The unique brain organization: variant yet reproducible

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Abstract:

Resting state fMRI (R-fMRI) is a powerful tool for in vivo identifying the organization of the human brain. Recent studies have suggested that the detection of abrupt transition zones in intrinsic functional connectivity (iFC) profiles can recapitulate classic distinctions in the functional architecture, which were established by invasive neurophysiologic and histologic methodologies. This novel approach has so far been established in population-level from averaged patterns as well as in individual-level using a rich single individual dataset. Here, we used test-retest R-fMRI dataset from 30 participants who were scanned every three days within one month to investigate the distinctions and/or variations of functional organizations within and between individuals. High intra-individual variability indicated the organization of individual is considerably reproducible, while low inter-individual variability implied that the cortical organization is unique and striking variant across individuals. In addition, the sources of variance exhibited spatial heterogeneous across the cortex. Specifically, the organization of association cortex was more stable within individual while substantially distinct across individuals. However, the parcellation of unimodal cortices such as visual, somato-motor area exhibited more consistent across individuals yet varies within individual. The convergence of transition zones has also been evaluated at individual level and demonstrated relatively high reliability of functional parcellation using sufficient data. Beyond the similarity of iFC, we measured the spatial transitions of local and global of iFC properties to capture different aspects of cortical organization and demonstrated their reliability and the correlations with the parcellation based on similarity of iFC. These findings established the reliability and reproducibility of the novel parcellation scheme, providing potential implications for understanding the complexity and uniqueness of functional brain organization in individuals.