

Adolescent Brain Maturation and Health: Intersections on the Developmental Highway



National American Indian & Alaska Native

ATTC Addiction Technology Transfer Center Network
Funded by Substance Abuse and Mental Health Services Administration



National American Indian and Alaska Native

MHTTC Mental Health Technology Transfer Center Network
Funded by Substance Abuse and Mental Health Services Administration



National American Indian & Alaska Native

PTTC Prevention Technology Transfer Center Network
Funded by Substance Abuse and Mental Health Services Administration



**Native Center for
Behavioral Health**



SAMHSA
Substance Abuse and Mental Health
Services Administration

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&

**Consultant, National American
Indian & Alaska Native Technology
Transfer Center**

September 22, 2021

***Essential Substance Abuse Skills: A
Guide for Professionals***

**National American Indian & Alaska Native
Technology Transfer Center**

Professional Disclosures

None to report

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Academies of*

SCIENCES
ENGINEERING
MEDICINE

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A Survival Guide
to the
Adolescent Brain for
You and Your Teen

WHY Do They Act That Way?

David Walsh, Ph.D.

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Get Out of My Life,

but First Could You Drive Me and Cheryl to the Mall?



A PARENT'S GUIDE TO THE NEW TEENAGER

Anthony E. Wolf, Ph.D.

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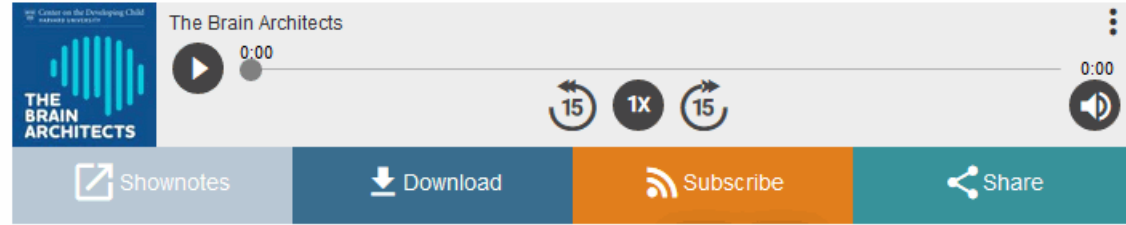
YouTube Video

<https://youtu.be/6zVS8HIPUng>
Sarah-Jayne Blakemore's Ted Talk:
*The mysterious workings of the
adolescent brain*



Podcast Series

- Harvard's Center on the Developing Child new podcast series, *The Brain Architects*



- “Learn the science behind how brains are built and what it means how to build a strong brain.”
- <https://developingchild.harvard.edu/science/key-concepts/brain-architecture/>

Cautionary Note #1



- **My “spotlight” on brain development and its impact on adolescent behavior and health does not diminish the impact of environment and social determinants on adolescent behavior.**
- **I will be integrating into today’s discussion the important role of non-biological influences.**

Cautionary Note #2



- The science of adolescent brain development is still in its relative infancy
- Studies typically do not have large samples and not diverse in terms of ethnicity/race

Adolescent Brain Cognitive Development National Longitudinal Study

U.S. longitudinal study of 13,000 children enrolled at age 9-10 years to assess effects of drugs on individual brain development trajectories



Slide courtesy of Maureen Boyle, PhD

Teen Brain Development Quiz



- 1. There are several health indices suggesting that teenagers take less risk than in years past. T or F ?**
- 2. What lifestyle choices during adolescence promote good brain development?**
- 3. Which is more harmful to the developing brain?**
 - a. Chronic, heavy use of marijuana**
 - b. Chronic, heavy drinking**

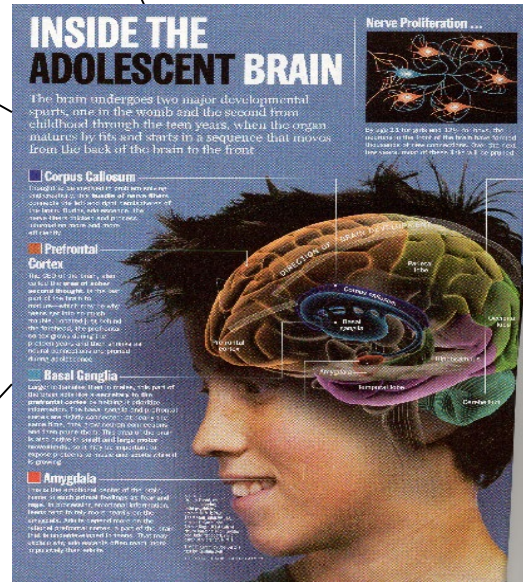


I. Brain development

IV. Summary

III. Youth Service Providers

II. Developing brain: drug use, mental health, early experiences



Major Points from My Talk



- 1. The maturation of the adolescent brain likely contributes to behaviors that are characteristic of this developmental period.**
- 2. This maturation also informs our understanding of risk for substance use disorders and other behavioral disorders.**
- 3. Service providers can leverage teen brain science when working with adolescents and parents.**

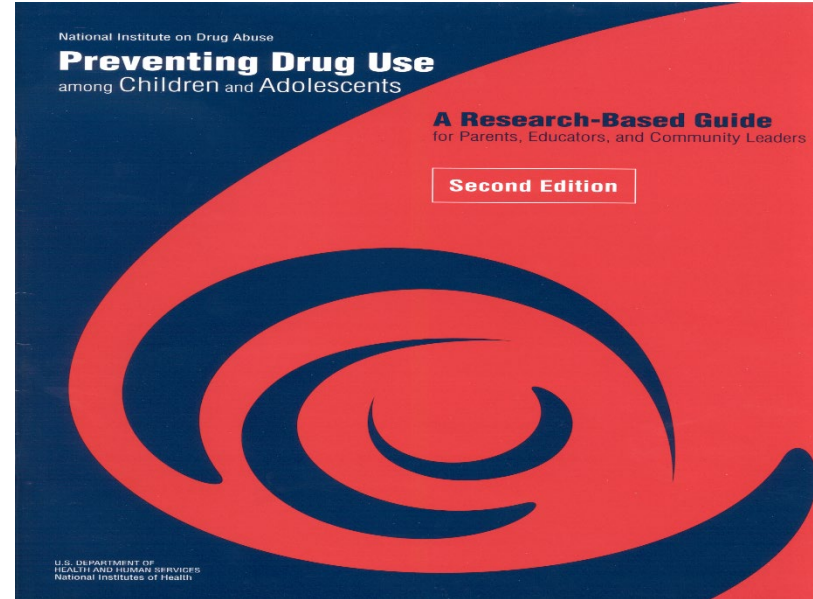
Brain Development: Implications for Service Providers

1. Teach youth about *brain development* and how it impacts mental health



Brain Development: Implications for Service Providers

2. Promote evidenced-based *prevention* programs



<http://www.drugabuse.gov>

Brain Development: Implications for Service Providers

3. Earlier the treatment, the better



Brain Development: Implications for Service Providers

4. Use evidenced-based treatment strategies

- **Evidenced-based treatment programs are “teen-brain friendly.”**

Brain Development: Implications for Service Providers

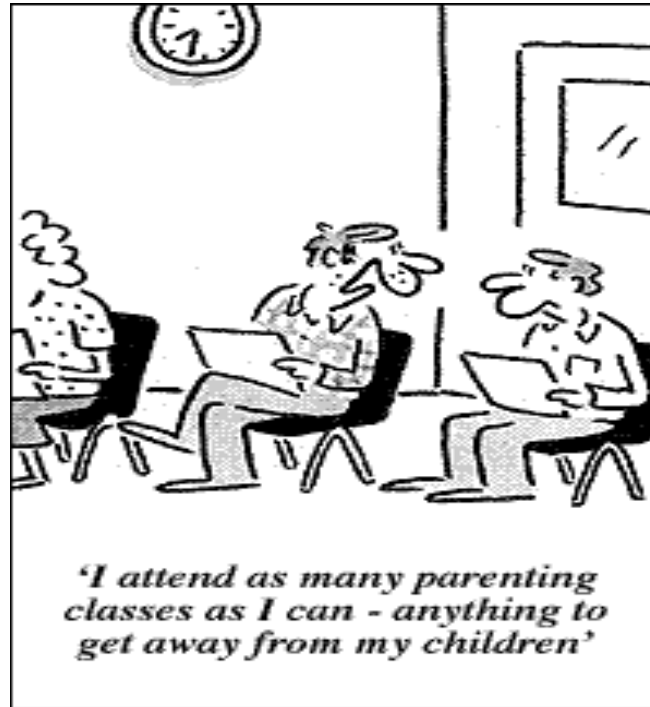
5. Increase youth “cannabis and vaping IQ”

- Many misperceptions and myths about cannabis and vaping are held by youth (and adults, too!)

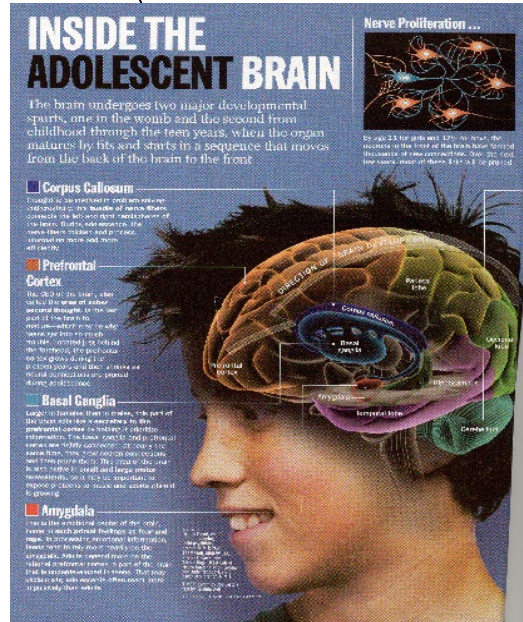


Brain Development: Implications for Service Providers

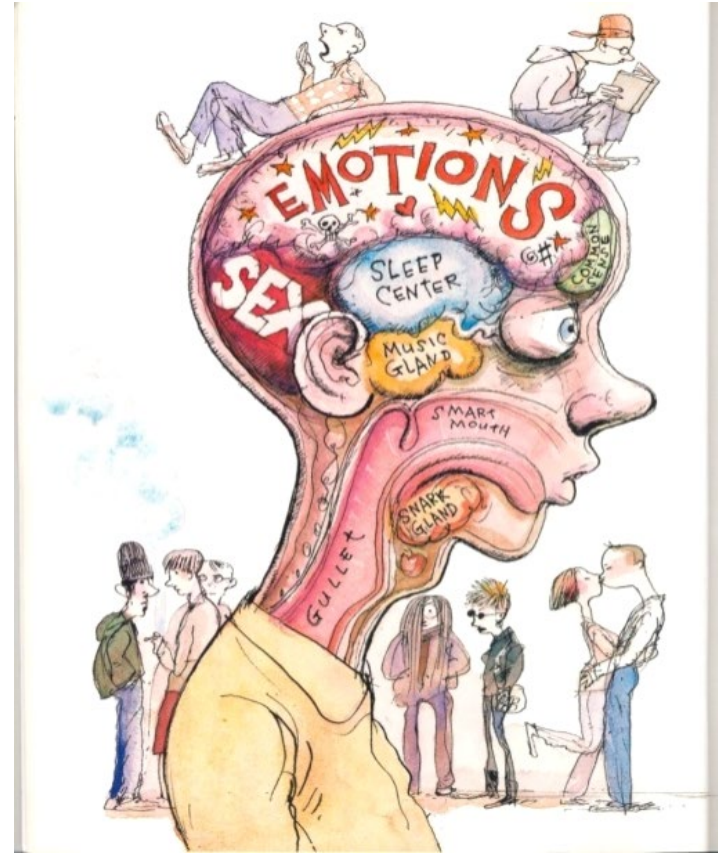
6. Teach parents about brain development



I. Brain development



- **Based on research by neuroscientists, brain maturation continues through adolescence, until approx. age 25**



Source: US News &
World Report, 2005

An Immature Brain = Less Brakes on the “Go” System

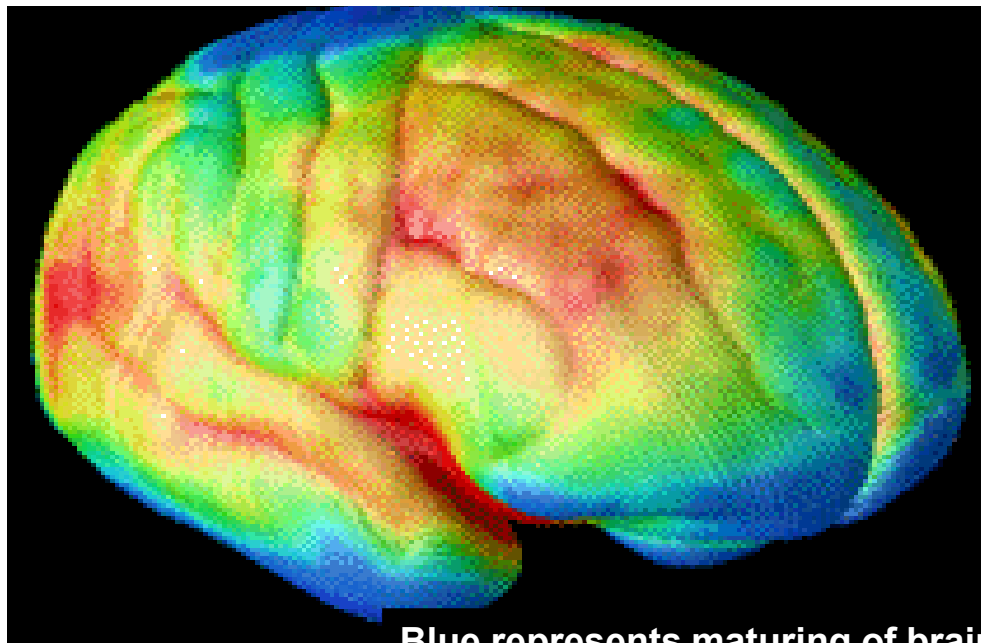


Maturation Occurs from Back to Front of the Brain and Inside to Outside

Images of Brain Development in Healthy Youth
(Ages 5 – 20)

