Scripps Research Alcohol Center Neuroscience Course

The brain's reward system

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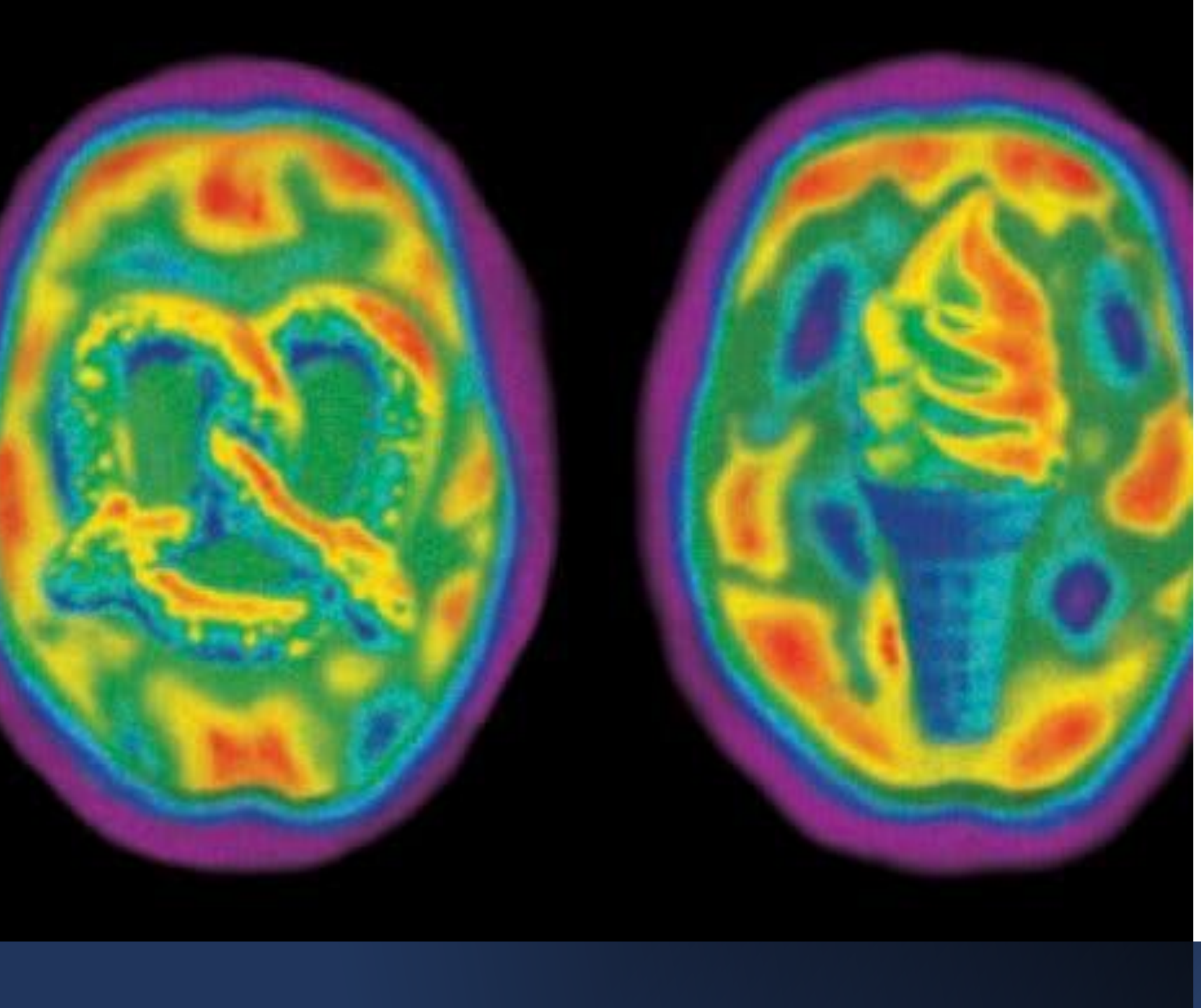
Science Changing Life

Today's Topics

- What is reward?
- Brain's reward regions
- Reward chemistry
- Measuring reward in laboratory animals

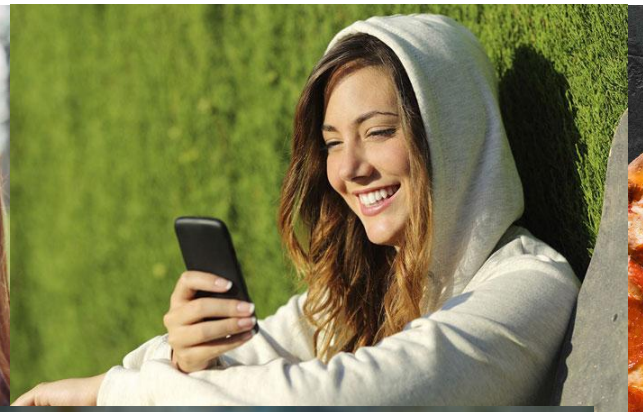


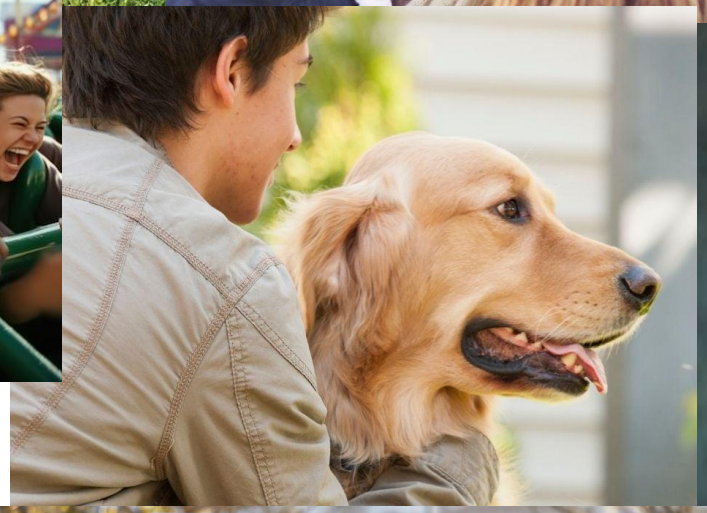
Reward

A thing, situation or event that produces a pleasant or positive emotional experience

