

# Effects of Alcohol and Marijuana on Teen Brain Development

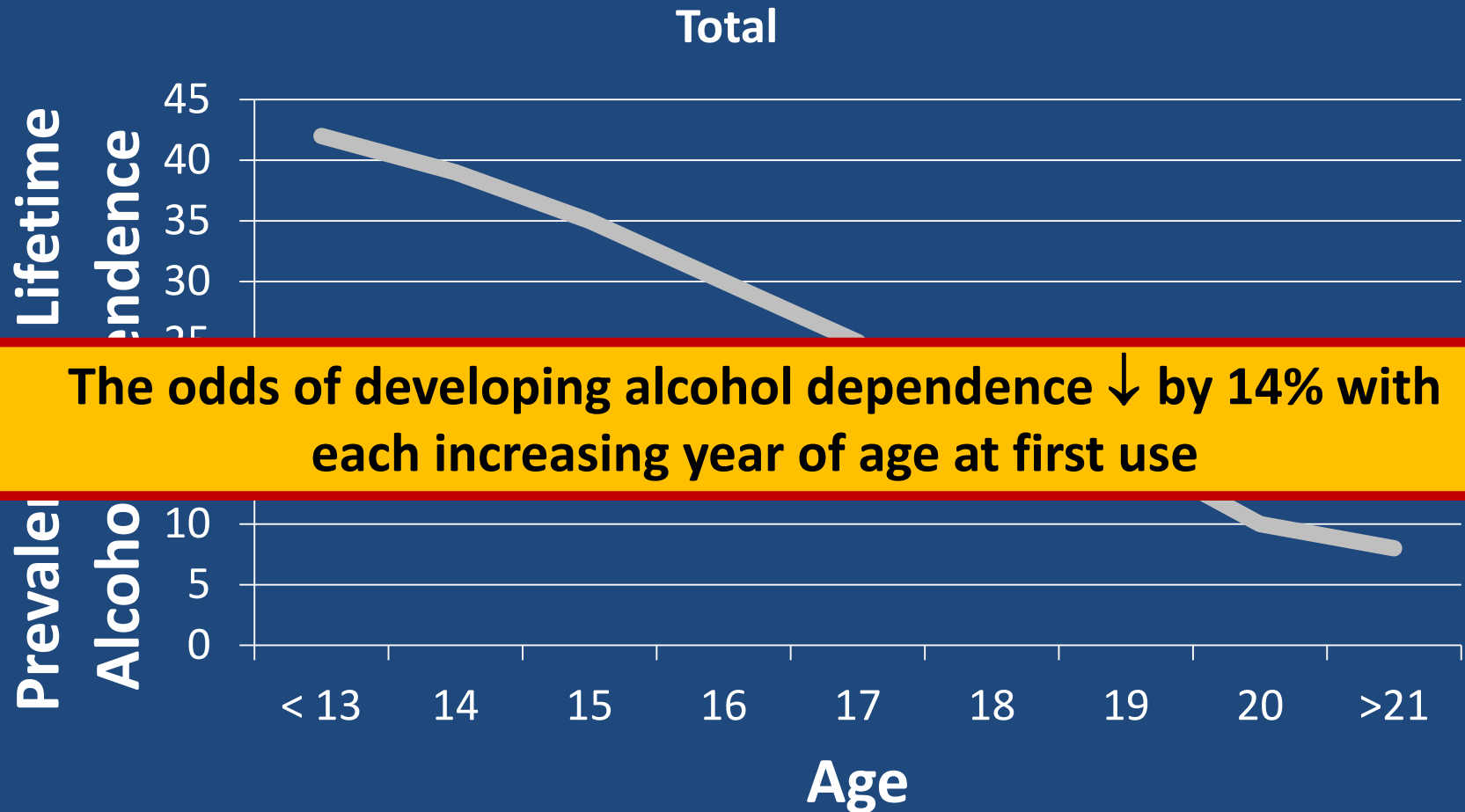


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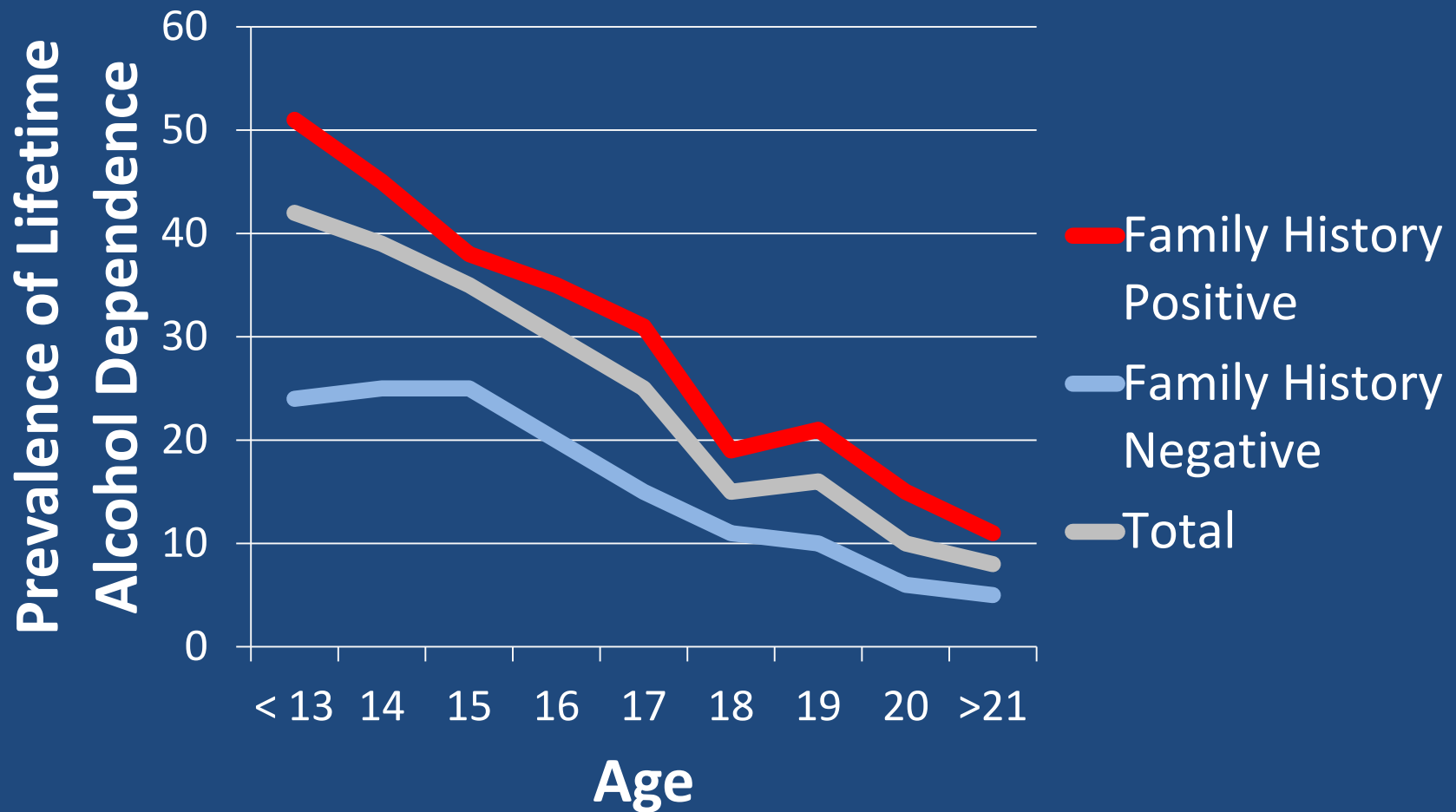
# Past Month Substance Use



