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Optimality in cellular response: Microorganisms anticipate and prepare in advance to environmental changes

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Natural habitats of some microorganisms may fluctuate erratically, whereas others, which are more predictable, offer the opportunity to prepare in advance for the next environmental change. In analogy to classical PavlovianConditioning, microorganisms may have evolved to anticipate environmental stimuli by adapting to their temporal order of appearance. Our research indicated that this adaptation exists in two model microorganisms, *Escherichia coli* and *Saccharomyces cerevisiae*(Mitchell et al., *Nature*, 2009). In both species we observed that the predicative response strategy entails the organism with a fitness advantage. Focusing on the molecular level revealed that the natural temporal order of stimuli is embedded in the wiring of the regulatory network. Additionally we have developed a mathematical framework to better elucidate the interplay between key biological and environmental forces that select for this type of adaptation (Mitchell and Pilpel, *PNAS* 2011). The combined theoretical–experimental approach employed helps to assess the potential of natural ecologies to support a predictive behavior.

Biography

Amir has completed his Ph.D at the Weizmann Institute of Science, Israel, and is currently a postdoc at the University of California, San Francisco. Amir has employed experimental and computational approaches to uncover the parallels between evolutionary adaptation and cognitive learning. His discovery that microorganisms can actually "predict" future changes, and prepare to them in advance, was published in Nature and PNAS and was reported in many of the leading journals. Amir has received the Haim Holtzman Prize and the Israeli Society for Biochemistry award of excellence for this work and was a fellow of the Adi Lautman interdisciplinary program for outstanding students at Tel-Aviv University, Israel.