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Brandon Caie

Article

Neuron

The Basal Ganglia Do Not Select Reach Targets but Control the Urgency of Commitment

Highlights

- The BG do not contribute to deciding which movement target choice is selected
- BG activity reflects an urgency signal and its adjustment between SAT policies
- The BG are involved in confirming the commitment to a cortically determined choice

Authors

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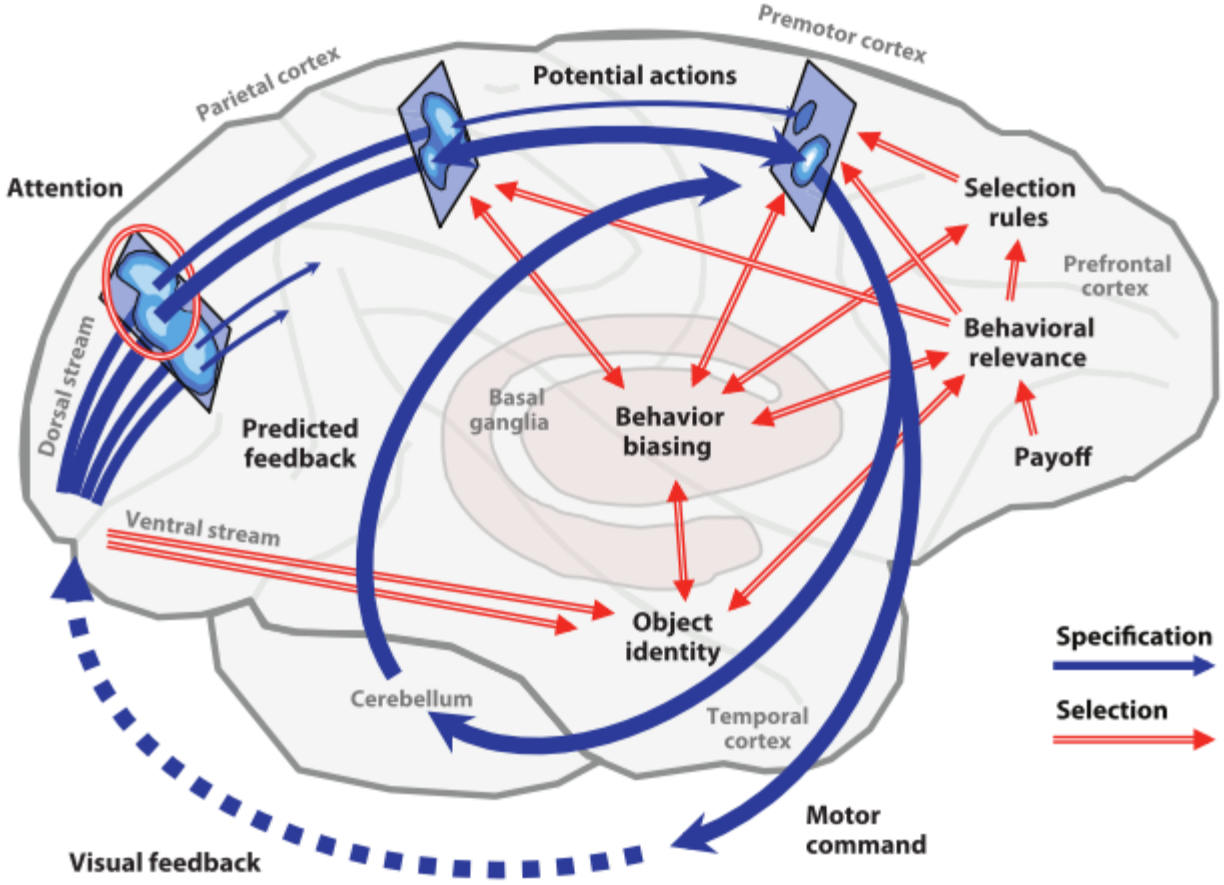
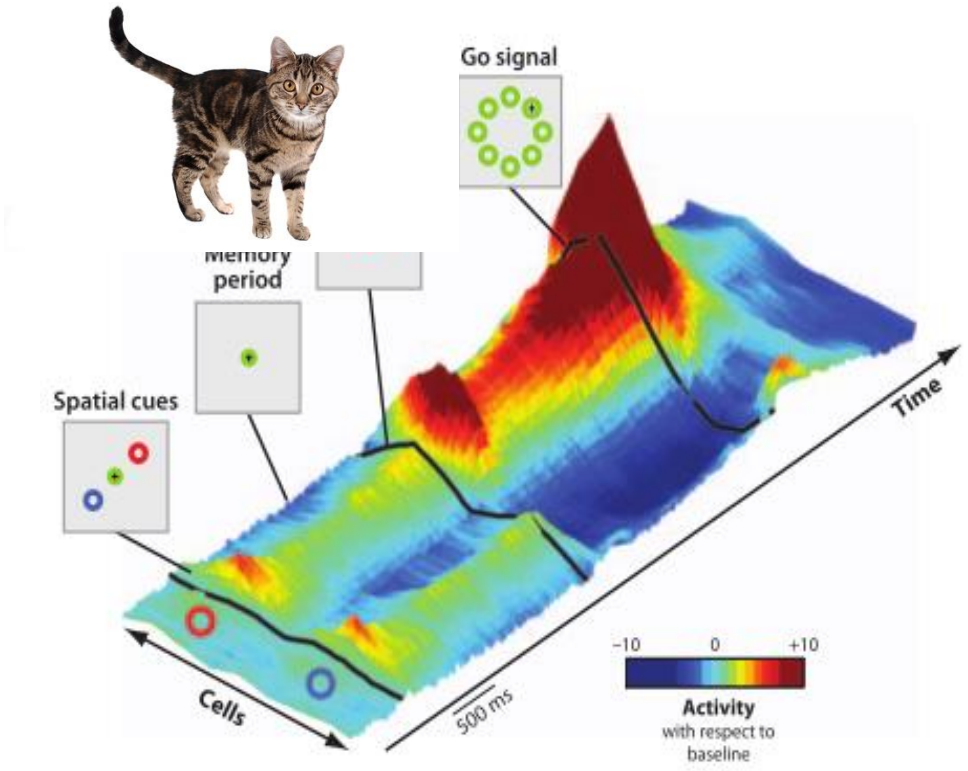
In Brief

Thura and Cisek show that the basal ganglia do not influence the choice of the target for action, but rather provide a context-dependent urgency signal that invigorates the deliberation process before confirming the choice determined in the cerebral cortex.