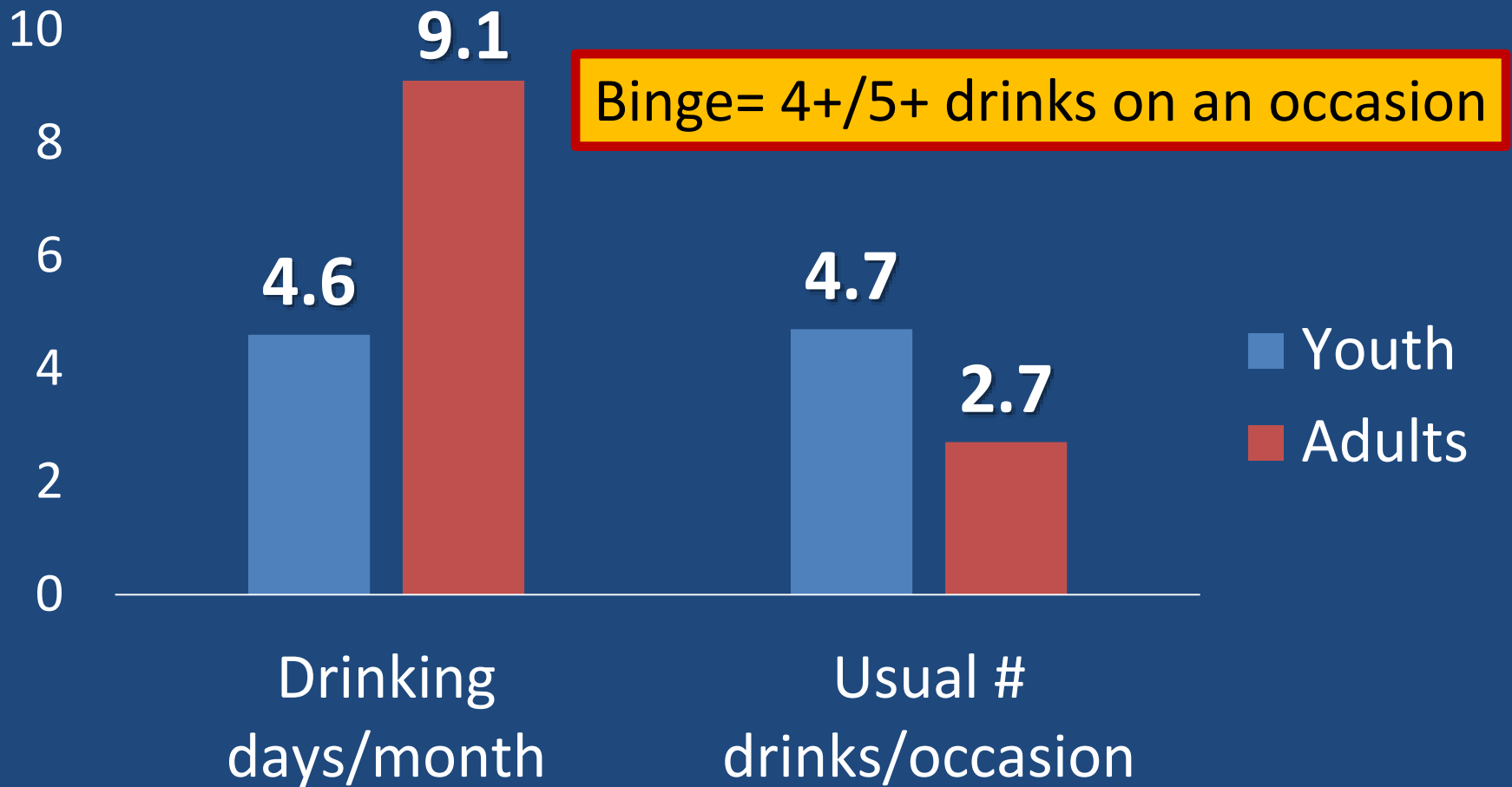
# Earlier Onset=More Problems



# Genetics Play a Role...To a Point

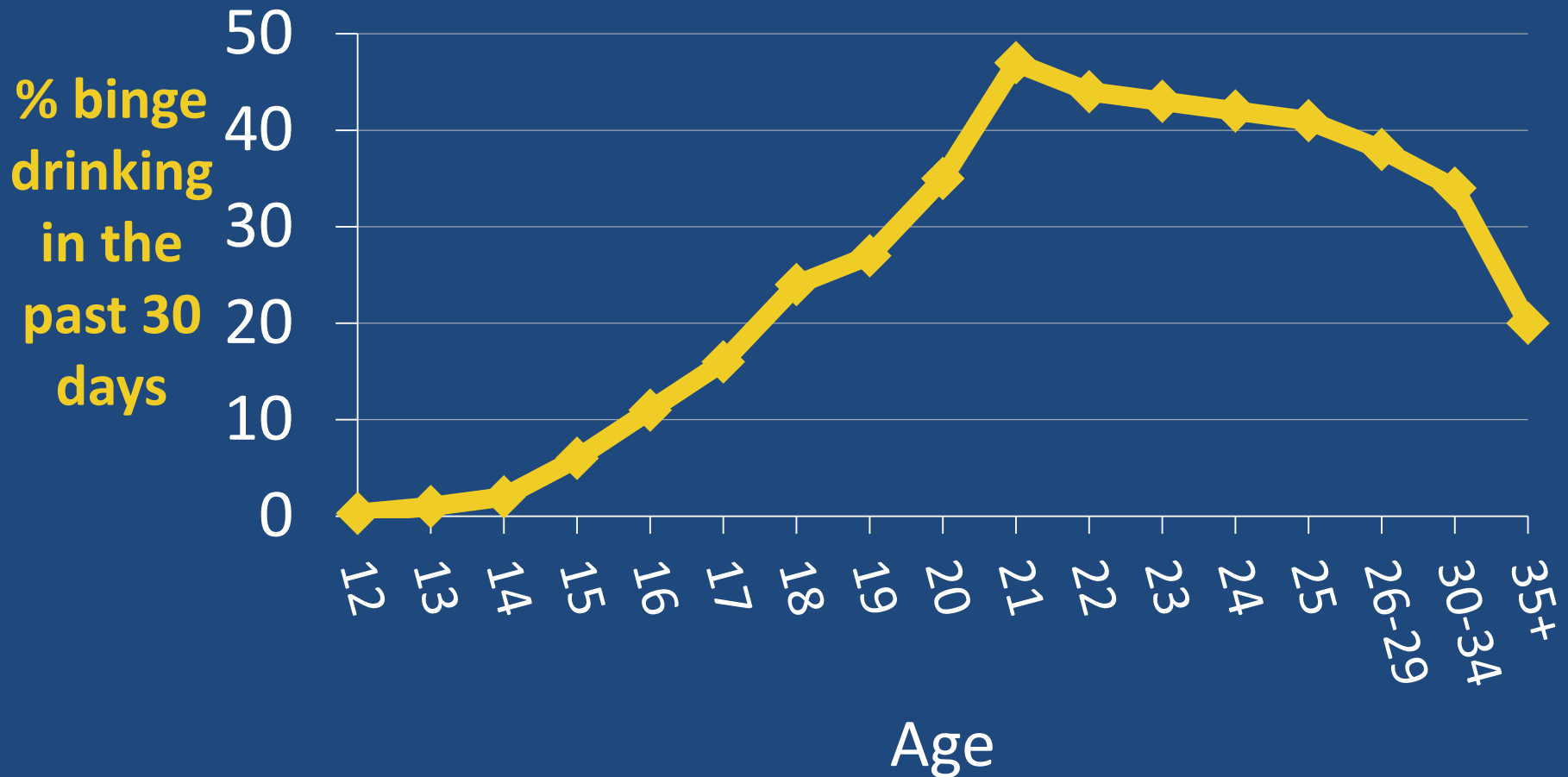


# Youth Drink ½ as often, but 2xs as much!



20% of high school seniors binge drank in the past 2 weeks!

# Binge Drinking Peaks in Young Adulthood



*2014 National Survey on Drug Use and Health*

# Alcohol's Acute Effect on Youth

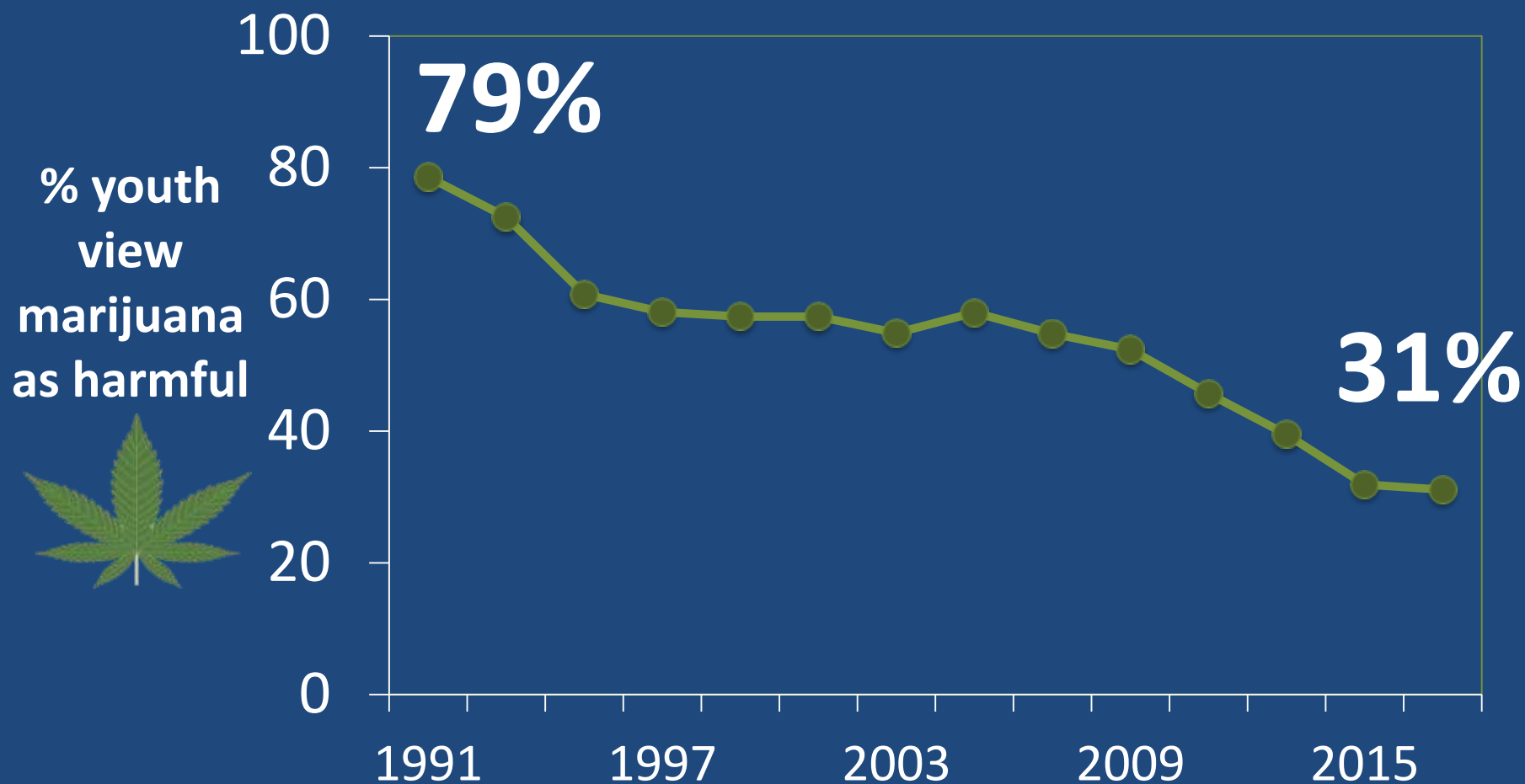
- ↓ Negative effects
  - Hangover
  - Motor impairments
- ↑ Positive effects
  - Rewarding effects
  - Social facilitation

