# This is your brain without drugs:

## Neurobiology of addiction and relapse

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# DISCLOSURES

## This is your brain without drugs

**LaTonia Rice Sweet , MD , ABPN, ABAM**

- Financial disclosure: I have no financial conflicts of interest or relationships to disclose
- Off label disclosure: I will not discuss any off label or investigational uses of medication in this presentation

**Tara C. Stanfield, LCSW**

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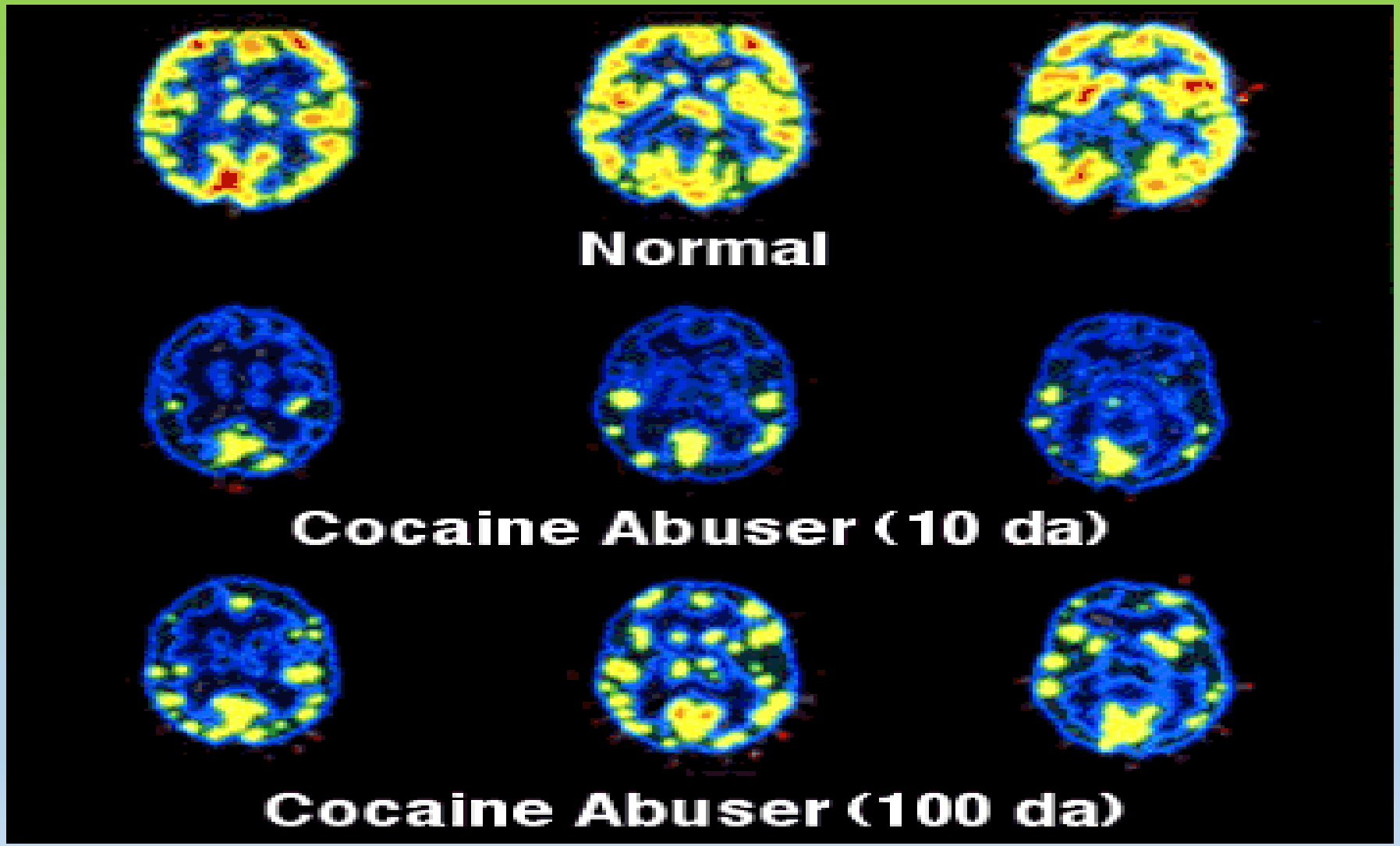

Normal
Cocaine Abuser (10 da)
Cocaine Abuser (100 da)

# Neurons

- Neurons ( including brain cells) are nerve cells that are electrically excitable.

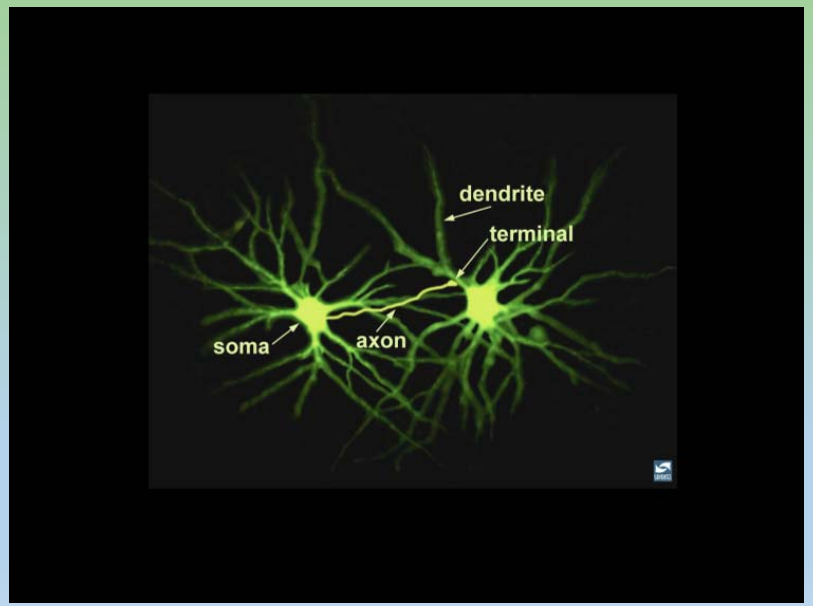
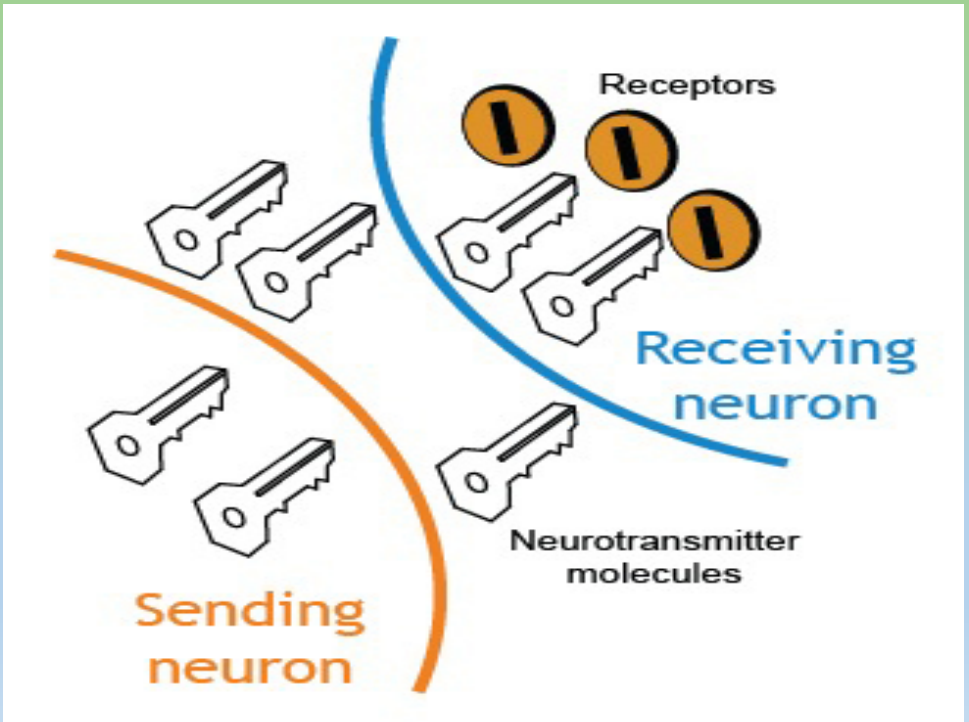


