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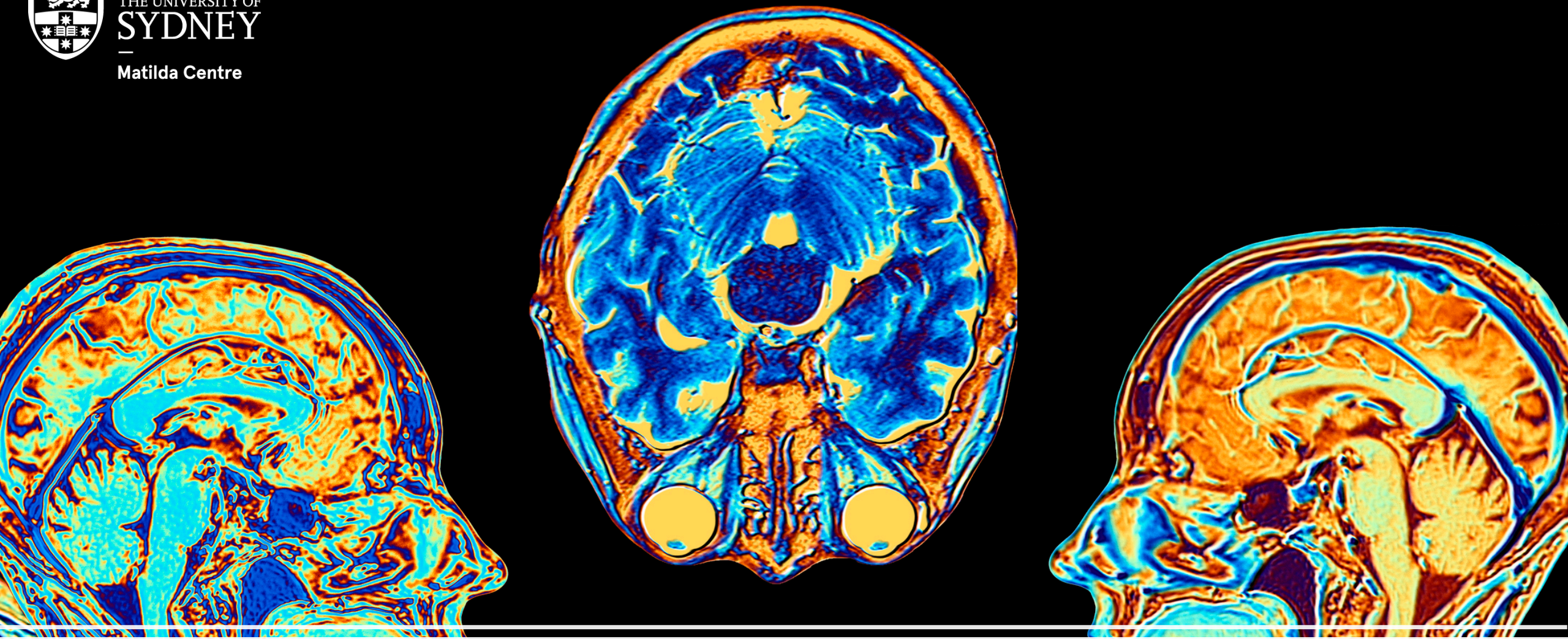

Adolescent substance use: Alcohol, cannabis and MDMA & the growing brain

Ms Jennifer Debenham, A/Prof Nicola Newton, Dr Louise Birrell and Dr Katrina Champion
The Matilda Centre for Research in Mental Health and Substance Use, the University of Sydney

Summary:

1. Brain development
2. Alcohol & harm reduction
3. Cannabis & harm reduction
4. MDMA & harm reduction
5. Overall harm reduction strategies

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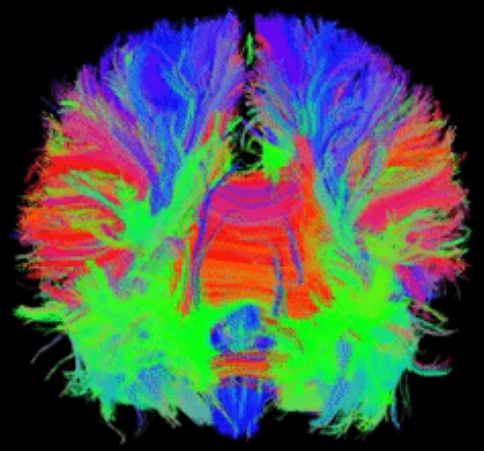
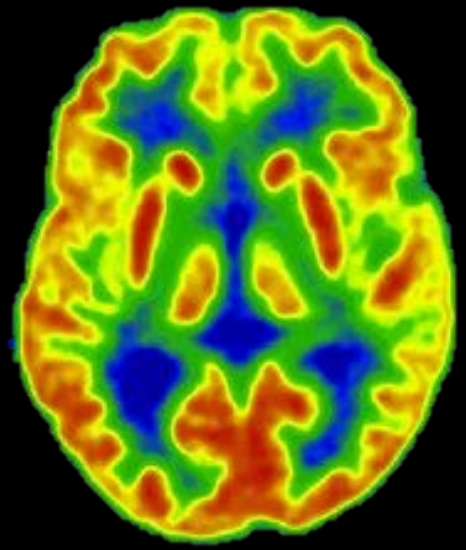
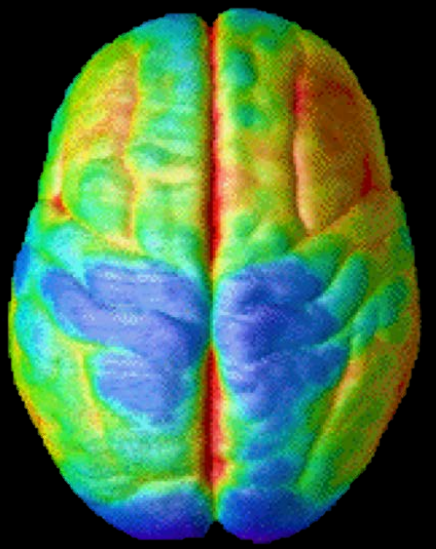
Positive Choices

The brain







1. The brain finishes developing around the age of 18years and remains the same for the rest of life.

A. True
B. False

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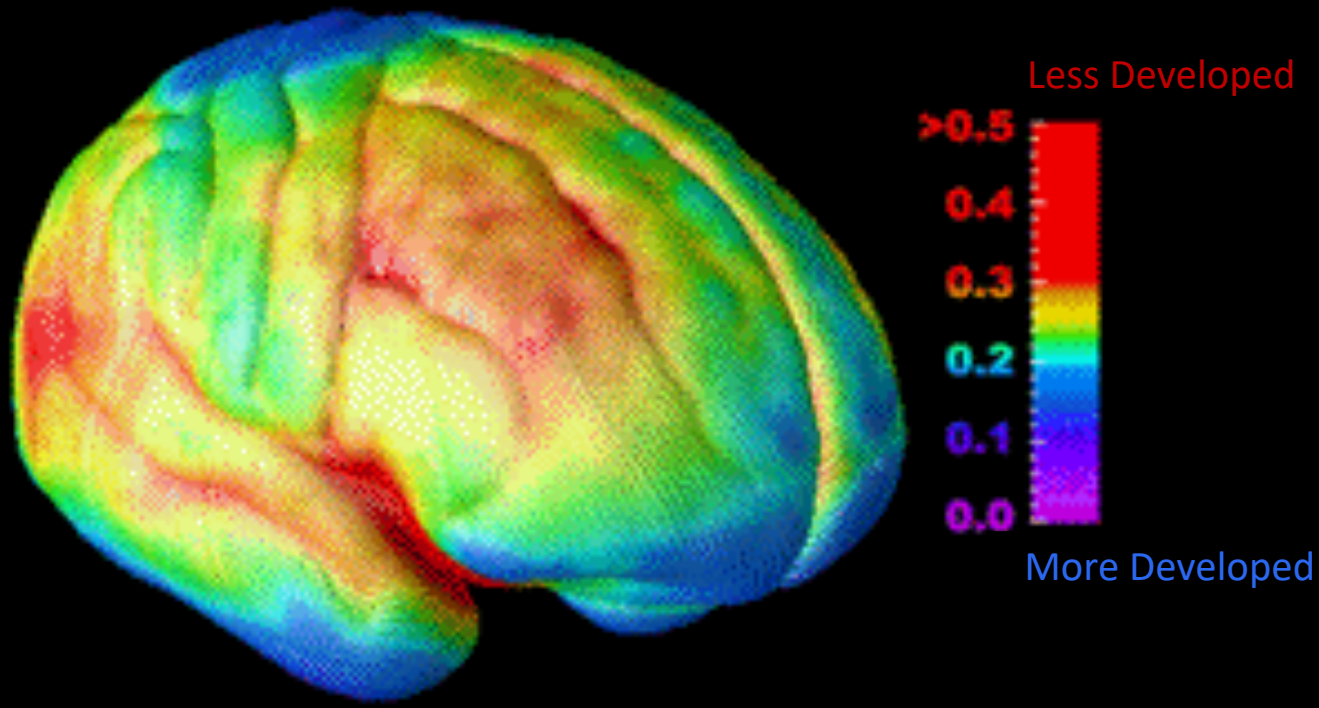
Positive Choices

