

# The Developing Brain, Adolescence and Vulnerability to Drug Abuse

Teaching Resource from  
The Mentor Foundation

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# Acknowledgements

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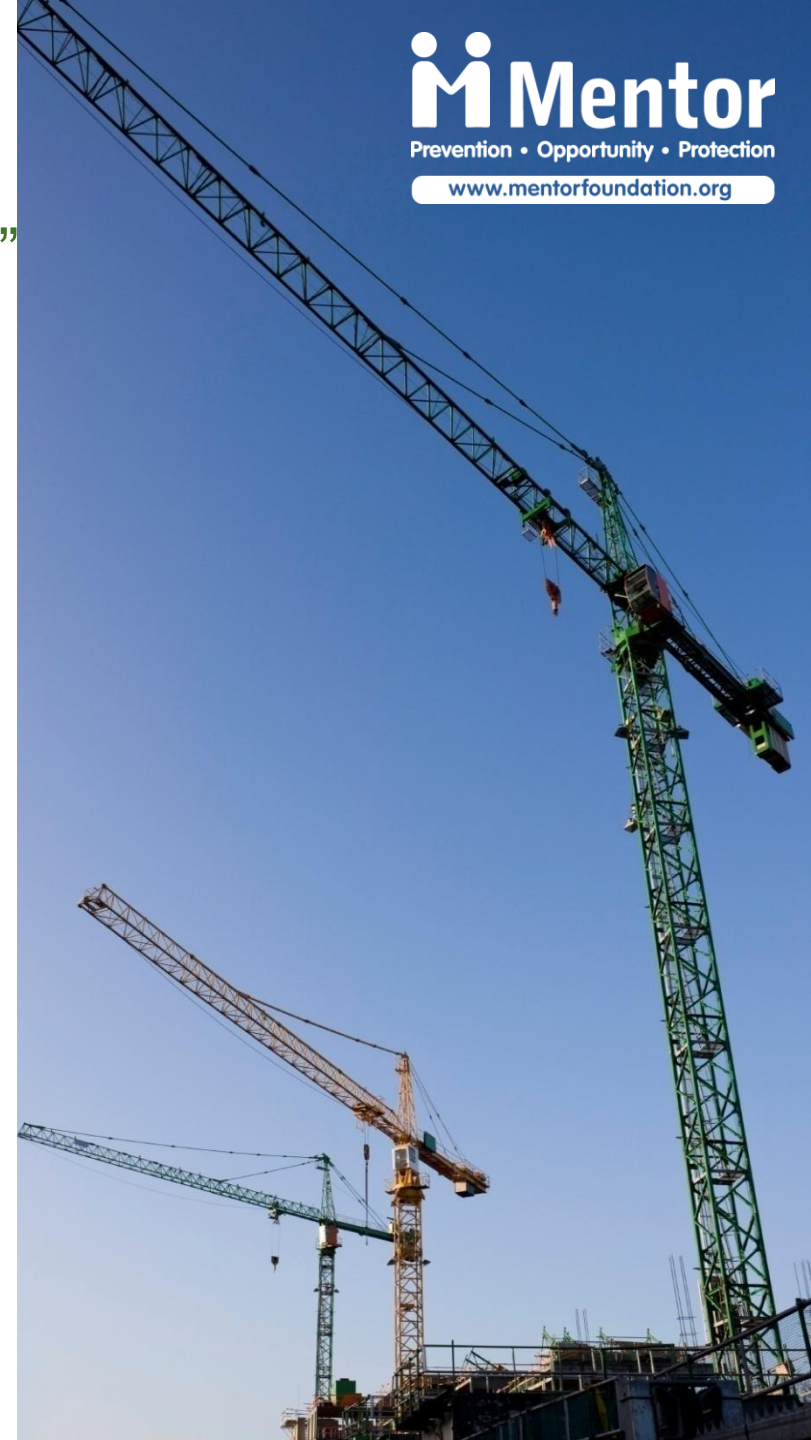
Linda Spear, SUNY at Binghamton (USA)

Susan Tapert, University of California – San Diego (USA)

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

New insights about:

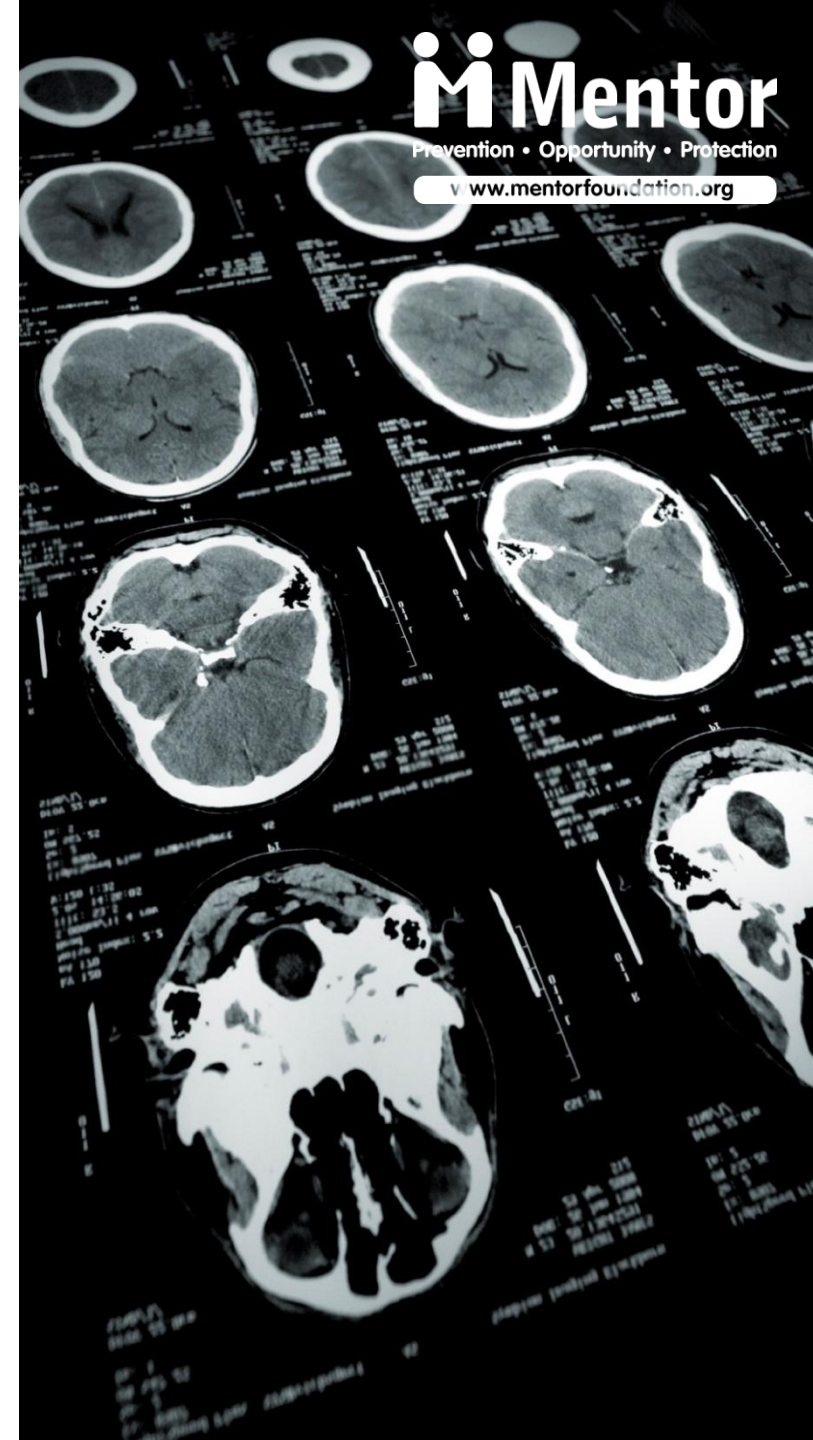
- Risk taking by teenagers
- How teenagers may be highly vulnerable to drug abuse



