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기능자기공명영상 (Functional MRI)

SY09-1

Probing Arousal Modulation of Brain Networks Using Multimodal fMRI

Zhifeng Liang

Institute of Neuroscience, Chinese Academy of Sciences, China

Arousal fluctuation is known to contribute to fMRI based functional dynamics, but its detailed mechanism is largely unclear. Combining invasive neural recording (electrophysiological recording and fiber photometry) and manipulation (optogenetics and chemogenetics) techniques with awake, unanesthetized animal fMRI provides unique opportunities to unravel the arousal contribution. Highly optimized unanesthetized mouse and marmoset fMRI setups allowed a wide range of arousal states from high alertness to NREM and REM sleep, which was identified through simultaneous electrophysiological recording. Dynamic functional connectivity analysis revealed an inverted U-shape modulation of global functional connectivity strength and functional gradient from low to high arousal level. Further combined with simultaneous fiber photometry, our multimodal fMRI revealed direct relationship between Locus Coeruleus Norepinephrine (LC-NE) system and such modulation. Direct neuronal manipulation using optogenetics/chemogenetics simultaneously with awake mouse fMRI confirmed the causal contribution of LC-NE system to inverted u-shape modulation. In conclusion, multimodal fMRI in awake rodent and non-human primate revealed arousal modulated inverted U-shaped functional connectivity dynamics, which can be driven by LC-NE activity.

Keywords: *Multimodal fMRI, Awake mouse fMRI, Locus coeruleus*