KING'S College LONDON

INSTITUTE OF PSYCHIATRY,
PSYCHOLOGY & NEUROSCIENCE

Module:
Biological foundations of mental health

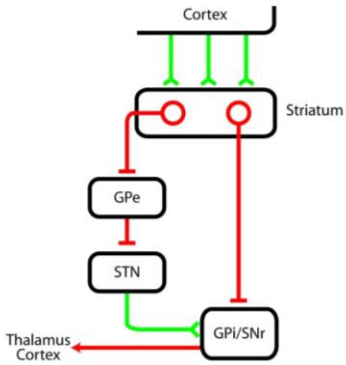
Week 5:
Reward, emotion and action

Dr Frank Hirth

Topic 2
The structure and function of the Basal Ganglia

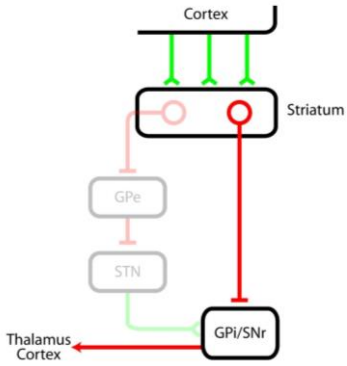
Part 2 of 5

Direct and Indirect Pathways (1)



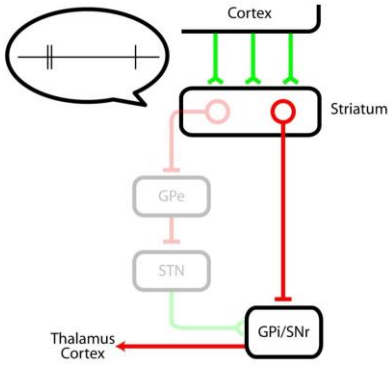
Direct and Indirect Pathways (2)

Direct Pathway



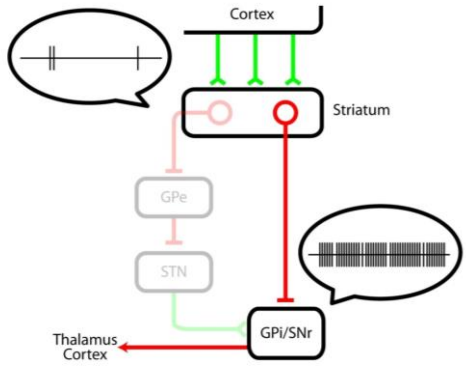
Direct and Indirect Pathways (3)

Basal firing rates in the striatum are very low, and dependent upon strong cortical excitation.



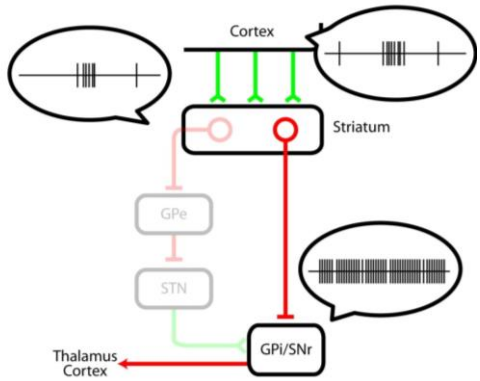
Direct and Indirect Pathways (4)

Under these conditions, striatal firing has little impact on GPi/SNr discharge



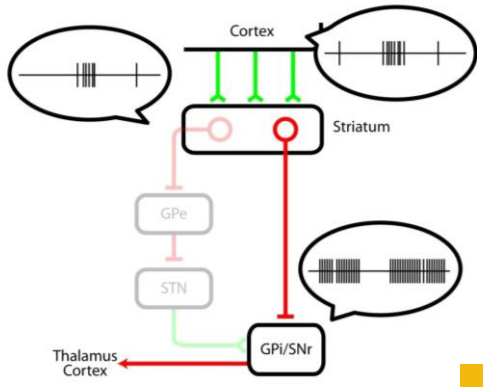
Direct and Indirect Pathways (5)

Phasic cortical excitation drives excitatory discharge in the striatum



Direct and Indirect Pathways (6)

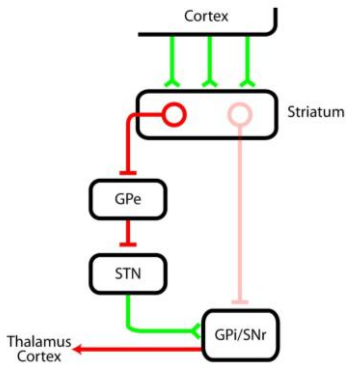
Activation of the direct pathway promotes action.