# 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).



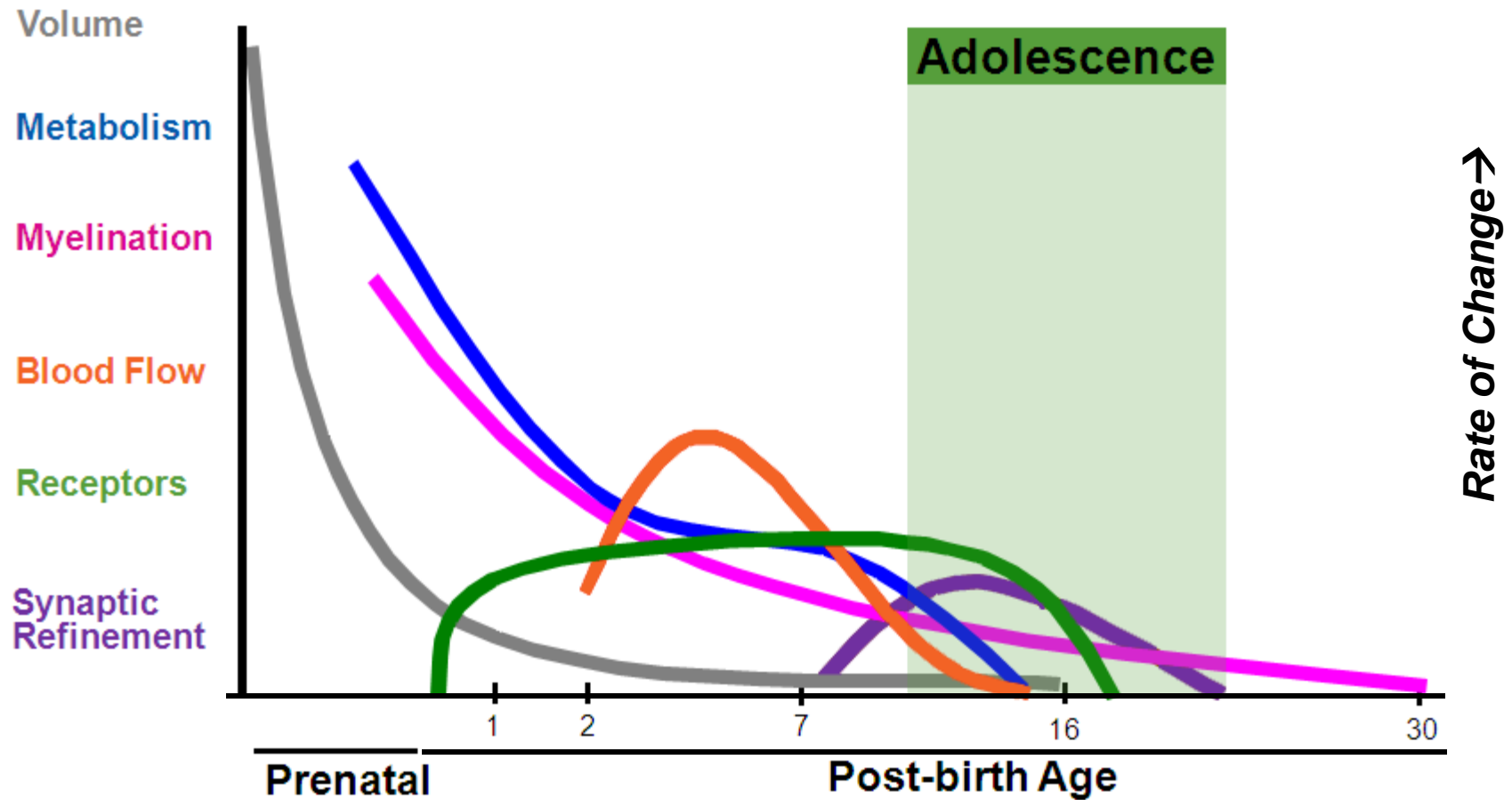
# What Have We Learnt?

- 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.



# Brain Development



Source: Tapert & Schweinsburg, 2005

# 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.



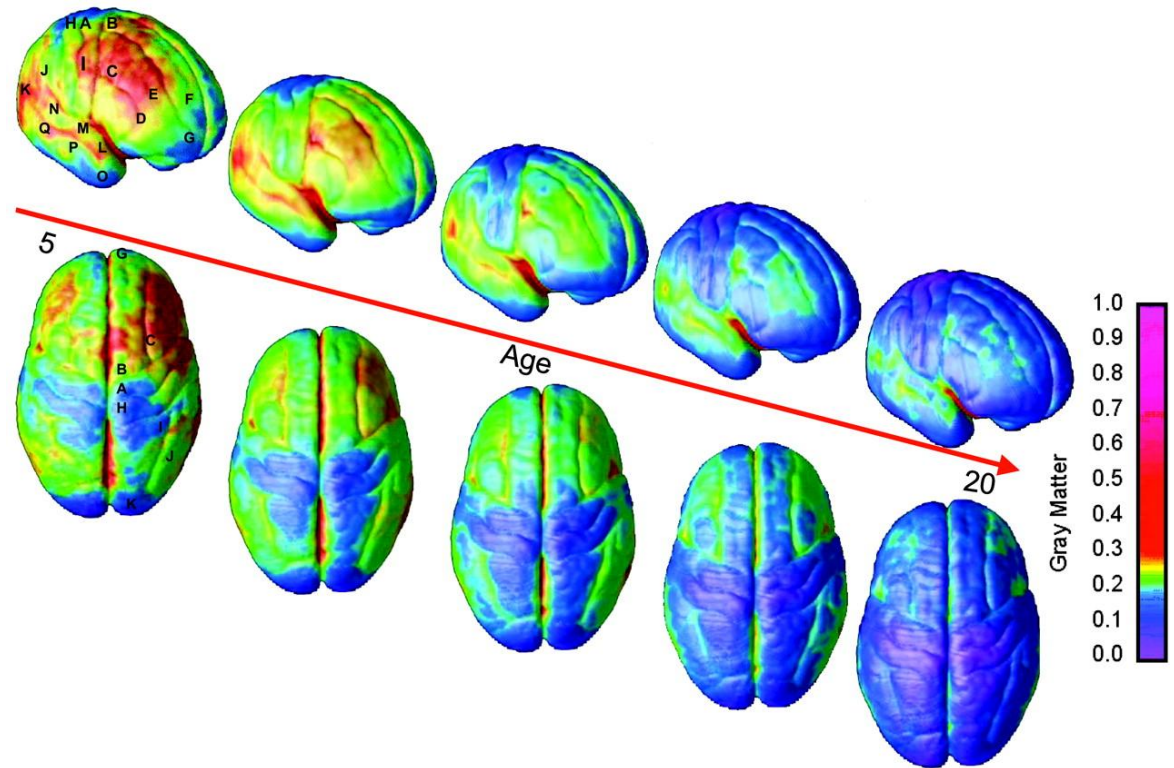
Source: Giedd, 2004.

