FUNCTIONAL NETWORKS IN THE MACAQUE BRAIN REVEALED BY INDEPENDENT COMPONENT ANALYSIS OF RESTING-STATE FMRI

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Purpose: To examine large-scale functional networks of the macaque brain.
Background: Electrophysiological studies of the macaque have revealed brain areas specialized in the processing of sensory modalities, feature dimensions, and task demands. Perception, cognition, and motor control, however, require functional integration of these brain regions through large-scale network organization. Examination of temporal correlations in the low-frequency fluctuations (0.01-0.1 Hz) of the BOLD signal acquired using functional connectivity fMRI has revealed the structure and dynamics of multiple independent distributed networks within the human brain[1]. These same techniques can be used to facilitate an understanding of homologous network processing of the macaque and guide future invasive investigations.
Materials and Methods: Six rhesus monkeys were anesthetized with isoflurane (1%) and imaged at 7 T with no stimulation parameters for 2 scans of 10 min. Functional images were acquired with an EPI sequence (matrix size=72 X 72, FOV=96 x 96 mm, 30 slices, TR=2s, TE=16 ms). The hypothesis independent, exploratory technique, independent component analysis (ICA) was implemented in the GIFT software package (20 component model). ICA uses a linear model to decompose independent, non-Gaussian datasets into distinct subparts[2] and has been successfully applied to functional data sets to show distinct functional network activity[3].
Results: Homologues were found for the most commonly reported human RSNs including higher-order networks facilitating executive functioning, attentional processing, reward evaluation, and default-mode activity as well as lower-order networks responsible for vision, audition, sensorimotor integration, and motor control (Fig. 1).
Discussion: The consistency of RSNs between macaques and humans suggests the same gross topological cortical organization, thereby providing strong support for their use as an animal model in the study of normal and abnormal functional connectivity

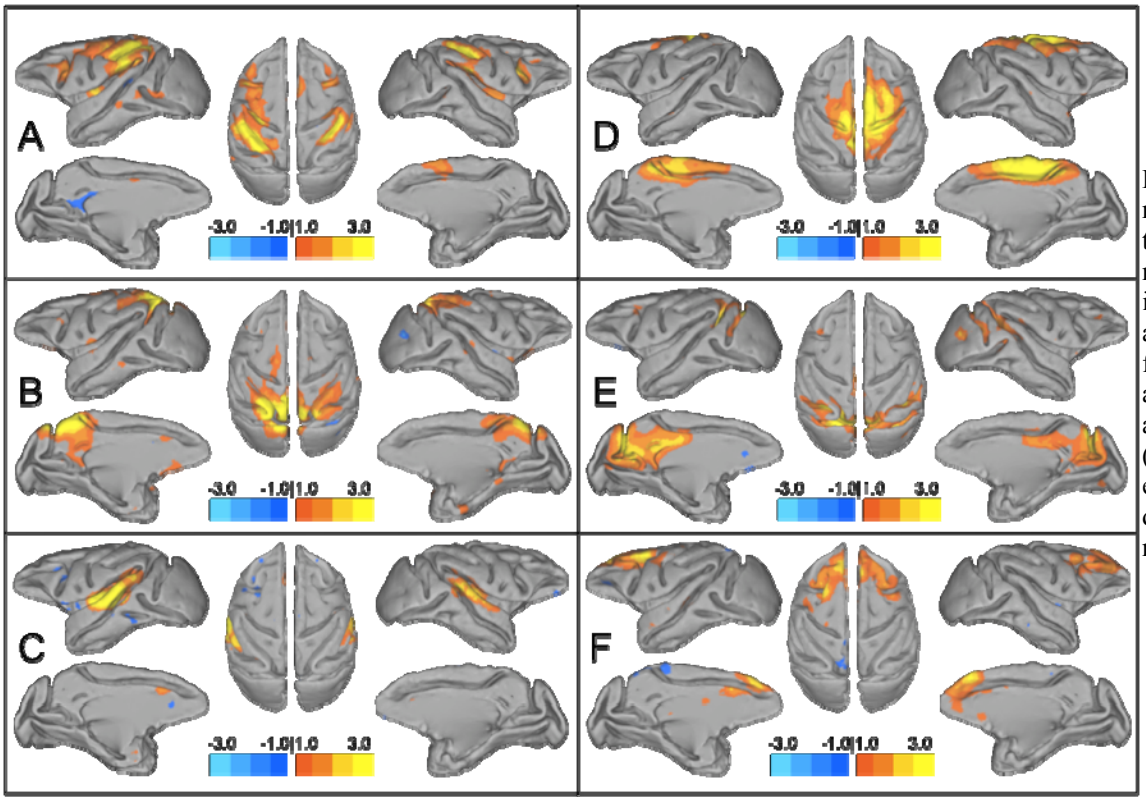

Fig 1. A selection of resting-state networks of the isoflurane anesthetized macaque derived using independent component analysis (ICA) of BOLD functional data. (A) attention, (B) default, (C) auditory, (D) dorsal motor, (E) visual, and (F) executive networks are displayed in 3D rendered, normalized space.

References
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