(Also… a thing, situation or event that decreases a yucky or negative emotional experience)








Reinforcement

learning the association between actions and rewards

- POSITIVE: Strengthening a behavior that increases the chance of a positive outcome

- NEGATIVE: Strengthening a behavior that increases the chance of reducing a negative outcome

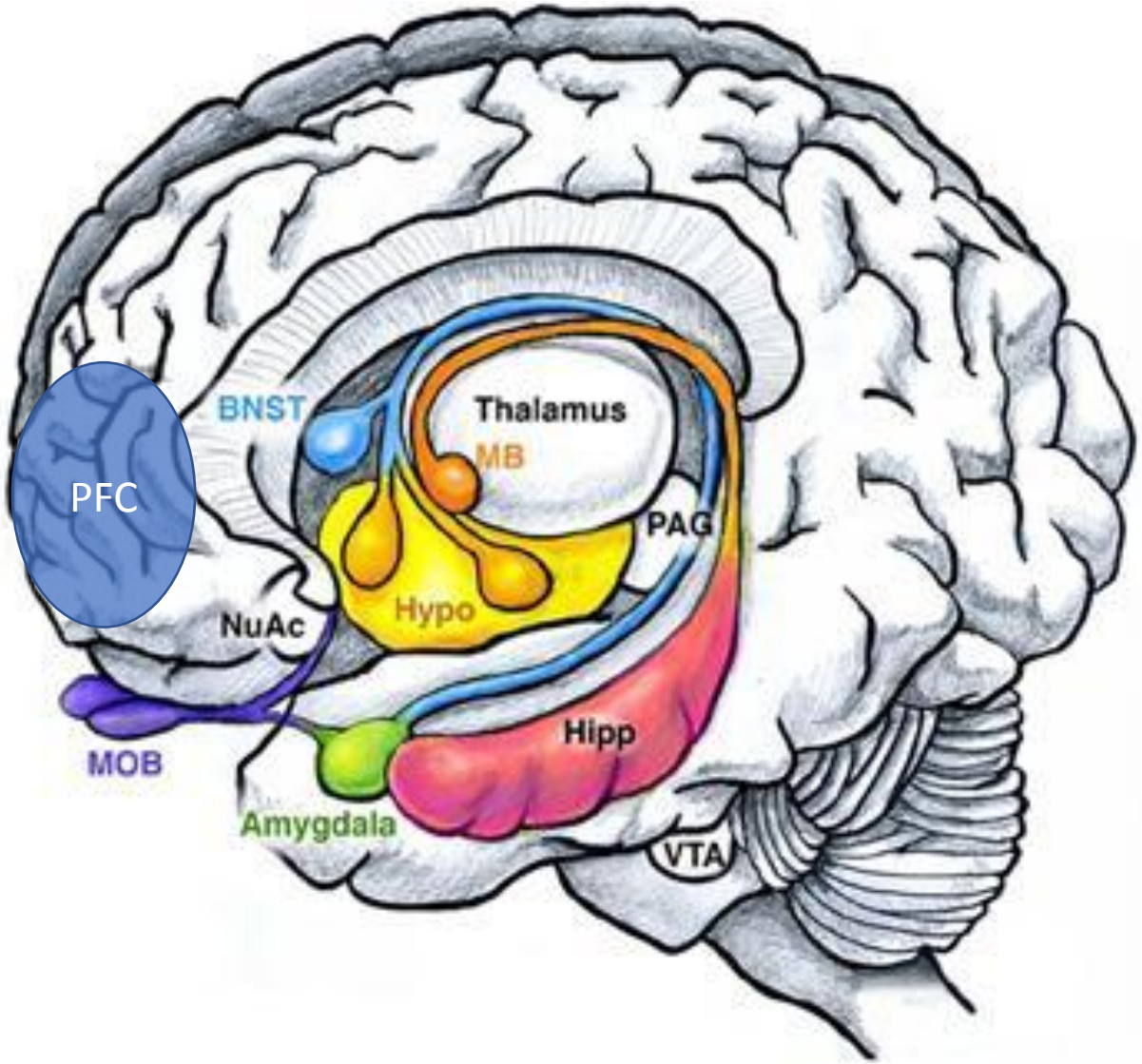
Reinforcement

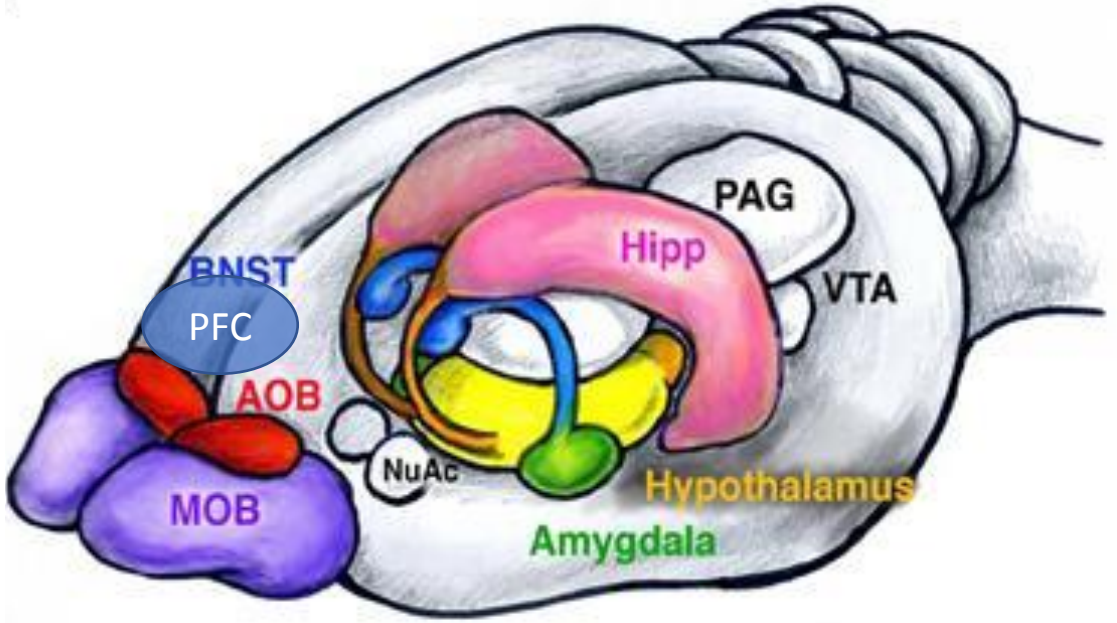
learning the association between actions and rewards