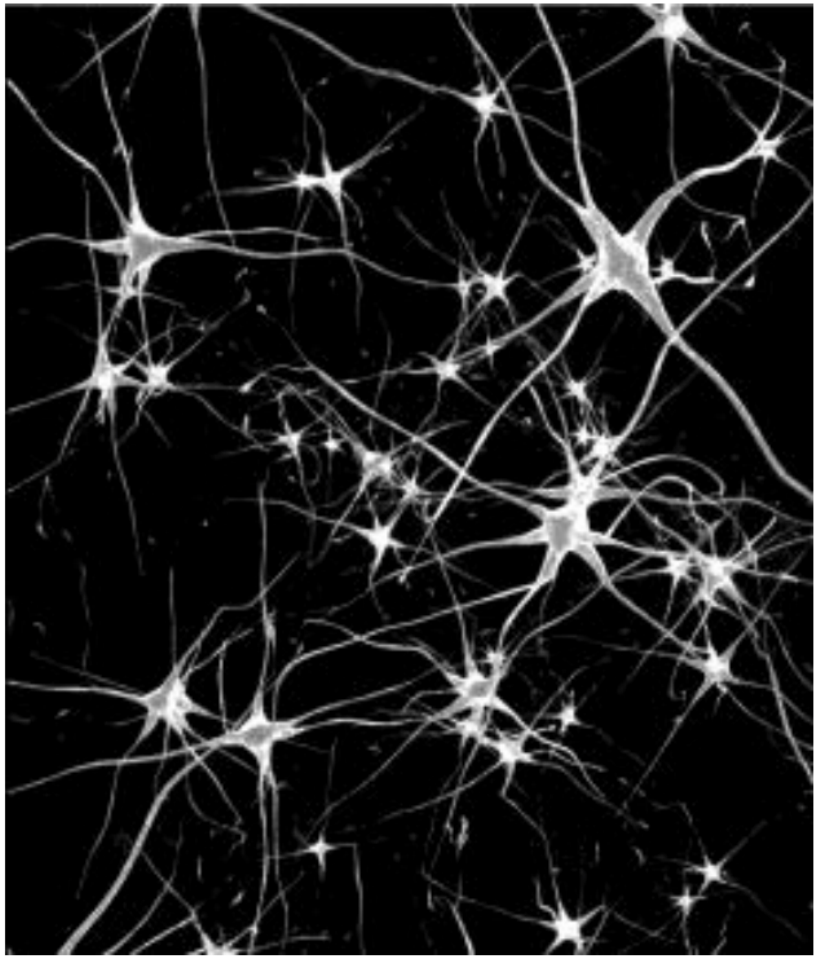
The brain finishes the last stage of major structural integration around 25years

Neuroplasticity:

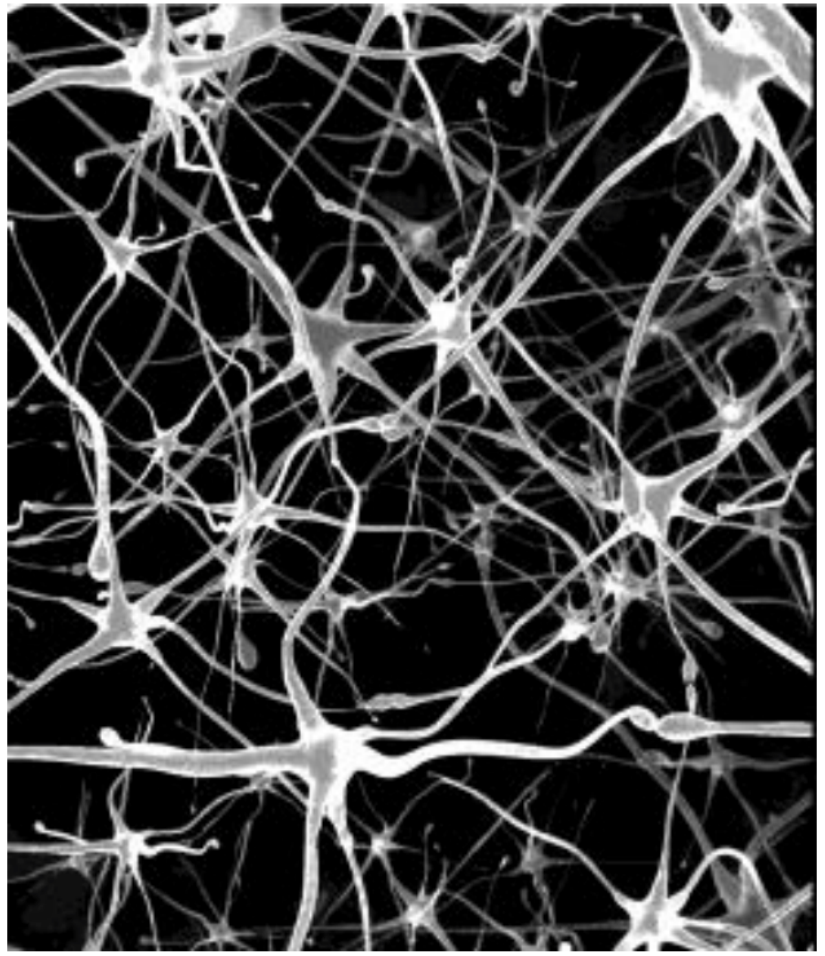
- Pruning = tossing out what isn't used
- Myelination = increasing the rate information flows throughout the brain
- Synaptogenesis = increasing the number between cells



Source: Gogtay, N., et al., *Dynamic mapping of human cortical development during childhood through early adulthood.* Proc Natl Acad Sci U S A, 2004. **101**(21): p. 8174-9.



At birth

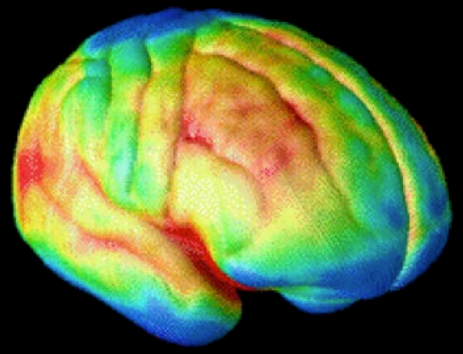


At age 6

2010, Mindset Works

The two primary tasks of cells in the CNS:

1) Neurons (brain cells) respond to the environment
2) Neurons adapt to the environment