Action Selection and Specification



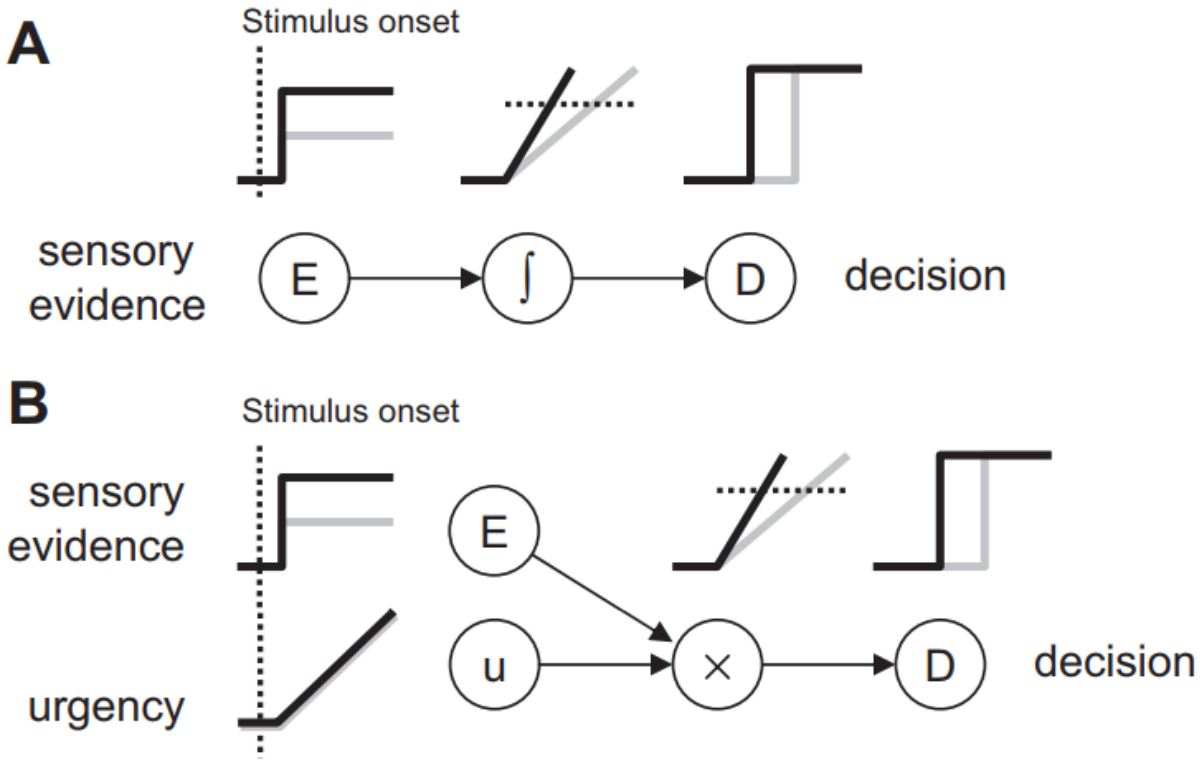
Cisek and Kalaska (2010)



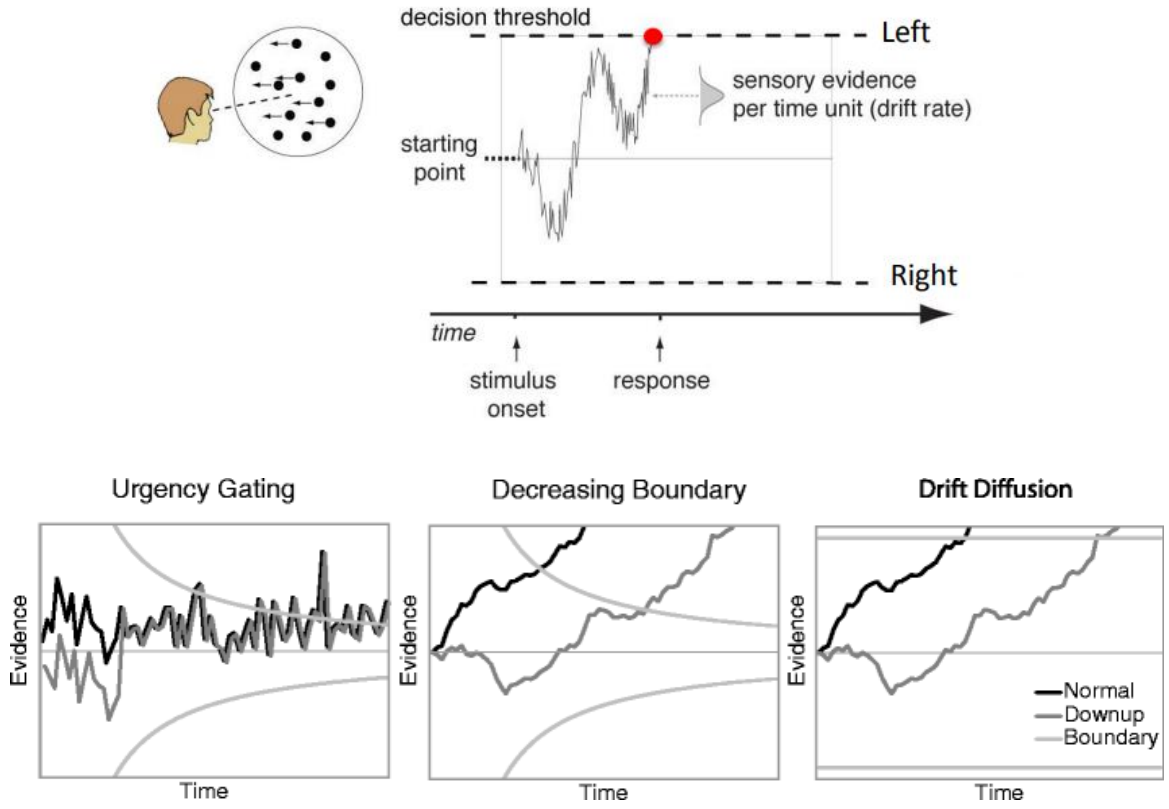
Cisek and Kalaska (2005) Pastor-Bernier (2013)

