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Information content and cross-talk in biological signal transduction: An information theory study ASHOK PRASAD, SAMANTHE LYONS, Colorado State University — Biological cells respond to chemical cues provided by extra-cellular chemical signals, but many of these chemical signals and the pathways they activate interfere and overlap with one another. How well cells can distinguish between interfering extra-cellular signals is thus an important question in cellular signal transduction. Here we use information theory with stochastic simulations of networks to address the question of what happens to total information content when signals interfere. We find that both total information transmitted by the biological pathway, as well as its theoretical capacity to discriminate between overlapping signals, are relatively insensitive to cross-talk between the extracellular signals, until significantly high levels of cross-talk have been reached. This robustness of information content against cross-talk requires that the average amplitude of the signals are large. We predict that smaller systems, as exemplified by simple phosphorylation relays (two-component systems) in bacteria, should be significantly much less robust against cross-talk. Our results suggest that mammalian signal transduction can tolerate a high amount of cross-talk without degrading information content, while smaller bacterial systems cannot.

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