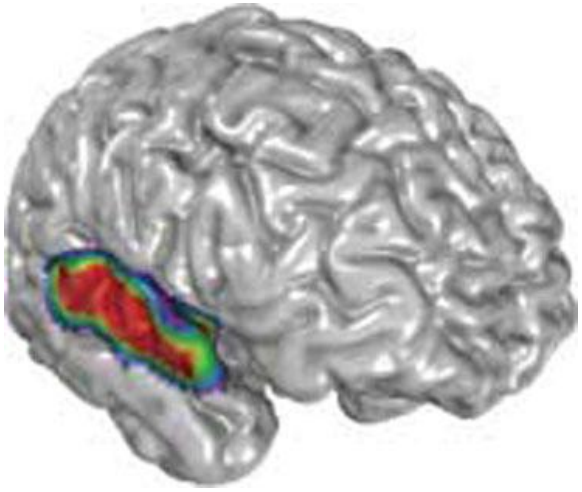
BIEN 2011

Neural Systems Laboratory

Rhythmic Perception & Neural Correlates

Brendan Fennessy



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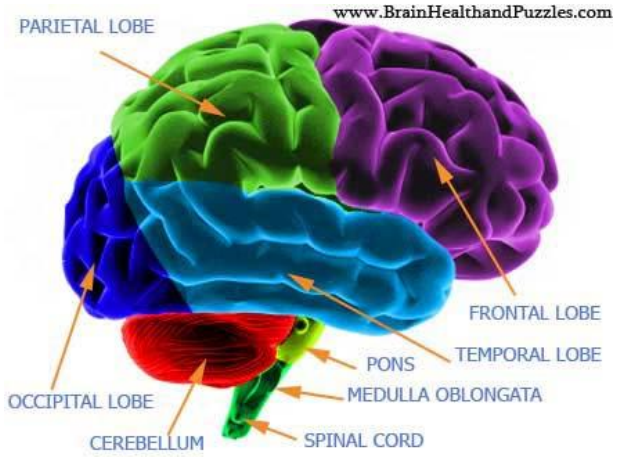
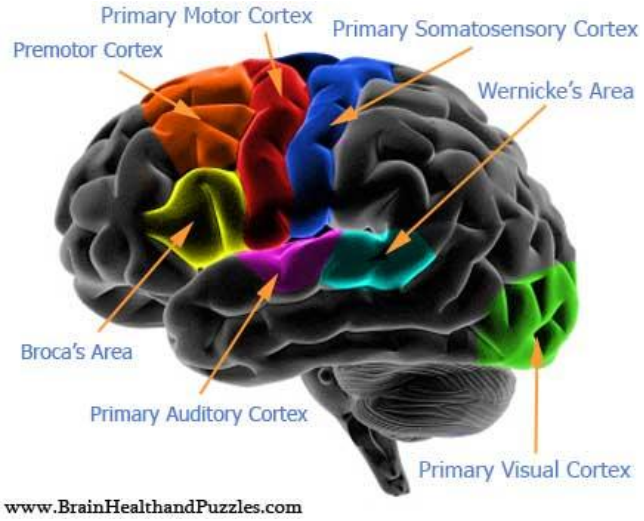
Neurophysiological Basis of Rhythm Processing

-Rhythm is a higher order of auditory processing involving:

- Premotor Cortex prepares the body for motion
- Cerebellum serves as predictor
- Auditory Cortex receiving MGB projections

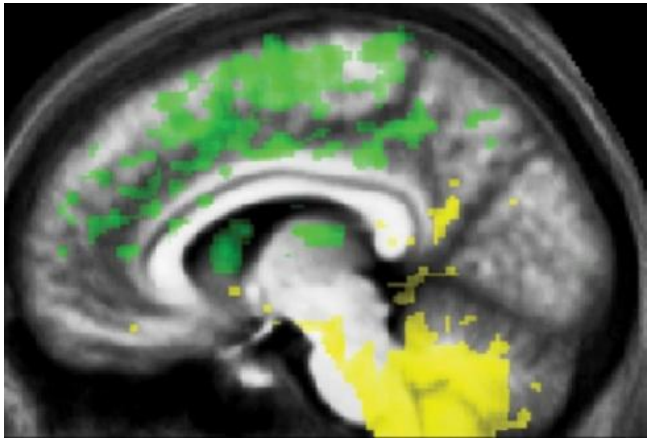




-<u>Two Methods of Keeping Time (theory)</u>:

- Absolute Time involving the cerebellum and olivocerebellar network

- Relative Beat Time involving the basal ganglia and striato-thalamo-cortical network