Earlier: Limbic
Motor Coordination
Emotion
Motivation

Later: Frontal
Judgment



Blue represents maturing of brain areas

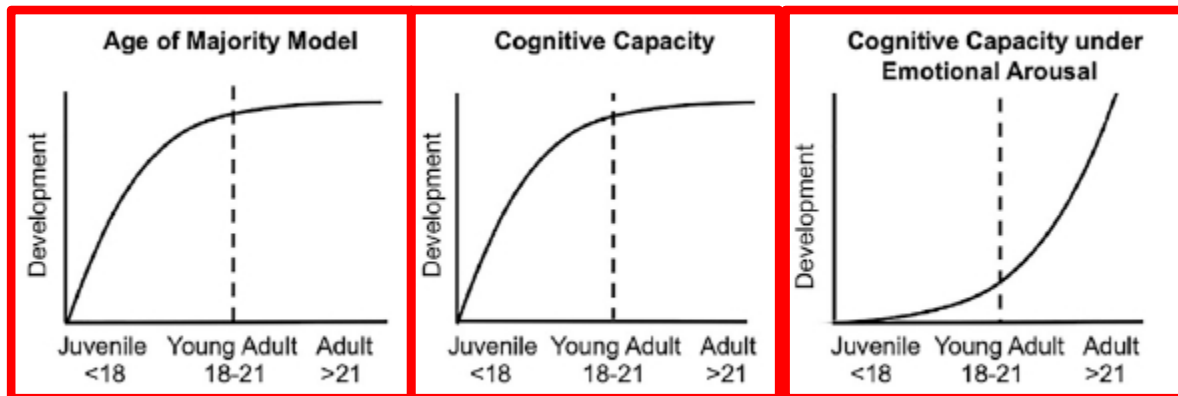


Figure 1. Legal, Psychological, and Brain-Based Accounts of When an Adolescent Is an Adult

Adapted from [Cohen et al. \(2016b\)](#) and [Icenogle et al. \(2019\)](#).

Implications of Brain Development for Adolescent Behavior



- **Preference for**
 - 1. physical activity**
 - 2. high excitement and rewarding activities**
 - 3. activities with peers that trigger high intensity/arousal**
 - 4. novelty**
- **Less than optimal..**
 - 5. control of emotions**
 - 6. consideration of negative consequences**
- **Greater tendency to...**
 - 7. be attentive to social information**
 - 8. take risks and show poor self-control**

Implications of Brain Development for Adolescent Behavior

(Winters et al., 1995)



- **Preference for**

1. **physical activity**
2. **high excitement and rewarding activities**
3. **activities with peers that trigger high intensity/arousal**
4. **novelty**

- **Less than optimal..**

5. **control of emotions**
6. **consideration of negative consequences**

- **Greater tendency to...**

7. **be overly attentive to social information**
8. **take risks**

**Contributors for healthy
or personal growth?**

Implications of Brain Development for Adolescent Behavior

(Winters et al., 1995)



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1. **physical activity**
2. **high excitement and rewarding activities**
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5. **control of emotions**
6. **consideration of negative consequences**

- **Greater tendency to...**

7. **be overly attentive to social information**
8. **take risks**

**Contributors for
unhealthy or unwise risk?**

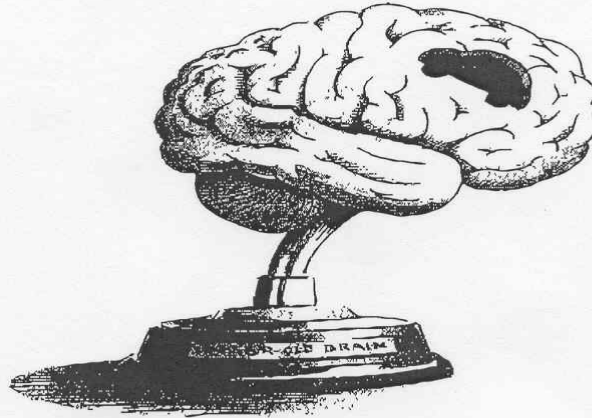
Risk-Taking & Self Control

- **Based on science of brain development, a modern view of risk taking in adolescence is...**
 - **evolutionarily adaptive**
 - **normative; important to development**
 - **significant individual differences**
 - **is due primarily to emotional and contextual, not cognitive, factors**

Why do most 16-year-olds
drive like they're
missing a part of their brain?



BECAUSE THEY ARE.



EVEN BRIGHT, MATURE TEENAGERS SOMETIMES DO THINGS THAT ARE "STUPID."

But when that happens, it's not really their fault. It's because their brain hasn't finished developing. The underdeveloped area is called the dorsal lateral prefrontal cortex. It plays a critical role in decision making, problem solving and understanding future consequences of today's actions. Problem is, it won't be fully mature until they're into their 20s.

It's one reason 16-year-old drivers have crash rates three times higher than 17-year-olds and five times higher

crashes. These laws restrict the more dangerous kinds of driving teens do, such as nighttime driving and driving with teen passengers. Since North Carolina implemented one of the most comprehensive GDL laws in the country, it has seen a 25% decline in crashes involving 16-year-olds.

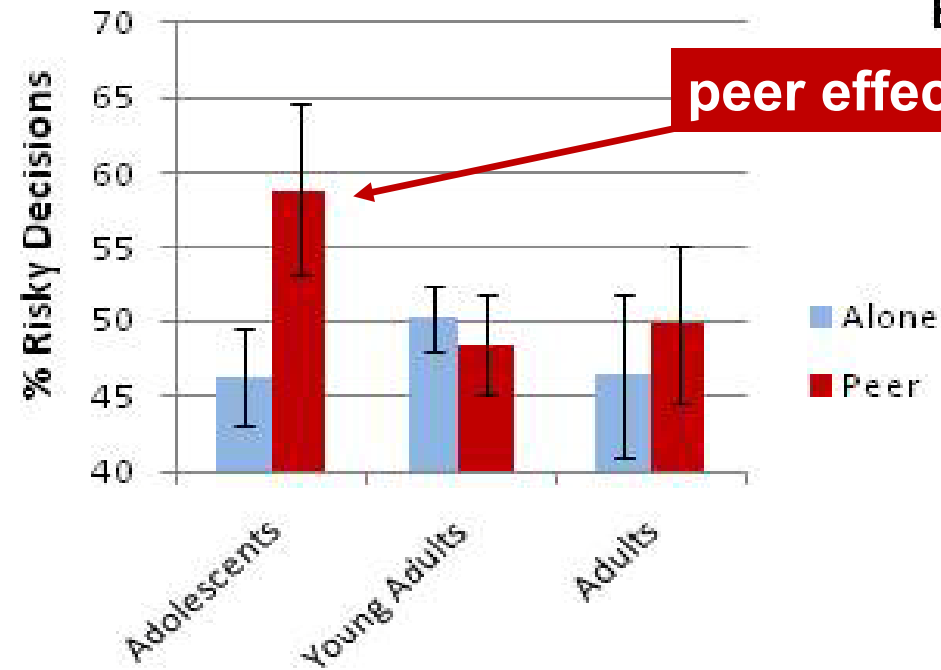
To find out what the GDL laws are in your state, visit Allstate.com/teen. Help enforce them—and if they aren't strong enough, ask your legislator to strengthen them.

Let's help our teenagers not miss out on tomorrow just

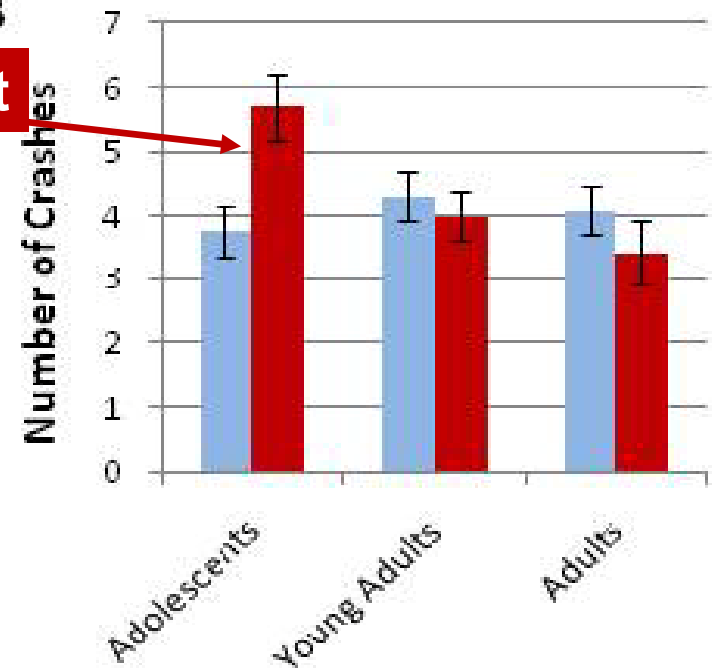
**Allstate ad, *NY Times*,
May, 2007**

Impact of Peer Presence on Risky Driving in Simulated Context

A



B



Risk-Taking & Self-Control

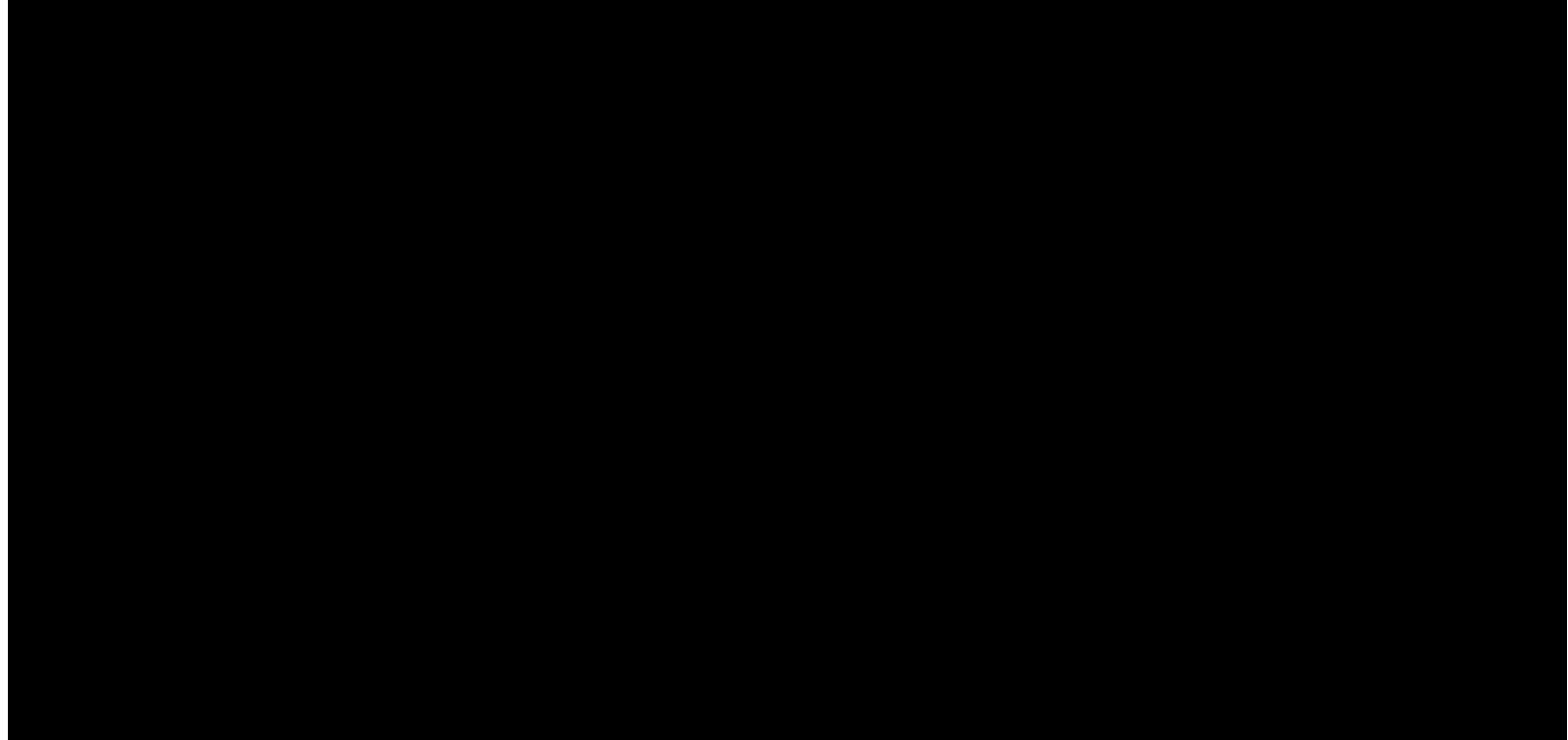


Resisting the marshmallow and
the success of self-control

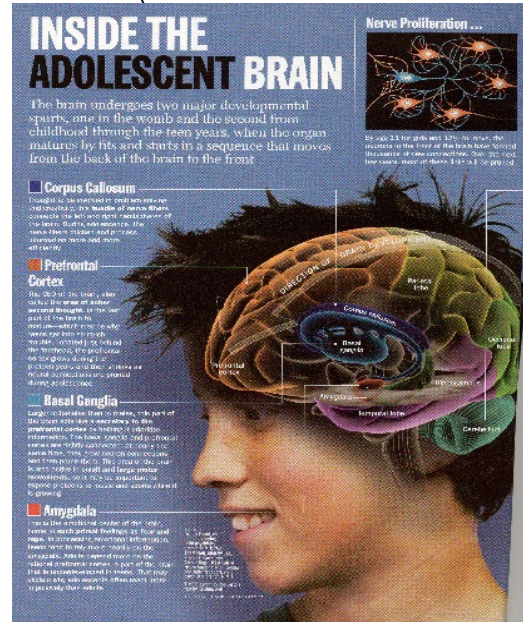
PBS NewsHour ✓

81K views

9:22



I. Brain development



II. Developing brain: drug use, mental health, early experiences

1. Developing brain and drugs

INSIDE THE ADOLESCENT BRAIN

The brain undergoes two major developmental spurts, one in the womb and the second from childhood through the teen years, when the organ matures by fits and starts in a sequence that moves from the back of the brain to the front.

