Novice and Expert Understandings of Space in Scientific Diagrams

Ben Sheredos*[1]

[1]UC San Diego, Department of Philosophy – United States

Abstract

Session: Reasoning with Diagrams in Biology (Ben Sheredos, Dan Burnston, Laura Perini)
Professional biologists are skilled graphic designers. In creating diagrams, they harness space-on-the-page to aid their own reasoning, and to communicate rich (but not error-free) theoretical conceptions of their domain of inquiry. I examine uses of diagrammatic space in portrayals of the mechanisms of circadian rhythmicity in various living systems (from humans to algae) to articulate aspects of what DiSessa labels the "meta-representational competence" that experts exhibit in their reasoning with these diagrams.
Meta-representational competence must be acquired. Novices can, as shown by cognitive scientists like Tversky and Hegarty, complete various tasks of diagram comprehension best if the distribution of ink on the page has a "natural mapping" to the semantic structure of a theoretical domain. It is thus often suggested that educators and working scientists alike would do well to design graphics so as to exploit any "natural mappings" which are available. I aim to add nuance to this view, by pointing out that in the course of coming to emulate expert practice, aspiring scientists must carefully learn to temper their reliance upon "natural mappings." Distinct sub-regions of space-on-the-page within a single diagram often require distinct mappings to a variety of theoretical domains. A great source of diagrams' utility in biology consists in enabling researchers to *coordinate* these theoretical domains, but this requires a bifurcation of the total space-on-the-page into *multiple* spaces which each support an independent mapping. As I show by example, there is frequently no sensible way to perform a "global" mapping from total space-on-the-page to theoretical domains.

*Speaker