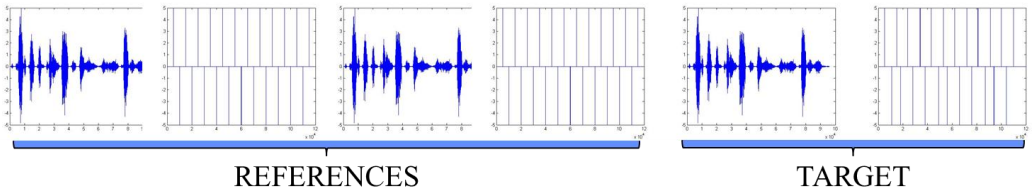
Teki et al., J. Neuroscience 31(10) 2011

Behavioral Training Methods

Reference: Naturalistic modulated bandpass noise and click train interweaved

-Provides temporal response properties

Target: Click train with a distinct rhythmic

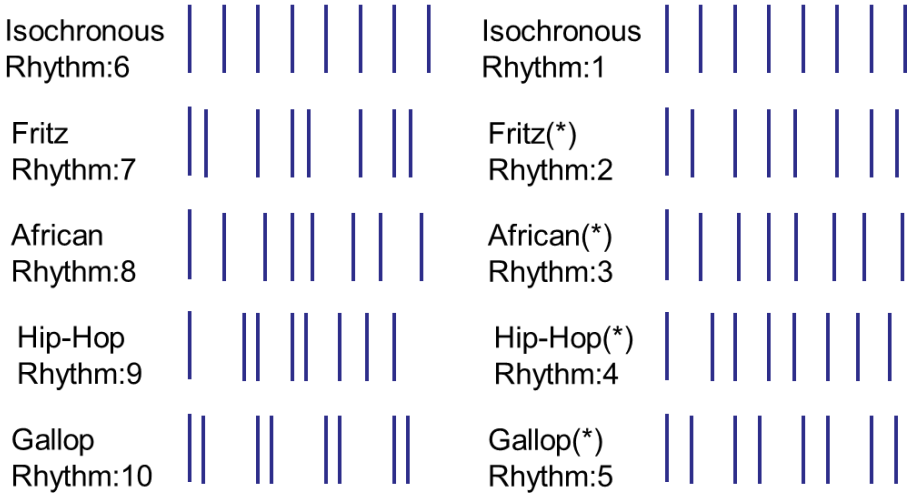


Training Stimuli

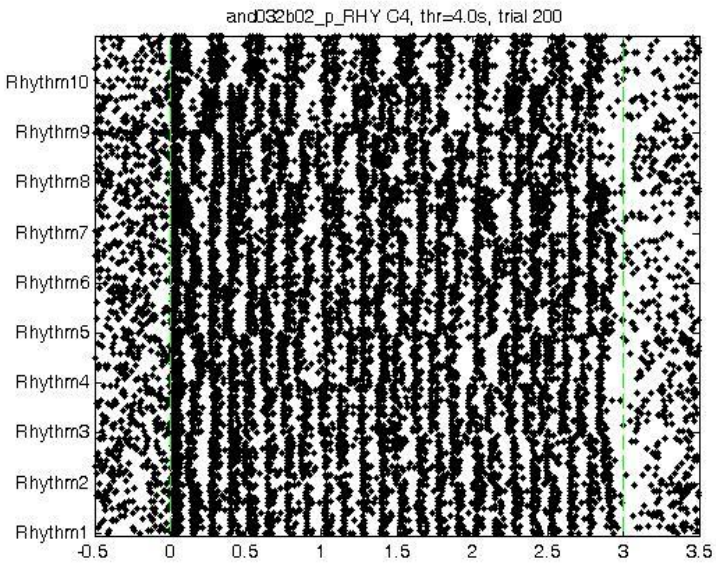
-Inadequate time to sufficiently train animals