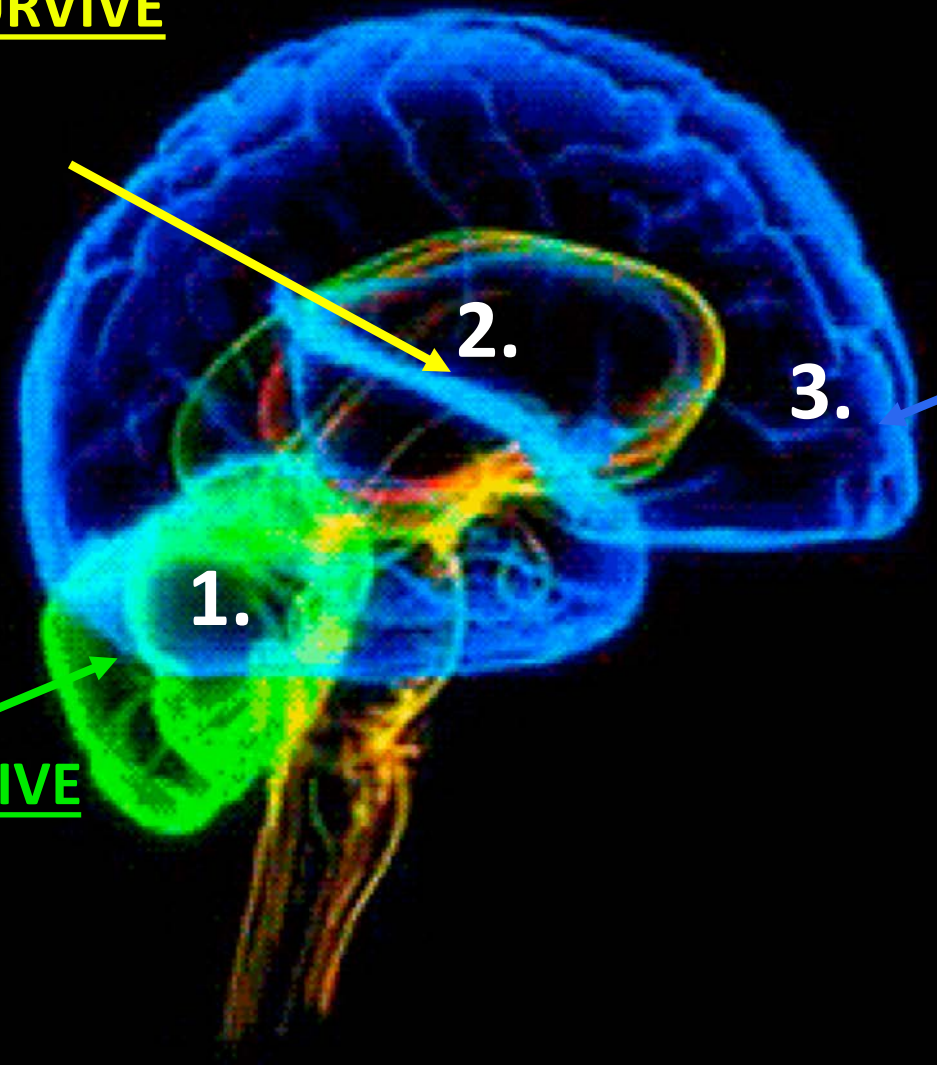


bidirectional

Regions of the brain: development occurs from back to front

2. MIDBRAIN: HELP YOU SURVIVE

- Emotions
- Memory
- Body homeostasis
- Pleasure center



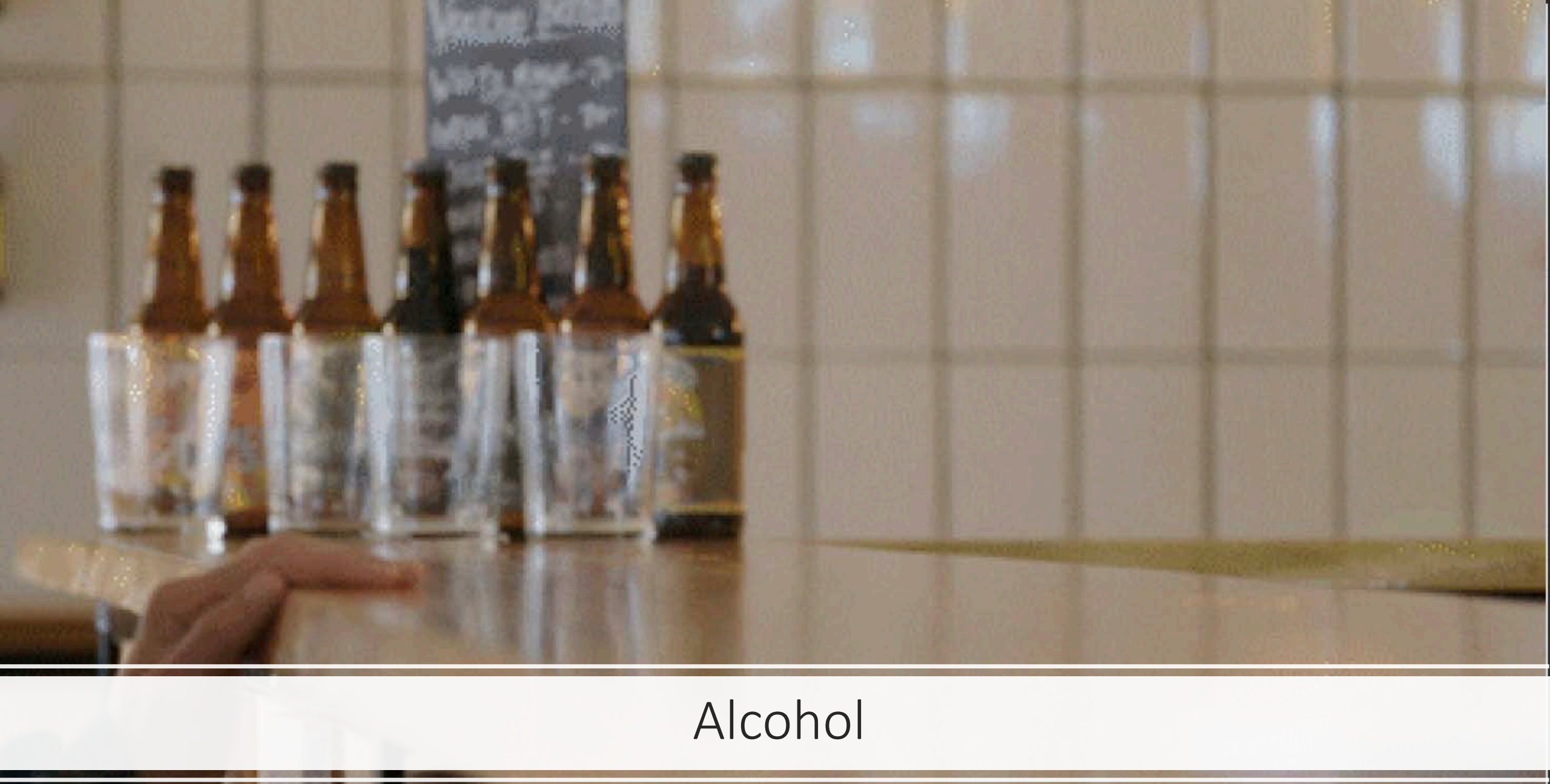
3. FOREBRAIN: ENABLE YOU TO THRIVE

- High level thinking
- Reasoning
- Planning
- Judgement
- Decision making
- Impulse control

1. HINDBRAIN: KEEP YOU ALIVE

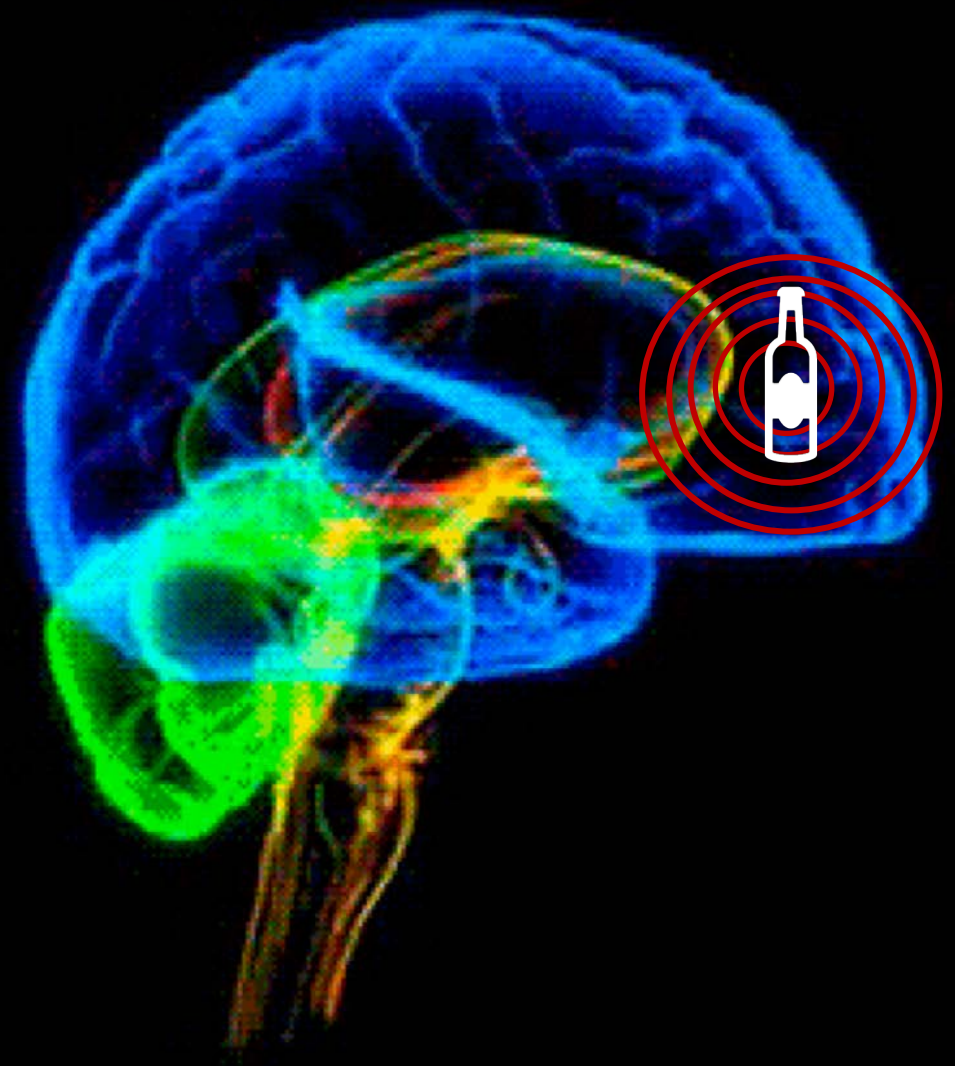
- Coordination
- Breathing
- Heart rate

Alcohol and other drugs



Alcohol

Alcohol decreases brain activity



THE FOREBRAIN:

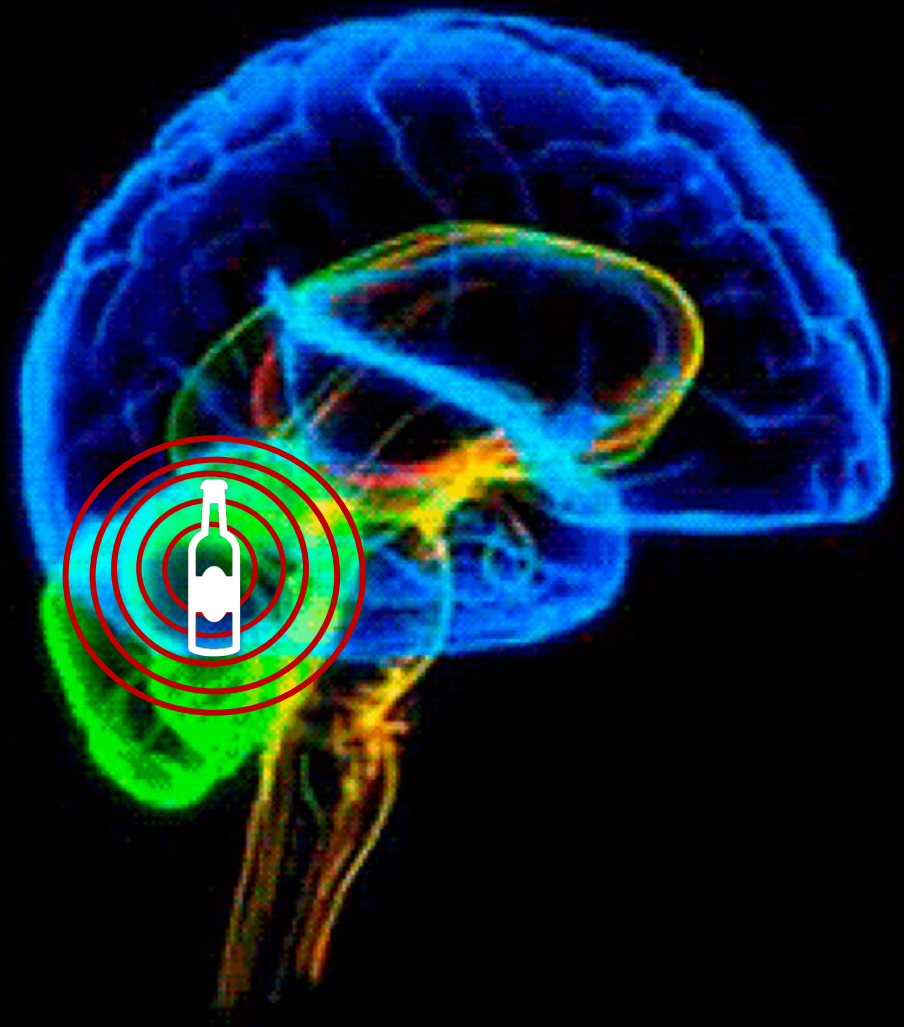
- Reduced inhibitions
- Reduced ability to plan & prioritize
- Reduced behavioral control

Alcohol decreases brain activity

2. THE MID BRAIN (sub-cortical)

- Reduced emotional control - amygdala
- Impaired memory formation – hippocampus
- Increased dopamine in reward pathways - NA & VTA

Alcohol decreases brain activity



3. THE HIND BRAIN:

- Reduced coordination- cerebellum
- Slowed breathing - medulla
- Slowed heart rate - medulla

Alcohol & brain activity → Short-term

Source: Volkow, N.D.; Wang, G.J.; F
D.; et al. Low doses of alcohol subst
decrease glucose metabolism in the
brain. *Neuroimage*29(1):295–301, 20

Longer-term brain outcomes associated with binge drinking

Structural differences:

Brain tends to grow more slowly

Reduced brain volume and white matter integrity

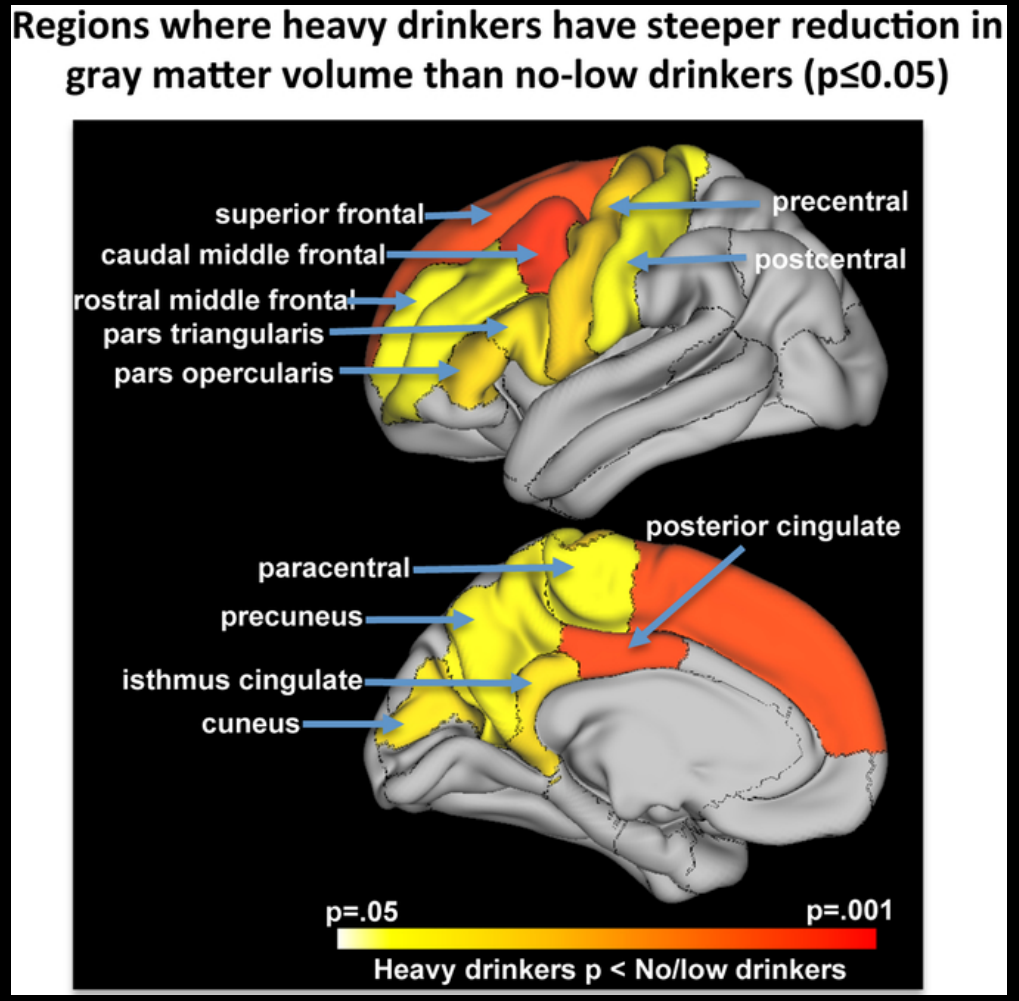
Functional differences:

Increased brain activity to complete the same task

Cognitive differences:

Reduced decision-making

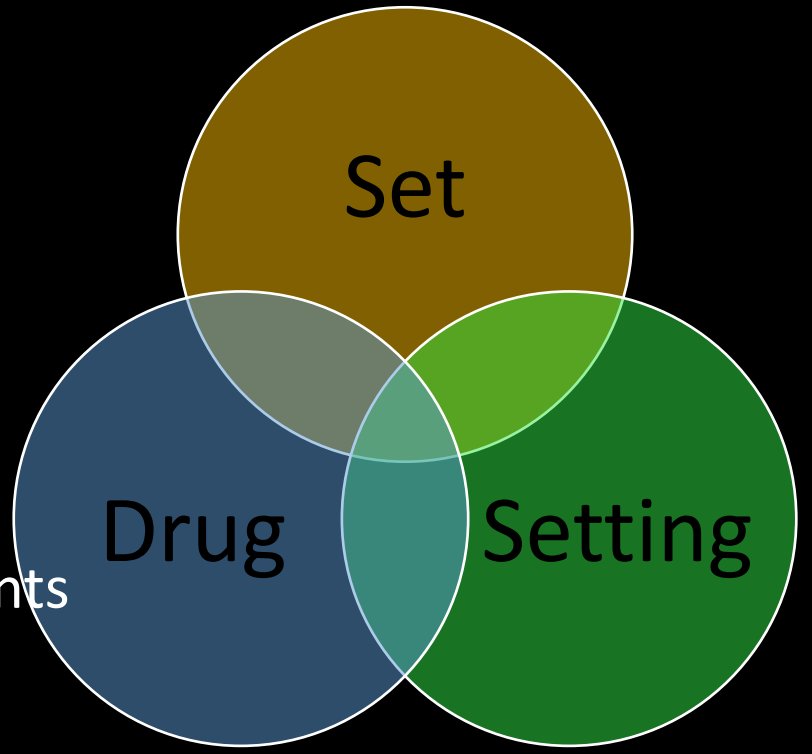
Reduced inhibition



Pfefferbaum, A., Kwon, D., Brumback, T., Thompson, W., Cummins, K., & Tapert, S. et al. (2018). Altered Brain Developmental Trajectories in Adolescents After Initiating Drinking. *American Journal Of Psychiatry*, *175*(4), 370-380.

