

Neurobiology of Addiction

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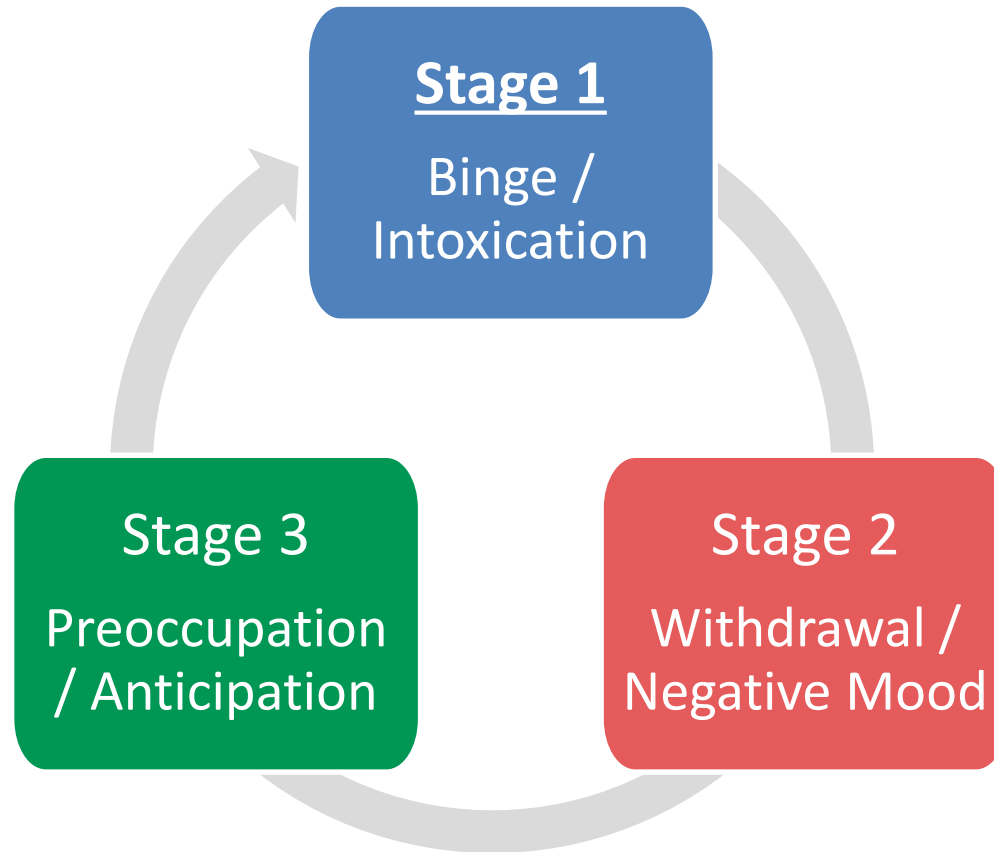


What is Addiction?

- Addiction is a chronic, relapsing, and treatable brain disorder.
- Compulsive drug seeking and use in spite of serious consequences



Three Stage Model of Addiction



Three Stage Model of Addiction

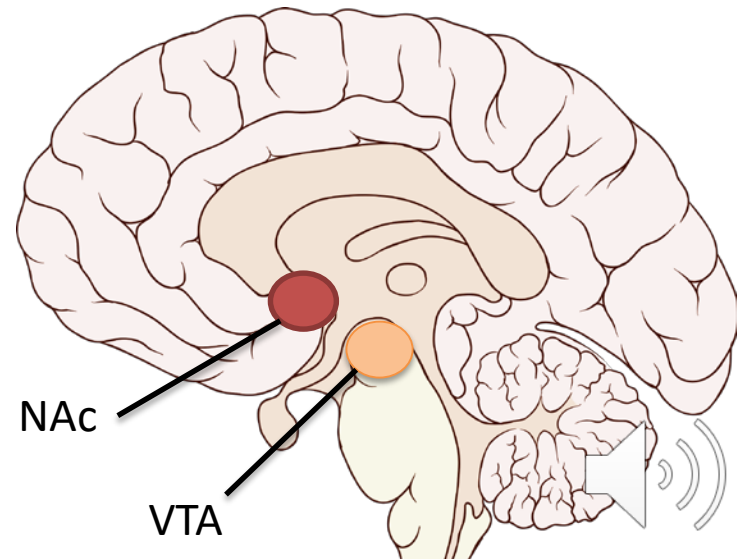
Stage 1

Binge /
Intoxication



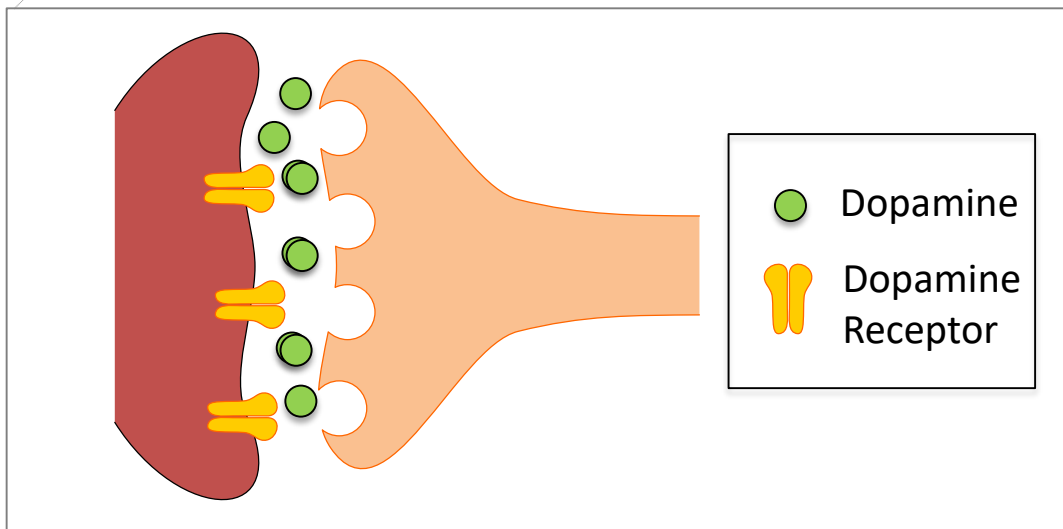
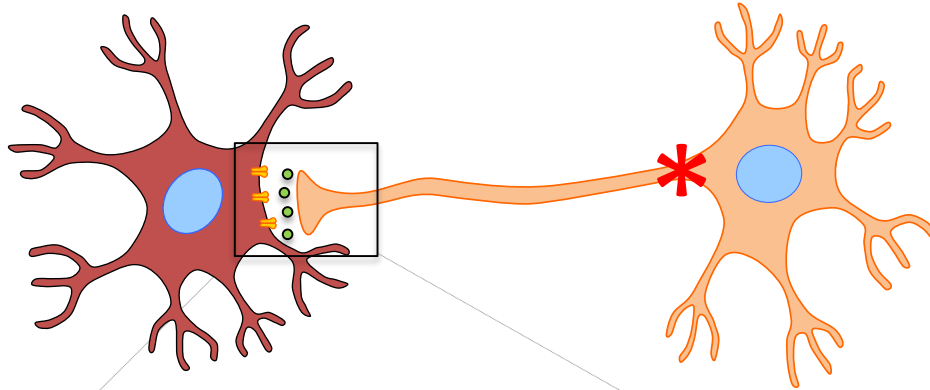
1. Binge / Intoxication

- Associated with positive reinforcement & motivational learning
- Associating cues with reward delivery



