Generalized simulated annealing on complex networks for modelling memory in psychology.

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We have previously described neurosis in terms of memory functioning and proposed a neural network mechanism, whereby neurotic behavior may be understood as an associative memory process in the brain. Memory was first modeled by a Boltzmann machine (BM), represented by a complete graph. Since it is known that brain neural topology is selectively structured, we have further developed the memory model, including known microscopic mechanisms that control synaptic properties, showing that the network self-organizes to a hierarchical, clustered structure.

The resulting power-law and $q$-exponential behavior for the node degree distribution of the network’s topology suggest that memory dynamics and associativity may not be well described by Boltzmann-Gibbs (BG) statistical mechanics. We thus model memory access dynamics by a generalization of the BM called Generalized Simulated Annealing (GSA), derived from the nonextensive formalism. In GSA, the probability distribution of the energy states of the system’s microscopic configurations is not the BG distribution, assumed in the BM, and this should affect the chain of associations of ideas which we are modelling. We illustrate the model with computer simulations.