# Brain Development

Maturation Occurs from Back to Front of the Brain

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

Blue represents maturing of brain areas



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



# Implications of Arrested Development: Adolescent Behaviour

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



# Implications of Arrested Development: Adolescent Behaviour

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 behaviours
- Minimal consideration of negative consequences

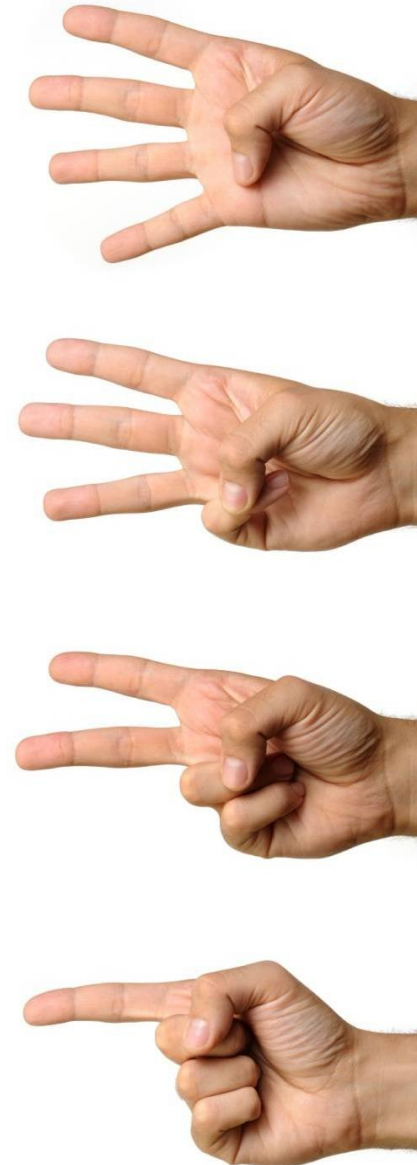


# Implications of Arrested Development: Drug Abuse Vulnerability

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:

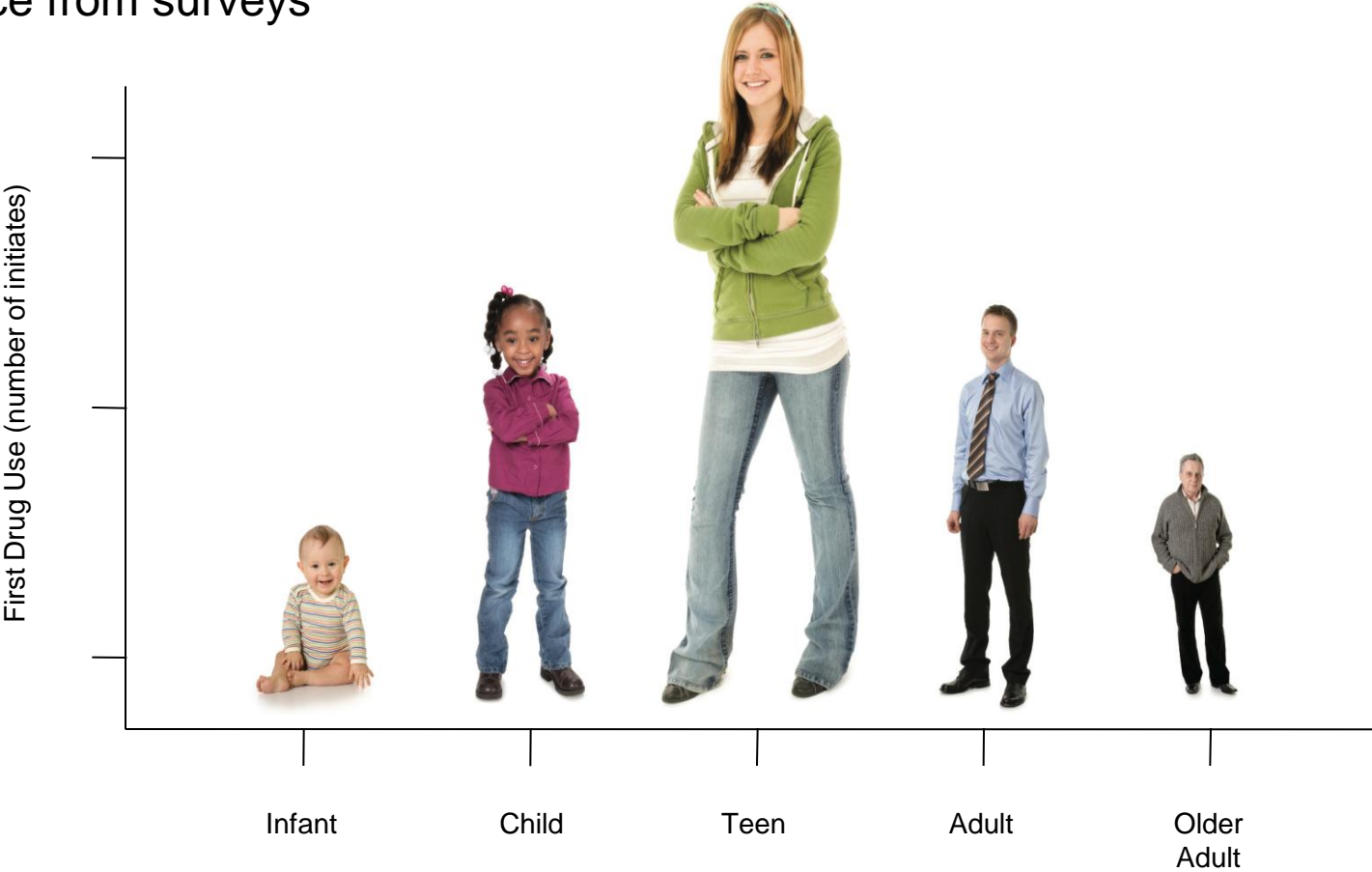
“ Are adolescents more  
susceptible than adults to  
alcohol? ”