"What we have is a circuit…the motor response determines the stimulus just as truly as the sensory stimulus determines movement" ~ John Dewey (1896)

Urgency vs. Accumulation

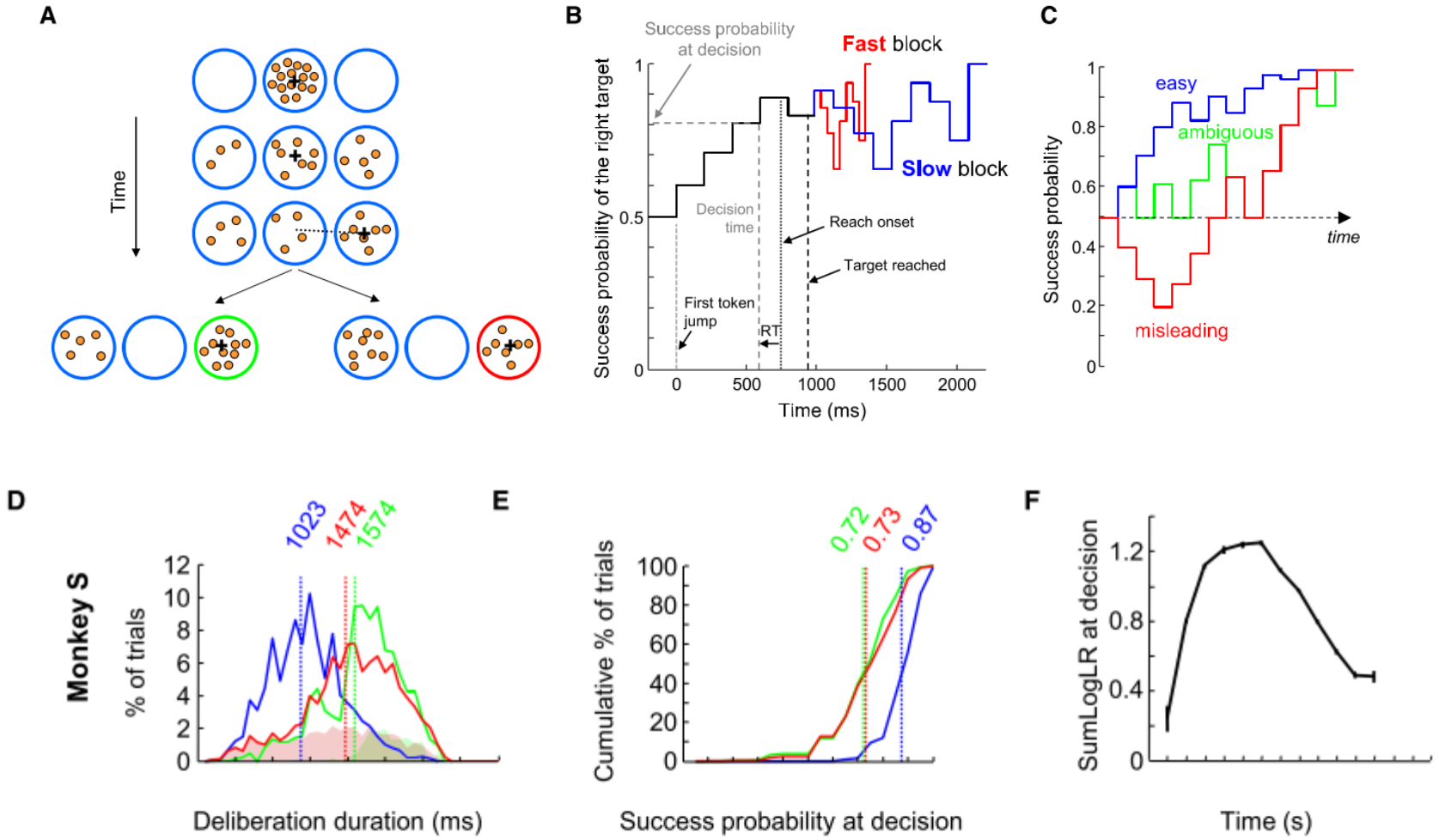


Cisek et al (2009)



Winkel et al (2014)

