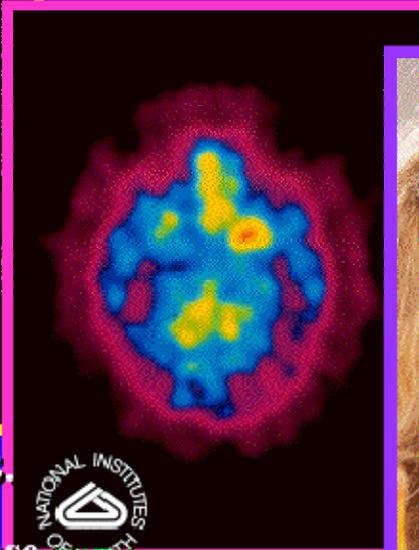
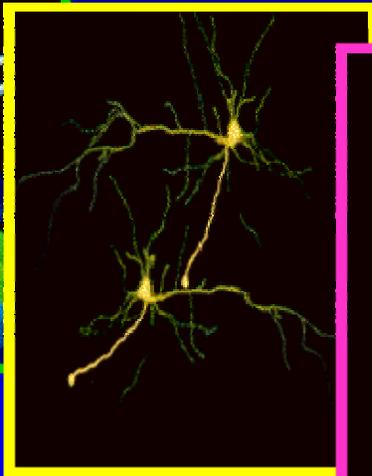
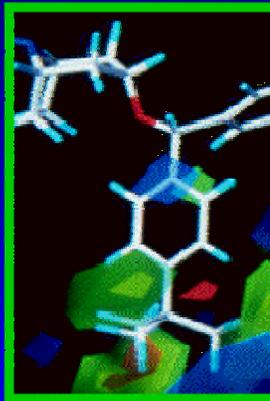


The Neurobiology of Addiction:

What Does It Mean for Children & Adolescents?



Glen R. Hanson, Ph.D., D.D.S.
Associate Director
National Institute on Drug Abuse

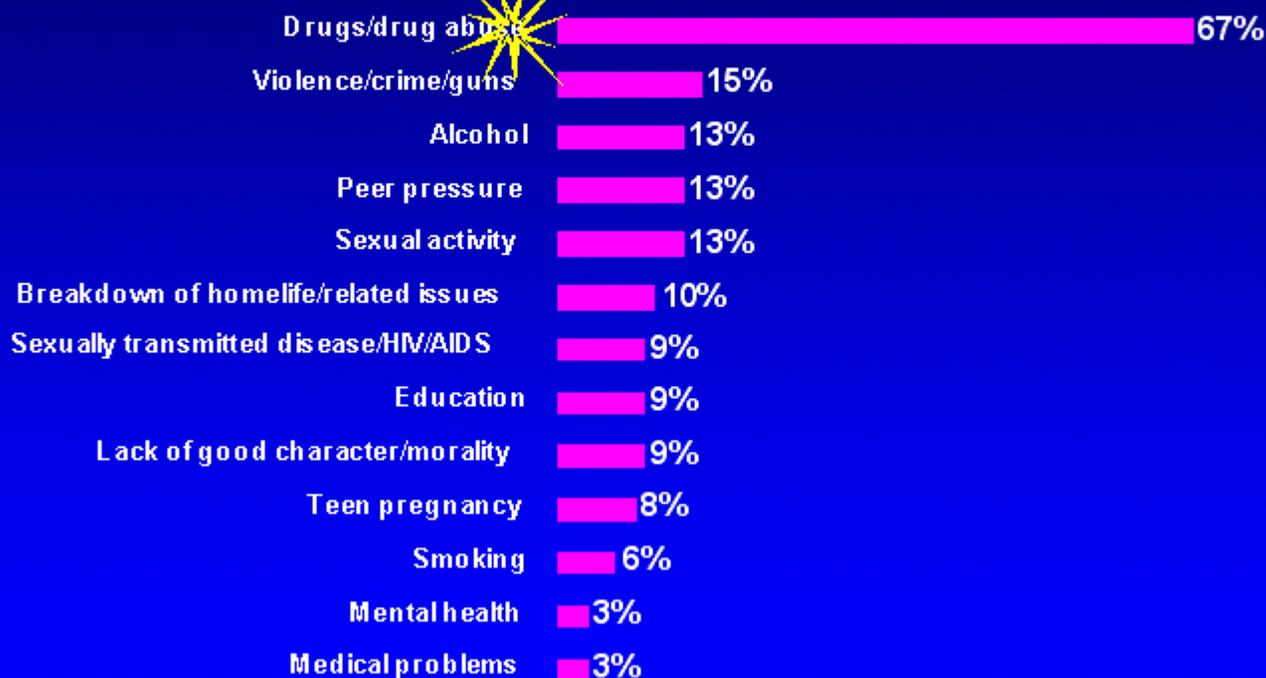


Director of Utah Addiction Center
University of Utah

**Many of the Potential Health
Problems Facing Adolescents
are Preventable**

**Drug Abuse and Addiction
Are Good Examples...**

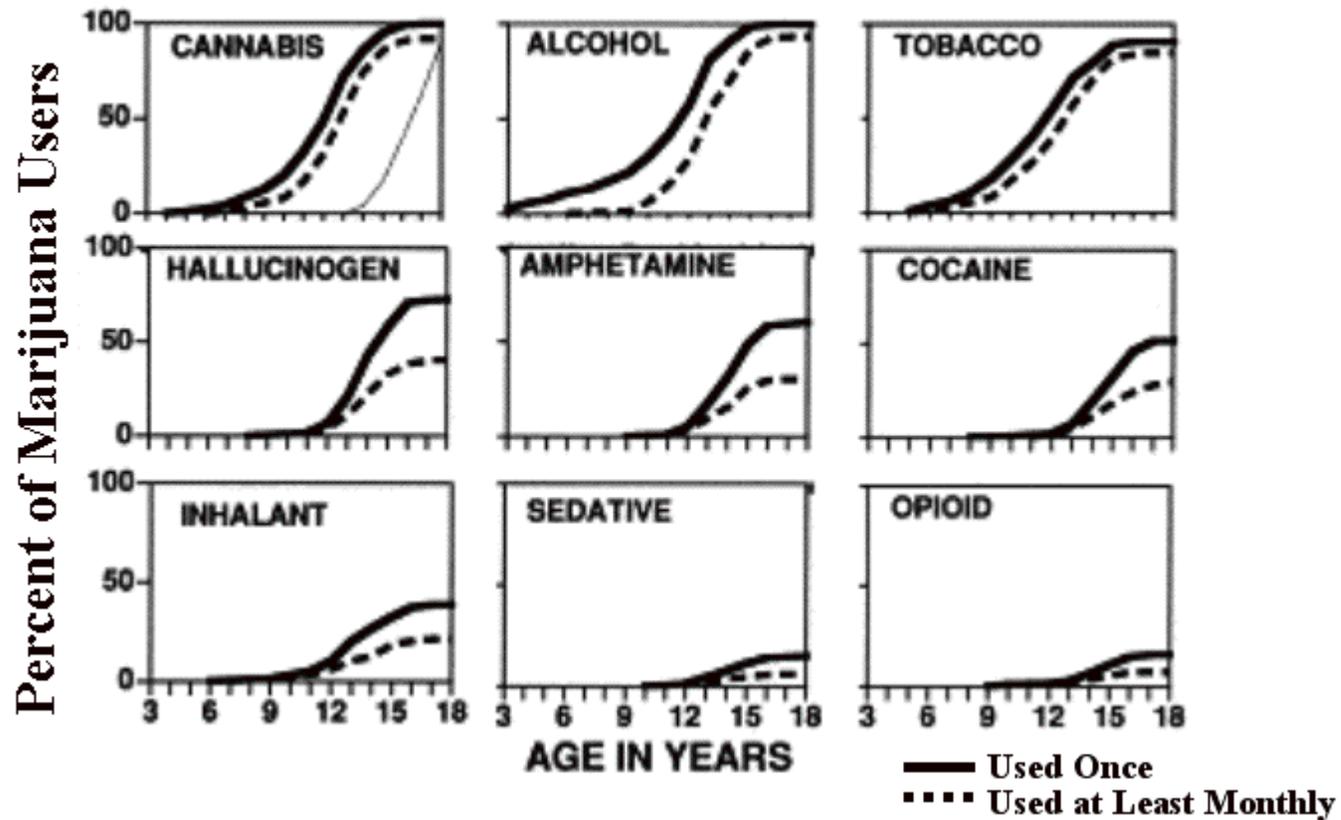
Americans' Views of the 2 or 3 Most Important Problems Facing Teenagers Today



Harvard School of Public Health/Robert Wood Johnson Foundation/ICR, July 2000

**The Use of Alcohol, Nicotine and
Other Commonly Abused Drugs
Generally Begins in *Adolescence***

And...Progression from First to Regular Use is Rapid for Many Drugs of Abuse



Source: Crowley, T.J. et al., *Drug and Alcohol Dependence*, 50, pp. 27-37, 1998.