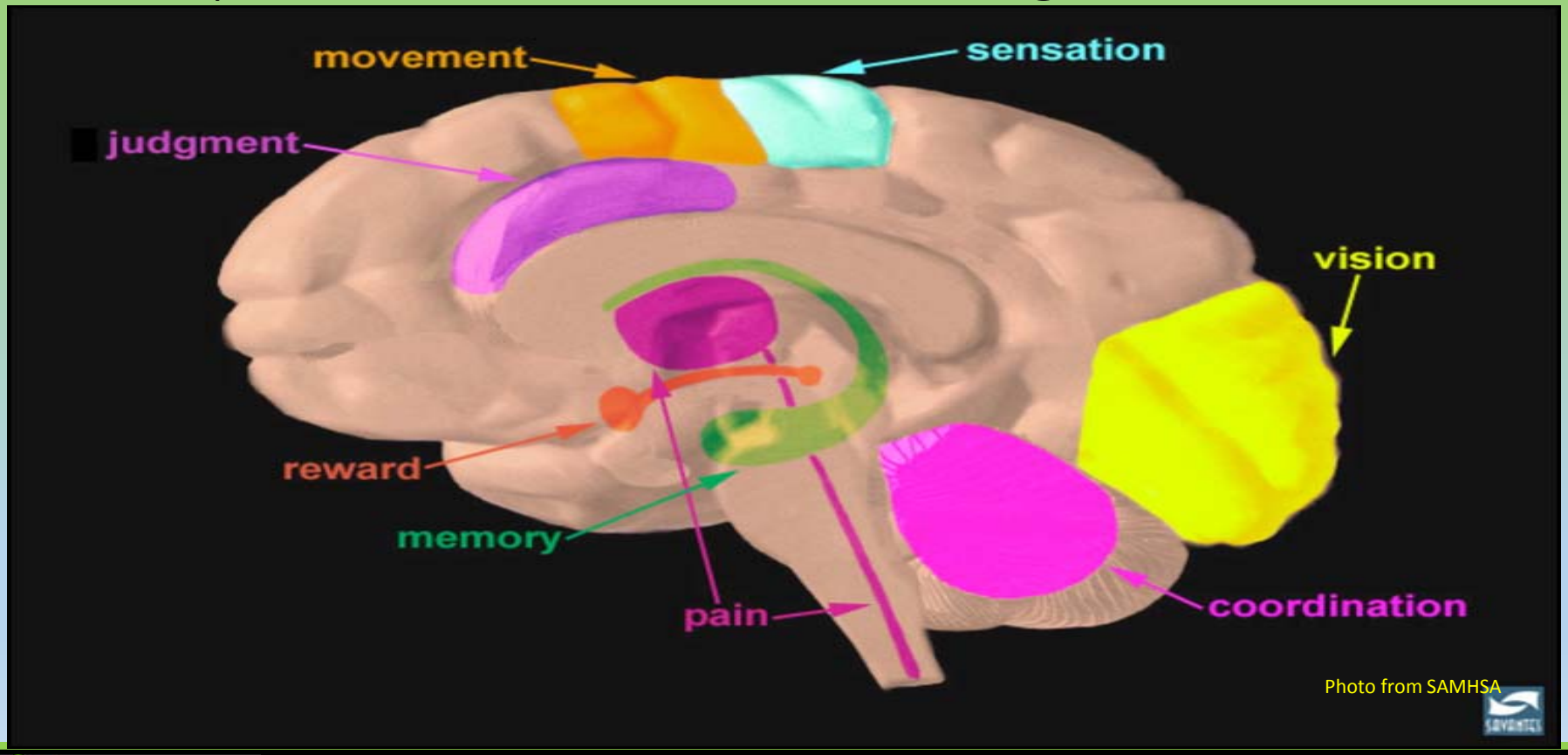

Photo from SAMHSA

# Neurotransmitters:

Neurotransmitter: Endogenous chemicals that transmit signals across a synapse from one neuron to another. They can result in activating or inhibiting the neuron.