# Marijuana Use ↑ during Adolescence

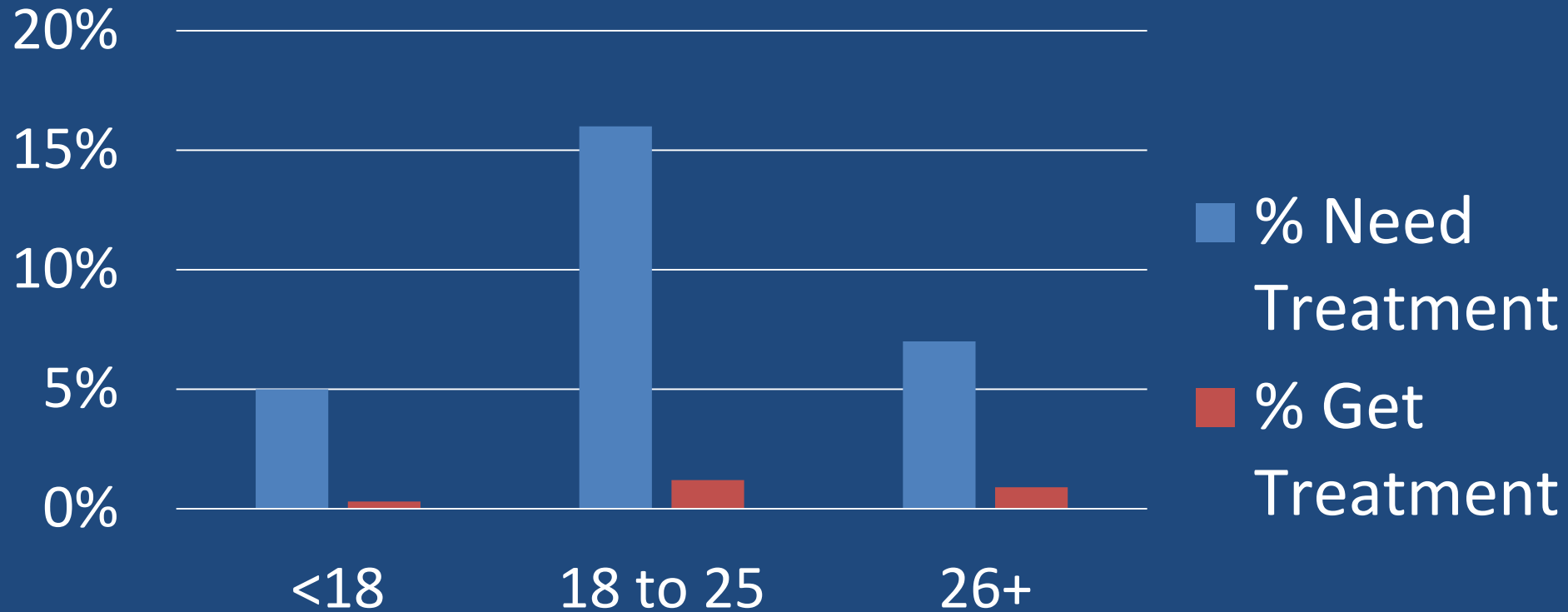




# Perception of Harm



# Substance Use Treatment



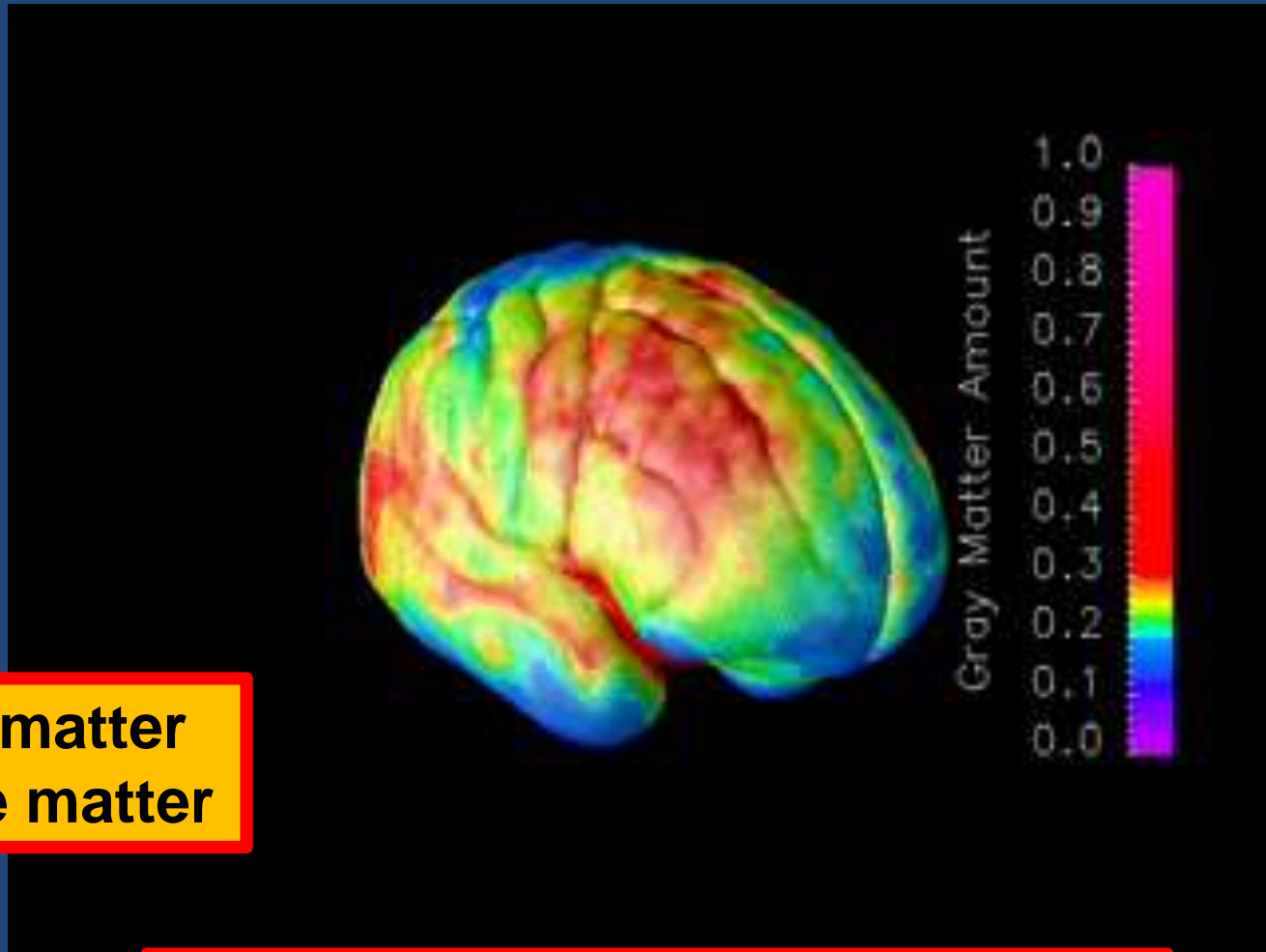
**Only 8% of population who *needs* treatment *gets* treatment!**

# Current Adolescent Substance Use Treatments

- Most do not receive evidence-based care
- 1 FDA-approved medication for adolescents:  
Buprenorphine (approved down to age 16)=Opioid Use Disorder
- Majority of evidence-based interventions are psychosocial
- Effect sizes = small to modest
- Up to 86% of youth return to alcohol or drug use within 12 months of treatment

*Brown et al, 1996; Winters et al, 2000; Jensen et al., 2011; Tripodi et al., 2010; Tanner-Smith et al., 2012; Waldron & Turner, 2008; Sussman et al., 2006*