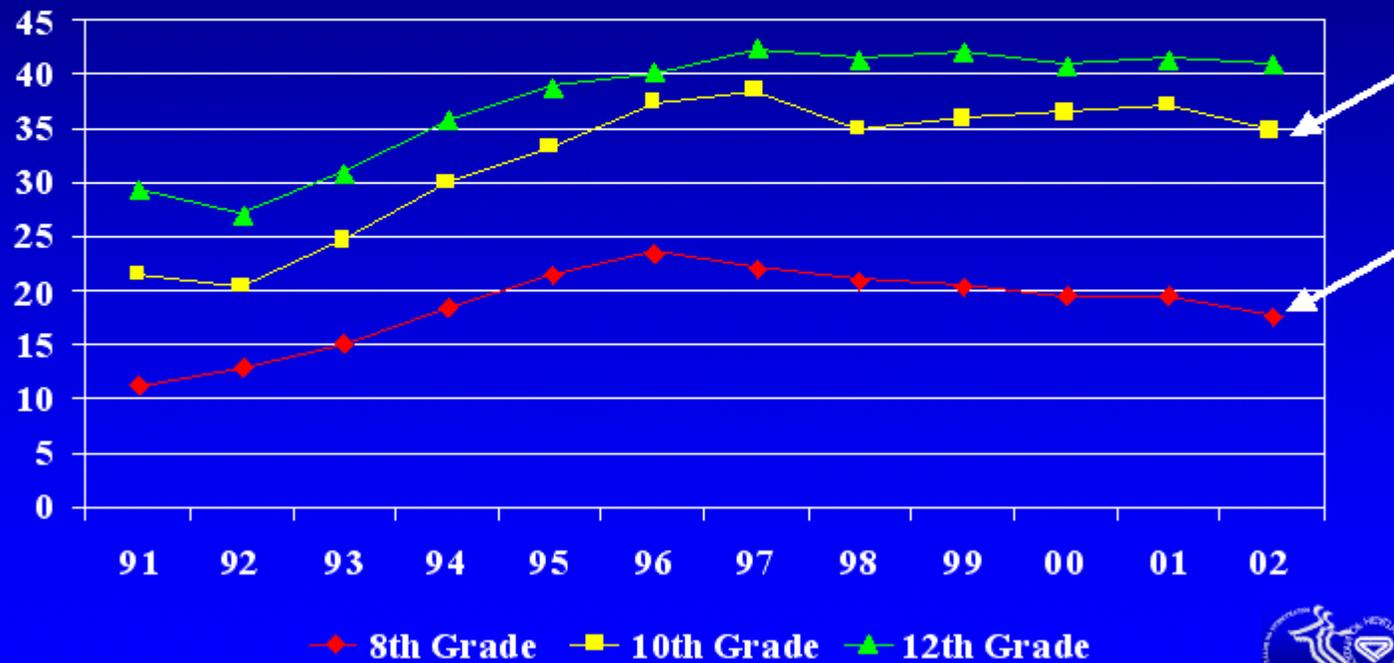
**What is the Significance
of Early Onset Use
of Drugs of Abuse?**

Note:

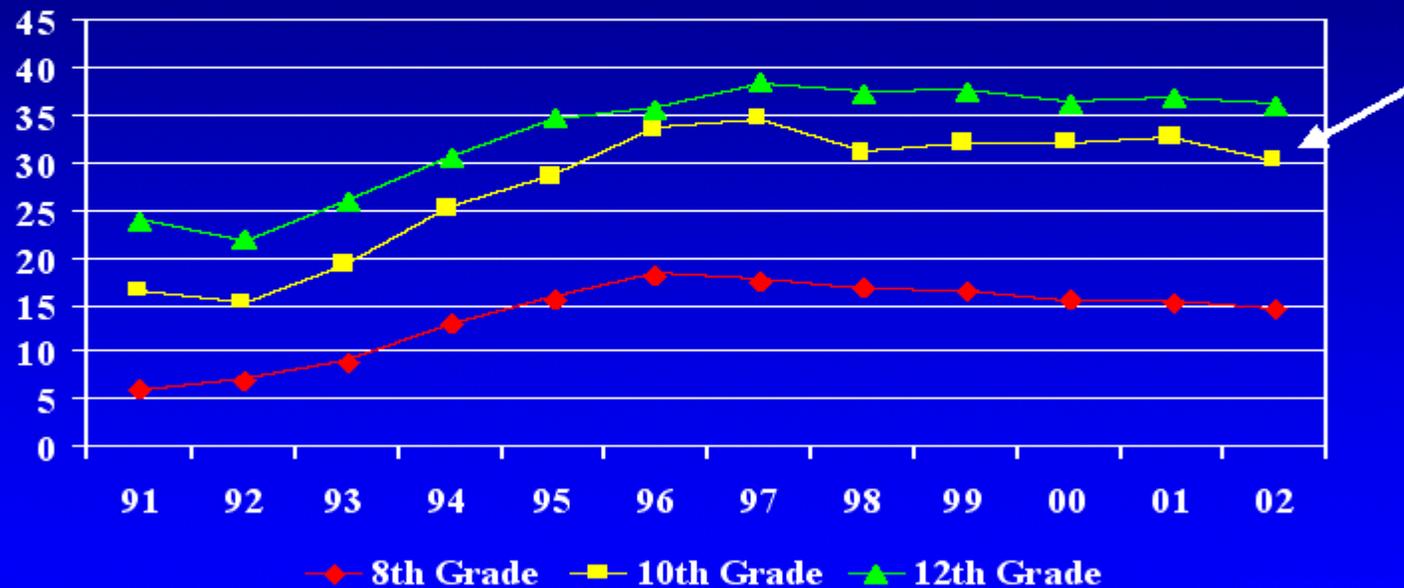
- **The younger the age of drug use initiation, the greater the likelihood the drug use will become an addiction and the more difficult it becomes to stop use later on**

*What Do Recent Trends in
Drug Use Among Youth Look Like?*

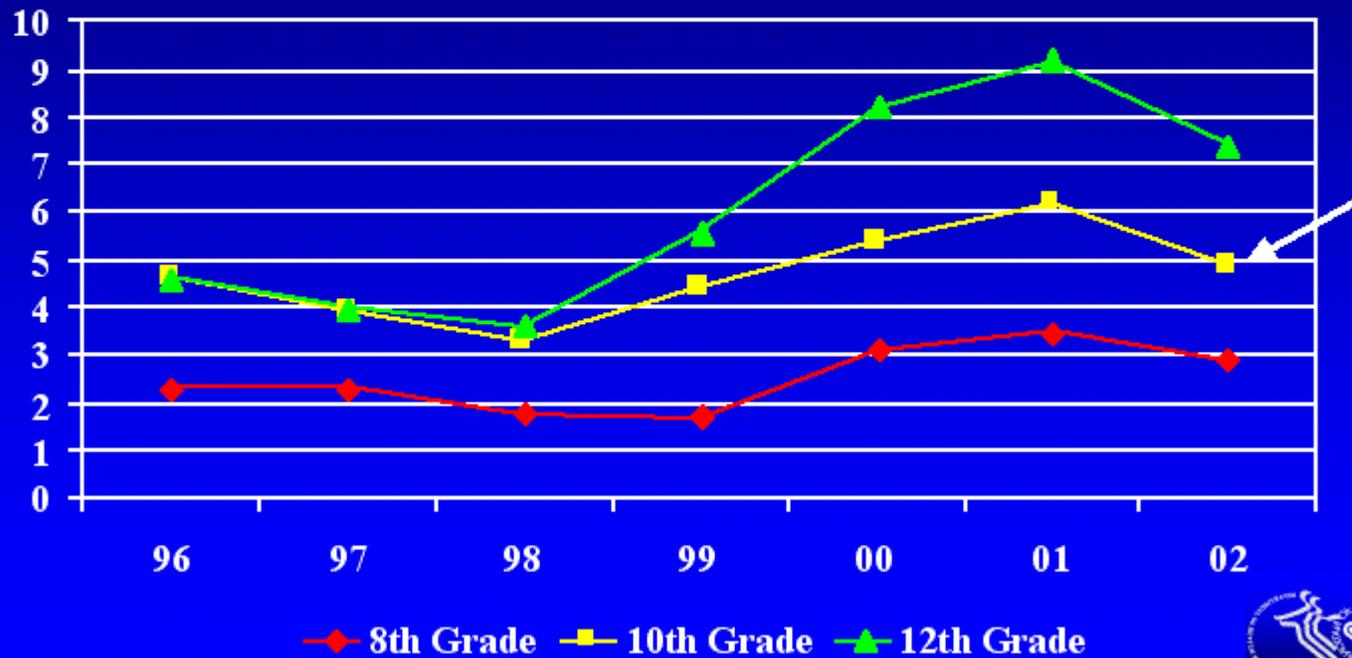
Percent of Students Reporting Any Illicit Drug Use in Past Year, by Grade