- POSITIVE: Strengthening a behavior that increases the chance of a positive outcome
  - example: practicing soccer so you might be a starter in the upcoming game
  - example: studying over the weekend to try to get an A on your math test

- NEGATIVE: Strengthening a behavior that increases the chance of reducing a negative outcome
  - example: practicing soccer so you won't be sitting on the bench all game
  - example: studying over the weekend to try to avoid failing your math test

Brain’s reward regions





Music

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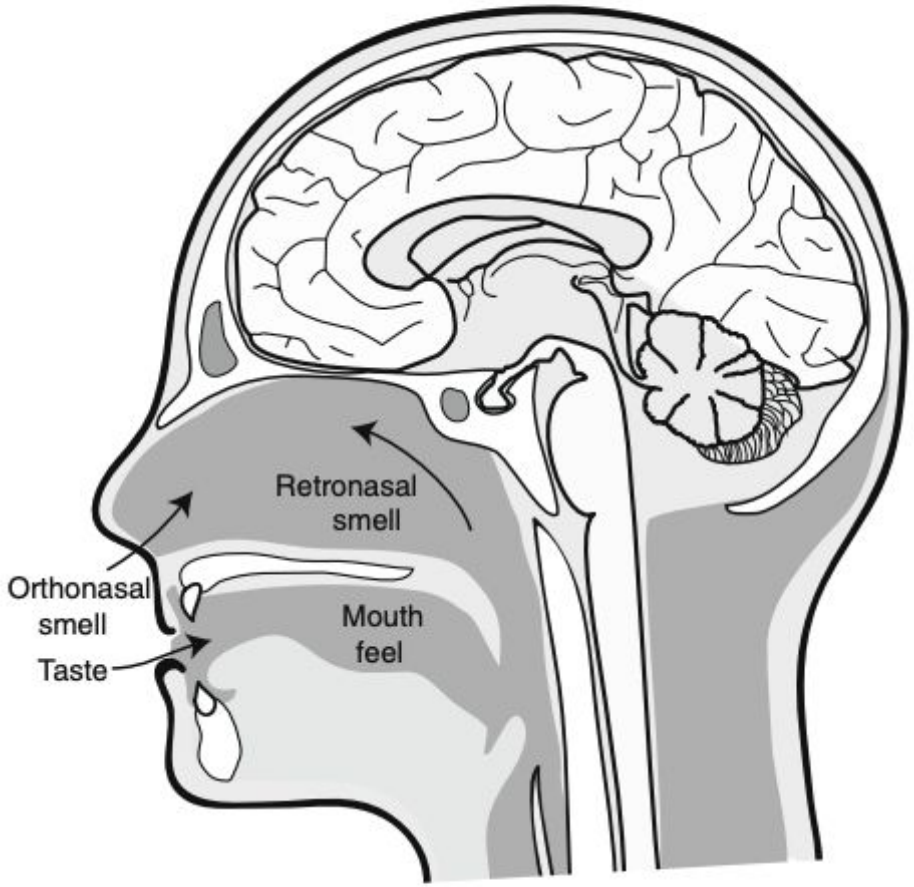
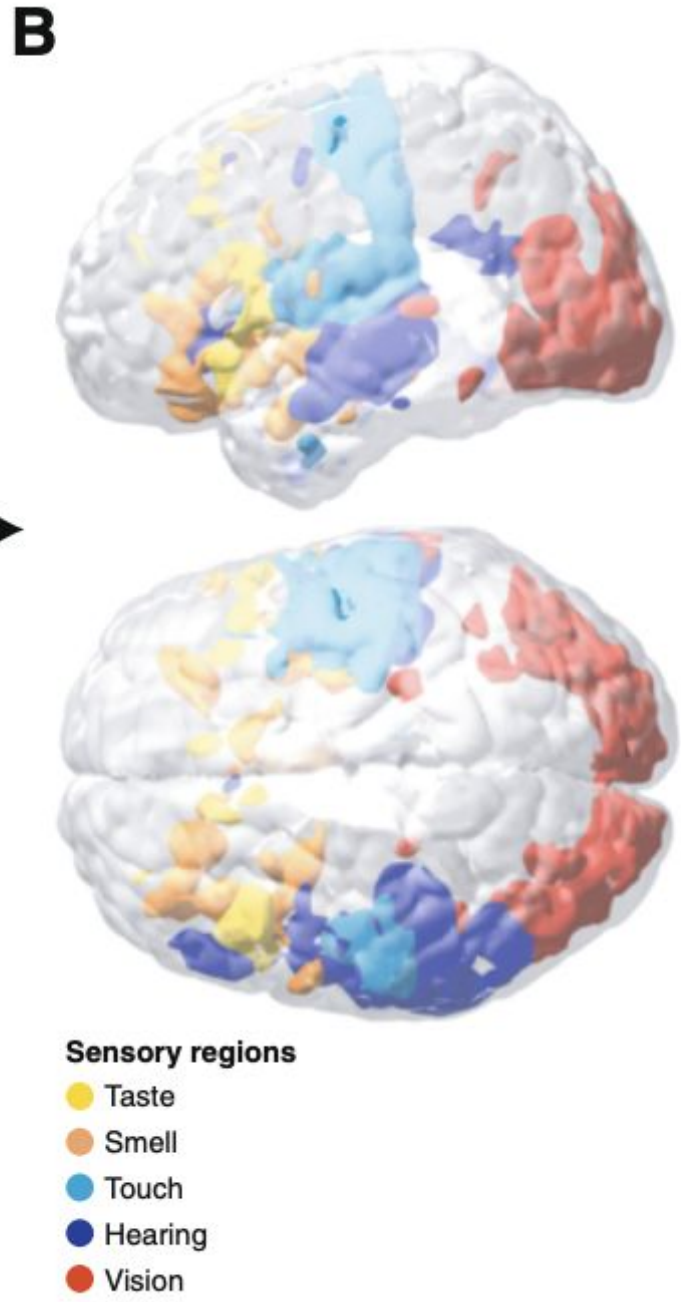
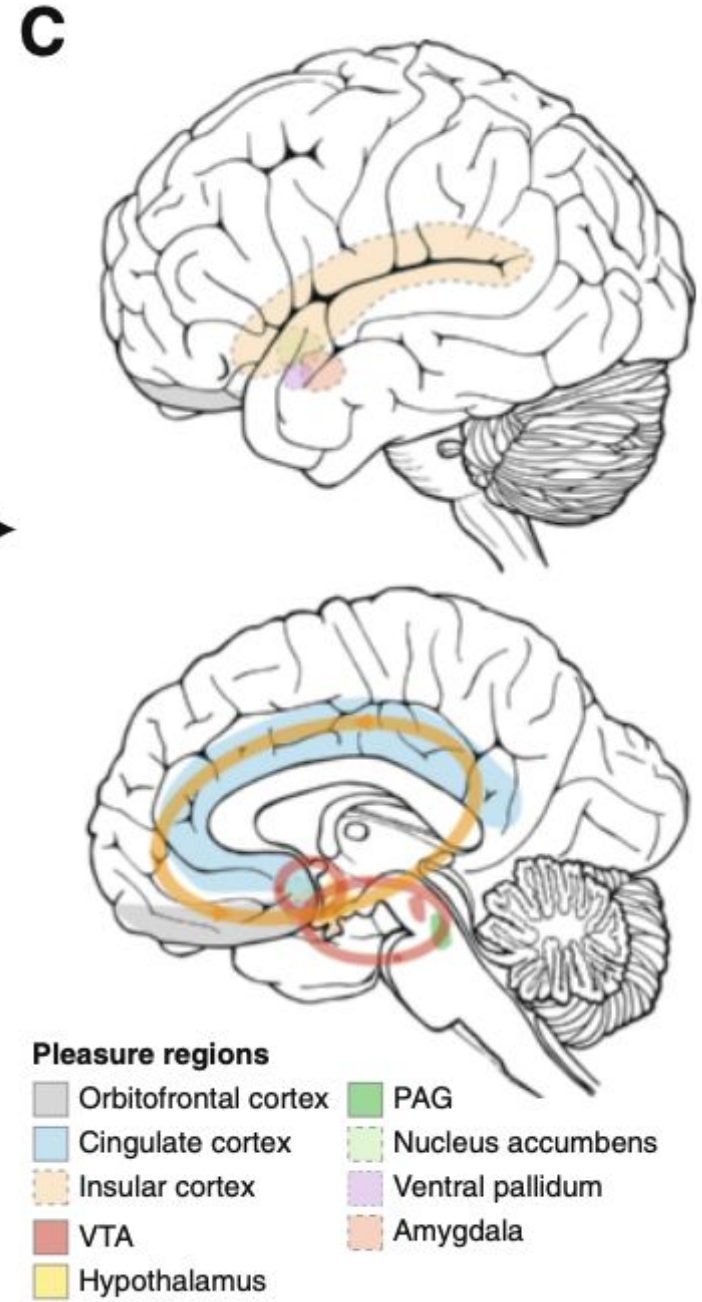
https://medicalxpress.com/news/2013-04-brain-music-rewarding.html

