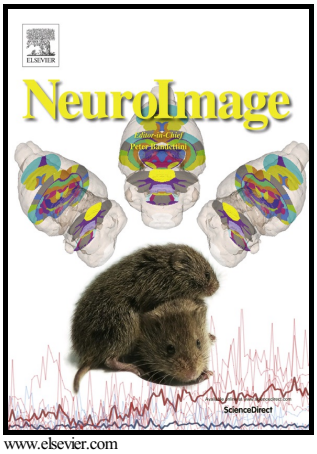

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Empirical validation of directed functional connectivity

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Abstract

Mapping directions of influence in the human brain connectome represents the next phase in understanding its functional architecture. However, a host of methodological uncertainties have impeded the application of directed connectivity methods, which have primarily been validated via “ground truth” connectivity patterns embedded in simulated functional MRI (fMRI) and magneto-/electro-encephalography (MEG/EEG) datasets. Such simulations rely on many generative assumptions, and we hence utilized a different strategy involving empirical data in which a ground truth directed connectivity pattern could be anticipated with confidence. Specifically, we exploited the established “sensory reactivation” effect in episodic memory, in which retrieval of sensory information reactivates regions involved in perceiving that sensory modality. Subjects performed a paired associate task in separate fMRI and MEG sessions, in which a ground truth reversal in directed connectivity between auditory and visual sensory regions was instantiated across task conditions. This directed connectivity reversal was successfully recovered across different algorithms, including Granger causality and Bayes network (IMAGES) approaches, and across fMRI (“raw” and deconvolved) and source-modeled MEG. These results extend simulation studies of directed connectivity,