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Emergence of oligarchy in collective cell migration. LINUS SCHUMACHER, PHILIP MAINI, RUTH BAKER, University of Oxford — Identifying the principles of collective cell migration has the potential to help prevent birth defects, improve regenerative therapies and develop model systems for cancer metastasis. In collaboration with experimental biologists, we use computational simulations of a hybrid model, comprising individual-based stochastic cell movement coupled to a reaction-diffusion equation for a chemoattractant, to explore the role of cell specialisation in the guidance of collective cell migration. In the neural crest, an important migratory cell population in vertebrate embryo development, we present evidence that just a few cells are guiding group migration in a cell-induced chemoattractant gradient that determines the switch between "leader" and "follower" behaviour in individual cells. This leads us to more generally consider under what conditions cell specialisation might become advantageous for collective migration. Alternatively, individual cell responses to locally different microenvironmental conditions could create the (artefactual) appearance of heterogeneity in a population of otherwise identical cellular agents. We explore these questions using a self-propelled particle model as a minimal description for collective cell migration in two and three dimensions.

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