Dynamic coding of action selection by the rodent striatum

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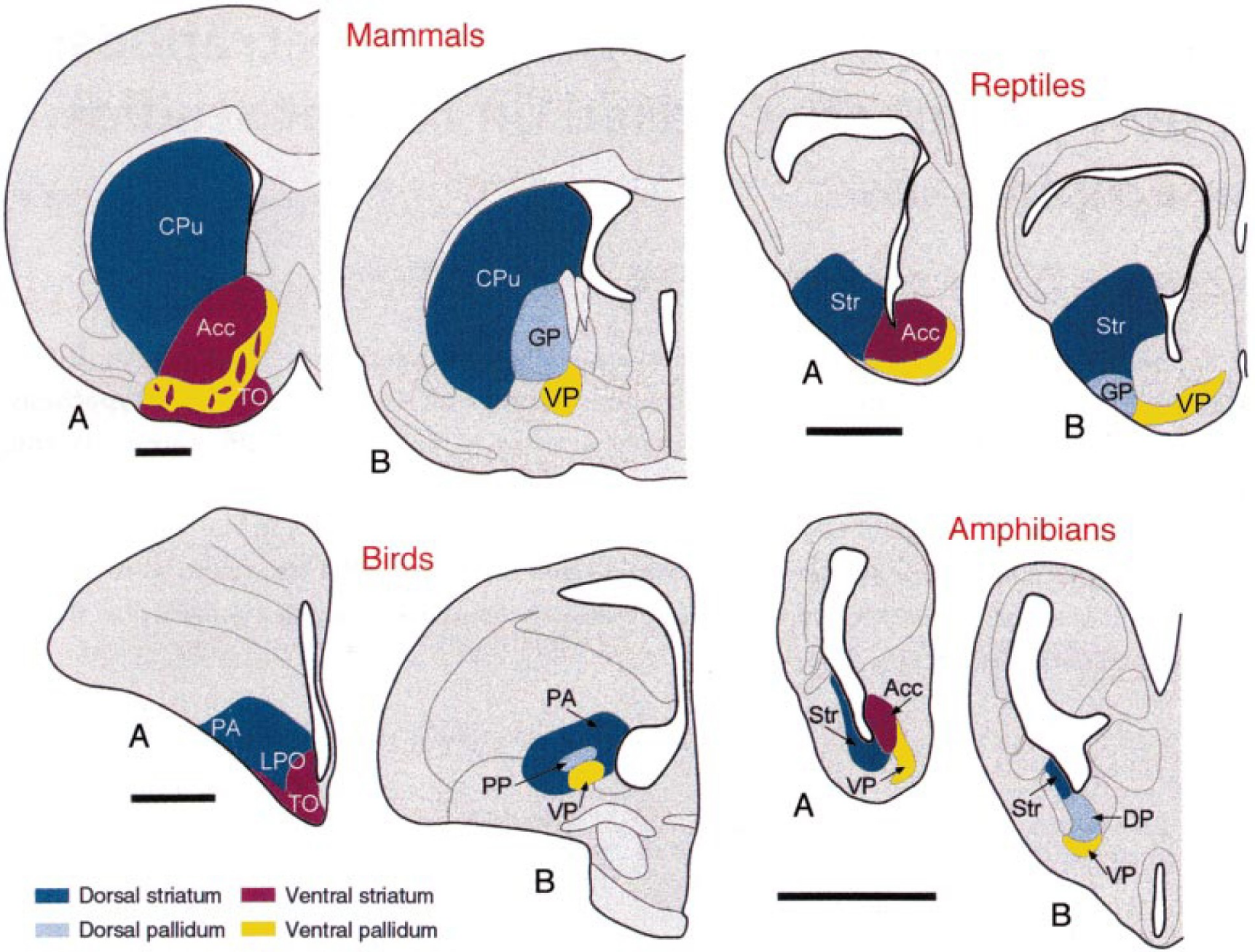
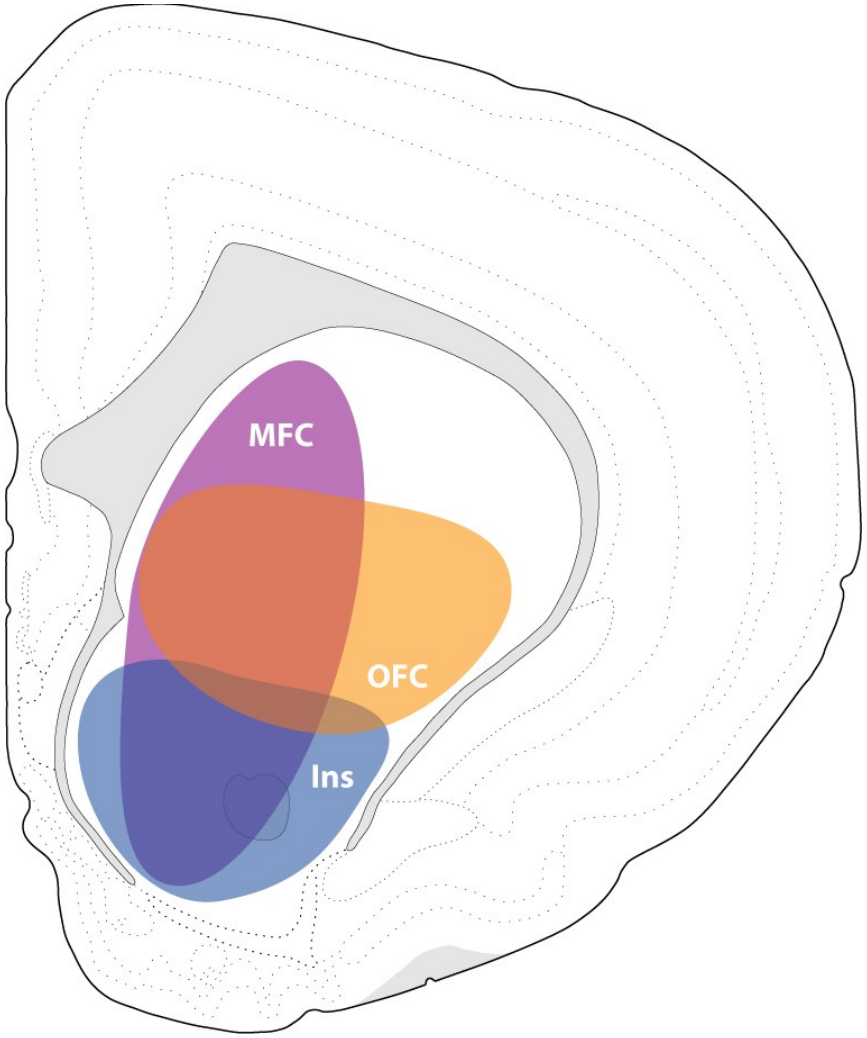
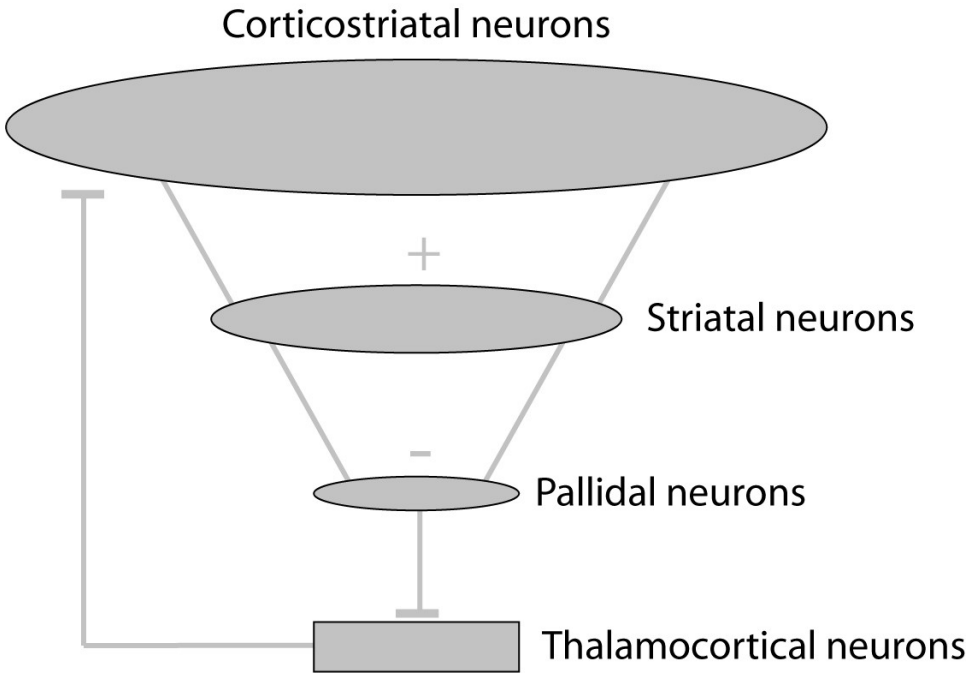


