in arousal regulation and cognition. There is also increasing evidence to suggest that arousal dysregulation is a core feature of ADHD (1,2) and that there are distinct subgroups with specific electrophysiological profiles that respond to different types of medication (3). As yet however, relationships between arousal regulation and cognition in ADHD have not been clearly defined. Most studies in this area have inferred impaired arousal from indirect measures such as poor cognitive performance under conditions that are designed to tax arousal. Very few studies have measured autonomic markers of arousal in ADHD or related these to EEG measures and cognitive function. The proposed studentship will form one part of a broader programme of work to investigate arousal regulation, cognition and medication response in ADHD, led by the primary supervisor. The student will conduct experimental work to compare children with and without ADHD using cognitive tests, EEG and autonomic measures (pupil size, heart rate, skin conductance). To guide the selection of arousal-linked EEG measures in this study, the student will utilise combined fMRI-EEG data collected in healthy adults to identify EEG correlates of BOLD activity in the brainstem regions implicated in arousal regulation. This image-guided selection of EEG measures will provide a firmer basis for interpreting the findings from the ADHD study whilst also avoiding the need to scan ADHD patients who will find it hard to remain still in the scanner.The studentship will address the following research questions:1. What are the electrophysiological and autonomic correlates of BOLD activity in brainstem regions responsible for arousal regulation (specifically the locus coeruleus) and of the connectivity between these regions and other cortical and sub-cortical sites?
2. What are the differences between children with and without ADHD on EEG and autonomic measures of arousal? How do these differences relate to cognitive function in ADHD?
3. How do these measures relate to clinical measures of symptom severity in ADHD?
4. Are there differences between children with ADHD depending on which medication they respond to clinically?

The project will provide a platform from which to identify prognostic markers of treatment response in ADHD in a larger study, facilitating a ‘personalised medicine’ approach to this complex, heterogeneous condition. This aligns well with the aim of the Beacon to establish image-guided approaches to medicine. The project brings together cross-disciplinary expertise in ADHD (Groom(4)), developmental cognitive psychology (Cragg (5)) and in measuring arousal regulation using EEG and autonomic measures (Danielmeier (6,7)). The student will benefit from training opportunities in both Schools and will receive full training in all relevant neuroimaging methods. The primary supervisor has strong links with local and national ADHD support groups and NHS clinics and is currently conducting work with imaging experts in the Sir Peter Mansfield Imaging Centre to image the human arousal system; the proposed project will benefit from and further strengthen these collaborations. The project will also receive some financial and infrastructure support from the NIHR Biomedical Research Centre mental health theme (based in the IMH). 1. Kuntsi J, Klein C. Intraindividual variability in ADHD and its implications for research of causal links. Curr Top Behav Neurosci. 2012;9:67–91. 2. Buyck I, Wiersema JR. State-related electroencephalographic deviances in attention deficit hyperactivity disorder. Res Dev Disabil. 2014 Dec;35(12):3217–25. 3. Arns M. EEG-Based Personalized Medicine in ADHD: Individual Alpha Peak Frequency as an Endophenotype Associated with Nonresponse. J Neurother. 2012 Apr 1;16(2):123–41. 4. Groom MJ, Scerif G, Liddle PF, Batty MJ, Liddle EB, Roberts KL, et al. Effects of Motivation and Medication on Electrophysiological Markers of Response Inhibition in Children with Attention-Deficit/Hyperactivity Disorder. Biol Psychiatry. 2010 Apr 1;67(7):624–31. 5. Retzler J, Johnson S, Groom M, Hollis C, Budge H, Cragg L. Cognitive predictors of parent-rated inattention in very preterm children: The role of working memory and processing speed. Child Neuropsychol. 2018 Sep 19;0(0):1–19. 6. Wessel JR, Danielmeier C, Ullsperger M. Error Awareness Revisited: Accumulation of Multimodal Evidence from Central and Autonomic Nervous Systems. J Cogn Neurosci. 2011 Jan 26;23(10):3021–36. 7. Danielmeier C, Allen EA, Jocham G, Onur OA, Eichele T, Ullsperger M. Acetylcholine Mediates Behavioral and Neural Post-Error Control. Curr Biol. 2015 Jun 1;25(11):1461–8.  |
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