

- How your brain processes information
- Sensory information
- Motor system
- Decision making



the same principles apply to  
d e c i s i o n - m a k i n g

# Do we have control?



Dictate  
behavior



Voluntary  
behavior



Involuntary  
behavior

Are we aware and conscious of our own behavior?

# How did I get here? What did I do?



The essence of a habit.

On ***auto-pilot!***

Once you have learned something so well, you stop paying attention to it and thinking about it.

# What does it all mean for us?

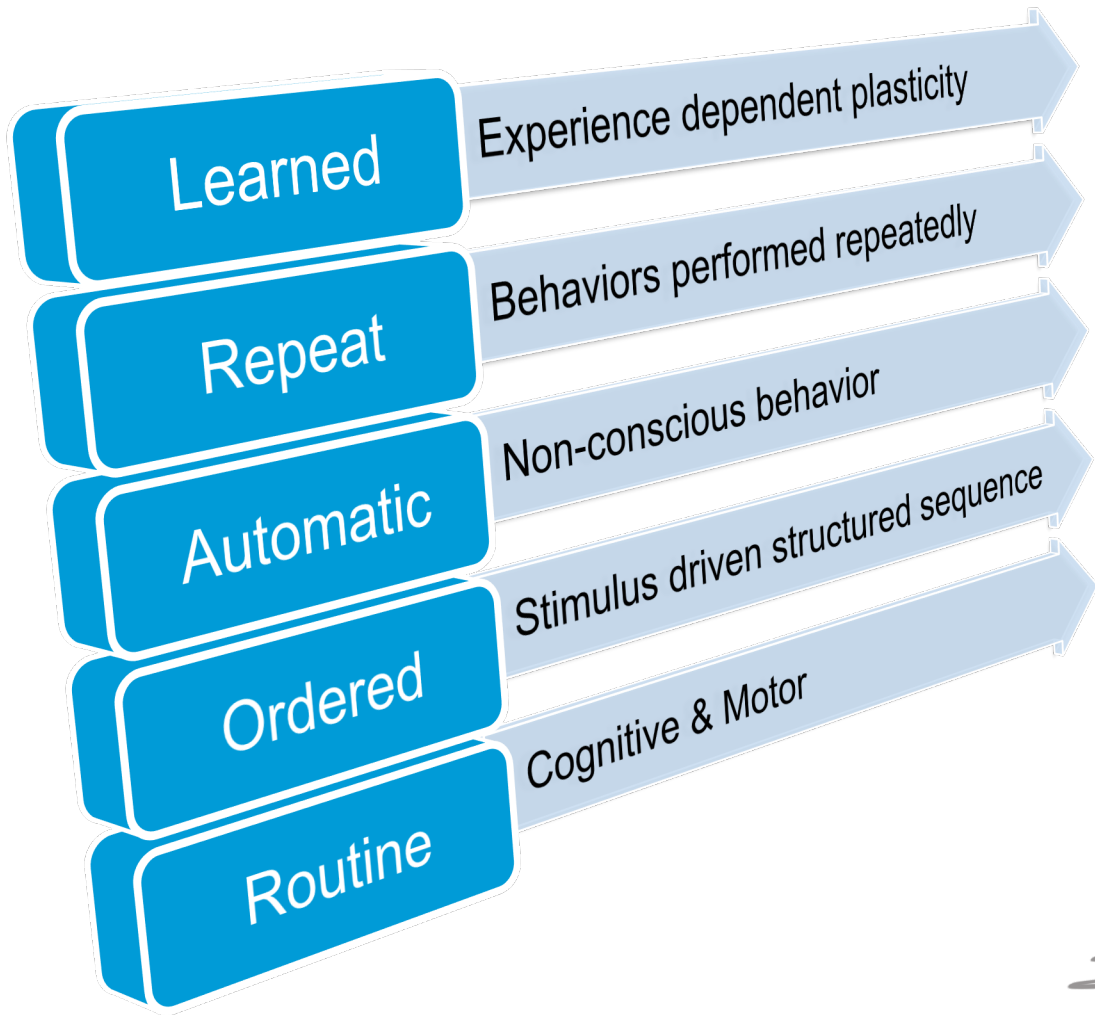


How are habits **different** from other types of learning?

How do habits **form**?

Why are they so **hard to break**?

Which behaviors turn **into habits**?