This causes a *transient* inhibition of GPi/SNr firing.

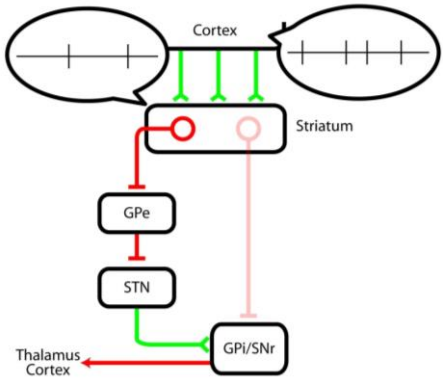
Direct and Indirect Pathways (7)

Indirect pathway



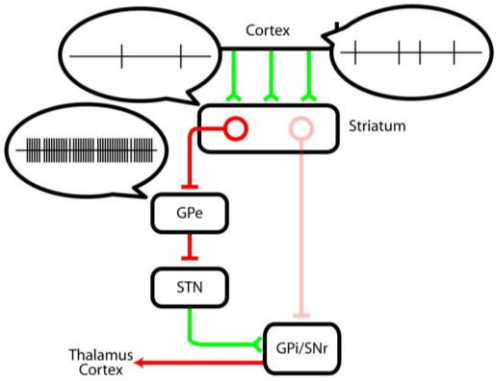
Direct and Indirect Pathways (8)

Striatal neurons have low tonic firing rates; again, dependent upon strong cortical inputs



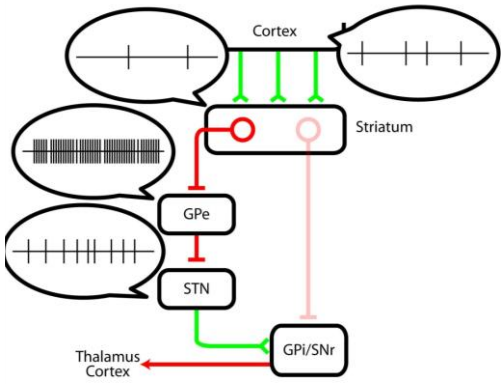
Direct and Indirect Pathways (9)

GPe neurons are similar to those in GPi; they have high tonic firing rates



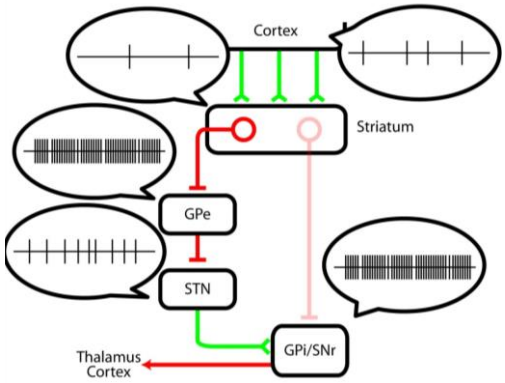
Direct and Indirect Pathways (10)

Because of Inhibitory Activity of GPe neurons STN Activity is Suppressed



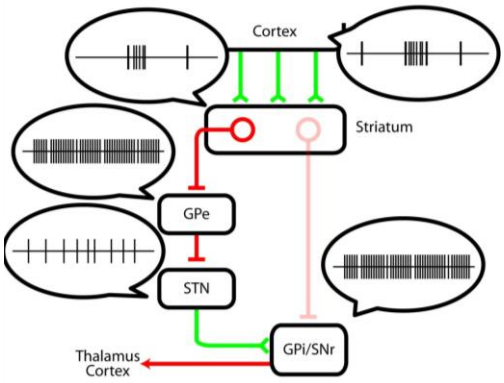
Direct and Indirect Pathways (11)

Firing under these quiescent conditions
high discharge in output nuclei (GPi/SNr) is maintained and thus thalamus inhibited



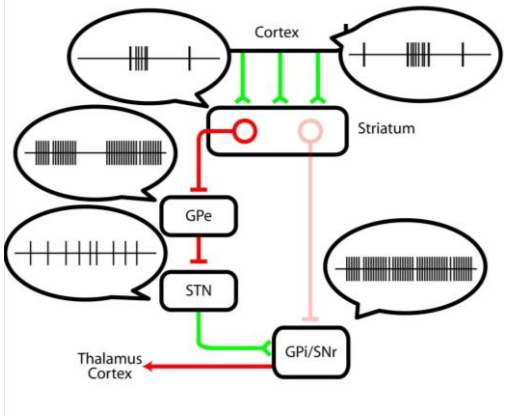
Direct and Indirect Pathways (12)

What happens to indirect pathway with strong, phasic cortical excitation?



