Evolution and variability of morphogenesis in *Volvox*

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Abstract:

All *Volvox* embryos undergo the process of inversion during which they turn themselves inside-out in order to expose their flagella. So far, inversion processes in different species have been divided into two distinct types: in type A inversion vour lips at the anterior embryo pole curl backwards while type B inversion starts with a circular invagination at the equator. However, our 3D *in vivo* studies using light sheet fluorescence microscopy show that the embryos of some species including *V. dissipatrix* and *V. tertius* show features of both inversion types. This finding stresses the question how different inversion tactics evolved.

In addition to variations between species there is also a certain variability between inversions of individual embryos. How stereotypic morphogenetic processes have to be in order to be completed successfully is an important but understudied question in developmental biology. To perform three dimensional deformations, such as invagination or involution, cell sheets need to overcome geometrical bottlenecks. The local regions that act to overcome these bottlenecks need to be more closely regulated and are likely to show less variation. In order to identify such crucial areas and stages we have quantified the variability of inversion of *V. globator* embryos. Our findings are consistent with previously observed cell shape changes and with the predictions of our mathematical model of type B inversion.