Noise Propagation in Transcriptional Cascades

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The flow of information through a biological network can greatly influence the operation and behavior of the system. Quantitative analysis of these properties is often difficult in naturally occurring systems, but can be greatly facilitated by studying simple synthetic networks. Here we present synthetic transcriptional cascades of various length and study their dynamic and steady state behavior both experimentally and through a stochastic model. These systems enable us to analyze sensitivity and noise propagation as a function of network complexity. We demonstrate experimentally steady state switching behavior that becomes sharper with longer cascades. The phenotypical variations in the system, which is referred to as “noise”, can be both attenuated and amplified depending on the input conditions. While noise attenuation allows the cascade to act as a low-pass filter by rejecting short-lived perturbations in input conditions, noise amplification results in loss of synchrony among a cell population. The experimental results demonstrating the above network properties correlate well the simulated model.