Nerve Proliferation ...



By age 23, for girls and 25% for boys, the neurons in the front of the brain have formed thousands of new connections. One-third of these connections, most of them, will be pruned.

Corpus Callosum

Thought to be involved in emotion and eye coordination, the bundle of nerve fibers connects the left and right hemispheres of the brain. It also coordinates the nerve fibers' output and processes. It grows in size and strength all through adolescence.

Prefrontal Cortex

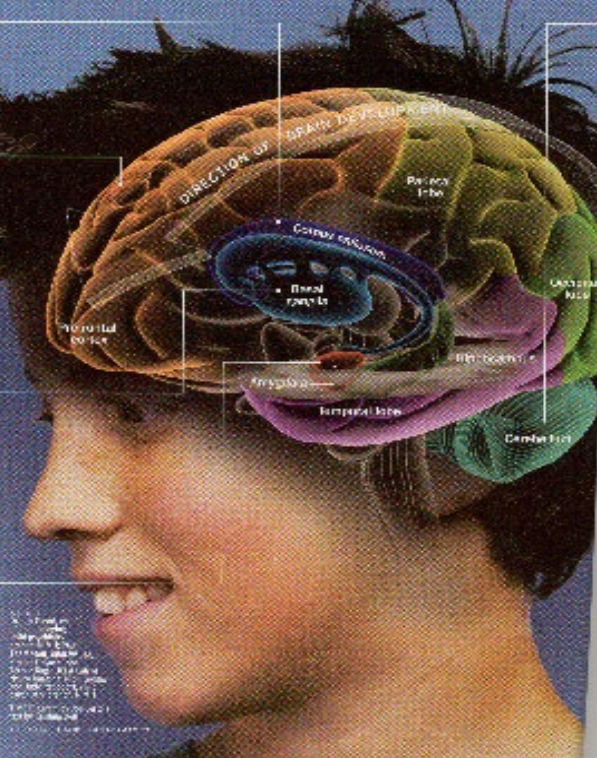
The CEO of the brain, also called the area of higher second thought, is the last part of the brain to mature, which may be why teens are prone to risk-taking behavior. It's not fully formed until the mid-20s, but it continues to grow during the next few years and then continues to mature during adolescence.

Basal Ganglia

Larger in females than in males, this part of the brain acts like a conveyor to the prefrontal cortex, helping it identify information. The basal ganglia and prefrontal cortex are highly connected, so as the same time, they also influence each other. The basal ganglia are made up of small and large motor neurons, so it's important to expose people at these ages to a variety of growing.

Amygdala

It's the emotional center of the body, home to such primal feelings as fear and rage. It processes, receives information, feeds into the motor cortex, and the cerebral cortex is spread across the lateral cerebral cortex, a part of the brain that is responsible for memory. They may also be involved in emotion, which may be why they're so important to growing.



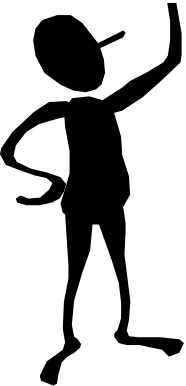
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Implications of Brain Development for Drug Abuse Vulnerability

Are adolescents more susceptible than adults to drugs?

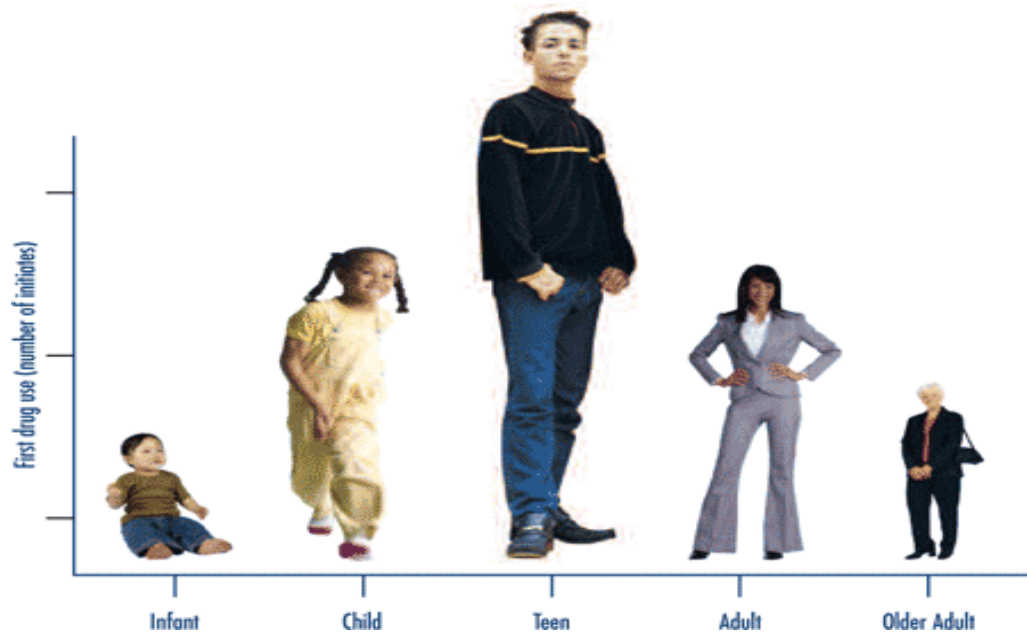
**Several lines of evidence
(acknowledgement to Linda Spear, Ph.D.)**

**Unethical to give human adolescents alcohol in the laboratory;
much of the best evidence comes from adolescent rat studies.**

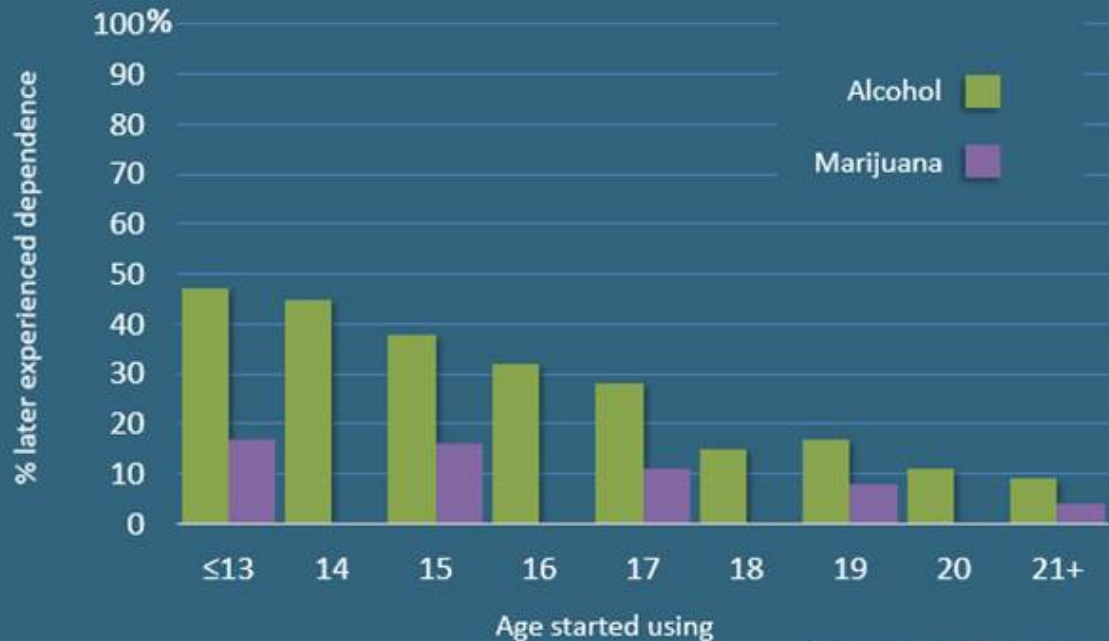


Evidence from epidemiological studies

Drug use starts early and peaks in the teen years



Age at substance use onset and later addiction



Implications of Brain Development for Drug Abuse Vulnerability

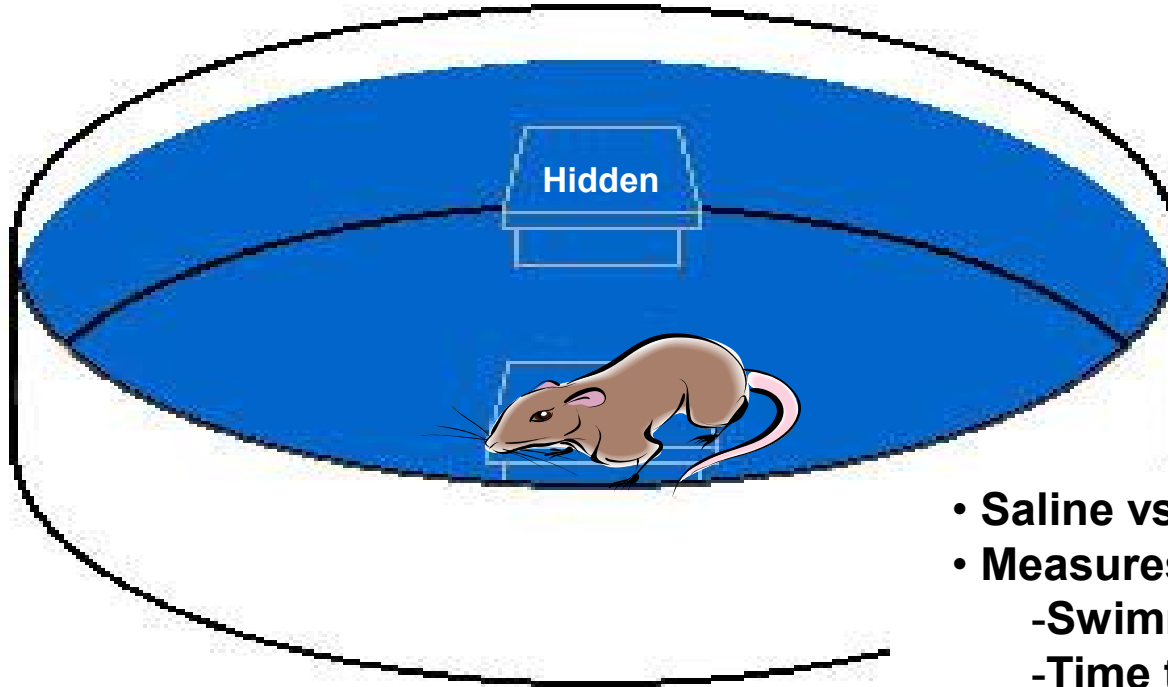
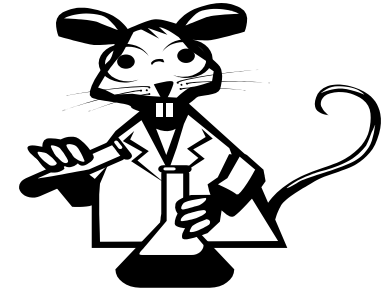
Alcohol



Are adolescents more susceptible to alcohol than adults?

- 1. Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication.**
- 2. Adolescent rats are more sensitive to the social disinhibition effects of alcohol.**

The Water Maze Test



- Saline vs alcohol
- Measures
 - Swimming speed
 - Time to find platform

Are adolescents more susceptible to alcohol than adults?

1. Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication.
2. Adolescent rats are more sensitive to the social disinhibition effects of alcohol.

#2 and **#3** : May contribute to **binge drinking** and increased risk to **alcohol dependence**.

**Wanna look
for some cheese
with me?**

Sure!