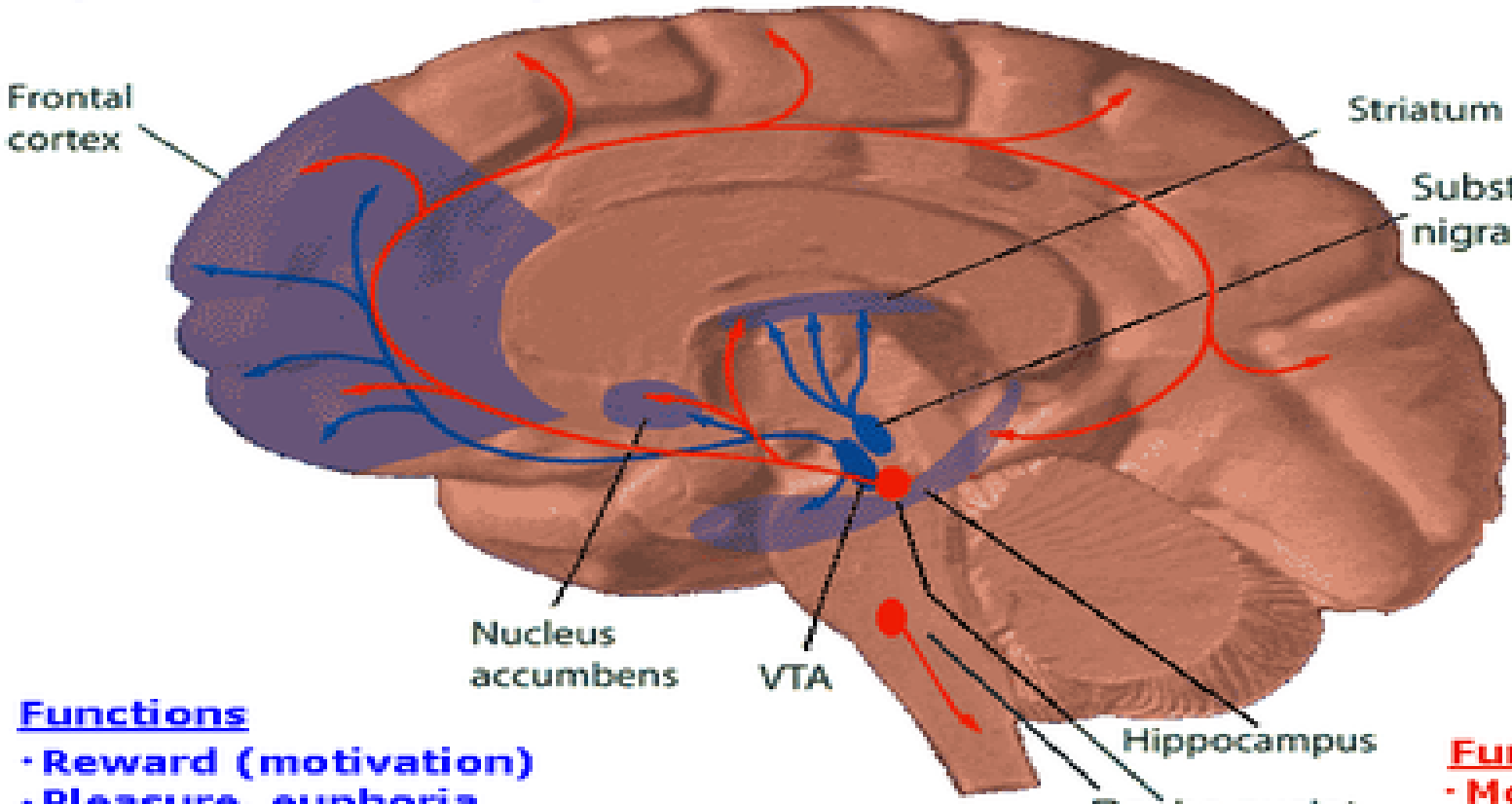


# These neurons develop many pathways in the brain that are responsible for all our functioning



## Dopamine Pathways

## Serotonin Pathways




**Functions**

- Reward (motivation)
- Pleasure, euphoria
- Motor function (fine tuning)
- Compulsion
- Perseveration

**Functions**

- Mood
- Memory processing
- Sleep
- Cognition

- Movement
- Vision
- Sensation
- Coordination
- Pain
- Memory
- Judgment
- *Reward*

- Natural rewards are

Food

Water

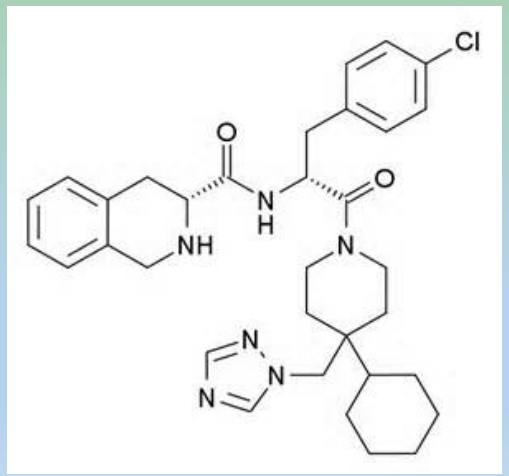
Sex

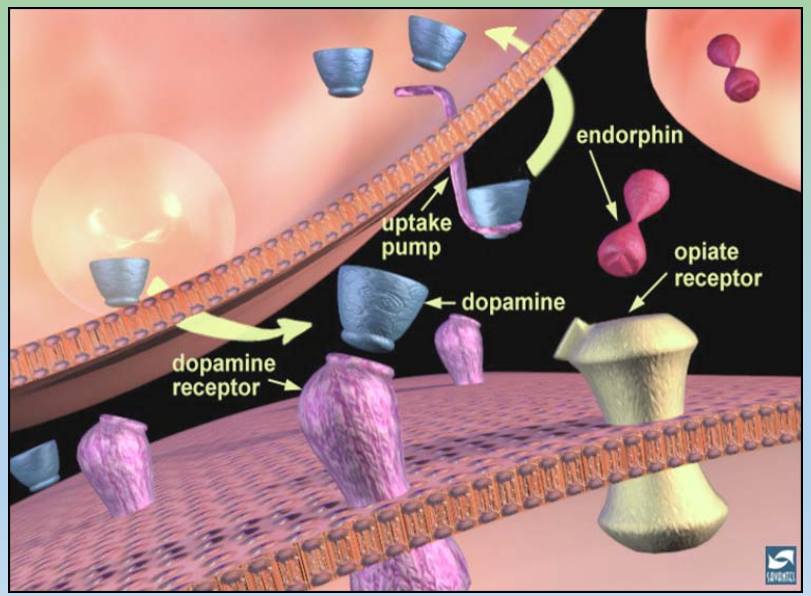
Nurturing

- Unnatural rewards
  - *Drugs*
  - Alcohol
  - High risk behaviors
  - Electrical probes

# Back to neurotransmitters

- Natural ( endogenous) opioids are morphine-like neurotransmitters. Heroin, prescription opioids, alcohol and even nicotine can effect the positive reinforcing properties of these systems

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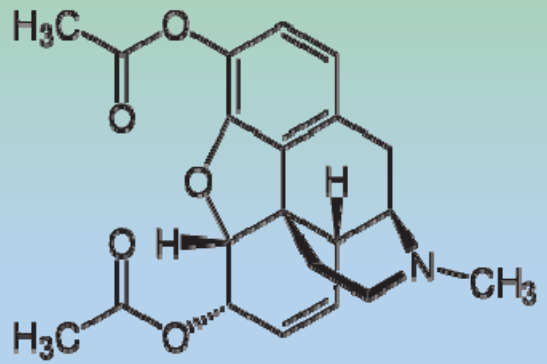


# Addiction

- Repeated self administration of something despite adverse medical and social consequence along with the desire to abstain from use

# WHY do people get addicted?

- First there is the decision to use a drug.  This in influenced by genetic, psychosocial and environmental factors
    - Clear studies on genes that are protective and linked to certain substance abuse

- However, after ingested, the drug itself can act directly on the brain to promote continued drug seeking behavior

