Dynamics of perceptual bistability.

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In binocular rivalry, a widely studied paradigm for visual perceptual bistabilty, each eye views different images but perception alternates randomly between them, time scale of seconds. Various dynamical models lead to alternating mutual exclusivity with neuronal competition implemented as reciprocal inhibition between two neuronal populations. We will describe two mechanistic frameworks for the switching behavior. Slow negative feedback sets the basic time scale for switching.

At one level of idealization, firing rate (mean field) models are formulated without stochastic features and the alternations are periodic. The negative feedback is strong enough to cause a dominant population to "release" the other from inhibition or feedback recovers enough to allow a suppressed population to "escape" from inhibition. The escape mechanism is consistent with widely accepted impressions of the experimental results that mean dominance period decreases with stimulus intensity; release is not.

In an alternate, attractor-based, framework negative feedback is relatively weaker and alternations are induced by noise operating on a bistable system. We have developed such attractor models at different levels of description – with double-well potential models, with rate-based and with spiking network models. A novel network architecture emerges and dominance period varies in accord with the classical view.