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When does entropy promote local organization?

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Crowded soft-matter and biological systems organize locally into preferred motifs. Locally-organized motifs in soft systems can, paradoxically, arise from a drive to maximize overall system entropy. Entropy-driven local order has been directly confirmed in model, synthetic colloidal systems, however similar patterns of organization occur in crowded biological systems ranging from the contents of a cell to collections of cells. In biological settings, and in soft matter more broadly, it is unclear whether entropy generically promotes or inhibits local organization. Resolving this is difficult because entropic effects are intrinsically collective, complicating efforts to isolate them. Here, we employ minimal models that artificially restrict system entropy to show that entropy drives systems toward local organization, even when the model system entropy is below reasonable physical bounds. By establishing this bound, our results suggest that entropy generically promotes local organization in crowded soft and biological systems of rigid objects.

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