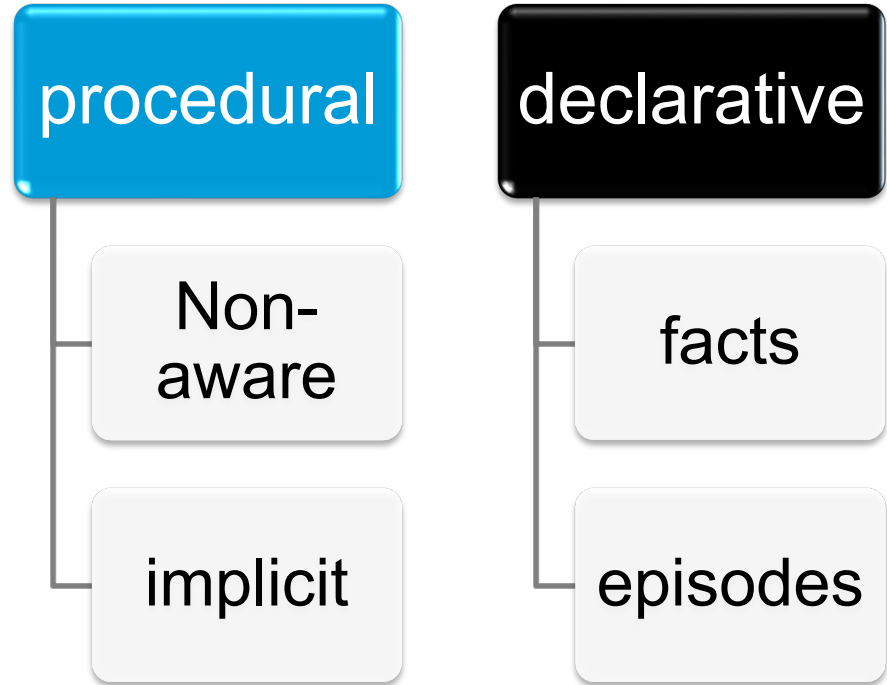


habits



Characteristics  
of Habits

Learning → experience dependent plasticity



## LETTERS

## Robust habit learning in the absence of awareness and independent of the medial temporal lobe

Peter J. Bayley<sup>1</sup>, Jennifer C. Frascino<sup>1</sup> & Larry R. Squire<sup>1,2,3,4</sup>

**Habit memory is thought to involve slowly acquired associations between stimuli and responses and to depend on the basal ganglia<sup>1</sup>. Habit memory has been well studied in experimental animals but is poorly understood in humans because of their strong tendency to acquire information as conscious (declarative) knowledge. Here we show that humans have a robust capacity for gradual trial-and-error learning that operates outside awareness for what is learned and independently of the medial temporal lobe.**

We tested two patients with large medial temporal lobe lesions and no capacity for declarative memory. Both patients gradually acquired a standard eight-pair object discrimination task over many weeks but at the start of each session could not describe the task, the instructions or the objects. **The acquired knowledge was rigidly organized, and performance collapsed when the task format was altered.**