Alcohol Harm Reduction

- Be aware of the stages of drunkenness
  - Nothing sobers you up other than time!
- Be aware of the signs of OD/alcohol poisoning
  - Slow or irregular breathing
  - Blue-tinged or pale skin
  - Low body temperature
  - Passing out and can’t be awaken
  - Seizures
- Dial 000 if suspect alcohol poisoning- police will not come
- Do not mix alcohol with other drugs, particularly depressants
- Alcohol increases your chance of having a car crash
- Be aware of drink spiking
- Pre plan how much and when you will stop
- You can’t get consent when intoxicated!



- Explore the *why* behind binge drinking

What are some of the motives behind young people drinking?

a) To feel good
b) To improve confidence
c) Peer influence
d) To feel better - cope with negative emotions such as anxiety
e) All of the above

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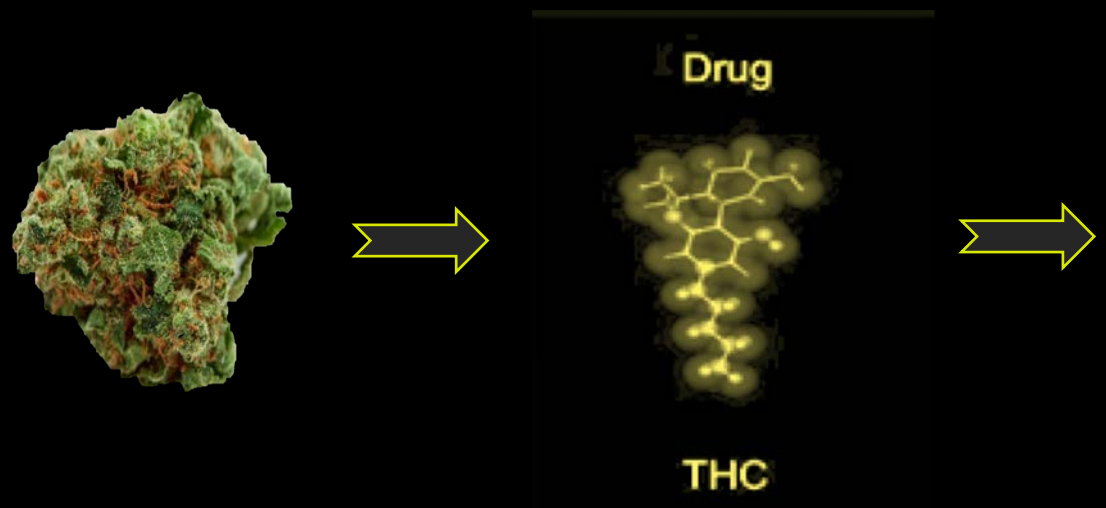
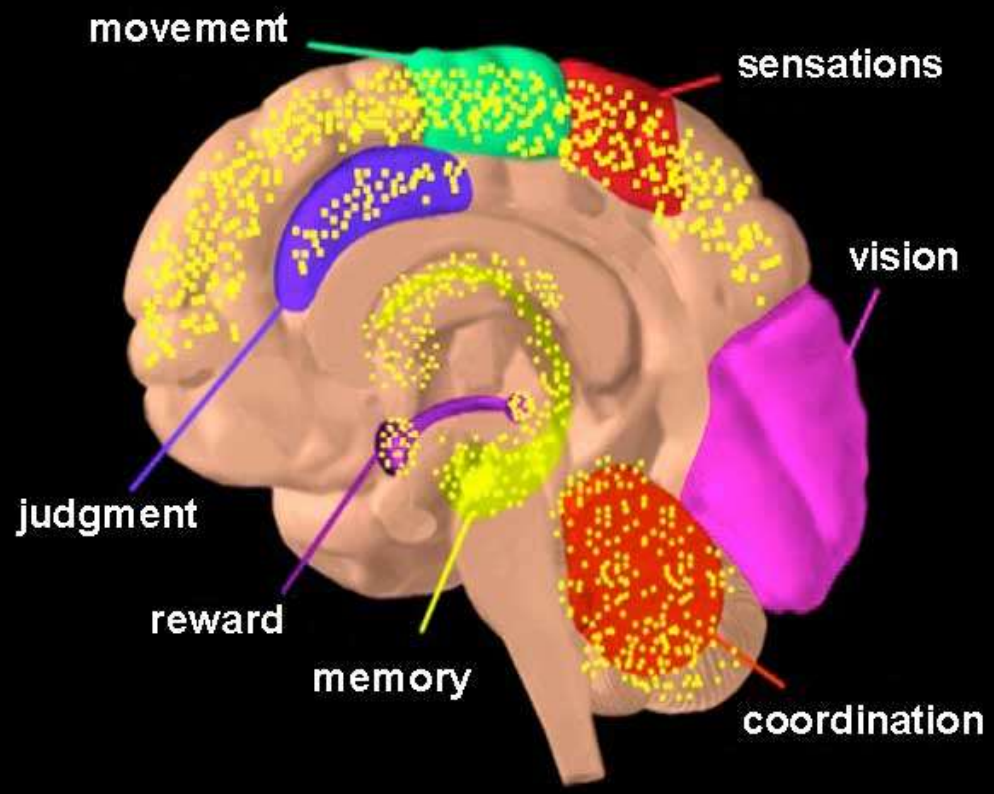
Positive Choices

