


**Teenage Brain Development:
Implications for Preventing
and Treating Drug Abuse**

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**Emerging Science:
Teen Brains Are Still “Under Construction”**

New insights about:

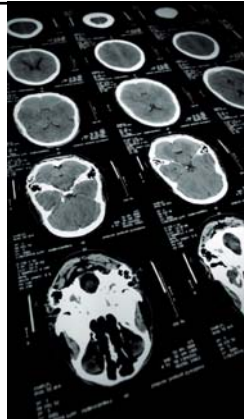
- Risk taking by teenagers
- How teenagers may be highly vulnerable to drug abuse



Emerging Science: Brain Imaging

New insights because:

- 1990's information explosion due to the development of brain imaging techniques (e.g., CT, PET and MRI).



What Have We Learned?

- Adolescence is a period of profound brain maturation.
- We thought brain development was complete by adolescence
- We now know... maturation is not complete until about age 25!



Source: Giedd, 2004.

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

BECAUSE THEY ARE.



Allstate ad, *NY Times*,
May, 2007

EVER ASKED, "WHY?" THROUGHOUT HISTORY, WE
TEND TO ASK "WHY?"
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 crucial 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.

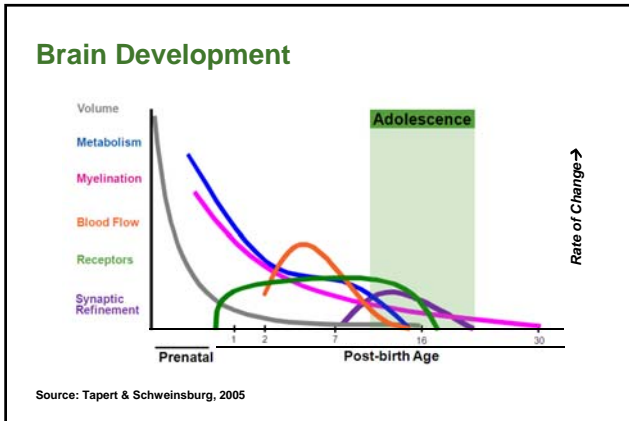
It's not unique. Teen-aged drivers have crash rates three
times higher than 20-year-olds, and four times higher

crashes. These teen drivers are more dangerous kinds
of drivers, even at night. In North Carolina, for
example, teen drivers are more likely to be involved in
crashes involving 16-year-olds.

To find out what the GDL laws are in your state,
visit Allstate.com/teen. If you're a driver, then—
and if they aren't strong enough, ask your legislature to
strengthen them.

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Brain Development

When the pruning is complete, the brain is faster and more efficient.

But... during the pruning process, the brain is not functioning optimally.

Source: Giedd, 2004.

Brain Development

Images of brain development in healthy youth (ages 5 – 20)

Maturation occurs from back to front of the brain

Blue represents maturing of brain areas

Source: Gogtay, Giedd, et al., 2004.

**Implications of Arrested Development:
Adolescent Behavior**

Earlier development of the back of the brain and later development of the front of the brain ...



**Implications of Arrested Development:
Adolescent Behavior**

Earlier development of the back of the brain and later development of the front of the brain ...

- Preference for physical activity
- Less than optimal planning and judgment
- More risky, impulsive behaviors
- Minimal consideration of negative consequences



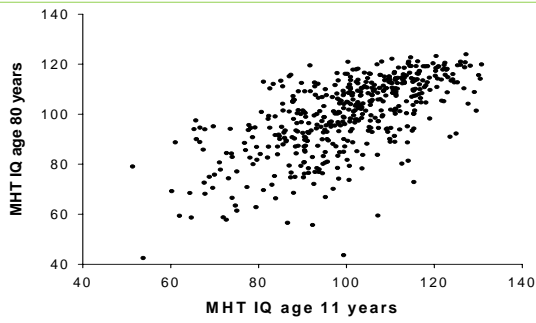
Cautions about what to not infer regarding the “Developing Brain”



A Developing Brain ≠ Low Brain Power



**Taking the Same Ability Test at Age 11 & Age 80:
Scottish Mental Survey 1932**



Deary et al. (2004) *Journal of Personality and Social Psychology*, 86, 130-147.