1. Epidemiological data



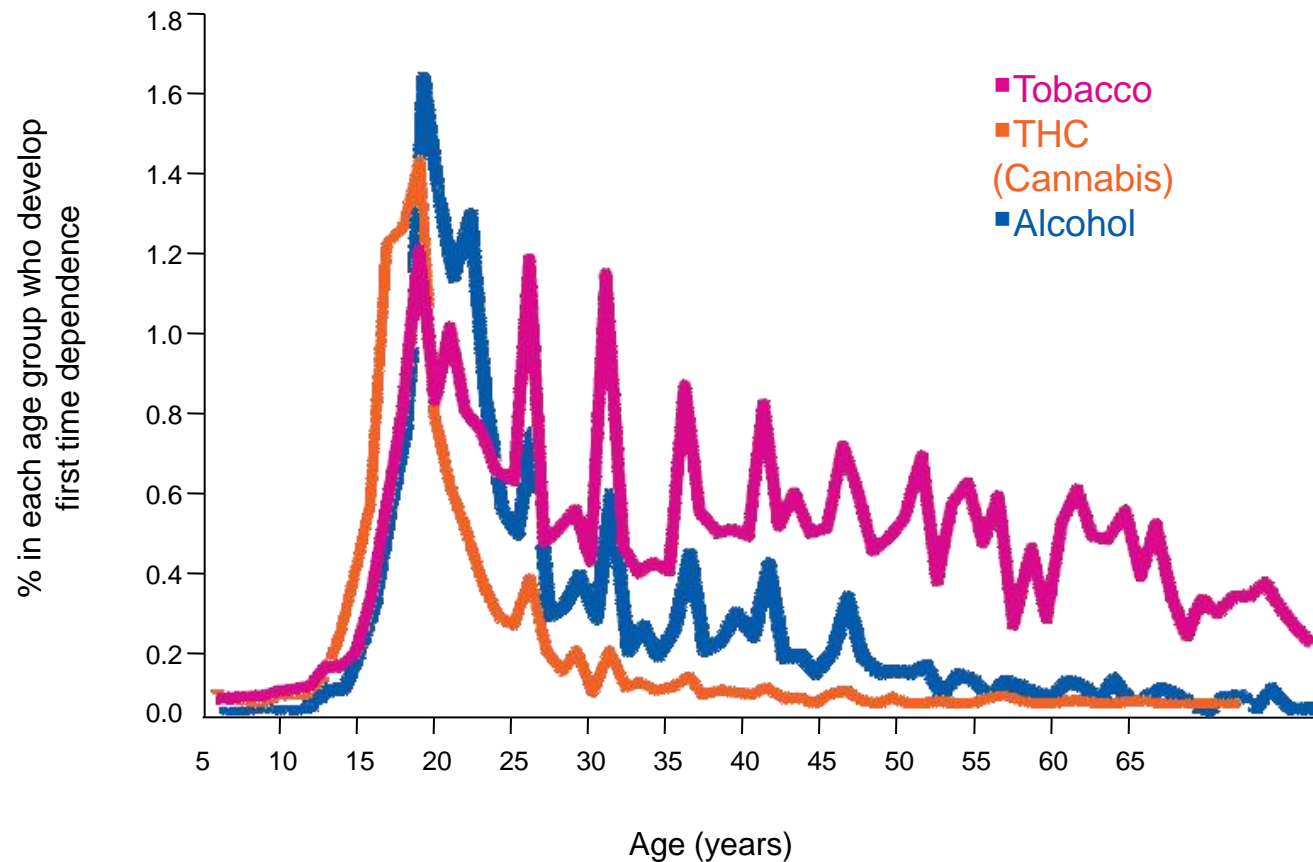
# Drug use starts early and peaks in the teen years