Food







file:///Users/arobdecki/Downloads/The_pleasure_of_food_underlying_brain_mechanisms_o.pdf

Reward chemistry

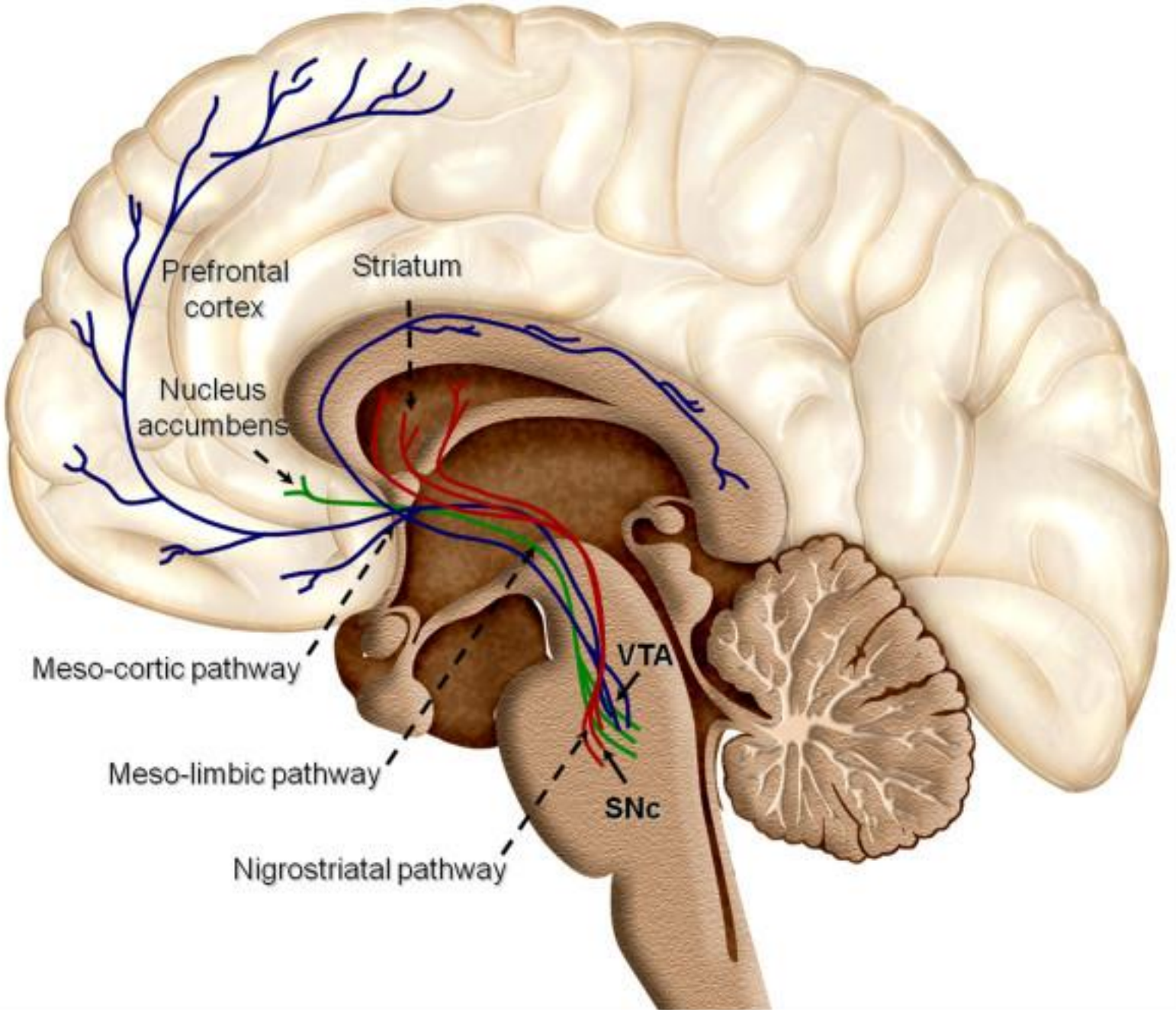
- **Dopamine**

- Opioids (endorphins)
- Endocannabinoids
- Serotonin
- Oxytocin

Dopamine

Increased in:

- Pleasurable activities
- Healthy behaviors



https://www.researchgate.net/publication/47356791_Dopaminergic_reward_system_A_short_integrative_review

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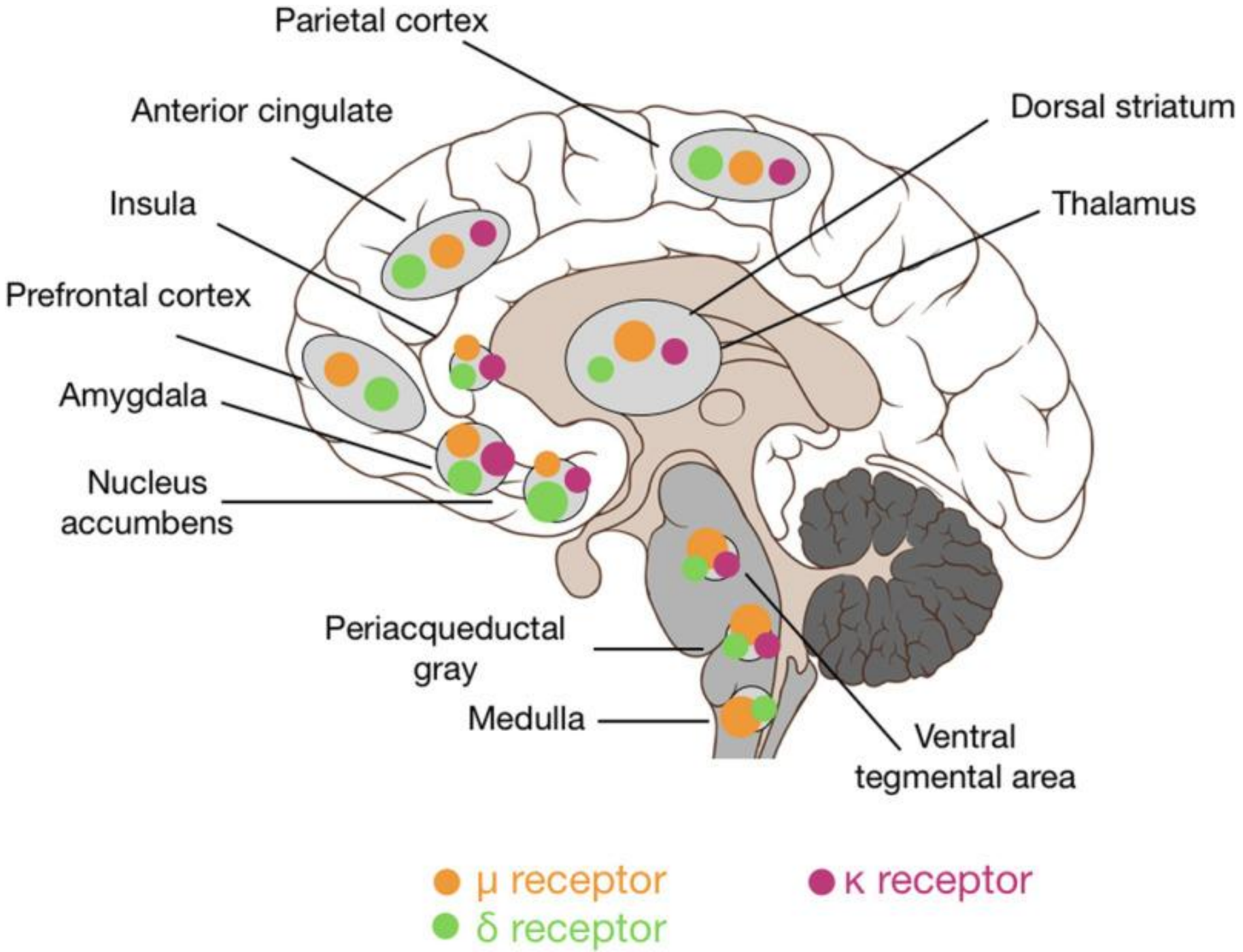
Opioids