**A Developing Brain ≠ Absence of Good
Judgment**



Judgment Gets Better with Age

- By age 18, the adolescent's judgement for structured challenges is roughly equal to that of adults.
- But judgement that involves resisting impulses or delaying gratification is still under construction during late adolescence and early adulthood.

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Implications of Arrested Development:

Drug Abuse Vulnerability

Research question addressed by scientists:

“ Are adolescents more susceptible than adults to alcohol? ”

4 lines of evidence



Implications of Arrested Development:

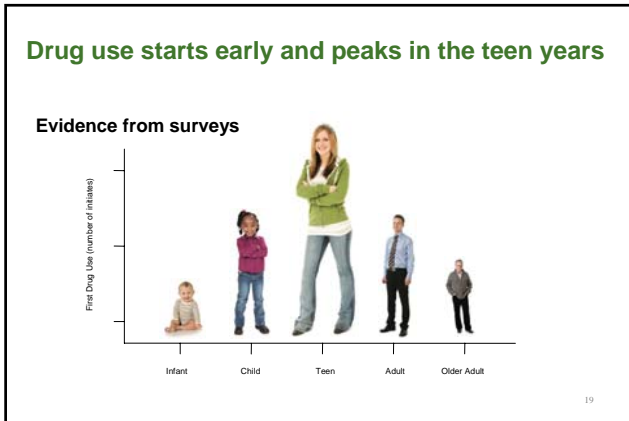
Drug Abuse Vulnerability

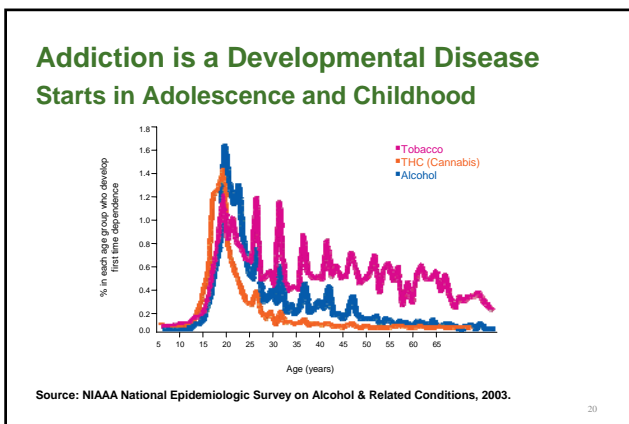
Research question addressed by scientists:

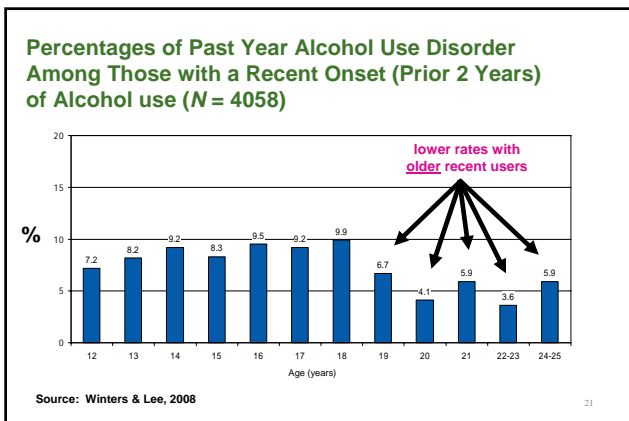
“ Are adolescents more susceptible than adults to alcohol? ”

1. Survey data










**Implications of Arrested Development:
Drug Abuse Vulnerability**

Research question addressed by scientists:

“ Are adolescents more susceptible than adults to alcohol? ”

1. Survey data
- 2. Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication.**



Susceptibility to Alcohol


Direct evidence can not obtained from human adolescents for ethical reasons.