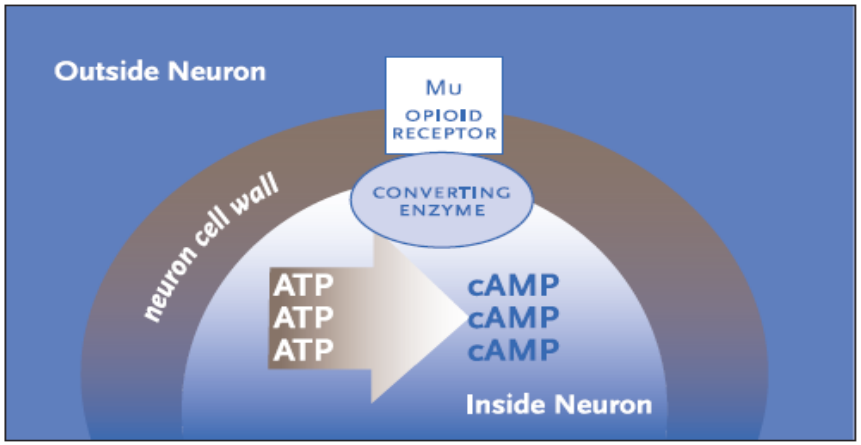
# Compulsion

- Very strong urge to do something
    - Cravings or want

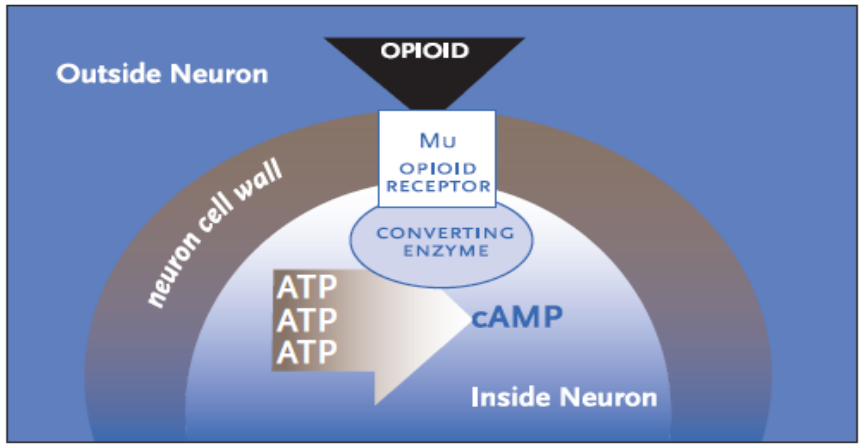
# Withdrawal

- Aches/muscle cramps
- Jitters
- Elevated BP
- Dilated pupils
- Diarrhea
- Rhinorrhea
- Anxiety

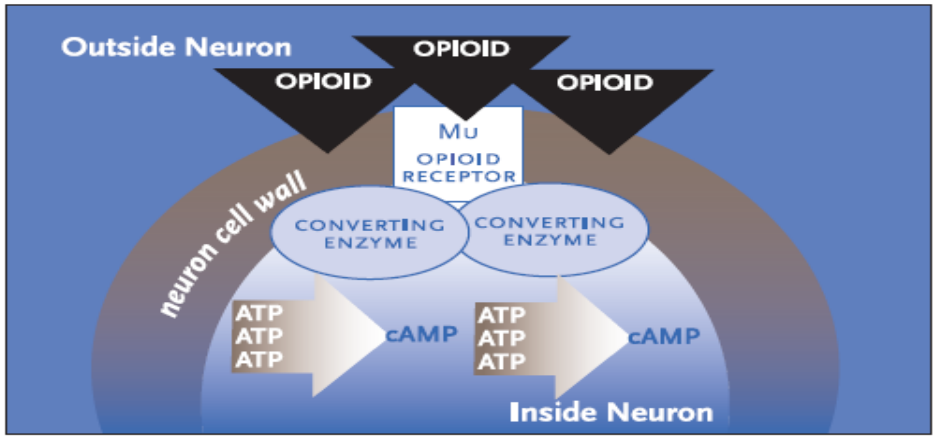
*A. Baseline: Normal production of NA*



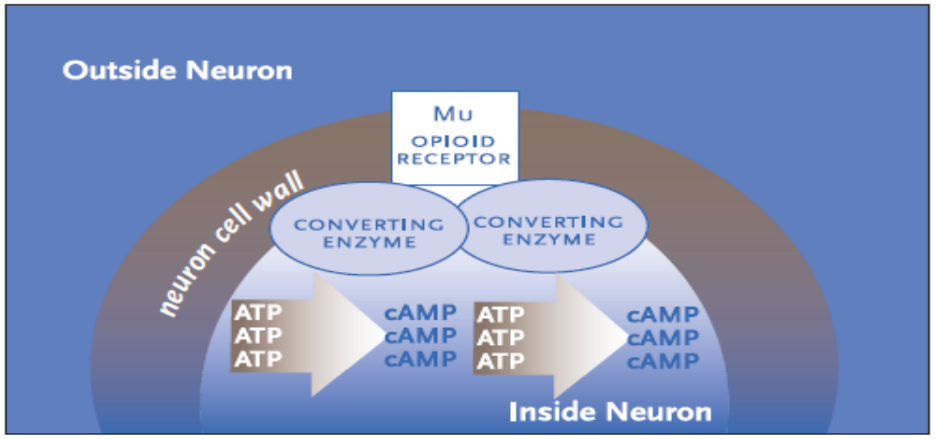

*B. Acute opioid inhibition of converting enzyme: Abnormally low production of NA*




*C. Chronic opioid inhibition leads to increased converting enzyme activity: Normal NA level*




*D. Discontinuing opioid leads to increased cyclic AMP due to loss of inhibition: NA excessively high*




Thompson, PhD NIMH

# What affects behaviors?

- Yours
- Mine
- Everybody's

# Reinforcement

and

# Neuroadaptation

# Reinforcement

Reinforcement:  A increases the likelihood of B.

Positive reinforcement is when doing B gives you something good

- Get 5 bucks for every A on report card
- Get Euphoric rush for taking Heroin

Negative reinforcement is when you do B to remove something bad

- Take out the trash so your wife doesn't complain
- Take heroin to stop withdrawals

# Reinforcement and Neuroadaptation

- Sometimes you can do things the same way so much that you don't even have to do A to get B..