Smeets et al. (2000) Journal of Anatomy, 196:501-517

Neural circuits of the basal ganglia



Corticostriatal connections
from frontal cortex



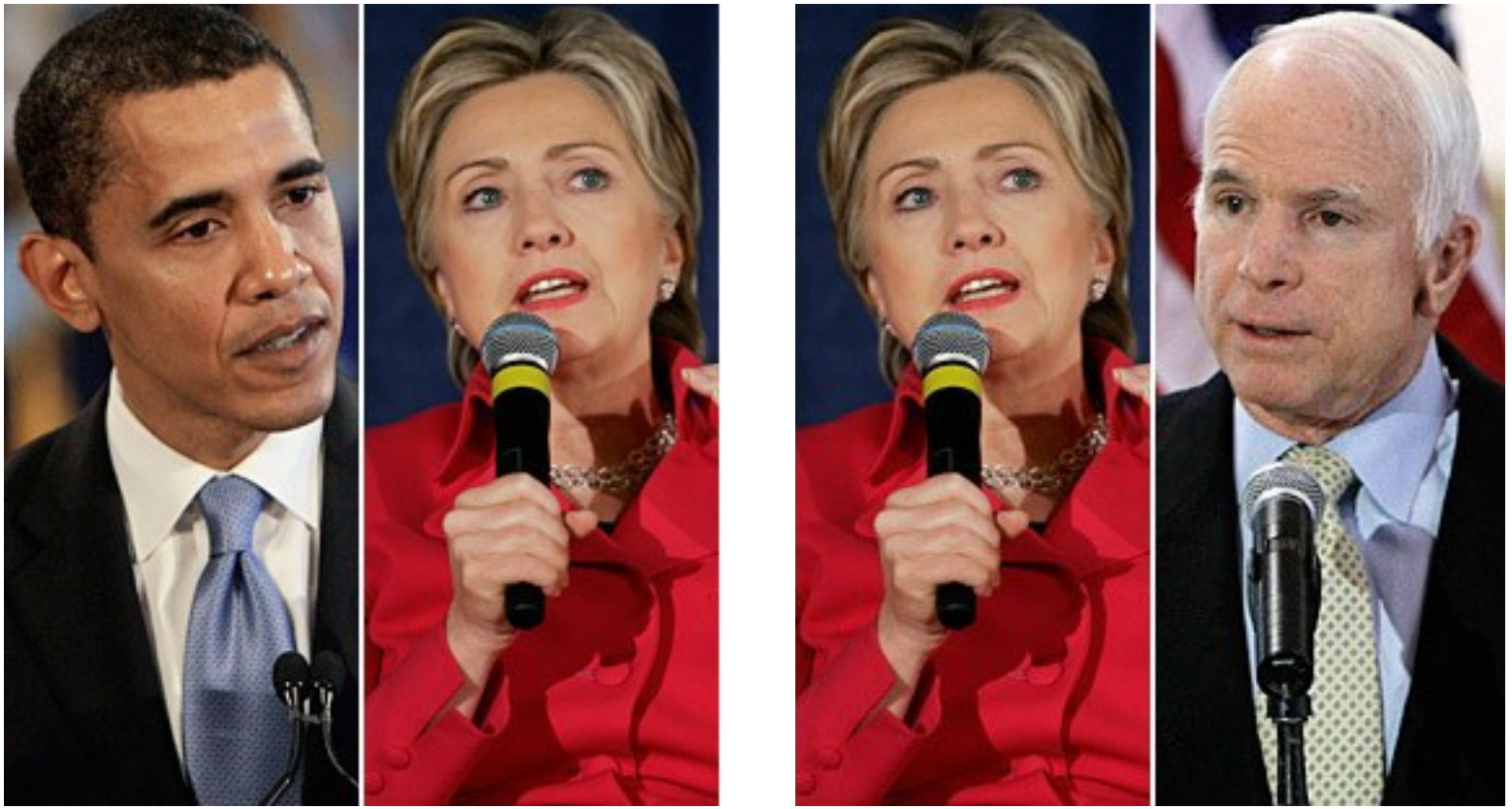
Dimension reduction across
levels of the basal ganglia

Overview

- A new behavioral task for studying neural basis of flexible decision making in rodents
- Spike activity in the striatum during the task
- Spike-field interactions during the task
- Future work
  - How could spike-field coherence contribute to decoding stimulus value from striatal population activity?

