



Reframing the Conversation  
Talking to Teens about Addiction  
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Yale University

Image source: NIDA

# Faculty Disclosure Information

- In the past 12 months, I have had no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial service(s) discussed in this CME activity.
- Funding Sources: National Institutes of Health, Health Resources and Services Administration, Substance Abuse and Mental Health Services Administration.
- I do not intend to discuss an unapproved/ investigative use of a commercial product/ device in my presentation.

# Session Objectives

1. List 3 ways the brain changes during adolescence
2. Describe the current evidence around the impact of substances on the neurobiology of the adolescent brain and development of addiction
3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.



# Adolescence

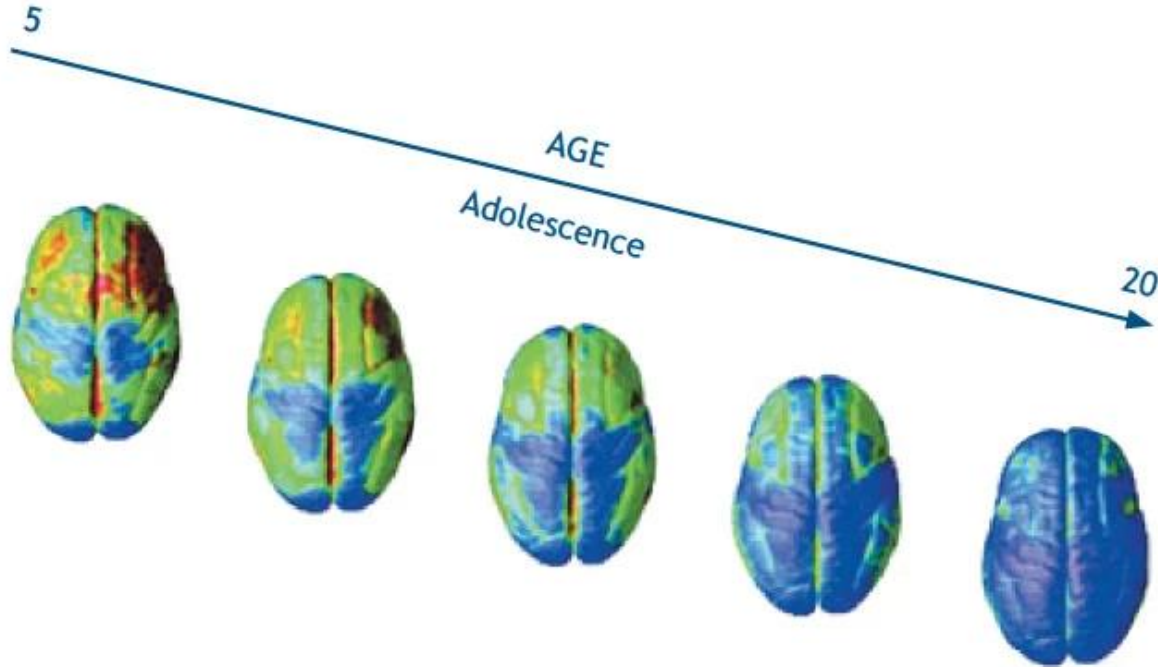
Derived from the Latin term

“*adolescere*”



To grow up or grow into maturity

# Adolescence



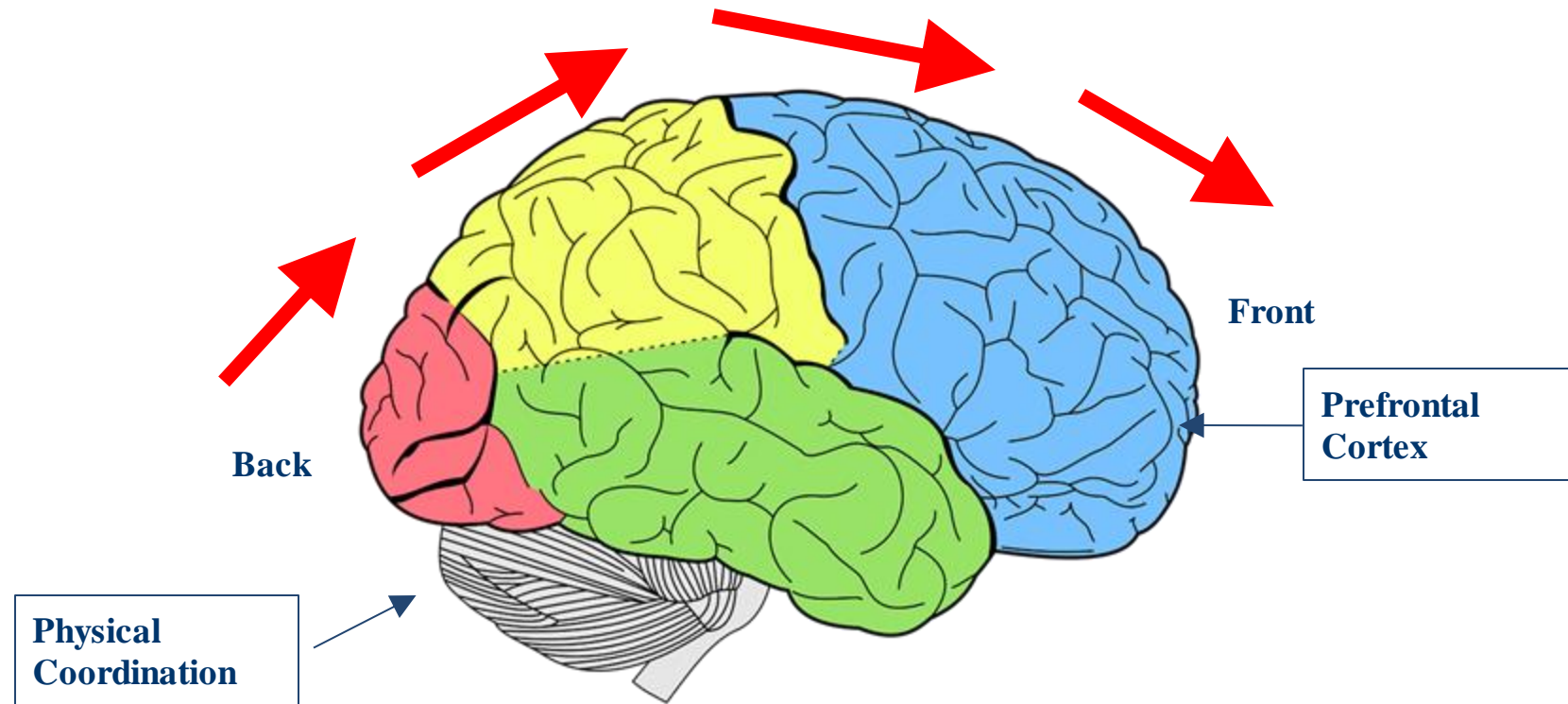
Gogtay et al. Dynamic mapping of human cortical development during childhood through early adulthood. Proceedings of the National Academy of Sciences May 2004, 101 (21) 8174-8179

Marked by changes in

- Brain structure
- Function
- Connectivity

THE ADOLESCENT BRAIN

# IS GROWING (A LOT)



Source: Stanford Cannabis Awareness and Prevention Toolkit

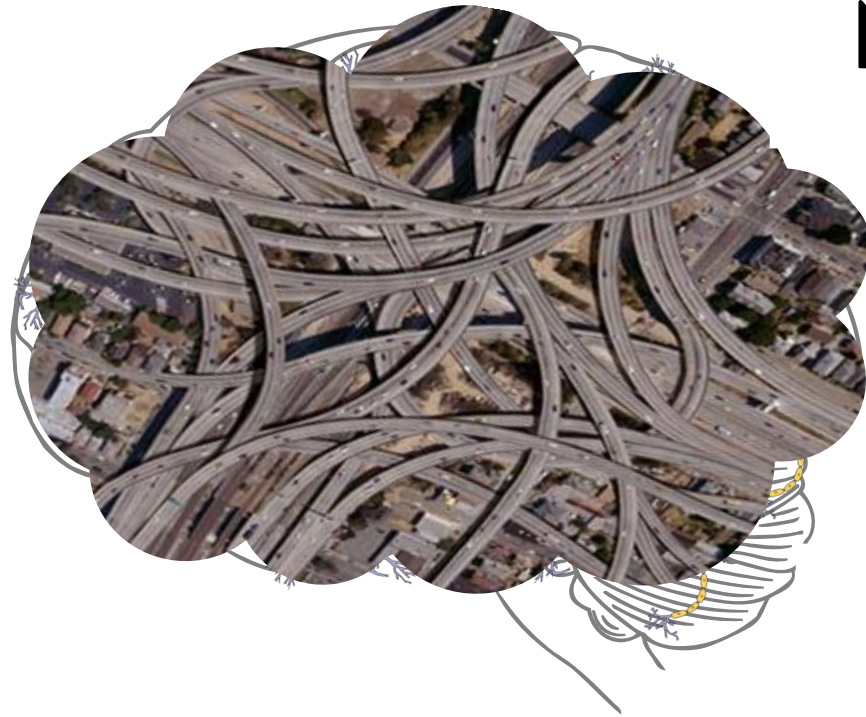
Image Credit: Pixabay.com

Reference: <http://www.drugfree.org/why-do-teens-act-this-way/adolescent-brain-and-behavior>

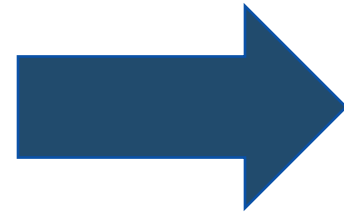
# Change 1: Synaptic Pruning & Myelination

