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Coupled feedback loops govern bistability properties in gene networks ABHINAV TIWARI, OLEG IGOSHIN, Rice University — Positive feedback is a necessary component for network bistability - the simplest design being a positive autoregulatory circuit. Then why some biological systems have multiple feedback loops? We hypothesize that the presence of multiple additively or multiplicatively coupled feedback loops affects the net cooperativity of the system, thereby influencing the possibility of bistability. We find that additively coupled feedback loops in the MprAB-SigE-RseA network in mycobacteria do not lead to bistability. Only the inclusion of post-translational regulation of SigE by RseA makes the system robustly bistable. In general we find that if two one-feedback networks are individually monostable, then only multiplicative coupling can generate bistability in the combined circuit. We analytically perform pair-wise controlled comparisons between the autoregulation circuit, additively and multiplicatively coupled two-gene circuits that reveal neither of the circuits has an advantage with regards to bistability range. We numerically validate our results by employing Monte Carlo parameter sampling for the comparisons.

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