Flexible decision making

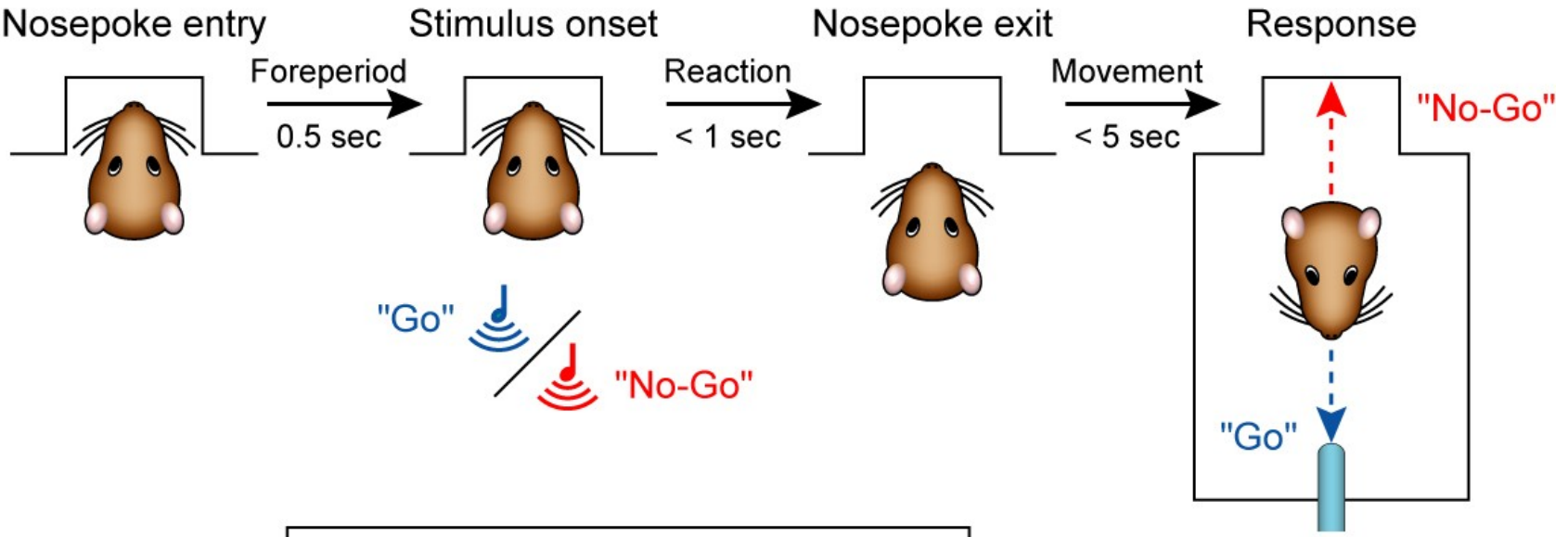
Flexible decision making



S+ SW- SW+ S-

Flexible decision making

A

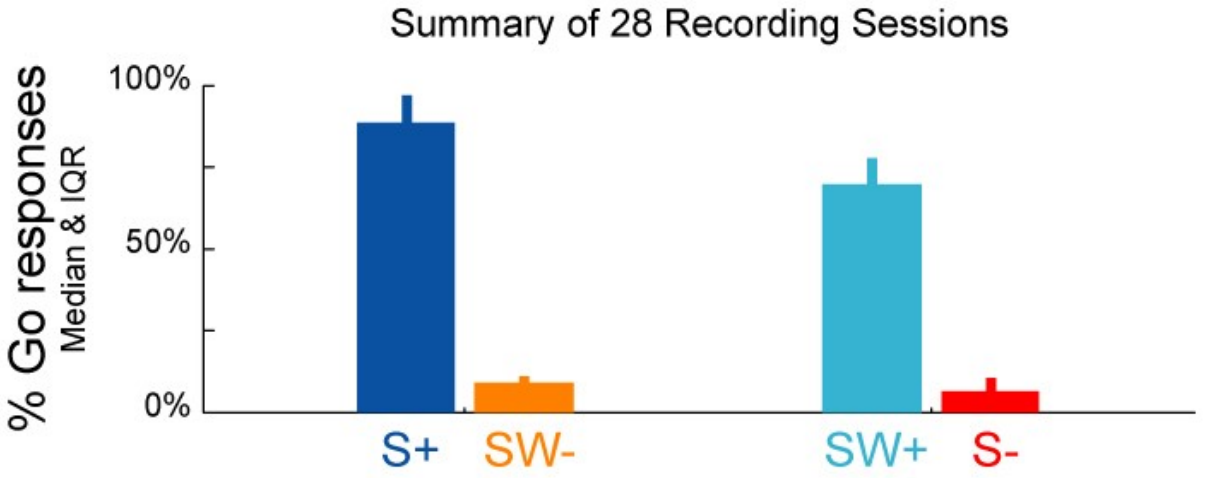


B

	Switch	
	Before	After
Rewarded Stimulus	S+ = Low Tone	SW+ = Noise
Unrewarded Stimulus	SW- = Noise	S- = High Tone