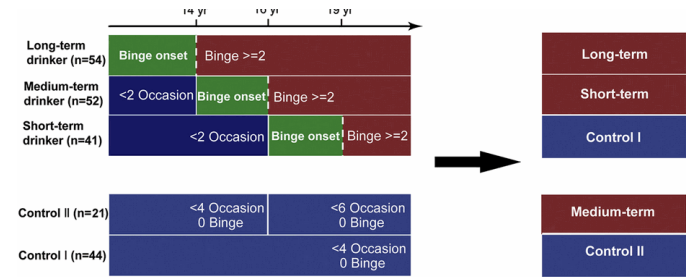
Impact of Binge Drinking

Adolescent binge drinking disrupts normal trajectories of brain functional organization and personality maturation

Ruan et al., 2019



- Longitudinal design; assessed at ages 14, 16 and 19
- Accumulating effect of binge drinking....
 - Neuroimaging data: disruption in the maturation of frontal connectivity (caution: small sample with neuroimaging data at baseline)
 - Personality data: slower developmental improvement of impulse control



Implications of Brain Development for Drug Abuse Vulnerability

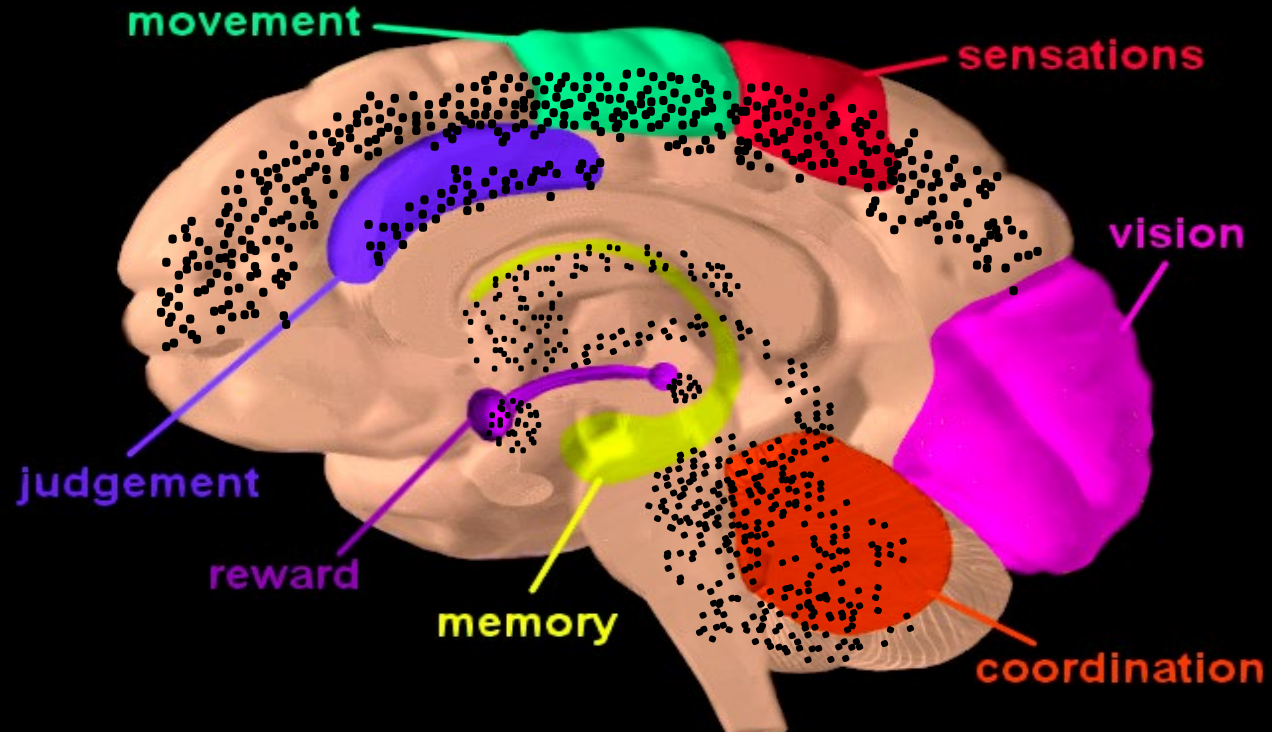
Marijuana



Marijuana Binds Cannabinoid Receptors Located Throughout the Brain

(source NIDA)

- Brain Development
- Memory & Cognition
- Motivational Systems & Reward
- Appetite
- Immunological Function
- Reproduction
- Movement Coordination
- Pain Regulation & Analgesia



Slide courtesy of Maureen Boyle, PhD

Eight Adverse Health Effects of Chronic Marijuana Use (Volkow et al., 2014)

“Low Level of Confidence”

- Lung cancer

“Medium Level of Confidence”

- Altered brain development
- Progression to use of other drugs
- Increased risk of schizophrenia, depression and anxiety disorders (in persons with a predisposition to such disorders)

“High Level of Confidence”

- Addiction
- Motor vehicle accidents
- Diminished life achievement (including cognitive impairment and poor educational outcome)
- Symptoms of chronic bronchitis



The Health Effects Strongly Associated with Initial Cannabis Use Early in Adolescence

(Volkow et al., 2014)

“Low Level of Confidence”

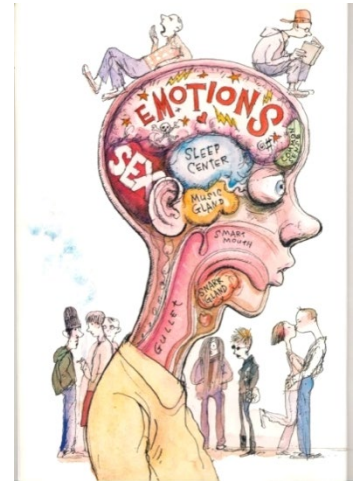
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“Medium Level of Confidence”

- Altered brain development
- Progression to use of other drugs
- Increased risk of chronic psychosis disorders (including schizophrenia and depression) in persons with a predisposition to such disorders

“High Level of Confidence”

- Addiction
- Motor vehicle accidents
- Diminished life satisfaction and achievement (including cognitive impairment and poor educational outcome)
- Symptoms of chronic bronchitis



Source: US News &
World Report, 2005

The Dunedin Study (New Zealand) (N=1,037)



13 yrs
(Pre-initiation)

1



18 yrs

2

21 yrs

3



32 yrs

4

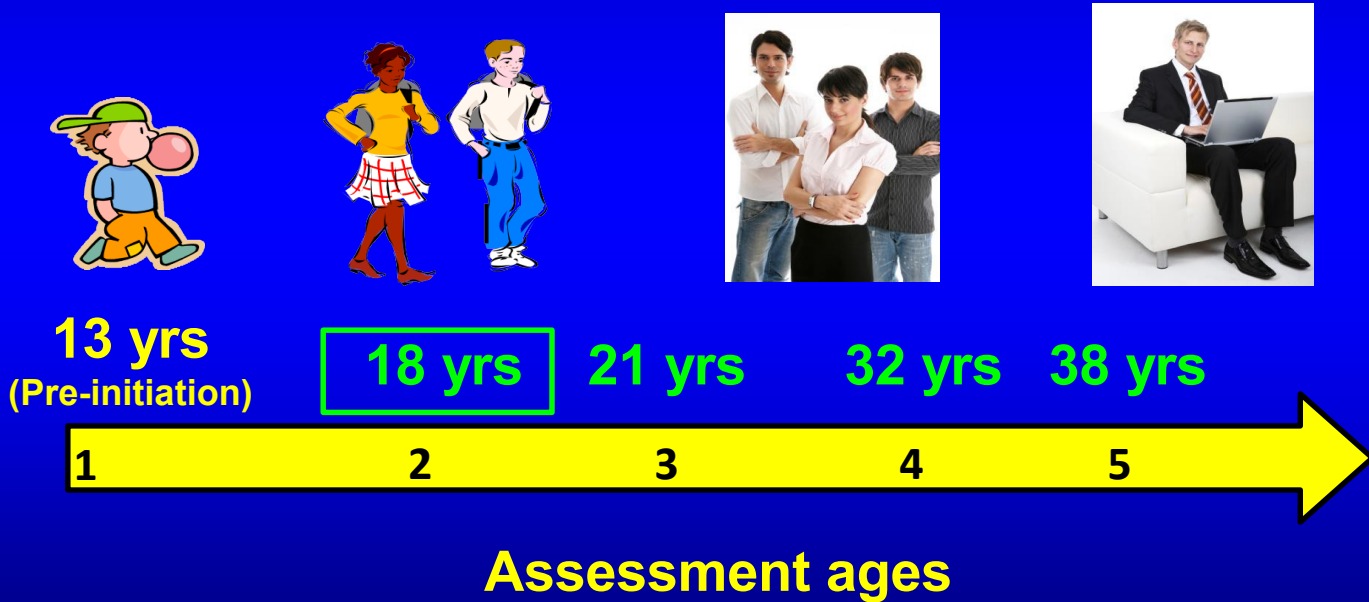
38 yrs



5

Assessment ages

The Dunedin Study (New Zealand) (N=1,037)

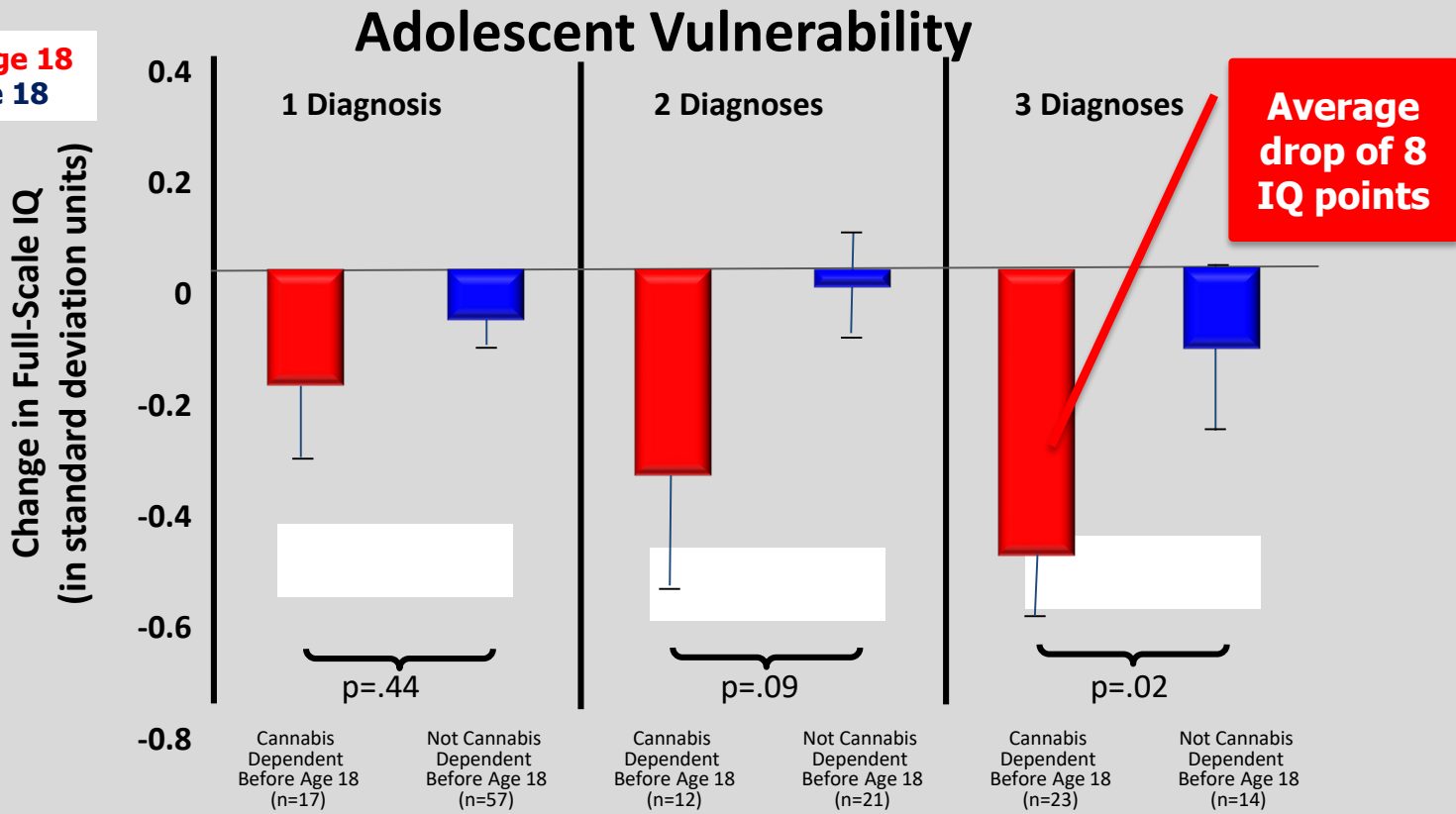




Major New Study Shows Heavy Marijuana Use Lowers IQ

Marijuana and Cognitive Development

Red = use onset before age 18
Blue = use onset after age 18



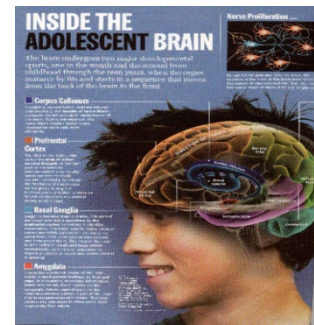
Source: Meier MH et al., PNAS Early Edition 2012.



WHY?

A. Could there be inherent risk factors of brain development that contribute to drug use?

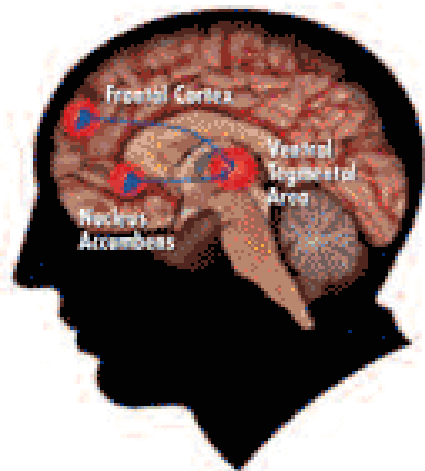
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B. Adolescent pleasure centers in the brain may be more sensitive to the acute effects of drugs than pleasure centers in the adult brain.

