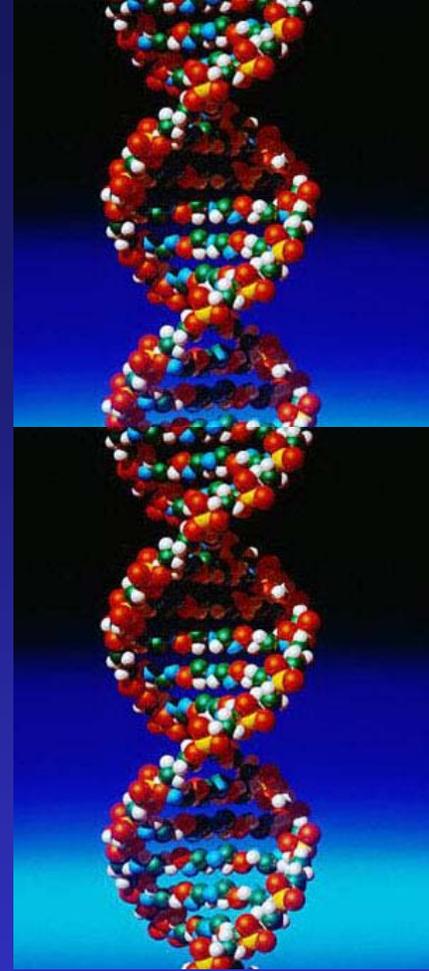
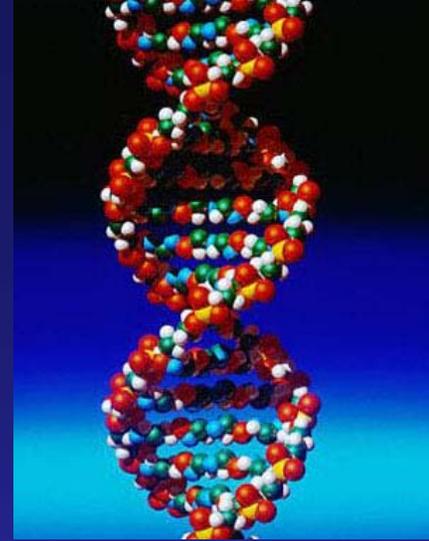


The New Public Health:
Genes and Health Behaviors
Donald F. Schwarz, MD, MPH

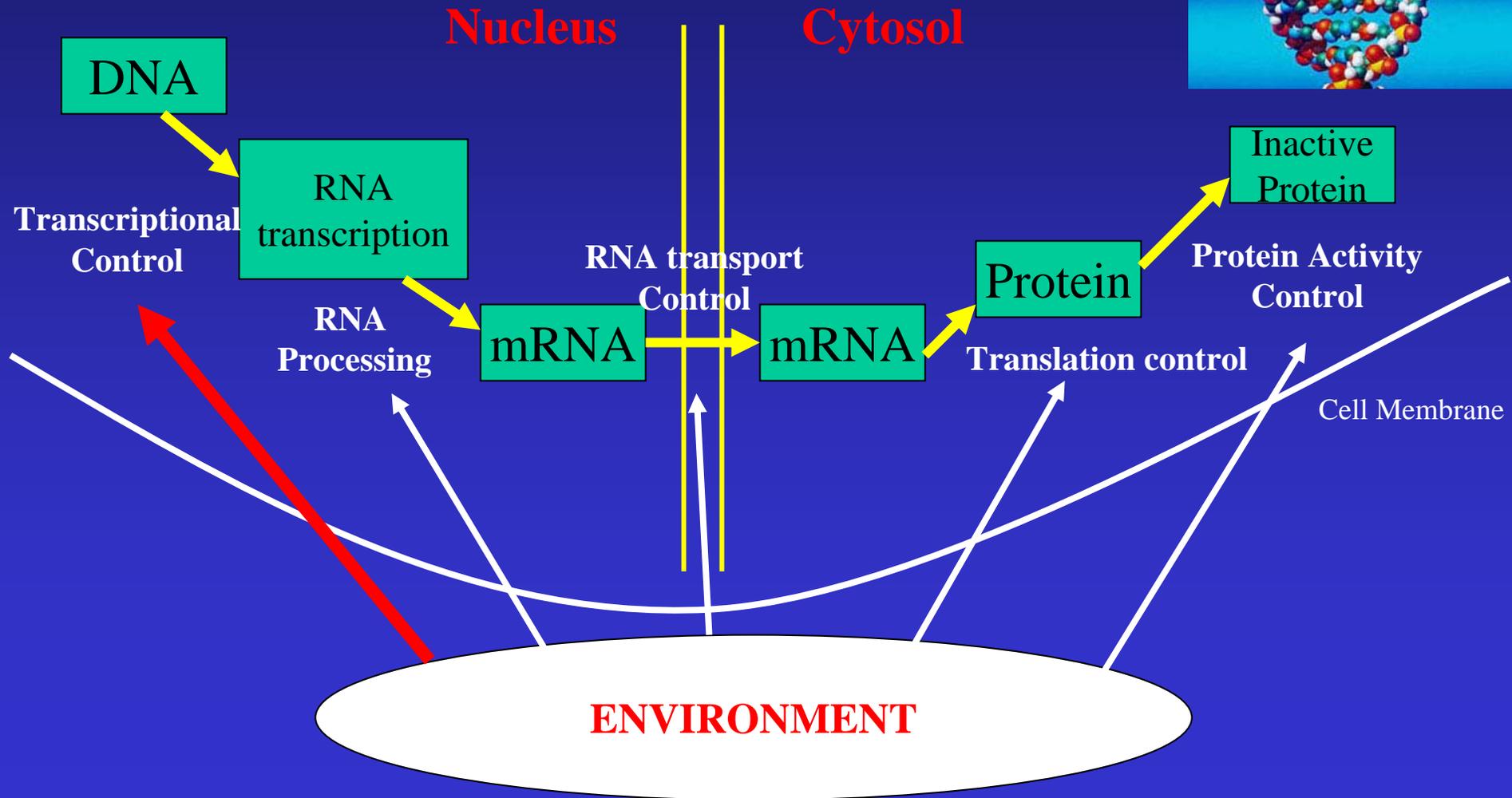
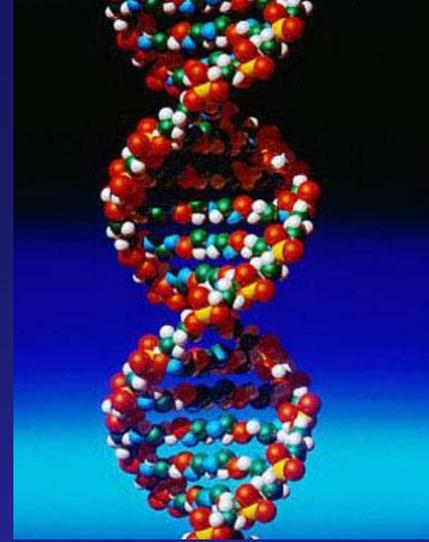