Flexible decision making

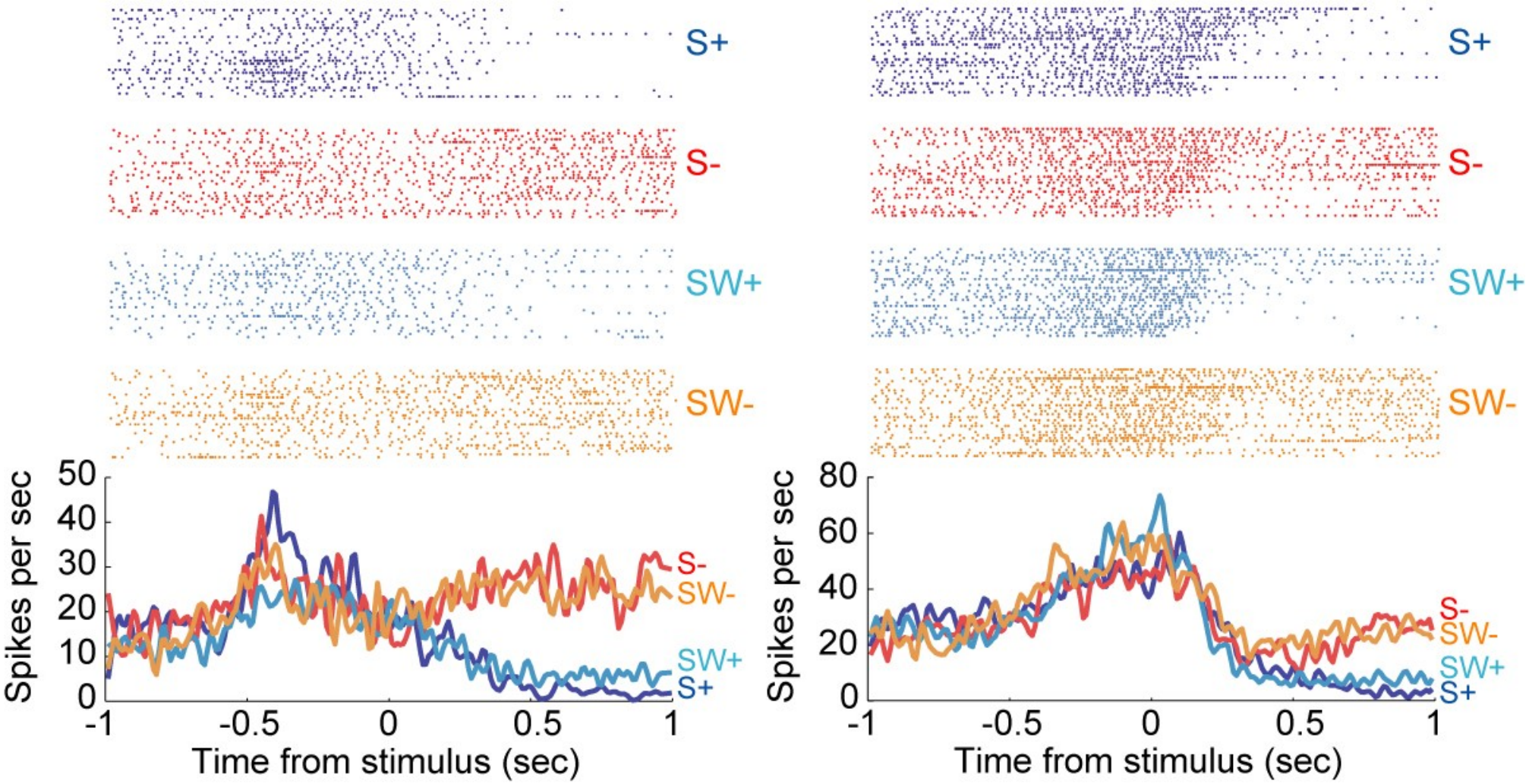
A



B

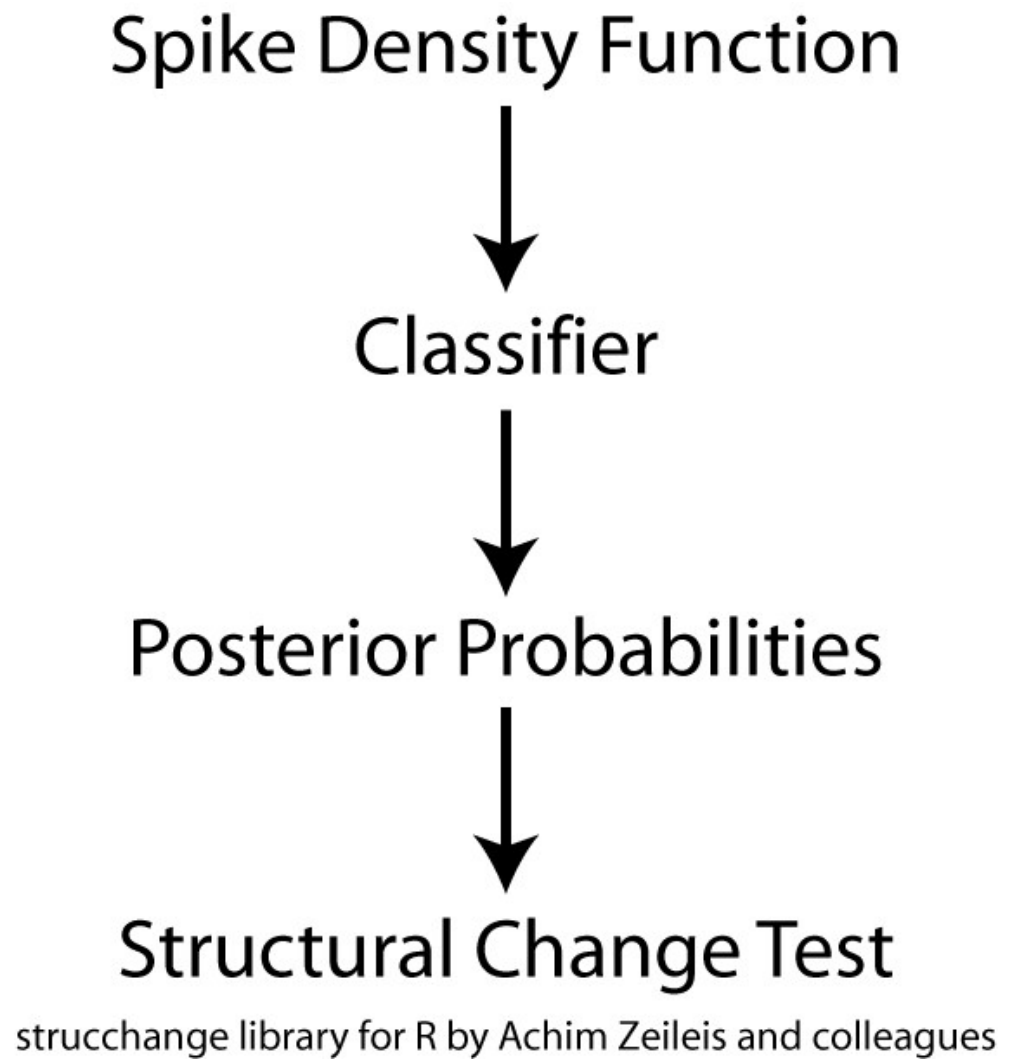
	Switch: Before	Switch: After
Rewarded Stimulus	S+ = Low Tone	SW+ = Noise
Unrewarded Stimulus	SW- = Noise	S- = High Tone

