Small World, Big Picture: can graph analysis help explain visual feature binding in Autism?

Background: If, as has been claimed, Autistic Spectrum Disorders (ASD) are characterised by anomalous temporal binding[1], then they should show abnormal functional connectivity during tasks requiring visual feature binding(VFB). VFB, when viewing illusory figures such as Mooney faces, has been shown to be associated with changes in both local gamma activity[2] and functional connectivity[3] but as both can be seen in the absence of VFB, neither can be considered to be neural correlates of the process. Perhaps then, the critical feature is not the presence or absence of functional connectivity but the pattern, or topology, of the connections that exist[4]. However, although some evidence supports this position[5], the approach has been severely restrained by computational limitations. Fortunately, developments from graph theory (e.g. Small World Networks[6]) that can be interpreted as measures of local and global efficiency[7] can overcome many of these limitations and some have already been applied to EEG/MEG[8]. Despite successes in revealing differences between healthy and clinical populations (e.g. Alzheimer's, Parkinson's, Schizophrenia and closed head injury), however, this approach has not been applied to ASD and has been studied in the resting state almost exclusively. The aim of this project is to indentify appropriate experimental protocols and analysis techniques that can be used to characterise anomalies in the topology of connectivity seen in ASD.

Hypothesis: Perception of images requiring VFB will be associated with a more 'small world' pattern of connectivity than comparable images not requiring VFB in controls**.** Individuals with ASD will show a topology of connectivity with local efficiency comparable to controls but with relatively impaired global efficiency.

Method: EEG/MEG will be collected from ASD participants and matched controls during rest and appropriate experimental conditions that involve visual feature binding. Functional connectivity will be measured using two methods that eliminate volume conduction (Phase Locking Index[9] and Imaginary Coherence[10]) and graph theory measures of 'Small Worldness' (Global and Local efficiency) will be calculated from the resulting matrices and compared between conditions using Partial Least Squares Analysis[11]

Expected Outcomes: This will be a significant test of an important theoretical perspective on the dynamic organisation of the brain in ASD and will also permit a comparison of two important measures of functional connectivity.

References:

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