

## Module:

Biological foundations of mental health

Week 5:

Reward, emotion and action



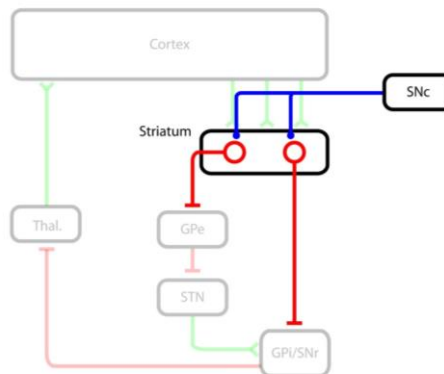
Dr Frank Hirth

**Topic 2**  
**The structure and function**  
**of the Basal Ganglia**

*Part 3 of 5*

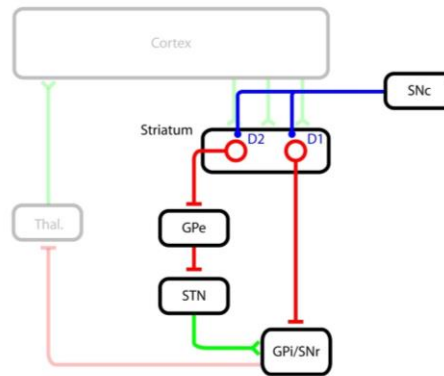
### Dopamine as modulator of the pathways (1)

**Dopamine (DA) input arises from the SNc**



## Dopamine as modulator of the pathways (2)

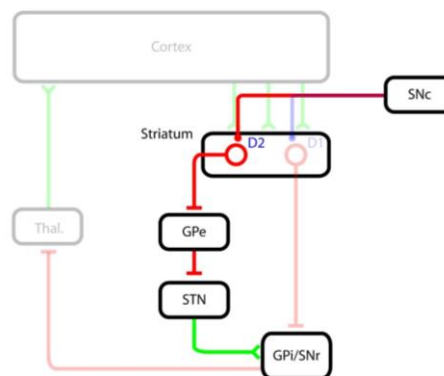
## Direct and Indirect pathways express distinct dopamine receptors



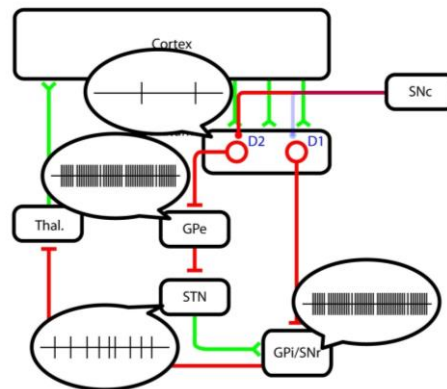
Because of the different nature of D1 and D2 receptors, they respond differently to DA

## Dopamine as modulator of the pathways (3)

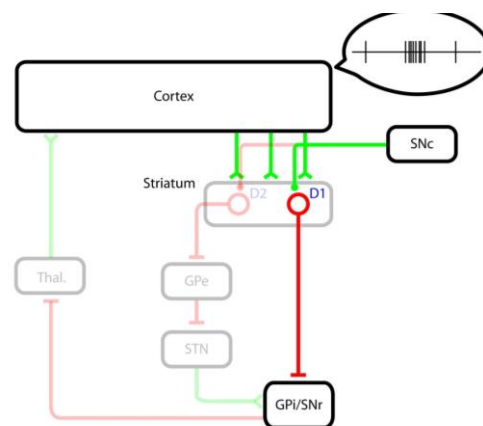
## D2 signalling suppresses firing in indirect pathway neurons



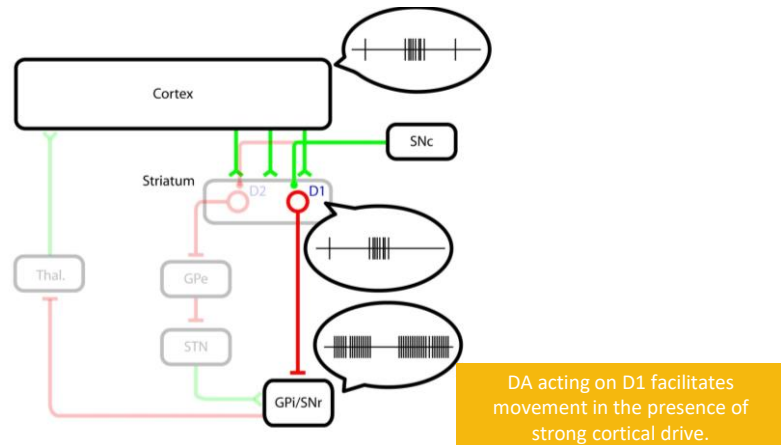
## Dopamine as modulator of the pathways (4)

**D2 signalling suppresses firing in indirect pathway neurons**

## Dopamine as modulator of the pathways (5)

**Strong cortical inputs are facilitated by D1 signalling**

## Dopamine as modulator of the pathways (6)

**Strong cortical inputs are facilitated by D1 signalling**

## Dopamine as modulator of the pathways (7)

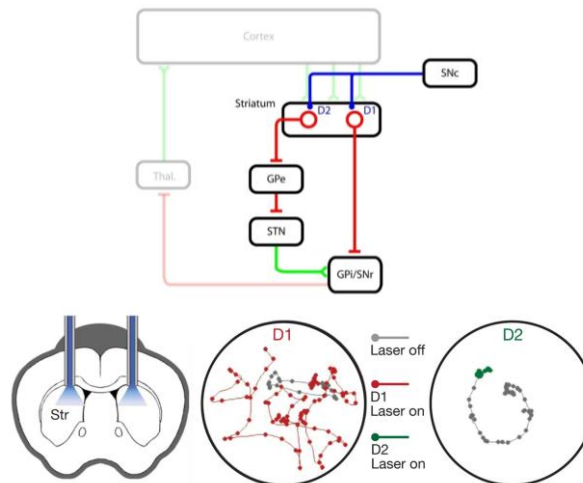
**Dopamine effects on direct and indirect pathways**

- Dopamine signaling through D2 receptors in the indirect pathway suppresses striatal inhibitory activity
- Dopamine signaling through D1 receptors in the direct pathway:
  - Facilitates strong, phasic inputs
  - Suppresses weak inputs

Thus, dopamine modulates impact of direct and indirect pathway activity via differential action of D1 and D2 receptors

## Dopamine as modulator of the pathways (8)

**Indirect pathway suppresses action. Direct pathway facilitates action.**



**Figure 5:** *In vivo* activation of direct or indirect pathways reveals pathway-specific regulation of motor function.

## Dopamine as modulator of the pathways (9)

This video from original paper Kravitz et al. shows that optogenetic activation of the indirect pathway suppressed action and thus inhibits motor behaviour.

[Click on video below to play](#)

**Movie S2:  
Bilateral illumination of indirect pathway**

**Kreitzer lab, 2010**