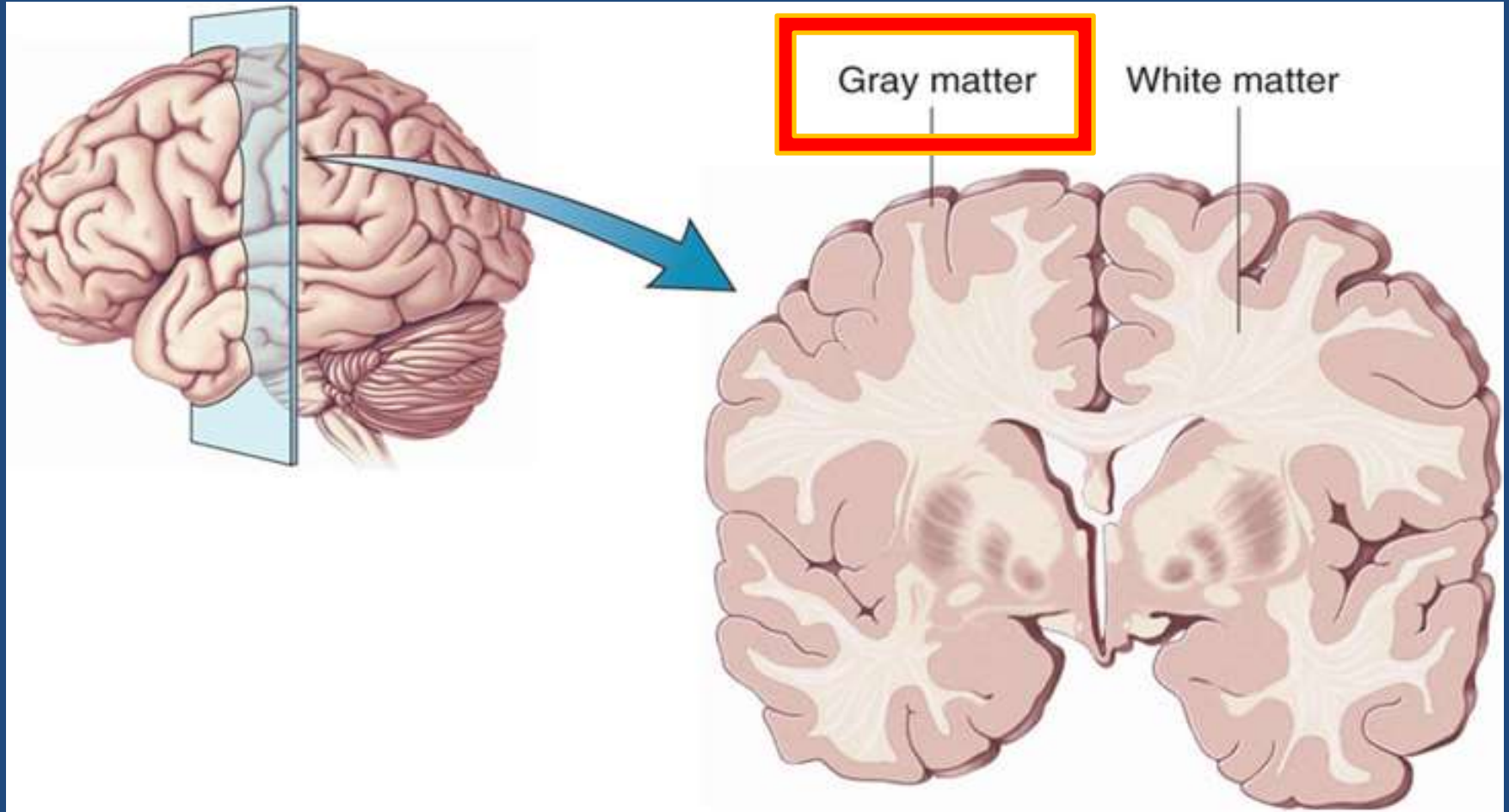
# The Developing Brain



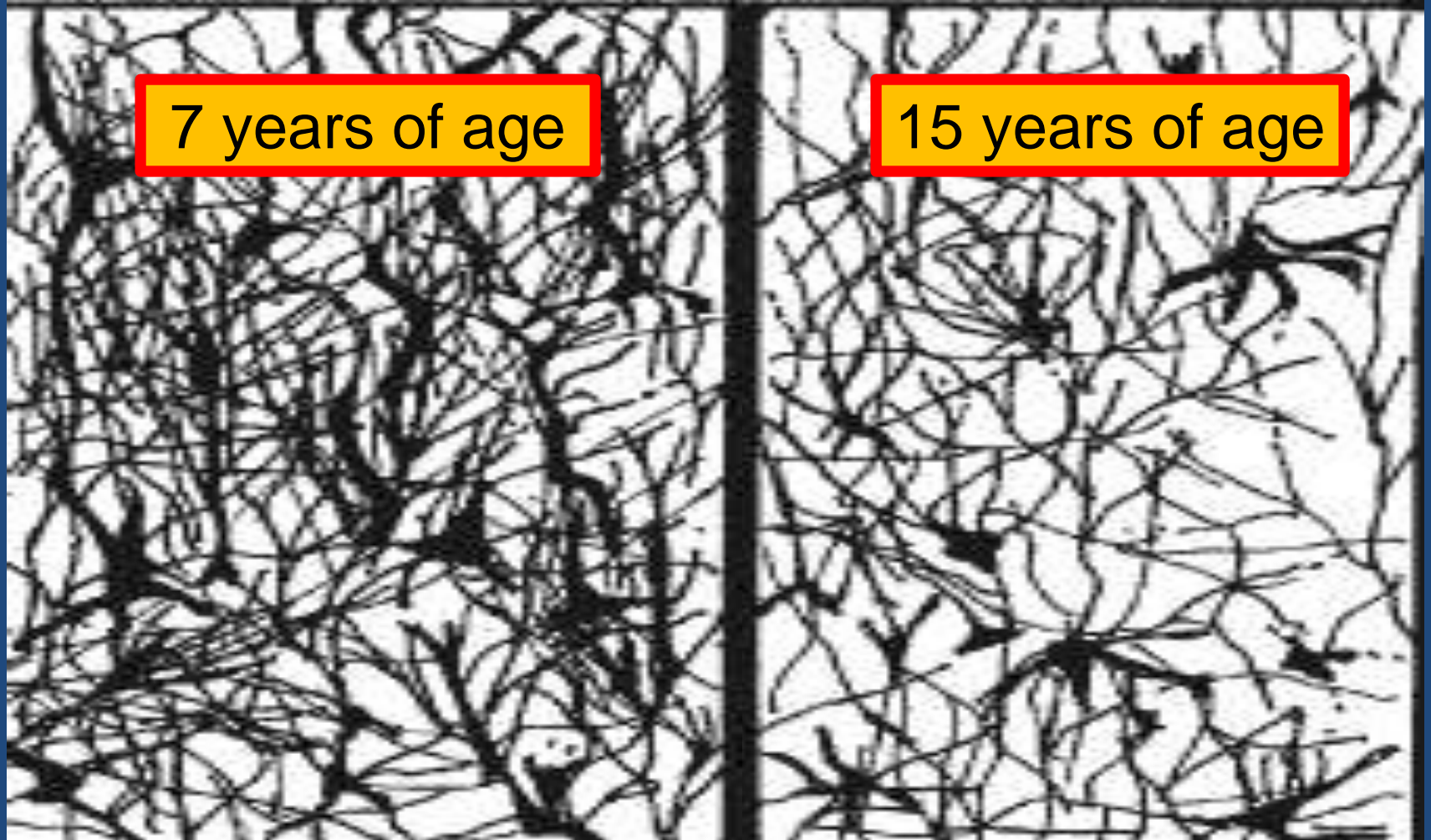
↓ Gray matter  
↑ White matter

**The brain develops until age ~25**

# Brain Basics: Gray Matter



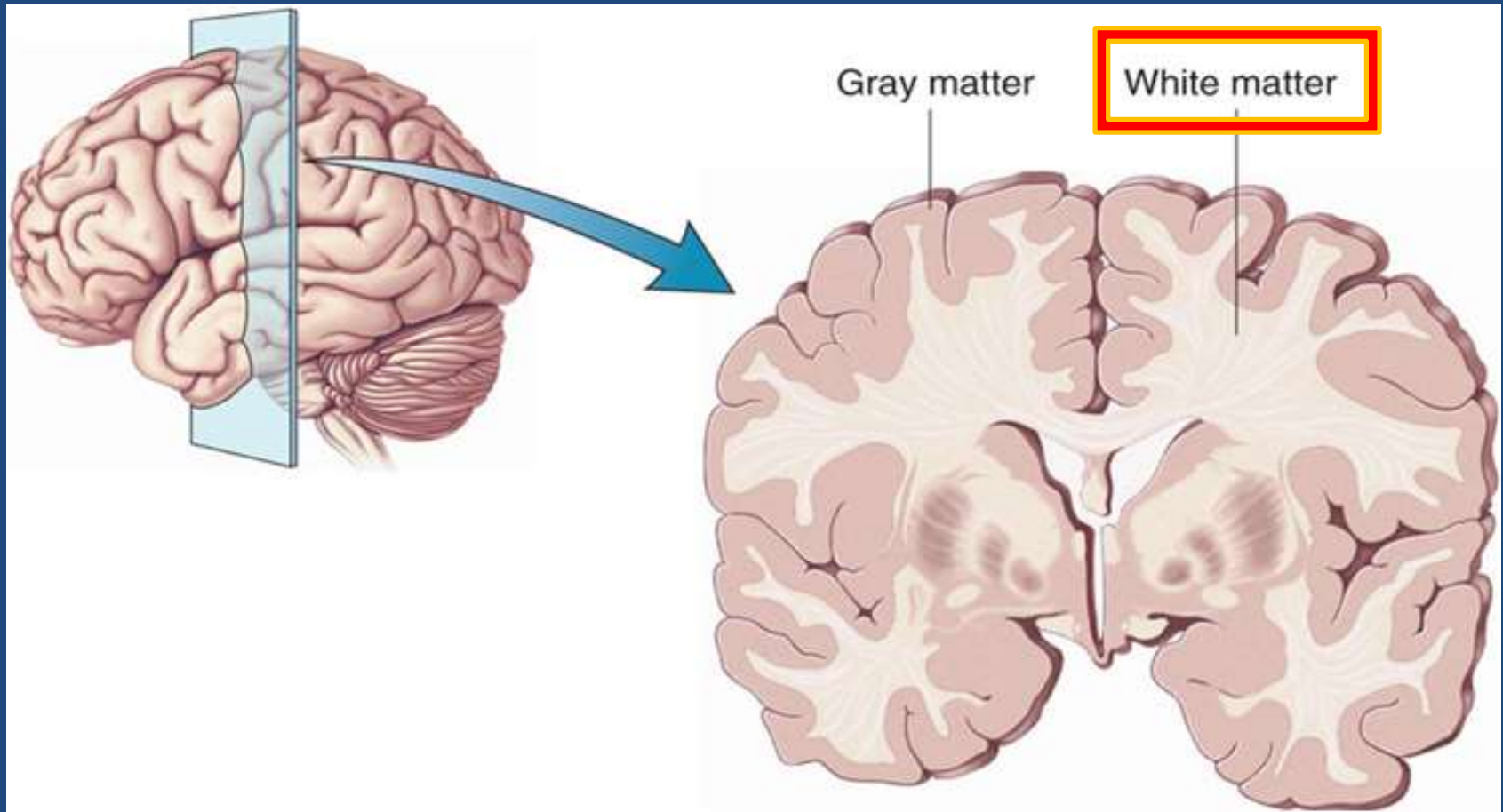
# Brain Basics: Gray Matter



Adolescence = ↓ gray matter = synaptic pruning

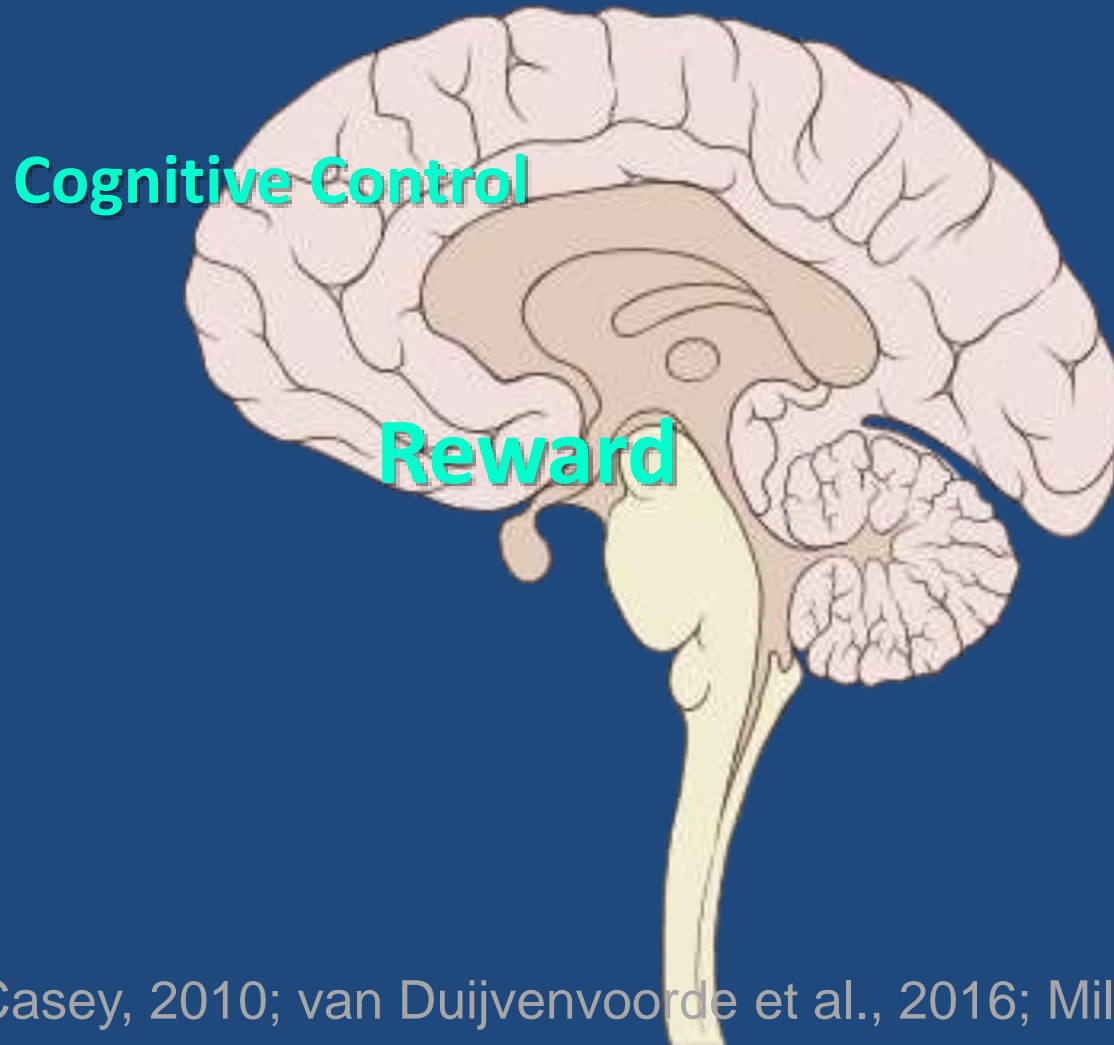


# Brain Basics: White Matter



Adolescence=  $\uparrow$  white matter = myelination

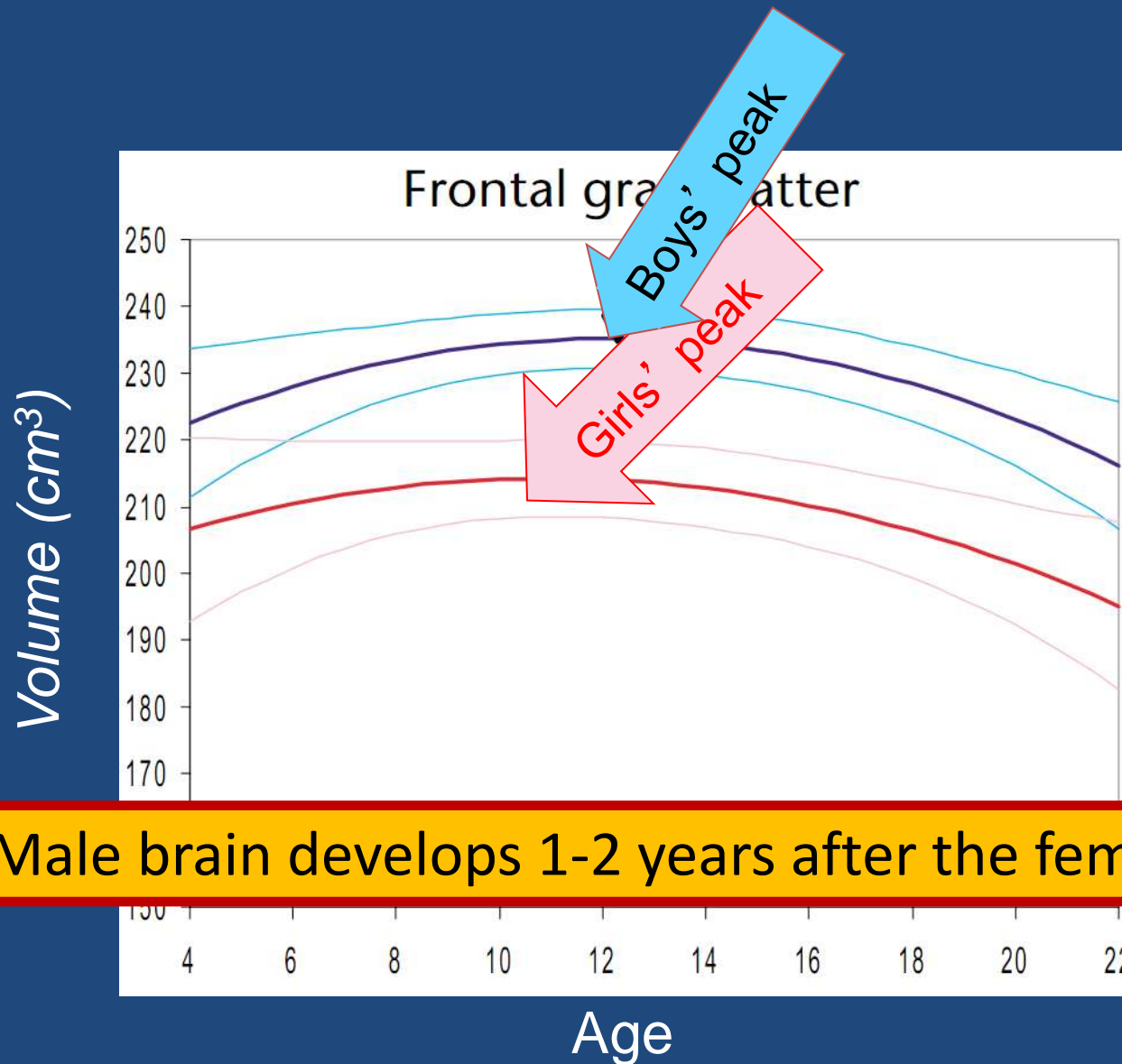
# Reward Regions Develop before Cognitive Control Regions



Somerville & Casey, 2010; van Duijvenvoorde et al., 2016; Mills et al., 2014;  
Baker et al., 2015



# Gender Differences



Male brain develops 1-2 years after the female brain!

# Important Predictors of Drinking by age 18

<b>Demographics:</b>	Male	High parent income/education	
<b>Behaviors:</b>	Dating	Conduct disorder sx's	Motion during fMRI
<b>Expectancies:</b>	+Alcohol expectancies	+Alcohol social facilitation expectancies	
<b>Neuropsych scores:</b>	More impulsive responding	Poorer cognitive control	
<b>Gray Matter:</b>	Thinner gray matter		
<b>Brain activation to working memory:</b>	Less brain activation		

