

“ A Reexamination of Biological Information from the Perspective of Practice”

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Abstract

Much of the debate surrounding the concept of information in biology centers on the question of whether or not biological systems ‘really’ carry information. The criterion for determining if a system “really” carries information is whether or not there is a principled, theoretical account of information that captures the relevant biological usages. If biological systems do not carry information in this sense, information talk is termed merely heuristic and dismissed as philosophically uninteresting. To date, all three proposed theoretical accounts of information—mathematical, causal and teleosemantic—fail to capture the meaning of biologists. Details of other biological practices that utilize informational concepts are often lost because the debate is too focused on one instance of information talk—genetic information and because biological representations are thought to need a certain kind of theoretical foundation. The problem with this methodology is that it takes the failure of philosophical accounts of information to capture current biological practices as conclusive evidence that informational representations in biology are incoherent. This approach is backwards. A better strategy is to get a clear understanding of biological practice and then to use it to shape our understanding of the philosophical significance of biological information.

In this paper, I shift attention from abstract reasoning about information in the philosophical literature to concrete reasoning about informational models in biology. The current debate pays too little attention to the biologically prominent concept of signal. I develop a contextualized understanding of signaling models in biological practice. I argue that biologists use the concept of signal to model distinct functional roles in biological systems and not in any of the theoretical senses of information found in the current philosophical literature. For cell biologists, a signal causally indicates the state of a system at a given point and is used in the context of a style of functional explanation generally known as ‘causal role function,’ in which a mechanism or entity has a function if its behavior explains a contribution to a capacity of interest.

I support this analysis with an example drawn from cell biology and reframe the debate over the significance of informational terms in biology. The focus on signal recasts the debate by highlighting examples of information talk which are central to active research programs in biology. The advantage of looking at these models is that their centrality to biological practice forces us to reconsider the adequacy of a methodology that dismisses biological models because we lack a particular kind of philosophical understanding of them. Standard philosophical accounts of information rely on assumptions appropriate for the needs of philosophers but are ill-suited for capturing biological practice. A contextualized understanding of the role of signal in biological practice allows us to work out from the details of practice to tackle broader philosophical issues. On this view, the significance of information talk in biology hinges more on our understanding of how biologists represent function than on our understanding of philosophical accounts of information.

Keywords: Biology, Information, Signal

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