Methods

MATLAB Generated Stimuli ⟶ Played to ferret and recorded from Auditory Cortex



African

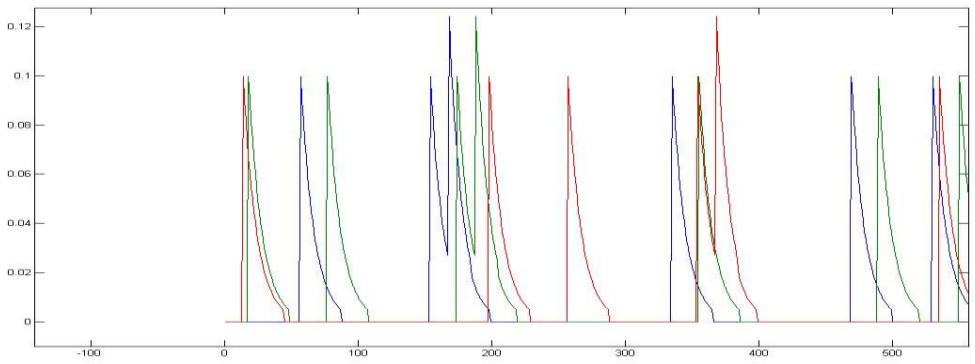


Raw Data over 20 Trials

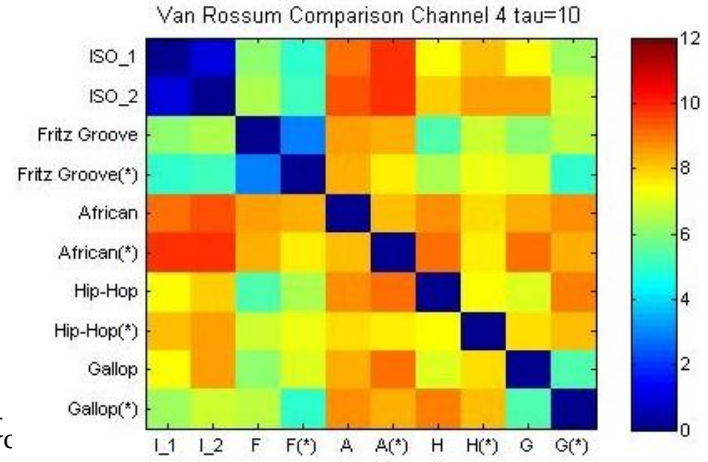
Data Analysis

van Rossum Analysis

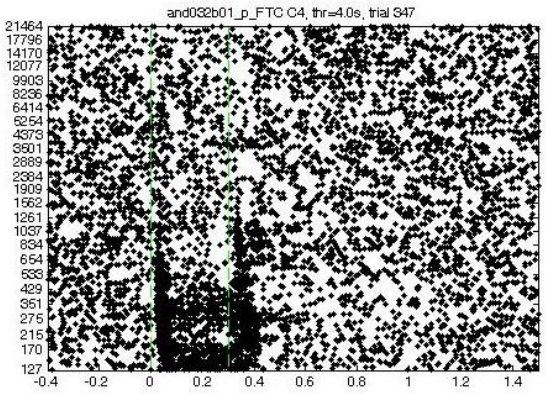
Van rossum Spike Comparison Distance=$[F(x)-G(x)]^2$ → Comparison Matrix



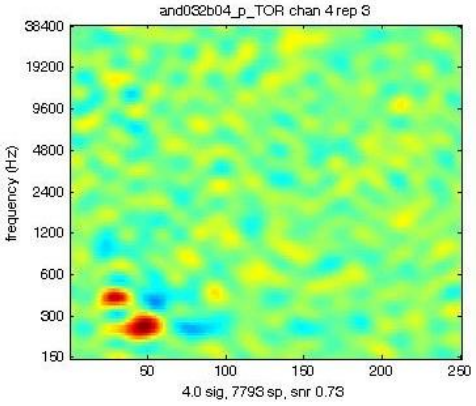
$$f(t) = \sum_i H(t - t_i)e^{-(t-t_i)/t_c} \longrightarrow$$ Grouping Importance α t_c



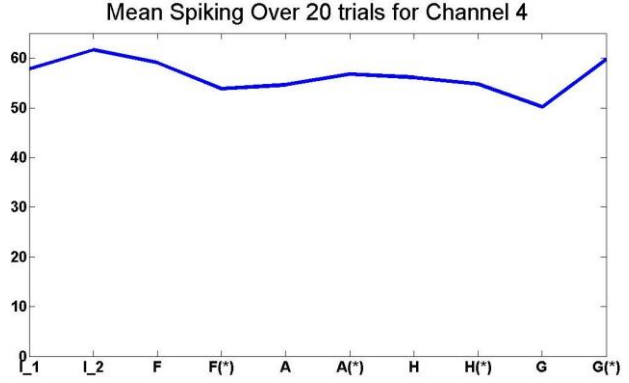
Methods of Cell Characterization



Frequency Tuning Curve



STRF
(Spectro-temporal-receptive-field)