Much of what is known about alcohol susceptibility is from adolescent rat studies.

Comparing adolescent and adult rats, both having no prior exposure to alcohol and matched on temperament....

Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication. more drinking before “signals to stop”

Source: Spear, 2002




**Implications of Arrested Development:
Drug Abuse Vulnerability**

Research question addressed by scientists:

“ Are adolescents more susceptible than adults to alcohol? ”


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



Social Disinhibition

Adolescent rats are more sensitive to the social disinhibition effects of alcohol compared to adults.

These studies suggest that adolescent rats derive greater "social comfort" from intoxication than adult rats.



Source: Spear, 2002


**Implications of Arrested Development:
Drug Abuse Vulnerability**

Research question addressed by scientists:

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1. Survey data
2. Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication.
3. 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.




**Implications of Arrested Development:
Drug Abuse Vulnerability**

Research question addressed by scientists:

“Are adolescents more susceptible than adults to alcohol?”

1. Survey data
2. Adolescent rats are less sensitive to the sedative and motor impairment effects of intoxication.
3. Adolescent rats are more sensitive to the social disinhibition effects of alcohol.
4. Alcohol produces greater cognitive disruptions in adolescents.



Animal Data: Alcohol's Effects

When exposed to alcohol, adolescent rats, compared to adult rats, reveal more...

- Disruption in memory
- Impairment of neurotransmission in hippocampus and cortex



Source: Spear, 2002

Human Data: Alcohol's Effects

The hippocampus encodes new information into memory.

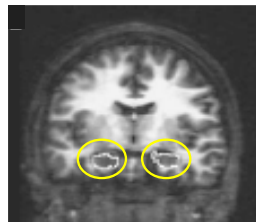
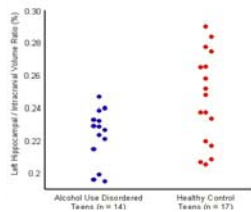
Adolescents with a history of alcohol use disorder have a smaller hippocampus volume (on average, by about 10%).



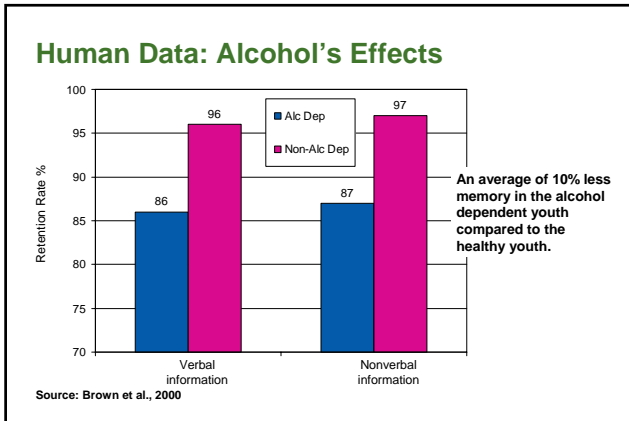
Source: Tapert & Schweinsburg, 2005

MRI: Hippocampal Size

Left hippocampal smaller in AUD (alcohol use disordered) teens compared to healthy teens by about 10%.

