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Limits to Chemically Guided Multicellular Migration JULIEN VARENNES, BUMSOO HAN, ANDREW MUGLER, Purdue Univ — Collective cell migration in response to a chemical cue requires both multicellular sensing of chemical gradients and coordinated mechanical action. Examples from morphogenesis and cancer metastasis demonstrate that clusters of migratory cells are extremely sensitive, responding to gradients of less than 1% difference in chemical concentration across a cell body. While the limits to multicellular sensing are becoming known, the ensuing consequences for coherent migration remain poorly understood. We develop a model of multicellular sensing and migration based on the cellular Potts model. Multicellular sensing of noisy chemical gradients is modeled as a process of local excitation and global inhibition (LEGI) among communicating cells. The output of the sensing process is coupled to individual cells polarization to model migratory behavior. We find that larger clusters of cells detect the gradient direction with higher precision and thus achieve stronger polarization bias. At the same time, larger clusters are also accompanied by less coherent collective motion. The trade-off between these two effects leads to an optimally efficient cluster size. We discuss how our results relate to cancer metastasis.

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