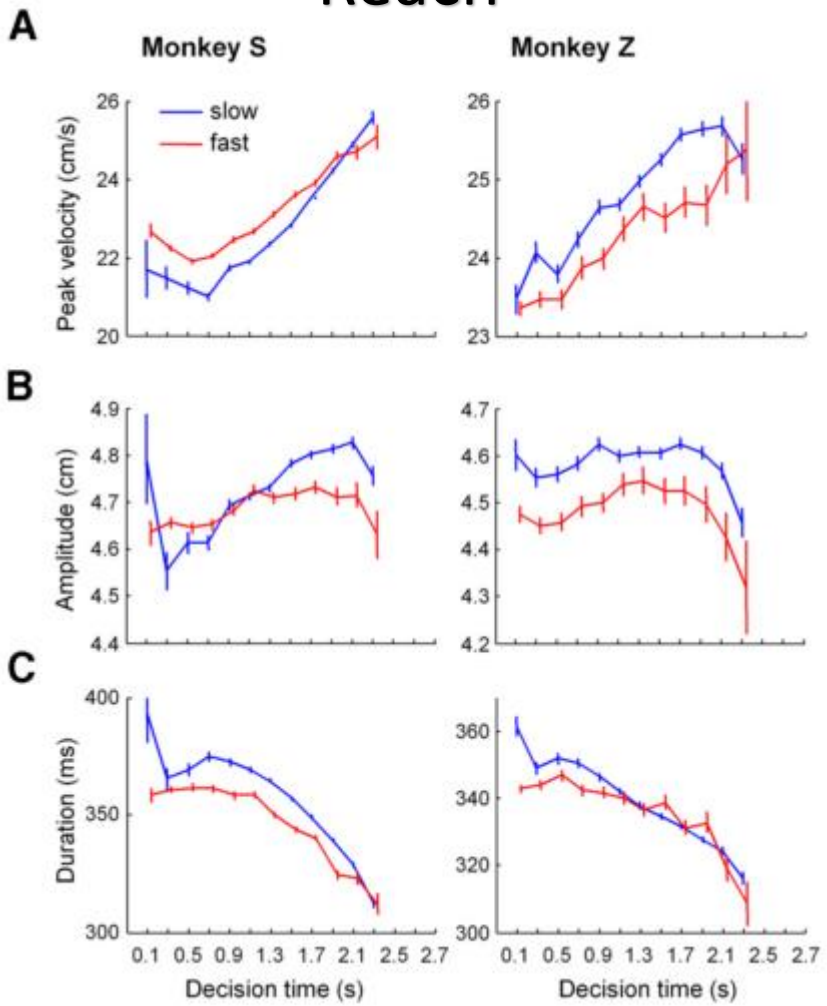
Dynamic Decision-making:
The Tokens Task



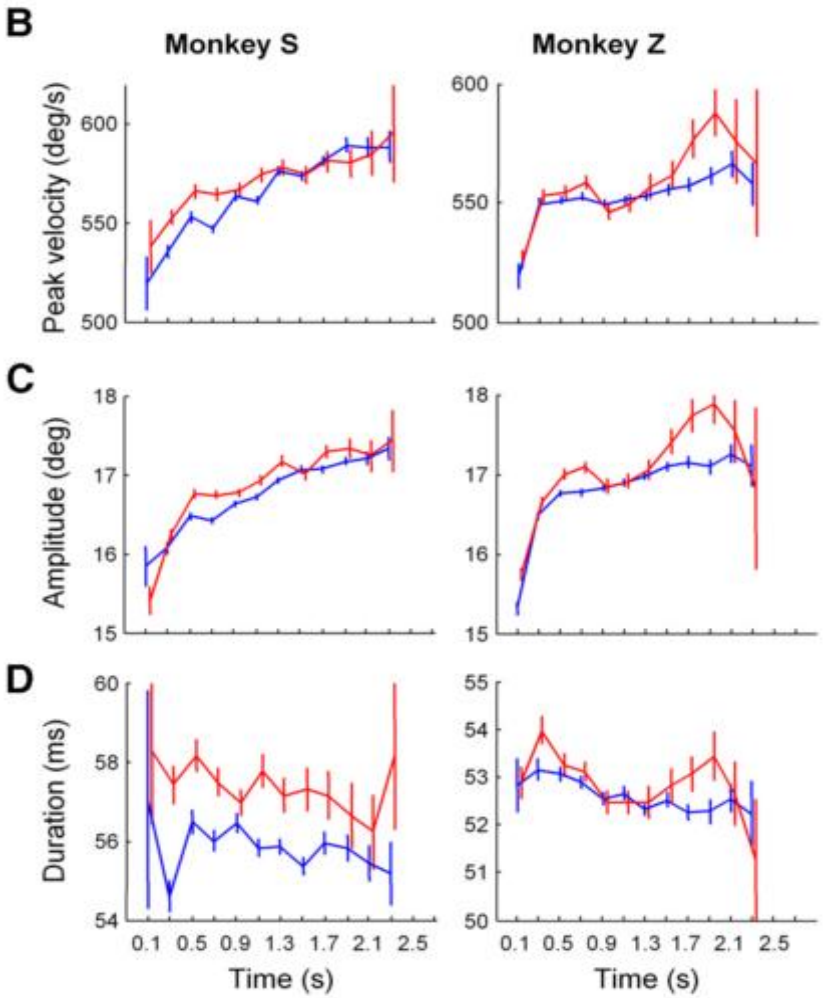
Thura et al (2014)

