

Analysing Cognitive Systems in Parkinson Disease Patients

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Outline

- What is Parkinson's Disease
- Investigating cognitive systems of PD patients
 - Reinforcement learning
 - Decision making
 - Working memory

Parkinson disease (PD)

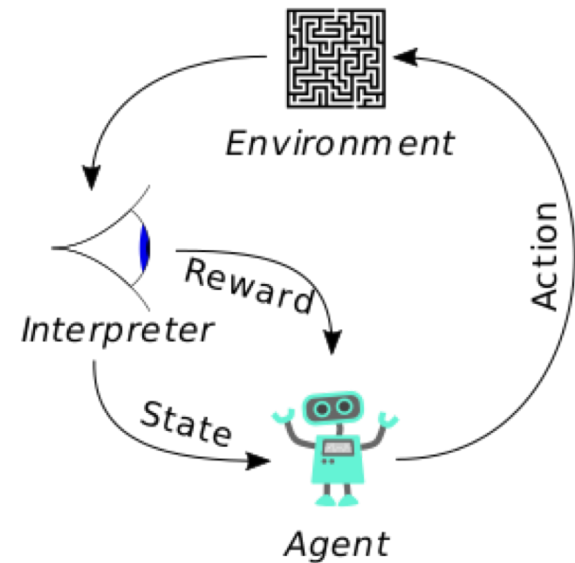
- Is a long-term degenerative disorder
 - Of the central nervous system
- Less cells that release dopamine (DA)
 - Substantia nigra
- Mainly affects the motor system

PD symptoms

- Physical problems
 - Shaking, rigidity and slowness of movements
- Mental/cognitive deficits
 - Thinking and behavioral problems

Reinforcement learning

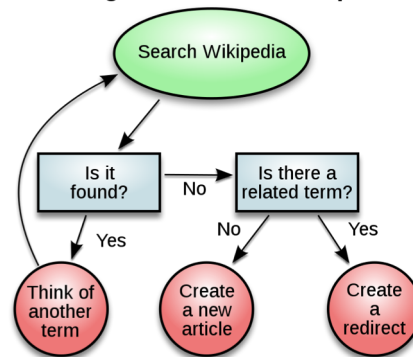
- Taking action in an environment
 - Maximizing some reward
- Used in:
 - Game theory
 - Simulation-based theory
 - Multi-agent systems



Decision making

- A cognitive process resulting in selecting an action among several alternatives

