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Review

Spontaneous activity in developing sensory circuits: Implications for resting state fMRI

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ABSTRACT

The immature brain spontaneously expresses unique patterns of electrical activity that are believed to contribute to the development of neuronal networks. Certain electrographic features of this activity, particularly modulation on an infraslow time scale, resemble activity patterns observed in the mature brain at 'rest', loosely defined as the absence of an investigator imposed task. However, it is not clear whether the immature activity patterns observed at rest are precursors of the spontaneous neuronal activity that forms resting state networks in the adult. Here, we review recent studies that have explored the generative mechanisms of resting state activity during development in the primary sensory systems of premature human neonates and neonatal rodents. The remarkable hypothesis suggested by this work is that while resting state activity during the pre- and possibly near-term period can bear superficial resemblance to adult activity it is fundamentally different in terms of function and origin. During early development spontaneous thalamocortical activity in primary sensory regions is determined largely by transitory generators in the sensory periphery. This is in contrast to the adult, where spontaneous activity generated within thalamocortex, particularly by cortico-cortical connections, dominates. We therefore suggest a conservative interpretation of developmental mapping studies which are based on indirect measurement of activity (e.g. fMRI), or on the partitioning of EEG frequency using bands derived from adult studies. The generative mechanisms for brain activity at early ages are likely different from those of adults, and may play very different roles; for example in circuit formation as opposed to attention.

Contents

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