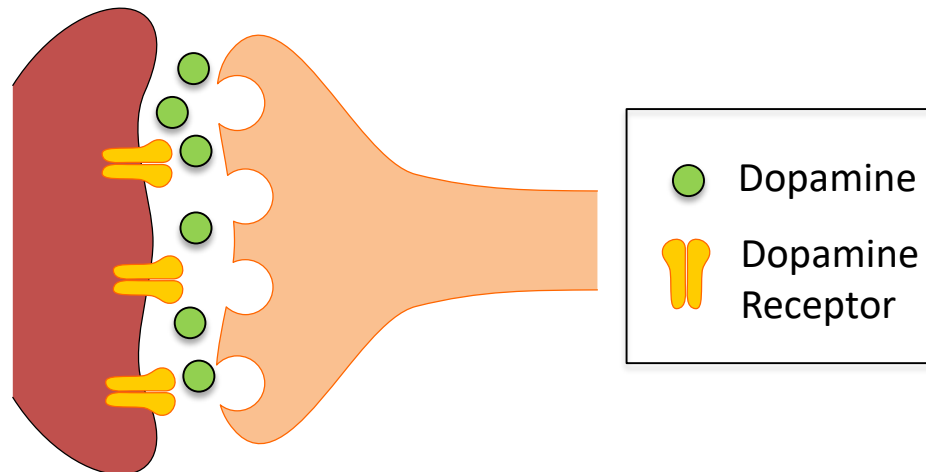
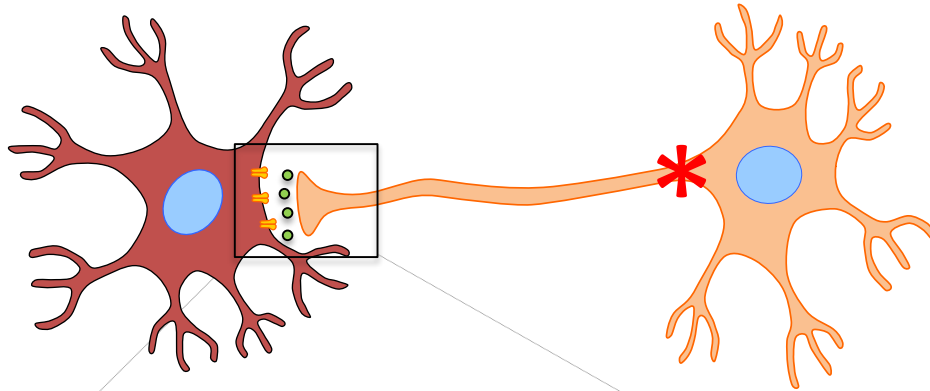
Nucleus Accumbens

Ventral Tegmental Area



Nucleus Accumbens

Ventral Tegmental Area



What does \uparrow dopamine signal?

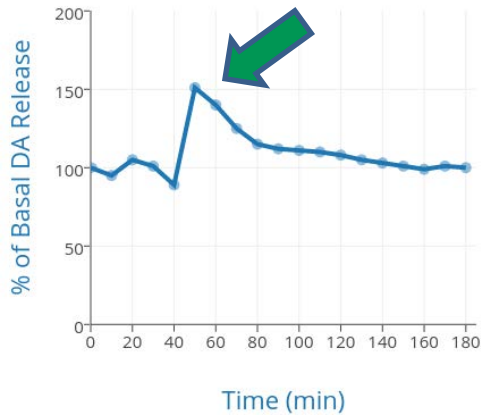
- \uparrow Value of future reward / of work to gain the reward
- \uparrow Motivation to obtain reward
- \uparrow WANT

— *Evolved out of survival* —

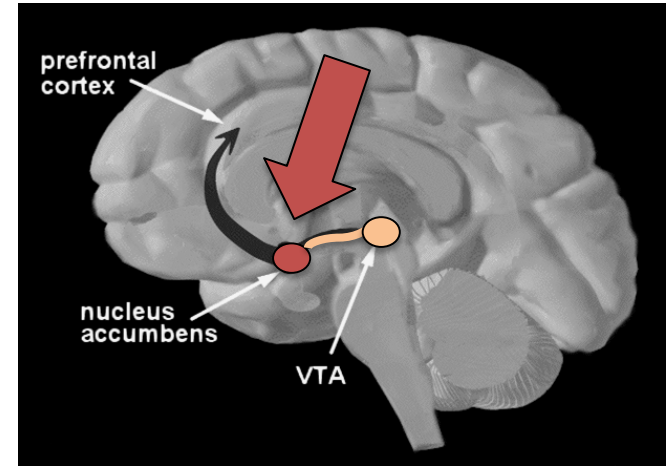
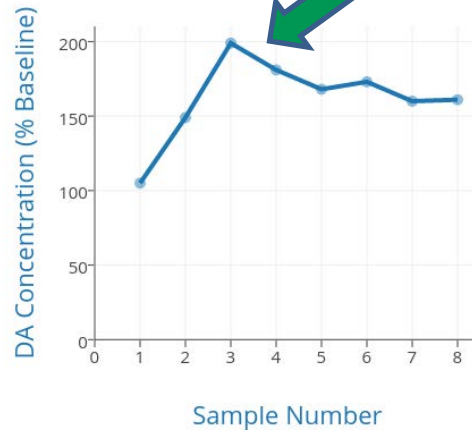


Dopamine is released in response to many types of rewards

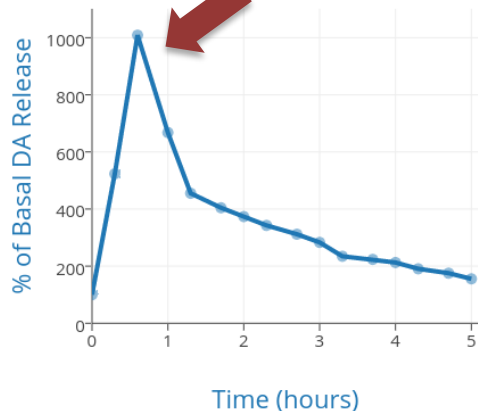
Food



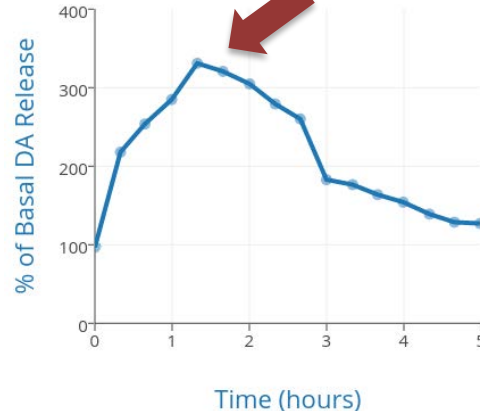
Sex



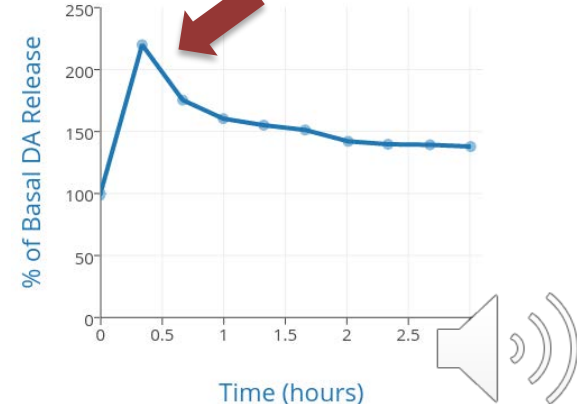
Amphetamine



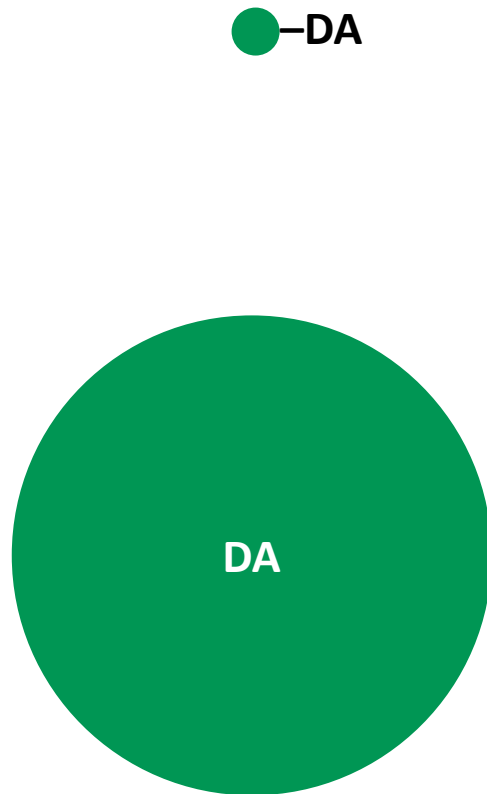
Cocaine



Nicotine



Drugs of abuse can be more reinforcing than natural rewards



Drugs of abuse can release up to 10 times the amount of DA that natural rewards do

Overstimulation of the reward circuit:

- Leads to an increase in the drive to obtain drugs over natural rewards



DA neurons will eventually fire in response to cues that predict the reward

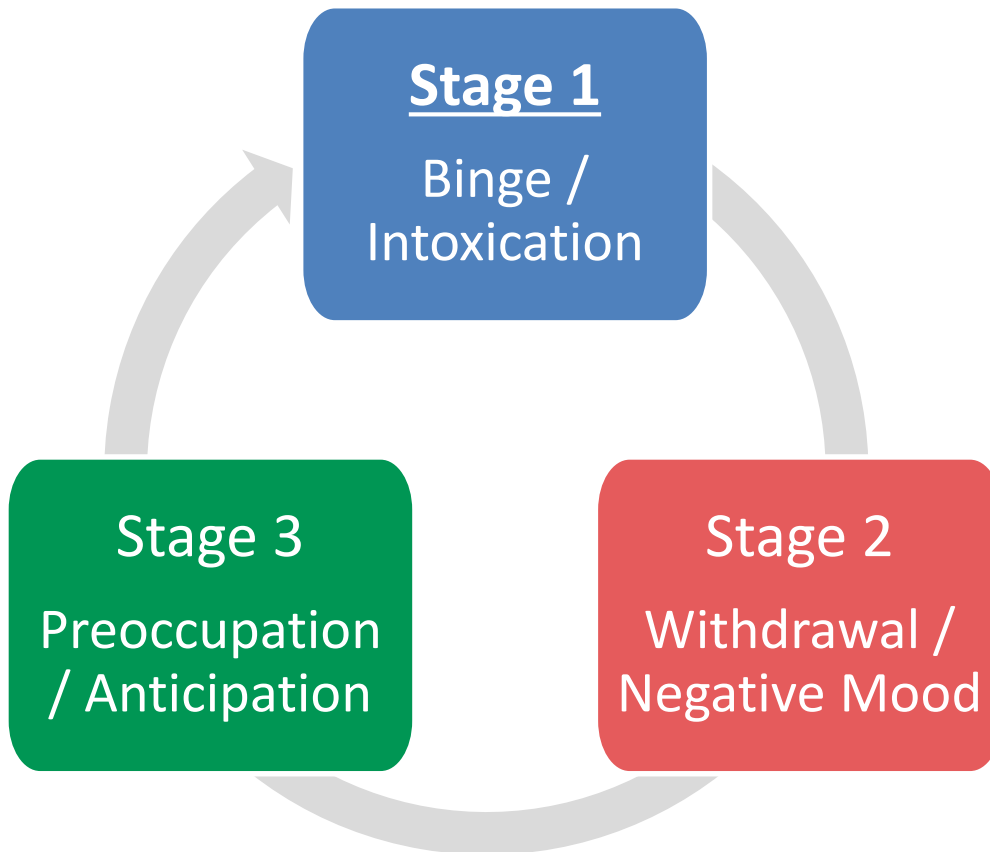


Conditioned stimuli
paired formerly paired
with the drug elicit DA
release

- Trigger craving
- Increase motivation to seek out drug
- May lead to binge use

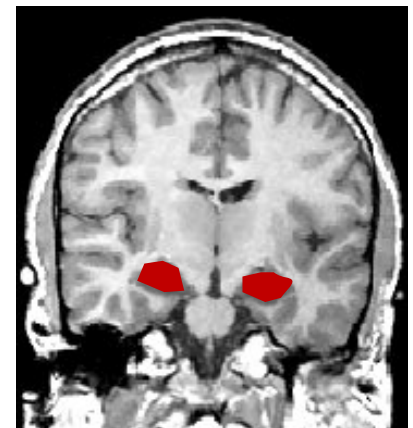


Three Stage Model of Addiction



2. Negative Affect & Withdrawal

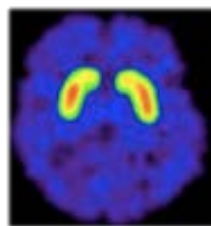
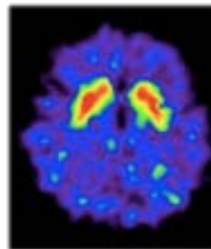
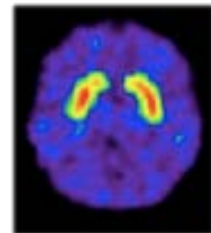
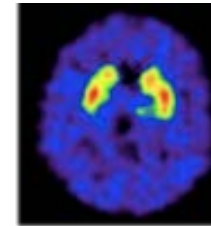
- Associated with negative reinforcement and increases in stress



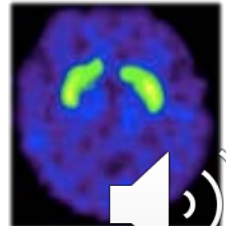
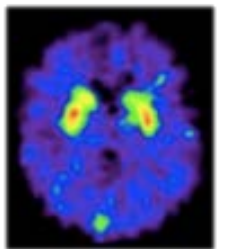
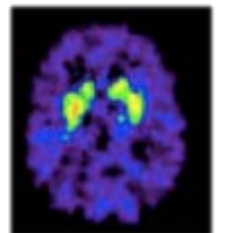
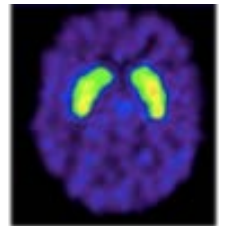
Neuroadaptations as a result of *prolonged* drug use: Dopamine

- At baseline, dopamine receptor concentration is reduced to compensate for the frequent, large dopamine surges elicited by drug use

Volkow et al 2009



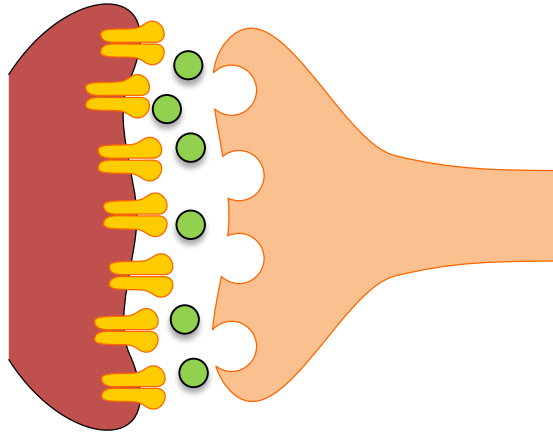
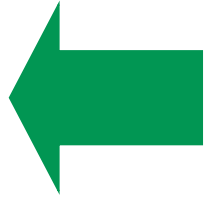
Control





Drug Abuser

Normal

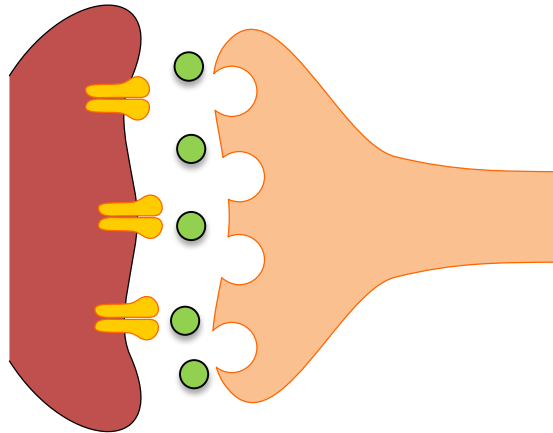
Reward
Circuits



-  Dopamine
-  Dopamine Receptor

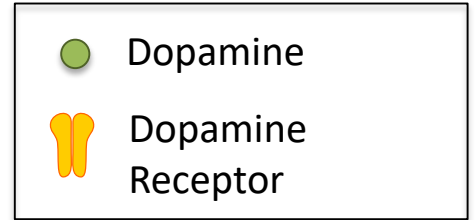
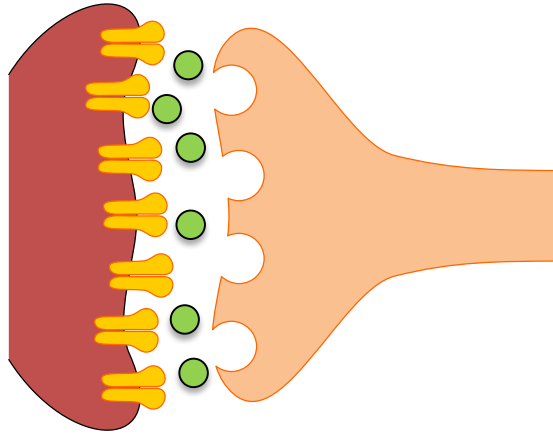
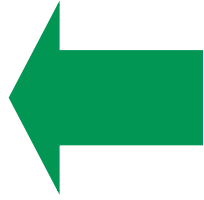
Prolonged Drug
Use

