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MODELING GOAL-ORIENTED DECISION MAKING THROUGH COGNITIVE PHASE TRANSITIONS

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Cognitive experiments indicate the presence of discontinuities in brain dynamics during high-level cognitive processing. Non-linear dynamic theory of brains pioneered by Freeman explains the experimental findings through the theory of metastability and edge-of-criticality in cognitive systems, which are key properties associated with robust operation and fast and reliable decision making. Recently, neuropercolation has been proposed to model such critical behavior. Neuropercolation is a family of probabilistic models based on the mathematical theory of bootstrap percolations on lattices and random graphs and motivated by structural and dynamical properties of neural populations in the cortex. Neuropercolation exhibits phase transitions and it provides a novel mathematical tool for studying spatio-temporal dynamics of multi-stable systems. The present work reviews the theory of cognitive phase transitions based on neuropercolation models and outlines the implications to decision making in brains and in artificial designs.

Keywords: Neurodynamics; phase transition; neuropercolation; metastability; decision theory