**Teen**

**Mid-20s**

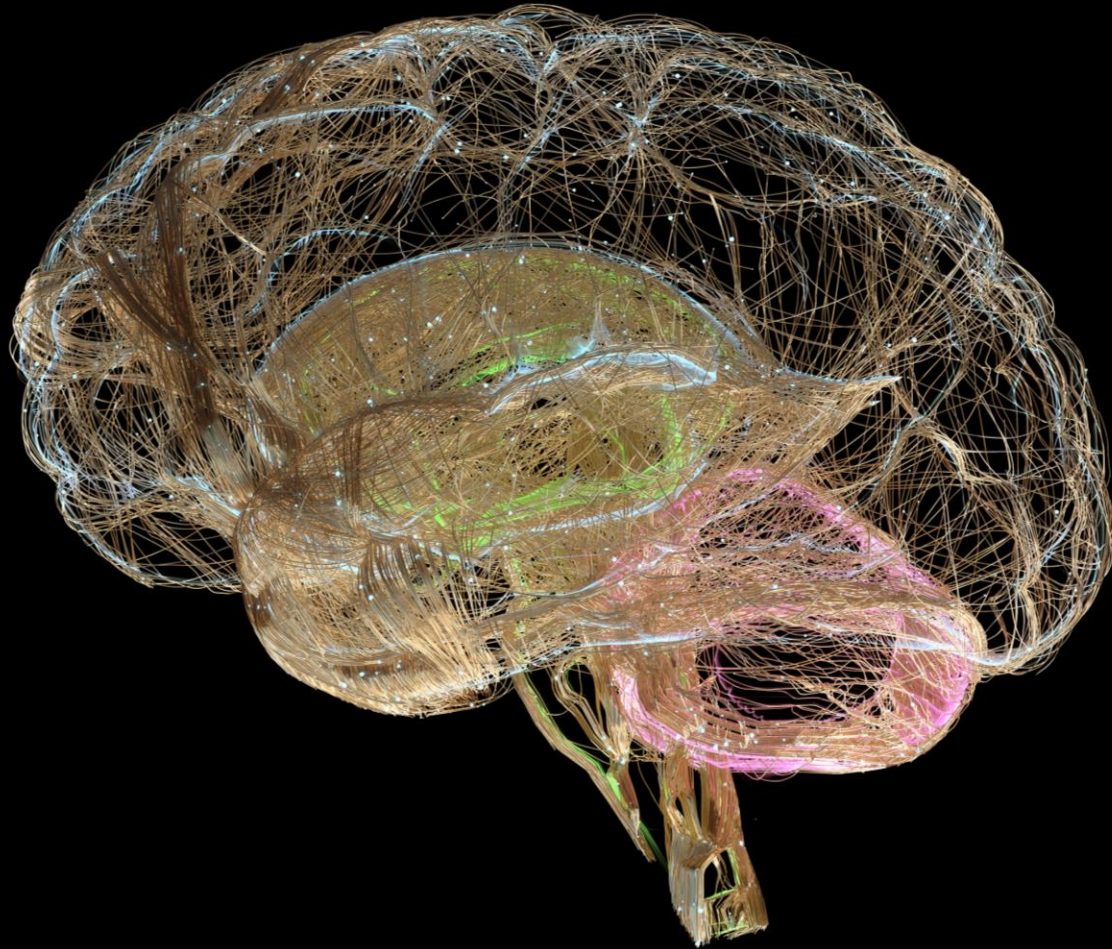


Myelination



Synaptic Pruning





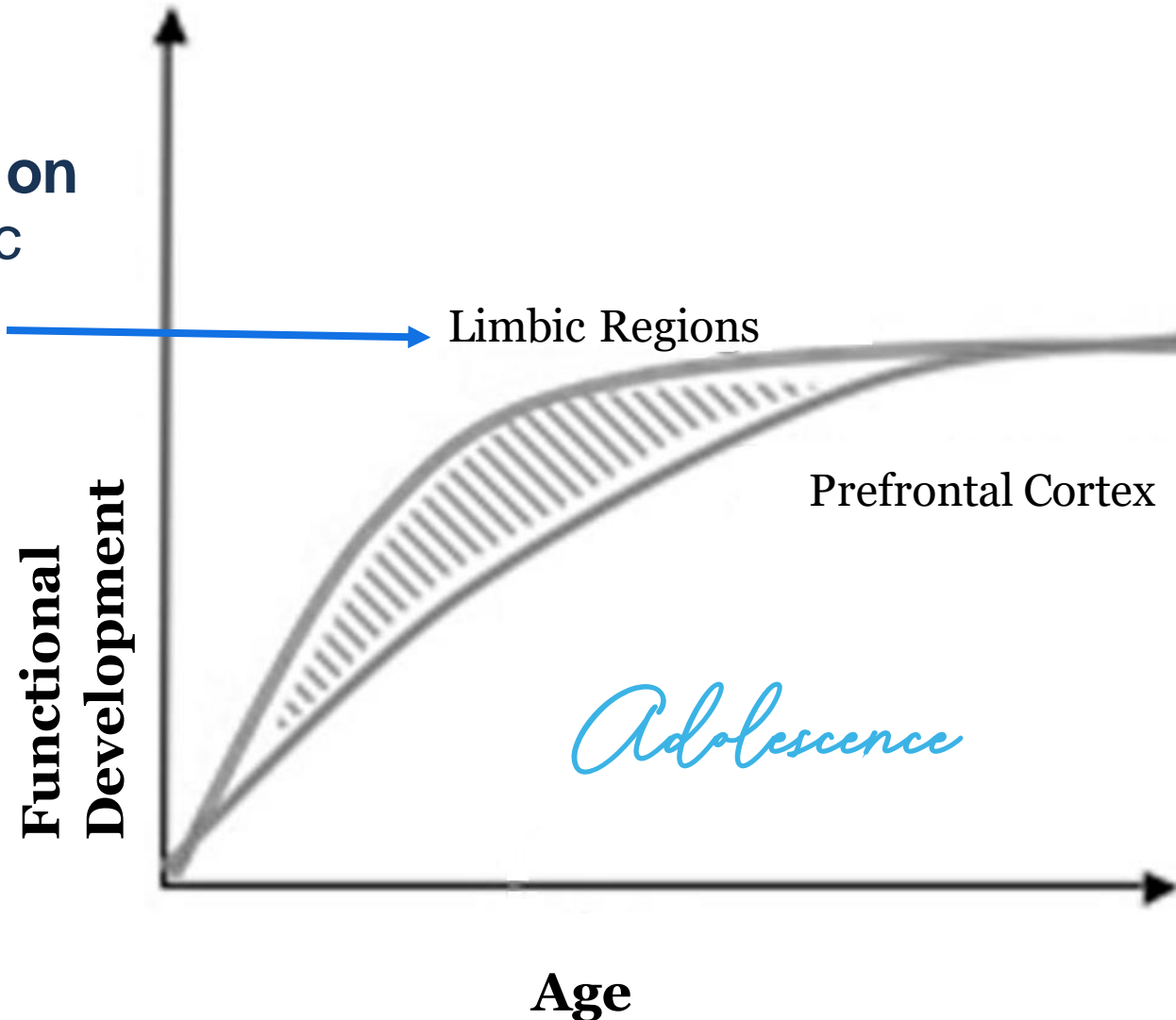
## **Change 2:**

**Improved connectivity between  
the pre-frontal cortex and limbic  
regions**

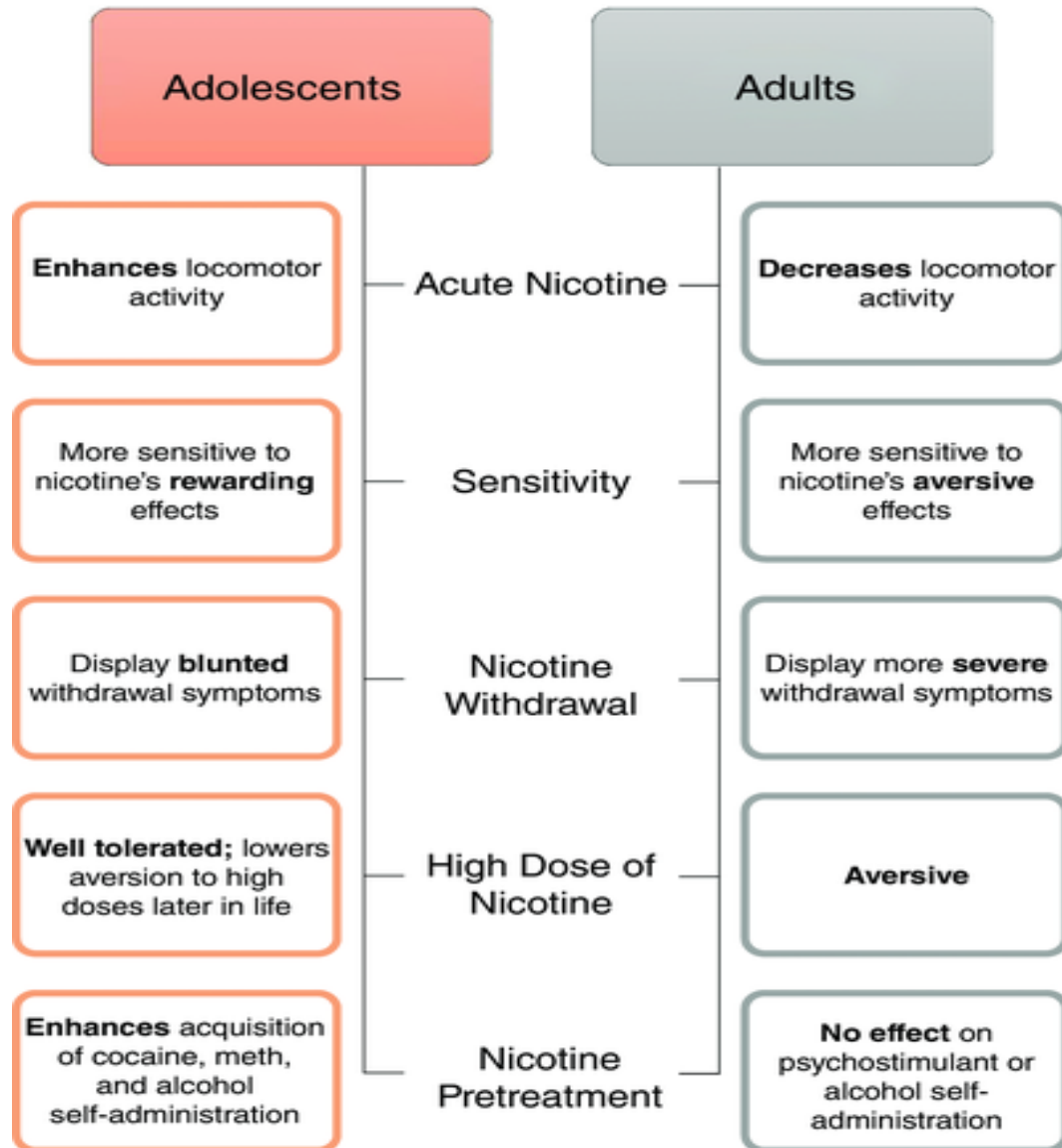


# Asynchronous development

**Early maturation**  
of dopaminergic  
systems in the  
limbic regions



**Later maturation** of  
innervation between the  
dopaminergic regions  
and prefrontal cortex.



# Asynchronous development leads to:

A unique sensitivity to drug initiation

# Asynchronous development leads to:

- Propensity to explore new things and take risks
- The development of the cognitive, social, and emotional skills for adulthood