Cannabis

Cannabinoid receptor location in the brain: acute exposure

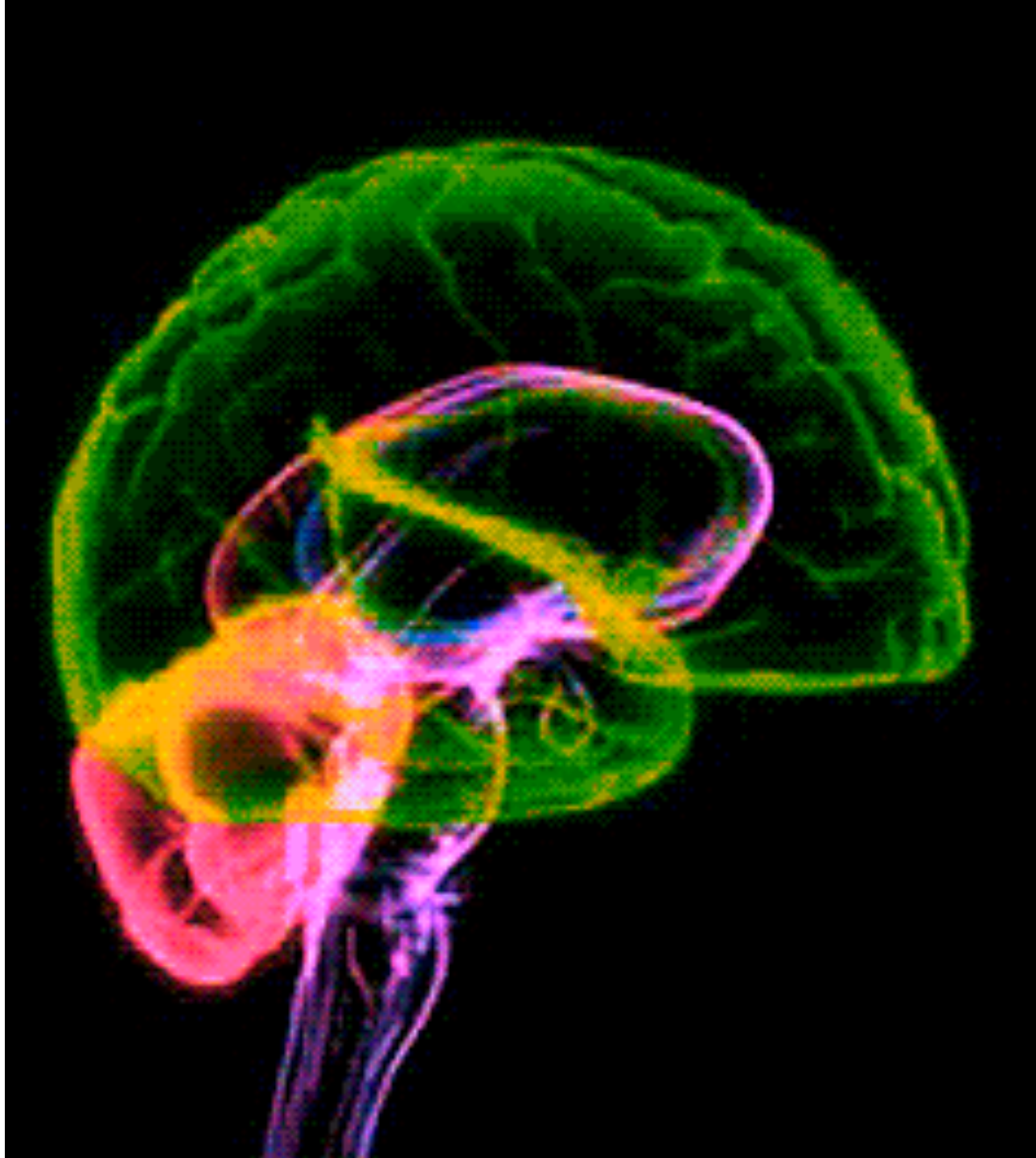




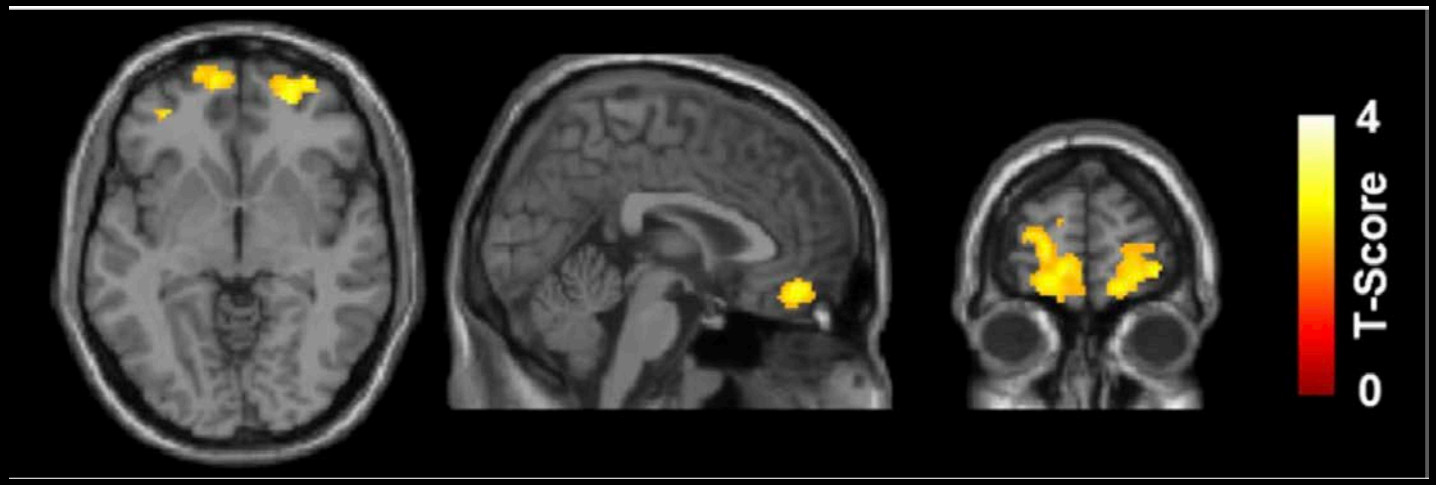
NIDA, 2019

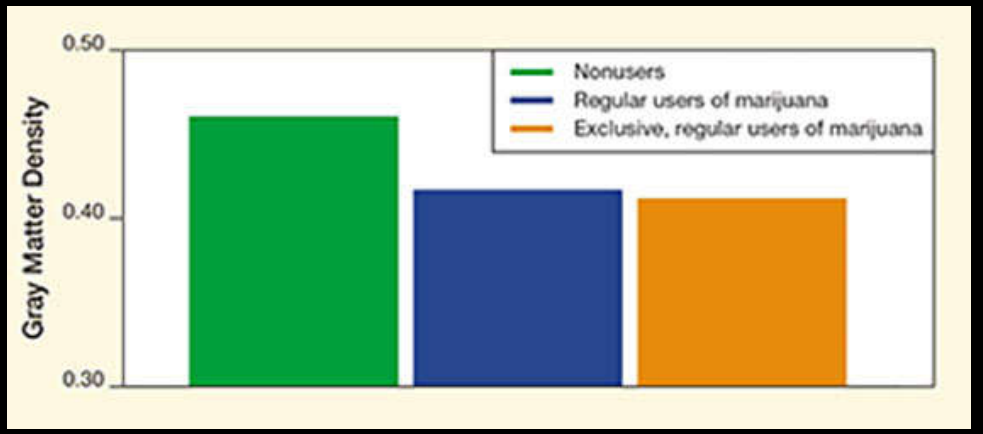
The cannabinoid system coordinates brain development

- OHS team;
- The cannabinoid system regulates synaptic pruning;
- With more cannabinoids in the system, pruning can be accelerated;
- Bidirectional relationship between drugs and the brain: complex neuroadaptive processes;
- Leads to abnormal connectivity;



Cannabis & brain structure (chronic exposure)



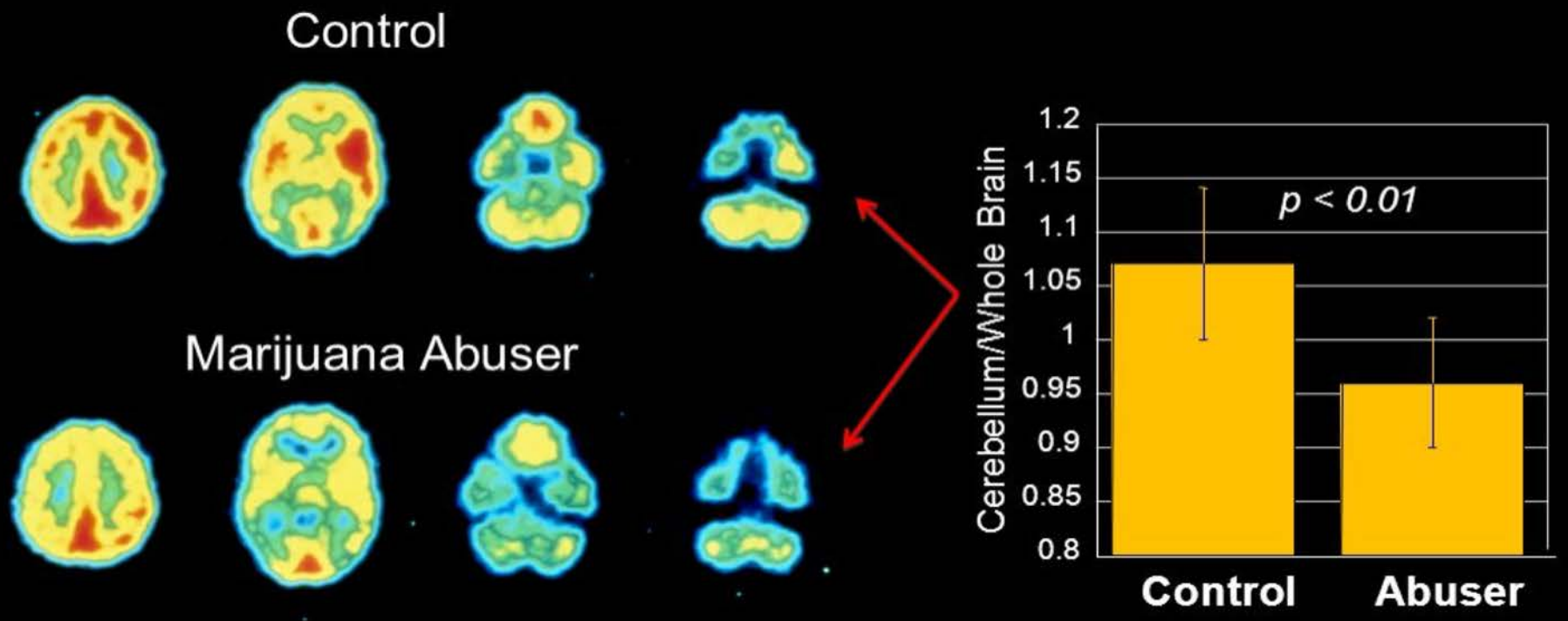


The longer the period of abstinence, the reduced the size of this effect

Filbey, F.M.; Aslan, S.; Calhoun, V.D.; et al. Long-term effects of marijuana use on the brain. *Proceedings of the National Academy of Sciences* 111(47)