Reward
Circuits



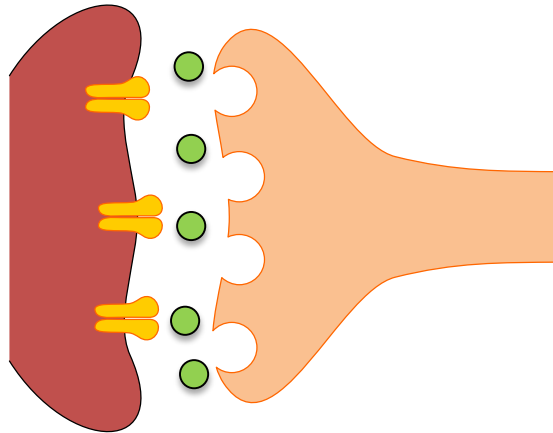
Normal

Reward
Circuits

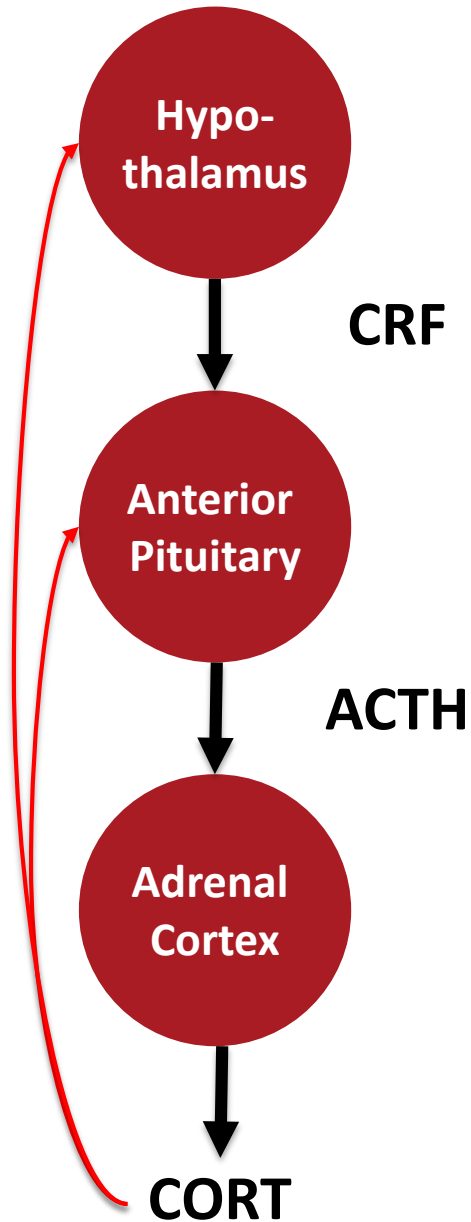


Prolonged Drug
Use

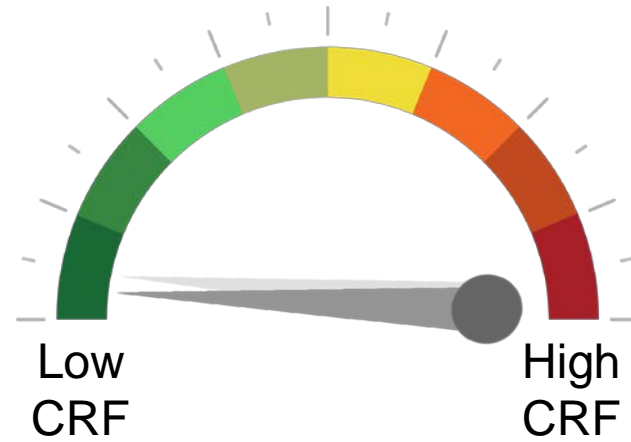
Reward
Circuits



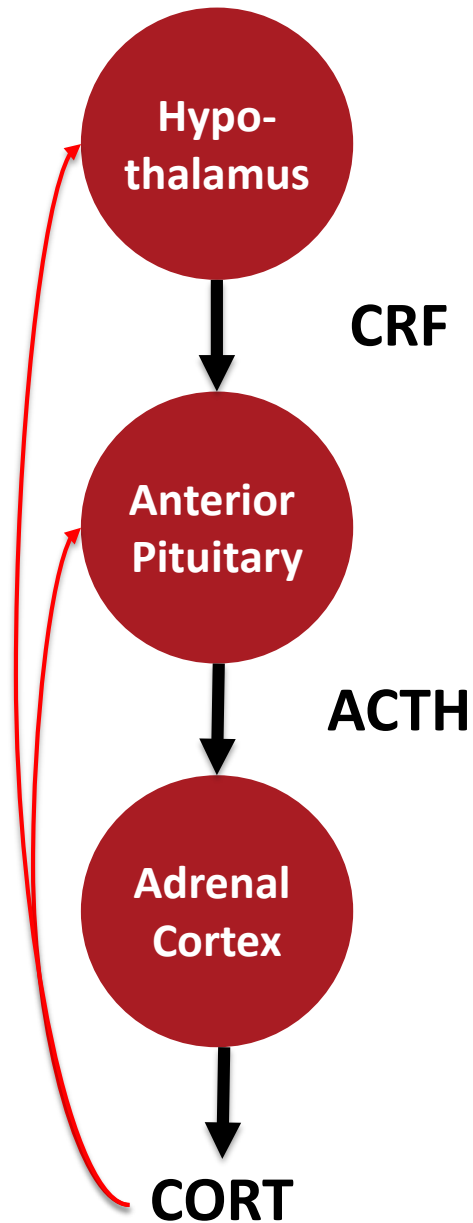
HPA/Stress Axis



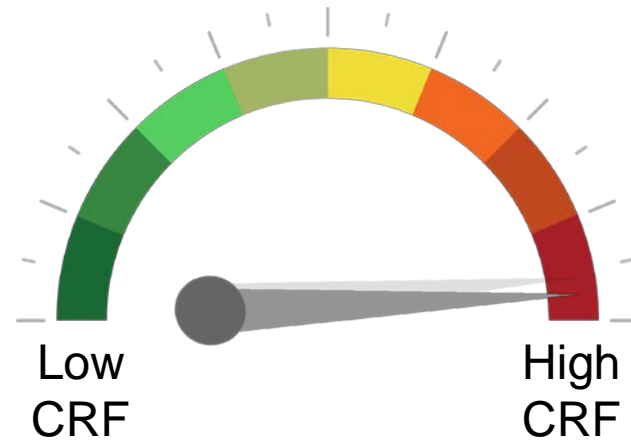
Stress Systems Dysregulated



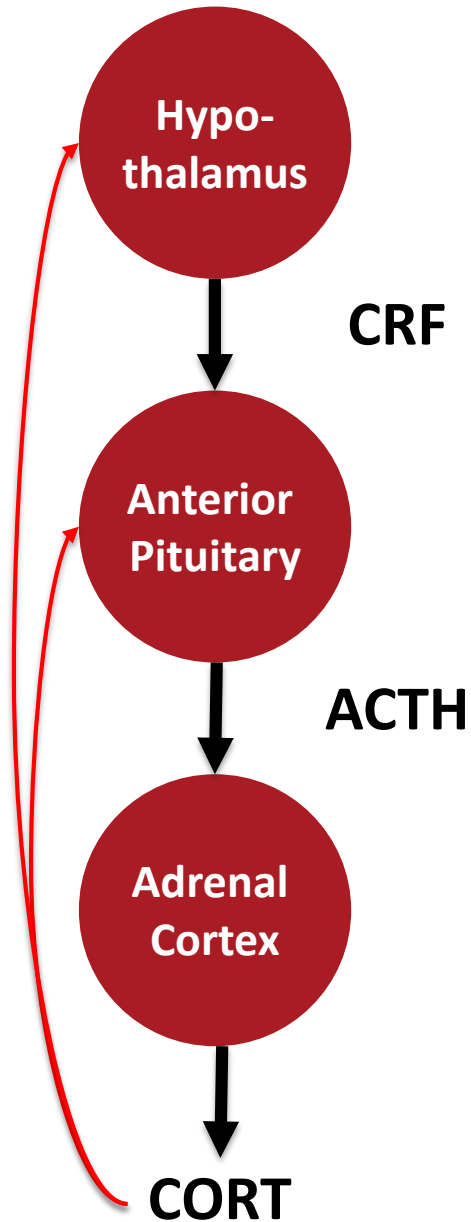
HPA/Stress Axis



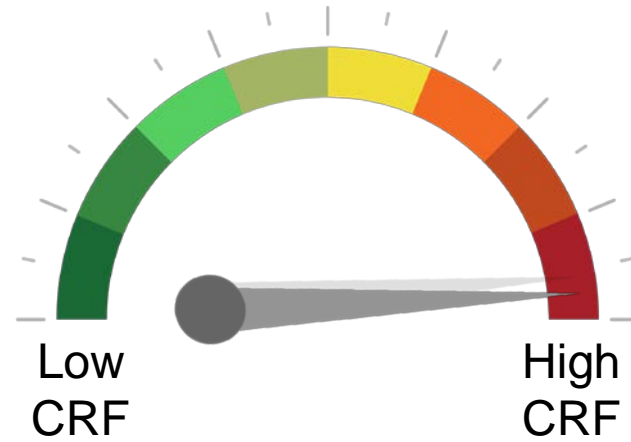
Stress Systems Dysregulated



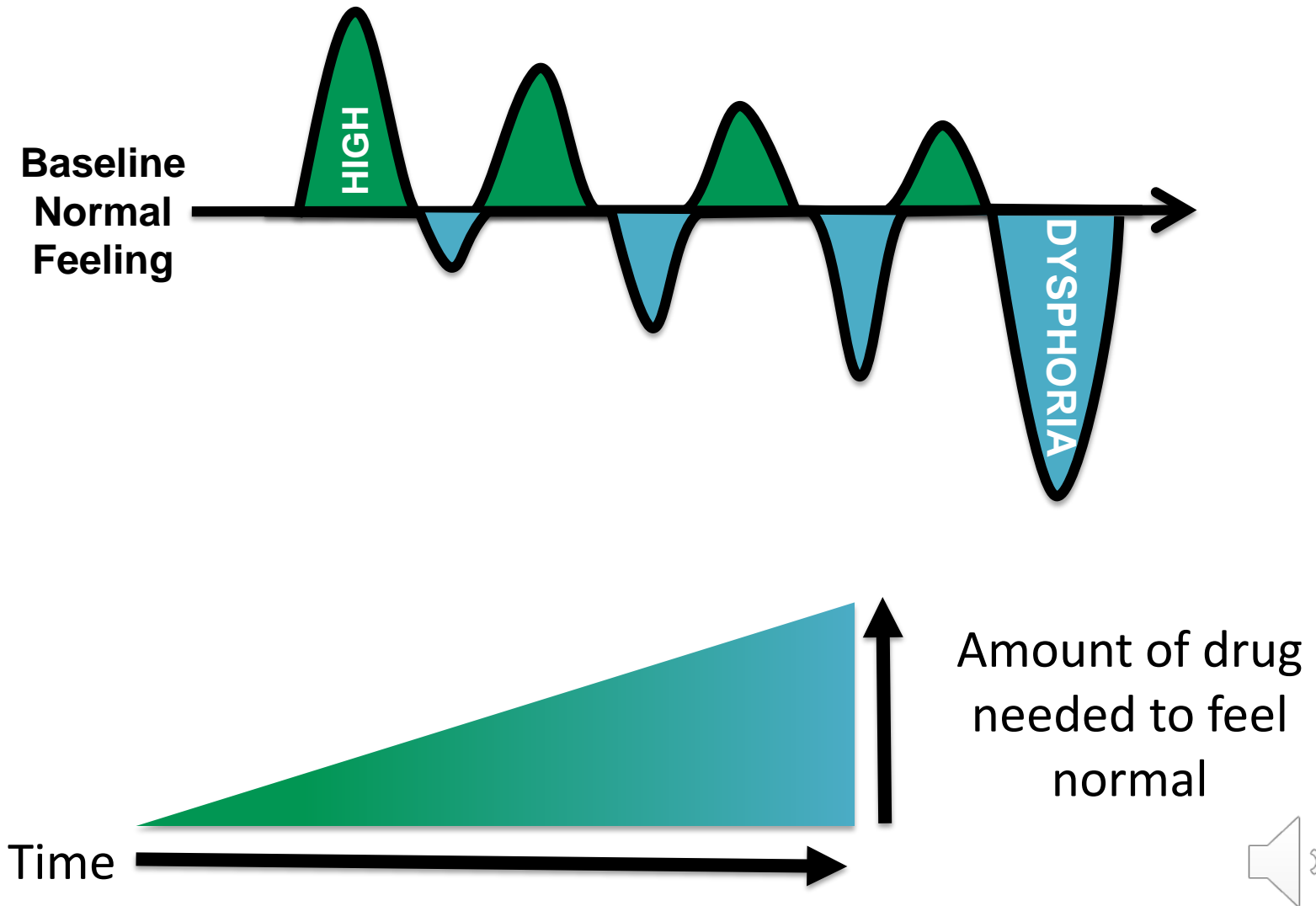