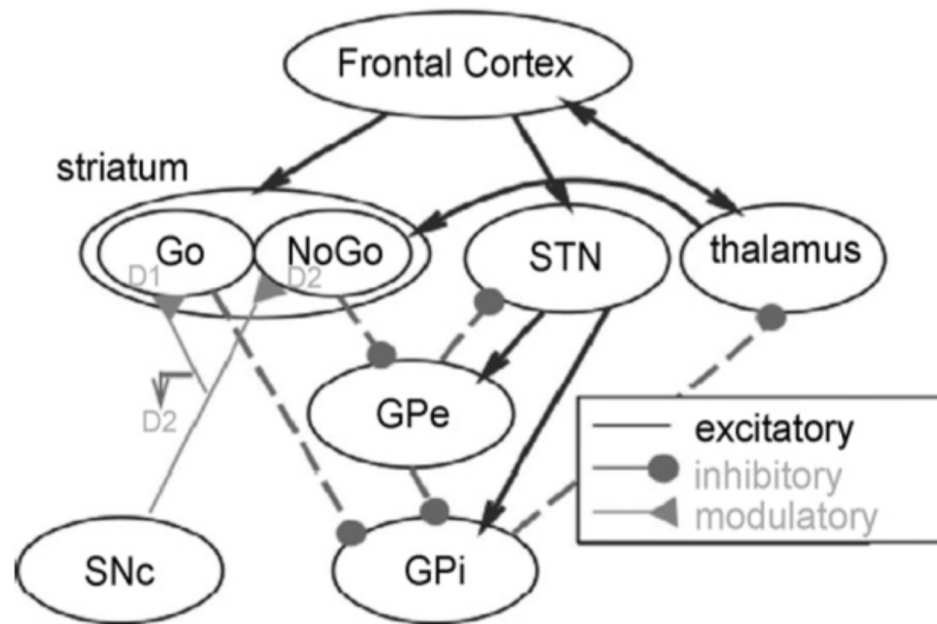
Adding an article to Wikipedia



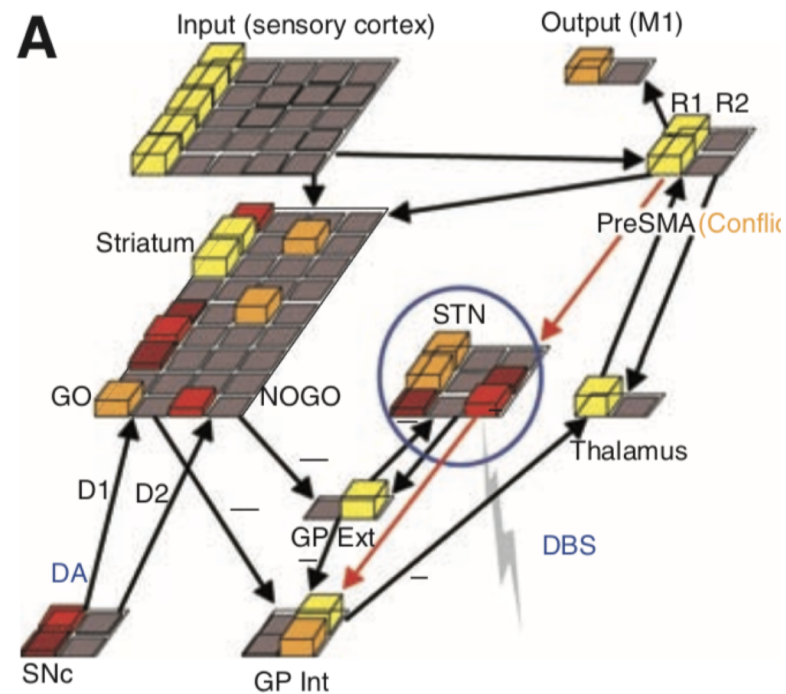
Working memory

- Temporarily holds and manages information
- Keeps the information available for processing
 - Encoding, storing, and retrieving data

Basal ganglia pathway



Neural Network Model

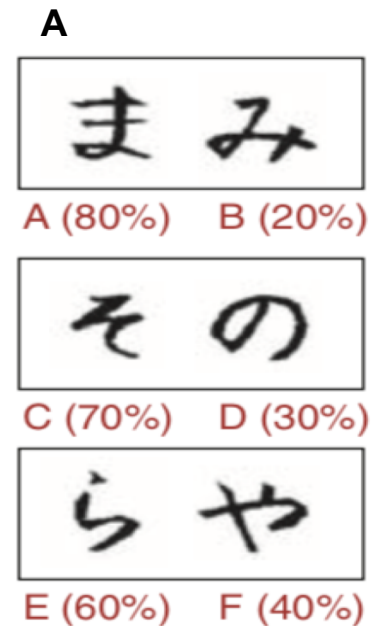


Dopamine in PD patients

- Dopamine
 - Excites the GO & Inhibits the NoGo pathway
- Depleted level of dopamine in PD patients
 - Influences learning from +/- outcomes
 - Effects working memory
- STN disruption
 - Impulsivity in decision making

Training in RL experiment

- 30 PD patients and 19 healthy
- Choosing one in each pair
- Feedback is provided
- Learning could be more
From + or - outputs