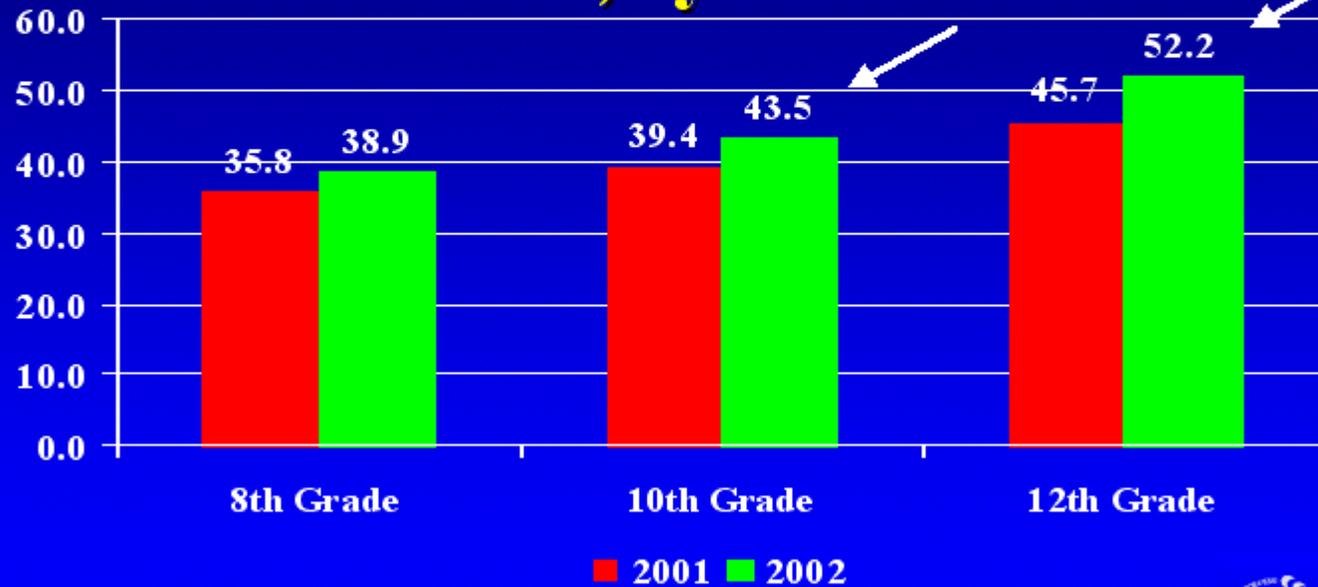
Percent of Students Reporting Use of Marijuana in Past Year, by Grade



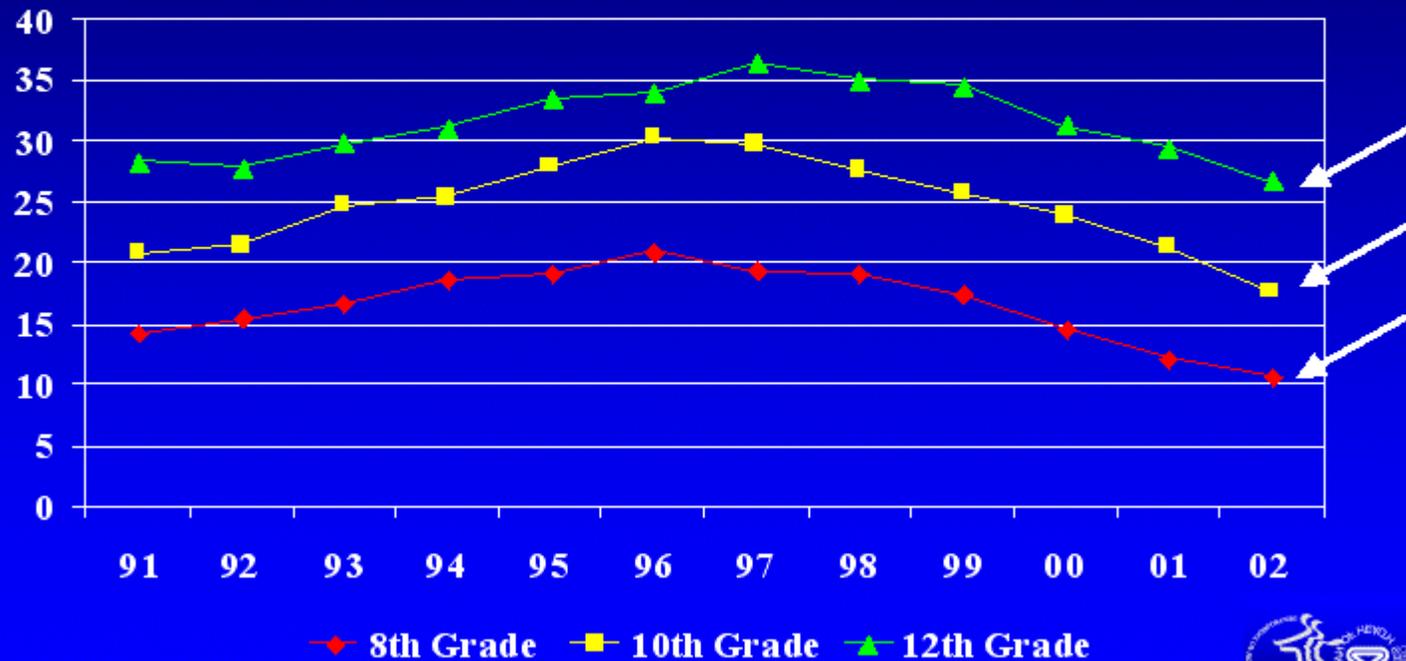
Percent of Students Reporting Past Year Use of MDMA (Ecstasy), by Grade



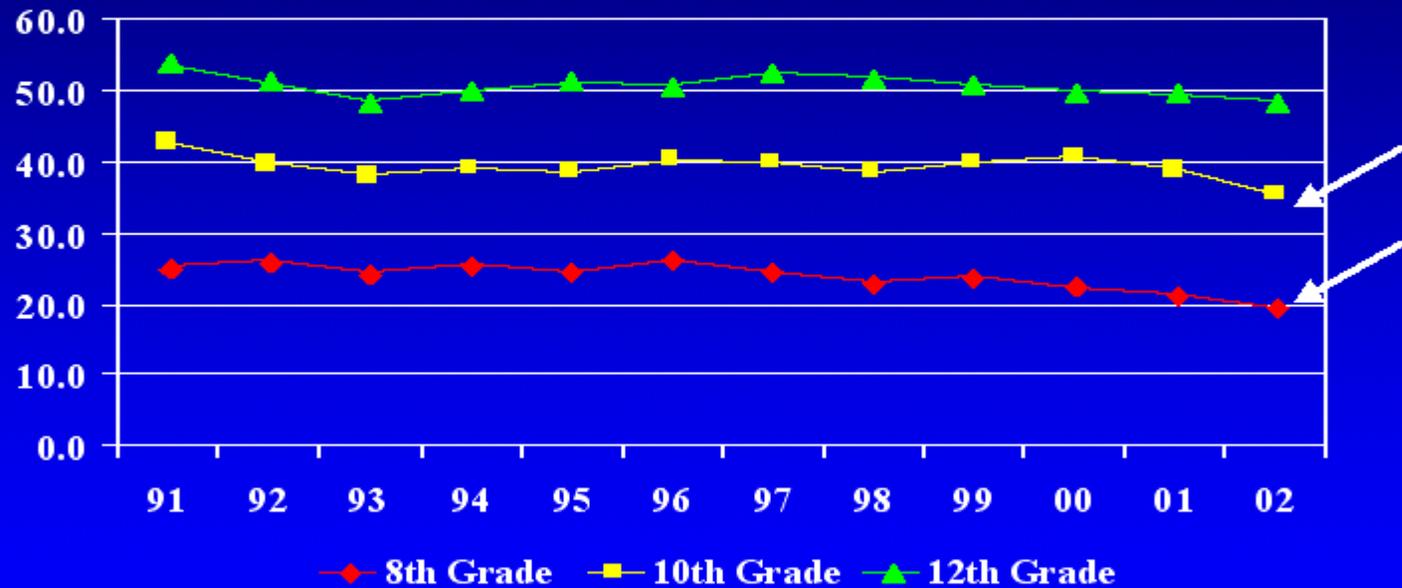
Percent Saying "Great Risk" from Trying MDMA (Ecstasy) Once or Twice, by Grade