- Go back to your old high school and feel a little rush
- Go to the same place you always used heroin and start to feel a little rush
- Go to an area when you often couldn't get drugs (e.g. jail, hospital) and start to feel like withdrawal

# Neuroadaptation

- Repeated exposure affects how respond to B
  - Sensitized or attenuated response to drug
    - “wanting” or ‘craving” increases with each drug exposure
    - Euphoria and other effects such as sedation can decreases with exposure

Neuroadaptation can have very long term effects….sometimes permanent

# Reinforcement and Neuroadaptation

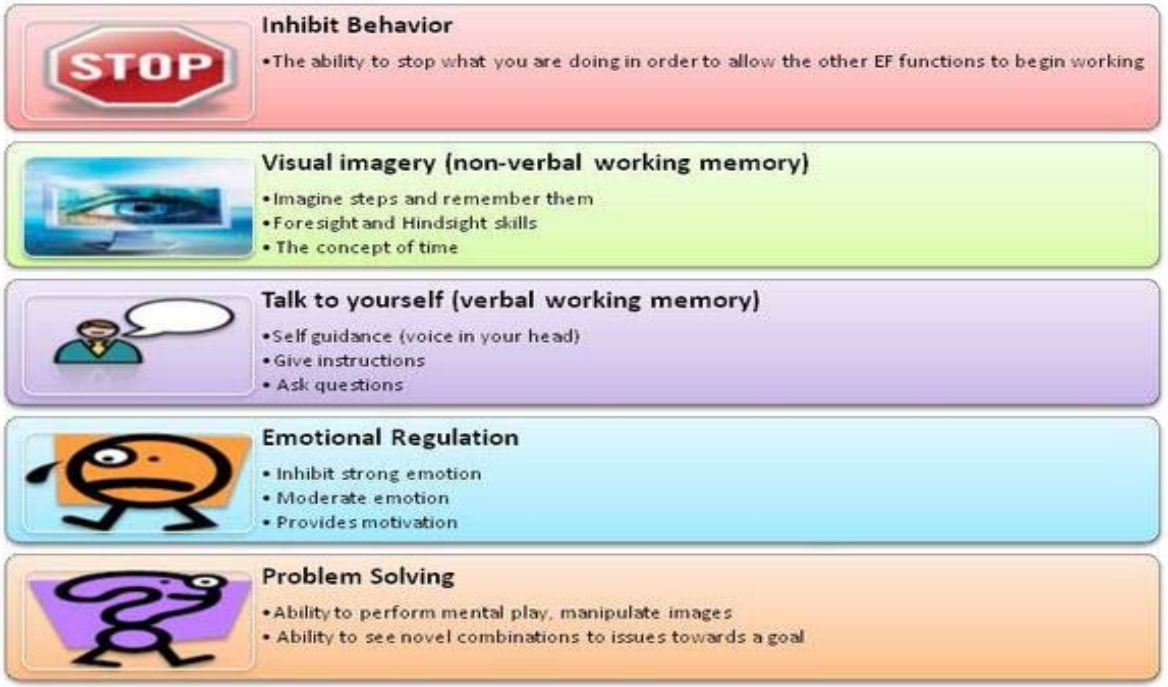
Reinforcement -establishes the behavior

Neuroadaptation -maintains it

# Remember Judgment?

One of the last areas of the brain to develop is the prefrontal cortex. This is involved in executive function.

# Executive Function




**Persistent self control capacities + problem solving = Goal**

My picture of Dr Russell Barkley's EF video: EF introduction by Dr Barkley

Studies have clearly shown that exposure to drugs and alcohol while this area is developing may have irreversible consequences

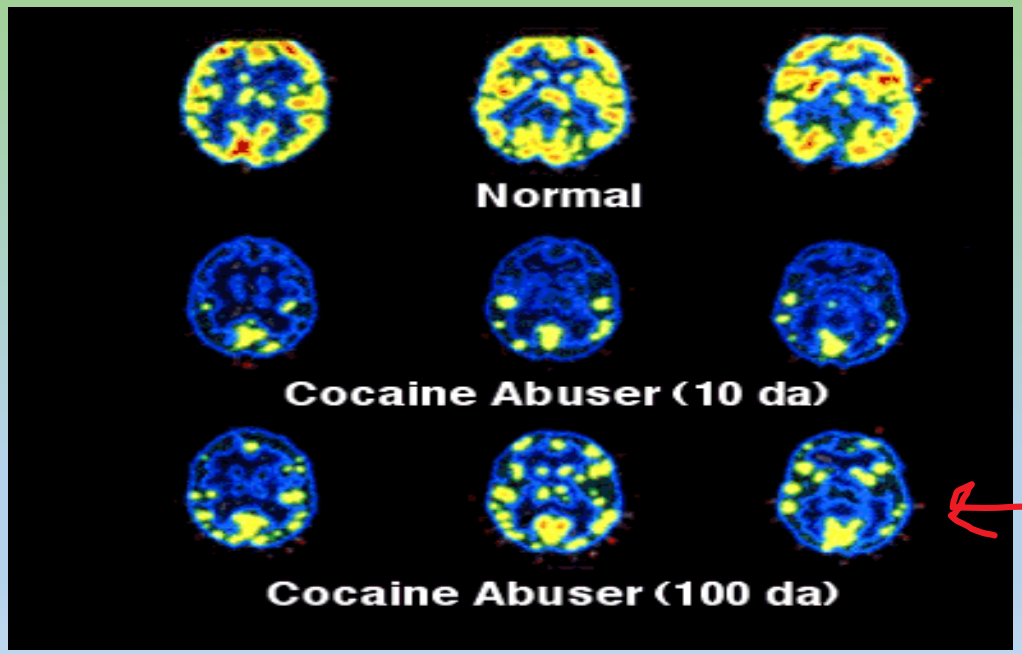
- Impulse control
- Foresight
- Self guidance
- Moderate emotion
- Motivation
- Problem solving abilities

SOUND FAMILIAR?

