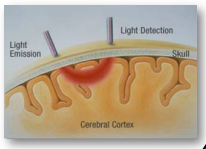
Brain Imaging and Behavioural Measures of Nutrition Related Cognitive Development in Rural Gambia: Studies from Birth to 24 Months of Age

D. Halliday[1], S. Lloyd-Fox[2], K. Begus[2], H. Maris[2], M. Papademetriou[1], N. Everdell[1], M. K. Darboe[3], A. M. Prentice[3,4], S. E. Moore[3,4], C. E. Elwell[1]

[1]Department of Medical Physics and Bioengineering, University College London, UK
[2]Centre for Brain and Cognitive Development, Birkbeck, University of London, UK
[3]MRC International Nutrition Group, Keneba Field Station, The Gambia
[4]MRC International Nutrition Group, London School of Hygiene and Tropical Medicine, UK

Optical Imaging

- Changes in the absorption of very low levels of near infrared light are used to measure the changes in brain blood flow and oxygen consumption associated with neuronal activation.
- The technique is completely safe, low cost and requires minimal setup and training.
- Optical imaging provides better spatial resolution than EEG, and, unlike fMRI, is well suited to field based studies.



The optical imaging headgear consists of 6 sources (red) and 4 detectors (blue) contained in a lightweight silicon headband, which takes less than 30 seconds to set up on the infant's head.

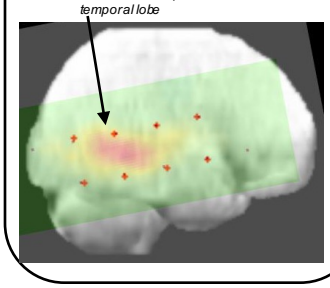
Aims

- To examine longitudinal and cross-sectional associations between optical brain imaging of cognitive function, behavioural performance, and physical growth measurements in the first 1000 days of life.
- To establish an objective and field-friendly assessment battery, to provide novel biomarkers for the evaluation of nutritional interventions.

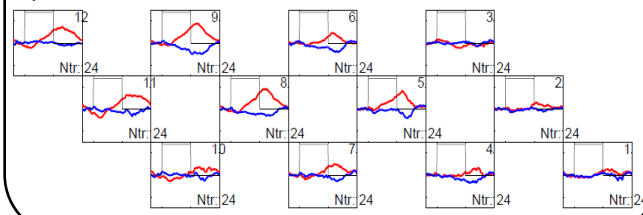
Optical Imaging Detects Localised Brain Function in Response to Vocal Auditory Stimuli

Optical image of brain function in a single 4-month infant.

Activation localised over the posterior temporal lobe



Averaged 4-8 month-old (n=24) time course changes in oxyhaemoglobin (red) and deoxyhaemoglobin (blue), denoting evidence of functional brain activation in the posterior channels..



*Active channels in response to **VOCAL** (e.g., laughter, crying) vs. **NON-VOCAL** (e.g., rattles) sounds.*

4-8 months

9-13 months

18-24 months

Summary

Our Phase One grant has demonstrated the viability of optical brain imaging and behavioural assessment of infants over the first two years of life in a resource poor setting.

Our Phase Two Vision is to apply these methods to investigate brain development and cognitive function in infants with varying trajectories of growth and nutritional status.