Percent of Students Reporting Smoking Cigarettes in Past Month, by Grade



Percent of Students Reporting Use of Alcohol in Past Month, by Grade



Risk and Protective Factors

<i>Risk Factors</i>	<i>Protective Factors</i>
<i>Individual</i>	
<i>Sensation-seeker</i>	<i>Successful student</i>
<i>Child of drug user</i>	<i>Close to family</i>
<i>Family</i>	
<i>Lack of supervision</i>	<i>Consistent discipline</i>
<i>Parent/Sibling drug use</i>	<i>Parental warmth & affection</i>
<i>School</i>	
<i>Pro-drug use school norm</i>	<i>School-bonding</i>
<i>Availability of substances</i>	<i>High achievement</i>
<i>Community</i>	
<i>Affiliation with deviant peers</i>	<i>Consistent anti-drug use message</i>
<i>No availability of after-school programs</i>	<i>Strong enforcement of anti-drug laws</i>

DATOS-A Rationale

- **Research on drug abuse treatment outcomes for adolescents is limited.**
- **Evaluations of adolescent treatment need to consider:**
 - ✓ **different alcohol and drug use patterns**
 - ✓ **role of family, school, and peers**
 - ✓ **developmental processes**
 - ✓ **juvenile and criminal justice involvement**
 - ✓ **co-occurring mental disorders**
 - ✓ **behaviors that increase risk for infectious diseases**

Behaviors of Adolescents Before And One Year After Treatment

	Before	After
DRUG USE	Percentage	
Weekly Marijuana Use	80.4%	43.8%
Heavy Drinking	33.8	20.3
Hallucinogen Use	31.0	26.8
Stimulant Use	19.1	15.3
SCHOOL PERFORMANCE		
Regular Attendance	62.6	74.0
Grades Average or Better	53.4	79.6
CRIMINAL ACTIVITIES		
Any Illegal Act	75.6	52.8

Treatment does have benefits

Hser et al. (2001), Archives Gen Psychiatry

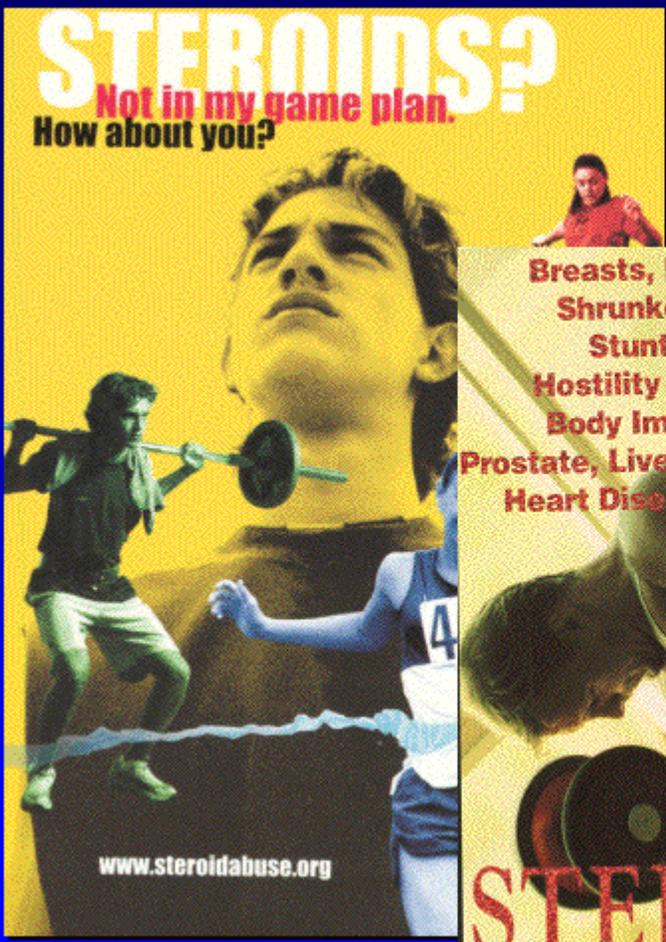
**Drug Use Can Result in
A Wide Variety of
Physical Changes and Conditions**

Effects of Marijuana Use -- Lung Toxicity

- **Heavy Hashish Use:**
Chronic Bronchitis
Chronic Cough
- **Heavy Marijuana Use**
(5 Times a Day for 59 Days):
Produces Airway Obstruction
Marijuana Smoke Contains More "Tar"
Than Tobacco
Smoke Contains Carcinogenic Materials

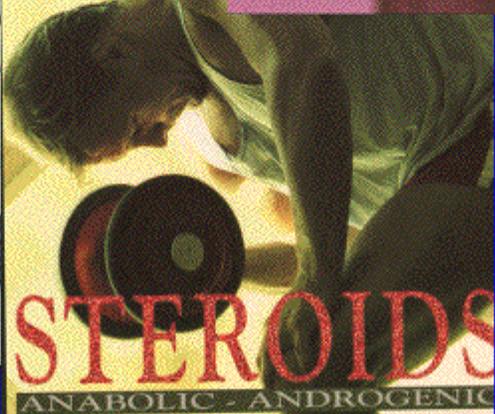
Marijuana Use -- Endocrine Effects

- **Male Sex Hormones: - Controversial**
 - Decrease in **Testosterone** - Usually Within Normal Range
 - Decreased **Sperm** Production - No Evidence of Infertility
 - Gynecomastia** Has Been Implicated But Not Proven
 - THC is **Not Estrogenic**
- **Female Sex Hormones:**
 - Suppressed **LH** Surge and **Ovulation**
 - Increased Incidence of **Anovulatory** Cycles (Use More Than 4 Times a Week)



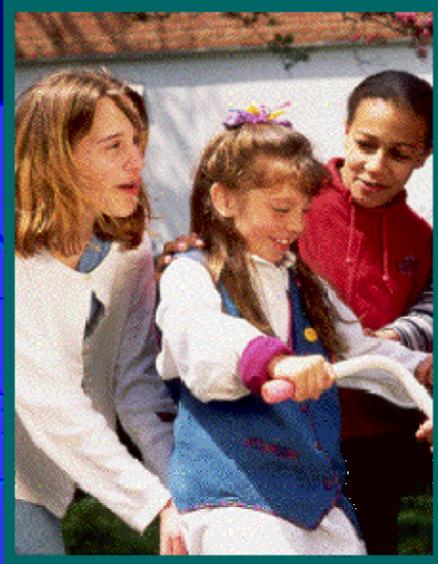
Breasts, B
Shrunke
Stunte
Hostility &
Body Ima
Prostate, Liver
Heart Disoa

HEART DISEASE
KIDNEY CANCER
LIVER CANCER
DEPRESSION
HOSTILITY & AGGRESSION
EATING DISORDERS
STUNTED HEIGHT
BEARD
ACNE
RISK OF HIV
ANABOLIC - ANDROGENIC
STEROIDS



**Drug Use Can Also Have A
Profound Impact on A Child's
Social and Emotional
Development**

What Is NIDA Doing About This?



Epidemiology

Treatment

Behavioral
Science

Prevention

Health
Disparities

S and
Other Med
Consequences

**Children and
Adolescents**

National Institute on Drug Abuse Children and Adolescent Research

Areas of Current Research

- **Consequences of Prenatal Drug Exposure**
- **Etiology and Epidemiology of Drug Use**
- **Drug Abuse Prevention (Risk and Protective Factors)**
- **Treatment of Drug Abuse and Addiction**
- **Drug Abuse Aspects of Child and Adolescent HIV/AIDS**
- **Community Outreach**

**We Have Learned A Lot About
the Origins and Pathways
to Drug Abuse**

Epidemiology/Origins and Pathways of Youth Drug Abuse

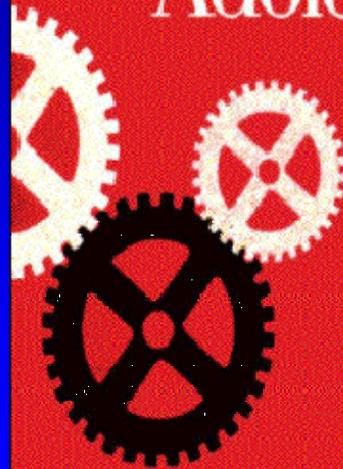
- **Genetic vulnerability**
- **Environmental (family, school, peers, neighborhood)**
- **Economics**
- **Gender**