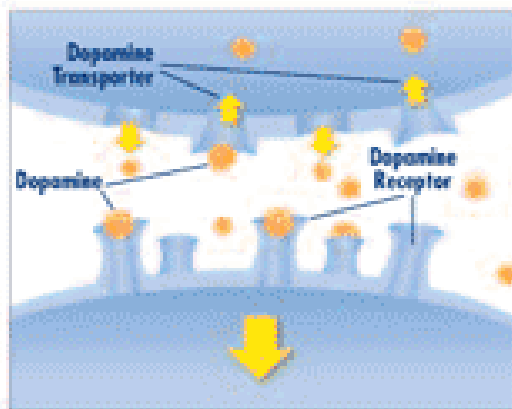
ALL DRUGS OF ABUSE TARGET THE BRAIN'S PLEASURE CENTER

Brain reward (dopamine) pathways



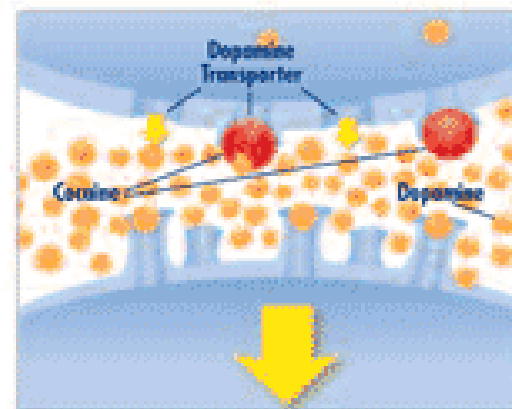
These brain circuits are important for natural rewards such as food, music, and art.

All drugs of abuse increase dopamine



FOOD

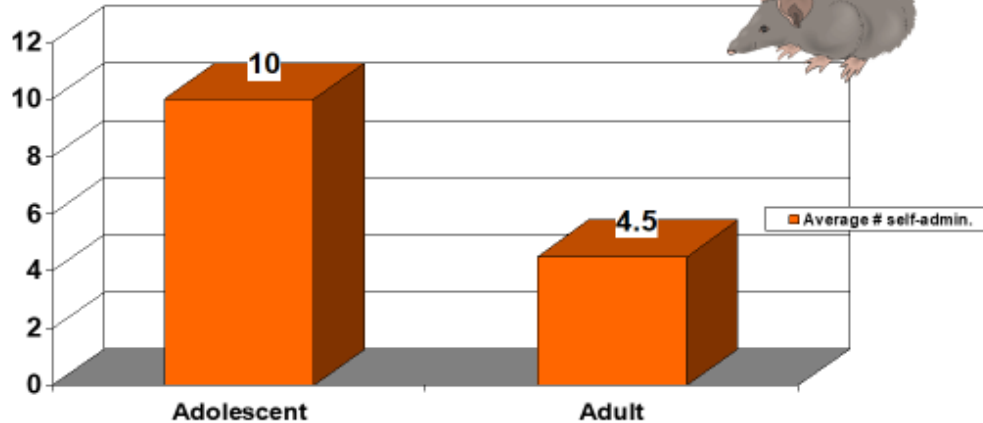
Typically, dopamine increases in response to natural rewards such as food. When cocaine is taken, dopamine increases are exaggerated, and communication is altered.



COCAINE

C. Early Use May Create a Biological Priming or Gateway Effect

Average Number of Self-Administered Doses of Nicotine When Rats Were Adults (Levin et al., 2003)



Age of Rates When First Exposed to Nicotine. All Data Collected When Rats were Adults.

Nicotine Gateway Effects on Adolescent Substance Use

Michelle Ren, MS*
Shahrdad Lotfipour, PhD†

*University of California, Irvine, Department of Pharmaceutical Sciences, Irvine, California
†University of California, Irvine, Department of Emergency Medicine and Pharmaceutical Sciences, Irvine, California

Section Editor: Tony Zitek MD

- Literature suggests: “Disruption of nicotinic acetylcholine receptors (nAChR) development with early nicotine use may alter the release of reward-related neurotransmitters, and thus increase the likelihood of future drug seeking behaviors, including drugs other than nicotine.”
- There is a “large collection of clinical and preclinical evidence that adolescent nicotine exposure influences long-term molecular, biochemical, and functional changes in the brain that encourage subsequent drug abuse.”

2. Brain development and behavioral disorders

INSIDE THE ADOLESCENT BRAIN

The brain undergoes two major developmental spurts, one in the womb and the second from childhood through the teen years, when the organ matures by fits and starts in a sequence that moves from the back of the brain to the front.

Corpus Callosum

Thought to be involved in emotion and eye coordination, this bundle of nerve fibers connects the left and right hemispheres of the brain. It acts as a highway, the nerve fibers making and receiving signals to and from each other.

Prefrontal Cortex

The CEO of the brain, what you feel the area of other second thought. In the last part of the brain to mature, which may be why teens are into so much risk-taking. Compared to adults, the prefrontal cortex is still growing in the first few years of life, and then continues to grow during adolescence.

Basal Ganglia

Larger in females than in males, this part of the brain acts like a secretary to the prefrontal cortex, handling it cognitive information. The basal ganglia and prefrontal cortex are highly connected, so as the former grows, the latter grows more slowly. The structure is crucial to fine-tuning small and large motor movements, so it's the impetus to respond quickly to tasks and stimuli related to growing.

Amygdala

It's the emotional center of the body, home to such primal feelings as fear and rage. In adolescence, neuronal information flows from the amygdala to the prefrontal cortex. It's been argued that the reduced prefrontal control in teens may stem from the amygdala's often being more developed than adults.

Nerve Proliferation ...



By age 23, for girls and 25% for boys, the neurons in the front of the brain have stopped the process of new construction. One-third of the neurons that are born in the brain will be pruned.

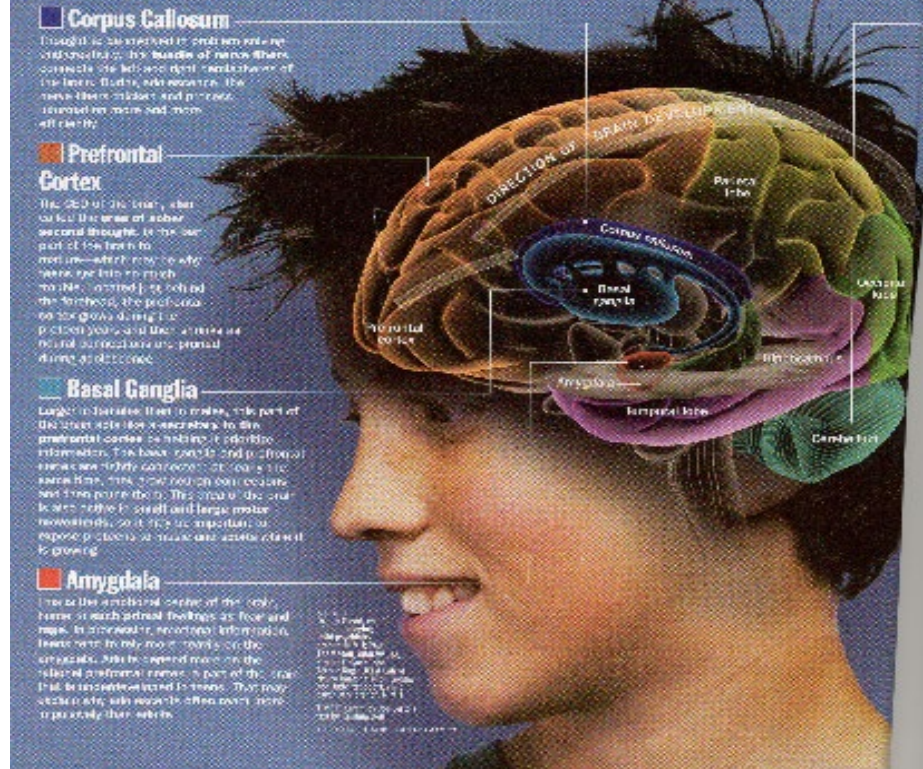
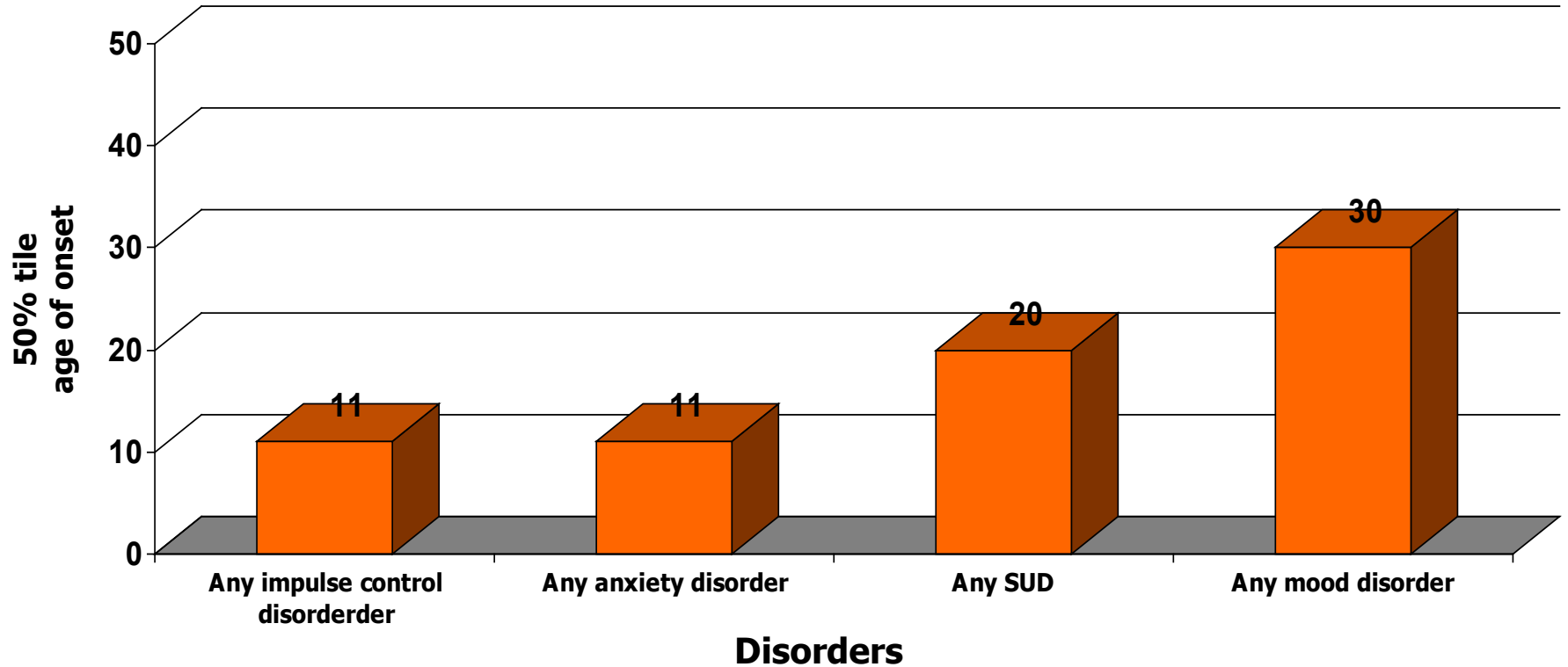


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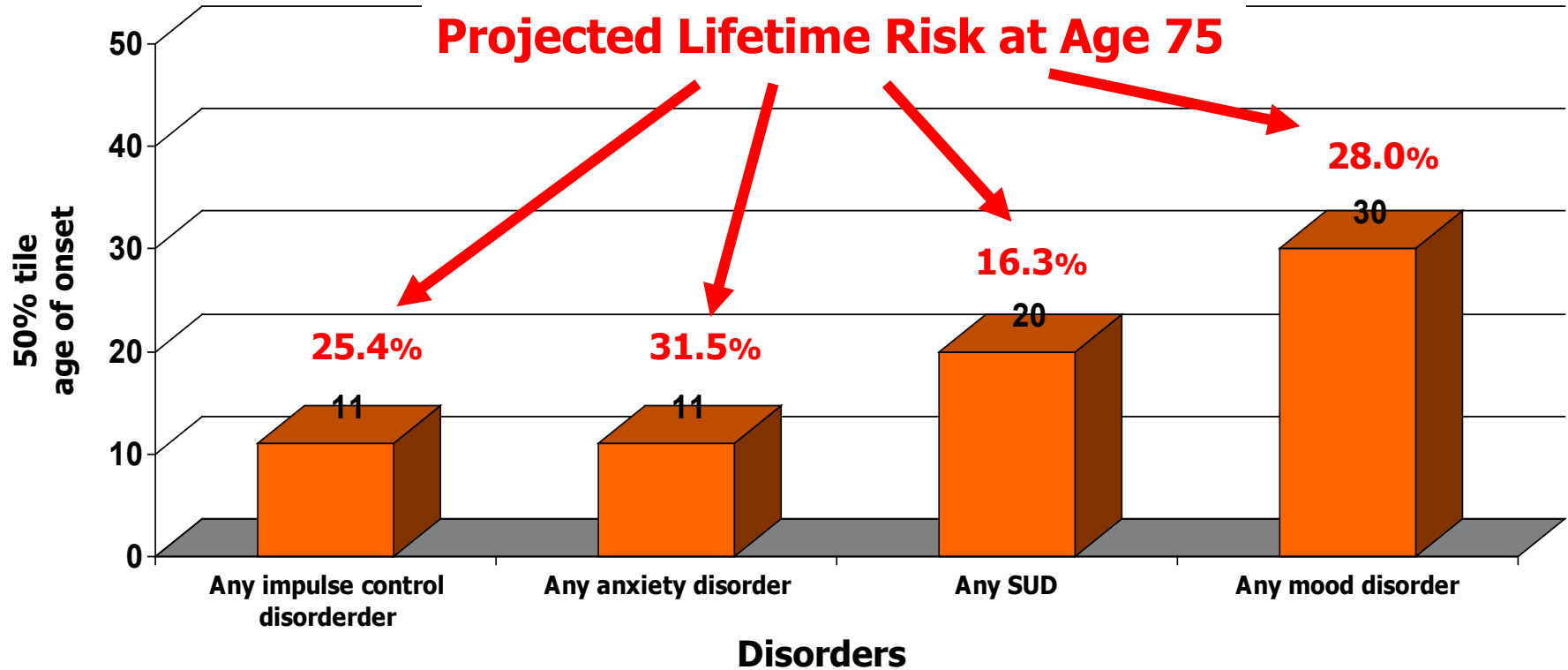
Adolescence and Behavioral Disorders

