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Hierarchical disruption in the Bayesian brain: Focal epilepsy and brain networks

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Running title: Focal epilepsy and false inference in brain networks

Abstract

In this opinion paper, we describe a combined view of functional and effective brain connectivity along with the free-energy principle for investigating persistent disruptions in brain networks of patients with focal epilepsy. These changes are likely reflected in effective connectivity along the cortical hierarchy and construct the basis of increased functional connectivity in focal epilepsy. We propose a testable framework based on dynamic causal modelling and functional connectivity analysis with the capacity of explaining commonly observed connectivity changes during inter-ictal periods. We then hypothesise their possible relation with disrupted free-energy minimisation in the Bayesian brain. This may offer a new approach for neuroimaging to specifically develop and address hypotheses regarding the network pathomechanisms underlying epileptic phenotypes.

Keywords: focal epilepsy, free-energy principle, functional connectivity, effective connectivity, Bayesian inference, predictive coding

1. Background

Epilepsy is a dynamic disorder of the brain that is characterised by both paroxysmal abnormal states (i.e. epileptic seizures), and more persistent abnormalities across the functional brain networks (Powell et al., 2007). Advances in understanding the relationship between these observable phenomena and underlying pathophysiology have directly informed current treatment approaches, such as epilepsy surgery, and can potentially improve patient outcomes (Goodfellow et al., 2016). However, understanding the neuronal