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# Stochastic transitions between discrete attractor states in a model taste-processing network

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Trial-to-trial variability in neuronal systems can arise from the timing of stochastically induced, rapid changes between discrete, metastable network states. Such transitions between states produce correlated, rapid changes in firing rates of the neurons. The sharp changes occur at a discrete but unpredictable time in an individual trial, but can be rendered into slow variations of activity when standard trial-averaging is used. Hidden Markov modeling has been used to verify such discontinuous network activity during taste processing in gustatory cortex [1].

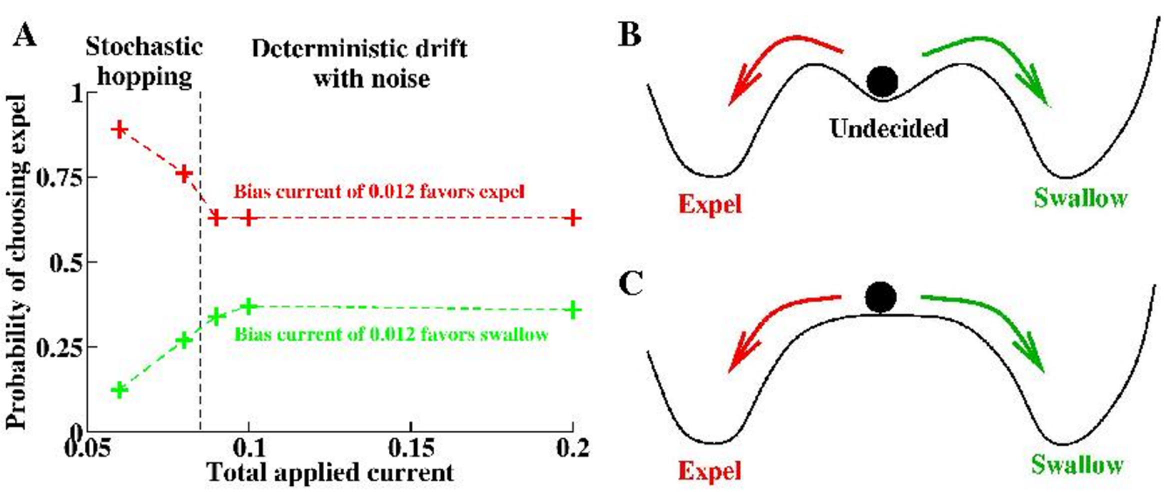


**Figure 1**
**Stochastic hopping between metastable states improves accuracy of choice**. (**A**) Results of 100 simulations with two mutually inhibiting populations, each of 100 neurons and fixed noise. Current is applied to each group, with a bias to favor one outcome. With low applied current, both populations would remain inactive (undecided state) in the absence of noise, so a change in state corresponds to stochastic hopping (**B**). With greater applied current the inactive (undecided) state is unstable so a deterministic drive (**C**) causes one population to become active.

Here we model a network of discrete attractor states, where taste-specific inputs bias the stochastic transitions between states to produce a sequence that is taste-specific, as seen in the experimental data. As in the experimental data, hidden Markov analysis reveals the discrete transitions between attractor states that are obscured by trial averaging. Furthermore, we find for a given noise level, that when external inputs provide a bias to one attractor state rather than another, that bias more strongly influences the trajectory of the system if the initial state remains stable, so that the noise itself produces the transition (see Figure 1). We consider the decision-making aspect of taste processing, "to swallow" or "to expel", as corresponding to a transition to one of two final attractor states. We suggest that a noise-induced transition to one of these decisive states leads to fewer mistakes and matches the activity of recorded neurons better than the alternative of a slowly ramping accumulation of evidence.

## References

1. Jones LM, *et al.*: **Ensemble responses of gustatory cortical neurons accurately predict tastant identity.** *Program No. 238.4 Society for Neuroscience Meeting Planner Atlanta, GA. Online* 2006.

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