Project Details	
Project Code	MRC22NMHCa Lawrence
Title	Long-term Neural Embedding of Childhood Adversity in the Avon Longitudinal Study of Parents and Children (ALSPAC)
Research Theme	Neuroscience & Mental Health
Summary	This project will utilize a unique large-scale data set to examine the link between prospectively ascertained adversity during childhood and adolescence and cutting-edge multi-modal neuroimaging measures of both the structural and functional connectome, providing novel insights on the mechanisms through which childhood adversity becomes neurally embedded and influences mental health and cognition.
Description	Childhood adversity is associated with lasting negative mental health outcomes. Identifying mechanisms through which childhood adversity becomes biologically embedded and thereby impacts development is a key focus of clinical cognitive neuroscience. To date, research has revealed that childhood adversity is associated with alterations in the structural and functional integrity of affective, mnemonic, and cognitive control networks. However, to date most research relies on cross-sectional designs and retrospective reporting, which have critical limitations. Little neuroimaging research has studied individuals whose exposure to adversity was ascertained prospectively, and prospective studies have often focused on extreme forms of adversity, such as institutionalization, which may not generalize to more common forms of adversity. To address these issues, our innovative approach combines: [1] Unique resources from a longitudinal birth cohort This project utilizes data acquired from a £1.8m MRC-funded multi-centre study, which obtained state of the art multimodal neuroimaging, cognitive and mental health data from 220 individuals (equal numbers of males and females (age ~27-29) from the Avon Longitudinal Study of Parents and Children (ALSPAC) (data collection finished August 2021). The ALSPAC cohort contains a vast array of detailed adversity data, alongside important demographic and other covariates, which has been obtained from multiple parent- and child-completed questionnaires administered throughout childhood and adolescence/early adulthood. This high-dimensional data has been used to create a small number of derived measures allowing investigation of overall cumulative adversity exposure, timing and type of adversity (including the key stressor of poor maternal mental health - > 40% of Alspac mothers report mental health problems) to allow focused investigation of the impact of type, degree and timing of adversity exposure on the adult connectome. [2] Cutting-edge brain-imaging The student will be able to utilise a wide-array of cutting-edge multi-modal neuroimaging data to quantify brain network structure and function, encompassing: (1) ultra-high field (7T) structural and functional MRI for precise structural and functional mapping of brain regions in the medial temporal lobe (amygdala/hippocampus) that are key targets for the impact of early life stress, alongside: (2) high-gradient diffusion-weighted MRI for modelling whole brain structural connectivity; and (3) high resolution 3T functional MRI (fMRI) for measuring functional networks during the resting state, naturalistic movie viewing and/or tasks tapping language, memory and social cognition. [3] Opportunities for application of new analytic

	approaches The success of network neuroscience stems in part from the ability to quantify different aspects of brain organization and function (e.g. structure-function relationships, brain network dynamics, and the brain's system-level architecture) using an ever-growing suite of mathematical and statistical tools. One new approach is network control theory, which presupposes that the brain is a networked dynamical system, and that offers an elegant and mathematically tractable framework that naturally links brain connectivity, dynamics, and activity. Goodfellow is an expert in the development and use of mathematical and computational methods to help understand the dynamics of complex biological systems and has used this dynamical approach to calculate novel metrics for individual subjects that can be used to study inter-individual or group-level differences that can be related to early life adversity metrics, thus contributing new knowledge on the systems level mechanisms by which early life adversity impacts adult brain structure and function.
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