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Title Neural network models of hierarchically organized mental states show highly variable activity with long range temporal correlations.

Text The neural activity recorded in behaving animals is highly variable in time. It is observed to change within every trial of the task, and across different trials. Such variability might be due to uncorrelated noise or to more structured fluctuations in the neuronal activity reflecting the occurrence of uncontrolled events.

We propose a neural network model in which mental states are represented by stable attractors of the neural dynamics and external or mentally generated events induce transitions from one state to another. The structure of mental states and event driven transitions is encoded in the synaptic couplings between neurons, and it contains the instructions to react to specific events. Every state might represent a particular combination of disposition to behavior, intentionality, emotionality, and, more in general, it represents a general form of context. Some states can be equivalent concerning the task relevant behavior, but differ when the neural representation is considered. The sudden and simultaneous modification of multiple neuronal activities observed in monkey experiments supports the scenario in which controlled or uncontrolled events drive transitions between different mental states.

We show that there is a wide class of hierarchically organized sets of states and transition schemes which produce highly variable neuronal activity. These fluctuations show long range power law autocorrelations.

Moreover, the proposed models can explain the 1/f noise widely observed in human cognitive and performance tasks, and they can provide a useful interpretative tool to decode the highly variable activity recorded in vivo.
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Theme F - Cognition and behavior
Human cognition and behavior - Decision making and reasoning
