Self-organisation of biological patterns

Marie Manceau

Center for Interdisciplinary Research in Biology, Collège de France, CNRS 7241, INSERM U1050, Paris, France
marie.manceau@college-de-france.fr

During pattern formation, morphogenetic events provide a response of the naïve tissue to chemical and mechanical positional cues. To what extent these processes shape pattern establishment and contribute to natural variation remains unclear. We produced a mathematical model predicting that intrinsic tissue properties shape the emergence of feather array geometries in birds, which involves a gradual regionalisation of the skin through self-organisation. We identified highly dynamic modifications of local cell density, movement, and shape occurring during primordia emergence in the Japanese quail. Using inter-species comparison in poultry, finch, emu, ostrich and penguin embryos, followed by perturbation of skin architecture ex vivo, we showed that oriented anisotropy of dermal cells prior to primordia formation is necessary for the regularity of the final array. Our results provide key insights into the cellular basis of self-organisation and demonstrate that initial tissue morphology constrains pattern attributes, uncovering a morphogenetic mechanism contributing to pattern evolution.