HPA/Stress Axis



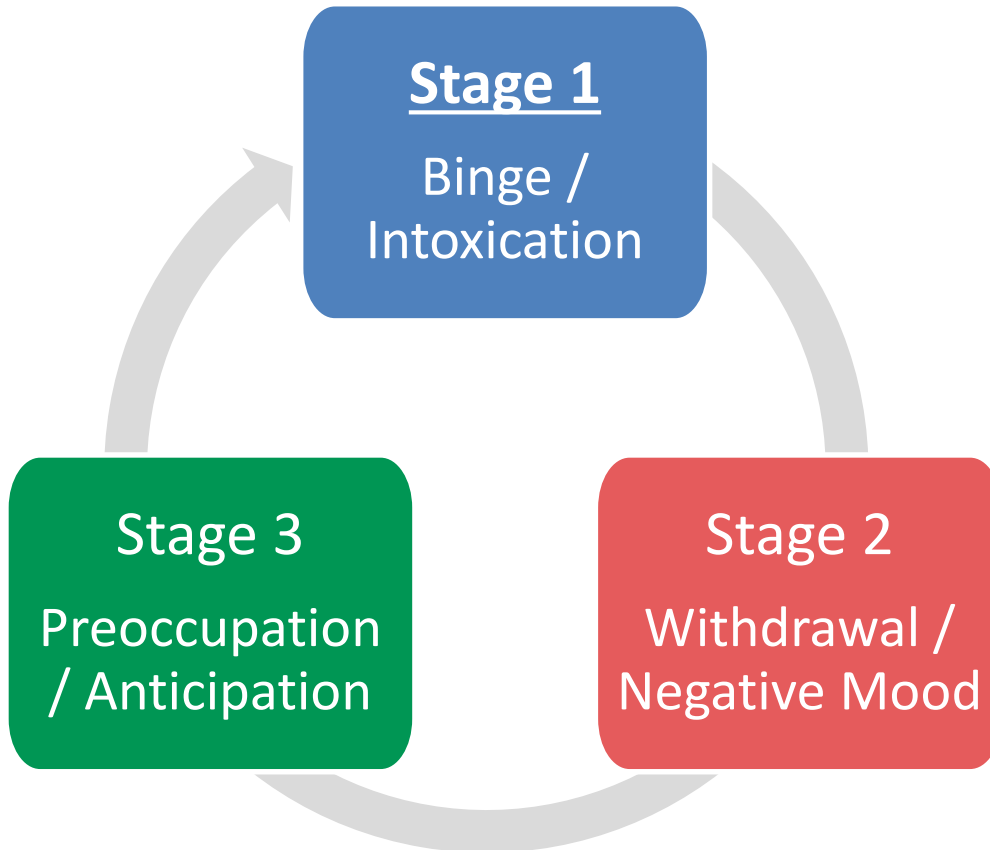
Stress Systems Dysregulated



Long-term Result of Neuroadaptations

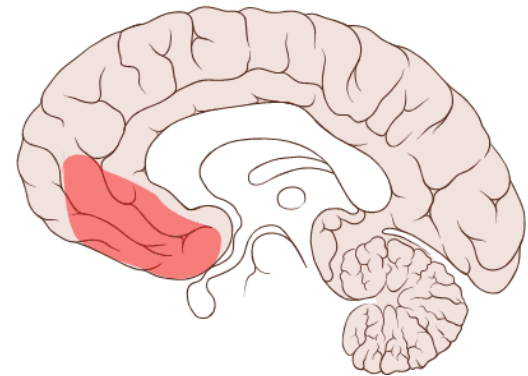


Three Stage Model of Addiction



3. Preoccupation & Anticipation

- Associated with changes to executive functioning



Normal

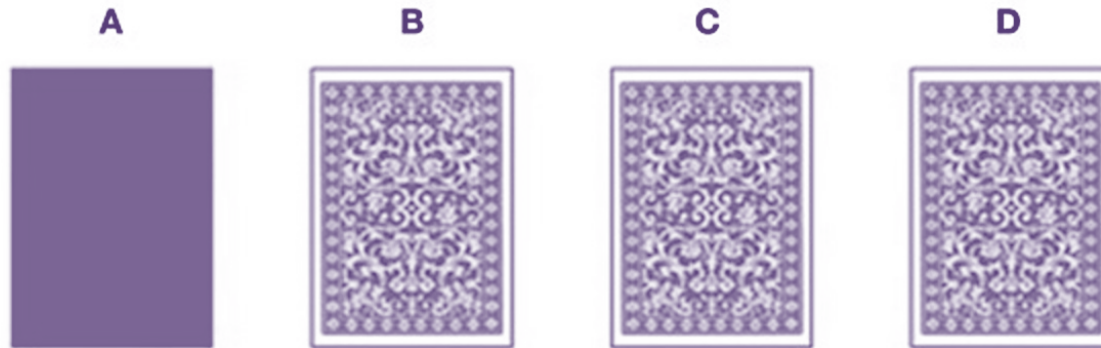
Control

Automatic

STOP



Iowa Gambling Task



Iowa Gambling Task



C



D

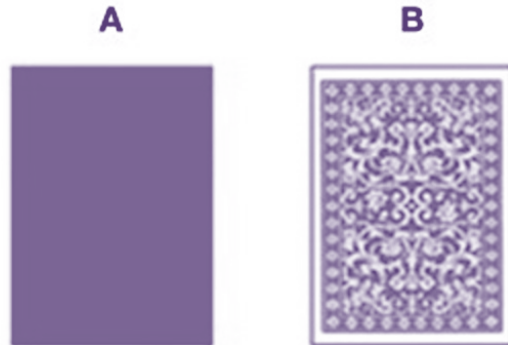


GOOD

- WINS: Small, Frequent