*anatomy of addiction*



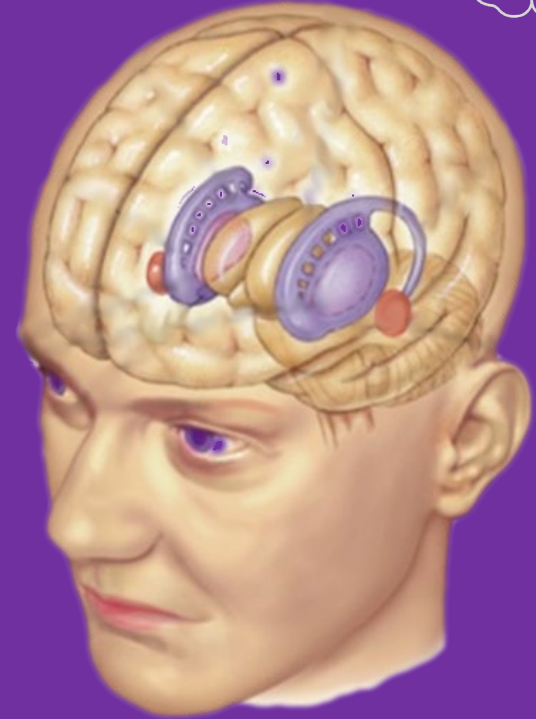


## Habit memory

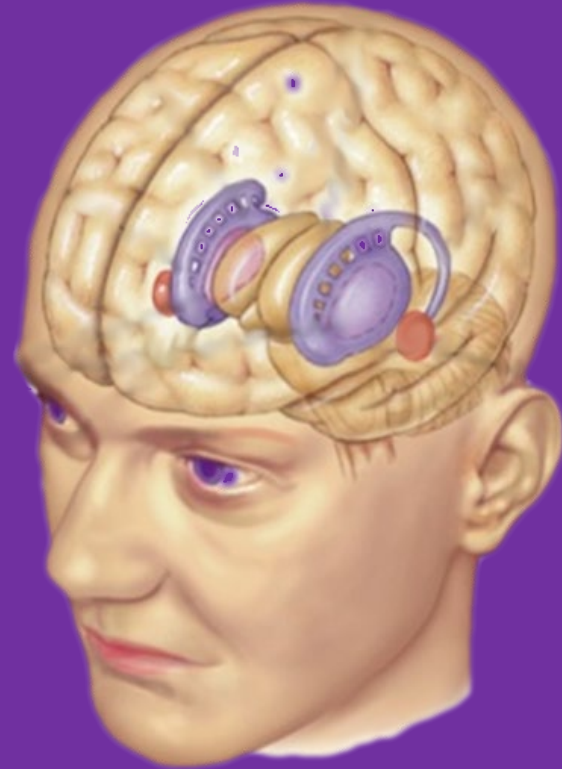
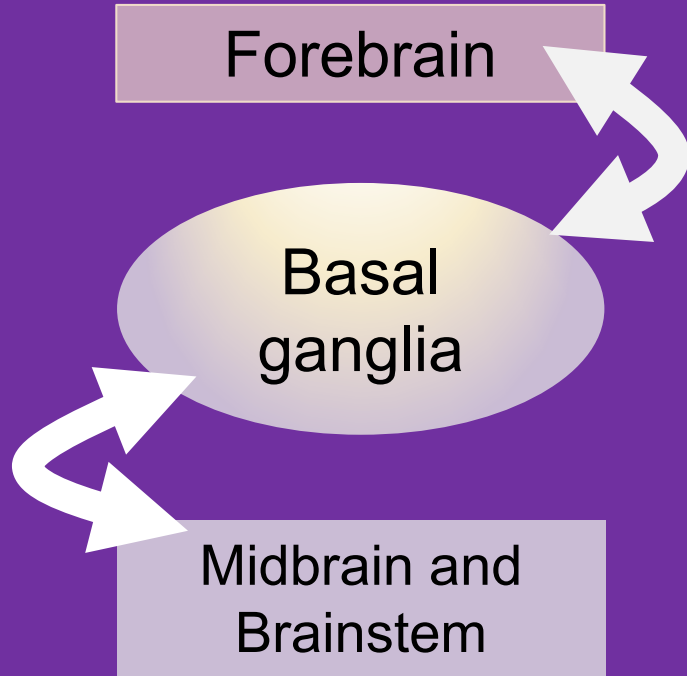
- Slowly acquired associations between stimuli and response
- Trial and error learning
- Performance based