Neural activity in the striatum

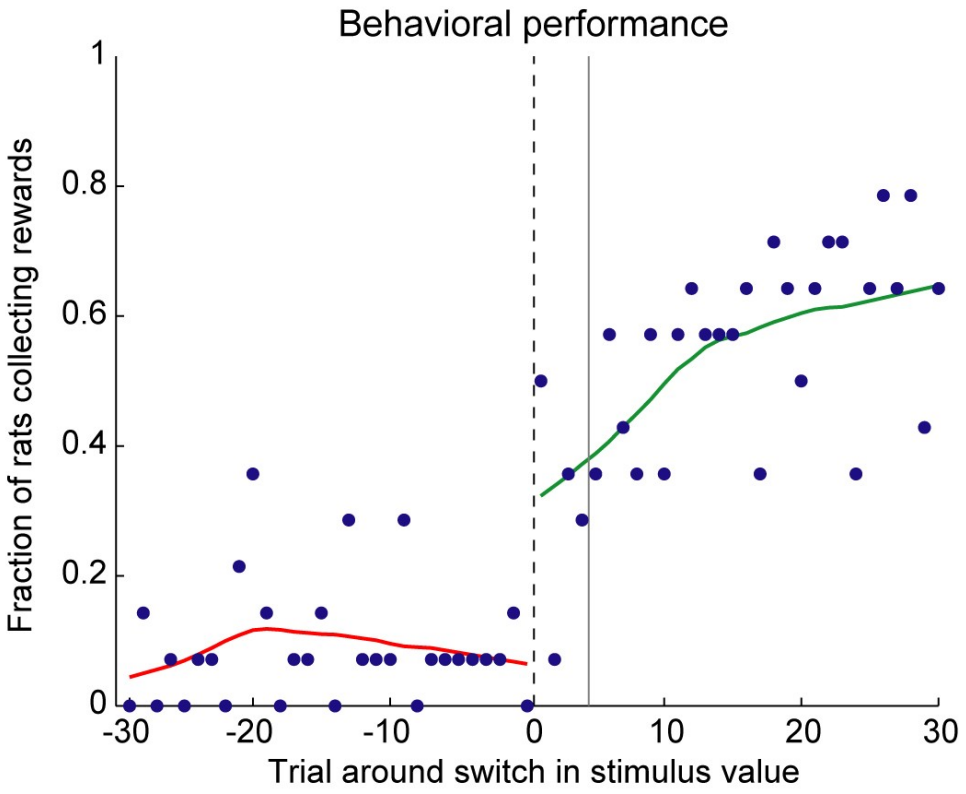


Dynamics of switching

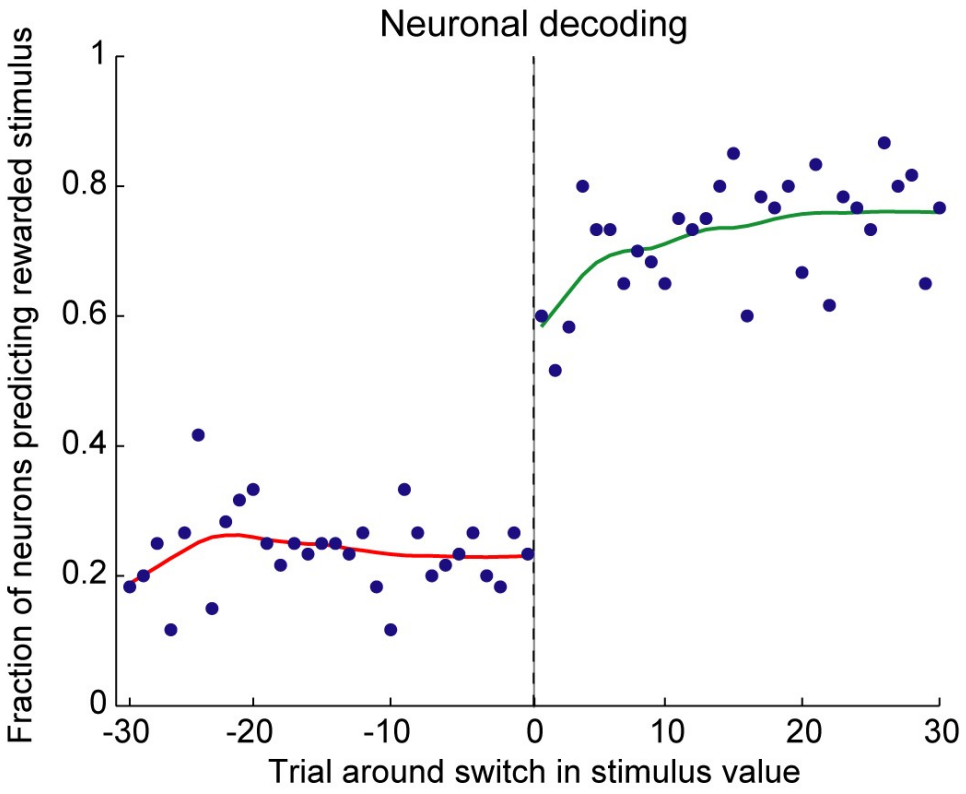
Decoding stimulus value with striatal neurons



