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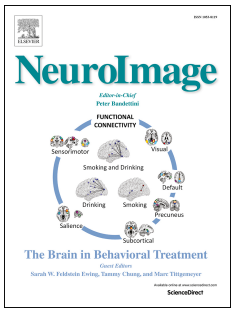

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Fluctuations between High- and Low-Modularity Topology in Time-Resolved Functional Connectivity

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Abstract

Modularity is an important topological attribute for functional brain networks. Recent human fMRI studies have reported that modularity of functional networks varies not only across individuals being related to demographics and cognitive performance, but also within individuals co-occurring with fluctuations in network properties of functional connectivity, estimated over short time intervals. However, characteristics of these time-resolved functional networks during periods of high and low modularity have remained largely unexplored. In this study we investigate basic spatiotemporal properties of time-resolved networks in the high and low modularity periods during rest, with a particular focus on their spatial connectivity patterns, temporal homogeneity and test-retest reliability. We show that spatial connectivity patterns of time-resolved networks in the high and low modularity periods are represented by increased and decreased dissociation of the default mode network module from task-positive network modules, respectively. We also find that the instances of time-resolved functional connectivity sampled from within the high (respectively, low) modularity period are relatively homogeneous (respectively, heterogeneous) over time, indicating that during the low modularity period the default mode network interacts with other networks in a variable manner. We confirmed that the occurrence of the high and low modularity periods varies across individuals with moderate inter-session test-retest reliability and that it is correlated with previously-reported individual differences in the modularity of functional connectivity estimated over longer timescales. Our findings illustrate how time-resolved functional networks