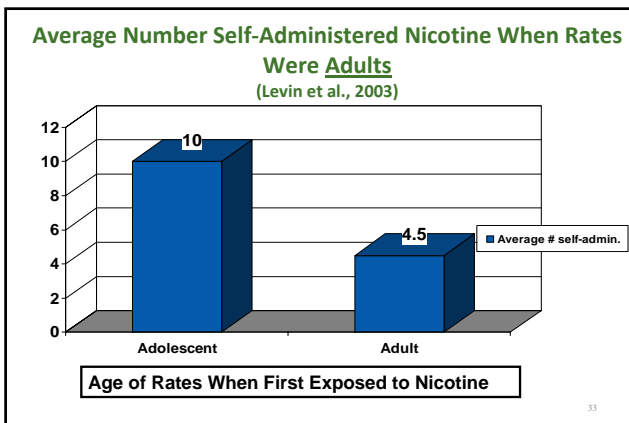


Source: Tapert & Schweinsburg, 2005



Recap

- The brain undergoes a considerable amount of development during the teen years
- The last area to develop is the prefrontal cortex, which is involved in planning, decision making and impulse control
- Alcohol - and likely other drugs - affects the young person more profoundly than its effects on adults
- Repeated alcohol exposure may harm adolescent brain development.
- **New studies are contributing more insights**



Opportunities for Drug Prevention

- Because many teens begin using substances at a young age and because of their possible deleterious effects on the developing brain, the urgency for prevention is real.
- Delaying the onset of drug use, especially if it is delayed until adulthood, is better for both brain development and for preventing escalation of use.
- These emerging findings should reinforce that youth drug use is associated with more dangers than the vague social and legal consequences often highlighted in prevention messages.
- Teenagers who abuse drugs may avoid permanent neurological damage if they can cut down or abstain.



Opportunities for Drug Prevention

- There is also the need to educate parents – both because they better explain adolescent behavior and because they present cautionary signs that parents may want to heed.
- If the seemingly irresponsible behaviors of teens are not truly willful acts but are the result of the brain still “under construction,” parents will want to be more tolerant of such annoying behaviors common during adolescence.
- Rather than the message: “I need to know where you are and who you are with because you are too immature to be trusted,” the more scientifically justified message is: “I need to help you anticipate a risky situation until your brain is fully developed and capable of recognizing the danger signs on your own.”



Take Home for Parents

- P**romote activities that capitalize on the strengths of the developing brain
- A**ssist your child with challenges that require planning
- R**einforce their seeking advice from you and other adults
- E**ducate about risk taking and negative consequences
- N**ever underestimate drug effects on developing brain
- T**olerate “oops” behaviors common during the teens

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Opportunities for Drug Prevention

- There is a need to creating age-appropriate curriculum to educate youth about their developing brain.
- The emerging sciences of the neurobiology of addiction and of brain development are providing new insights about how drugs affect the brain and how teenagers make critical and life influencing decisions, including their decisions about drug use.



Opportunities for Drug Prevention

- This new science also places importance on educating youth about the skill of using the "thinking breaks" when in an emotional or arousing situation.
- Conditions under which the developing judgment region of the brain is likely to be challenged, and how to engage in "second thought" mechanisms, should be part of health education classes in schools.



Opportunities for Drug Treatment

- Two treatment approaches for drug abuse seem to be “teen brain” friendly:
 - Cognitive – behavioral therapy
 - Motivational interviewing



Characteristics of CBT

- Focus on immediate, relevant and specific problems
- Change based on self-responsibility
- Self-efficacy can occur quickly



Characteristics of Motivational Interviewing

- De-emphasize labels
- Emphasis on personal choice and responsibility
- Therapist focuses on eliciting the client's own concerns
- Resistance is met with reflection and non-argumentation
- Treatment goals are negotiated; client's involvement is seen as vital



Implications for Optimizing Programs

- The youthful brain is not likely to exhibit optimal....
 - Planning (second thought)
 - Weighing negative consequences
 - Impulse control

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Implications for Optimizing Programs

- Shape programs to accommodate the youthful brain....
 1. Responds to novelty
 2. Primed for physical and sensory activities
 3. Influenced by peers
 4. Focus on social skills to help with resisting certain impulses (teach to use "on second thought")
 5. Provide adult supervision

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Keep in mind....

- Taking risks is not always unhealthy.
- Growth experiences and extending one's talents may involve risk-taking.



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Suggested Readings

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Comments or Questions

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For more on adolescent brain development, visit

www.mentorfoundation.org (link to Teenage Brain Development)

www.drugfree.org/teenbrain