- **Alterations in neurodevelopment have been linked to several adolescent-onset mental and behavioral disorders (Charney et al., 2013):**
 - **ADHD**
 - **Affective Disorders**
 - **Anxiety Disorders**
 - **Autism**
 - **Obsessive-Compulsive Disorders**
 - **PTSD**
 - **Schizophrenia**

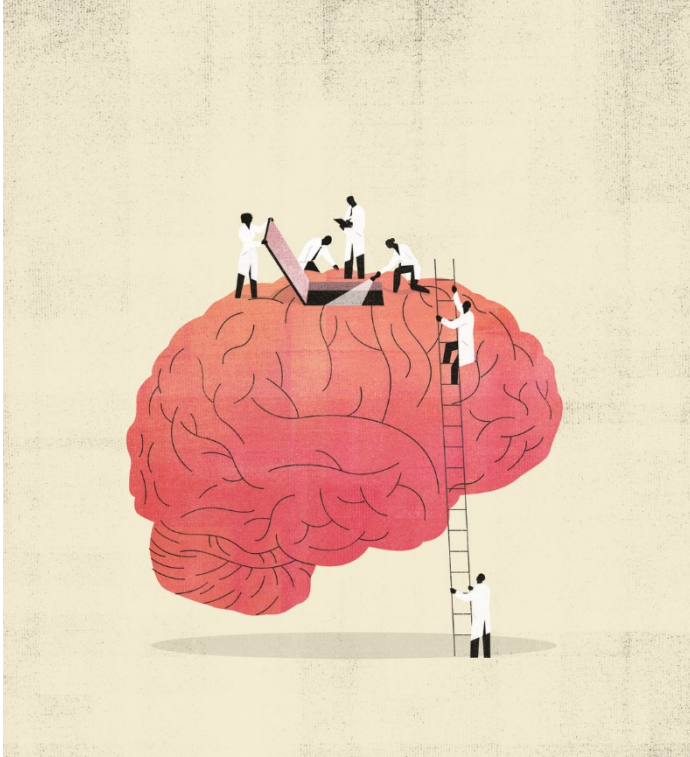
Ages at the 50 Percentile of the Age-at-Onset Distribution for Major Disorders (Kessler et al., 2005)



Ages at the 50 Percentile of the Age-at-Onset Distribution for Major Disorders (Kessler et al., 2005)

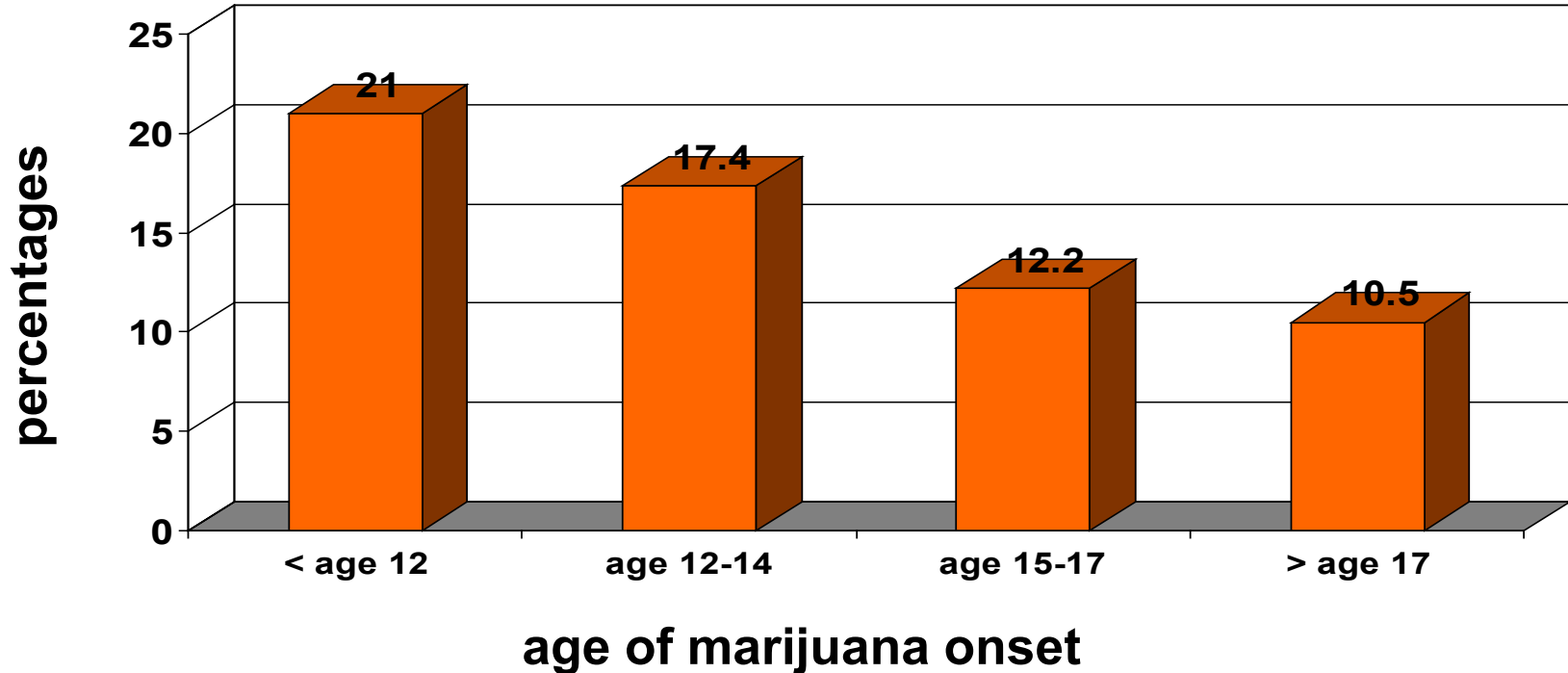


Adolescent Use of *Marijuana* and Behavioral Disorders



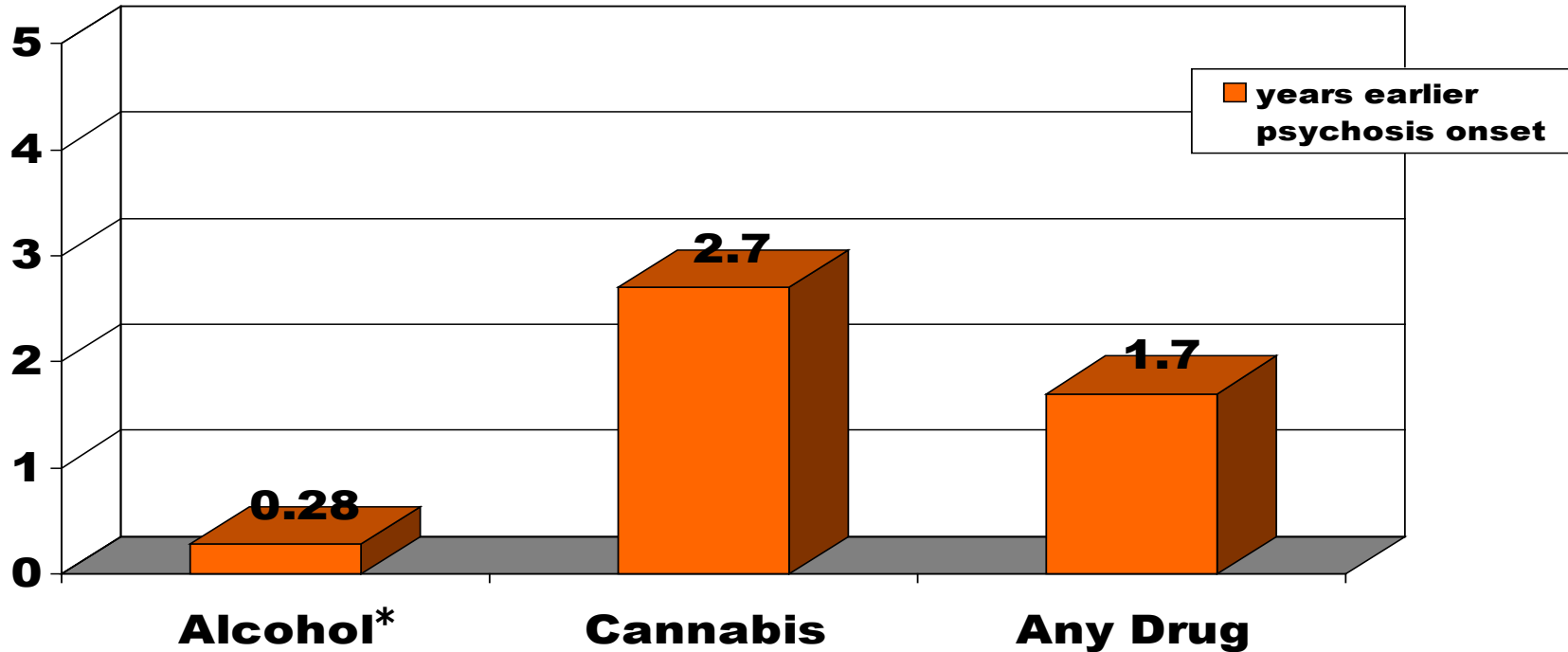
Psychosis: Prevalence of Past Year Serious Mental Illness Among Lifetime Marijuana Users Aged 18+

(SAMHSA, 2005; data collected 2002-2003)



Psychosis: Drug Use and Age at Onset of Psychosis

(Large et al., 2011; meta-analysis)



mean years earlier of age at onset of psychosis compared to non-drug using controls

* = nonsig. with controls

Miller's Review of the Marijuana and Mental Health Connection

Disorder	Cross-Sectional Data	Longitudinal Data
Schizophrenia	++	++
Bipolar	+	
Anxiety Disorders	+	+
Depressive Disorders	+	+
Risk of Suicide	+	

Key: ++ = several studies; + a few studies

Yellow box = risk greater when MJ use onset during youth.

Miller, C. L. (in press). The impact of marijuana on mental health. In K. Sabet & K.C. Winters, *Contemporary health issues on marijuana*. NY: Oxford Press.

The contribution of cannabis use to variation in the incidence of psychotic disorder across Europe (EU-GEI): a multicentre case-control study

Marta Di Forti, PhD • Diego Quattrone, MD • Tom P Freeman, PhD • Giada Tripoli, MSc •
Charlotte Gayer-Anderson, PhD • Harriet Quigley, MD • et al. [Show all authors](#)

Source: Lancet Psychiatry, 2019

- 901 patients with first episode psychosis across 11 clinic sites in Europe
- Compared 1237 population controls from those same sites
- Cannabis use was associated with increased odds of psychotic disorder compared with never users
 - Daily use of low potency cannabis = adjusted odds ratio, 3.2 (95% CI 2.2 – 4.1)**
 - Daily use of high potency cannabis = adjusted odds ratio, 4.8 (95% CI 2.5 – 6.3)**

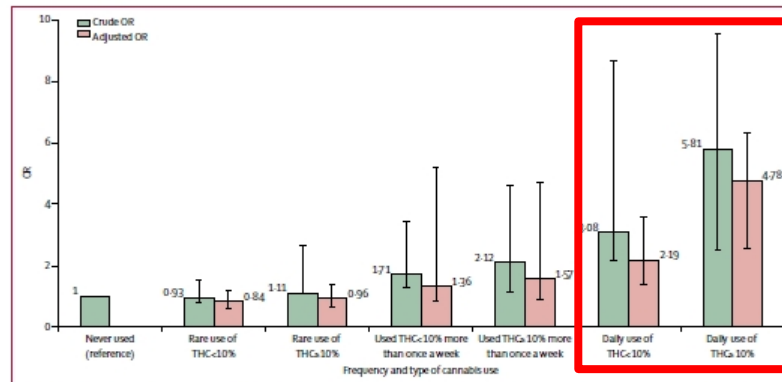
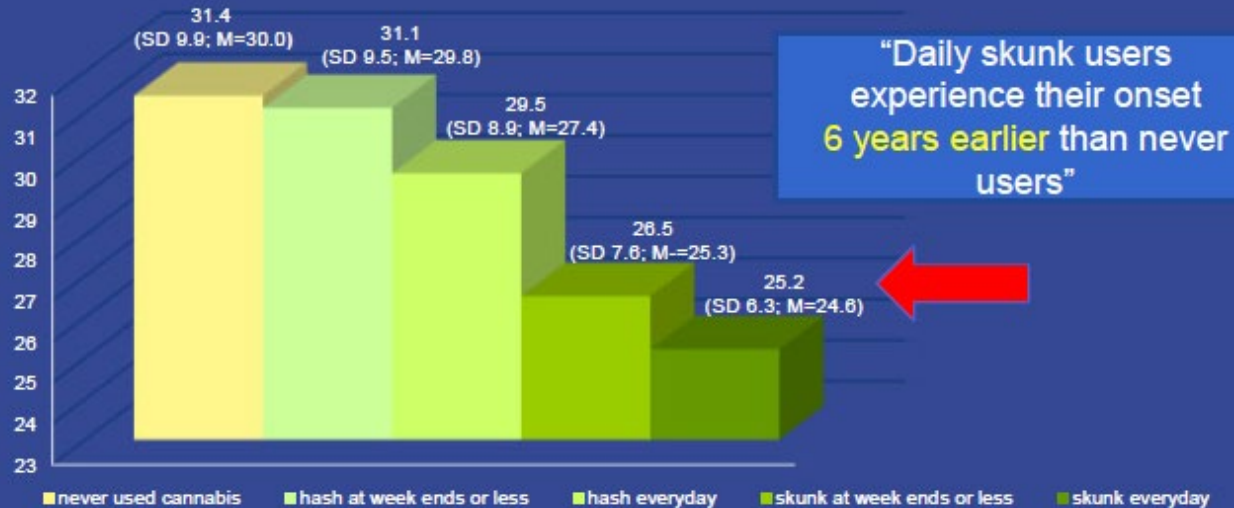


Figure 1: Crude and fully adjusted ORs of psychotic disorders for the combined measure of frequency plus type of cannabis use in the whole sample. Crude ORs are adjusted only for age, gender and ethnicity and fully adjusted ORs are additionally adjusted for level of education, employment status, and use of tobacco, stimulants, ketamine, legal highs, and hallucinogenics. Error bars represent 95% CIs. OR=odds ratio.