- **Complex problem-solving skills**
- **Creativity**
- **Deep Learning**

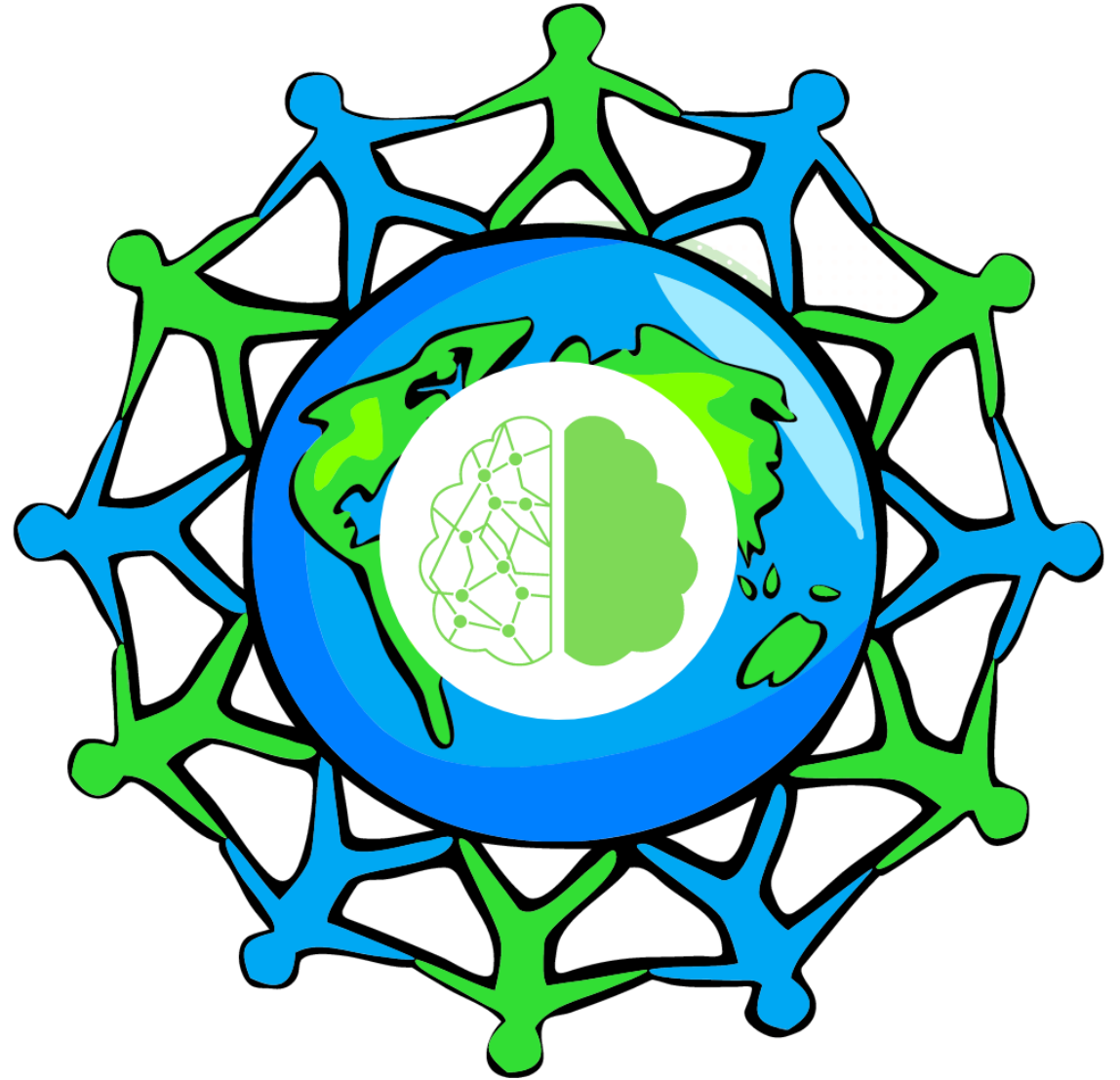


# Change 3: Neuroplasticity

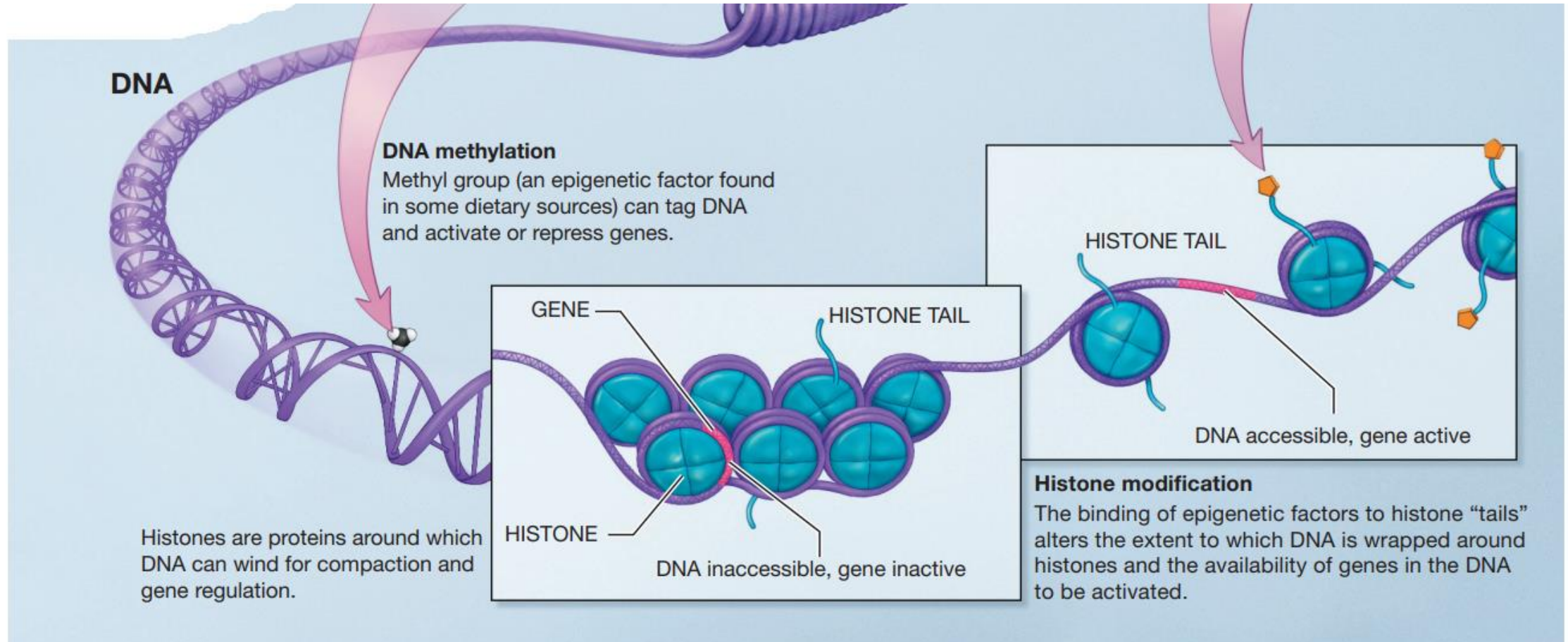
“The ability of the nervous system to **change** its activity in response to stimuli by **reorganizing** its structure, functions, or connections.”



# **The Adolescent Brain is Designed to Adapt to the Environment**



# Epigenetics - The environment influences how genes are expressed



# Epigenetics - The environment influences how genes are expressed across the life course

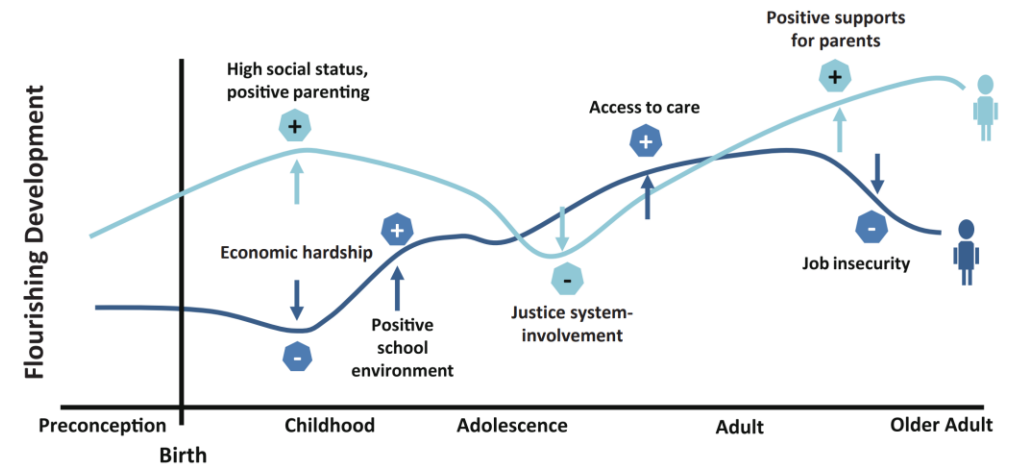


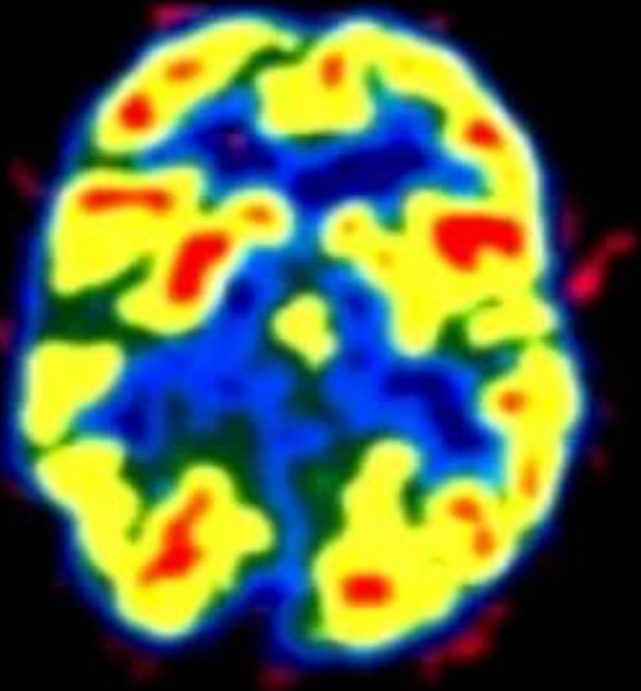
FIGURE 3-2 Epigenetic life-course perspective: Preconception to older adult.  
SOURCE: Adapted from Halfon et al. (2014, p. 352).



# Session Objectives

1. List 3 ways the brain changes during adolescence
  1. Synaptic Pruning & Myelination
  2. Connectivity
  3. Neuroplasticity and Epigenetics
2. Describe the current evidence around the impact of substances on the neurobiology of the adolescent brain and development of addiction
3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.

