

REPRODUCIBILITY ASSESSMENT OF THE FIRST PRINCIPAL NETWORK CALCULATION: A TOOL FOR STUDYING ANATOMICAL BRAIN CONNECTIVITY

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Target audience: Scientists and physicians interested in methods to study brain connectivity through identification of relevant networks of cortico-cortical connections.

Introduction and purpose: Cortico-cortical connectivity refers to a pattern of structural, statistical or causal association between anatomically segregated areas of the grey matter (GM). At a macro-scale human brain is a “small-world network”¹, so, neural connectivity is meaningfully characterised only in relevant subnetworks. The “Principal Networks”² (PNs) analysis enables the calculation of highly-interconnected cortico-cortical patterns from measures of between-subject correlation of cortical thickness. In this work, 1) we evaluate the reproducibility of the main brain subnetwork, called “first PN”; 2) we assess the influence of individual subjects over the first PN calculation; 3) we evaluate the dependency of the outcome on the size of the data set.

Lobe	Cortical gyri included in the first PN
Frontal	Superior Frontal
	Caudal/Rostral Middle Frontal
	Pars Opercularis/Triangularis/Orbitalis**
	Medial/Lateral Orbitofrontal
	Precentral
Parietal	Paracentral**
	Caudal*/ Rostral Anterior Cingulate
	Superior/Inferior Parietal
	Supramarginal
	Postcentral
Temporal	Precuneus
	Posterior Cingulate
	Superior/Middle/Inferior/Transverse* Temporal
	Fusiform
Occipital	Parahippocampal**
	Lateral Occipital
	Lingual
	Cuneus**

Table 1 Regions in the first PN. */** detected only in the left/right hemisphere (LH/RH).

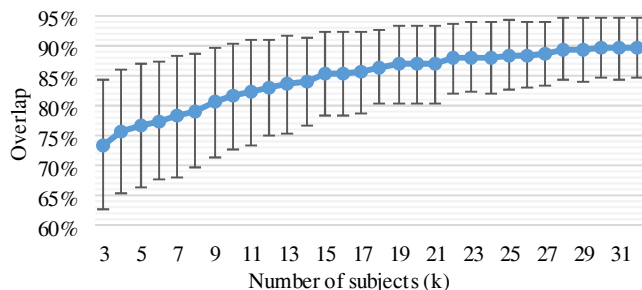


Figure 1 Proportion of vertices (mean and SD) common to the first PN calculated with the full data set and first PN recalculated 1000 times from random samples of k subjects (with replacement).

Discussion and conclusion: We suggest the PNs technique to calculate the main influential subnetwork in the brain along with a leave-one-out approach to assess the influence of individual subjects over the final result. We underline that determination of the first PN is robust against the exclusion of a single subject, but dependent on the total number of subjects involved in the calculation. In fact, with reference to previously reported finding², we showed that calculation of the first PN was reproducible using two different data sets, and that our outcome appeared to be stabilising considering 28 subjects (or more) out of 32. This fact, in particular, shows that it was meaningful to compare our first PN with the one previously published, for which 28 subjects were considered. Differences between our network and the reference may have been caused by different imaging protocols and MRI scanners or by FreeSurfer cortical reconstruction process itself, which has 0.5 mm accuracy, while thickness of the human cerebral cortex varies between 1 and 4.5 mm. However, good overlap of the networks obtained from two different data sets encourages future use and development of this technique.

References: 1) E. Bullmore et al. in *Nat. Rev. Neurosci.* 2012. 2) J. D. Clayden et al. in *PLoS ONE* 2013. 3) V. Lippolis et al. in *Proc. Intl. Soc. Mag. Reson. Med.* 2014.