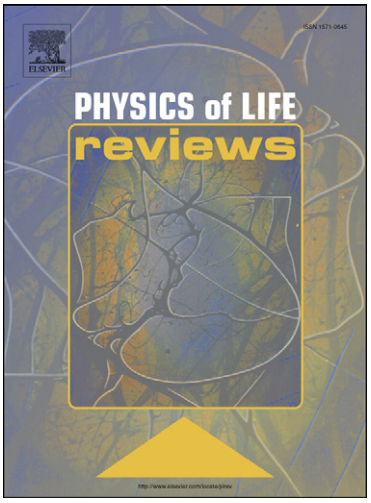

The function of neurocognitive networks

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Comment

The function of neurocognitive networks
Comment on "Understanding brain networks and brain organization" by Pessoa

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Pessoa [5] has performed a valuable service by reviewing the extant literature on brain networks and making a number of interesting proposals about their cognitive function. The term *function* is at the core of understanding the brain networks of cognition, or neurocognitive networks (NCNs) [1]. The great Russian neuropsychologist, Luria [4], defined brain function as the common task executed by a distributed brain network of complex dynamic structures united by the demands of cognition. Casting Luria in a modern light, we can say that function emerges from the interactions of brain regions in NCNs as they dynamically self-organize according to cognitive demands. Pessoa rightly details the mapping between brain function and structure, emphasizing both its pluripotency (one structure having multiple functions) and degeneracy (many structures having the same function). However, he fails to consider the potential importance of a one-to-one mapping between NCNs and function. If NCNs are uniquely composed of specific collections of brain areas, then each NCN has a unique function determined by that composition.

Luria's definition implies that NCNs are highly versatile: by dynamically uniting brain areas in a large number of different combinations as demanded by a broad range of cognitive demands, they perform a wide variety of functions. However, the attribution of function to an NCN may not always be straightforward given the limited repertoire of available behavioral paradigms, the lack of knowledge of the cognitive demands required, and the imprecision of NCN measurement. As an example of this difficulty, the function "face recognition" may be attributed to a distributed set of ventral occipital and temporal regions that are active when subjects recognize faces, but "face recognition" may not adequately describe all the functions of the various NCNs that involve these areas. The composition, and hence the function, of NCNs may be idiosyncratic, changing with the cognitive demands imposed by a particular behavior performed by a given individual.

Finally, for Pessoa, functional connectivity is largely undirected and measured by correlation. This emphasis ignores the directedness of structural connectivity in the brain: the axons of neurons in the brain leave the soma, travel to receiving neurons, and terminate with synapses on postsynaptic neurons. To conform to this basic directionality of structural connectivity, the characterization of NCNs and their functions should be described in terms of directed functional connectivity. Although still in its infancy, the study of directed functional connectivity is already making advances in neuroscience,