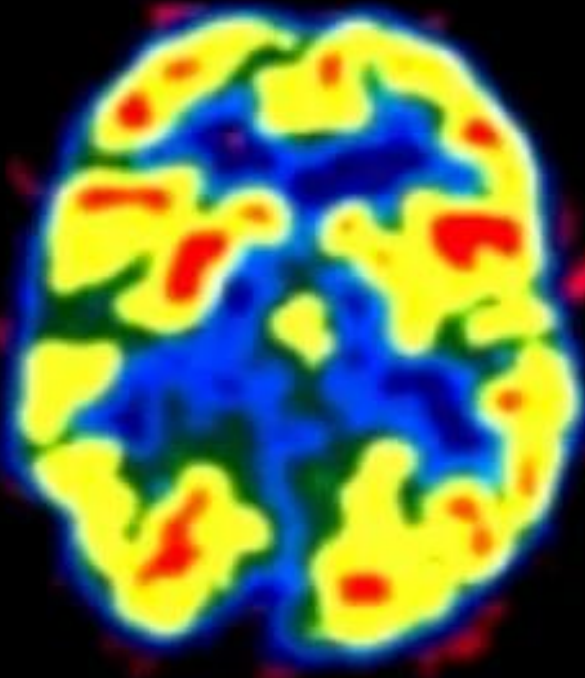




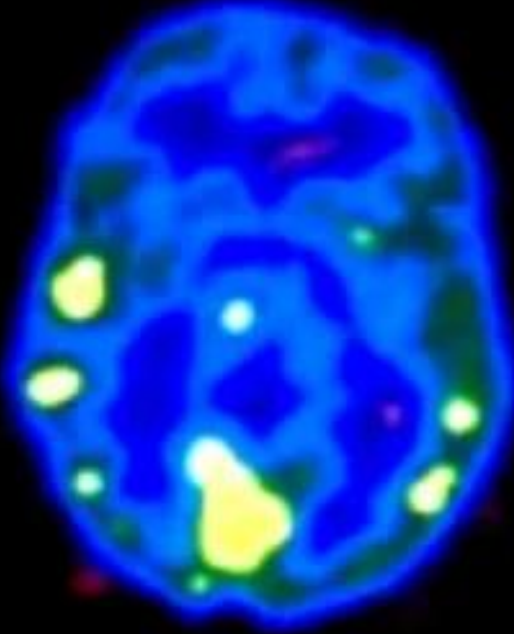
NORMAL  
BRAIN ACTIVITY

## Positron emission tomography (PET) scan

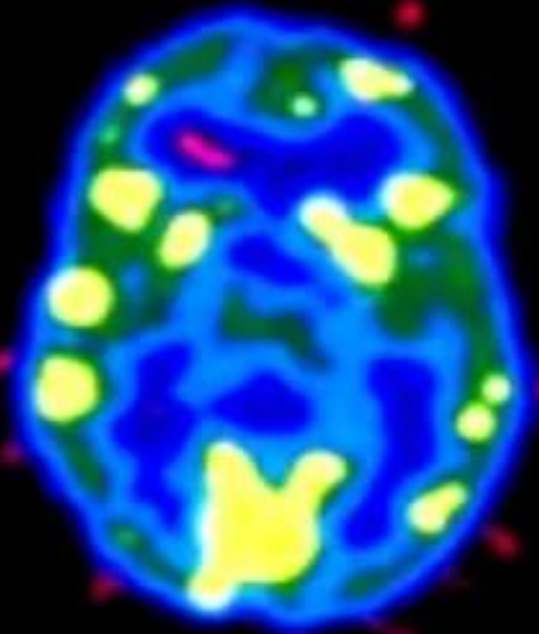
- Measures brain activity by measuring Glucose utilization
- Red= high glucose utilization
- Yellow= Medium
- Blue=Low



NORMAL  
BRAIN ACTIVITY



**10 days abstinent**



**100 days abstinent**

Cocaine Exposed Brain

# Brain Regions

Affected by Drug Exposure

## Prefrontal Cortex

9 Functions of the Prefrontal Cortex

1. Empathy
2. Insight
3. Response Flexibility
4. Emotion Regulation
5. Body Regulation
6. Morality
7. Intuition
8. Attuned Communication
9. Fear Modulation



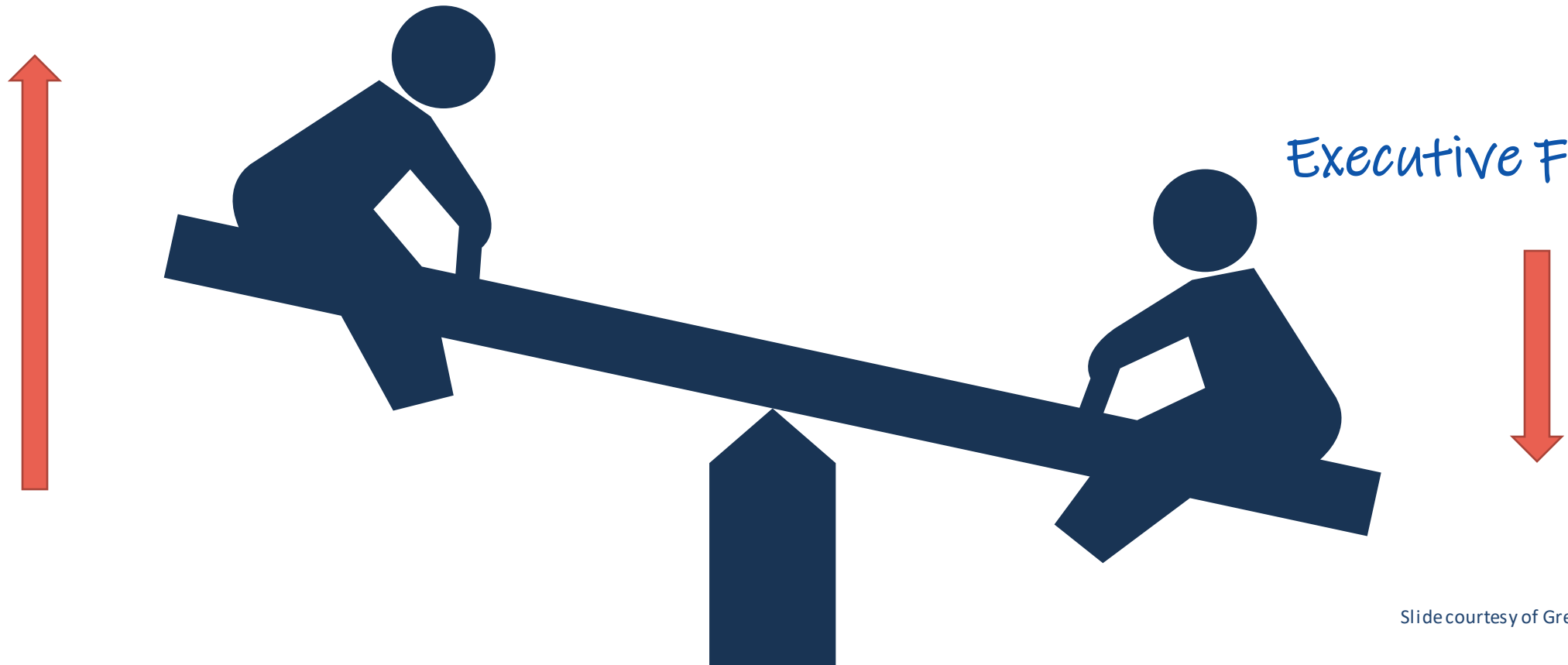
## Limbic Brain

1. Fight, flight, freeze stress response
2. Thinks, "Am I safe? Do people want me?"
3. Emotions live here

# SUBSTANCE USE DISORDERS:

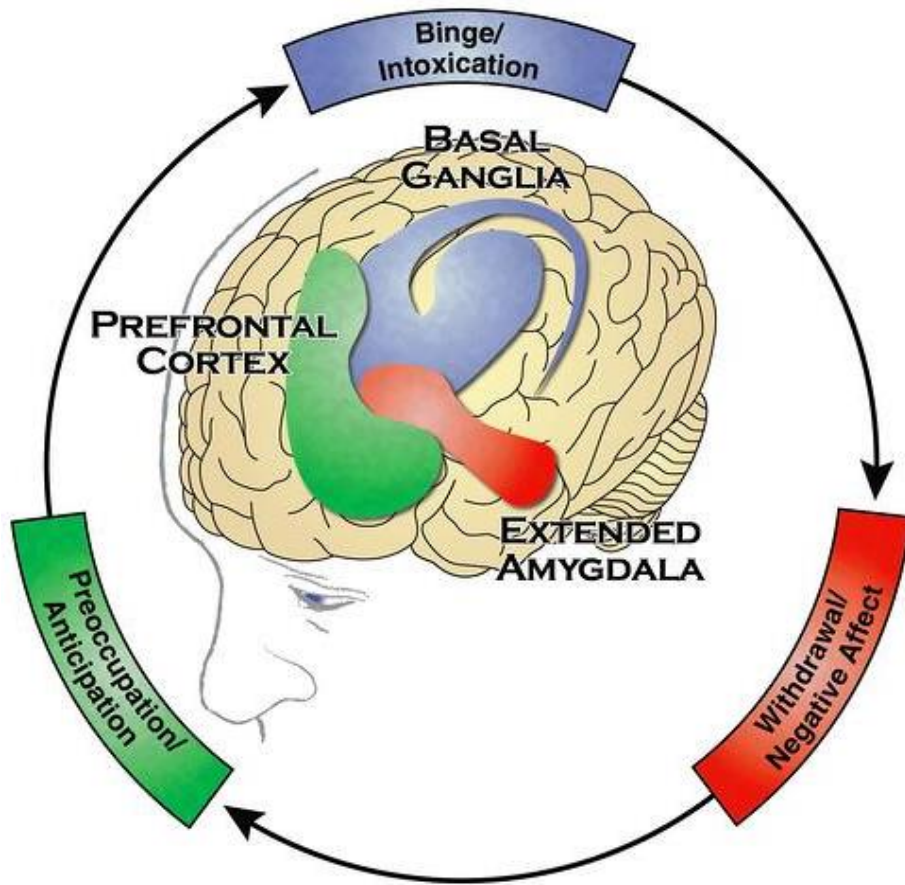
Disease of Neuroplasticity

Limbic Function



Executive Function

# Stages of addiction cycle



- **Intoxication**

- The brain's reward regions (in blue) release large amounts of dopamine

- **Withdrawal**

- Activation of brain regions involved in emotions (in pink) results in negative mood and enhanced sensitivity to stress.