Psychosis: Age of Onset and Cannabis Exposure

Mean age (yrs) of onset of psychosis by degree of exposure to cannabis



Cautionary Notes

- **Reverse causation (self-medication).**
- **Early drug use may be a marker of underlying genetic risk and not causative, or only partially causative.**



3. Impact of early experiences on the developing brain and subsequent health and well-being

INSIDE THE ADOLESCENT BRAIN

The brain undergoes two major developmental spurts, one in the womb and the second from childhood through the teen years, when the organ matures by fits and starts in a sequence that moves from the back of the brain to the front.

■ Corpus Callosum

Thought to be involved in emotion and memory, the **Corpus Callosum**, the bundle of nerve fibers connecting the left and right hemispheres of the brain, builds and matures. The nerve fibers mature and increase in number over time and remain all healthy.

■ Prefrontal Cortex

The CEO of the brain, what you'd call the area of sober second thought, is the last part of the brain to mature, which may be why teens are into so much risk-taking. Formed by the end of the embryonic stage, it continues to develop during the prepubertal years and then undergoes a final maturation period during adolescence.

■ Basal Ganglia

Larger in females than in males, this part of the brain acts like a secretary to the prefrontal cortex by making it efficient. Information from the back goes to and from the basal ganglia, which also sends the same info, plus a few more bits, to the rest of the brain. The structure is made up of many small and large motor neurons, so it's the impulsion to respond quickly to tasks and activities that is growing.

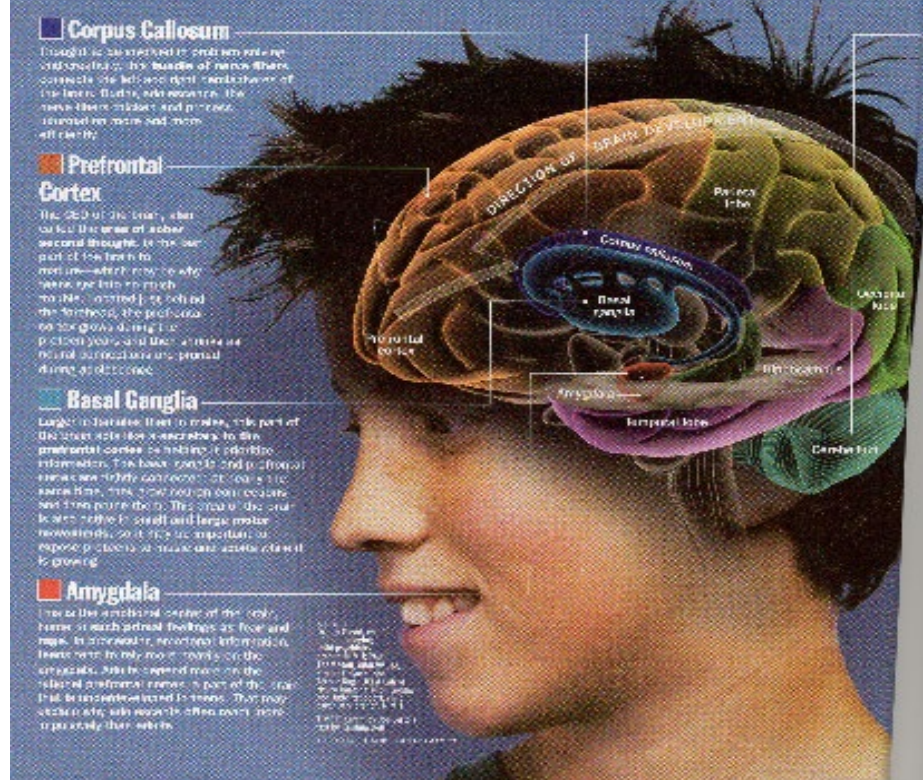
■ Amygdala

It's the emotional center of the body, home of such primal feelings as fear and rage. In adolescence, neuronal information flows from the amygdala to the cerebral cortex, which is wired more on the rational and logical side. A part of the brain that is still developing in teens, they may seem to act with emotion often, even if it's just a little more than you'd expect.

Nerve Proliferation ...



By age 23 for girls and 25 for boys, the neurons in the front of the brain have stopped the process of new construction. Over the next few years, most of them will be pruned.



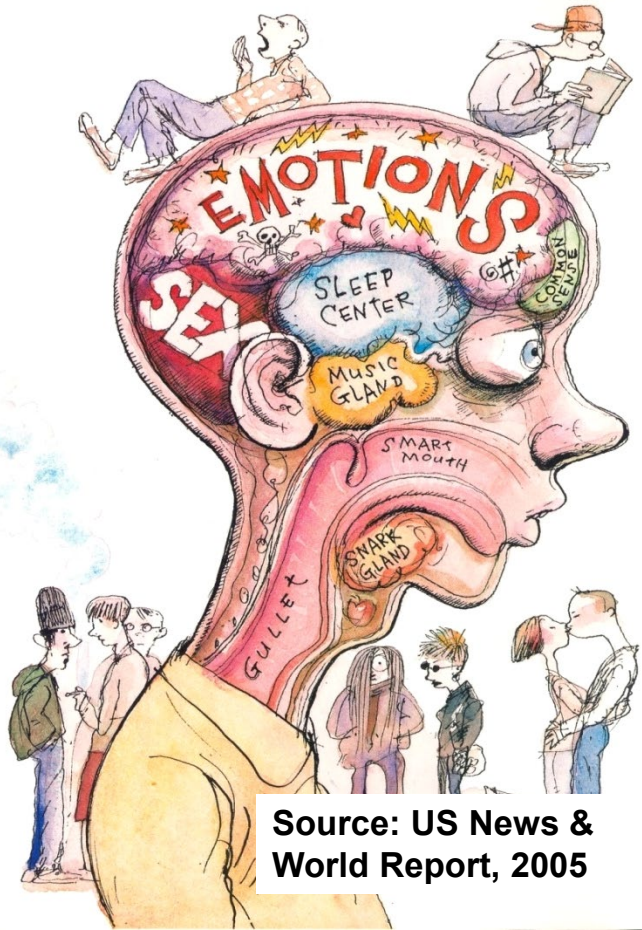
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A Developing Brain

> Impact from Environment?

- “Exposure to both positive and negative elements before adolescence can imprint on the final adult topography in a manner that differs from exposure to the same elements after adolescence.”

(Anderson, 2003, *Neuroscience & Biobehavioral Reviews*)



Source: US News &
World Report, 2005

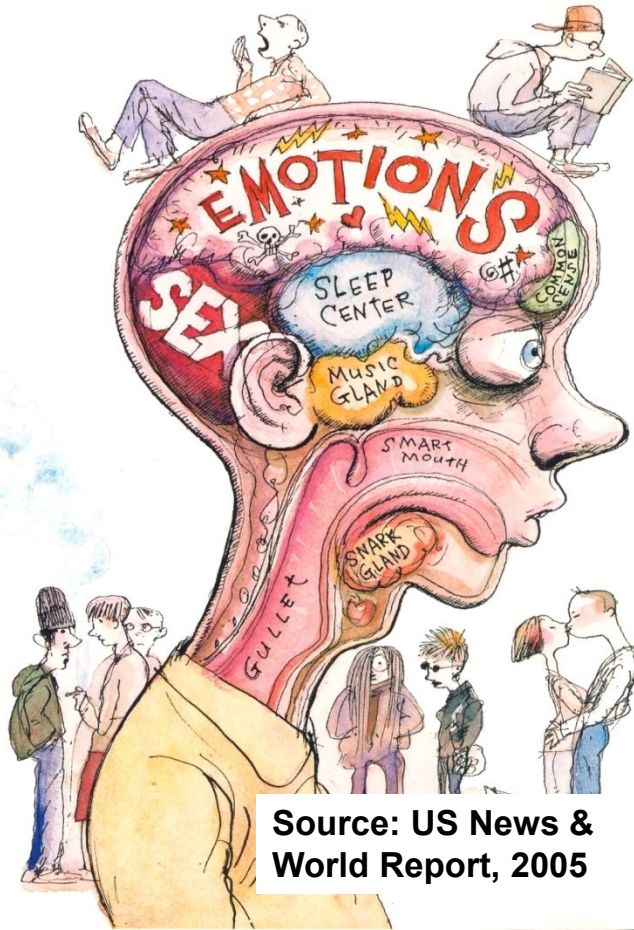
A Developing Brain

> Impact from Environment?

<https://developingchild.harvard.edu/science/deep-dives/mental-health/>

 Center on the Developing Child
HARVARD UNIVERSITY

- “The interaction between genetic predispositions and sustained, stress-inducing experiences early in life can lay an unstable foundation for mental health that endures well into the adult years.”



Source: US News &
World Report, 2005



A Developing Brain

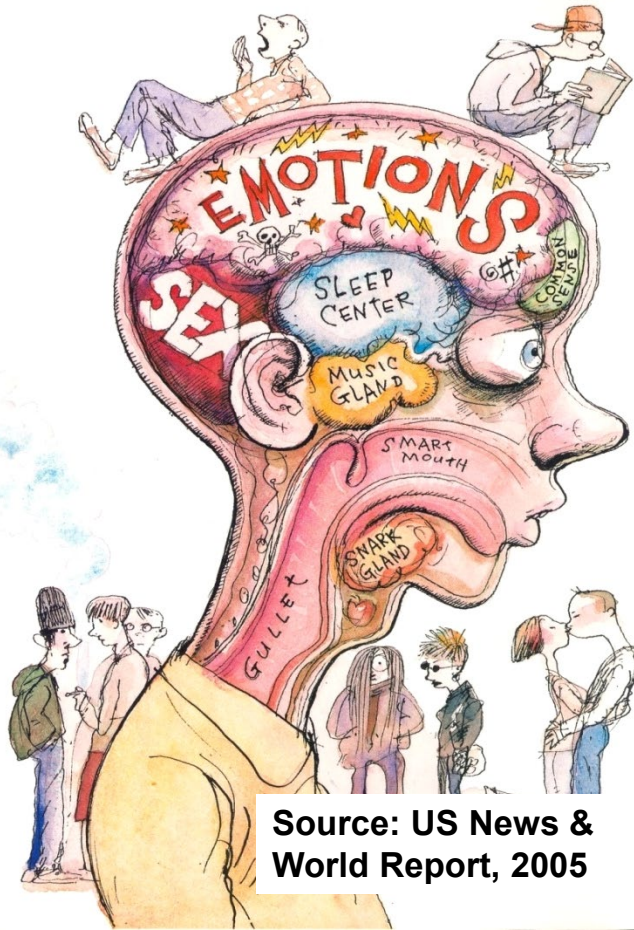
> Impact from Environment?

<https://developingchild.harvard.edu/science/deep-dives/mental-health/>

 Center on the Developing Child
HARVARD UNIVERSITY

Rays of Hope!

- **“Some individuals demonstrate remarkable capacities to overcome the severe challenges of early, persistent maltreatment, trauma, and emotional harm.”**
- **“Most potential mental health problems will not become mental health problems if we respond to them early.”**



Source: US News &
World Report, 2005

Early experiences can alter brain development in positive ways



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

“Nurturing and responsive care for the child’s body and mind is the key to supporting healthy brain development.”



Early experiences can alter brain development in positive ways.



Preschool is a sensitive period for the influence of maternal support on the trajectory of hippocampal development

Joan L. Luby^{a,1}, Andy Belden^a, Michael P. Harms^a, Rebecca Tillman^a, and Deanna M. Barch^{a,b,c}

^aDepartment of Psychiatry, Washington University in St. Louis, St. Louis, MO 63110; ^bDepartment of Psychological & Brain Sciences, Washington University in St. Louis, St. Louis, MO 63130; and ^cDepartment of Radiology, Washington University in St. Louis, St. Louis, MO 63110

More parental support = more hippocampus volume



Early experiences can alter brain development in negative ways

WHAT ARE ACES?
AND HOW DO THEY RELATE TO TOXIC STRESS?

SAMHSA
Substance Abuse and Mental Health
Services Administration



The impact of child traumatic stress can last well beyond childhood. Associated with...

