Electronic Supplementary Material (ESI) for Integrative Biology
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Supplementary Figure 1

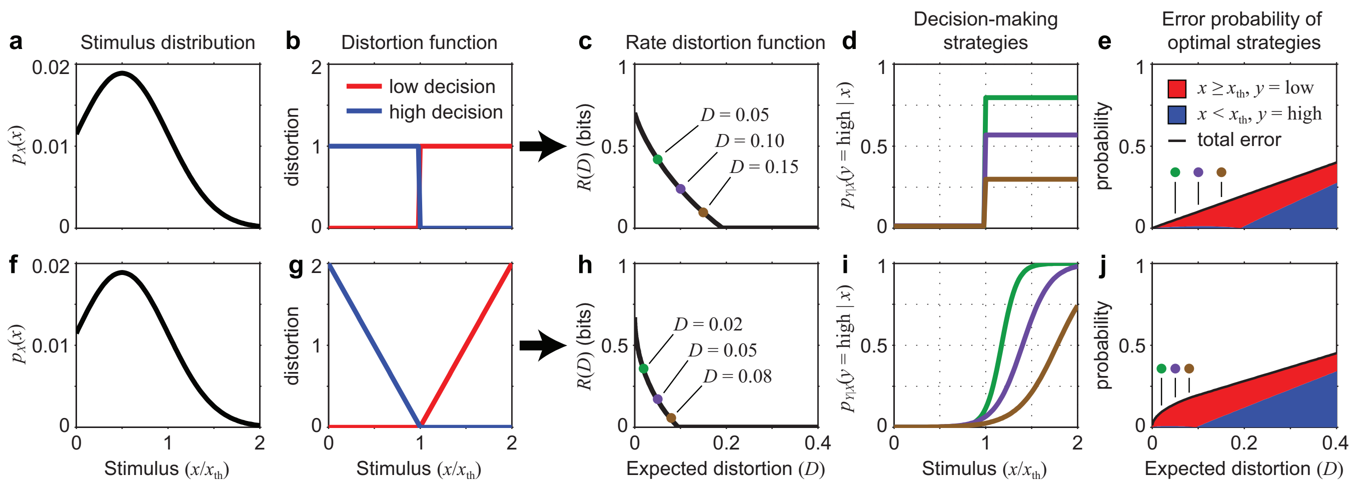

Figure S1: When using the rate distortion framework to design decision-making strategies, a Gaussian distribution of stimuli leads to results qualitatively similar to those obtained with an exponential distribution. (a-e) A Gaussian distribution of stimuli (a) was used with the Hamming distortion function (b) to compute the rate distortion function (c) and optimal strategies achieving several levels of expected distortion (d). As with the exponential stimulus distribution, the optimal conditional probability of deciding "high" takes one of two values depending on whether the stimulus exceeds the threshold x_{th}. The probability of error for these optimal strategies is shown in (e). (f-j) The same Gaussian stimulus distribution (f) was used with the graded distortion function (g) to compute the rate distortion function (h) and optimal strategies achieving several levels of expected distortion (i). As with the exponential stimulus distribution, the optimal conditional probability of deciding "high" is a sigmoidal function of the stimulus level. The probability of error for these optimal strategies is shown in (j).

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Supplementary Figure 2

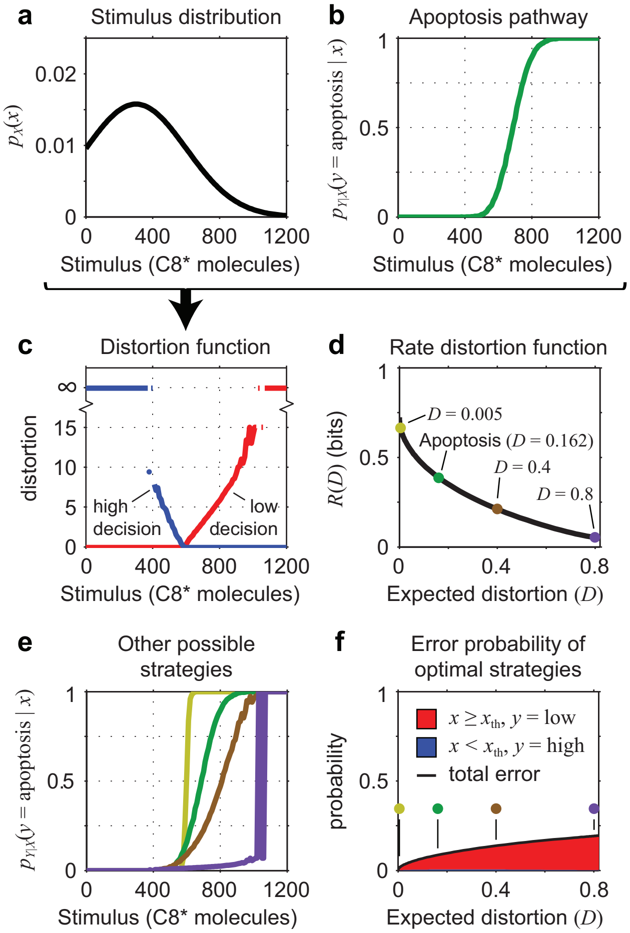

Figure S2: When using the rate distortion framework to analyze a cellular decision-making pathway, a Gaussian distribution of stimuli leads to results similar to those obtained with an exponential distribution. (a-c) Assuming a Gaussian distribution of stimuli (a), for the decision-making pathway that controls apoptosis (b), we can find the distortion function around which the pathway is optimized (c), which quantifies the goals of the pathway. The "jumps" in the distortion function are an artifact that arises when probabilities are estimated from a finite number of simulations. (d-e) For a given set of goals, we can compute the rate distortion function (d), which describes the information cost of low distortion. Points along this curve correspond to different optimal strategies (e), forming a trajectory for the evolution of a pathway to better achieve a fixed set of goals. The probability of error for these optimal strategies is shown in (f).