Brain network model

Brain network models derived from graph theory have the potential to guide functional neurosurgery and to improve rates of postoperative seizure freedom for patients with epilepsy. A barrier to applying these models clinically is that intracranial EEG electrode implantation strategies vary by centre, region and country, from cortical grid & strip electrodes (Electrocorticography) to purely stereotactic depth electrodes (Stereoelectroencephalography), to a mixture of both. To determine whether models derived from one type of study are broadly applicable to others, we investigate the differences in brain networks mapped by electrocorticography and stereo EEG in a cohort of patients who underwent surgery for temporal lobe epilepsy and achieved a favourable outcome. We show that networks derived from electrocorticography and stereo EEG define distinct relationships between resected and spared tissue, which may be driven by sampling bias of temporal depth electrodes in patients with predominantly cortical grids. We propose a method of correcting for the effect of internodal distance that is specific to electrode type and explore how additional methods for spatially correcting for sampling bias affect network models. Ultimately, we find that smaller surgical targets tend to have lower connectivity with respect to the surrounding network, challenging notions that abnormal connectivity in the epileptogenic zone is typically high. Our findings suggest that effectively applying computational models to localize epileptic networks requires accounting for the effects of spatial sampling, particularly when analysing both electrocorticography and stereo EEG recordings in the same cohort, and that future network studies of epilepsy surgery should also account for differences in focality between resection and ablation. We propose that these findings are broadly relevant to intracranial EEG network modelling in epilepsy and an important step in translating them clinically into patient care [1].

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Bernabei JM, Arnold TC, Shah P, Revell A, Ong IZ, Kini LG, Stein JM, Shinohara RT, Lucas TH, Davis KA, Bassett DS, Litt B. Electrocorticography and stereo EEG provide distinct measures of brain connectivity: implications for network models. Brain Commun. 2021 Jul 11;3(3):fcab156. doi: 10.1093/braincomms/fcab156. PMID: 34396112; PMCID: PMC8361393.