Dependent on Basal ganglia

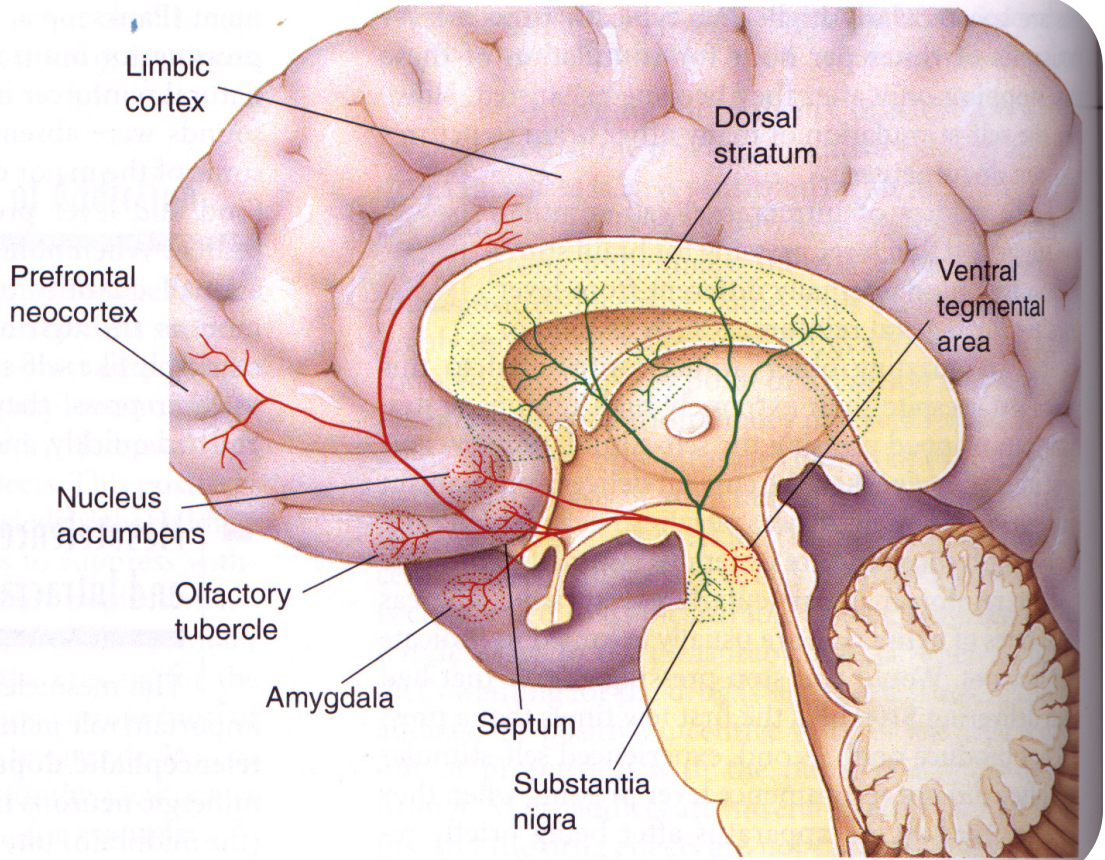
- Operates outside of awareness
- Trial and error learning
- Ridged organization



# Linking thought & movement simultaneously!



# The DOPAMINE System

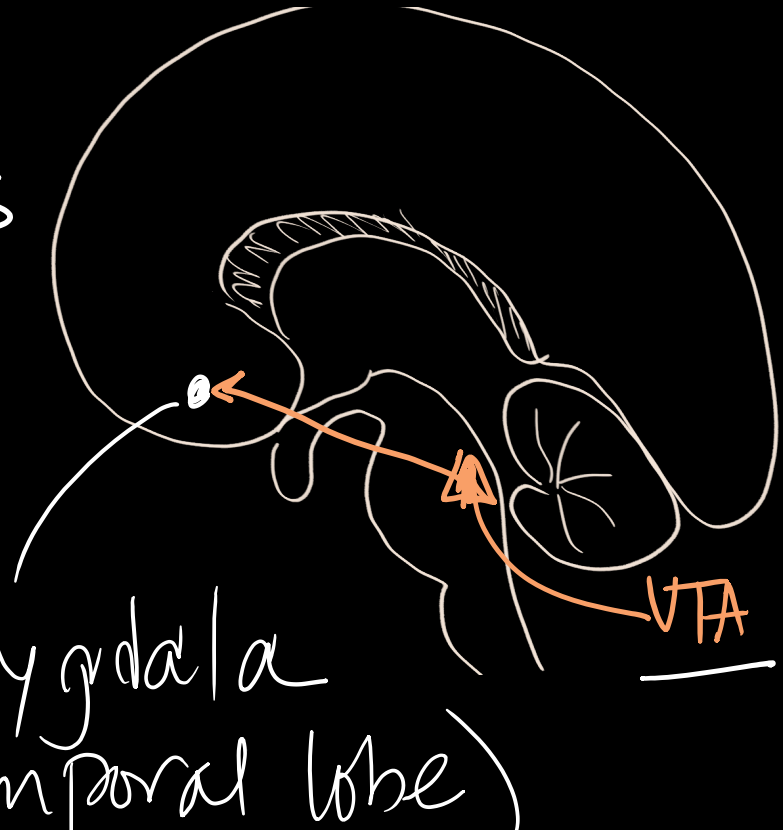


# How can the DA system be so powerful?

1. VTA projects to:

- emotional centers (amygdala)

↑  
helps form emotional memories



amygdala  
(temporal lobe)

How can the DA system be so powerful?