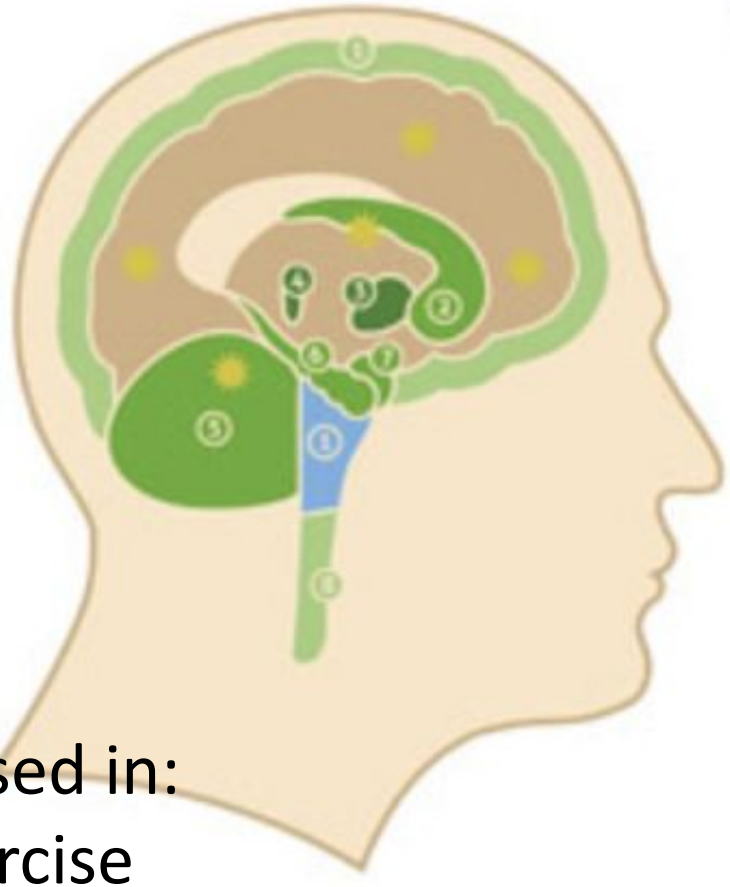


Increased in:

- Pain
- Stress
- Pleasurable activities

https://www.ncbi.nlm.nih.gov/books/NBK595465/figure/ch1.Fig4/?report=objectonly

Endocannabinoids



CB1 present:

1. cortex
2. caudate nucleus and putamen (nucleus acumbens)
3. basal ganglia
4. hypothalamus
5. cerebelum
6. hippocampus
7. amygdala
8. spinal cord

CB2 present

glial cells

CB1+CB2 present

1. brainstem

Increased in:

- Exercise
- Pleasurable activities

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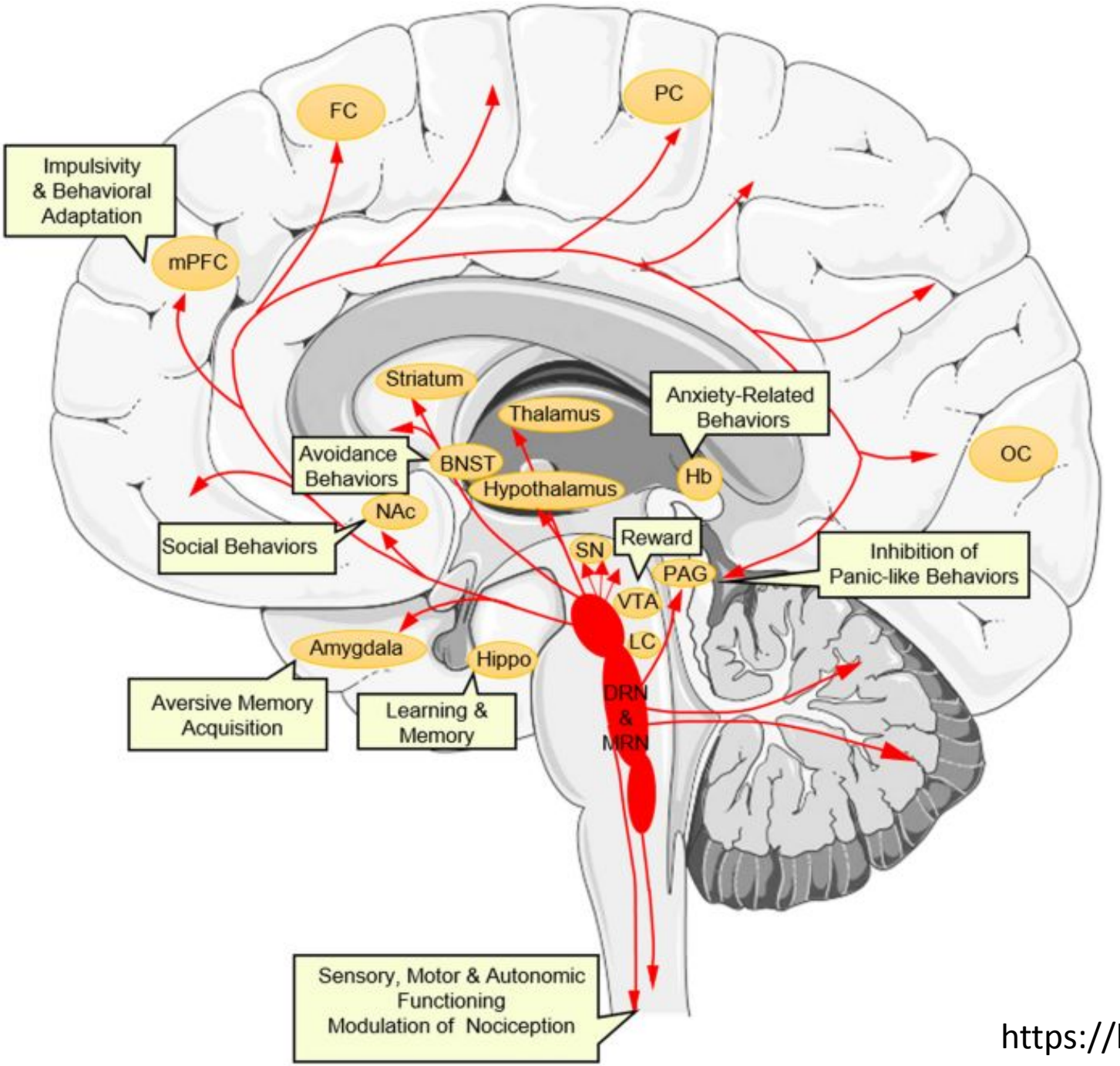
https://www.sciencedirect.com/science/article/abs/pii/S0306453021000470

Serotonin



Increased in:

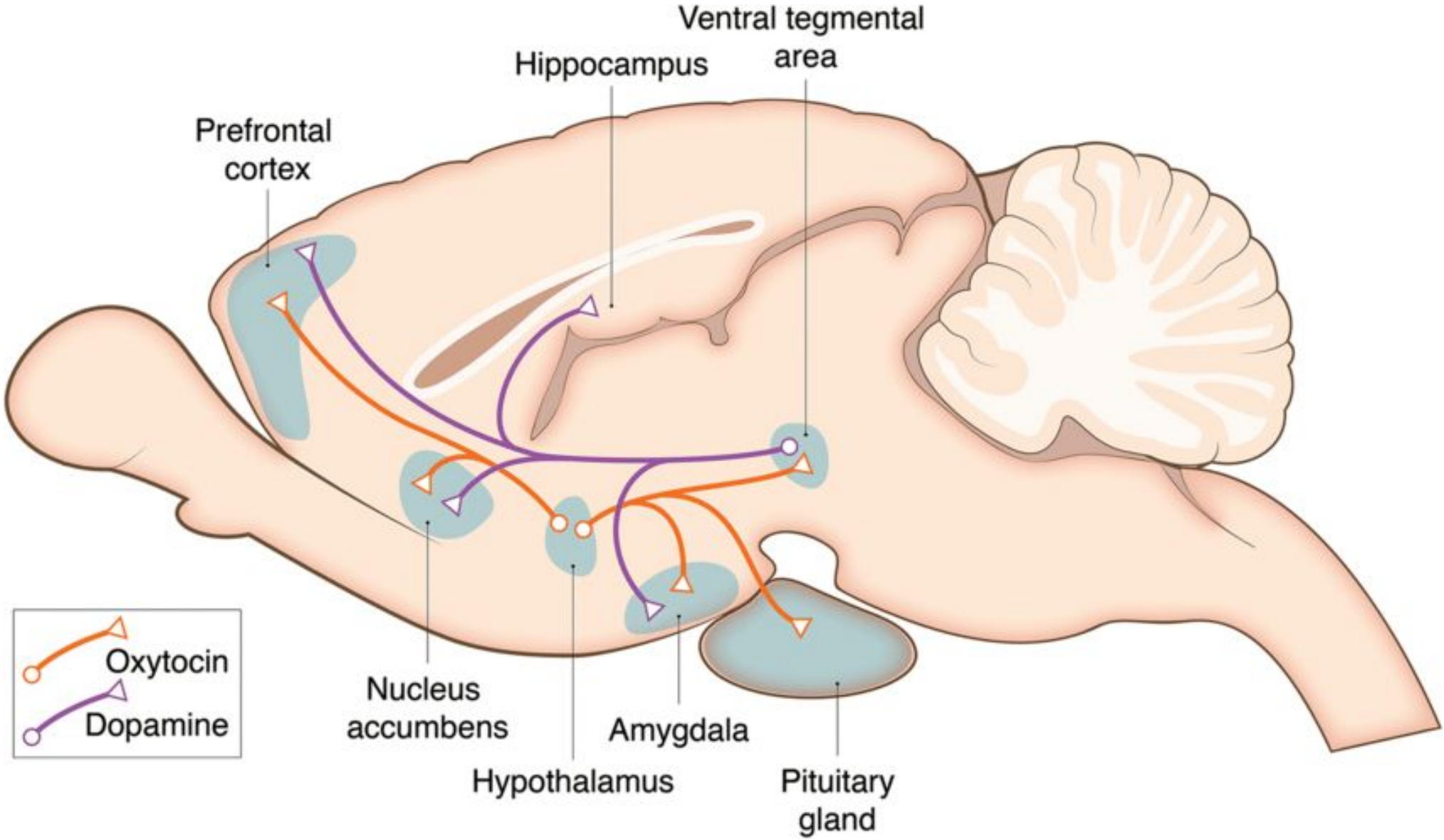
- Exercise
- Sunlight/time outside
- Eating a balanced diet
- Meditation

https://link.springer.com/article/10.1007/s10571-021-01064-9

Oxytocin

Increased in:

- Cuddling/ hugging/ massage
- Music
- Intimate times with friends
- Sex
- Childbirth



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https://www.researchgate.net/publication/329686031_The_maternal_reward_system_in_postpartum_depression