*How Are We Using Science
To Improve
Drug Abuse **PREVENTION?***

**We've Identified Some of the
Fundamental Principles that are
Important for Drug Abuse Prevention**

Preventing
Drug Use
Among Children
and Adolescents

A RESEARCH-BASED GUIDE



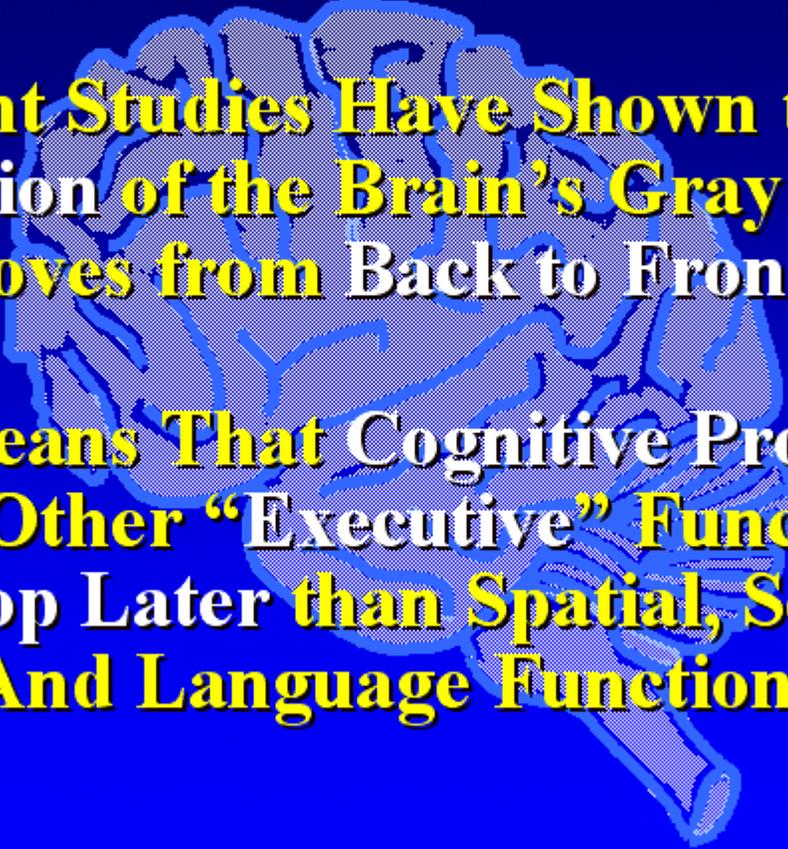
National Institute on Drug Abuse
National Institutes of Health

**Much of Prevention Research Now
Targets Risk and Protective Factors**

**We Also Need to Target
Initiating Motivations**



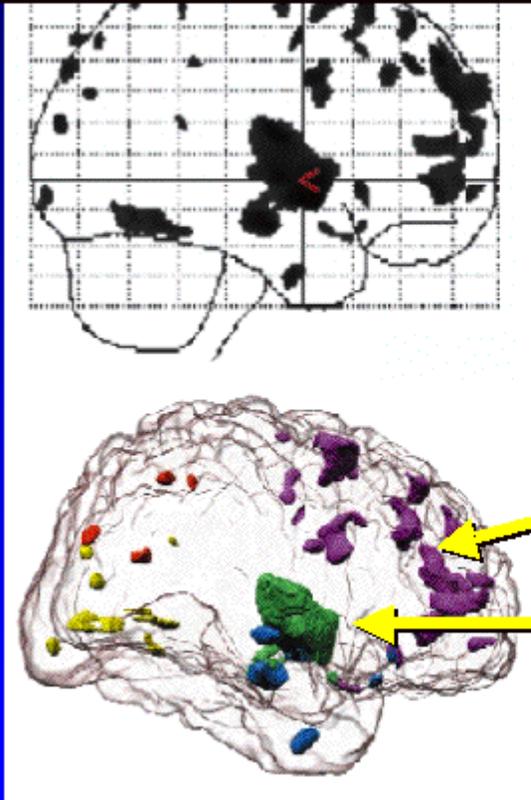
**To Understand This We Need
To Know More About
Adolescent Decision Making**



**Recent Studies Have Shown that
Maturation of the Brain's Gray Matter
Moves from Back to Front**

**This Means That Cognitive Processing
and Other “Executive” Functions
Develop Later than Spatial, Sensory
And Language Functions**

Evidence for Post-Adolescent Brain Maturation in Frontal and Striatal Regions



Differences in gray-matter density between:
16 year olds (adolescents) and
23-30 year olds (young adults)

Frontal Lobe

Subcortical Region

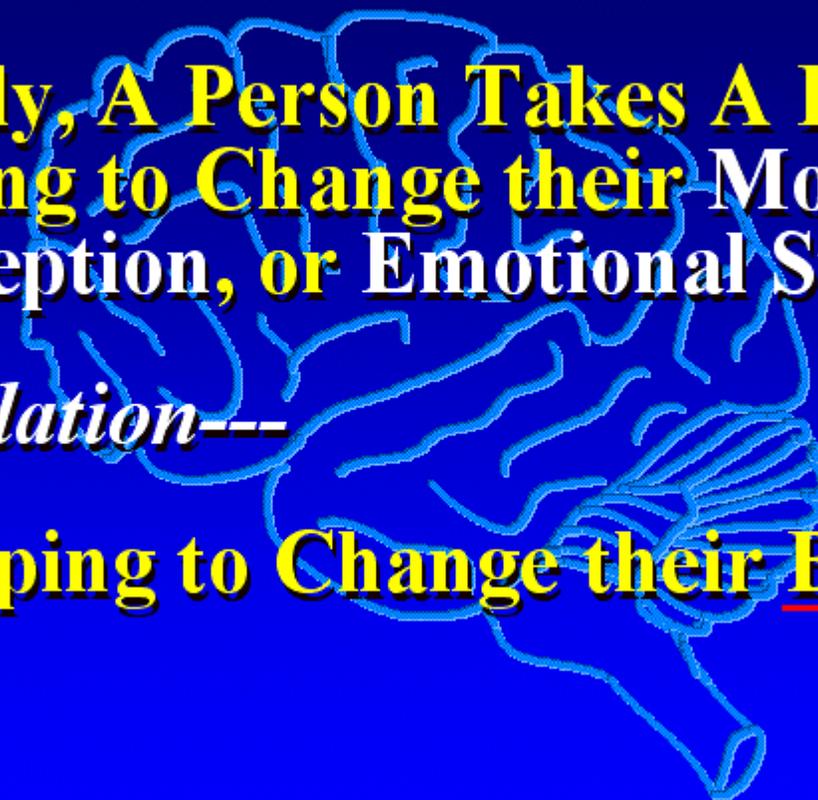
Likely reflect myelination differences

Source: Sowell, E.R. et al., *Nature Neuroscience*, 2(10), pp. 859-861, 1999

Implication:

Developmental differences must be considered in designing targeted prevention and treatment strategies

*Why Do Individual People Take
Drugs in the First Place?*



**Initially, A Person Takes A Drug
Hoping to Change their Mood,
Perception, or Emotional State**

Translation---

...Hoping to Change their Brain

For Example...