- **Preoccupation**

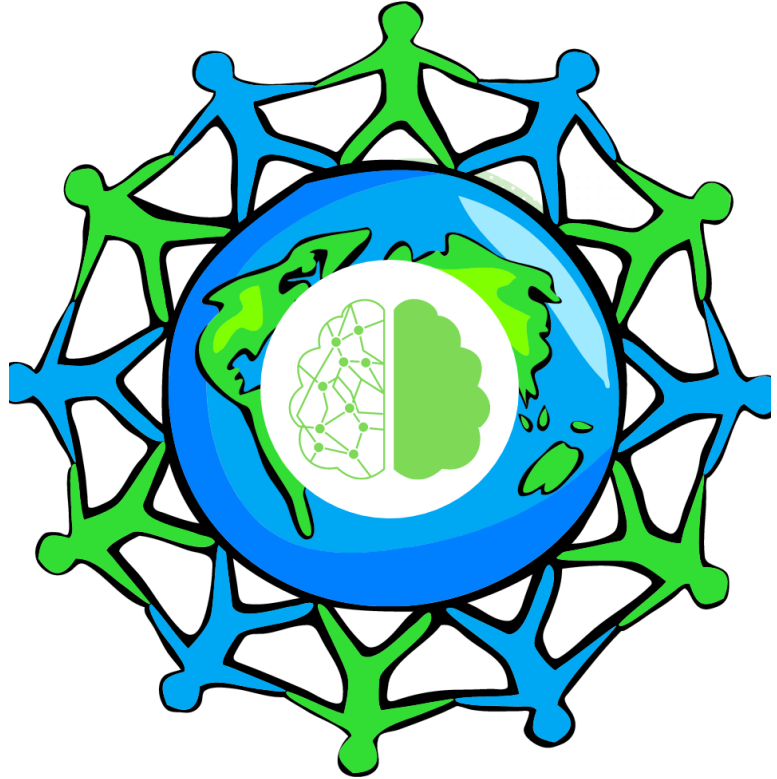
- Decreased function of the prefrontal cortex leads to an inability to balance the strong desire for the drug with the will to abstain.



## Drug exposure can:

- Down-regulate dopamine signaling
- Change the function of the prefrontal cortical regions
- Seriously impair executive processes
  - Self-regulation,
  - Decision making,
  - Flexibility in the selection and initiation of action.
- *Explains why people can be sincere in their desire and intention to stop and simultaneously impulsive and unable to stop.*

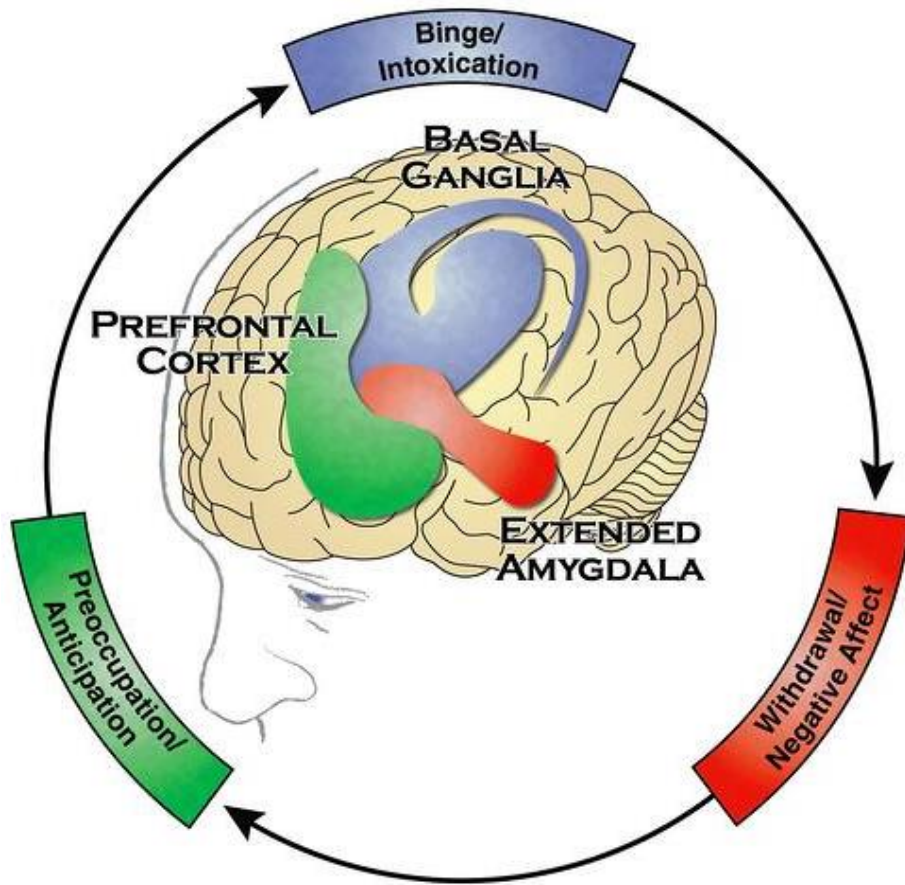
# ASAM Definition of Addiction



A treatable, chronic medical disease involving complex interactions among brain circuits, genetics, environment, and an individual's life experiences.



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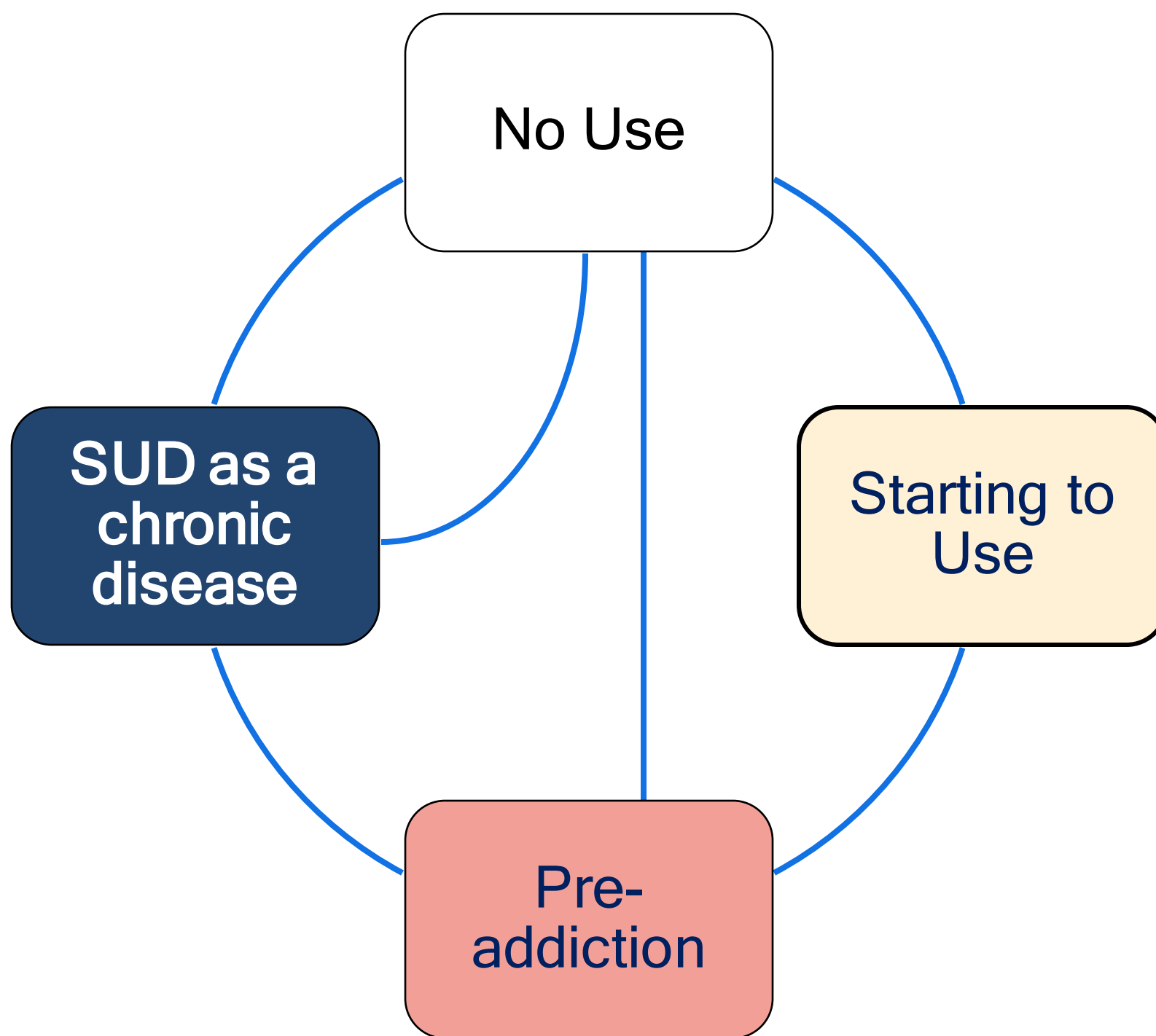


A treatable, chronic medical disease involving complex interactions among brain circuits, genetics, environment, and an individual's life experiences.

People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences.