Spike Rate Comparison

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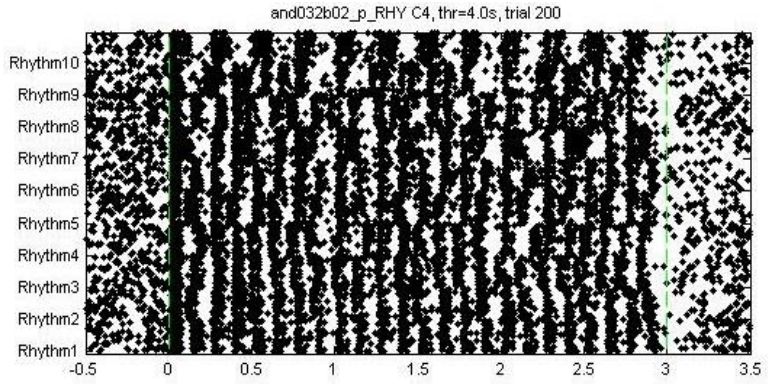
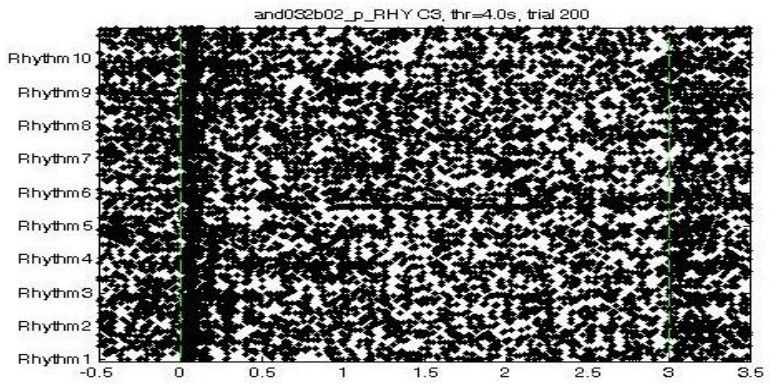
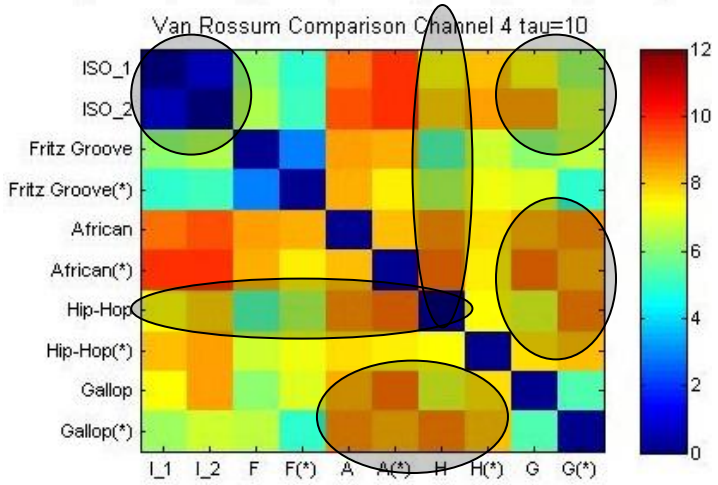
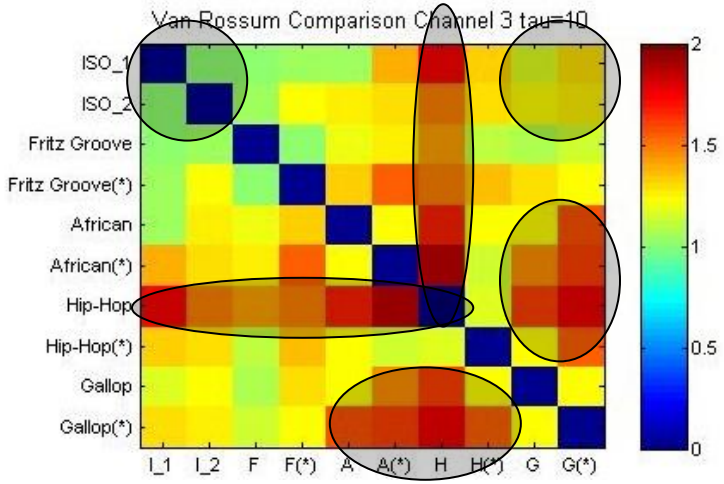
Neurophysiological Responses to Rhythmic Stimuli of a Naïve Ferret









-Rhythmic encoding in onset/offset neuron has comparable results to a 1-1
-Color axis scaling reveals less separation, however generic trends are apparent neuron

Future Studies

- Naïve vs. Trained Animals: Neural representation displaying greater separation

- Recording from PMC and Auditory Cortex from animals who have learned the discrimination task

- MEG recordings from humans who are: naïve, recognize the rhythm, and those that can replicate the rhythm.

Acknowledgments

- National Science Foundation OCI award #1063035
- Mentors Jonathan Fritz & Stephen V. David
- Teki et al., *Journal of Neuroscience, 9 March 2011, 31(10): 3805-3812; doi: 10.1523/JNEUROSCI.5561-10.2011*
- Morgenstein, Rod *perf. "Drums & Jam." Great Sky River. Jazz Is Dead. Zebra Records, 2001. CD.*