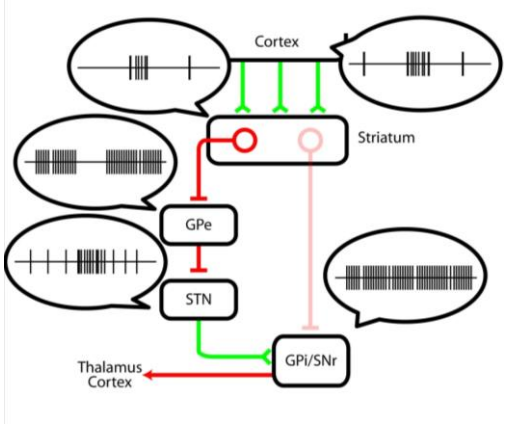
Direct and Indirect Pathways (13)

Transient inhibition of GPe firing



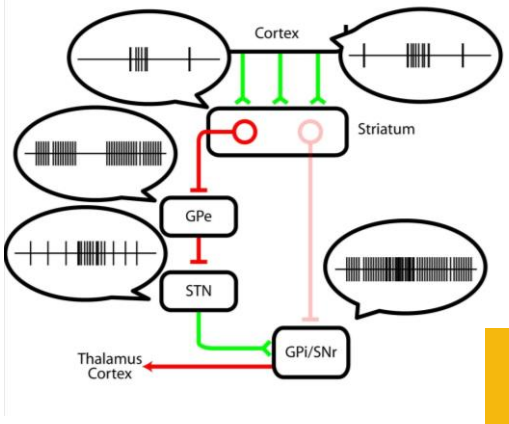
Direct and Indirect Pathways (14)

Followed by phasic excitation of the STN (through disinhibition)



Direct and Indirect Pathways (15)

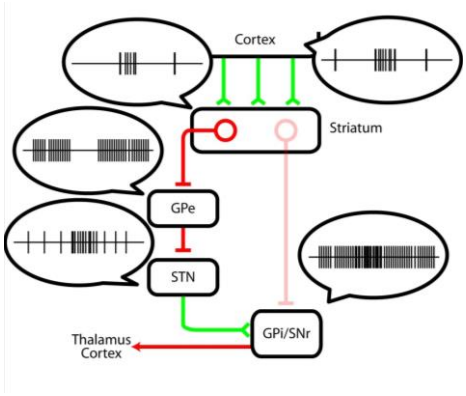
And finally, a increased rate of discharge in the output nuclei because of excitatory connection between STN and output nuclei



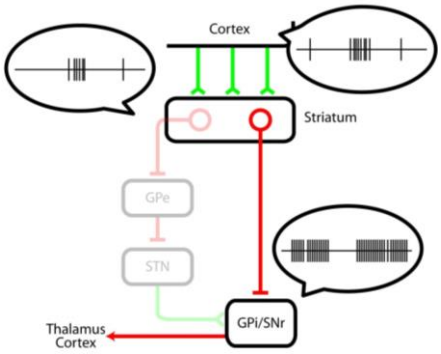
Activation of the indirect pathway suppresses action because of enhanced suppression of thalamus.

Direct and Indirect Pathways (16)

Indirect pathway

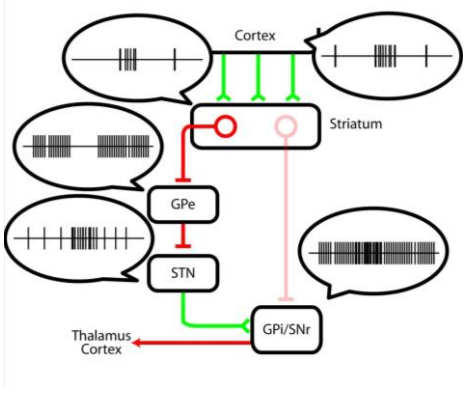


Direct pathway

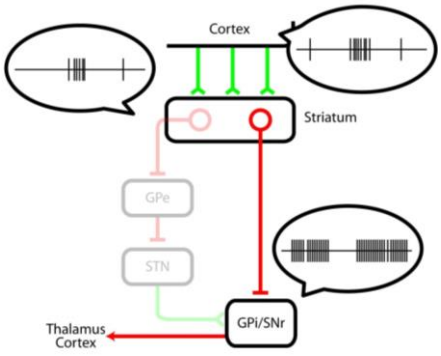


Direct and Indirect Pathways (17)

Indirect pathway suppresses action.



Direct pathway facilitates action.



How do they cooperatively regulate motor output?