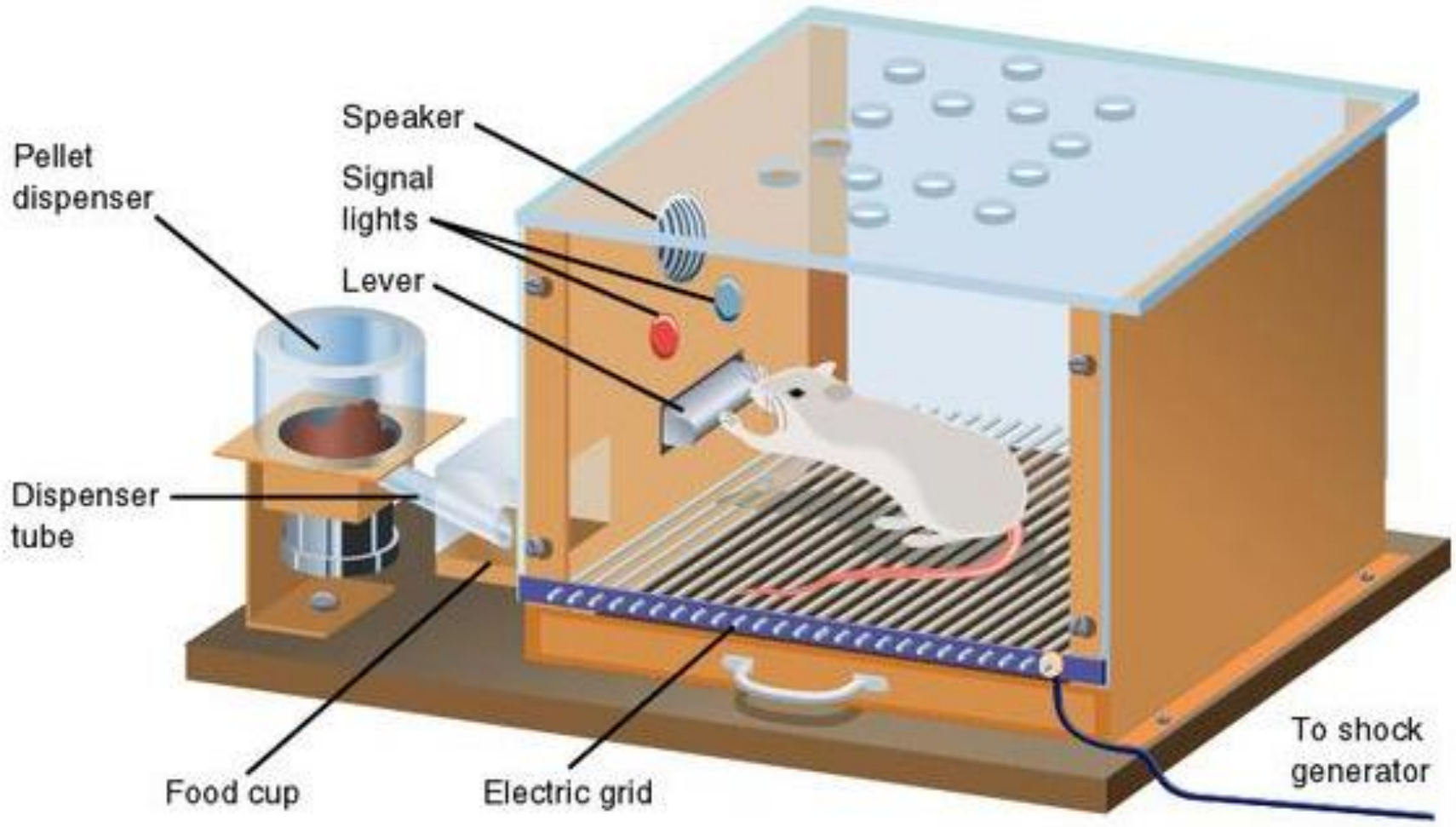
The Reward Circuit

How the Brain Responds to
Natural Rewards and Drugs

Studying reward using lab animals

Operant conditioning

Animal learns to perform a response to receive a reward



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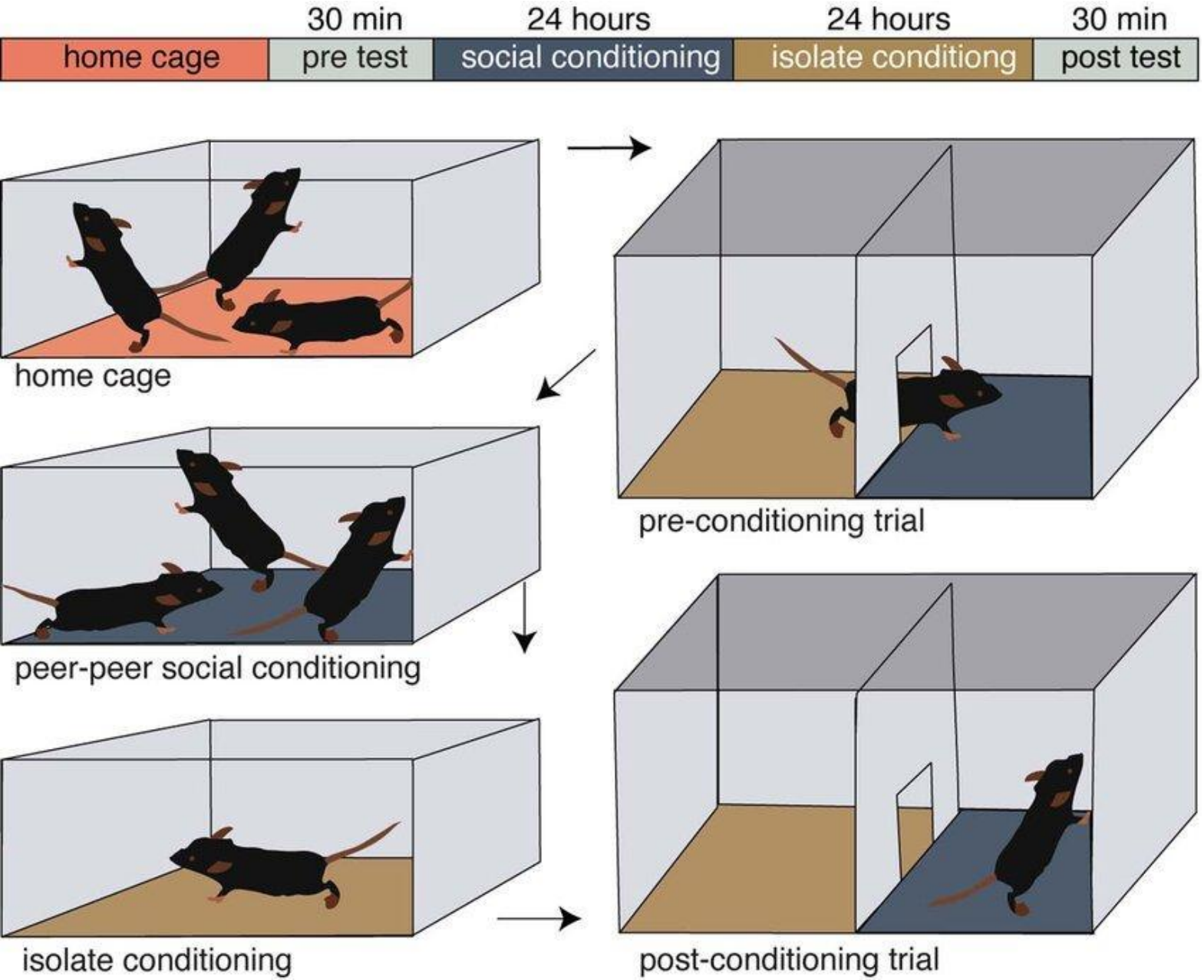
https://howardquest.weebly.com/blog/operant-conditioning


Touching Lever
Required

Place conditioning



Animal is exposed to different environments paired with different states and then chooses later which environment to spend time in

Nardou, Romain & Sawyer, Ted & Song, Young Jun & Wilkinson, Makenzie & Padovan-Hernandez, Yasmin & Deus, Júnia & Wright, Noelle & Lama, Carine & Faltin, Sehr & Goff, Loyal & Stein-O'Brien, Genevieve & Dolen, Gul. (2023). Psychedelics reopen the social reward learning critical period. Nature. 618. 10.1038/s41586-023-06204-3.

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