Transition to collective behavior in eukaryotic cell populations

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COLLECTIVE dynamics are widely observed during development of multicellular bodies and emerge as a result of communication among individual cells via signaling molecules. However, little is known experimentally of the fundamental features that describe how the highly nonlinear spatio-temporal dynamics at the single-cell level can give rise to coherent dynamics at the population level. Here a FRET-based sensor protein, combined with live-imaging is used to monitor cytosolic levels of cAMP which serves as the messenger molecule in developing cells of social amoebae *Dictyostelium discoideum* to allow individual cells to aggregate to form fruiting bodies. Timelapse recordings of cell populations during the first 10 hours of development reveal the very onset of periodic spike-like signaling and sequential changes in the frequency at single cell level resolution. Collective cAMP oscillations in populations of cells under perfusion reveal a sharp phase transition between a decoupled and a synchronized state for a range of cell densities and dilution rates. These observations suggest that the intact population is able to drive itself to this transition spontaneously during development.