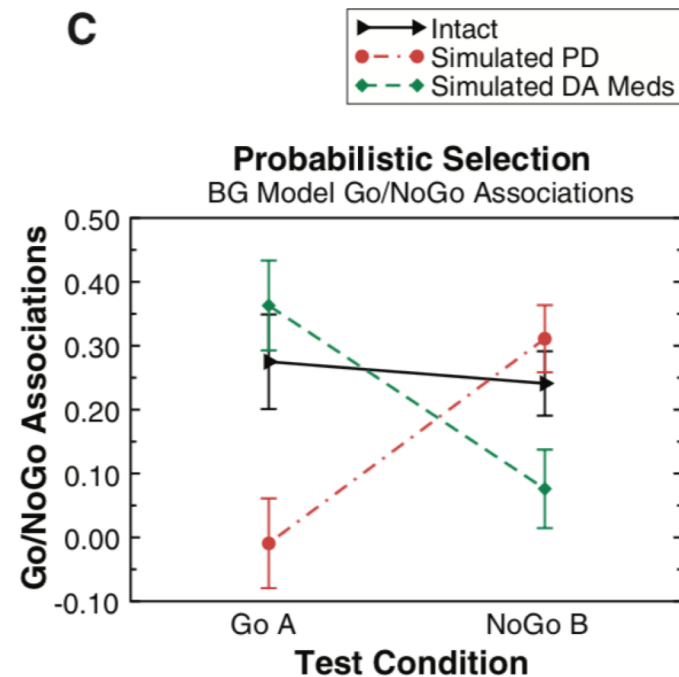


Testing in RL experiment

- Novel combination of the pairs
 - Involving an A
 - AC, AD, AE, AF
 - Involving a B
 - BC, BD, BE, BF

Result of DA on RL

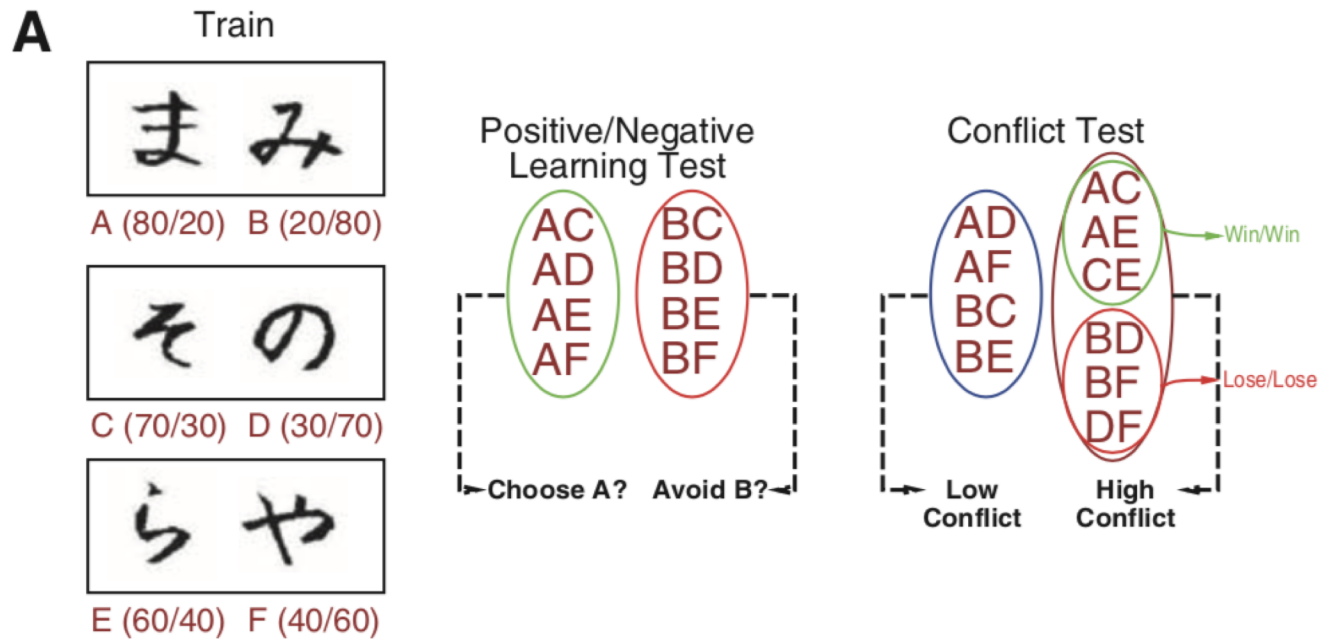
- On med patients
 - Learn from positive
- Off med patients
 - Learn from negative