Introduction

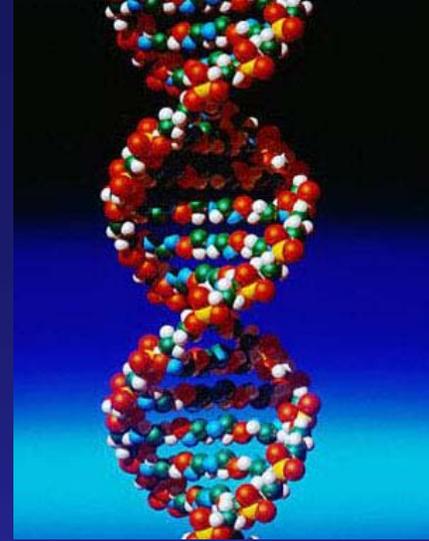
- The biology of behavior is only recently being explored
- Brain chemistry is programmed genetically and influenced by environment
- Only nuclear genetic programming is explored to date



Gene-Environment Interactions

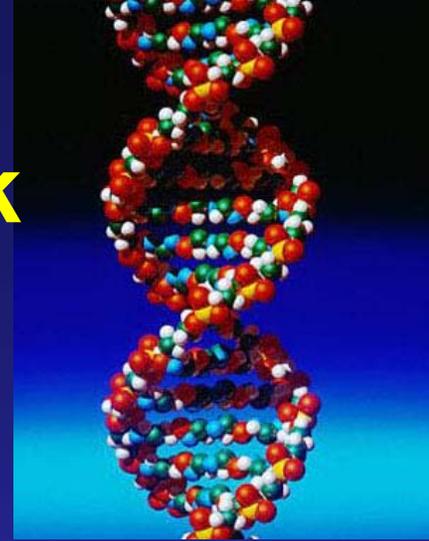


Genetic Principles



- Genes code for proteins
- Proteins control gene expression
- Gene expression influences behavior
- Behavior may change with time as gene expression changes
- Environment affects gene expression

A Framework for Early Risk Behavior Acquisition



Early Modeling -----> Peer Influence----> Risk Taking-----> Reinforcement--> Regular Behavior