2. VTA projects to:

→ hippocampus  
(temporal lobe)

helps form declarative  
memories

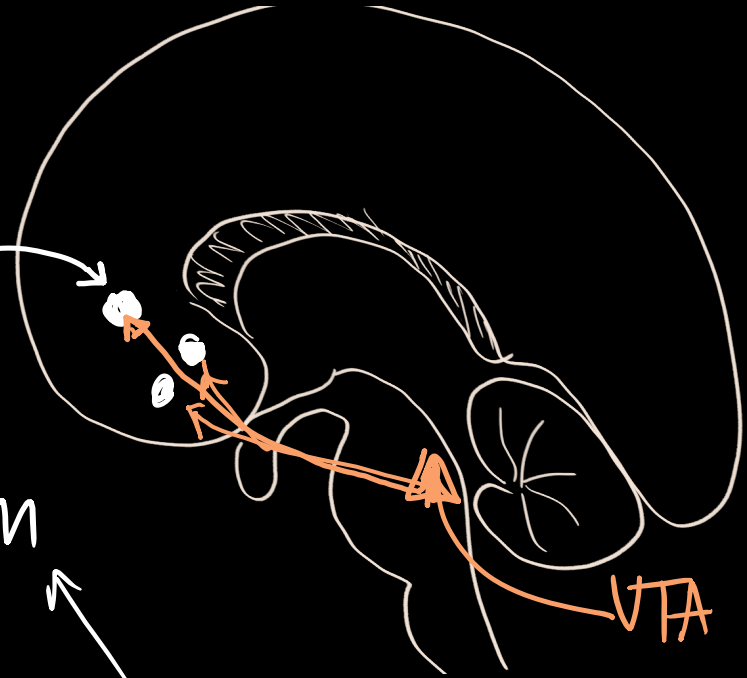


# How can the DA system be so powerful?

3. VTA projects to:

Nucleus  
Accumbens (NA)

→ part of v. striatum  
which controls  
motor functions



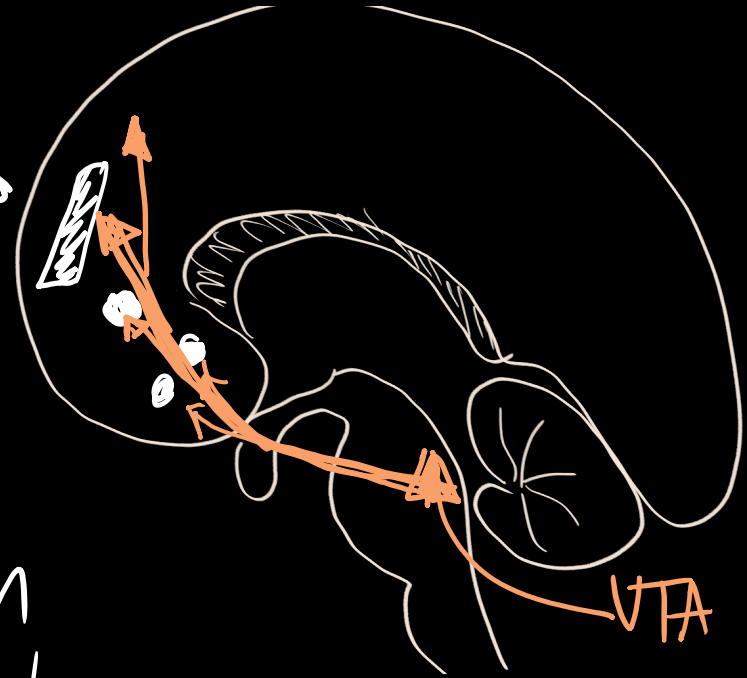
BASAL GANGLIA

# How can the DA system be so powerful?

4. VTA projects to:

prefrontal cortex (PFC)

