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Phase transition and Self-Organized Criticality in the Brain MARZIEH ZARE, University of North Texas, MALGORZATA TURALSKA, Duke University, PAOLO GRIGOLINI, University of North Texas — Empirical evidence for a scale free distribution of avalanche sizes in the brain as a manifestation of self-organized criticality (SOC) suggests that the brain operates near criticality. Simulations in the literature also show the optimal function of the brain at criticality. However, due to the lack of sufficient set of conditions in the SOC hypothesis for the classification of a system, there is no clear connection between the phase transition and SOC. Here we study a set of cooperative neurons in a two-dimensional regular network. Using a leaky integrate-and-fire model, we analyze the temporal complexity and find a phase transition from Poisson to periodic process for a specific value of the cooperation parameter. We also evaluate the efficiency of information transfer between two networks and find the maximum at the same critical value. To study the connection between phase transition and SOC, we measure the avalanche size distribution at the critical point. Our results show no evidence on scaling to the popular inverse power law of 1.5 in size, while we observe this scaling in the supercritical regime. Overall, based on these results, we propose that an epileptic brain can generate power law scaling while a healthy brain works in an intermediate regime.

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