Birth to 10 years

Early teens

Middle teens

Mid-late teens

Young adult

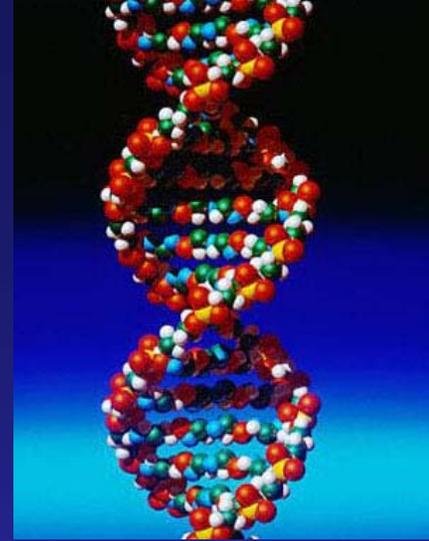
Parents/Adults
Media
Childhood
experience

Friends
Media

Opportunity
Hedonism
Genetics
Psychological
state

Peers
Hedonism
Family
Genetics

Methods of Study



Twin studies

- Monozygotic vs dizygotic
- Twins vs. siblings
- Twins raised separately

Gene frequency studies

Shared Genes

100% Monozygous
50% Dizygous, full-sibs
25% Half-siblings

Shared Environment

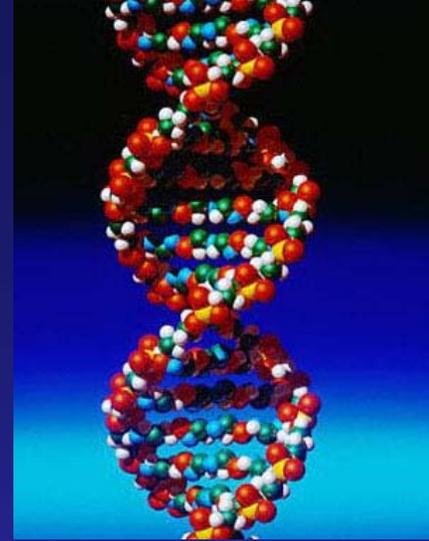
100% same family
0% adoption at birth

Unique Environment

Behavior

```
graph TD; A["Shared Genes  
100% Monozygous  
50% Dizygous, full-sibs  
25% Half-siblings"] --> D["Behavior"]; B["Shared Environment  
100% same family  
0% adoption at birth"] --> D; C["Unique Environment"] --> D;
```

Example: Smoking

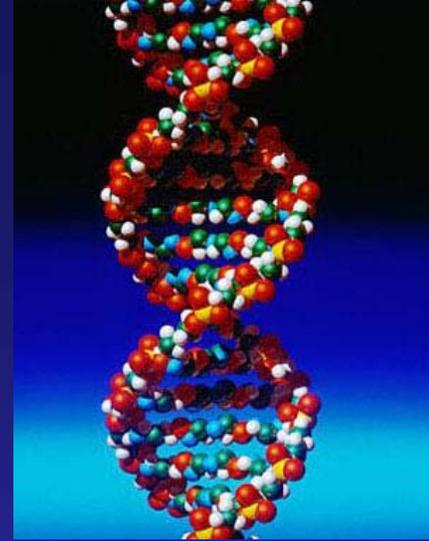


- Time from experimentation to dependence averages 2-3 years
- About 20% of adolescent smokers develop nicotine dependence
- 70% of adolescent smokers attempt to quit; 7% succeed
- 30% of dependent adolescent smokers attempt to quit; 3% succeed

Behavioral Genetics

Smoking

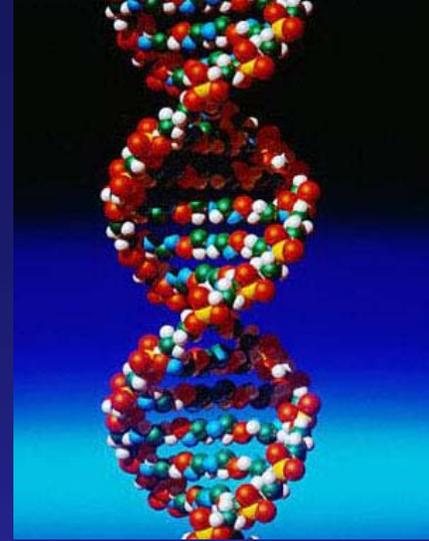
- Twin studies of smoking show 53% of variance in initiation and 67% of variance in nicotine dependence explained by genetics
- Link between anxiety and smoking initiation linked to chemical pathways in the brain.



