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Network complexity: when interaction strengths matter more than topology[1] MIKHAIL TIKHONOV, Joseph Henry Laboratories of Physics, Princeton University, WILLIAM BIALEK, Joseph Henry Laboratories of Physics, Lewis-Sigler Institute for Integrative Genomics, Princeton University — A typical cellular network has thousands of microscopic parameters that cannot all be equally relevant to the network function; yet discarding them and considering only the topology of interactions is unacceptably coarse. How much do quantitative details matter? We present a toy model where the appropriately mesoscopic level of description can be found exactly. We define a measure of network complexity and find that both the choice of topology and strength of interactions can affect the complexity dramatically, but optimizing interaction strengths typically has a stronger effect. We further show that a larger network is not automatically more complex; constructing a high-complexity network always requires a careful adjustment of the strengths of interactions. This suggests that the challenge of "evolving a complex network" does not reduce to making new connections and constructing a dense topology of interactions. Evolution acting on "numbers on arrows" (interaction strengths), even within the confines of a fixed topology, is a much more effective way of increasing complexity than adding new components and connections of some typical strength.

[1]NSF Center for Science of Information

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