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Dynamic connectivity and dynamic affiliation: Comment on “Understanding brain networks and brain organization” by Pessoa

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Structure-function mapping in the human brain is a non-trivial endeavor that has occupied neuroscientists for many years. While a network approach, elegantly summarized by Pessoa (Pessoa, 2014), has for the most part supplanted simple one-to-one mapping schemes, several outstanding issues remain. The concept of “dynamic affiliation” of a particular brain region with a network in a certain context goes a long way towards providing a more sophisticated description of how any given region may participate in multiple cognitive processes. Despite the considerable insights into brain function provided by the network perspectives summarized by Pessoa, it is apparent that “rigorous characterization of brain networks is in its infancy”.

An emerging literature suggests that an additional layer of complexity may exist when the time domain is considered in the study of human brain networks. Though it is often stated that *dynamic* interactions between brain regions constitute the basis of cognition, the majority of extant functional connectivity (FC) MRI studies assume temporal stationarity of functional connectivity metrics across a given period. However, recent reports challenge this notion, and have demonstrated changes in functional connectivity metrics over time. Thus, the assumption that FC measures are constant over time is overly simplistic.

The new science of “dynamic functional connectivity” attempts to account for variations in network structure as a function of time. A common strategy for examining dynamics in resting-state FC is a sliding window approach whereby a time window of fixed length is selected, and data points within that window are used to calculate the FC metric of interest. The window is then shifted in time by a fixed number of data points that defines the amount of overlap between successive windows. This process results in quantification of the time-varying behavior of the chosen metric over the duration of the scan (Hutchison et al., 2013). Using a sliding-window correlation procedure, Chang and colleagues identified regions across the brain that exhibited variable connectivity with the posterior cingulate cortex over time, including transient periods of functional connectivity with attention and salience processing systems (Chang & Glover, 2010). These and other recent dynamic functional connectivity findings may provide a mechanistic basis for the “dynamic affiliation” concept discussed by Pessoa. In his discussion of network overlap at connector hubs, Pessoa

describes how a given brain region (for example the amygdala) might participate in several communities or networks. An exciting avenue for future research may involve the use of dynamic functional connectivity measures to ascertain the moment-to-moment contribution of a particular brain region to a specific large-scale brain network.

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