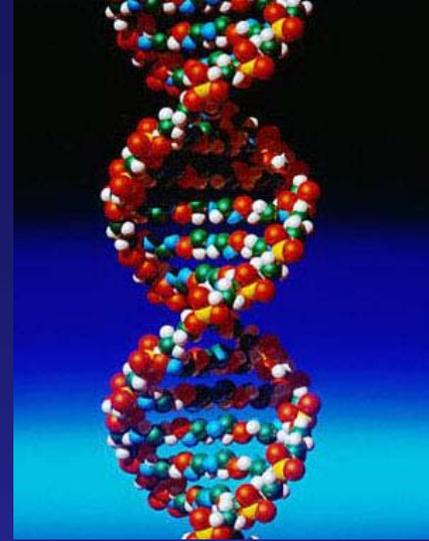
Behavioral Genetics

Alcohol

- Twin studies of alcohol use explain 30-70% of variance. Shared environment accounts for 47% of risk in one study of men.
- Alcohol dehydrogenase activity has strongest genetic linkage. ADH2 is protective in Asian and Ashkenazi Jewish populations.



Example: Alcohol Use Behaviors

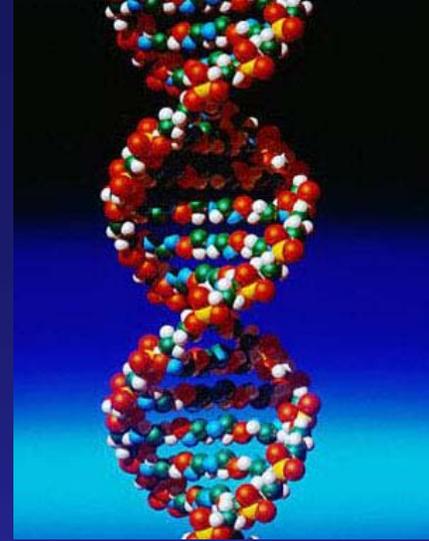


- Willingness to initiate: 56%
- Association with peers who drink: 64%
- Lawbreaking: 63-65%
- Transition to dependence: 70%

Example: Aggression

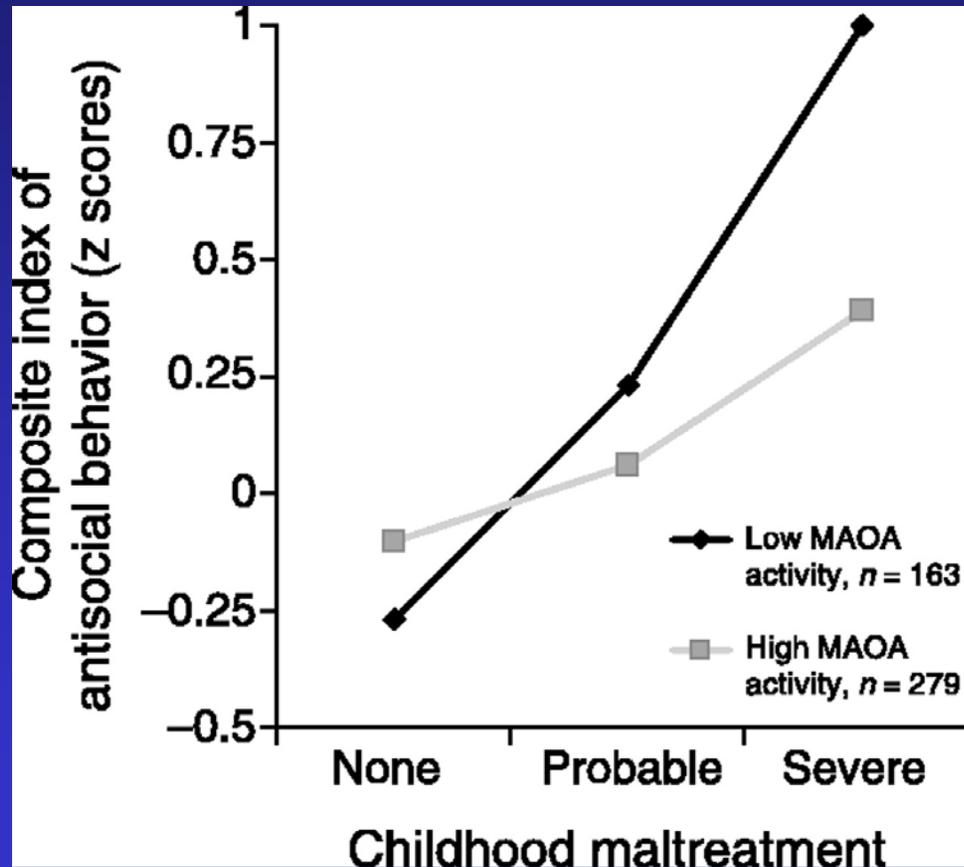
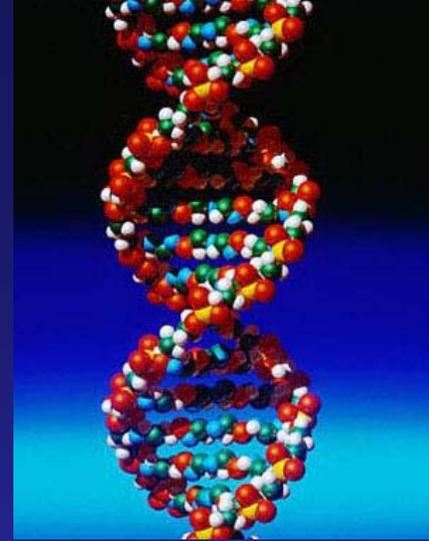
Neurobehavioral pathways