Evidence from surveys



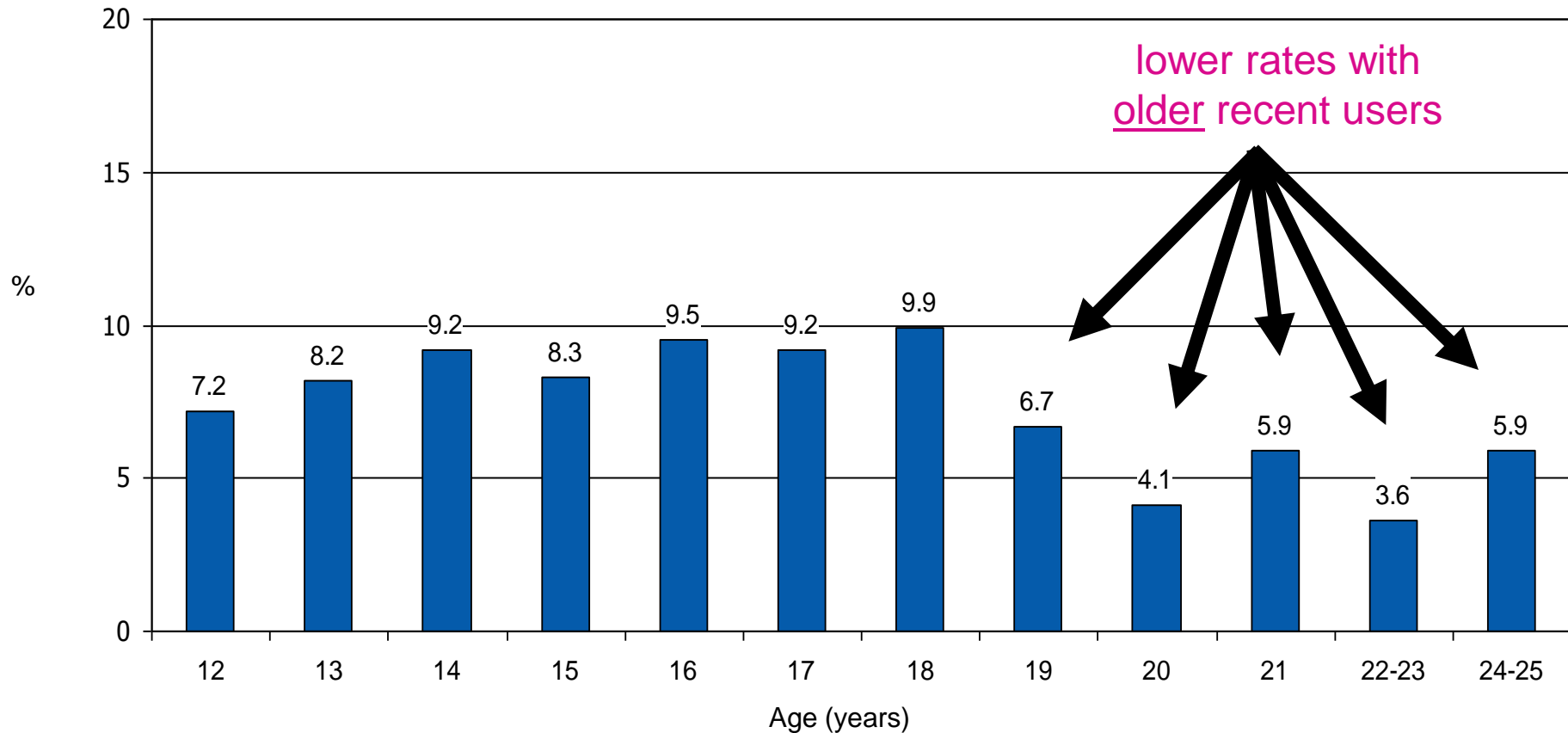
# Addiction is a Developmental Disease

## Starts in Adolescence and Childhood



Source: NIAAA National Epidemiologic Survey on Alcohol & Related Conditions, 2003.

# Percentages of Past Year Alcohol Use Disorder Among Those with a Recent Onset (Prior 2 Years) of Alcohol use ( $N = 4058$ )



Source: Winters & Lee, 2008

# 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 be 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.



# 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.

*2 and 3 may contribute to binge drinking and increased risk to alcohol dependence.*