**We Know That Despite
Their Many Differences, most
Abused Substances Enhance the
Dopamine and Serotonin Pathways**

Dopamine Pathways

Serotonin Pathways

frontal cortex

striatum

hippocampus

substantia nigra/VTA

nucleus accumbens

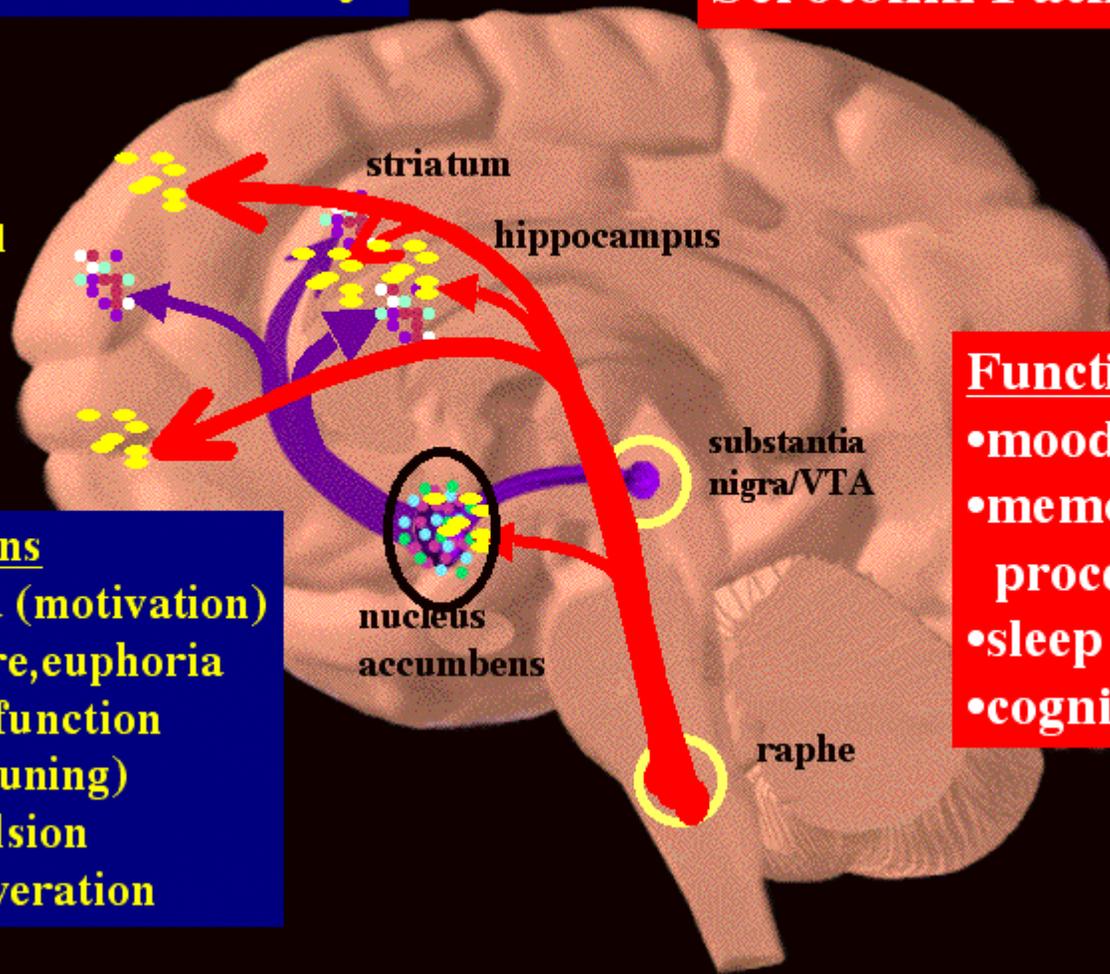
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Functions

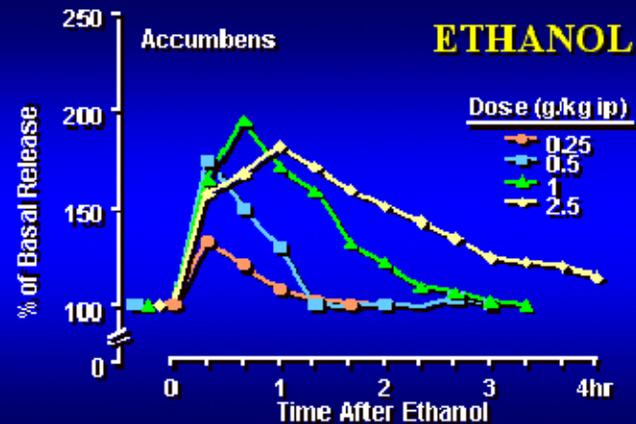
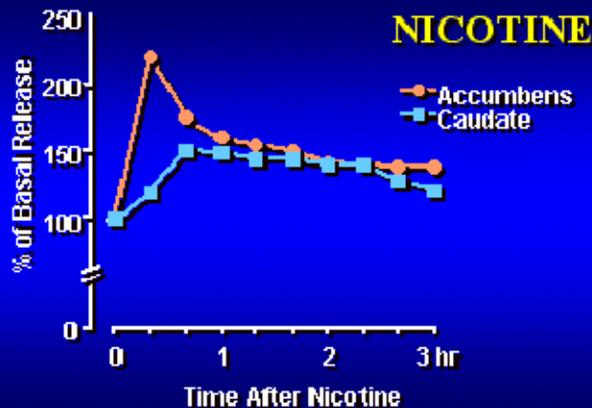
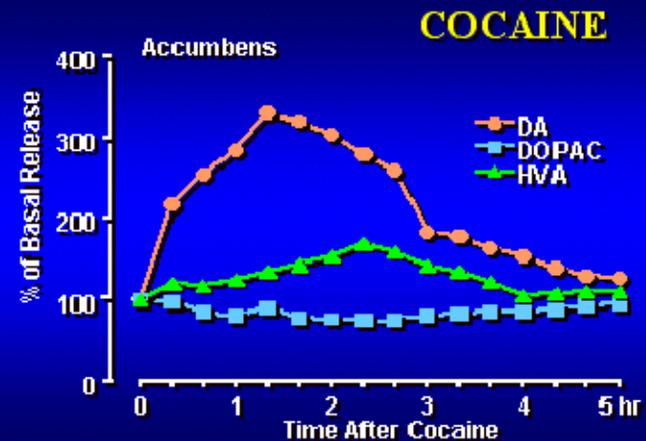
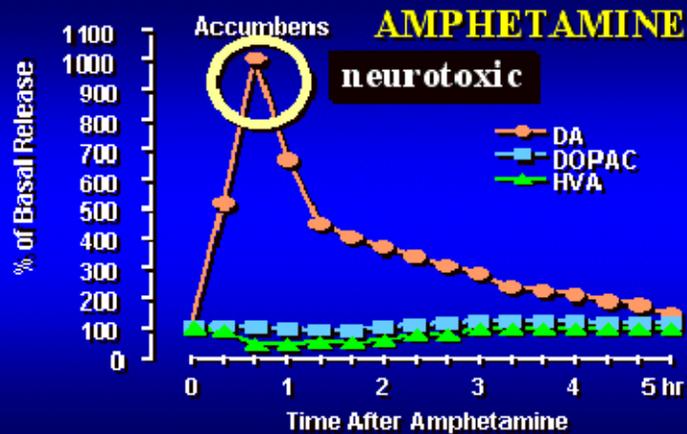
- reward (motivation)
- pleasure, euphoria
- motor function (fine tuning)
- compulsion
- perservation

Functions

- mood
- memory processing
- sleep
- cognition



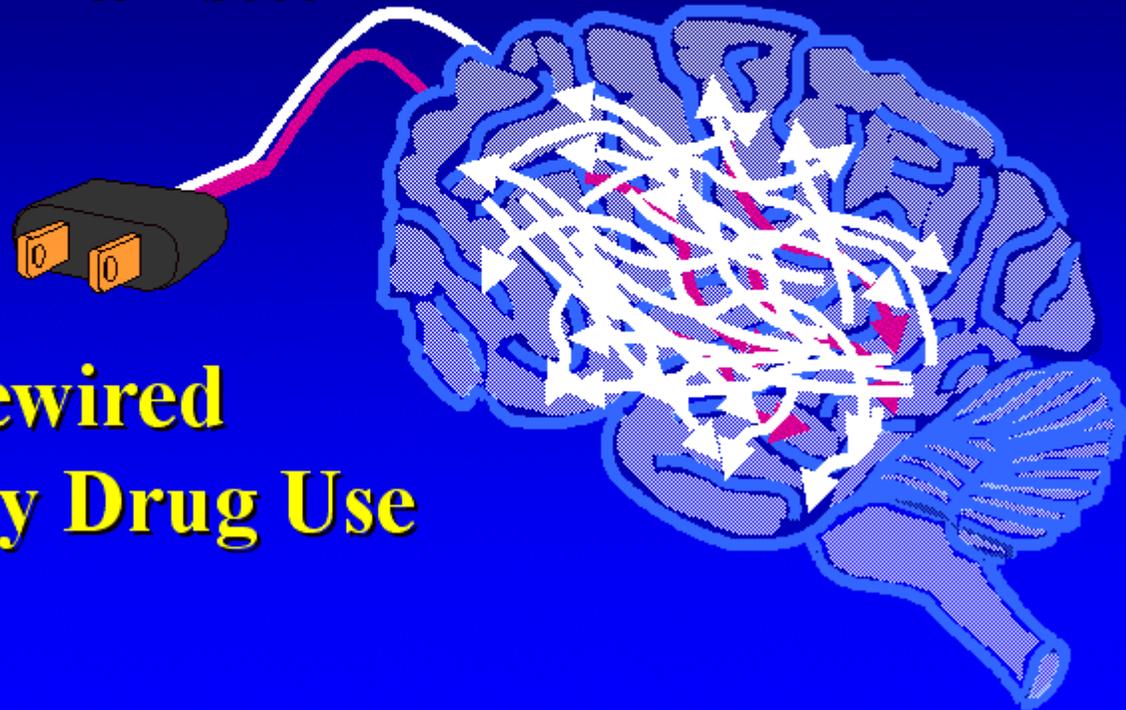
Effects of Drugs on Dopamine Levels



Source: Di Chiara and Imperato

**After Using Drugs For A While
A Person Can't Just Stop
*Because...***

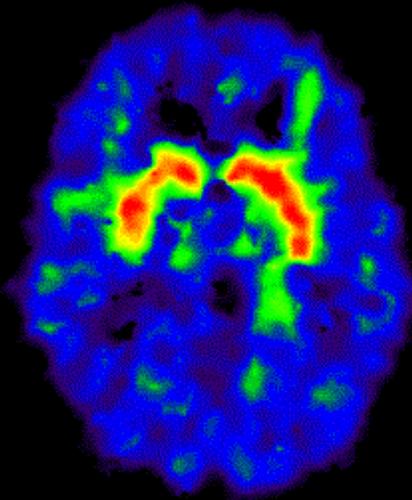
Their Brains...



