

Frontiers Research Topic

Title

Relationship between structural and functional brain connectivity.

Description

An important aspect of basic and clinical neuroscience research is to characterize structural and functional connectivity patterns of the human brain. Over the past decades, neuroscientists have isolated a variety of brain areas responsible for different mental processes by using functional neuroimaging technologies such as functional magnetic resonance imaging. However, most cognitive processes do not result from brain activity within one single brain area. Rather, behaviour results from the orchestrated activity of a distributed network comprised by several cortical and/or subcortical brain regions, which are all highly interconnected. Investigating the structural organization and functional coordination within these networks involves measuring the connectivity among brain areas. Therefore, characterising the interplay between distributed brain regions is mandatory for our deeper understanding of how cognitive, affective, motivational and volitional processes as well as their dysfunctions emerge from the brain.

While functional connectivity can only exist between regions that are connected structurally, the relationship between those kinds of connectivity is not as simple and straightforward as one might imagine. There are several ways of combining structural and functional connectivity measures (see Table 1 below).

Table 1. Ways of combining structural and functional brain imaging data to investigate neural connectivity. Table adopted from Rykhlevskaia and colleagues, *Psychophysiology*, 45 (2008), 173-187.

		Functional (physiological)	
		Each region is analyzed separately (univariate analysis).	Regions are combined (analysis of covariance).
Structural (anatomical)	Each region is analyzed separately (anatomy is used only as a reference).	Traditional functional imaging studies.	Functional connectivity studies seeded on the basis of anatomical information.
	Regions are combined (analysis of white matter tracts).	Structural connectivity analysis paired with univariate functional analysis.	Analysis of functional connectivity informed by structural connectivity.

In the present Frontiers research topic entitled “Relationship between structural and functional brain connectivity”, we invite work from the colour-shaded sections of Table 1, i.e. studies of functional connectivity informed by structural connectivity as well as structural connectivity analyses paired with functional analyses.

It has repeatedly been shown, for example, that resting-state functional connectivity reflects structural connectivity and that combining modalities can enrich our understanding of these canonical brain networks in health and disease. We invite contributions related to a wide range of state-of-the-art methodologies of combined structural and functional brain connectivity (e.g. diffusion MRI, sMRI, fMRI, rsfMRI, EEG, MEG, TMS) and the potential applications of such combined applied methods might involve a broad range of basic and clinical human system neuroscience. Work examining connectivity at the level of single connections as well as at the whole-brain level is invited.

Deadlines

Abstract submission: August 01, 2013.

Manuscript submission: February 01, 2014.

Hosts / Topic editors

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