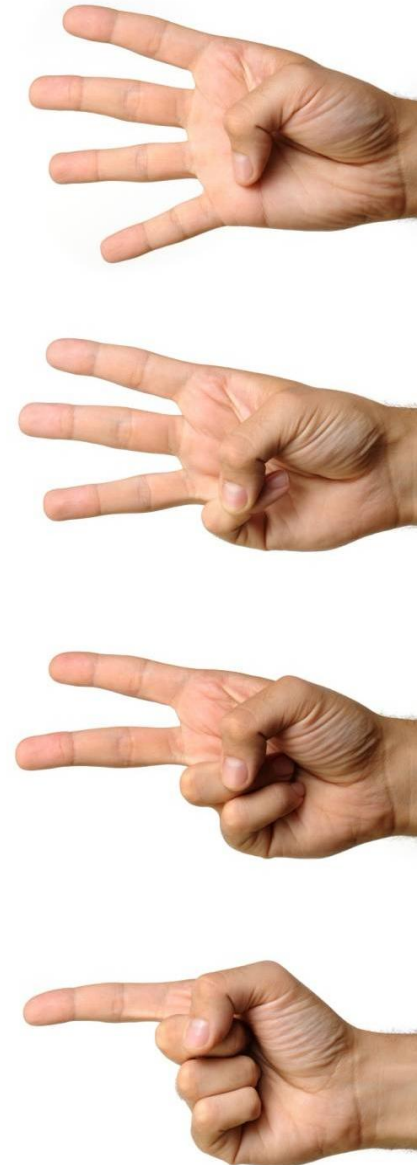


# Implications of Arrested Development: Drug Abuse Vulnerability

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

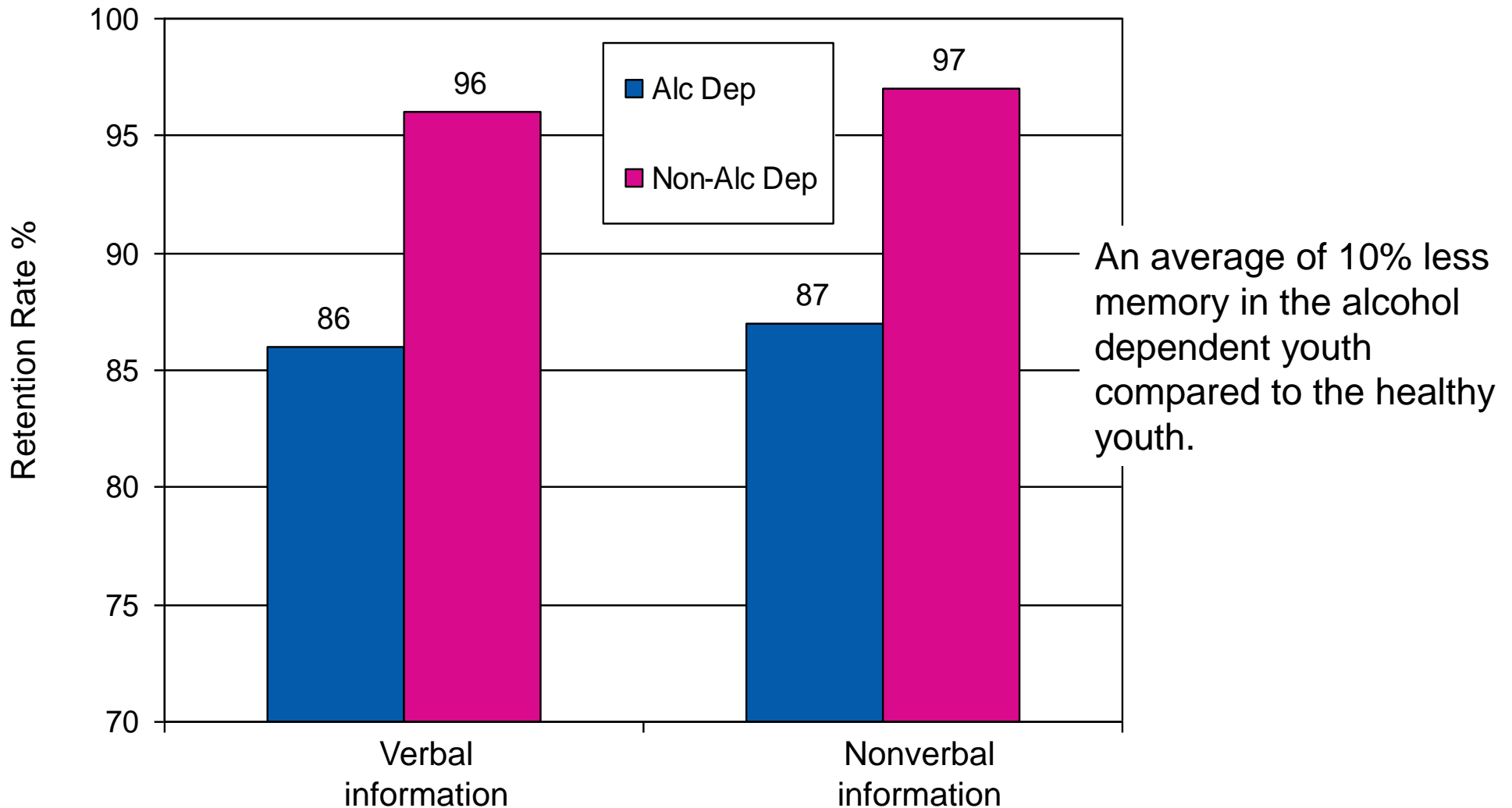


# Human Data: Alcohol's Effects

Adolescents with a history of an alcohol use disorder may show deficits in short-term memory.