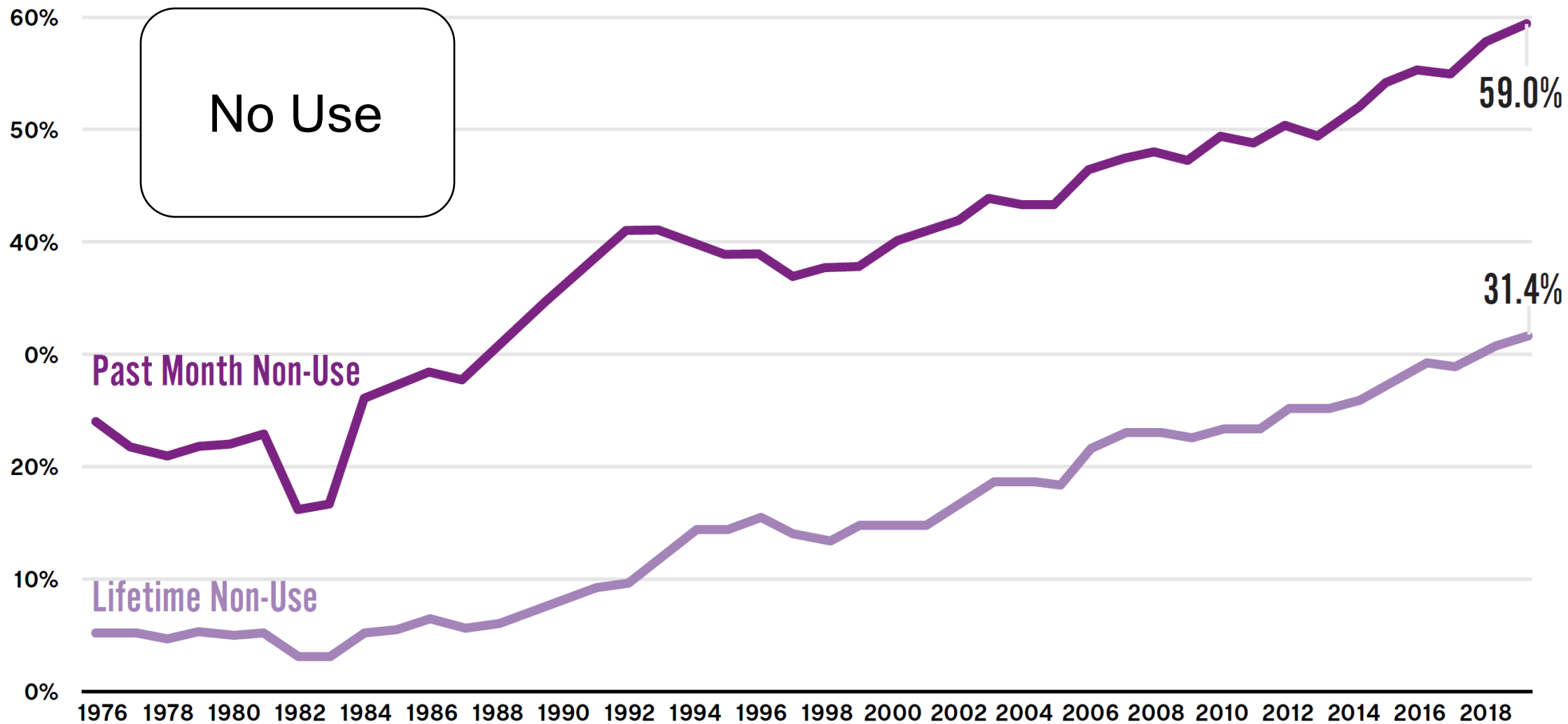


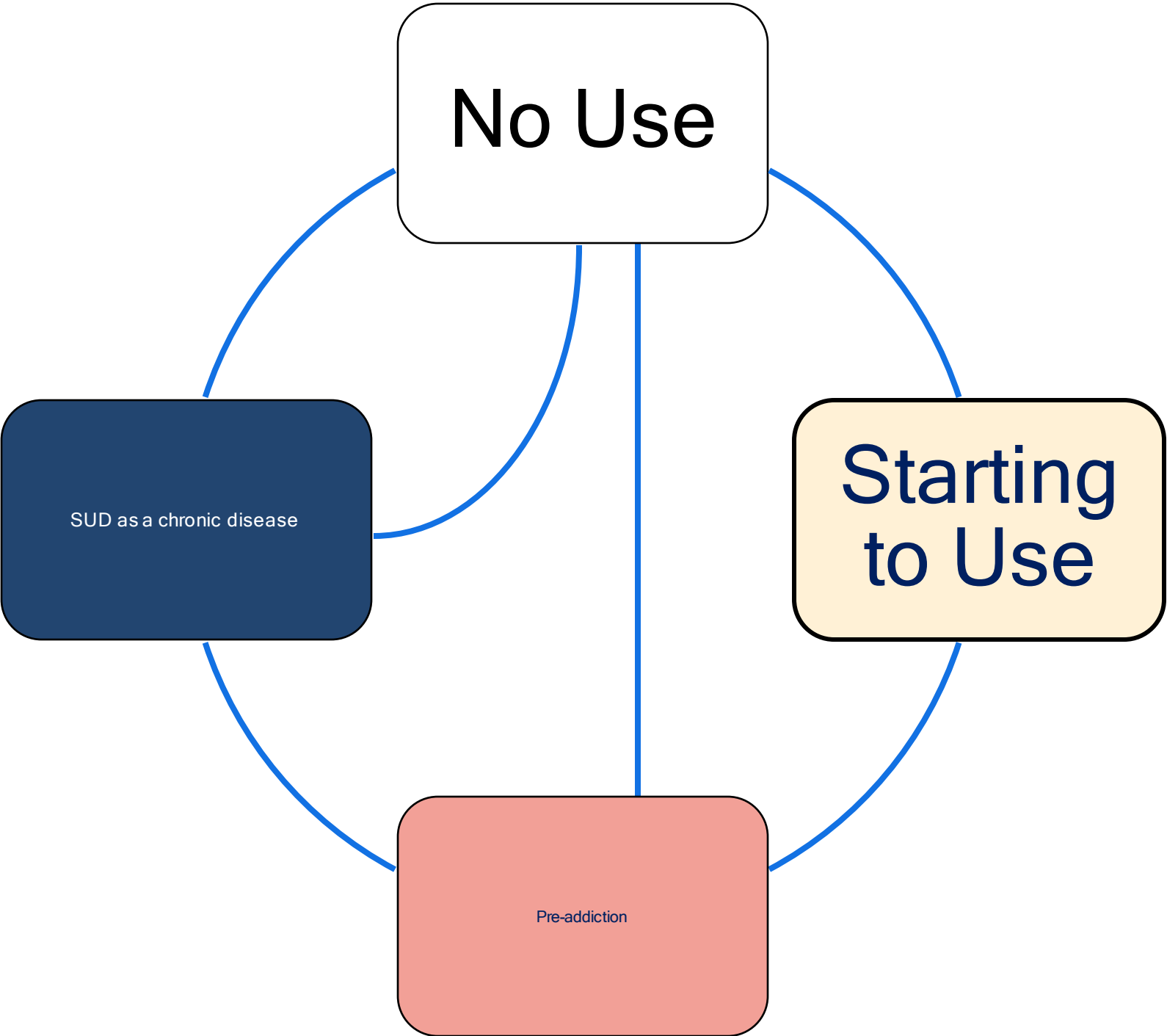
# **Spectrum of Addiction**



# TRENDS IN NO USE OF ANY ALCOHOL, CIGARETTES, MARIJUANA OR OTHER ILLICIT DRUGS

by 12th Grade Students in the US, 1976–2018





No Use

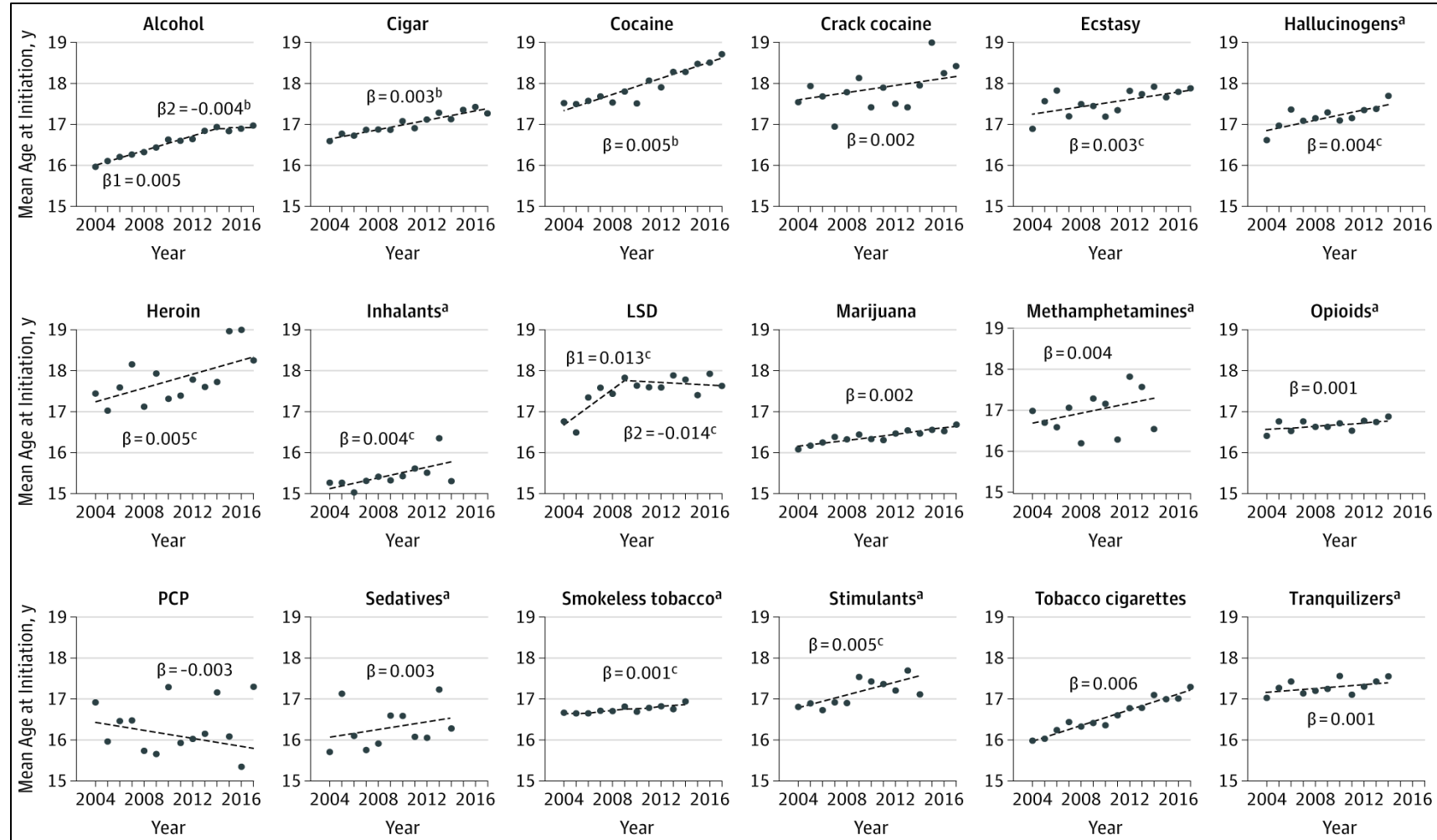
Starting  
to Use

Pre-addiction

SUD as a chronic disease

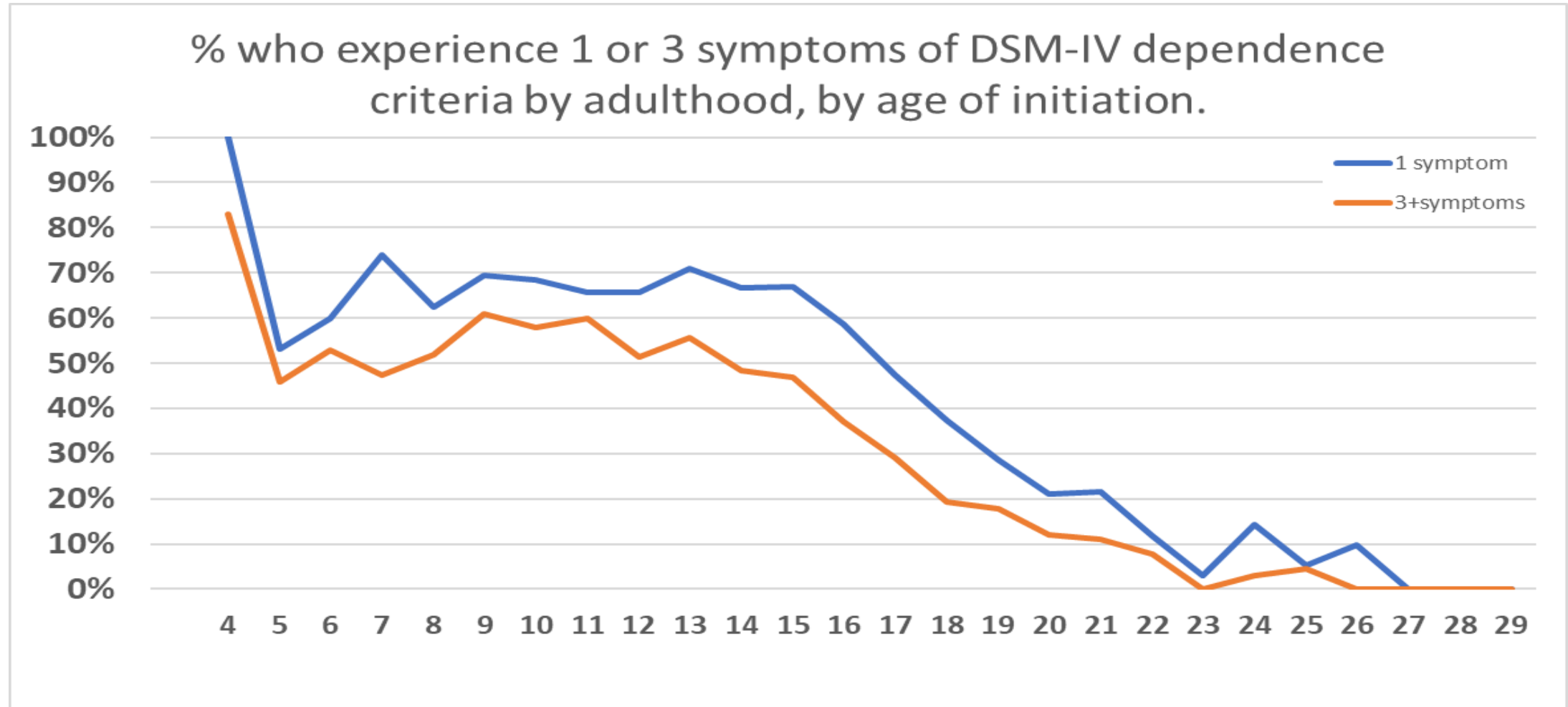
Starting  
To Use

# Patterns of Mean Age at Drug Use Initiation Among Adolescents Aged 12-21



JAMA Pediatr. 2020;174(7):725-727. doi:10.1001/jamapediatrics.2019.6235

# Earlier age of initiation and risk of progressing to tobacco dependence



# Preaddiction—A Missing Concept for Treating Substance Use Disorders

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**Despite decades of federal funding** to develop and deliver treatments for individuals with serious addictions, treatment penetration rates are less than 20%.<sup>1</sup> Facing a similar situation, the diabetes field increased treatment penetration and impact by identifying and intervening with early-stage diabetes, termed *prediabetes*. We use this example to illustrate the essential elements of this strategic clinical approach and discuss the changes that will be required within the substance use disorder (SUD) field to implement an analogous strategy. We suggest the *DSM-5* diagnostic categories mild to moderate SUD as a starting operational definition for the term *preaddiction*, a commonly understood, motivating term that could engender broader clinical efforts to effect that strategy.

## Background

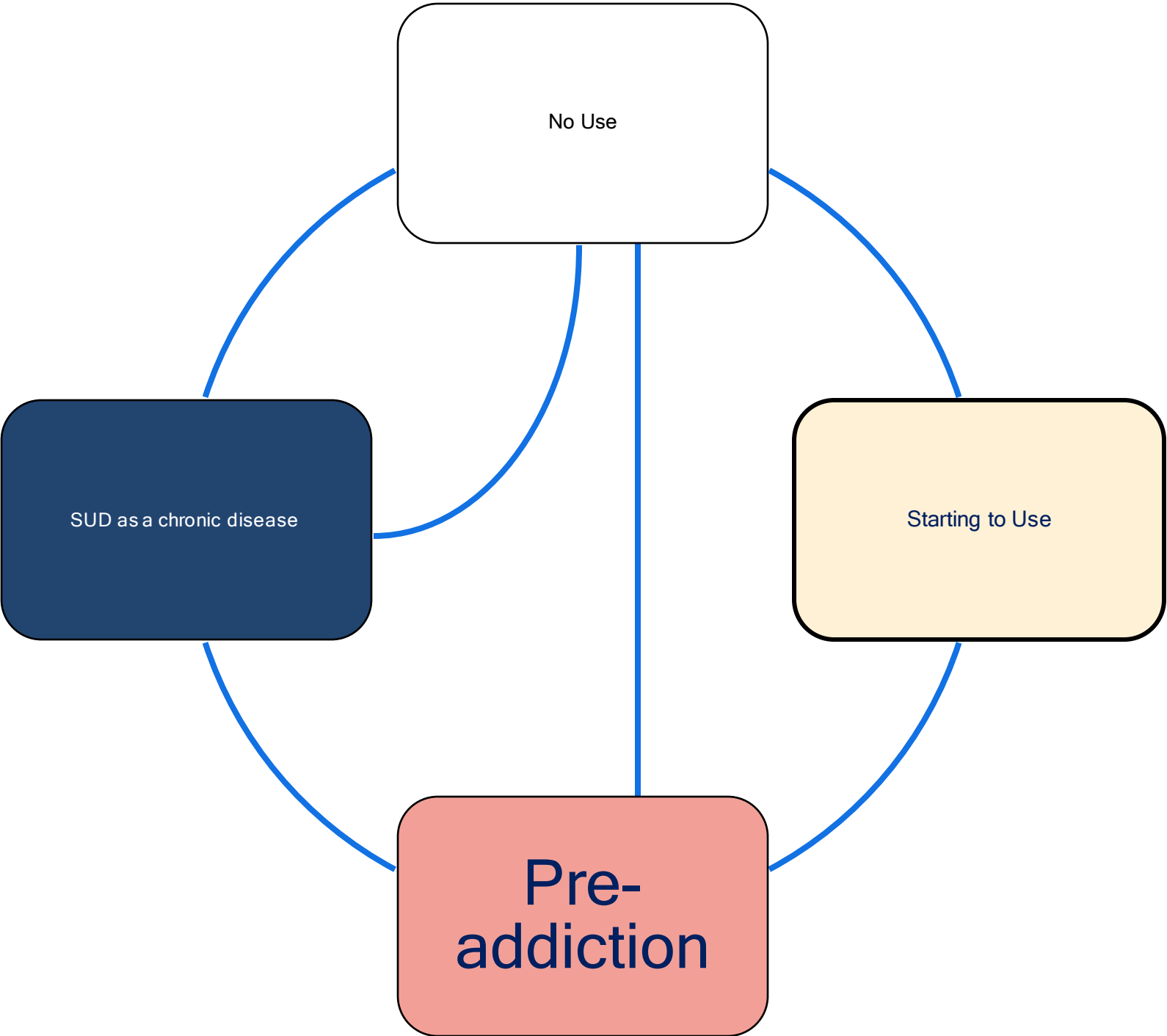