Tokens SAT and Movement Parameters

Reach

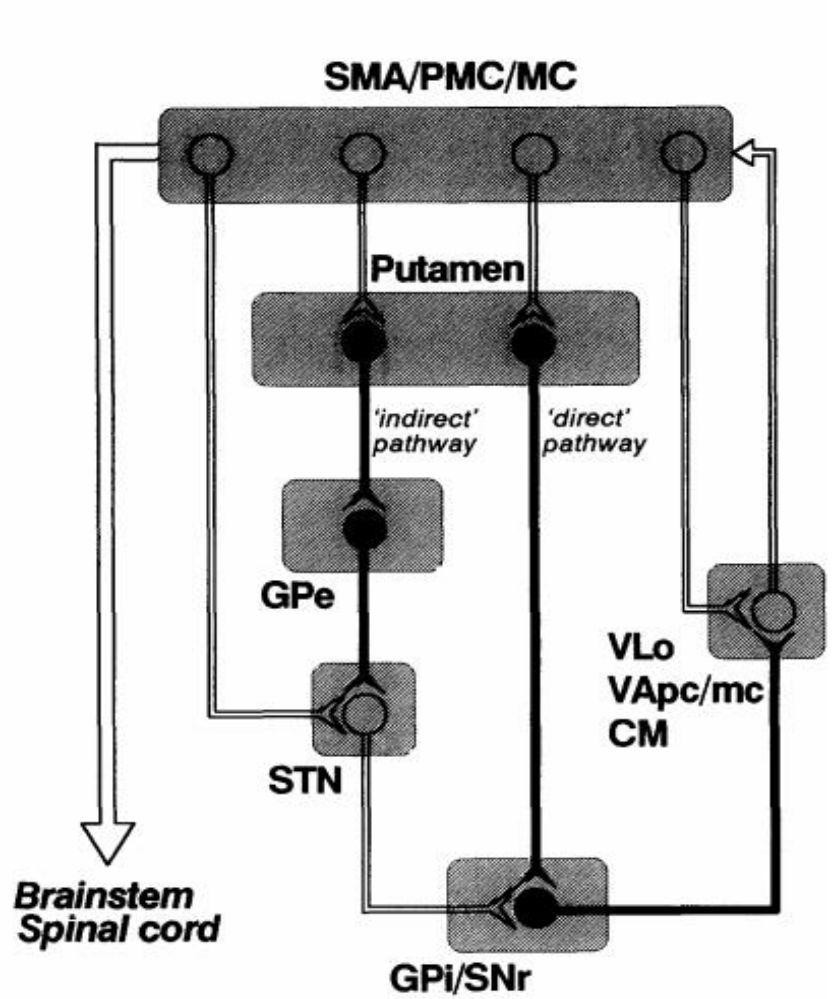


Saccade

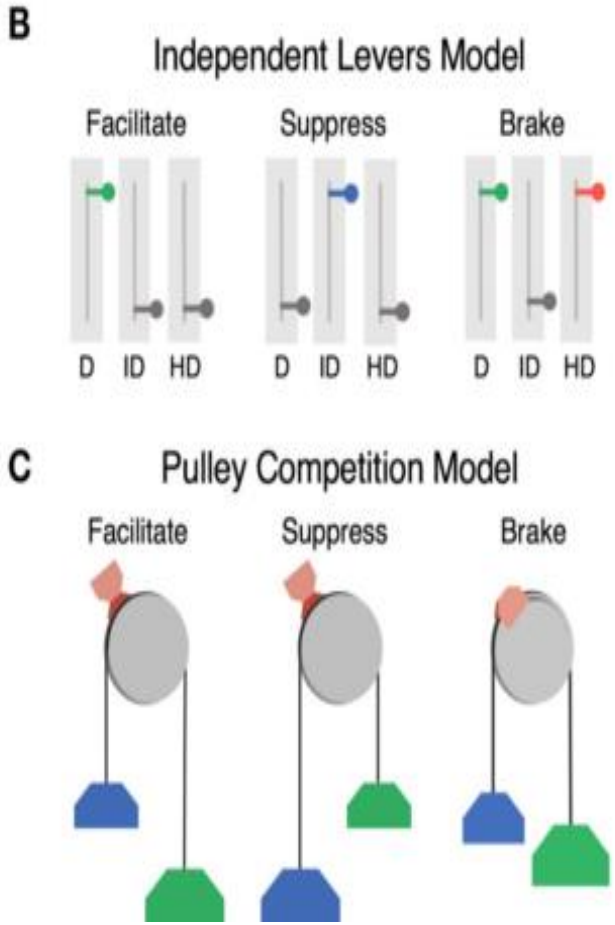


Thura et al (2014)

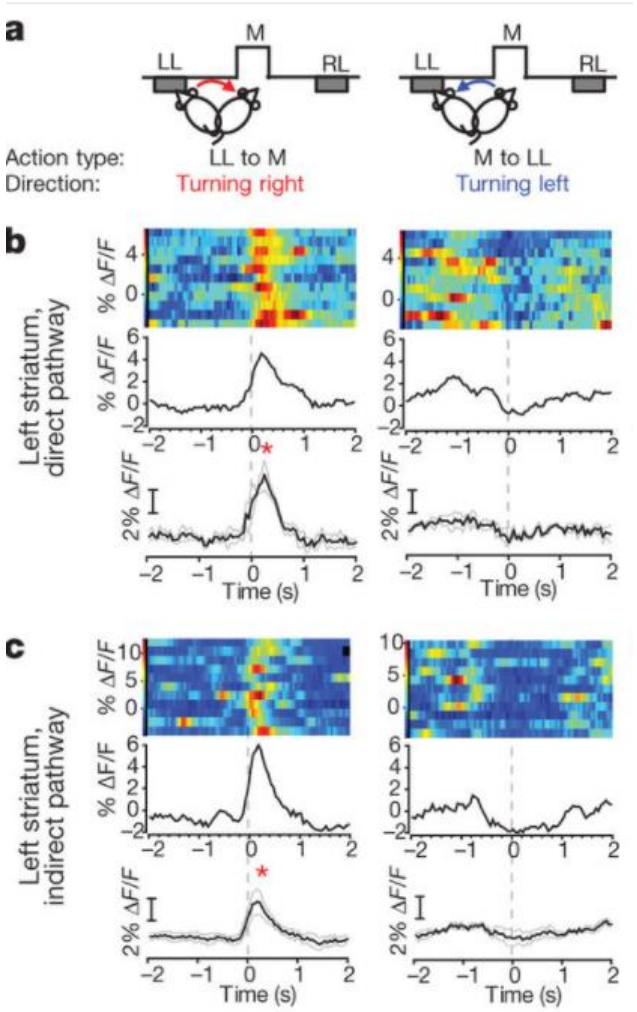
The Basal Ganglia



Garret and Crutcher (1990)