# Human Data: Alcohol's Effects





# Human Data: Alcohol's Effects

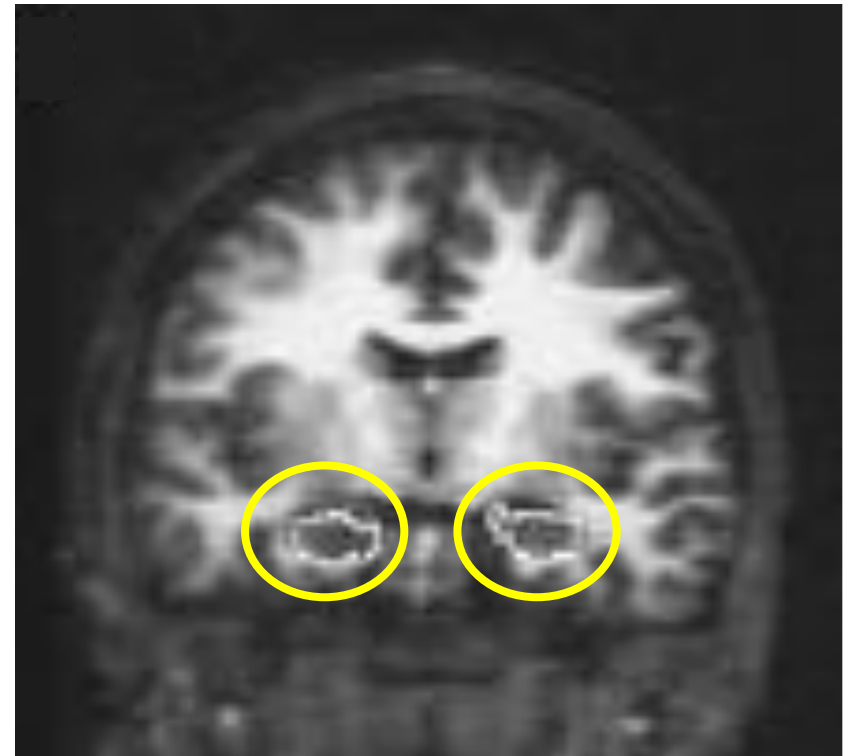
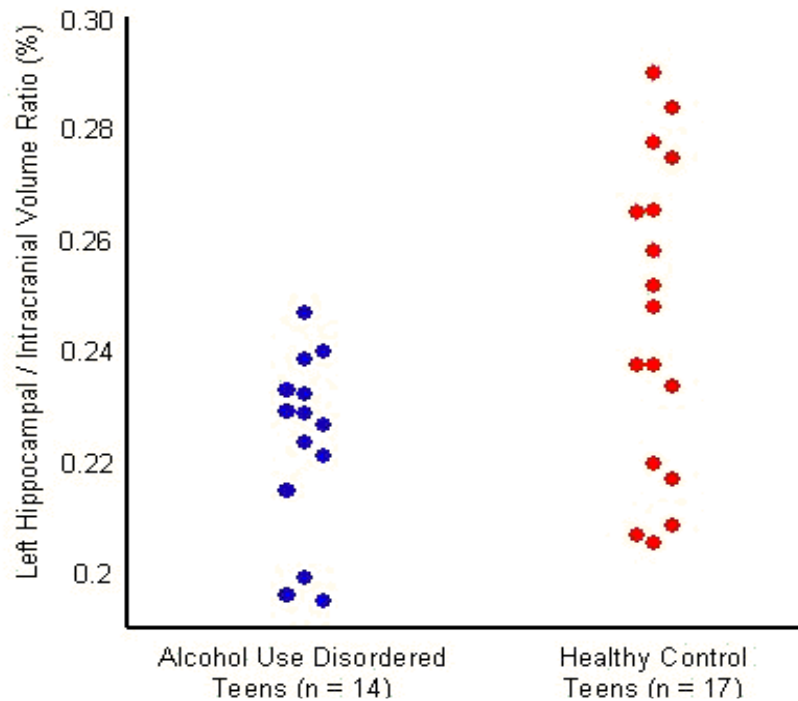
The hippocampus encodes new information into memory.

Adolescents with a history of abusing alcohol may have a smaller hippocampus volume.



# MRI: Hippocampal Size

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



# Summary

1. Expect impulsivity, poor judgment, emotionality
  - “On second thought...” *not* in the repertoire
  - Parents must use *their* judgment to protect teens
  - Parents must anticipate - teens need help with this
  - Less than optimal planning and judgment
2. Drugs, particularly alcohol, have different and more significant effects on teenagers
  - Drug experimentation is normal
  - *But...* can be dangerous



# 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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# Comments or Questions?

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## Visit

[www.mentorfoundation.org](http://www.mentorfoundation.org)

Mentor's site for more prevention information