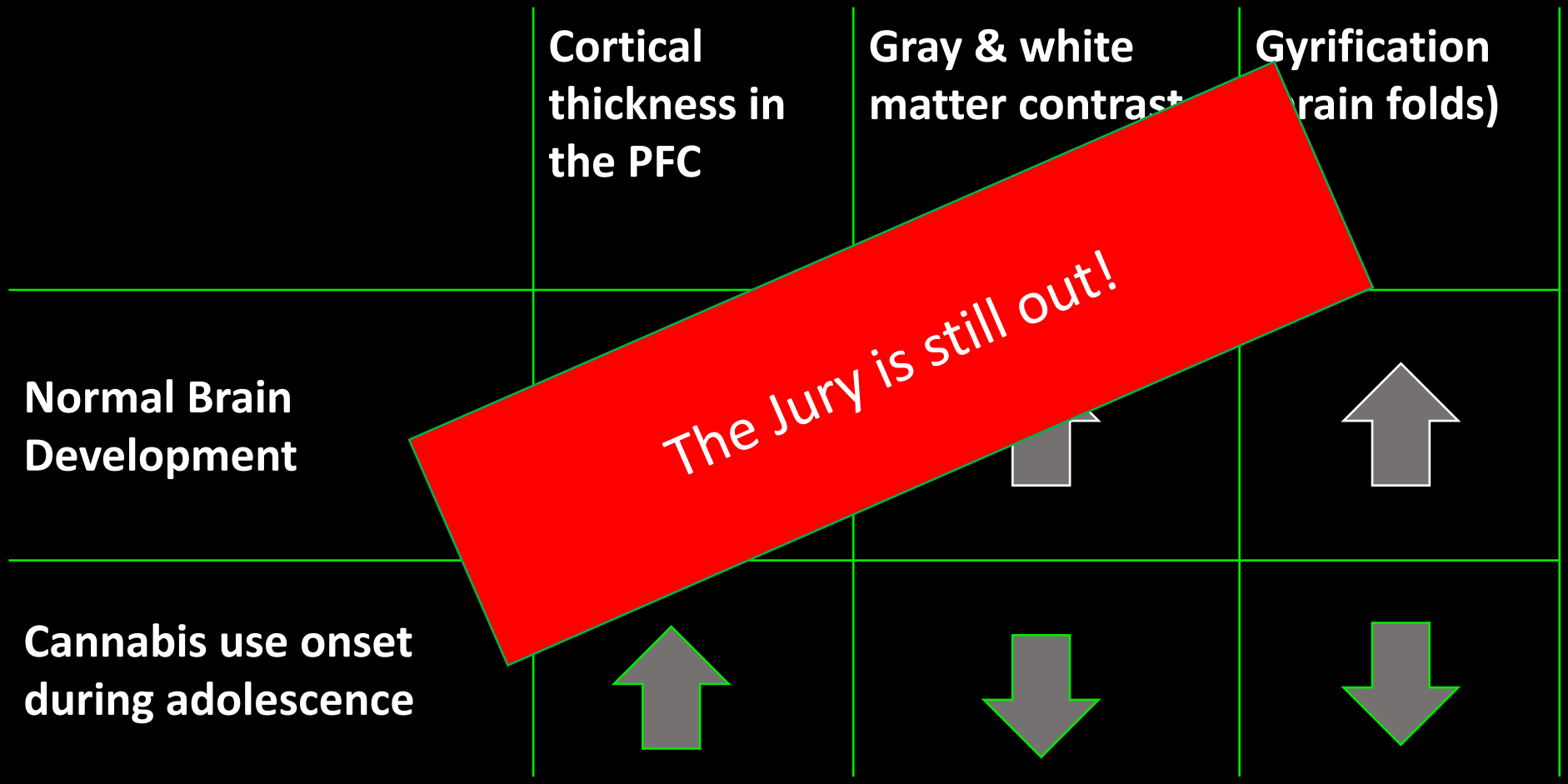
Cannabis & brain function (chronic exposure)

Reduced cerebral blood flow in the cerebellum



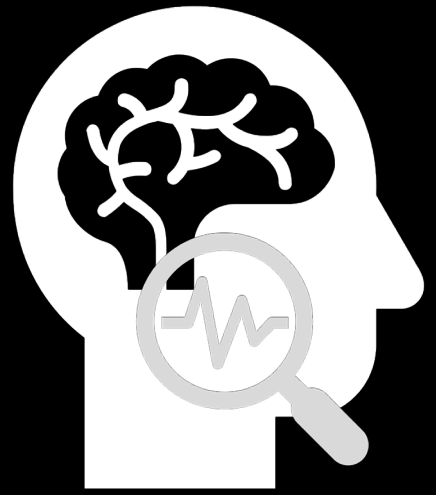
Source: Volkow et al., Psychiatry Research: Neuroimaging, 67, pp. 29-38 (1996).

Cannabis & Brain Structure



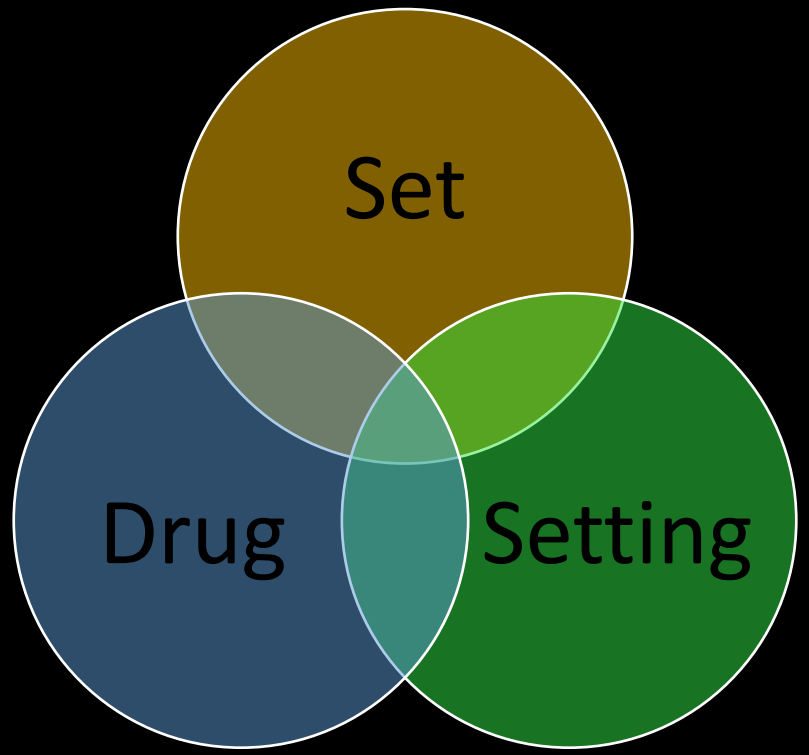
Inconclusive evidence

THC potency



Cannabis & Harm Reduction

- Avoid all use during adolescent and early adulthood
- The age of onset is proportionate to harm
- The frequency of use is proportionate to harm
- Educate about cannabis potency
- Cannabis is very addictive (17% young people)
- Track use
- Do not drive
- Explore underlying reasons for use



MDMA / ecstasy

MDMA/ecstasy increases the activity of the following neurotransmitters:

A. Dopamine
B. Serotonin
C. Noradrenaline
D. Endorphins
E. A, B & C

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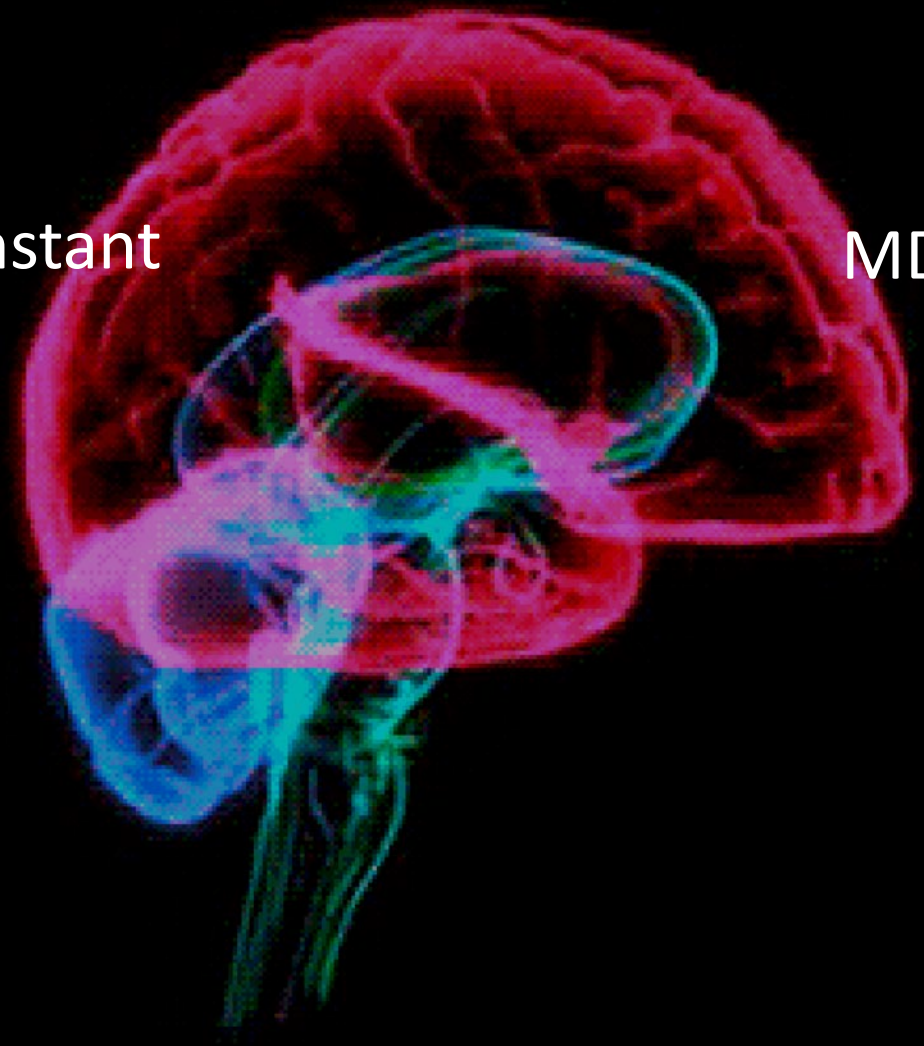
Positive Choices