- LOSSES: Moderate, Rare



Iowa Gambling Task



BAD

- WINS: Large, Rare
- LOSSES: Large, Frequent



Iowa Gambling Task



GOOD

- WINS: Small, Frequent
- LOSSES: Moderate, Rare

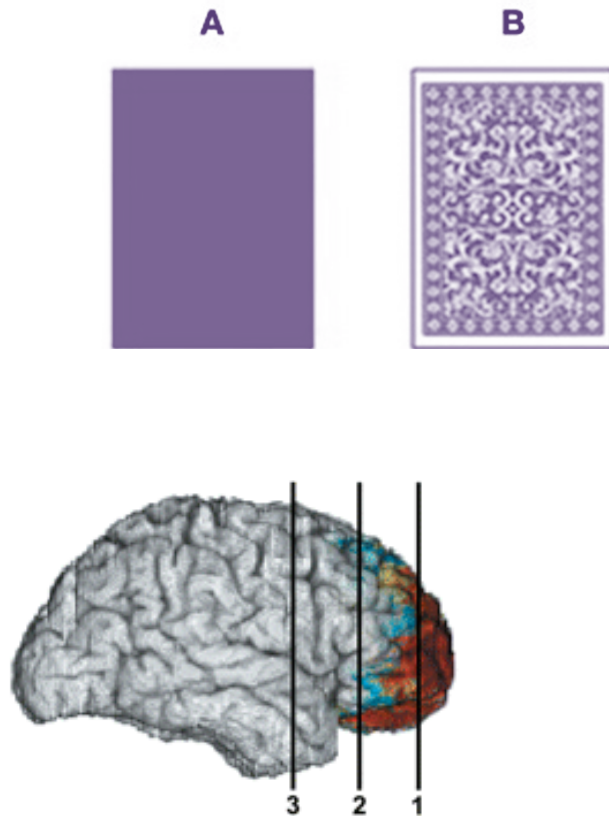


BAD

- WINS: Large, Rare
- LOSSES: Large, Frequent



Iowa Gambling Task



Bechara 2008

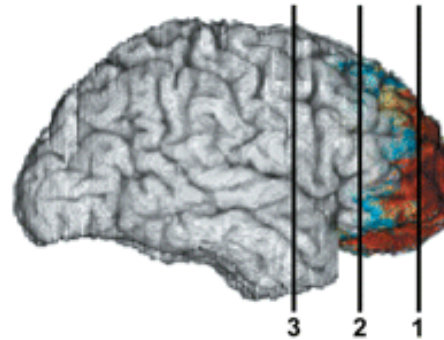
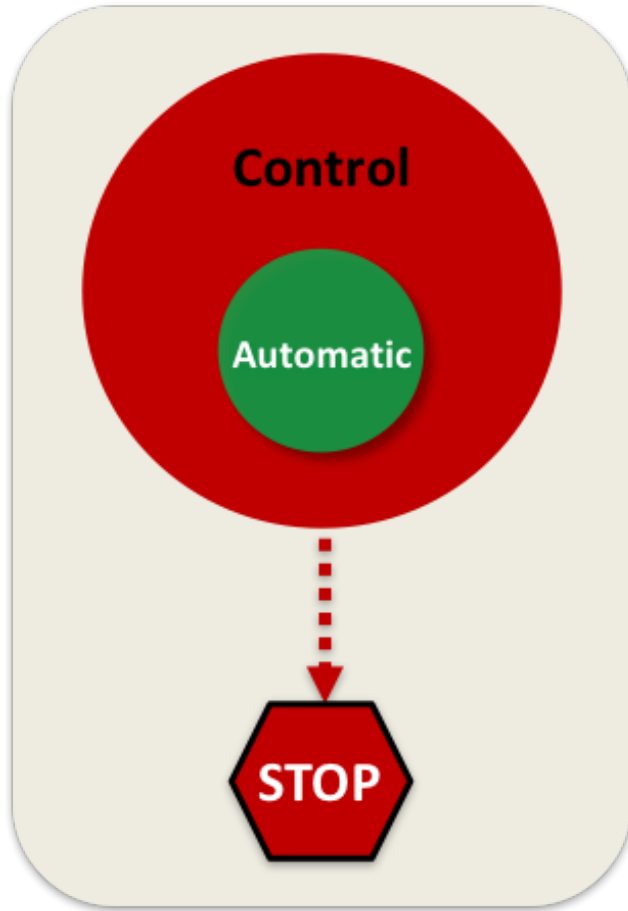


BAD

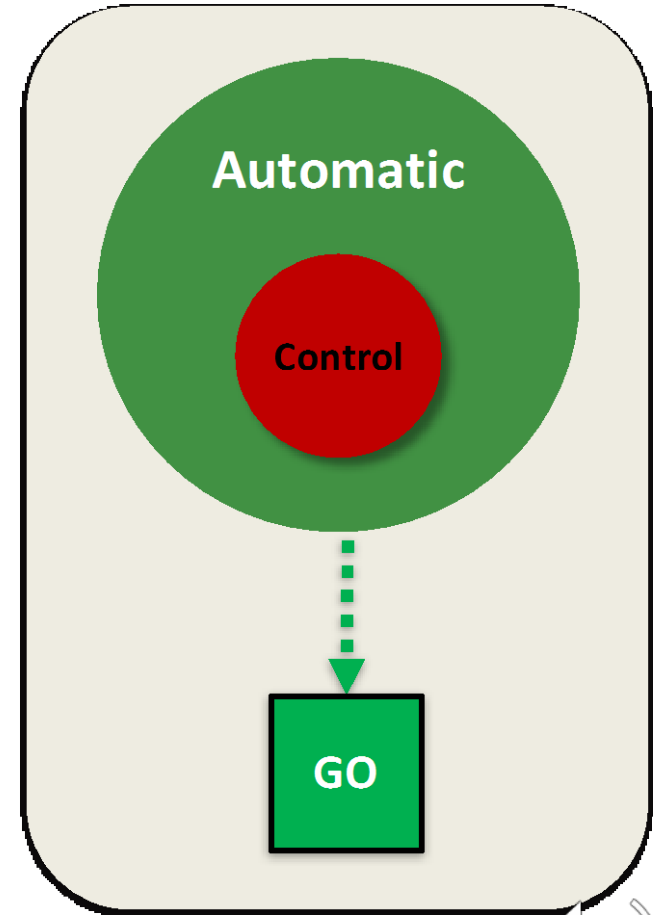
- WINS: Large, Rare
- LOSSES: Large, Frequent