# Relapse

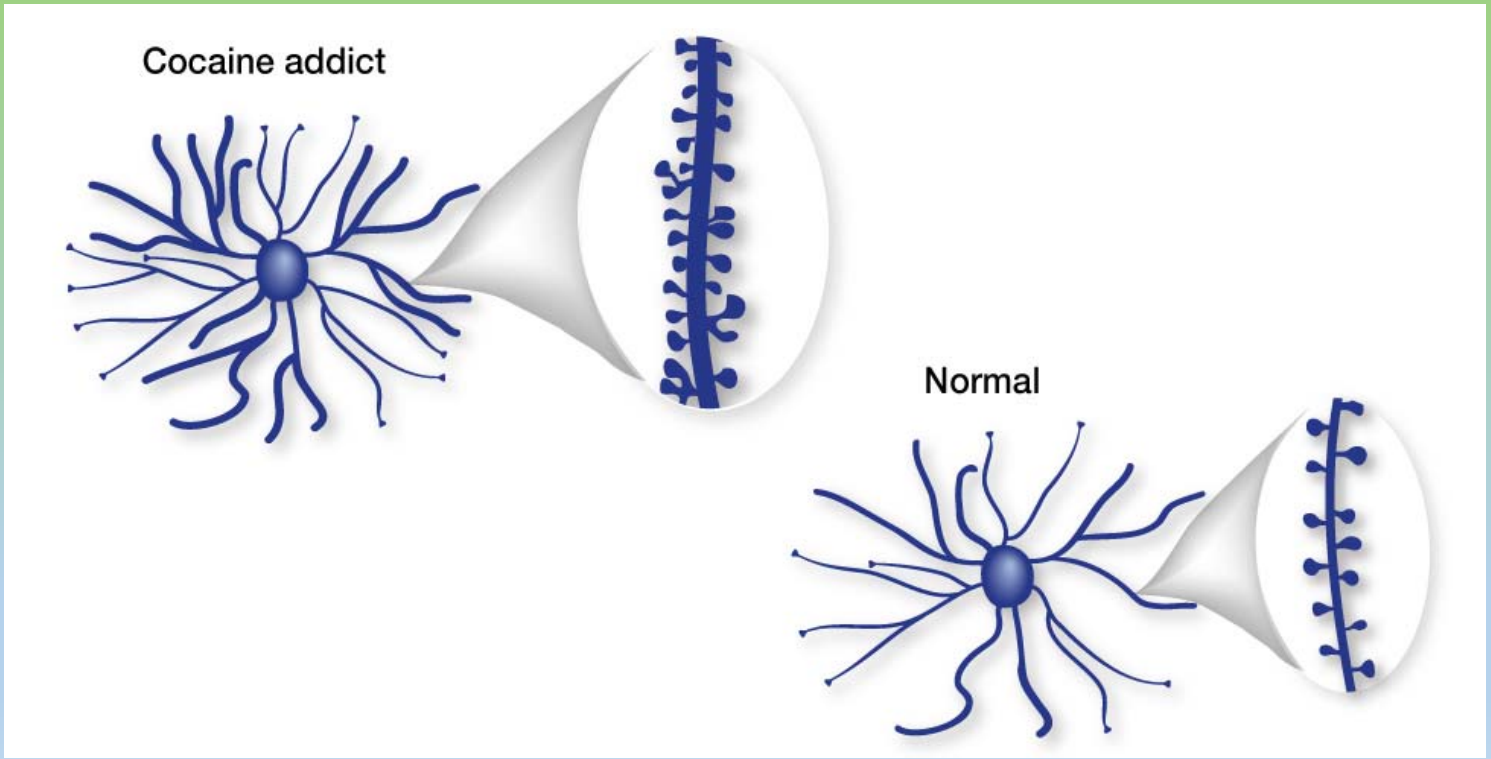
- Why return to drugs after prolonged abstinence?
  - You don’t have withdrawal
  - You have your kids
  - You have a job
  - You actually have money

# Remember brain without drugs?




Volkow, et al Synapse 1992

# Real changes have occurred…Changes we can see at individual brain cells

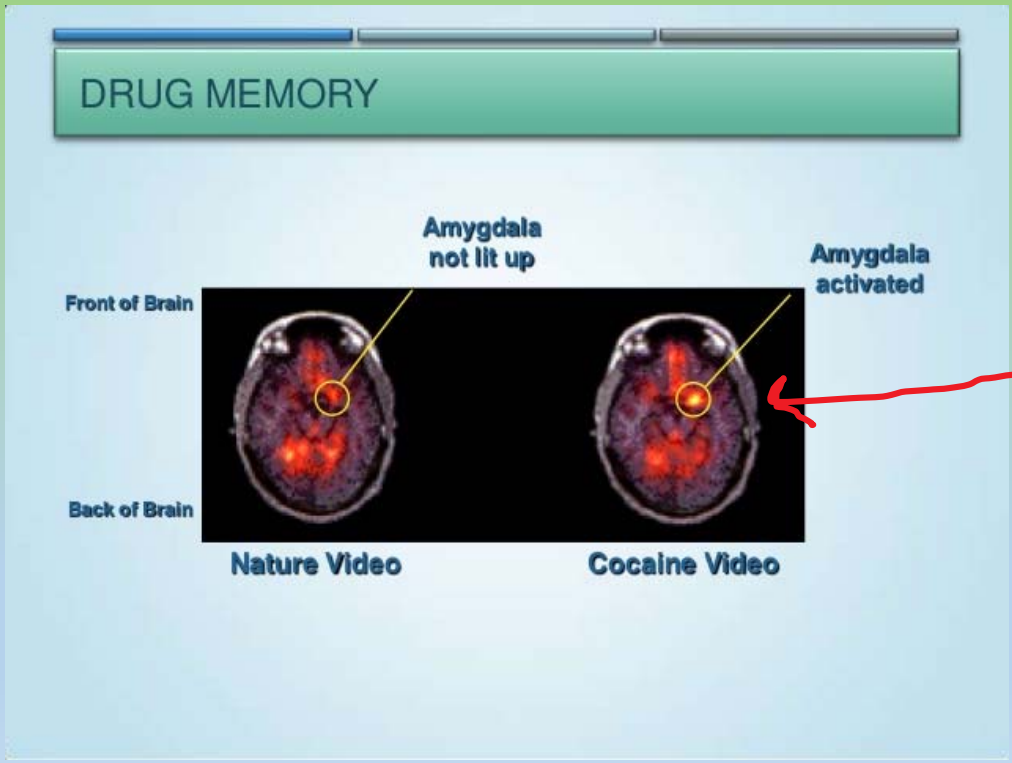


# So what..

- Once addicted the brain is **neuroadapted..**

It doesn't function like it did before drugs.  It is sensitized to that reward pathway easily be triggered to return

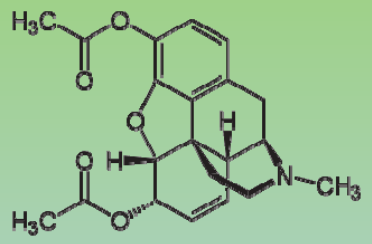
# And it is powerful




Volkow, et al Synapse 1992

- In animal studies the two most likely things that will reactivate addictive behaviors after they have long been extinguished……

  - Exposure to the drug

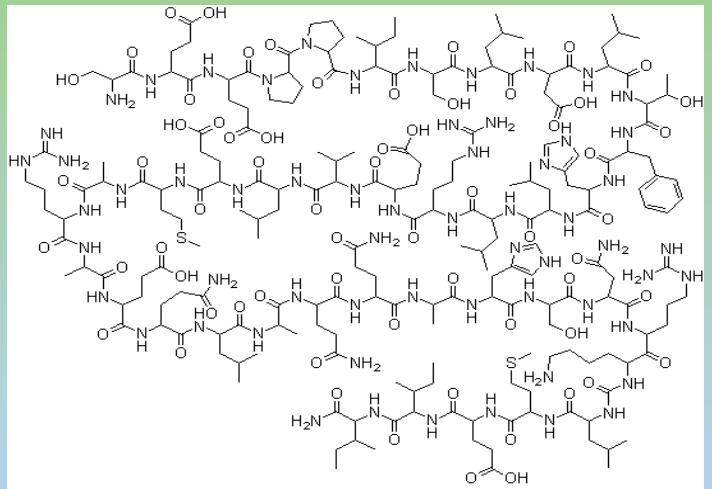



  - Stress… yes *Stress*

# Just deal with it everyone gets stressed…..

It is believed another chemical CRF that is released in stress response causing an increase in cravings

Lots of rat research to support this




## Worse ….

People (and rats) with a history of drug exposure are more sensitive to stress

Add this to a brain that was probably exposed to drugs while it was developing its executive functioning….