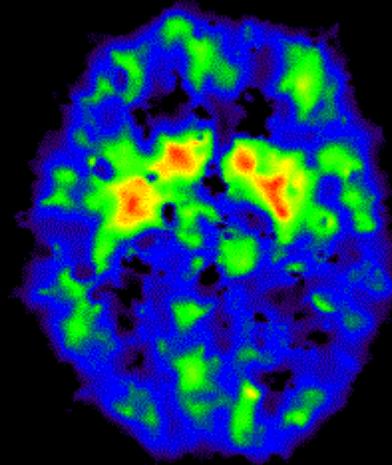
**Get Rewired
by Drug Use**

**Prolonged Drug Use Changes
the Brain In Fundamental and
Long-Lasting Ways**

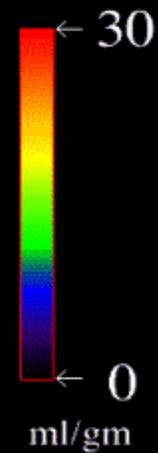
Loss of Dopamine Neurons After Heavy Methamphetamine Use



Comparison Subject

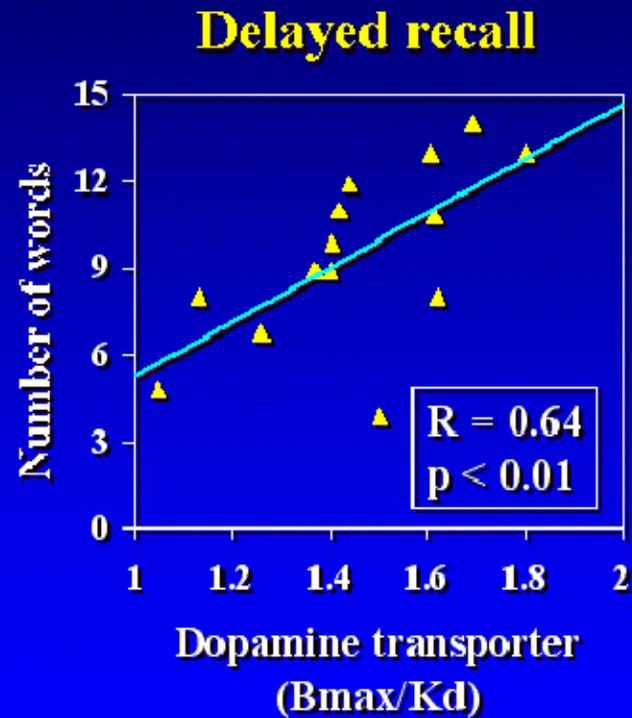
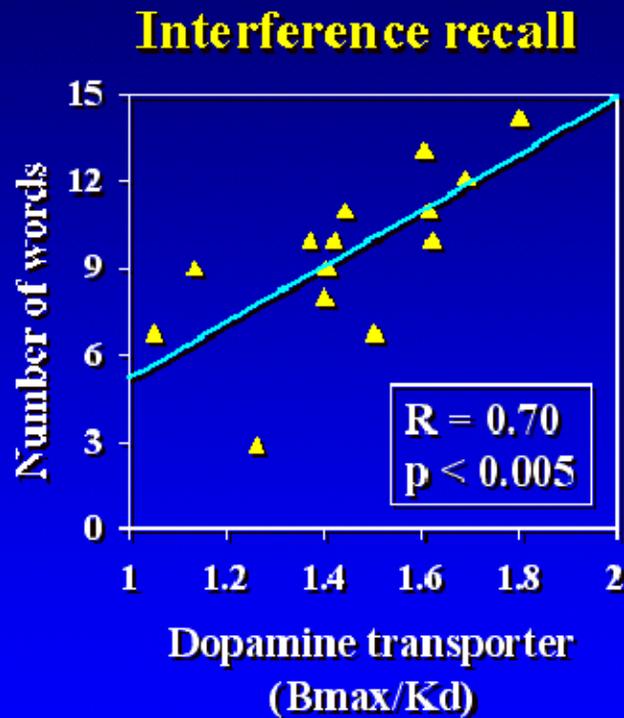


METH Abuser



Source: Volkow, N.D. et al., Am J. Psychiatry, 158(3), pp. 377-382, 2001.

Dependence of Verbal Memory on Striatal DAT



Source: Volkow, N.D. et al., *Am J. Psychiatry*, 158(3), pp. 377-382, 2001.

Implication:

Brain changes resulting from prolonged use of psychostimulants, such as methamphetamine may be reflected in compromised cognitive functioning

**Voluntary
Drug Use**



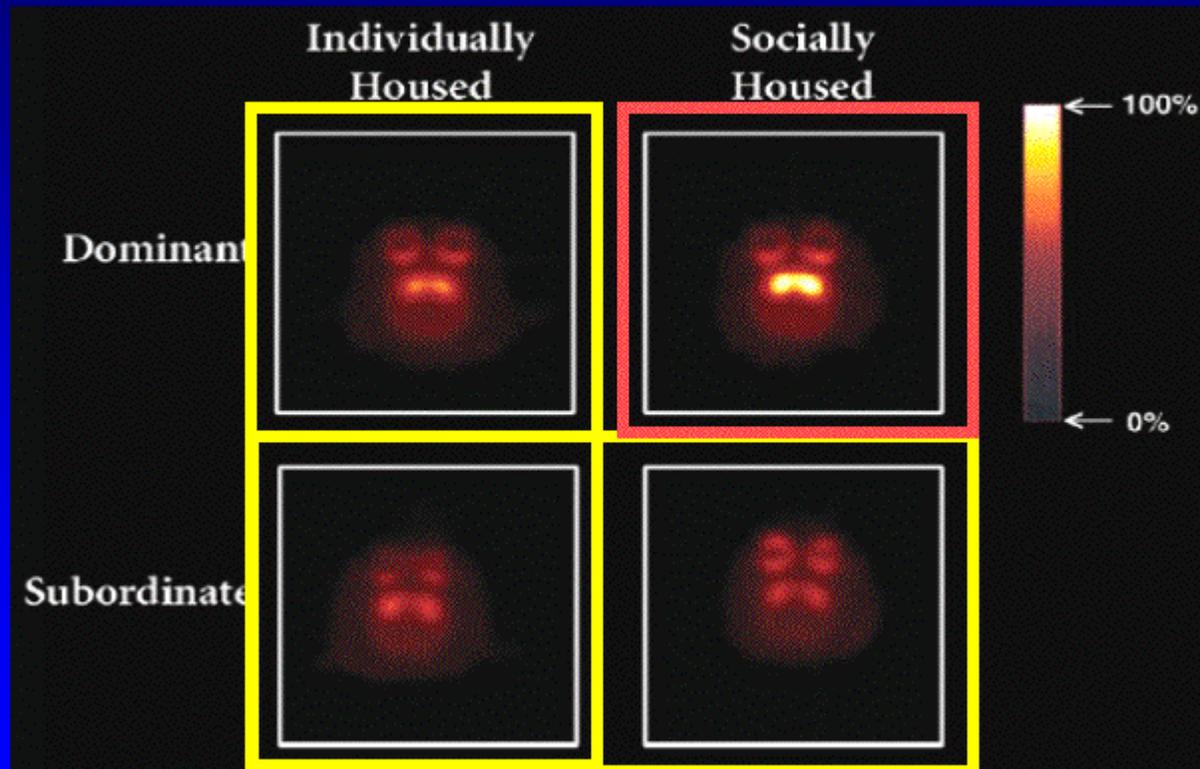
**Compulsive
Drug Use
(Addiction)**

Implication:

**Treatments to prevent initiation
of drug abuse likely will likely
differ from treatments to stop
long-term use or prevent relapse**