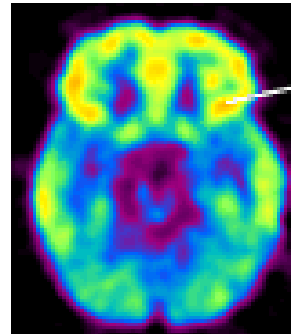
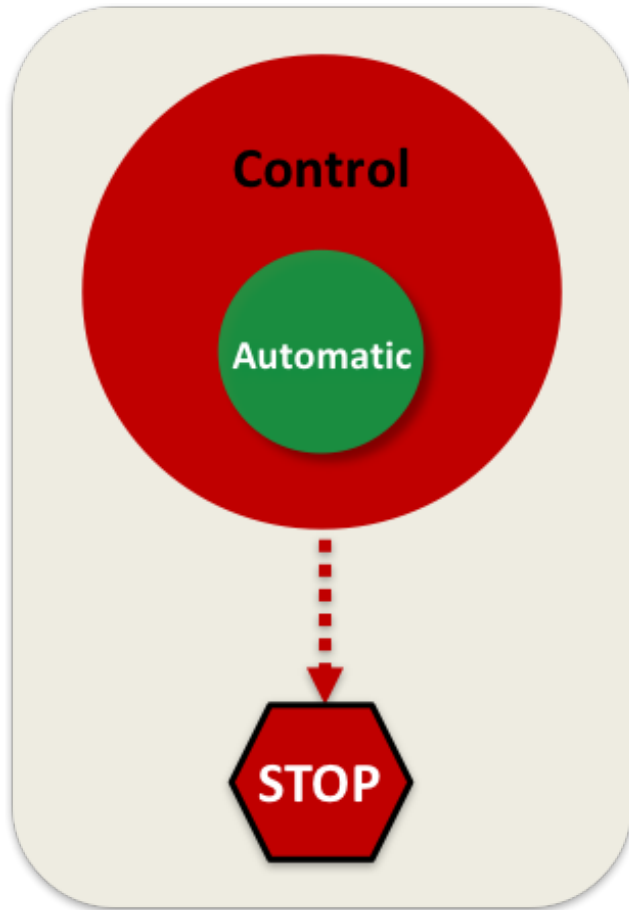
What happens if there is PFC dysfunction?



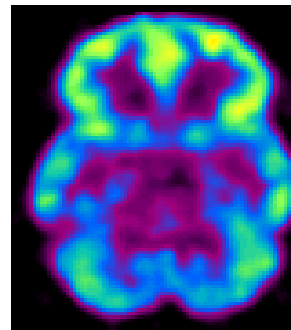
Bechara 2008



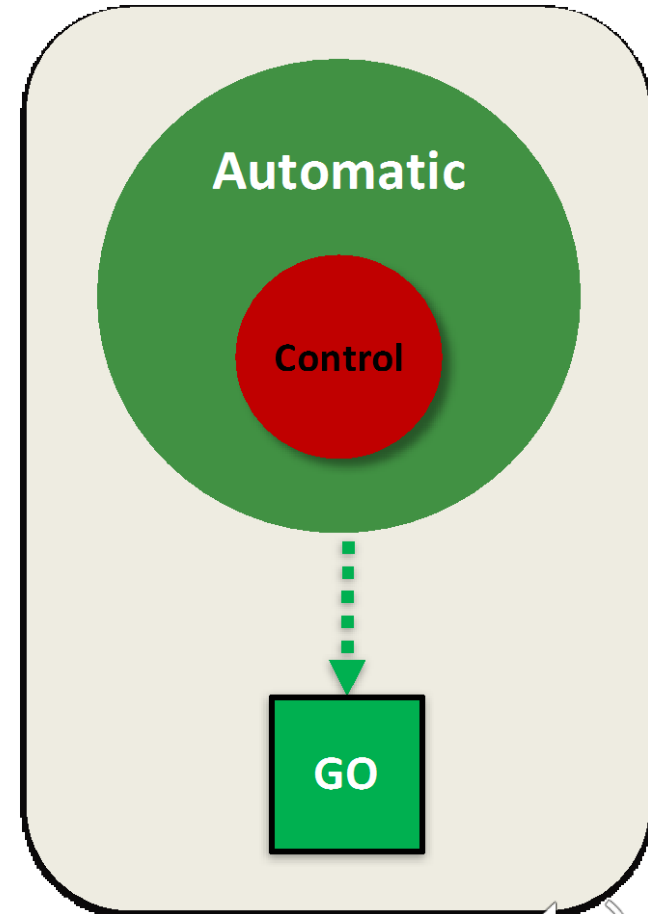
What happens if there is PFC dysfunction?



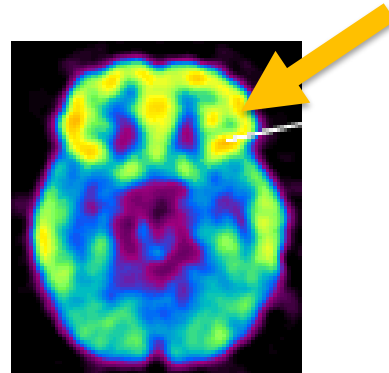
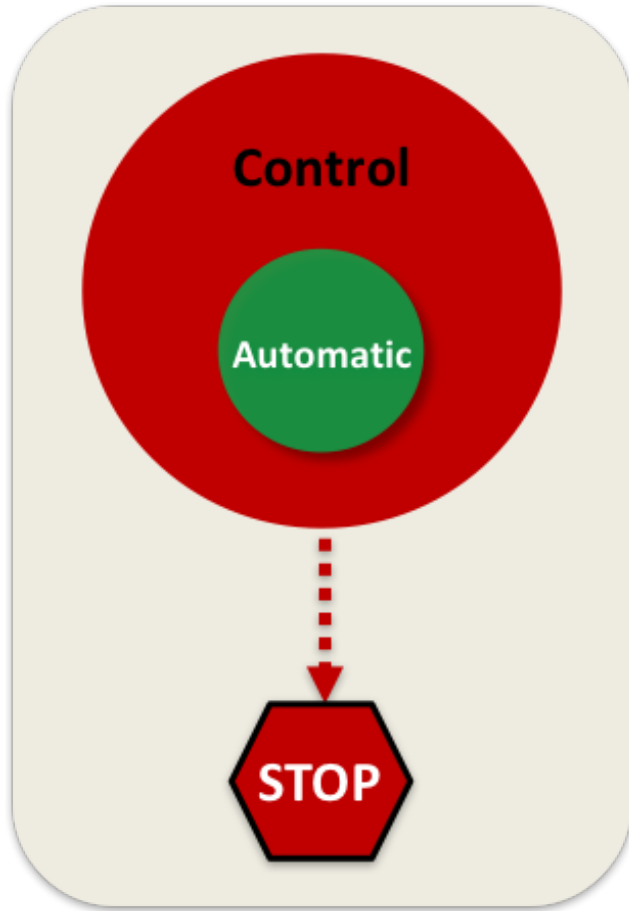
Control



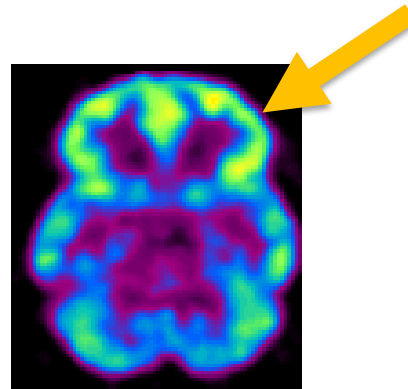
Cocaine Abuser



What happens if there is PFC dysfunction?



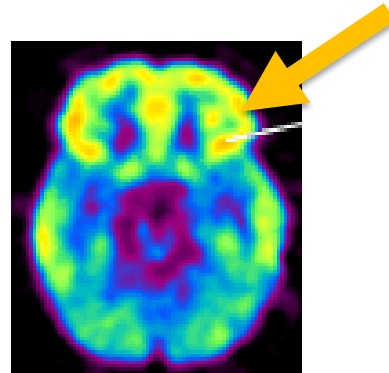
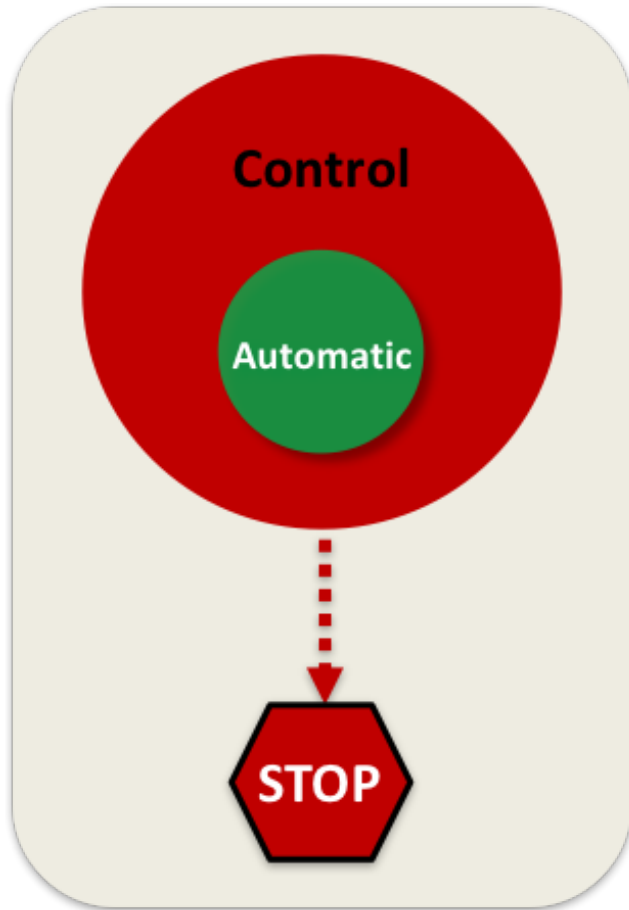
Control