- Childhood maltreatment has been associated with antisocial behaviors, including physical aggression
- Abused boys more likely to develop conduct disorder, antisocial personality and to be violent offenders
- Monoamine Oxidase A (MAOA) gene on the X chromosome
- MAOA enzyme deactivates brain chemicals (NE, 5-HTT, DA)
- MAOA activity has been associated with aggression in mice and humans



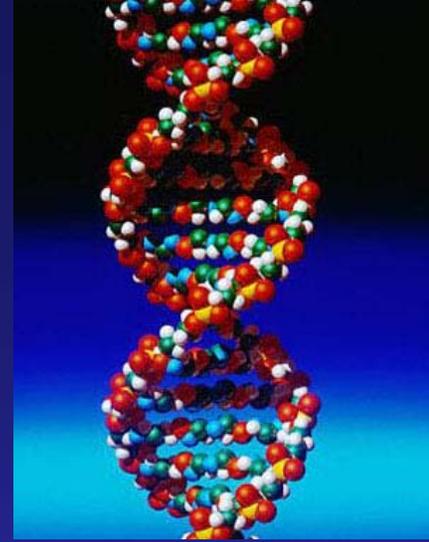
Example: Aggression

Neurobehavioral pathways



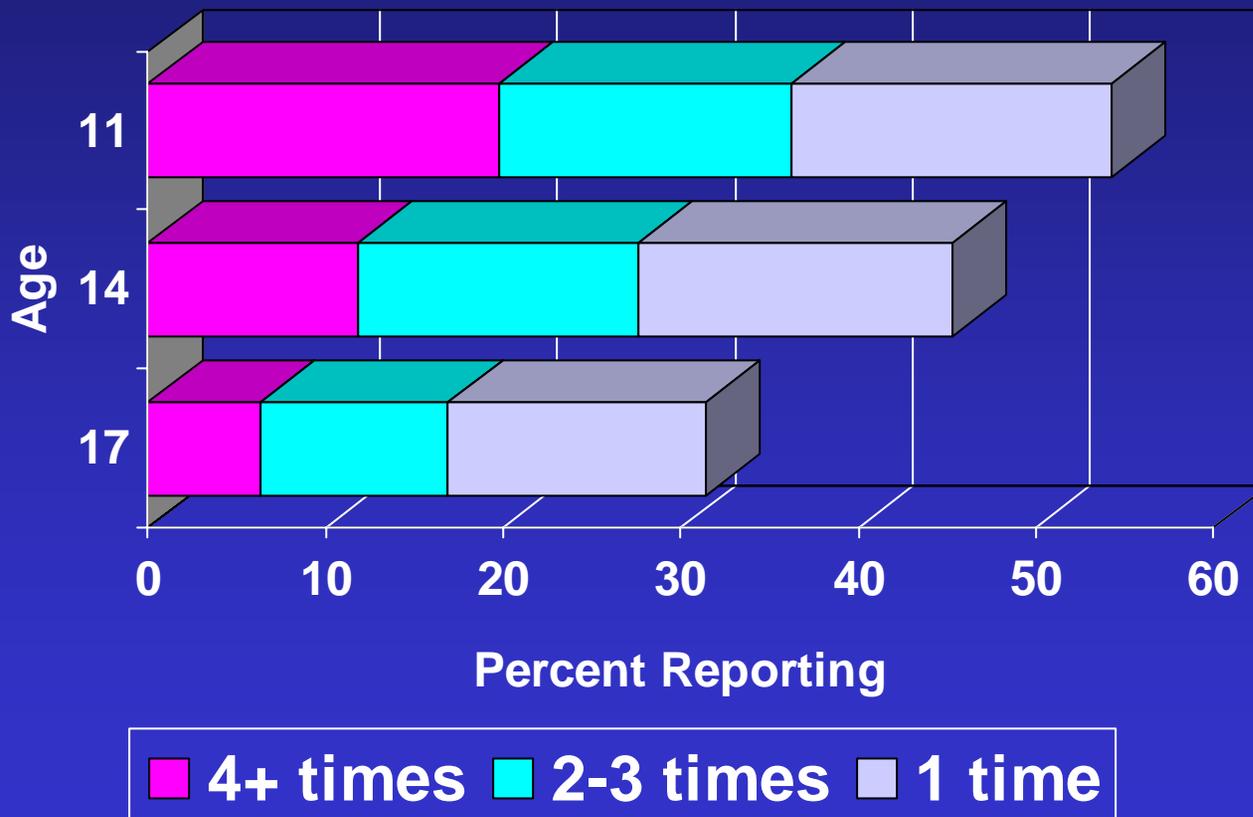
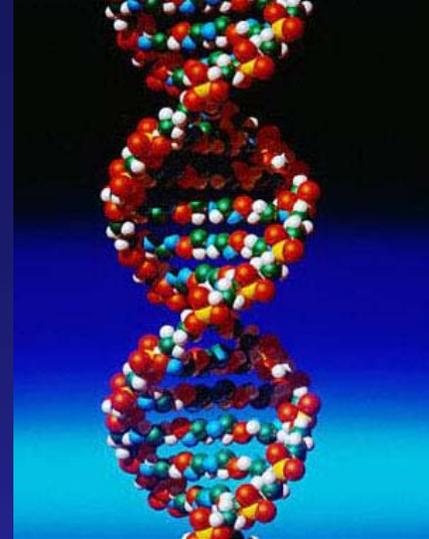
Behavioral Patterning