You don’t think about consequences well

+

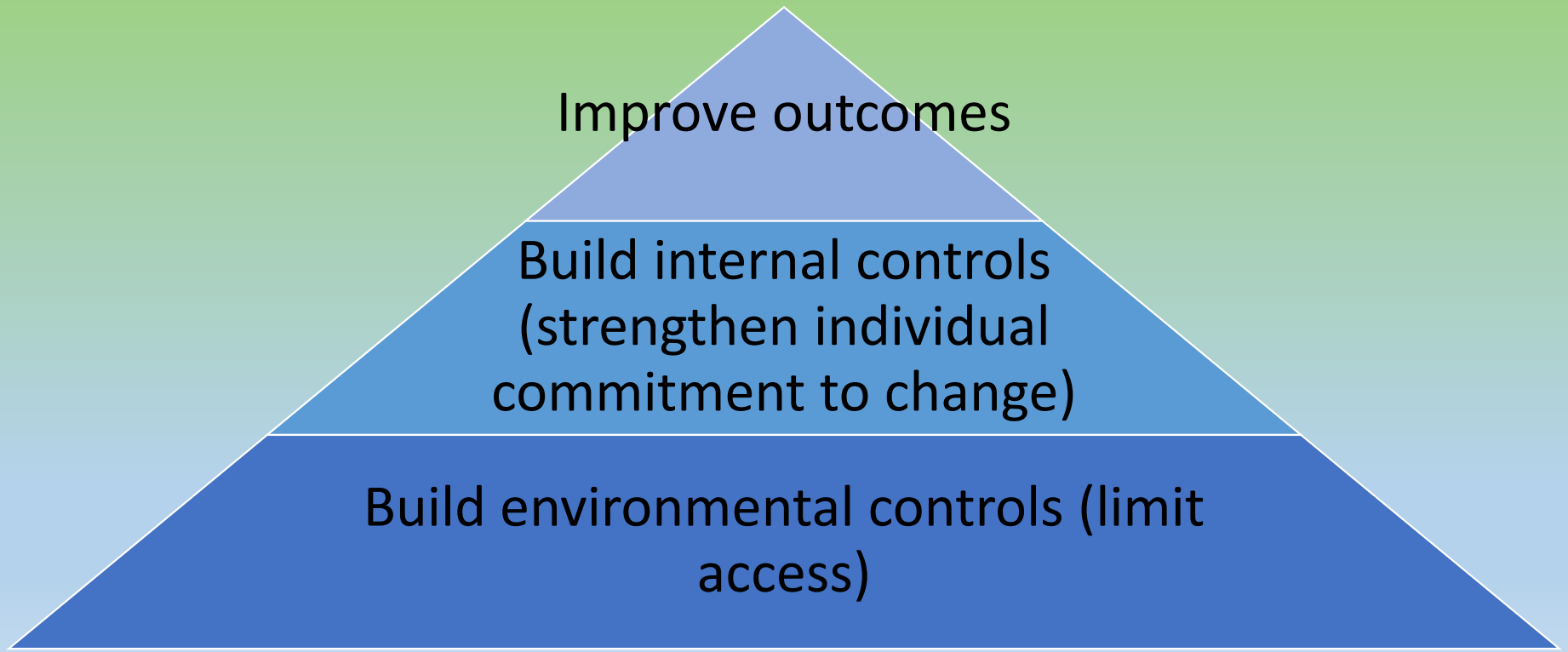
you have a huge biological push

= Relapse

# Wait a minute, some people recover……

- Sounds hopeless.  Its not
- Other environmental factors change your brain.
    - (think bad experiences and depression)
- Abstinent time helps bring things closer to normal
- Positive/supportive experiences are protective
- Therapy actually changes how our brain works
    - For example therapy can resolve mild to moderate depression without prescriptions
    - Substance abuse treatment provides better outcomes than placebo

# Building the best chance for success



# Lets start with the power of environmental control

# "Window of Access"

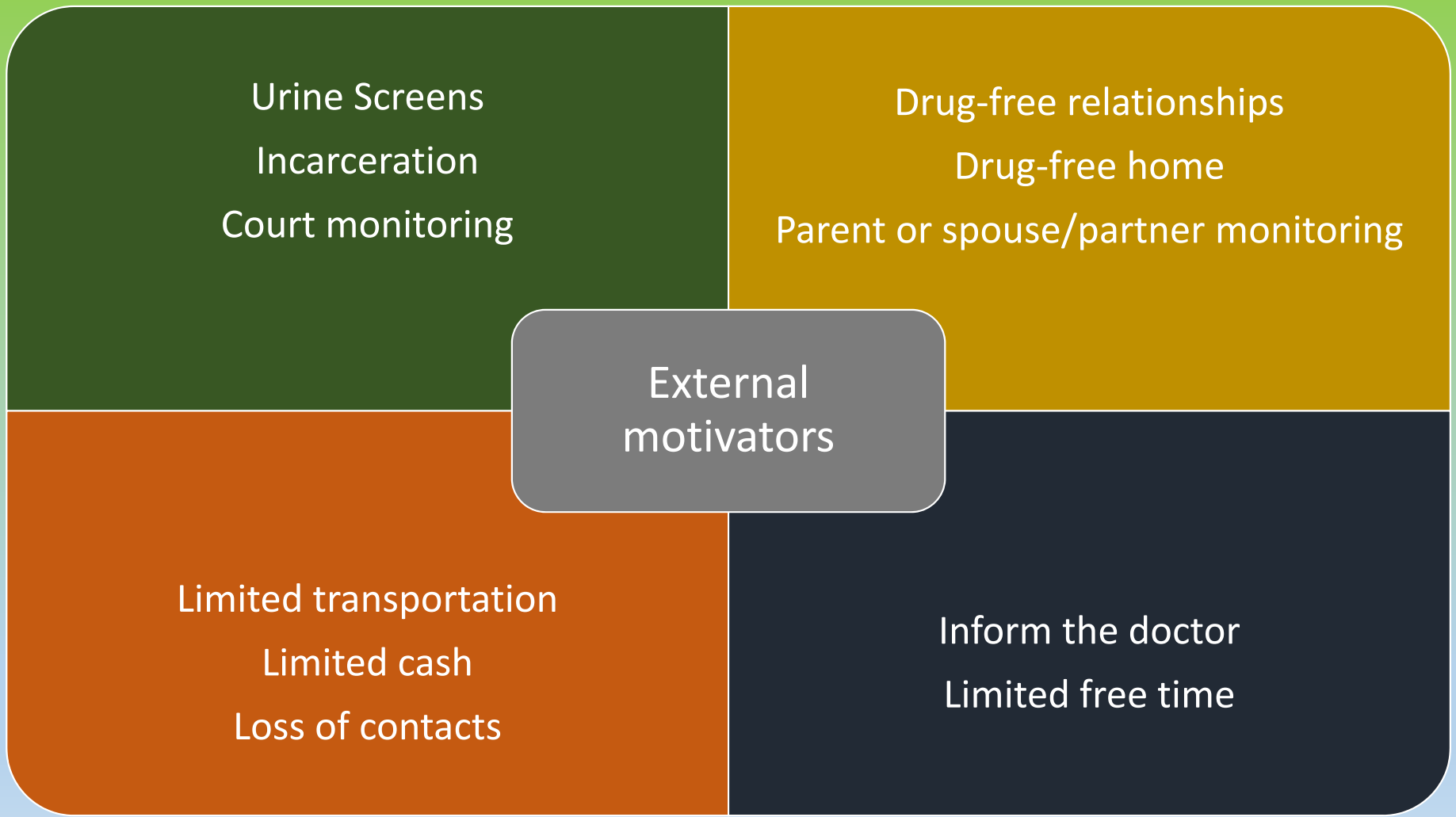
- Time between craving and access to substance
- Barriers to obtaining the substance
- The bigger the window, the greater the chance for a positive choice to be made.