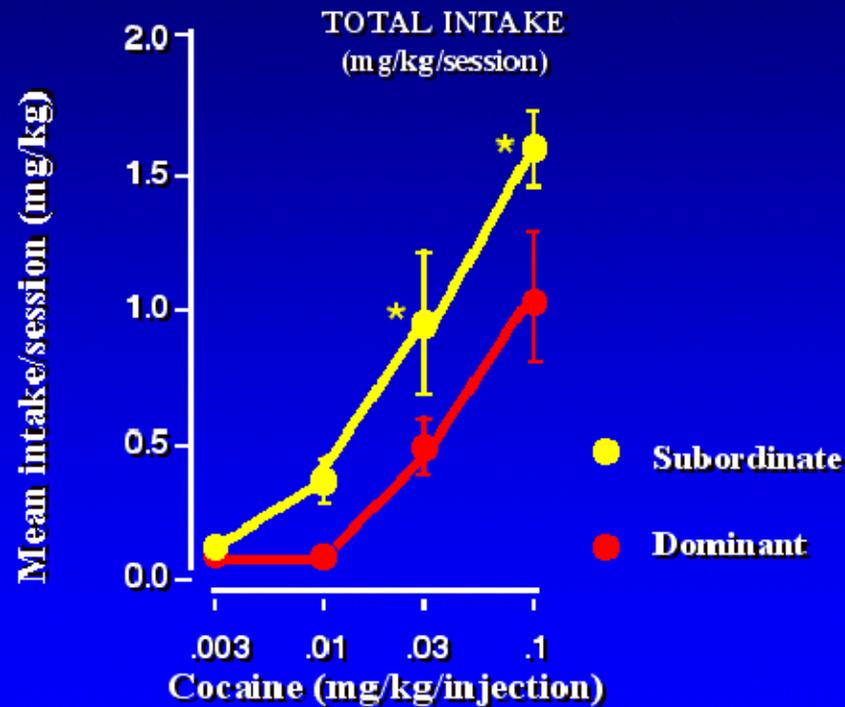
**Research Is Clearly Illustrating
the Critical Role That
Environmental Factors Play In the
Drug Abuse and Addiction Process**

PET Images: Dopamine Receptor (Target) Density



Source: Morgan, D. et al. Nature Neuroscience, 5(2), pp. 169-174, February 2002.

Effect of Social Dominance on Cocaine Self-Administration



Source: Morgan, D. et al. *Nature Neuroscience*, 5(2), pp. 169-174, February 2002.

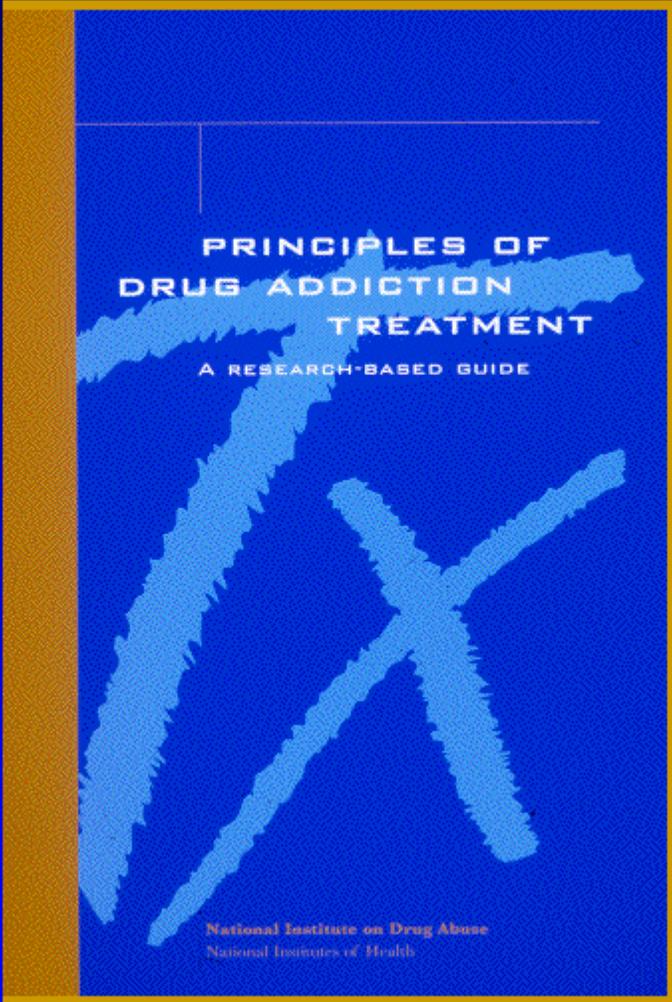
**In Addiction, Even After
Long Periods of Abstinence,
*Relapse is Common***

Relapse Can Be Triggered By Events Such As:

- **Stress**
- **Low Doses of Drugs of Abuse**
- **Drug-Associated Stimuli (Cues)**

*How Are We Using Science
To Improve
Drug Abuse **TREATMENT?***

**We Need to Communicate
Fundamental Principles that are
Important for Drug Abuse Treatment**



**PRINCIPLES OF
DRUG ADDICTION
TREATMENT**

A RESEARCH-BASED GUIDE

National Institute on Drug Abuse
National Institutes of Health

Drug Abuse Treatments for Youth

- **Individual, Peer Group and Family-Focused Behavioral Therapies**
- **Pharmacotherapies Alone and in Combination with Behavioral Therapies**
- **Treatment of Drug Abuse and Co-Occurring Mental Disorders**
- **Multi-Component Outpatient, Residential and Community-Based Treatment Programs**
- **Brief Behavioral Therapies in Primary Care Settings**

**Through Research We Are
Learning A Lot About
Kids, Brains, and Drugs**



**NIDA Is Working to Provide
Science-Based Information
to Adolescents and their
Parents, Teachers, and Caregivers**

NIDA NATIONAL INSTITUTE
ON DRUG ABUSE

**Many Useful Publications, Science Education
Materials and Other Drug Abuse Related Resources
Are Available Through Our Website @**

www.drugabuse.gov

Meeting Community Needs for Science-Based Information

NIDA
NATIONAL INSTITUTE ON DRUG ABUSE

National Institute on Drug Abuse
December 1999

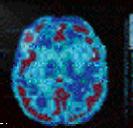
4000 Executive Plaza
Bethesda, MD 20892

COMMUNITY DRUG ALERT BULLETIN

Club Drugs

Club drugs is a non-scientific, informal nickname of those recreational drugs that are popular in the club scene. Some of the most common club drugs are MDMA (Ecstasy), GHB (Gamma Hydroxybutyrate), Ketamine, Methamphetamine, and LSD (Lysergic Acid Diethylamide). Club drugs are used in a variety of ways, from snorting to smoking to injecting. Club drugs are often used in combination with alcohol and other drugs, which can increase the risk of overdose and death. Club drugs are also used to enhance sexual activity, which can lead to unintended pregnancy and sexually transmitted infections.

KEEP YOUR BRAIN HEALTHY. DON'T USE DRUGS.



ADDITION IS A BRAIN DISEASE.



plain brain
brain after
Ecstasy

NATIONAL INSTITUTE ON DRUG ABUSE

Research Report
SERIES

HALLUCINOGENS AND DISSOCIATIVE DRUGS *Johelmar LEO, PhD; Katherine A. Macdonald, PhD*

What are hallucinogens?

Hallucinogens cause their effects by interacting with the neurotransmitter serotonin. Disruption throughout the brain and spinal cord, the nervous system is disrupted in the context of hallucinogen, psychedelic and dissociative systems, including mood, thought, body image, taste, social behavior, perception, and sensory perception. The substances of the mind are "tripped".

NIDA
NATIONAL INSTITUTE ON DRUG ABUSE

KEEP YOUR BRAIN HEALTHY. DON'T USE DRUGS.

ADDITION IS A BRAIN DISEASE.

When it comes to drugs, you've got to use your brain.

Or drugs will use it for you.

ADDITION IS A BRAIN DISEASE.

U.S. Department of Health and Human Services
National Institute of Health

MEMO: Club Drugs Memo - 12/10/99

http://www.clubdrugs.org

clubdrugs.org
A Service of the National Institute on Drug Abuse

Community Drug Alert Bulletin on Club Drugs

Information on Club Drugs

RESOURCES

Club Drugs

Club drugs are being used by young adults at all-night dance parties such as "rave" or "house" dance clubs, and have MDMA (Ecstasy), GHB, Risperidol, ketamine, methamphetamine, and LSD are some of the club or party drugs gaining popularity. NIDA-supported research has shown that use of club drugs can cause severe health problems and, in some cases, even death. Used in combination with alcohol, these drugs can be even more dangerous.