# Regions Predicting Alcohol Initiation by Age 18:

**YELLOW**

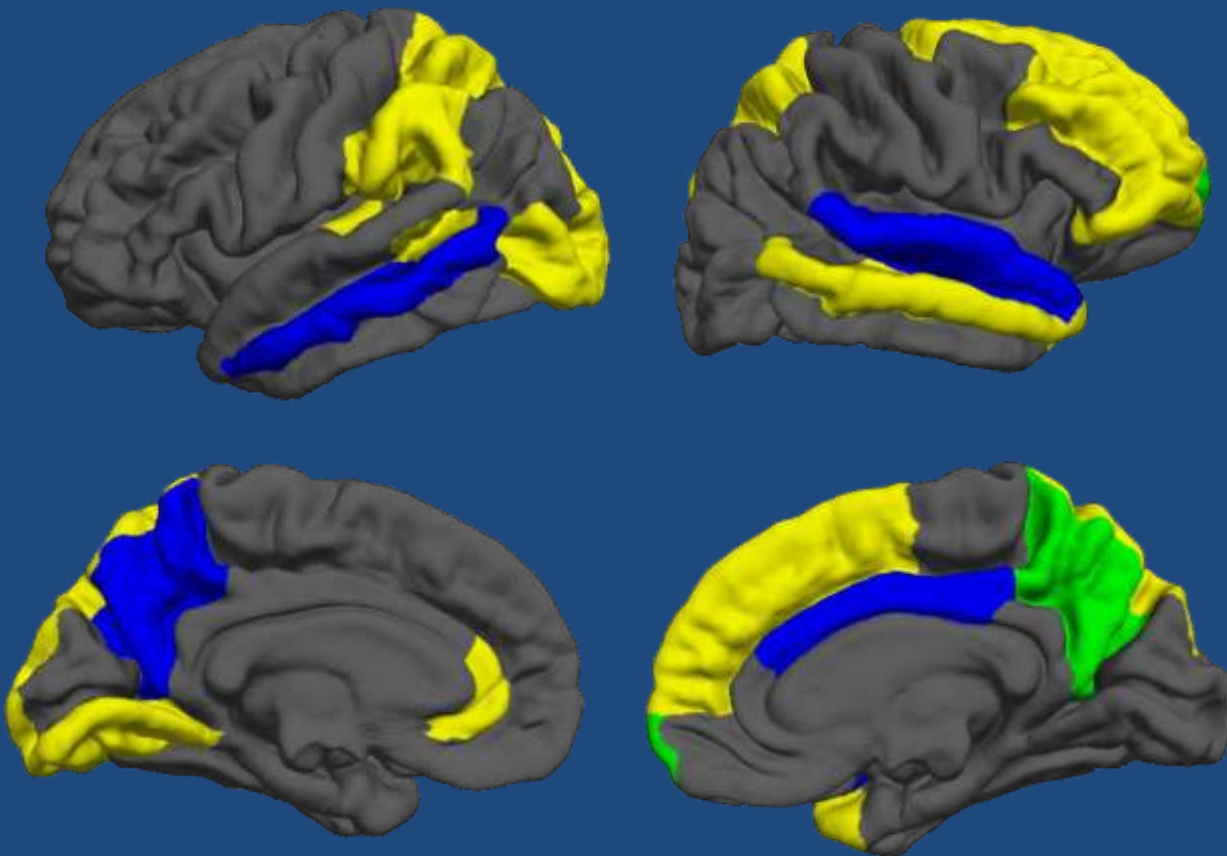
Thinner gray matter

**BLUE=BOLD**

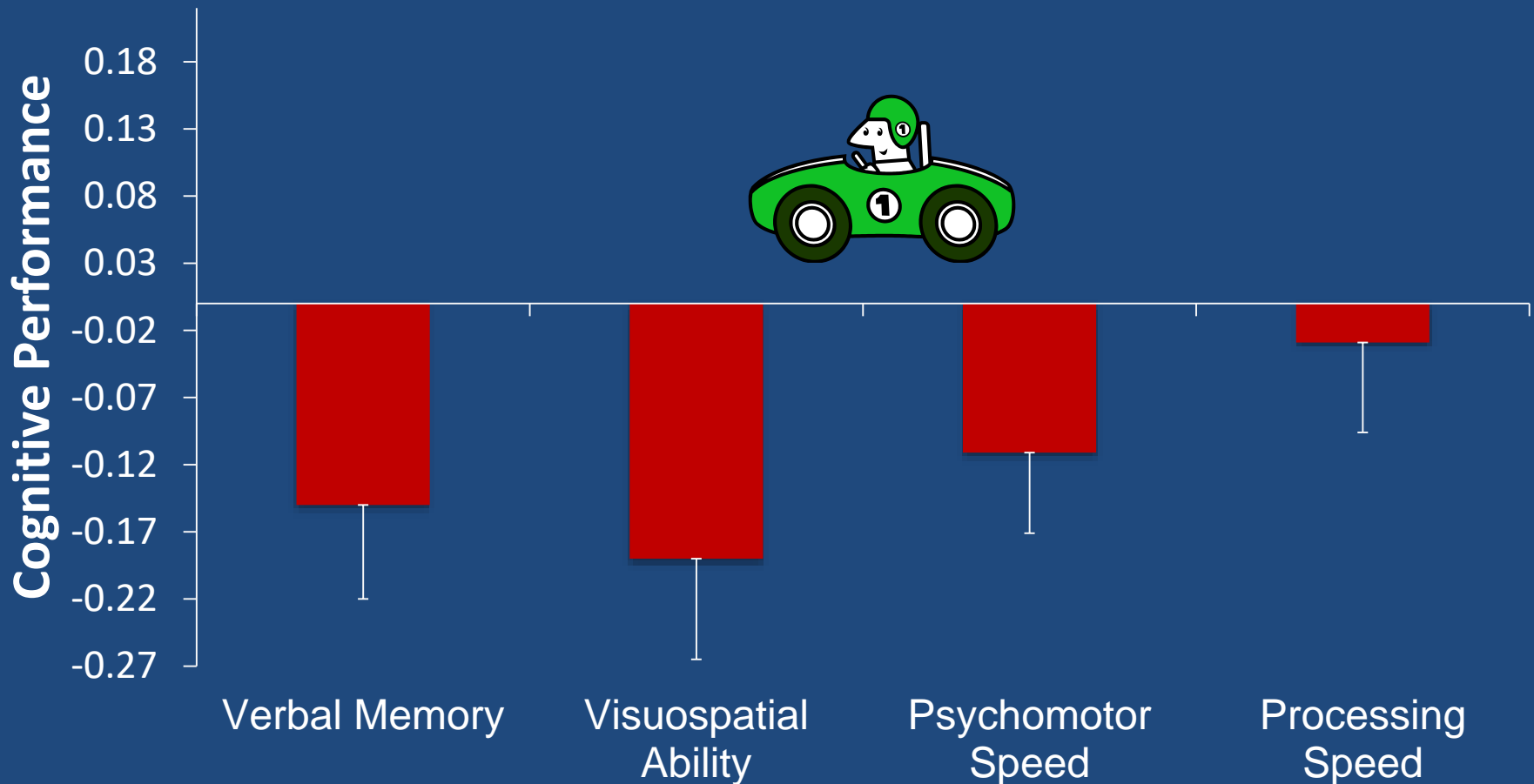
Less brain activation  
during working memory

**GREEN=both**

Thinner gray matter *and*  
less BOLD response



# Substance Use and Neurocognition



Nguyen-Louie et al., 2015, *JSAD*

# MRI

- Non-invasive
- Safe
- Structural MRI:  
measures brain structure
- Functional MRI:  
measures brain activity

