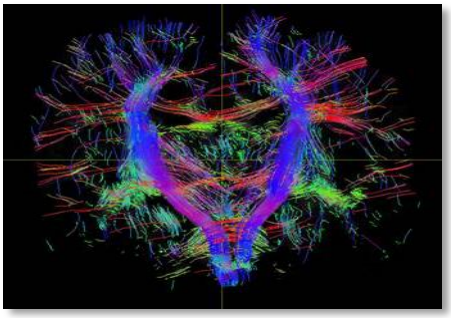
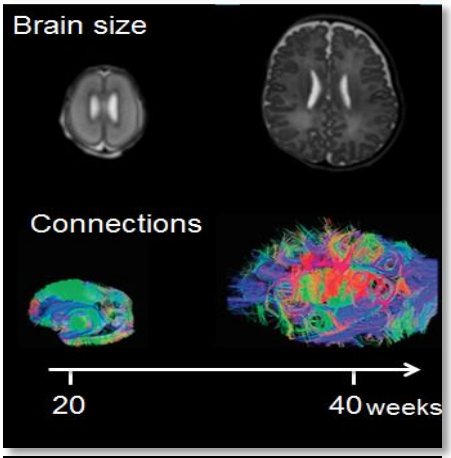
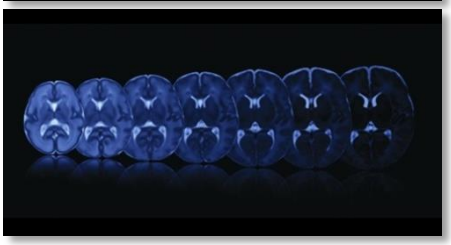
The Developing Human Connectome Project

Creating the first map of the developing human brain connectome

The **Developing Human Connectome Project (dHCP),** is a highly collaborative, €15 million project led by King's College London, Imperial College London and Oxford University that aims to make major scientific progress by creating the first 4-dimensional connectome of early life. Our goal is to create a dynamic map of human brain connectivity from 20 to 44 weeks post-conceptional age, which will link together imaging, clinical, behavioural and genetic information. This unique setting, with imaging and related data in an expandable open-source informatics structure, will permit wide use by the scientific community, and to undertake pioneer studies into normal and abnormal development by studying well-phenotyped and genotyped group of infants with specific genetic and environmental risks that could lead to Autistic Spectrum Disorder or Cerebral Palsy.







This 6 year project will move far beyond the current state of the art, delivering solutions to major scientific problems to acquire the first systematic set of diffusion MRI (dMRI) and resting-state functional MRI (rfMRI) from a large number (~1500) of well-characterized fetuses and newborn infants, together with genetic, clinical and developmental information, to deliver:

- **The first dynamic map of human brain connectivity from 20 to 44 weeks** post-conceptional age, linked to imaging, clinical, behavioural and genetic information; this initial mapping will define the term-age connectome with resolution approaching current adult studies, while initial fetal and preterm data will allow a sparser but longitudinal view of connection development.
- **Comparative maps of connectivity associated with neurodevelopmental abnormality**, studying well-phenotyped patients with (i) the environmental effect of prematurity or (ii) ASD of known genetic type.
- **Definition of cerebral endophenotypes** linked to genetic, functional and clinical information.
- **Novel imaging methods** for the acquisition of dMRI and rfMRI, overcoming the serious outstanding challenges in imaging the fetus and newborn by motion-tolerant image acquisition and analysis.
- **Novel image analysis and modeling tools with greater integration to data reconstruction** to extract structural and functional connectivity maps from fetal and neonatal MRI, including dedicated registration, segmentation, and parcellation algorithms.
- **Integration of data and tools with the adult connectome research**, allowing the comparison of brain connectivity during development and maturity and the beginning of a life-course connectome.
- **Open source availability of data, improved image acquisition methods, and analysis tools within an expandable future-proof informatics structure** that will provide the research community with a user-friendly environment for hypothesis-based studies and allow continual ongoing addition of new data.

By successfully creating the first human developing brain connectome and linking connectivity data to genetic, cognitive and environmental information; it will be possible to answer specific neurobiological questions on the creation of mental functions, structure-function relationships and the influences that shape them. It will transform our understanding of the developing human brain and give crucial insight into brain vulnerability and disease development.

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