The centuries-old term *addiction* remains widely used in both professional and popular media because it communicates commonly held imagery of those whose once-promising lives were ruined by their uncontrolled use of substances, such as alcohol, opi-

suggest impaired control as the core defining diagnostic construct, hypothesized to be the result of gradual use-related damage to brain circuits controlling reward sensitivity, motivation, self-regulation, negative emotional states, and stress tolerance.<sup>2</sup>

Among those who initiate alcohol or other drug use, progression to serious SUD is not common. When it does occur, the progression is rarely linear or rapid,<sup>3</sup> usually following years of harmful misuse that by itself is a serious personal and public health threat.<sup>1</sup> Adolescence is a particularly risky period for transition from use to disorder, likely owing to heightened sensitivity of still-developing brain circuits. Those adolescents at highest risk of transition have earlier onset of use, history of traumatic events, family history of substance use, and/or mental health problems.<sup>3</sup> Two points here are important. First, the long latency from use to disorder offers a significant window of opportunity for clinical interventions to stop progression. Second, early-stage harmful substance misuse is a pervasive, costly, and serious public health risk in itself.<sup>1</sup>

Recognizing that transition to serious SUD can be pro-





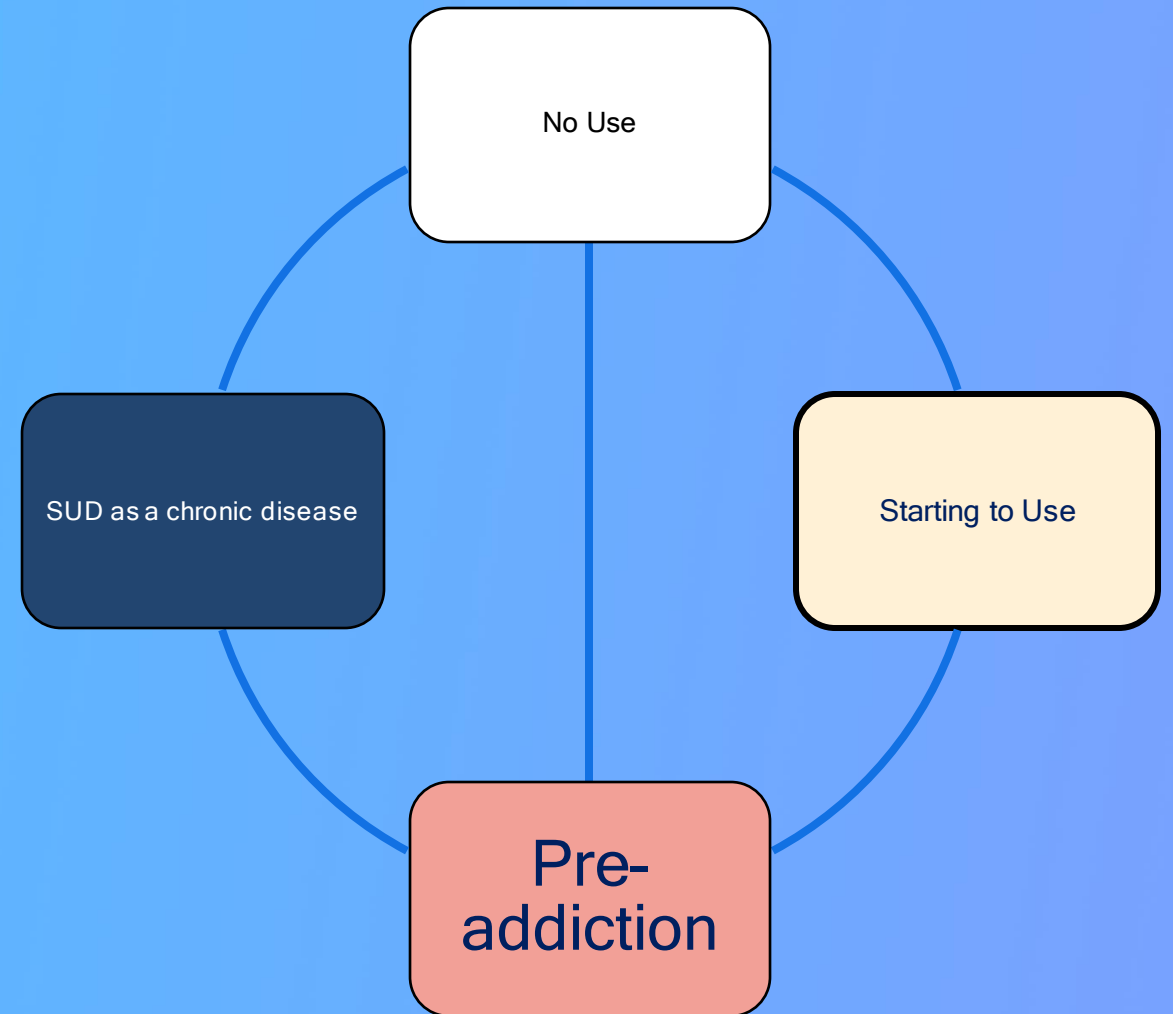
No Use

Starting to Use

SUD as a chronic disease

Pre-addiction

“Among those who initiate alcohol or other drug use, most do not develop addiction, but some develop pre-addiction.”