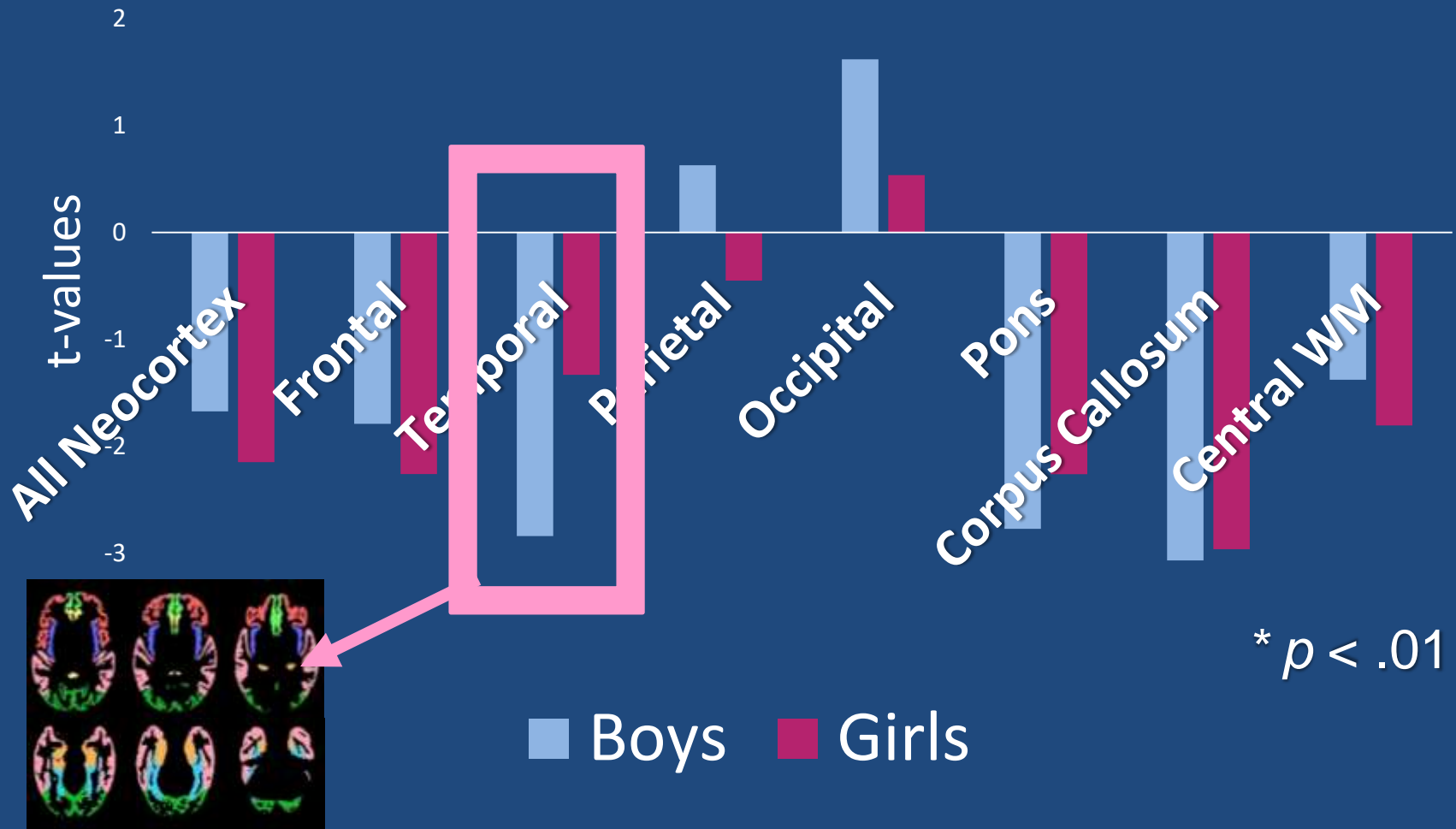


# Brain Structure and Youth Drinking

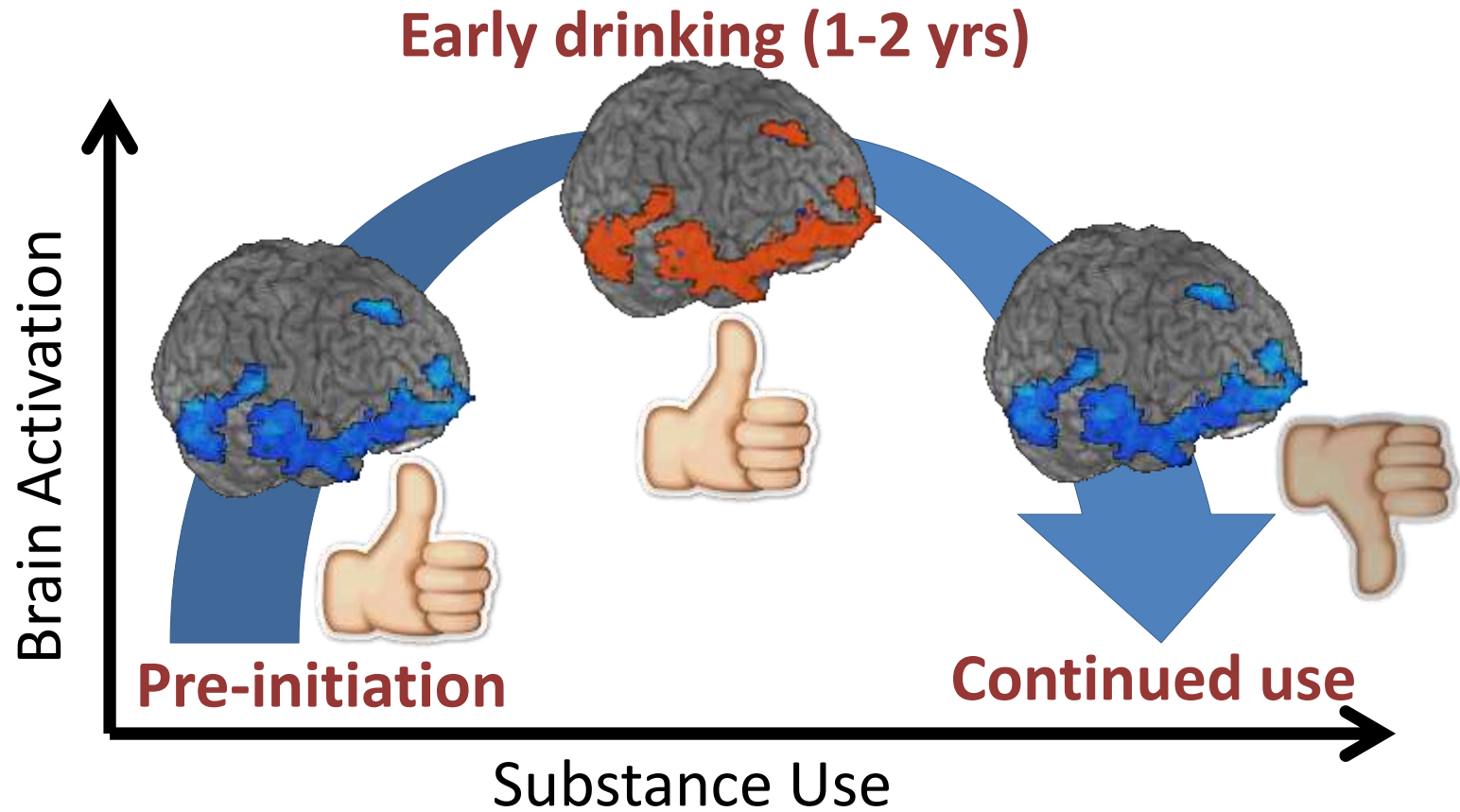


Substance Use= Greater ↓ Gray Matter, Less ↑ White Matter

# Minimal Gender Differences



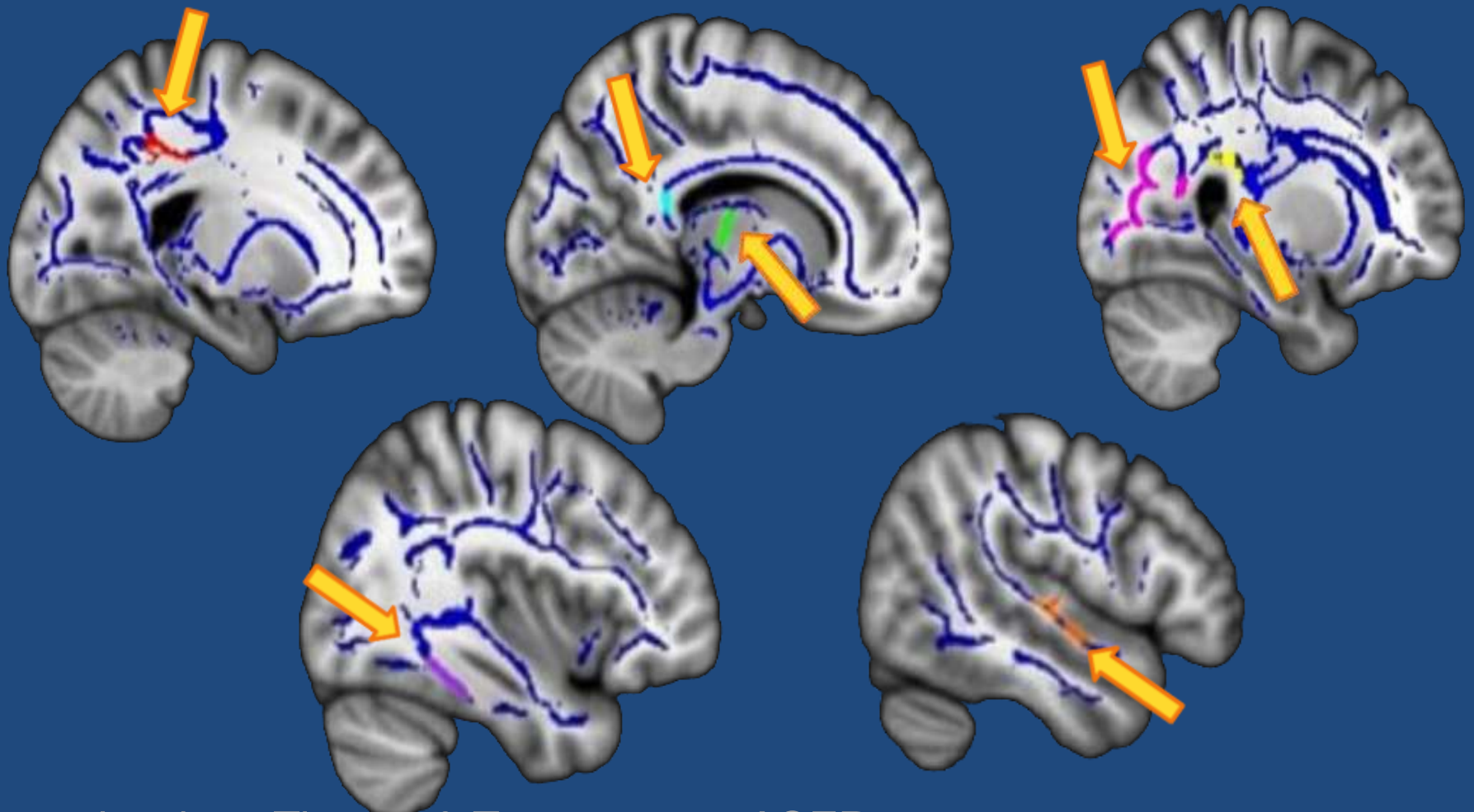
# Brain Function and Substance Use



Tapert et al., 2001, *ACER*; Tapert et al., 2004, *ACER*; Squeglia et al., 2012, *JSAD*



# Brain Structure and Youth Substance Use 🍺 🌿



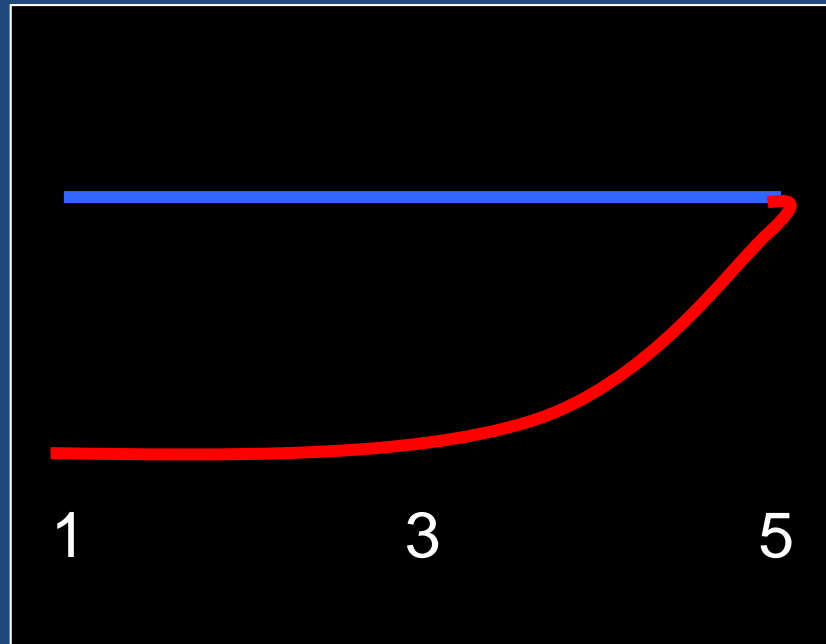
# Recovery?

Will cognition improve with abstinence?

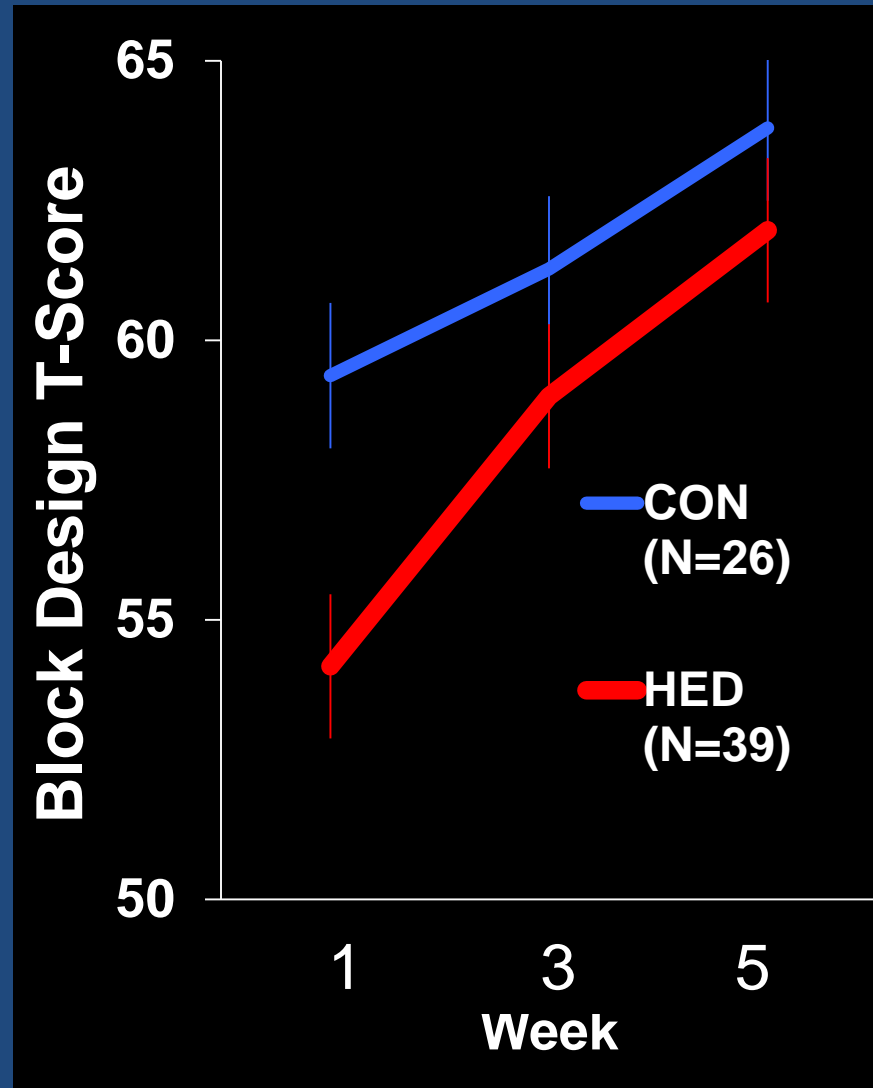
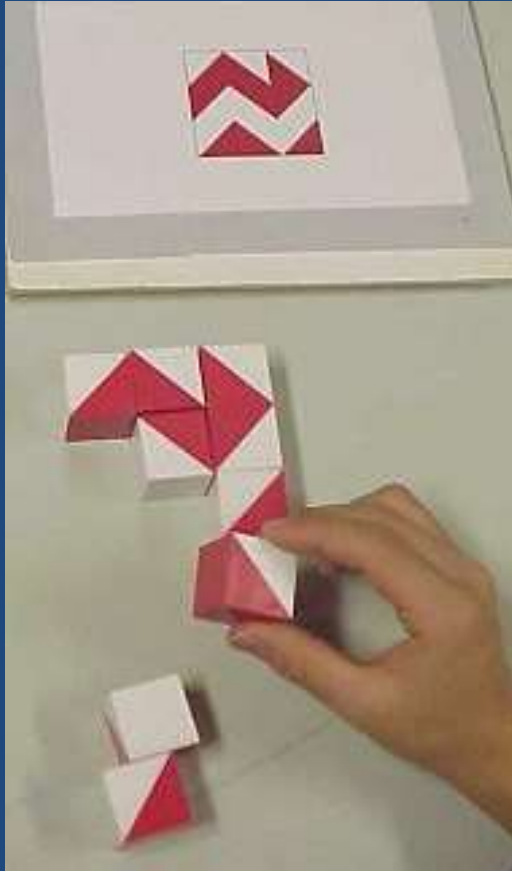
Controls