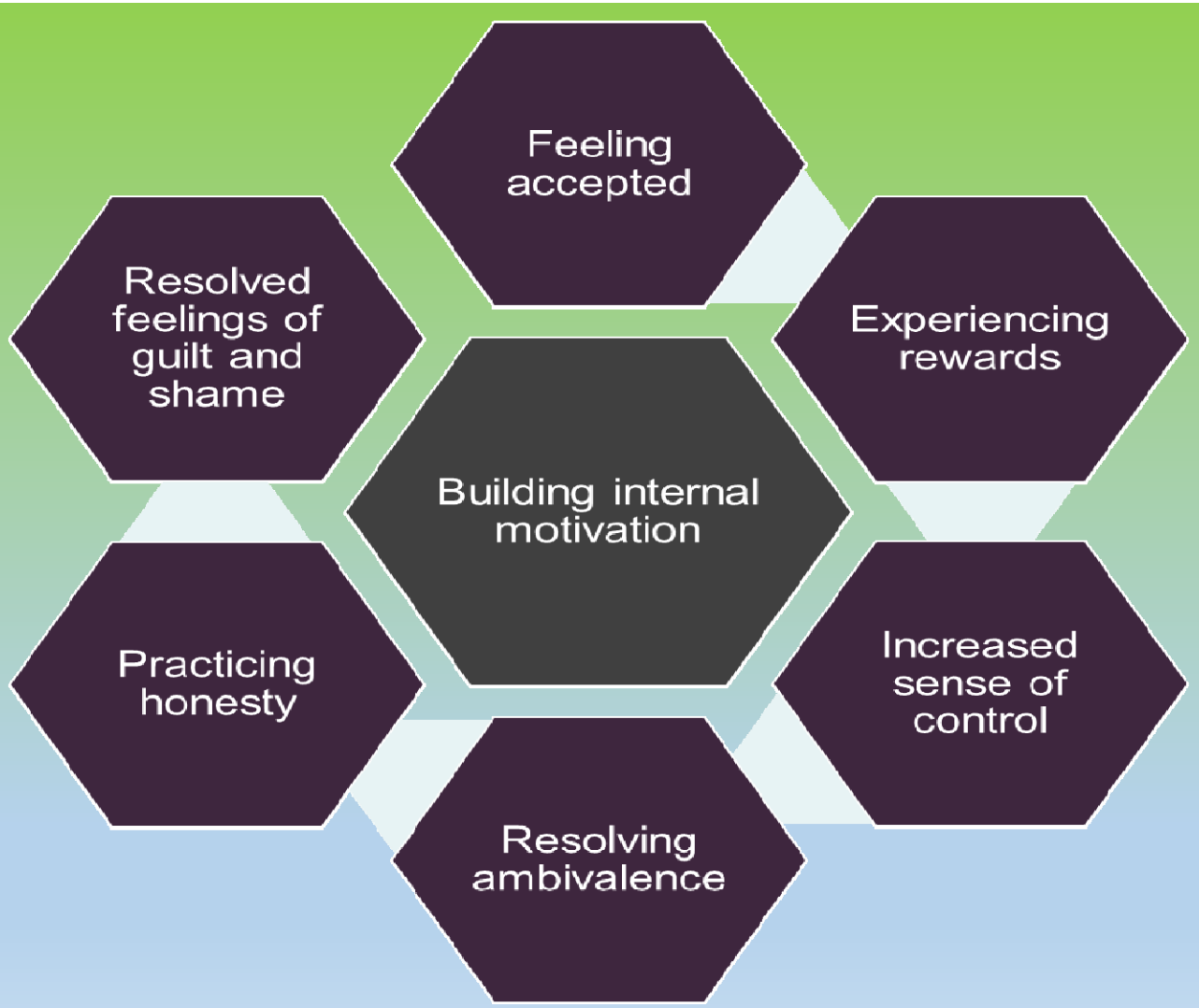
# External versus internal motivations

- External motivation = I'm not going to rob Fort Knox because I would never make it over the fence.
- Internal motivation = I'm not going to rob Fort Knox because I didn't earn that money and wouldn't feel right having it.
- Internal motivation influences what you do when no one is looking…

# External motivators buy time for internal motivation to return

- Internal motivation occurs when one self-generates a thought that promotes ongoing desire to avoid problematic use.


Urine Screens
Incarceration
Court monitoring
Drug-free relationships
Drug-free home
Parent or spouse/partner monitoring
External motivators
Limited transportation
Limited cash
Loss of contacts
Inform the doctor
Limited free time


Feeling accepted
Resolved feelings of guilt and shame
Experiencing rewards
Building internal motivation
Practicing honesty
Increased sense of control
Resolving ambivalence

# Internally motivated thinking

- I don't want to waste my money
- I'm afraid it will cause health problems

- I don't want to mess up my job
- If I use it I might not be able to stay focused at school

- If people find out they will lose all the resect I've gained back
- I can't put my kids through this again

- If I use again I might OD
- I couldn't possibly go buy it from people who think I'm clean and doing well

- If I use now I will have to start all over
- I can't disappoint my family anymore
- I'm not sure I could stop again if I tried

Treatment can serve as both external and internal extenders of the window of access

External

- Residential programs
- Monitor with urine drug screens
- Partnership with referral sources (court, parents, etc.)

Internal

- Safe place to work through difficult emotions.
- Learn/practice skills
- Feel accepted
- Partnership

# Where do I go for help

- Outpatient
- Intensive outpatient
- Residential treatment (short-term/long-term)
- Medical detox
- Medication Assisted Treatment
- Case management and peer support
- Support groups

# It may take a village to make it all happen…

- This is a complex problem that didn't occur and won't resolve overnight
- Long-term sobriety will not be achieved without internal motivation
- Internal motivation takes time to rebuild once your life and brain have been altered by years of heavy use
- An integrated treatment team (family, friends, clinical staff, health care providers, legal staff/judges, the support community, etc.) that works together will see the best results