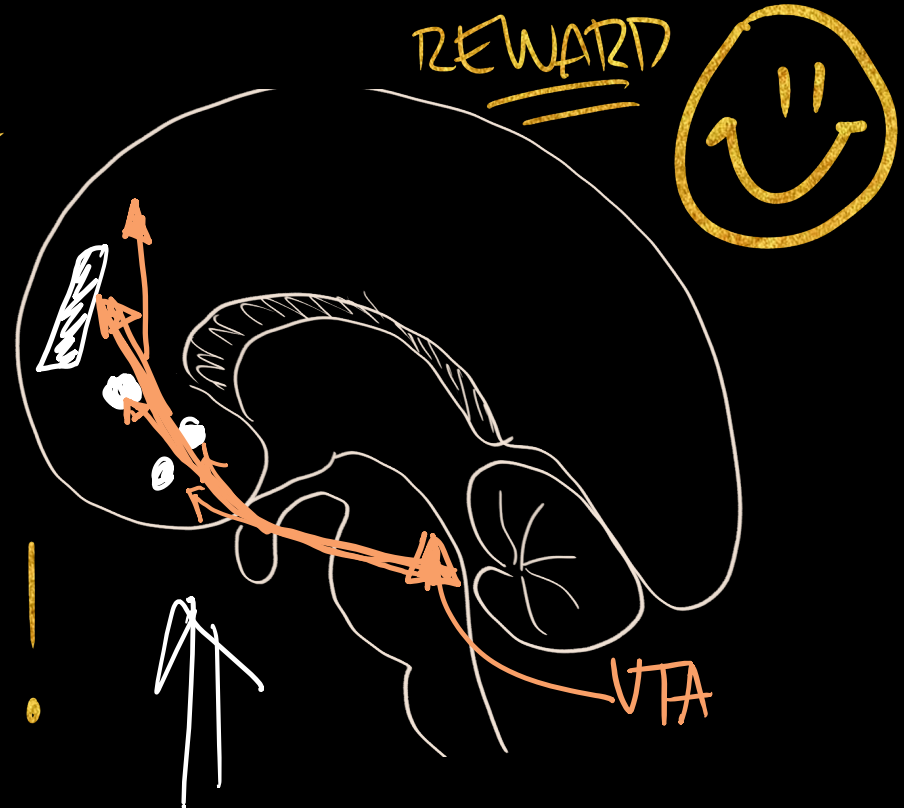
which controls  
planning & decision  
making.



How can the DA system be so powerful?

When you experience  
something GOOD  
& pleasurable -

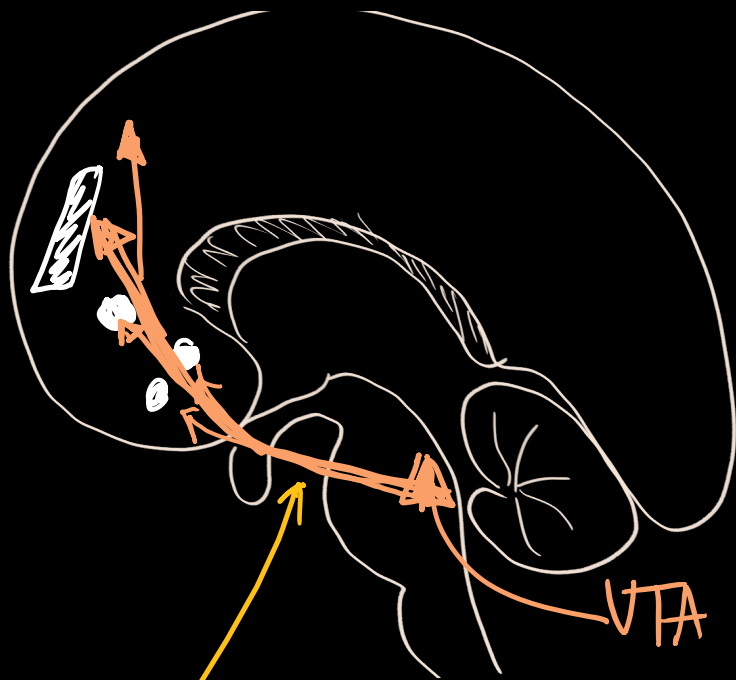
VTA neurons fire!!



DA SIGNAL IS SENT TO ALL THESE AREAS.



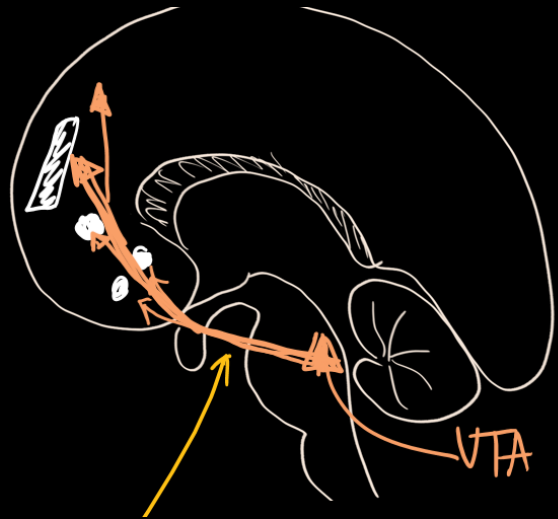
note:



MEDIAL FOREBRAIN BUNDLE

WHAT HAPPENS WHEN THE MEDIAL FOREBRAIN BUNDLE IS STIMULATED?

REWARD  
&  
PLEASURE



MOTIVATION  
TO DO IT  
AGAIN -  
& AGAIN  
& again

STIMULATE  
MEDIAL FOREBRAIN  
BUNDLE