Dynamics of switching

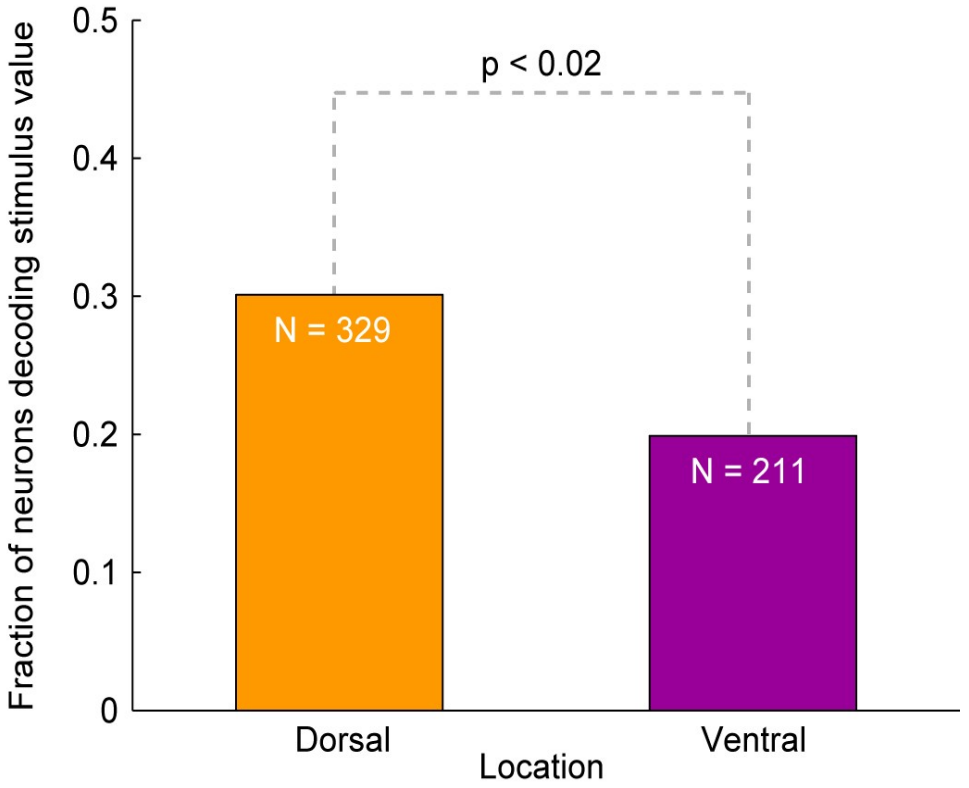


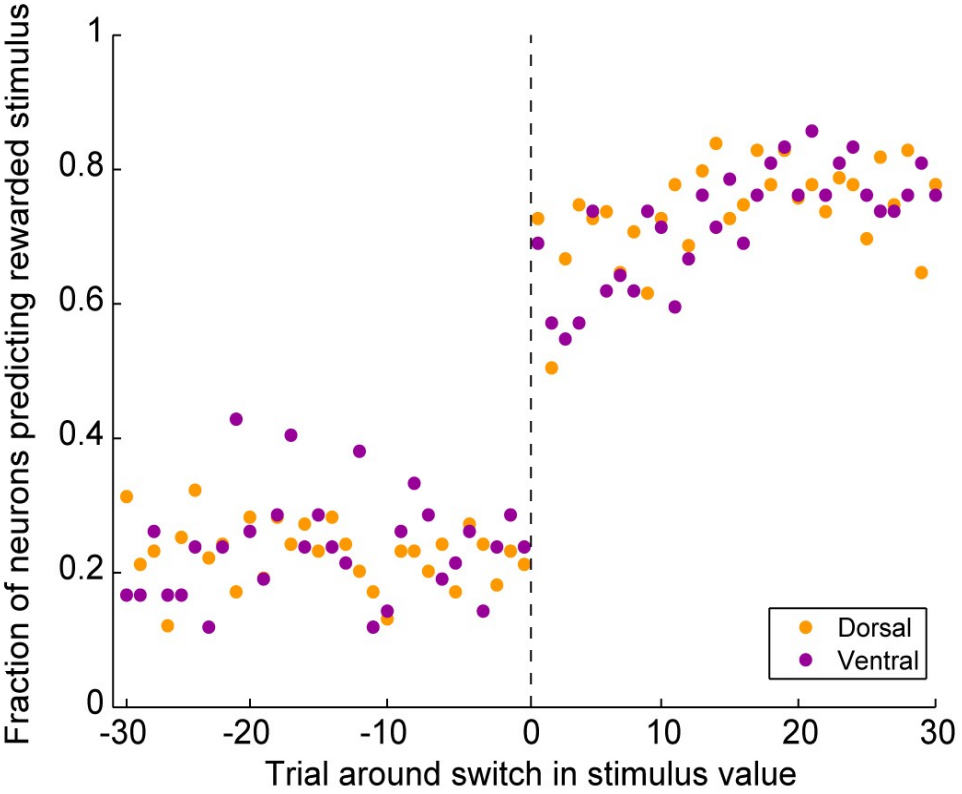
14 rats



133 of 540 neurons (24.6%)