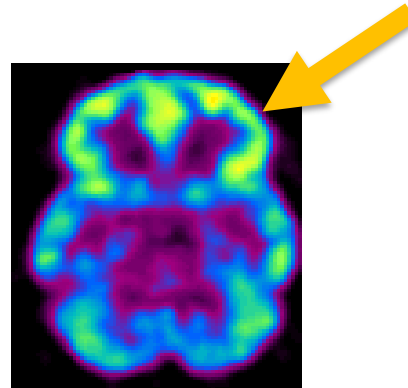
Cocaine Abuser



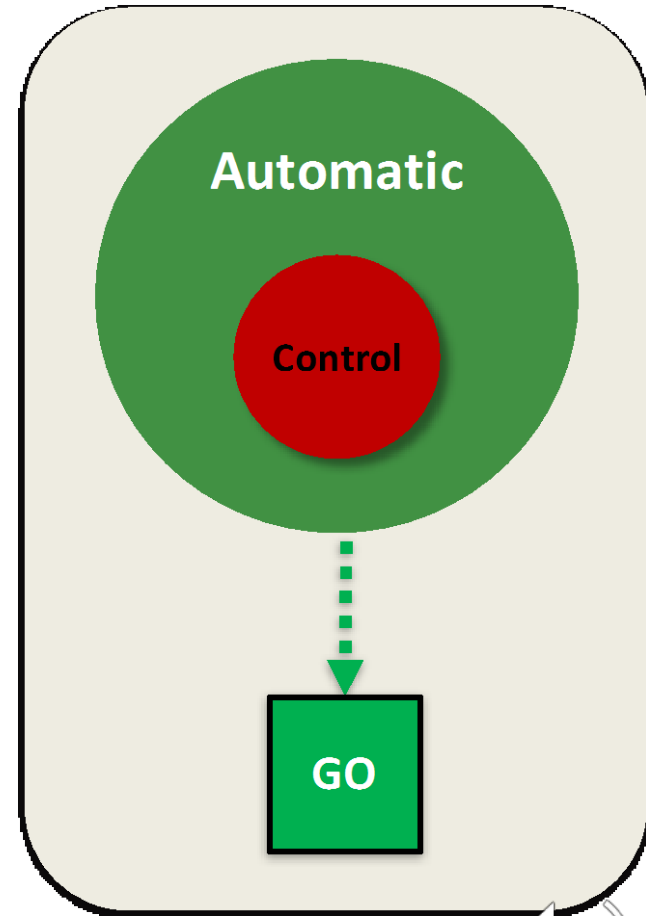
What happens if there is PFC dysfunction?



Control



Cocaine Abuser

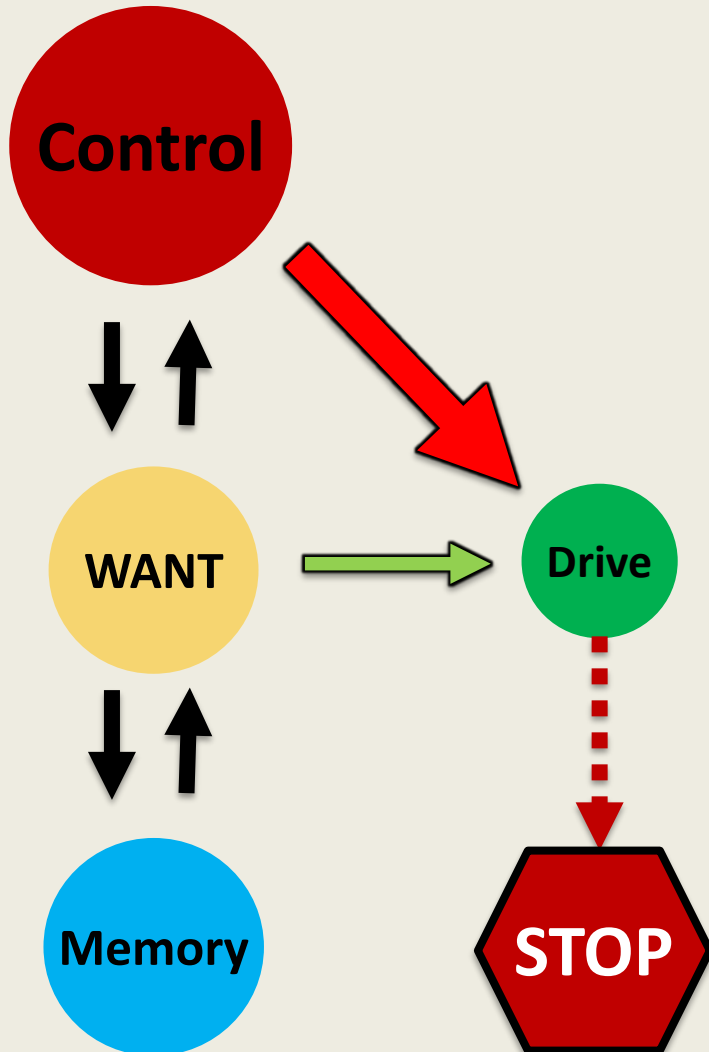


Summary:

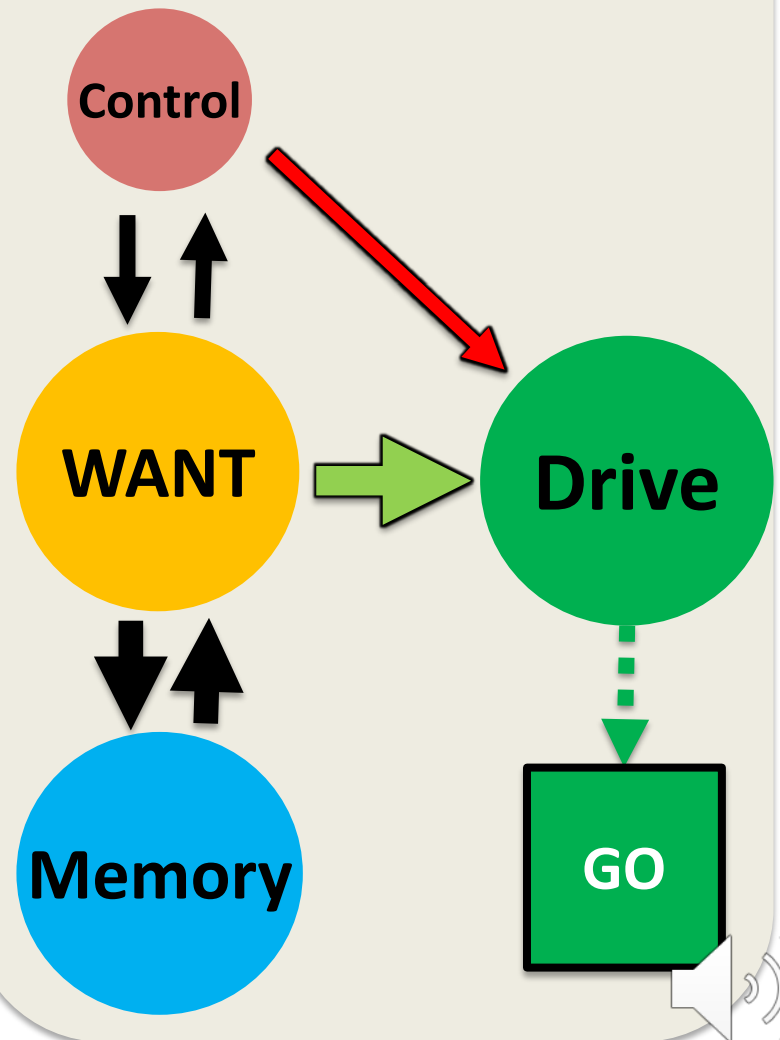
Why is it so difficult to quit?



Non-Addicted



Addicted



Thank you

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