Neural Information as a Correlate of Parkinson's Disease Symptom Severity

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Parkinson's Disease
- Affects ~1 million Americans.
- Death of dopaminergic neurons in substantia nigra.
- Exact causes unknown.

Standard neuroscience metrics fail to explain symptom severity.
- LDOPA decreases thalamic inhibition, DBS increases it.
- If none of the standard measures (firing rate, synchrony, etc) are predictive of symptom severity, we need new metrics.

Mutual information as a correlate of symptom severity
- Parkinsonian rats have increased irregularity and decreased mutual information in and across GP and SNr.
- DBS restores these values.
- We hypothesize that mutual information will decrease across all basal ganglia connections, as well as the BG to thalamus connection.

Treatments
- LDOPA
- Lesion
- DBS

Basal Ganglia

Information Theory
- Entropy is a measure of disorder and can be applied to spike trains.
  - Totally regular --> No entropy
  - More irregular --> More entropy
  - More entropic signal --> more information, a measurable quantity.
  - Mutual information measures the amount of information that can be obtained about one "random" variable by observing another.
  - Information that A gives of B is defined as the difference between the entropy of A and the entropy of A given knowledge of B.

Ongoing work
- Informational changes within basal ganglia to be analyzed in increasingly parkinsonian states in primate model.
- Rat model being used to analyze information transfer from SNr to thalamus.

Creating progressive model of PD in rats, to use rather than the healthy vs severely PD model commonly used.