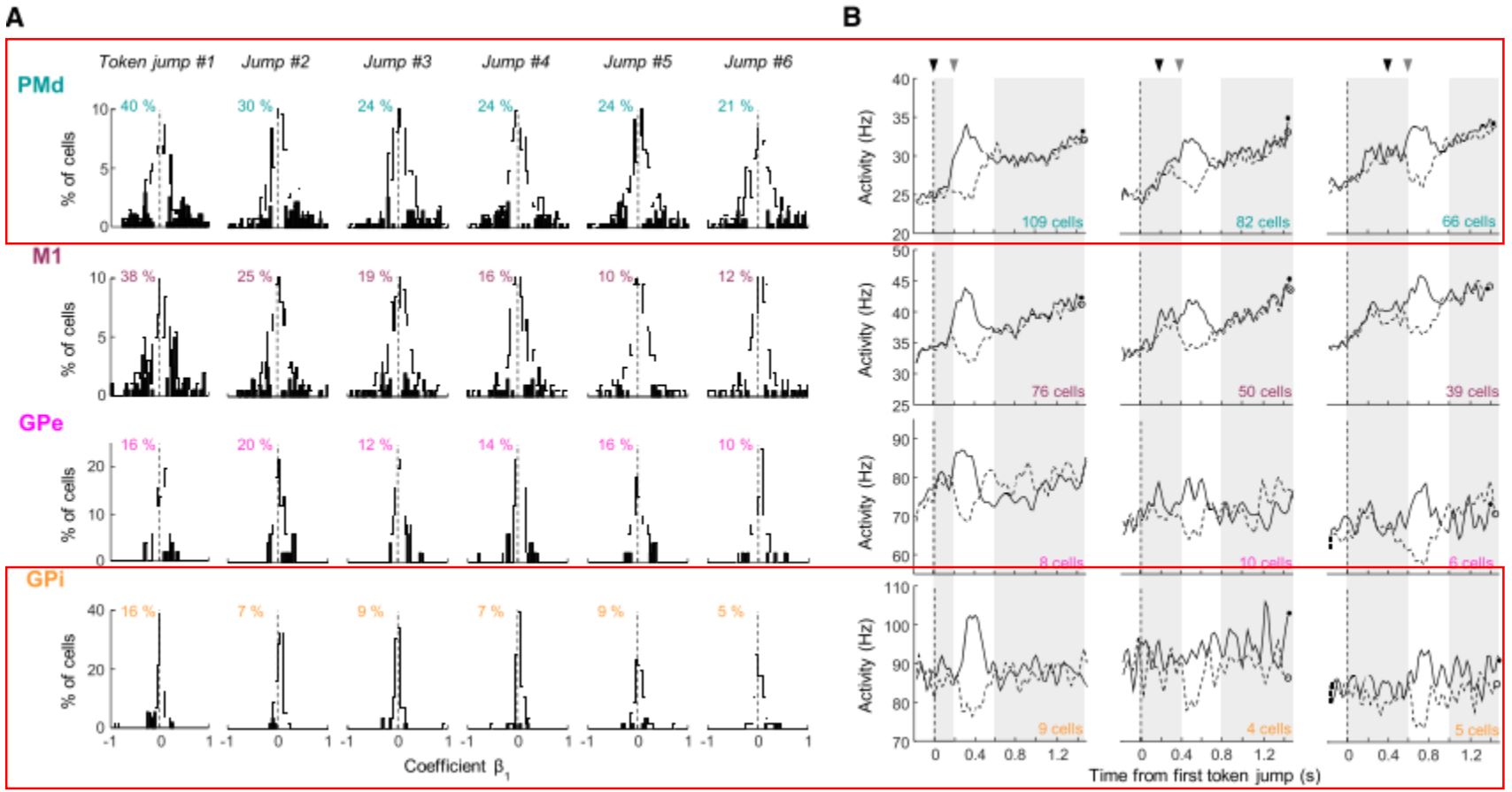


Dunovan and Verstynen (2015)

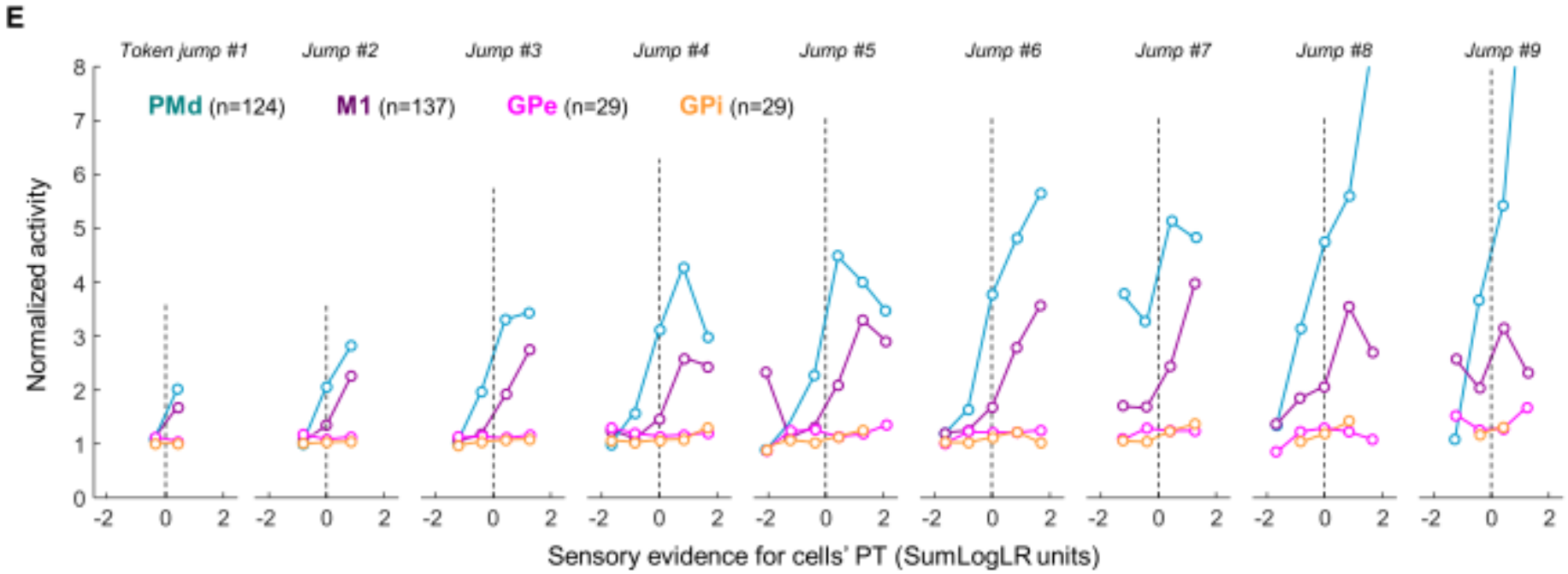


Cue *et al* (2013)