	Diabetes	Substance Use Disorder
Preventable	Yes	Yes
Disease progression dependent on behaviors	Yes- Physical Activity and diet choices	Yes- Use of substances
Both environment and genetics affects disease expression	Yes	Yes
Treatment includes behavioral changes and medications	Yes	Yes
Can be "cured"	No-always risk of returning	No-always risk of returning

# Pre-addiction

"The criteria defining mild to moderate SUD are one reasonable starting point for operationally defining pre-addiction until more objective measures are developed."

## VIEWPOINT

### Preaddiction—A Missing Concept for Treating Substance Use Disorders

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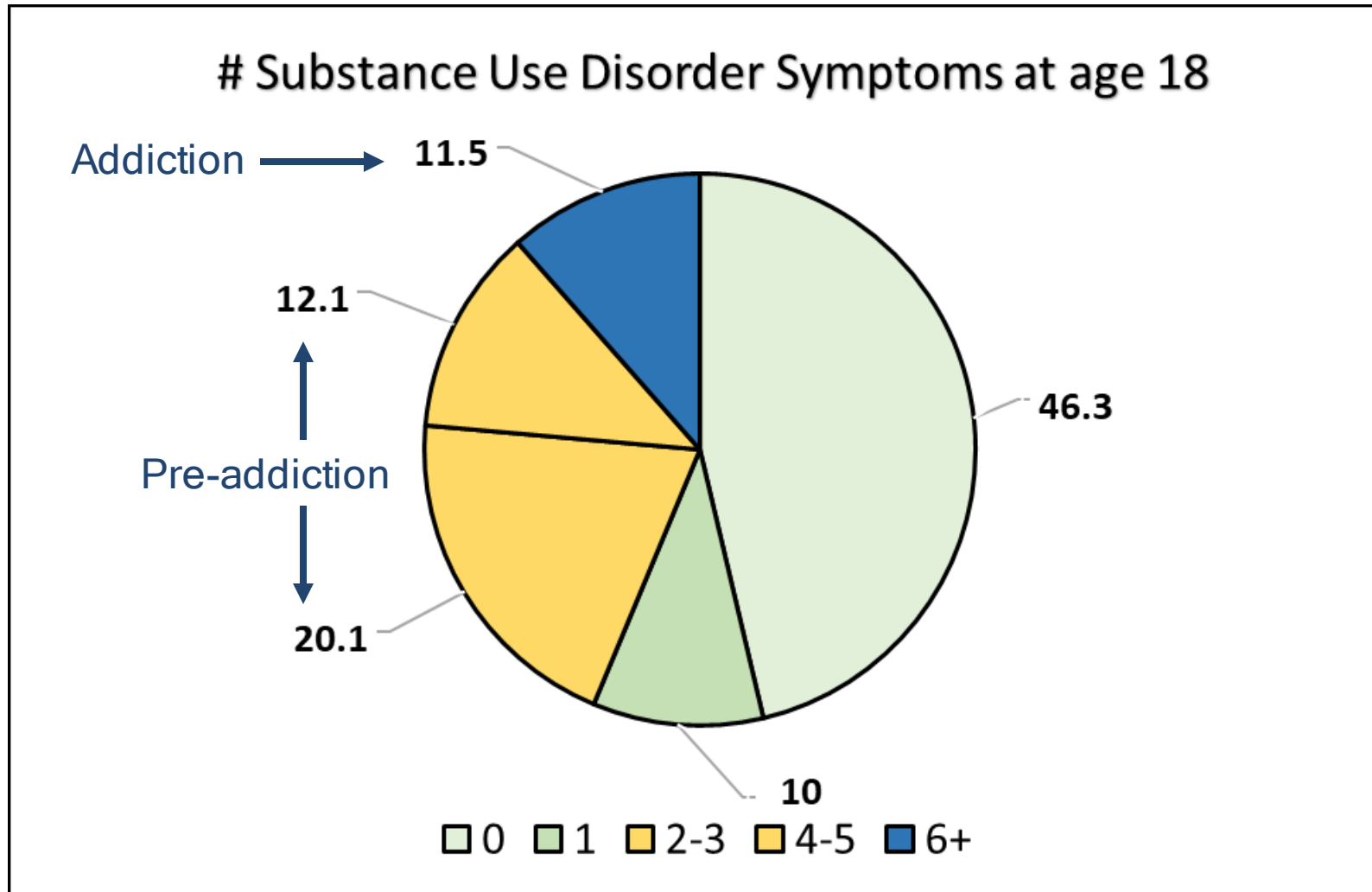
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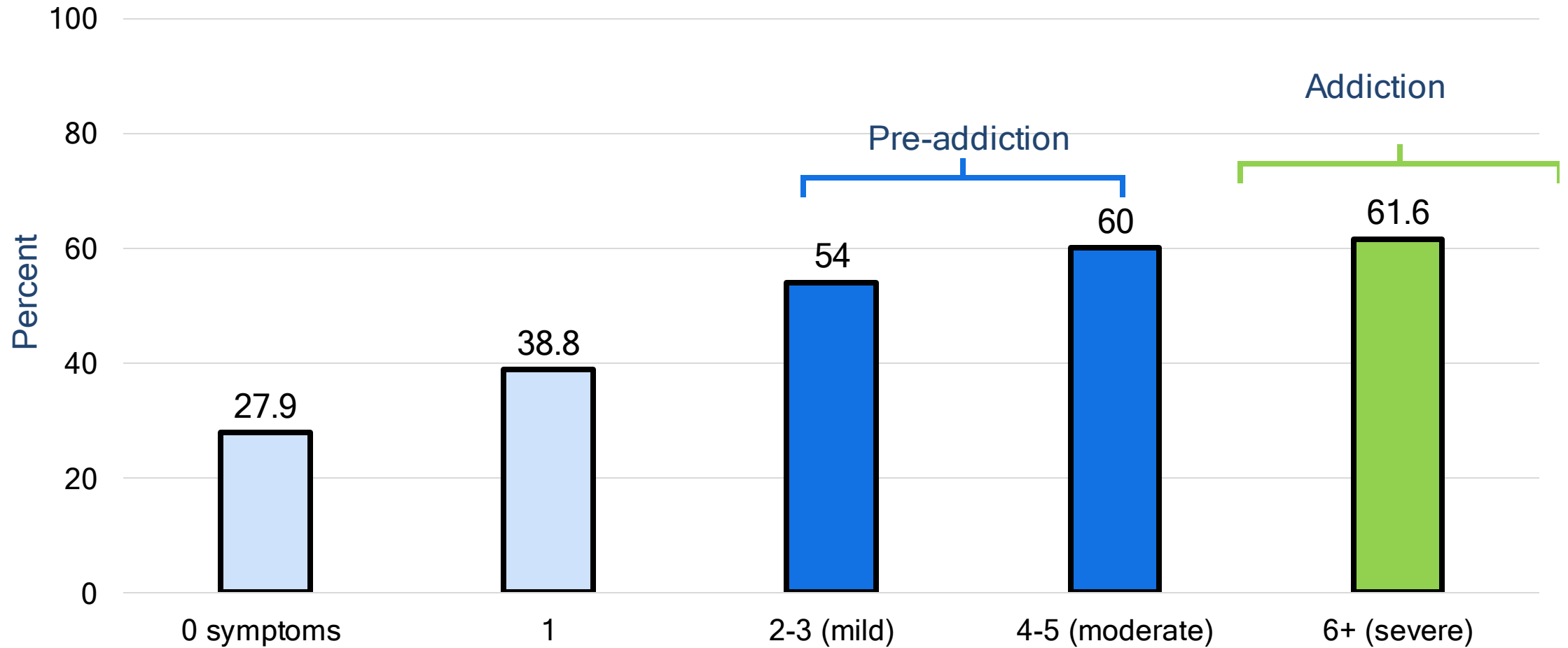
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Recognizing that transition to serious SUD can be progressive but variably manifested, the DSM-5<sup>4</sup> uses 11

# Prevalence of Pre-Addiction (1975-84)



## % with 2+ SUD symptoms at ages 35-50



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  - Changes the function of the prefrontal cortical regions
  - Seriously impairs executive processes
3. Apply strategies for discussing neurobiology when counseling teens and parents about substance use.



# Session Objectives

1. List 3 brain changes that occur during adolescence
2. Describe how substances can impact neurobiology and brain development
  - Down-regulates dopamine signaling
  - Changes the function of the prefrontal cortical regions
  - Seriously impairs executive processes
3. Explain concepts of neurobiology to adolescents





At this time in your life,  
your brain is growing to  
become FASTER and more  
EFFICIENT.

[Marijuana] affects how  
FAST and EFFICIENT it  
can be.

Myelination and Synaptogenesis

When you vape....

Your brain is wired to act differently than an older person's brain.

You have to be very careful, because, during adolescence, the brain is wired to develop an addiction very quickly.



Asynchronous Development of  
Limbic and Prefrontal Systems

When you are around positive things, your brain can start to rewire and heal itself.



Neuroplasticity

These are signs that **your brain wiring might be changing** and you may start developing an addiction

- Cravings
- Withdrawal when not Using
- Tolerance- Needing more cannabis to get the same effect
- Anger, depression, irritability
- Sleep Disturbance
- Pain
- Spending a lot of time using [cannabis]



What are signs of Addiction

# Summary

- Adolescence is a period of learning, exploration and growth
- Substances can adversely impact the brain's ability to grow, learn, and explore...
- But the adolescent brain has a profound ability to change and adapt



Thank you!

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