Heavy  
Drinkers

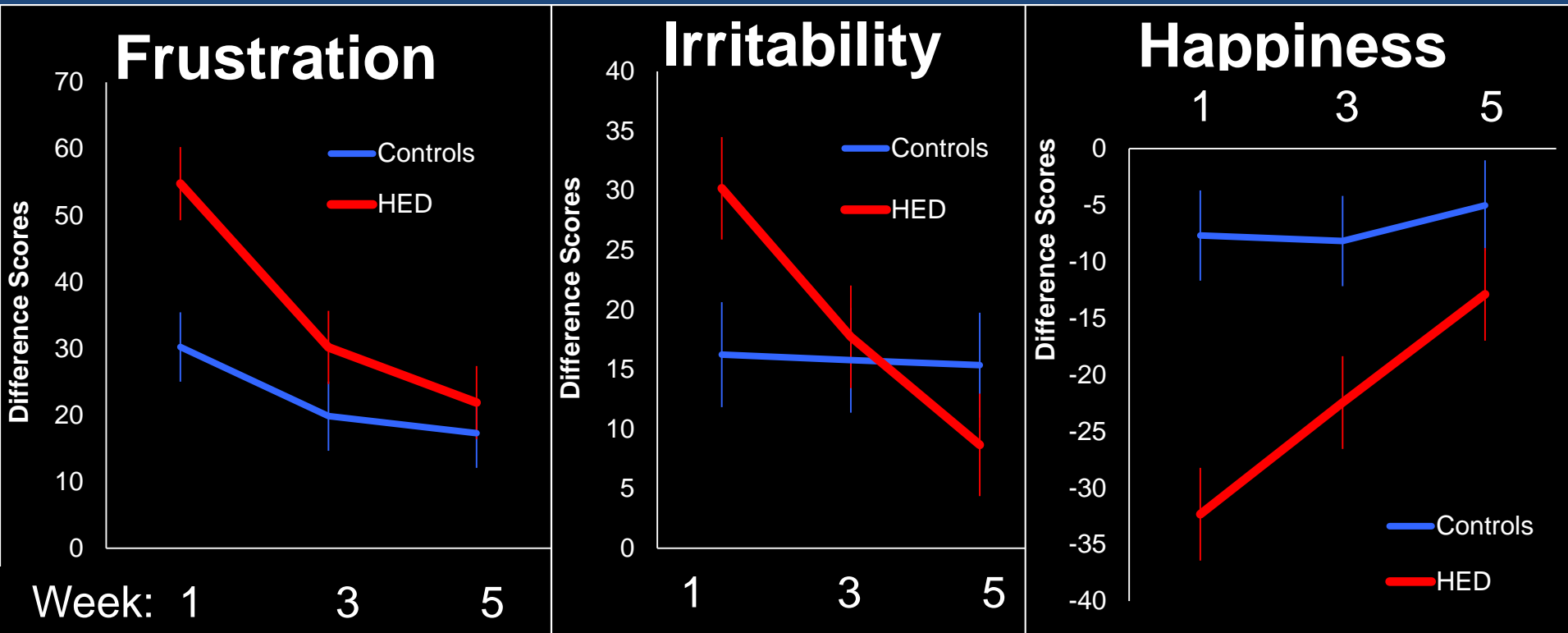
Week:



# Recovery of Spatial Skills



# Distress Tolerance: PASAT-D



# Mood Changes

- ↓ Negative mood
- ↓ Depression
- ↓ Anxiety

# Adolescent Immaturity Persists?

Adolescence



Adulthood



# Substance-Using Youth

- Before substance use

- **Demo/Behavioral:** Male, ↑ SES, early dating, ↑ + expectancies, ↑

- **Neuropsych:** vs control

- **Structural:**

- **Functional:**

- After substance use

- **Neuropsych:** spatial functioning, attention, memory, processing speed

- **Structural:** Greater ↓ gray matter, less ↑ white matter

- **Functional:** ↑ compensatory brain activation during early drinking



# Parents Should:

☑ Talk to youth!

Adolescents whose parents talk to them about alcohol use are **42% less likely** to drink than teens who parents do not.



# Parents Should Not:

- ☒ Take the permissive approach
- ☒ Think effects are only temporary!

# Summary

- Substance use disorder is a developmental disorder
- Neural differences exist BEFORE and AFTER youth start to use alcohol and marijuana
- There is SOME recovery with abstinence
- Talk to youth, delay drinking/drug use age



# Adolescent Brain Cognitive Development<sup>SM</sup>

*Teen Brains. Today's Science. Brighter Future.*

For More Information, Please Visit:

[ABCDStudy.org](http://ABCDStudy.org)

# Research Objectives

- Describe individual developmental trajectories (e.g., brain, cognitive, emotional, academic), and the factors that can affect them.
- Develop national standards of healthy brain development.
- Investigate the roles and interaction of genes and the environment on development.
- Study how physical activity, sleep, screen time, sports injuries, and other experiences affect brain development.
- Examine the factors that influence the onset, course, and severity of mental illnesses.
- Understand the relationship between mental health and substance use.
- Study how use of different substances (caffeine, nicotine, alcohol, marijuana) affects developmental outcomes, and vice versa.

Adolescent Brain Cognitive Development<sup>SM</sup>

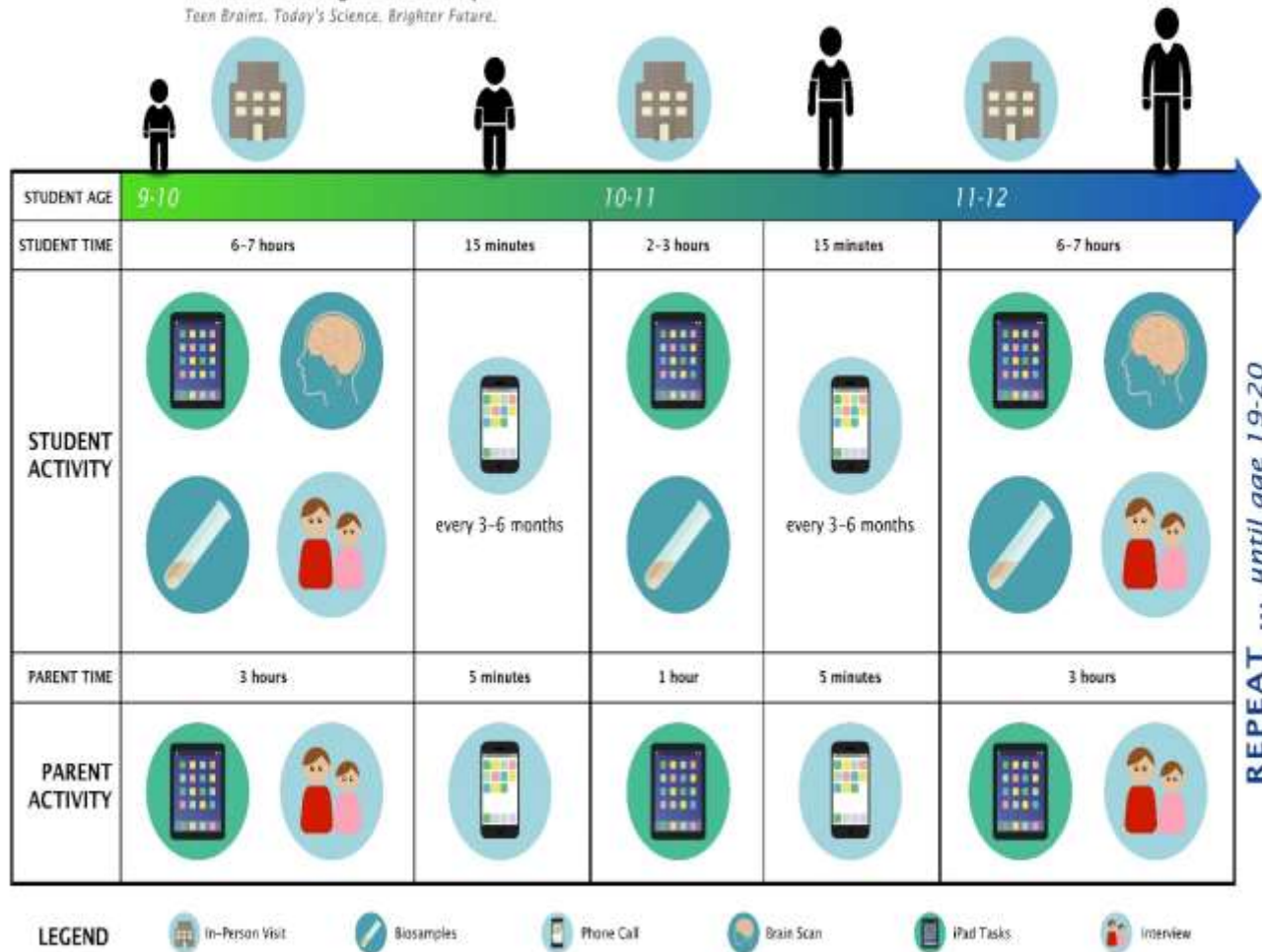
Teen Brains. Today's Science. Brighter Future.



**Adolescent Brain Cognitive Development**  
*Teen Brains. Today's Science. Brighter Future.*

# ABCD Study

## TIMELINE OF EVENTS



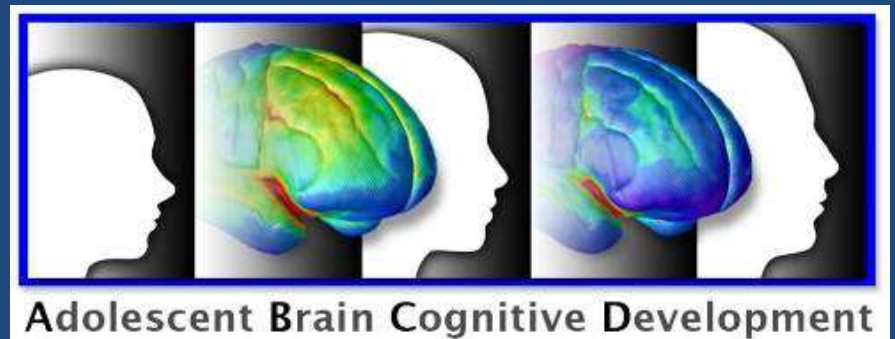
# Further Questions?

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# Considerations

- Heterogeneity in patterns of substance use
- Co-use of other drugs; understand less frequently used drugs
- More diverse samples needed
- Interactive effect w/:
  - ADHD, depression, anxiety
  - Genetics
  - Sleep habits
  - Age of initiation



# Teen Alcohol Use is an Important Public Health Issue!

Excessive drinking leads to:

- ↑ mortality (shortened lives by ~30 years)
- \$224 billion in costs (\$1.90 per drink)
- Earlier sexual activity, risk for STDs
- Violent behaviors
- Academic difficulties, school drop out

Alcoholism is a **developmental disorder**