- Learning problems
- Substance abuse
- Increased use of health services, including mental health services



Early experiences can alter brain development in negative ways

Development and Psychopathology

Article

Supplementary materials

Metrics

First View

Mind and gut: Associations between mood and gastrointestinal distress in children exposed to adversity

Bridget L. Callaghan ^(a1) ^(a2), Andrea Fields ^(a1), Dylan G. Gee ^(a3), Laurel Gabard-Durnam ^(a4) ... ^(a)
<https://doi.org/10.1017/S0954579419000087> Published online: 28 March 2019

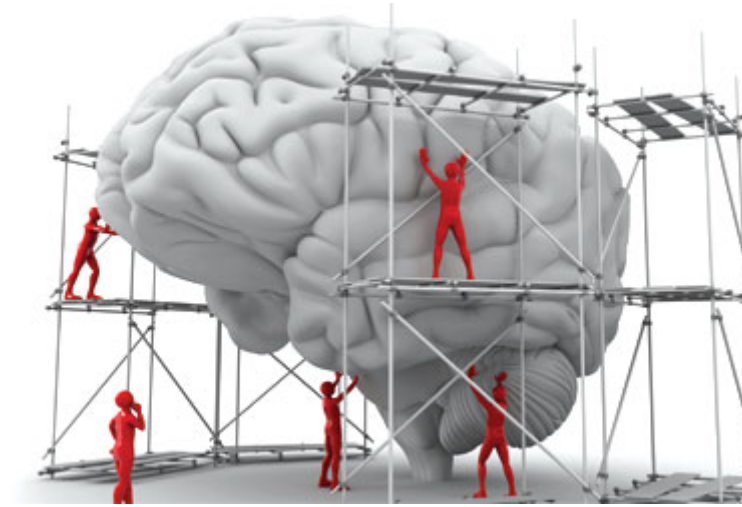


- **Children deprived of parents early in life (orphans), compared to children with parents, revealed....**
 - **increased gastrointestinal symptoms**
 - **pattern of gut microbiomes linked to..**
 - **current and future anxiety**
 - **prefrontal cortex activation to emotional faces**



Brain Development: Implications for Youth Serving Workers & Educators

- 1. Teach youth about brain development and its importance to health and personal growth**



Brain Development: Implications for Youth Serving Workers & Educators

- **Teach “adaptive” decision making**
 - **taking risks that promote “personal-growth”**
 - **“on second thought” skills**
 - **how to avoid peer pressure to engage in delinquency**

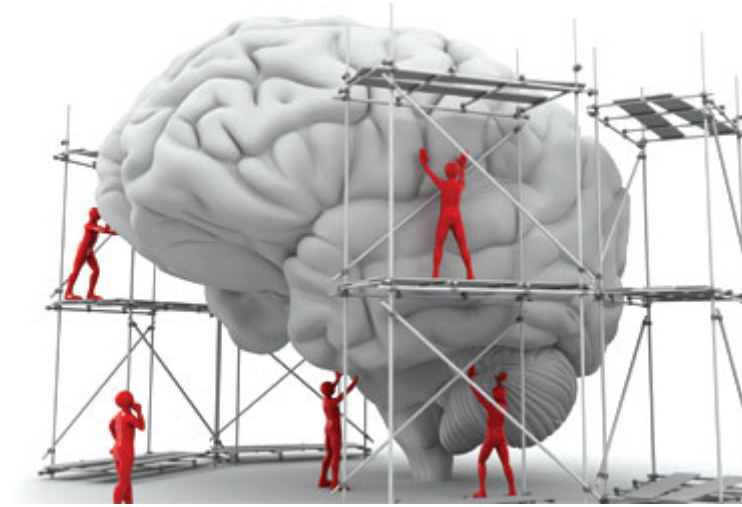


Brain Development: Implications for Youth Serving Workers & Educators

- Interested in a “teen brain” resource to help teach youth about brain development?

send me an e-mail:

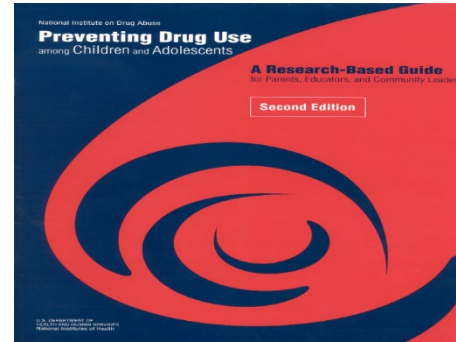
winte001@umn.edu



Brain Development: Implications for Youth Serving Workers & Educators

2. Use evidenced-based *prevention* programs

- Keys to effective prevention are in the research literature
 1. National Institute on Drug Abuse
<https://www.drugabuse.gov>
 2. Cochran literature review
<https://www.cochranelibrary.com/cdsr/about-cdsr>
 3. ISSUP's prevention curriculum
<https://www.issup.net/training/universal-prevention-curriculum>

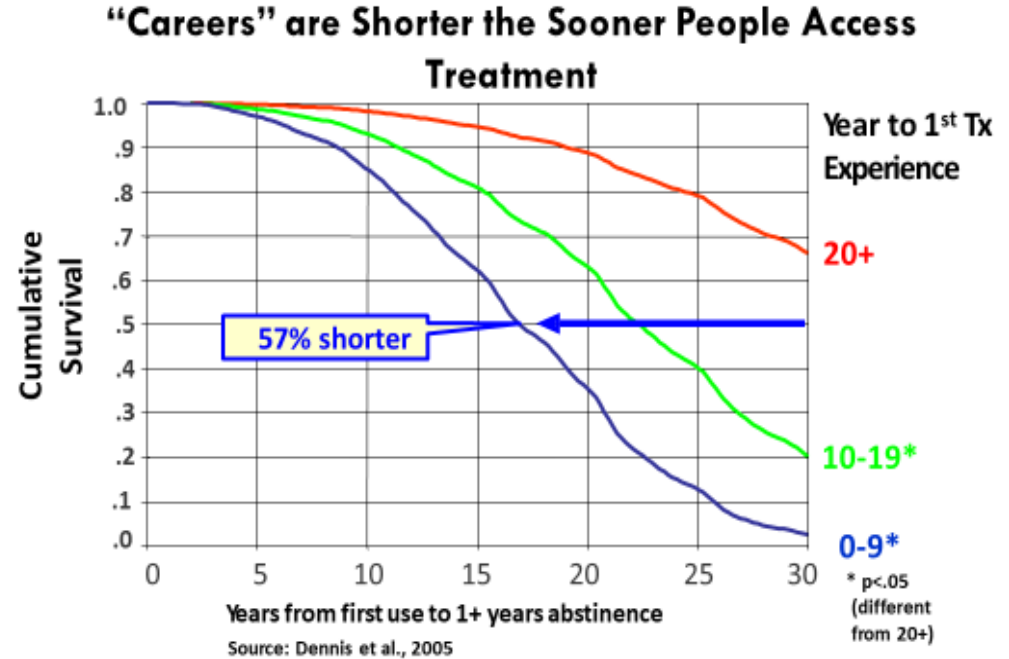


Trusted evidence.
Informed decisions.
Better health.



Brain Development: Implications for Service Providers

3. Earlier the *treatment*, the better



Brain Development: Implications for Service Providers

4. Use evidenced-based *treatment*

Treatment: Recent literature summary and meta-analysis (Hogue et al., 2018; **NIDA, 2014**; Tanner-Smith et al., 2012)

Treatment “as usual” is no better than prevention education only or no treatment.

A wide range of more recent evidenced-based treatment do significantly better.

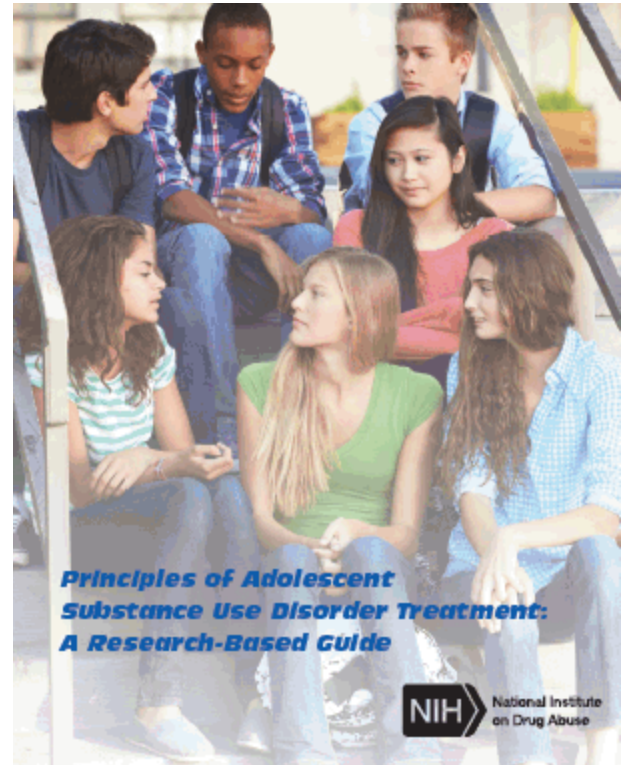
MET, CBT and family therapy



Evidenced-Based Treatment

NIDA (2014): *Principles of Adolescent Substance Use Disorder Treatment: A Research-Based Guide*

- **Motivational Interviewing**
- **Cognitive – Behavioral Therapy (CBT)**
- **Family Treatment**



CBT and MI Are Helpful for Teaching and Supporting Self-Regulation

- **impulse control**
- **“second” thought processes**
- **social decision making**
- **dealing with risk situations**
- **taking healthy risks**



New 12-Step Program for Adolescents ?

12-Steps of Self-Regulation

- 1. impulse control**
- 2. "second thought" processes**
- 3. social decision making**
- 4. dealing with risk situations**
- 5. taking healthy risks**
- 6. attention regulation**
- 7. anger control**
- 8. modulating reward incentives**
- 9. choosing options**
- 10. considering consequences**
- 11. minimizing arousal**
- 12. dealing with peer influences**

Brain Development: Implications for Youth Serving Workers & Educators

5. Increase the “cannabis and vaping IQ” of adolescents



- **Sources of exercises and quizzes**

- **Cannabis:**

- **www.dfaf.org (*Busting the Top Ten Myths of Marijuana*)**

- **Vaping:**

- **Google “CDC educating kids on vaping”**
<https://www.cdc.gov/tobacco/features/back-to-school/e-cigarettes-talk-to-youth-about-risks/index.html>

Brain Development: Implications for Service Providers

6. Teach parents about brain development

P = Promote activities that capitalize on the strengths of the developing brain.

A = Assist children with challenges that require planning.

R = Reinforce their seeking advice from adults; teach decision making.

E = Encourage a lifestyle that promotes good brain development.

N = Never underestimate the impact of a parent being a good role model.

T = Tolerate the “oops” behaviors due to an immature brain.



Parent Resources

1.

THE PARTNERSHIP
AT DRUGFREE.ORG

Prevent_Intervene_Get
Treatment_Recover

www.drugfree.org

2.



3.



Preventing Teen Drug Use

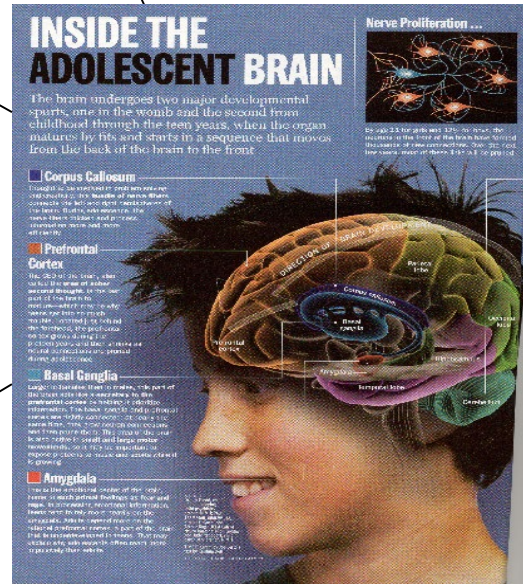
Prevent your teen from starting or continuing drug use.

I. Brain development

IV. Summary

III. Youth Service Providers

II. Developing brain, drugs and mental health



Summary

- **Adolescence is an extended period of transition from reliance on adults to independence**
- **Normal adolescence is characterized by....**
 - **increase in conflicts with family members**
 - **desire to be with one's friends**
 - **resistance to messages from authority**
 - **irritability**
 - **risk taking**
 - **proclamations of sheer boredom**



Summary

**reward incentives >
perception of
consequences**



Summary

- **Several lines of evidence suggesting that adolescence is a period of vulnerability to the effects of drugs, and a period linked to the onset of some mental disorders.**



Summary

- **Employ teen-brain friendly and evidence-based prevention and treatment**
 - **Prevention: decrease risk, increase protective factors**
 - **Treatment: employ these techniques**
 - **Motivational interviewing**
 - **CBT**
 - **Family therapy**
 - **Teach parents about brain development**



Teen Brain Development Quiz



1. There are several health indices suggesting that teenagers take less risk than in years past.
True (increased rate of "abstaining" from all substances; lower rate of teenage pregnancies and certain delinquency behaviors)

2. What lifestyle choices during adolescence promote good brain development?
Healthy diet; sufficient sleep; involvement in music; daily exercise; connect to community/culture; learn resiliency skills; no drug use

2. Which is more harmful to the developing brain?
 - a. Chronic, heavy use of marijuana
 - b. Chronic, heavy drinking**Good question!!**



THANK YOU

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Questions and Discussion