The brain is exceptionally sensitive to heat

The brain maintains constant temperature by:

- Hypothalamus
- Circulation

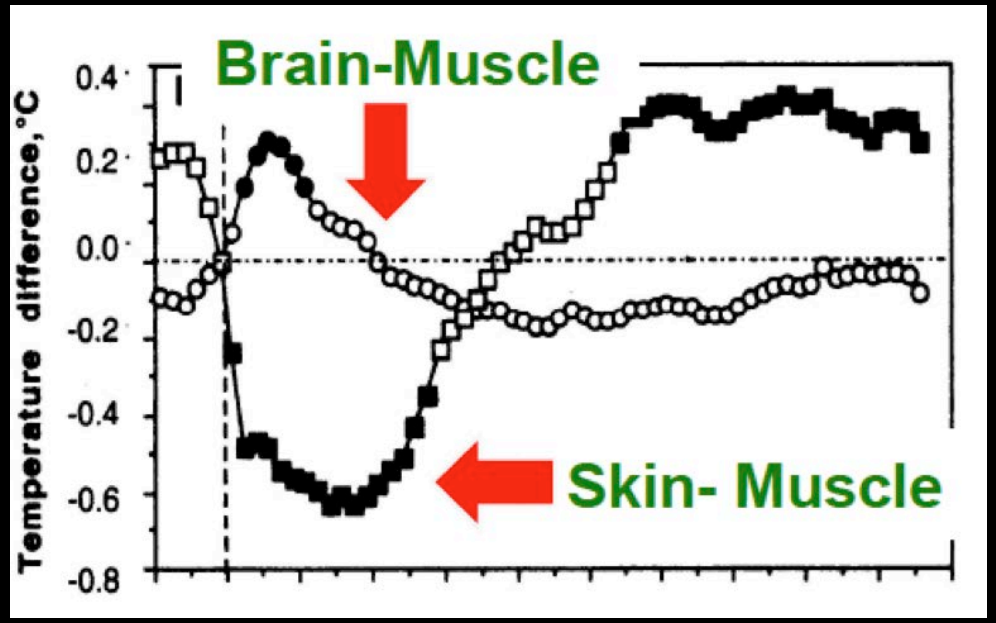


MDMA increases temperature:

- Impairs hypothalamus
- Impairs circulation through vasoconstriction

MDMA in freely moving rats in two conditions

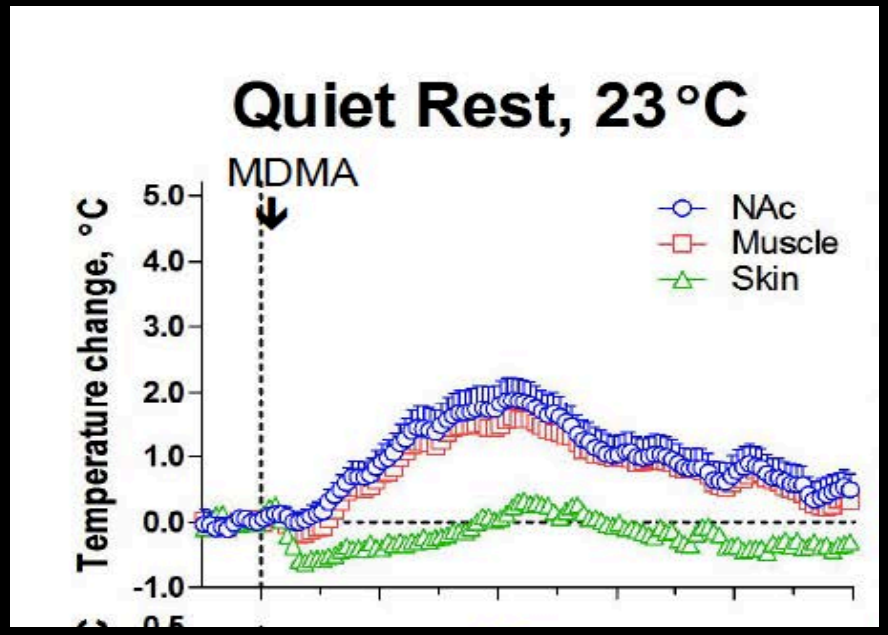
Normal heat regulation



Brain and body temperature

Skin temperature, peripheral vasoconstriction

MDMA induced changes



Brain and body temperature

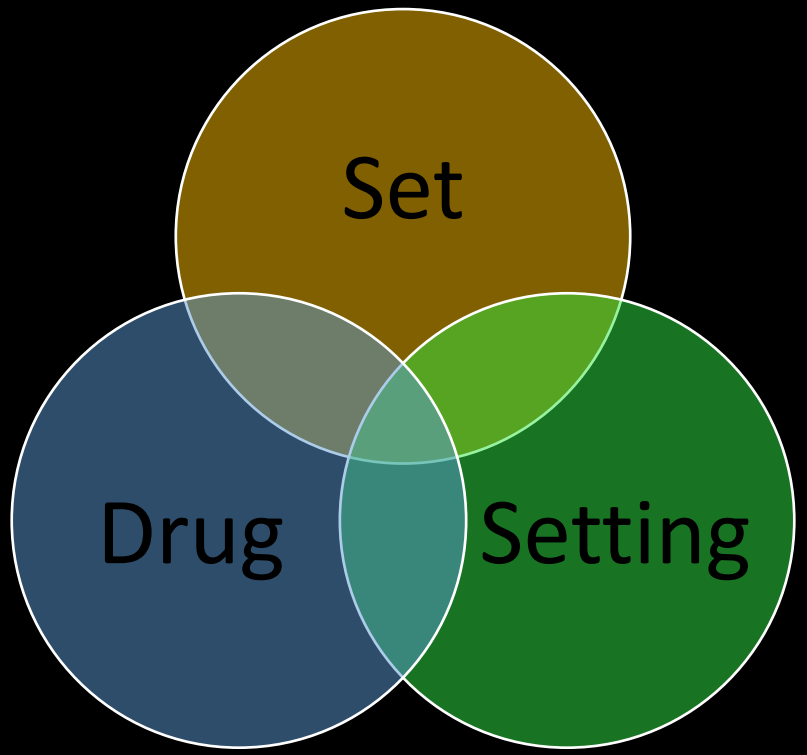
Skin temperature, peripheral vasoconstriction

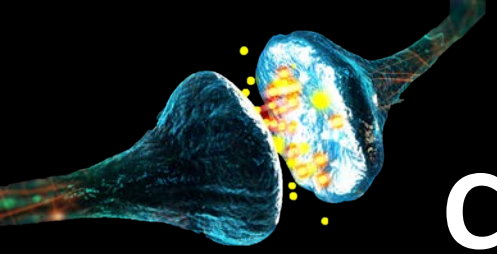
(Kiyatkin et al., 2014)

Music Festivals: Intense physical and emotional activity, high temperature and humidity

MDMA & Harm Reduction

- Safest is to not use any
- Learn the signs of overdose
  - High temperatures
  - Severe headaches
  - Confusion
  - Chest pain
  - Difficulty breathing
  - Agitation or paranoia
- Know the location of medical units
- Purity & dose variation
- Sniffer dogs at every event, don’t take anything in
- Do not mix with other drugs
- Hydration & breaks in cool places





Conclusion

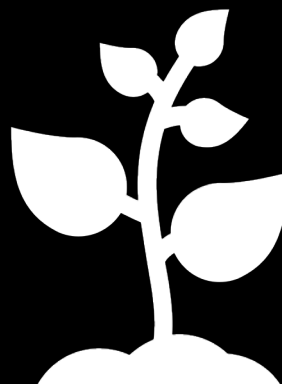
- Early age of onset has been linked with the greatest neurocognitive deficits.

- Alcohol – reduces brain activity (ST), which can lead to volume reduction for young people (LT)
- Cannabis – impacts brain connectivity
- MDMA – compromises heat loss

- The issue of causality is still to be resolved.

Harm Reduction Strategies overall

1. Open, non-judgmental conversations
2. Encourage protective factors: social-problem solving, self-efficacy, commitment to school, family time, hobbies, exercise etc.
3. Discuss risk factors: perceived support for substance use by peers, genetic predisposition, negative communication patterns, school commitment etc.
4. Explore underlying reasons why



Thank you!

The research team:

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Positive Choices

The Illicit Project