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Positive feedback produces broad distributions in maximum activation attained within a narrow time window in stochastic biochemical reactions[1] JAYAJIT DAS, The Ohio State University — Stochastic fluctuations in biochemical reactions can regulate single cell decision processes. Using exact solutions and semi-analytical methods we calculate distributions of the maximum value (N) of species concentrations ($P_{max}(N)$) and the time (t) taken to reach the maximum value ($P_{max}(t)$) in minimal models of stochastic chemical reactions commonly found in cell signaling systems. We find, the presence of positive feedback interactions make $P_{max}(N)$ more spread out with a higher "peakedness" in $P_{max}(t)$. Thus positive feedback interactions may help single cells to respond sensitively to a stimulus when cell decision processes require upregulation of activated forms of key proteins to a threshold number within a time window. Moreover, unlike other models of strongly correlated random variables such as Brownian walks or fluctuating interfaces, the extreme value distributions for the chemical reactions display multiscaling behavior emphasizing the presence of many time scales in cell signaling kinetics.

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