Dynamics of switching

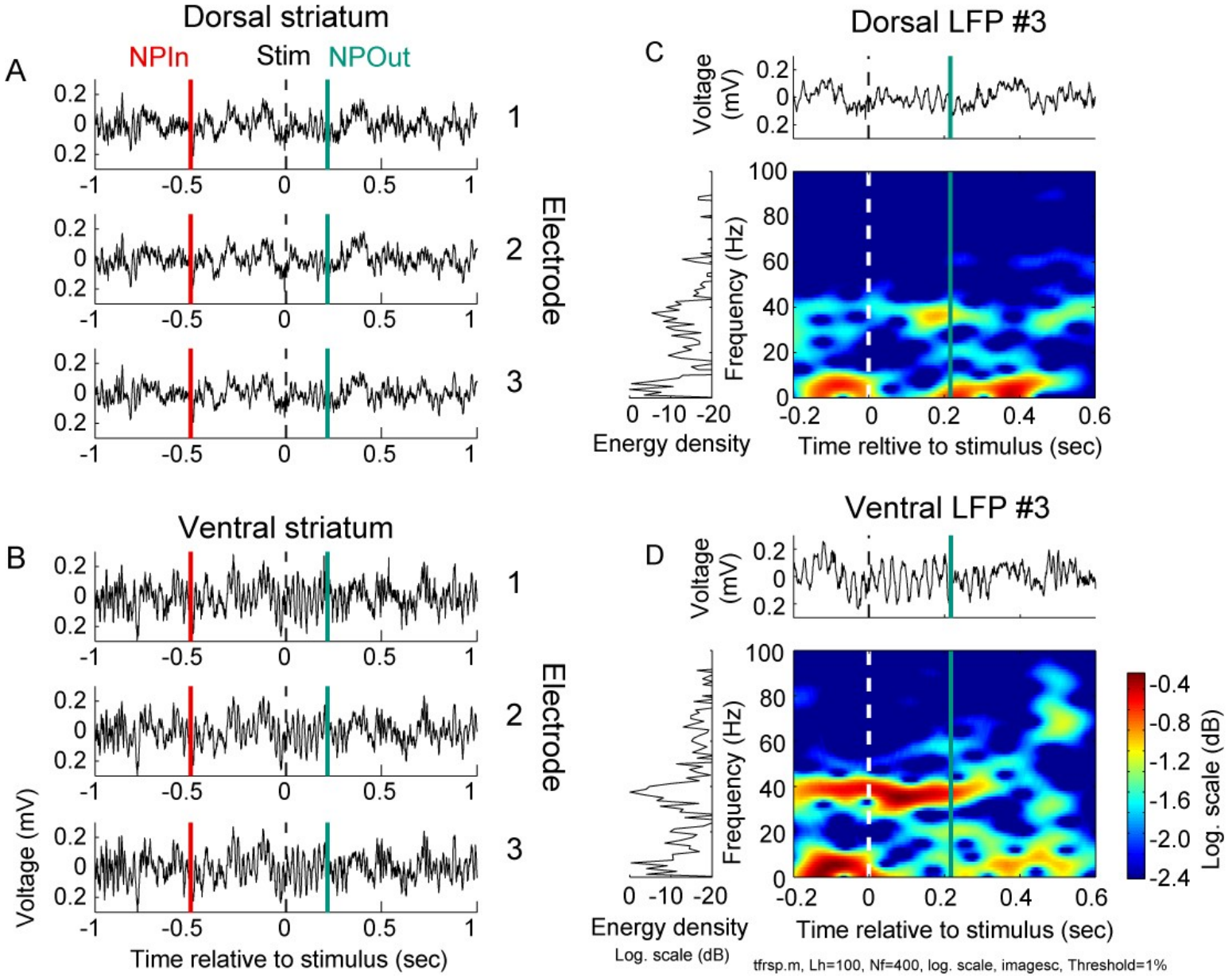




Summary

- Rats can flexibly assign value to a stimulus.
- Decoding analysis suggests that striatal neurons may mediate this capability.
- Striatal neurons vary with stimulus value and reaction time.
- Striatal neurons are mostly modulated during the period of action selection.
- More value-sensitive neurons are found in dorsal striatum compared to ventral striatum.

Local Field Potentials



Conclusions

- Rats are capable of flexible decision making. As such, this capacity is not exclusive to primates and does not require granular frontal cortex.
- Striatal neurons are highly sensitive to changes in stimulus value.
- Value-sensitive neurons are found primarily in dorsomedial striatum, and may thus be under the control of cingulate and orbital cortical areas.
- Spike coupling to low and high frequency gamma oscillations might be useful for decoding value- and movement-related signals at the level of the globus pallidus.