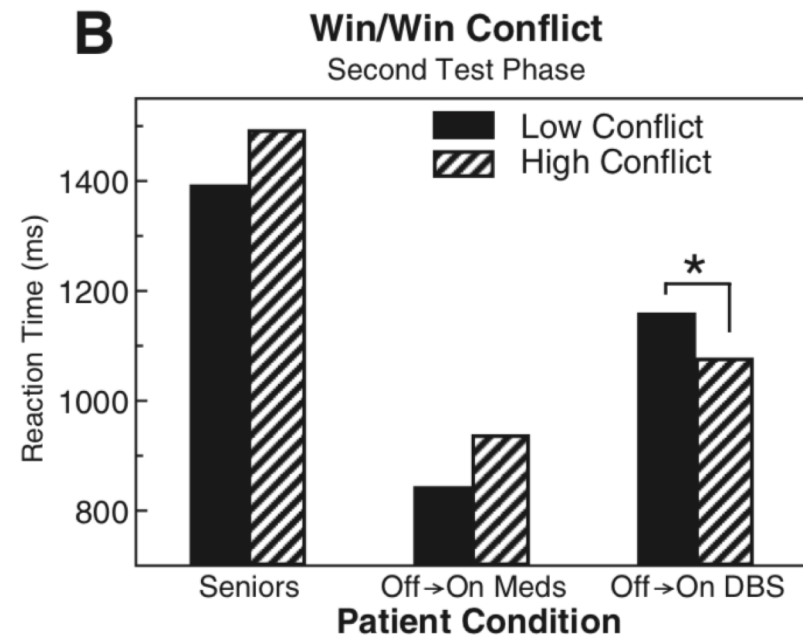
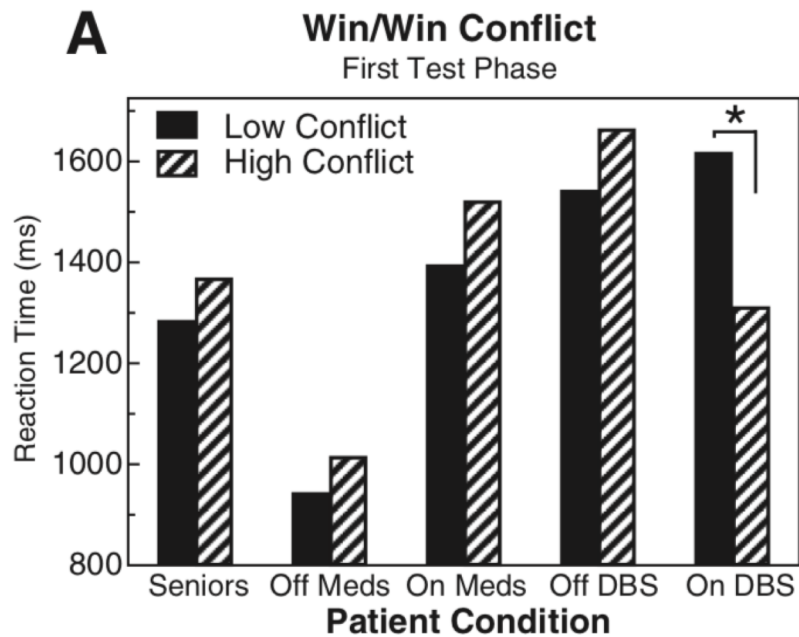
Deep brain stimulation of STN

- A surgical procedure to treat motor symptoms
- Improving motor symptoms in PD patients

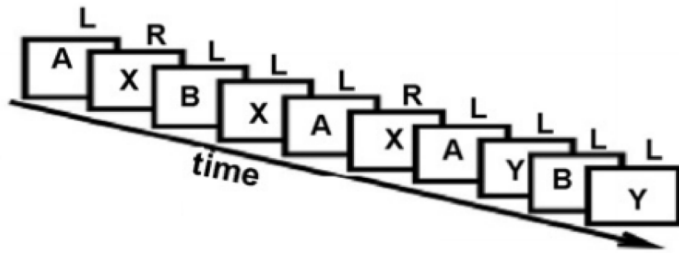
Decision making experiment



High conflict win/win



Working memory experiment



Maintain context information

A	Perform well on AX Bad on AY
B	Perform well on BX

Working memory results

	On medication	Off medication
AY- performance	decreased	increased
BX- performance	increased	decreased

- DA medications enhance WM updating, which is indexed by relatively better BX and worse AY performance

Summary

- Dopamine improves learning from positive but worsen learning from negative cases
- DBS causes impulsivity
- Dopamine improves the working memory updating

Thank you