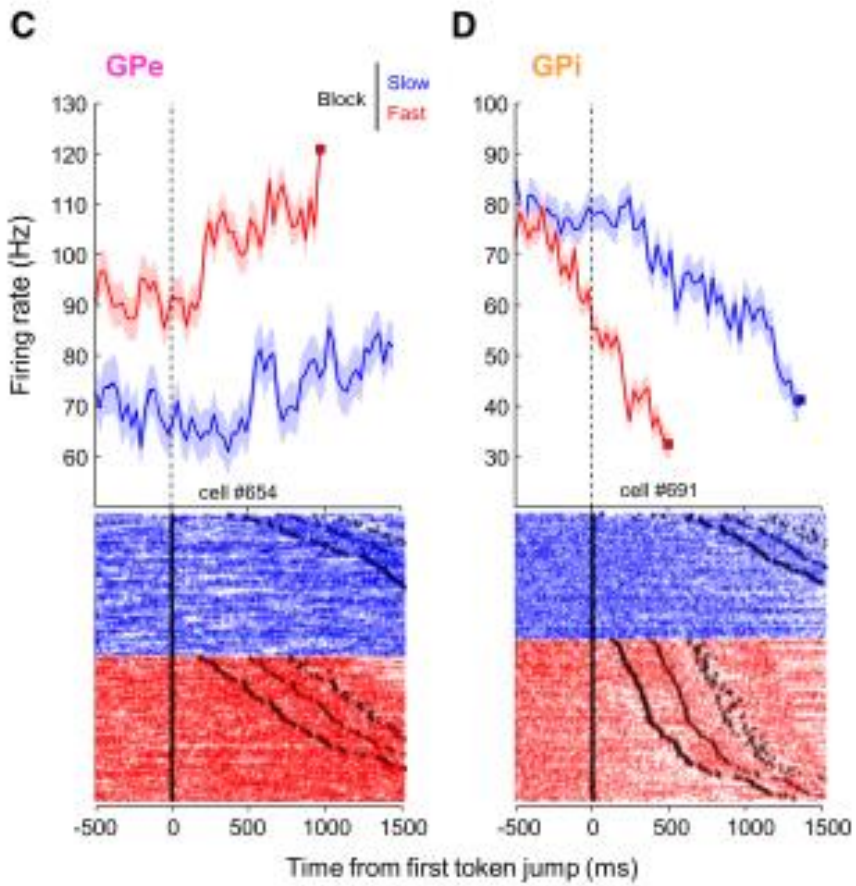
Neural Activity in the Globus Pallidus During Evidence Integration

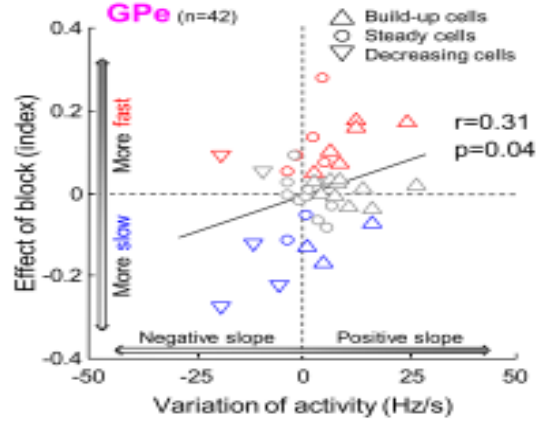


Neural Activity in the Globus Pallidus During Evidence Integration



Speed Accuracy Tradeoff and GP Activity





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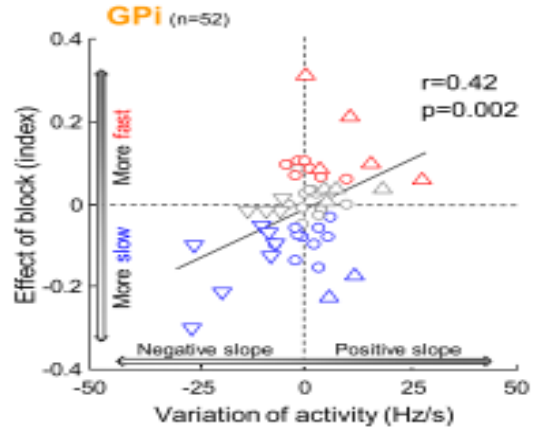
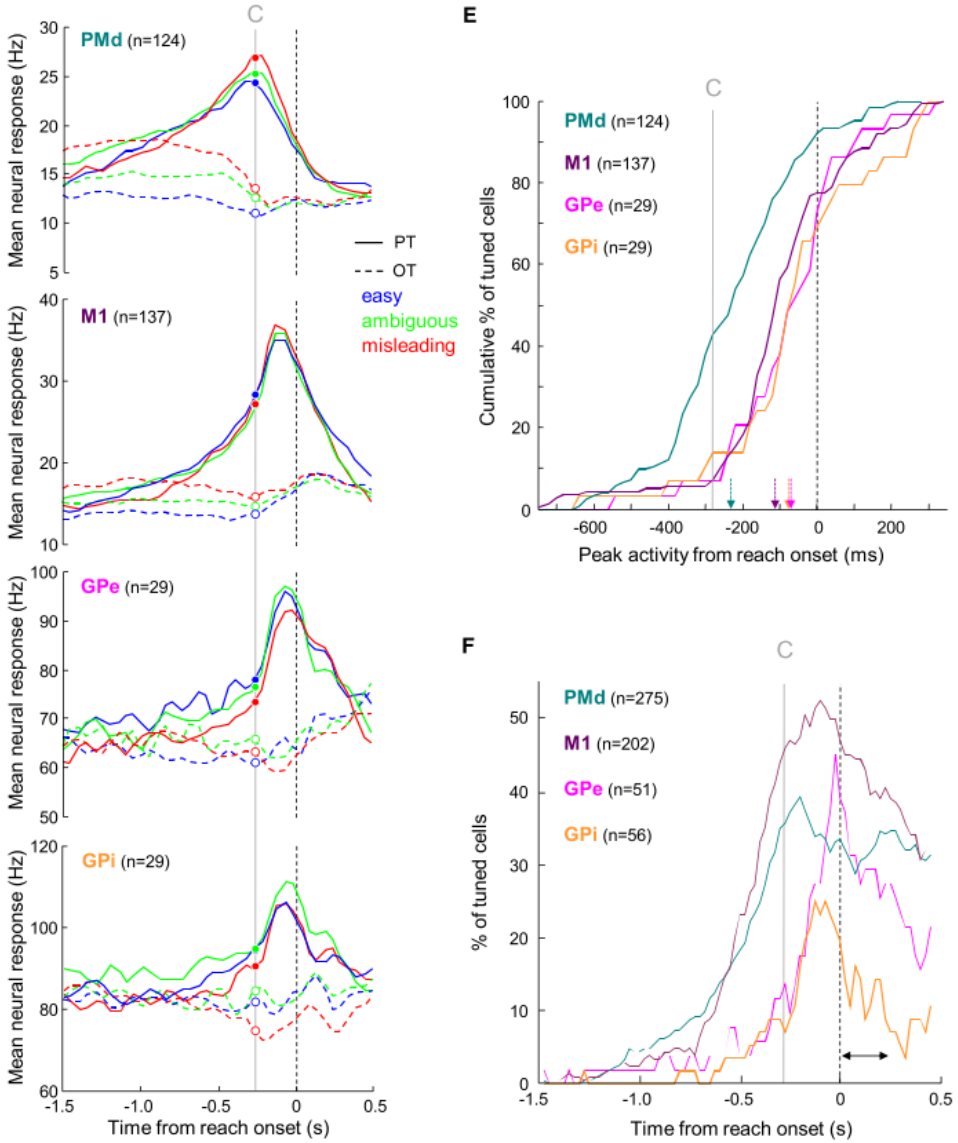


GP Activity and The Moment of Commitment

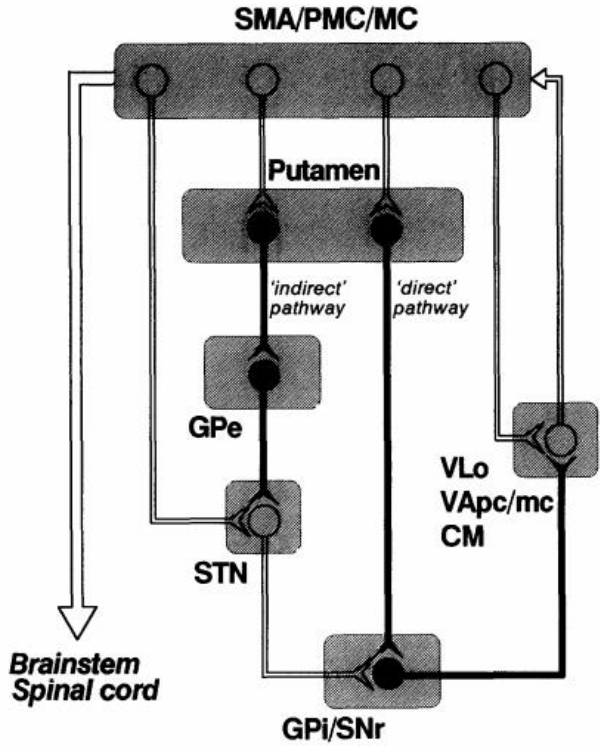


Paper Conclusions

- BG do not contribute to deciding which movement target choice is selected, but reflect an urgency signal and its adjustment between SAT policies
- The BG are involved in confirming the commitment to a cortically determined choice, controlling the amount of evidence needed before an action is selected

Discussion

- Basal Ganglia is strongly implicated in sequential procedures and motor learning. The two monkeys tested here are extremely well trained on the task (…years of practice). How would the observed correlates between BG output activity and selection/specification change when task outcome (although probabilistic) is less predictable across the duration of a session?



Related Resources

Cisek, **Cortical Mechanisms of Action Selection: the Affordance Competition Hypothesis.** *Phil Trans B* (2007).

Cisek and Kalaska, **Neural Mechanisms for Interacting with a World Full of Action Choices.** *Annu. Rev. Neurosci* (2010).

Thura, Cos, Trung, and Cisek, **Context-Dependent Urgency Influences Speed-Accuracy Trade-Offs in Decision-Making and Movement Execution**. *J Neurosci* (2014).

Cisek, Puskas, and El-Murr, **Decisions in Changing Conditions: The Urgency-Gating Model**. *J Neurosci* (2009).

Winkel, Keuken, van Maanen, Wagenmakers, and Forstmann, **Early Evidence Affects Later Decisions: Why Evidence Accumulation is Required to Explain Response Time Data**. *Psychon Bull Rev* (2014).

Carland, Thura, and Cisek, **The Urgency-gating Model Can Explain the Effects of Early Evidence**. *Pscyhon Bull Rev* (2015).

Dunovan and Versytnen, **Believer-Skeptic Meets Actor-Critic: Rethinking the Role of Basal Ganglia Pathways during Decision-Making and Reinforcement Learning**. *Frontiers in Neuroscience* (2016).

Alexander and Crutcher, **Functional Architecture of Basal Ganglia Circuits: Neural Subtrates of Parallel Processing**. *TINS* (1990).

Cui, Jun, Jin, Pham, Vogel, Lovinger, and Costa, **Concurrent Activation of Striatal Direct and Indirect Pathways During Action Initiation**. *Nature* (2013).