Clues to Genetics vs. Environment



- **Stereotypic changes with age**
- **Constancy across populations and time**
- **Association with known genetic syndromes/genotypes**

Age-Associated Behaviors: Physical Fighting in the Last Year

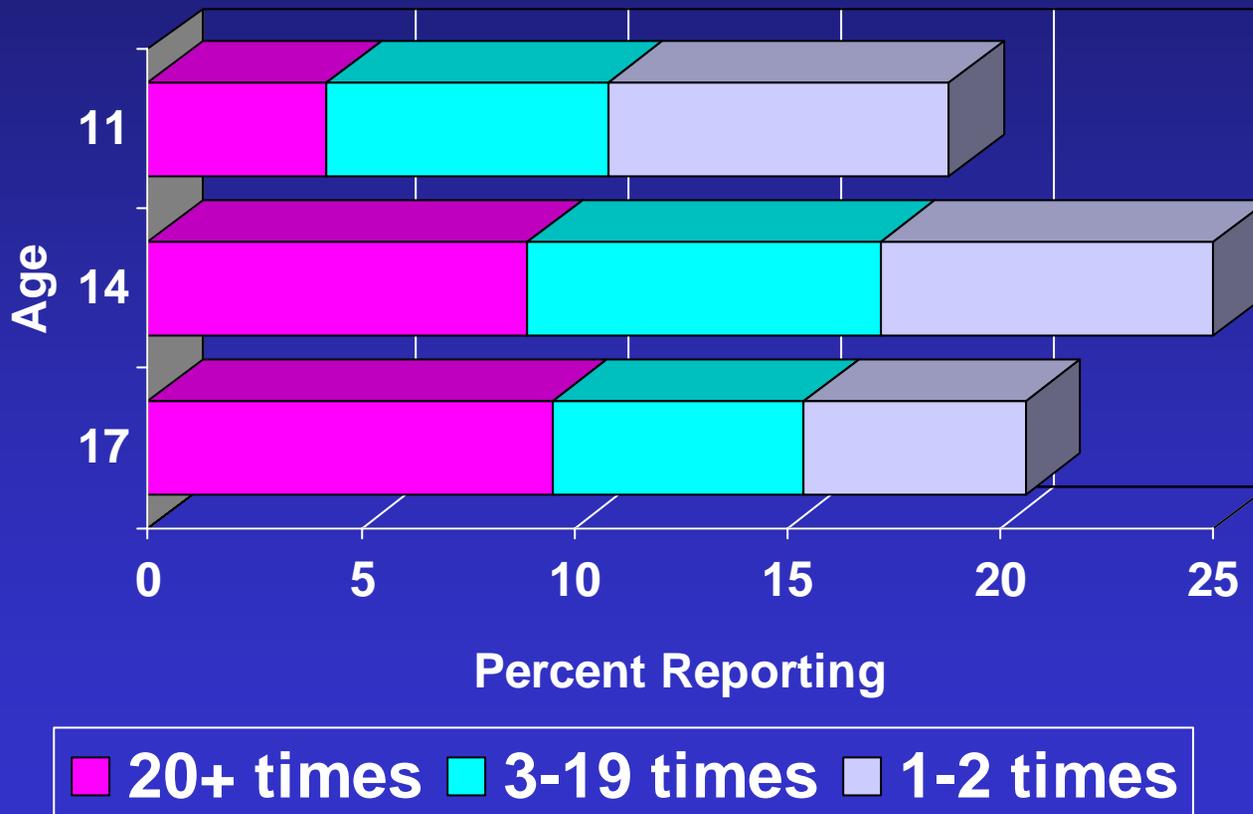


Source: Pennsylvania Youth Risk Survey, 1995



Youth Behaviors:

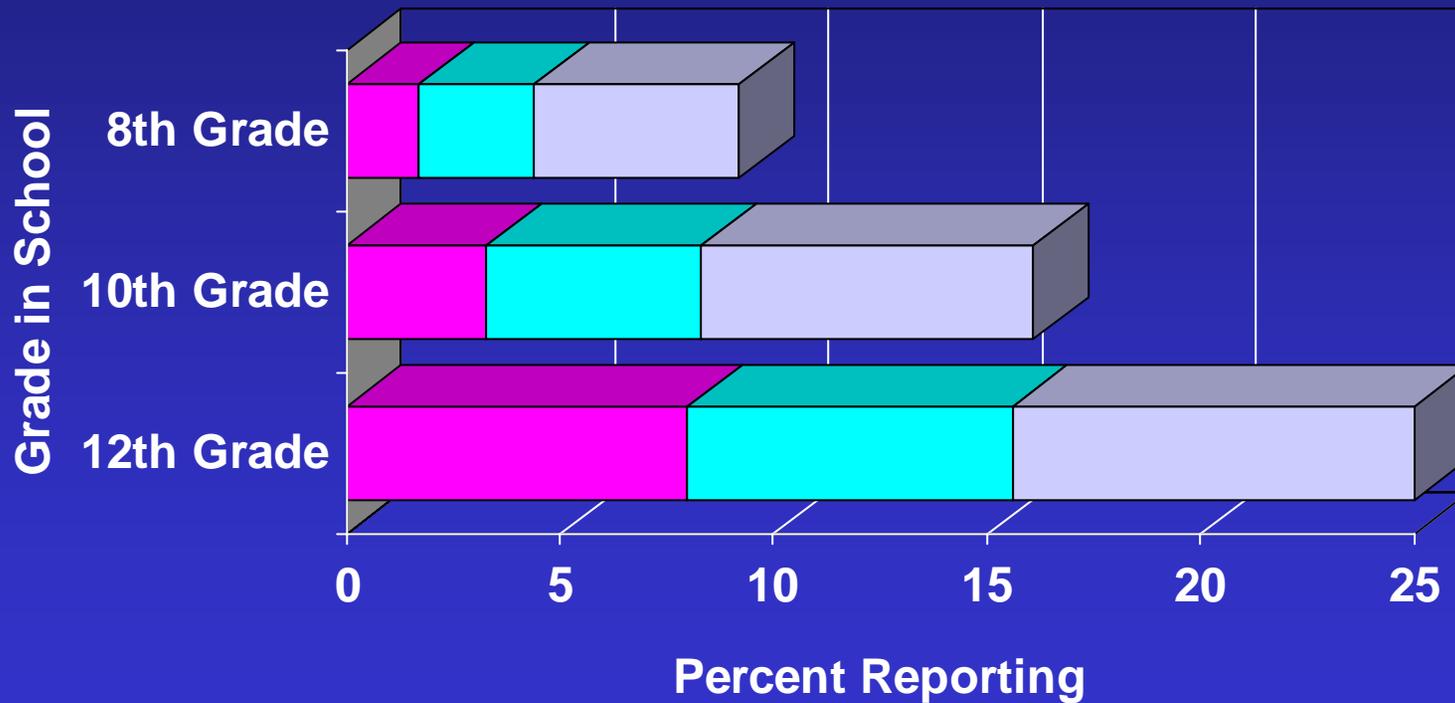
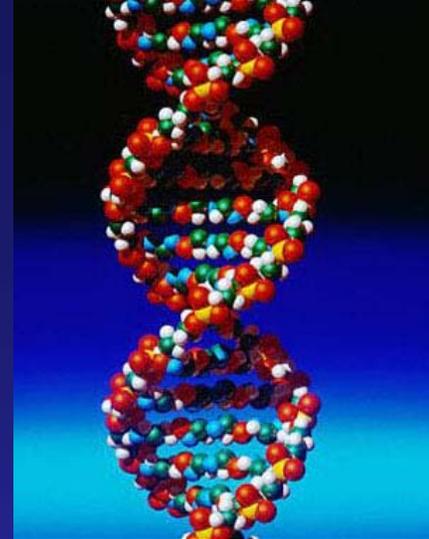
Weapon Carrying in the Last Year



Source: Pennsylvania Youth Risk Survey, 1995

Youth Behaviors:

Cigarette Smoking in the Past Month

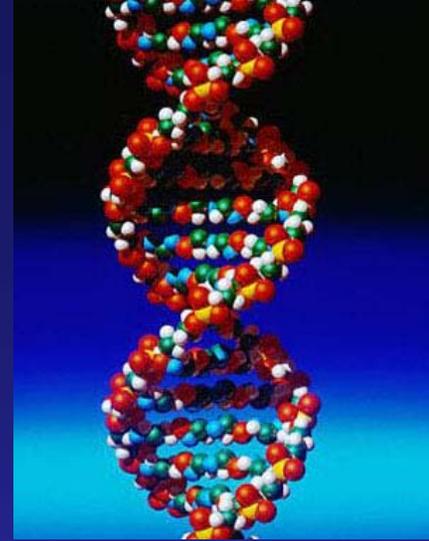


■ 10+ per day ■ 0-10 per day ■ Less than 10 per day

Source: Monitoring the Future, 2004

Behavioral Patterning

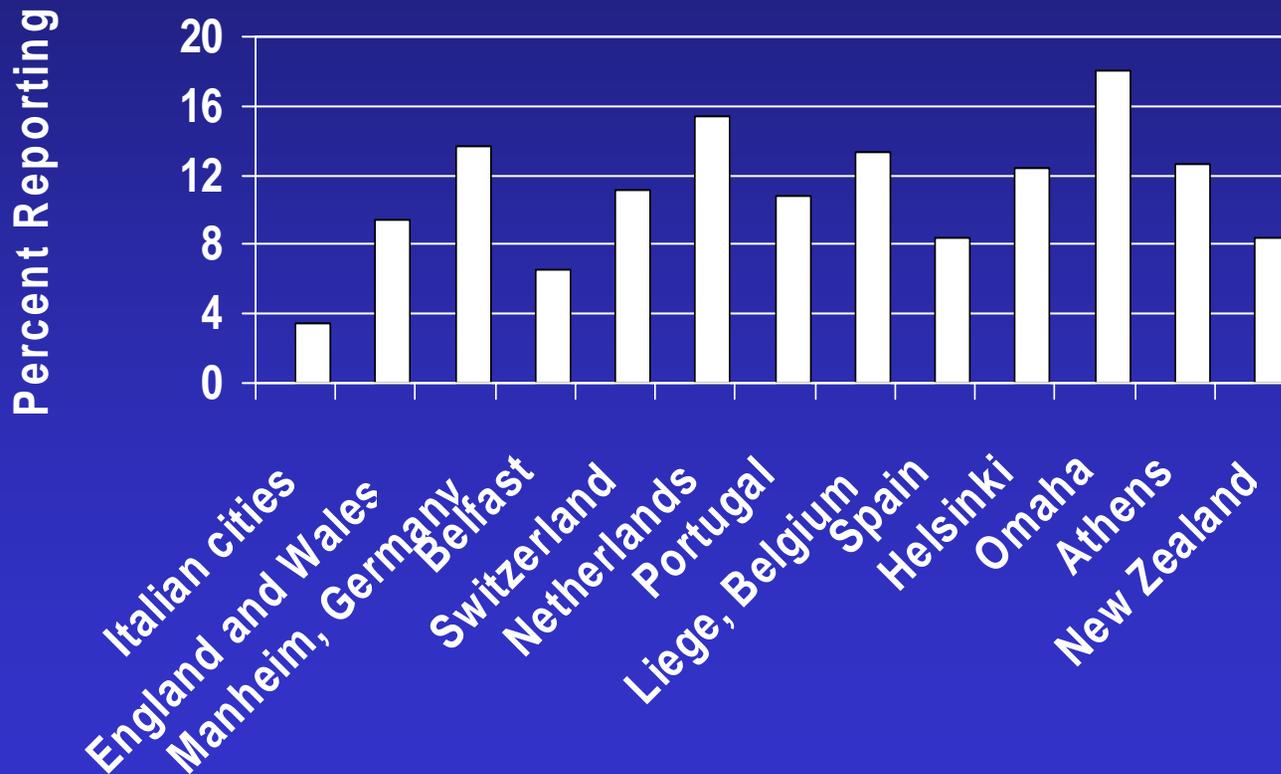
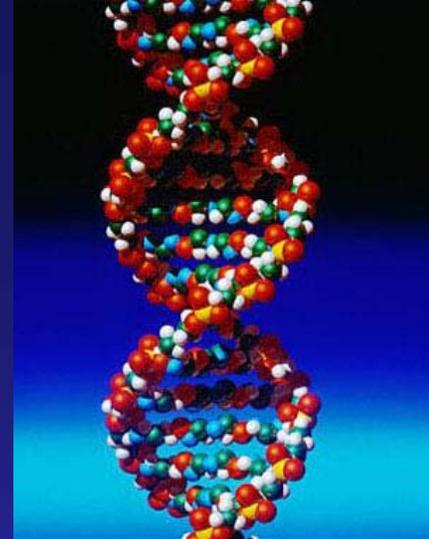
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Youth Risk Behaviors

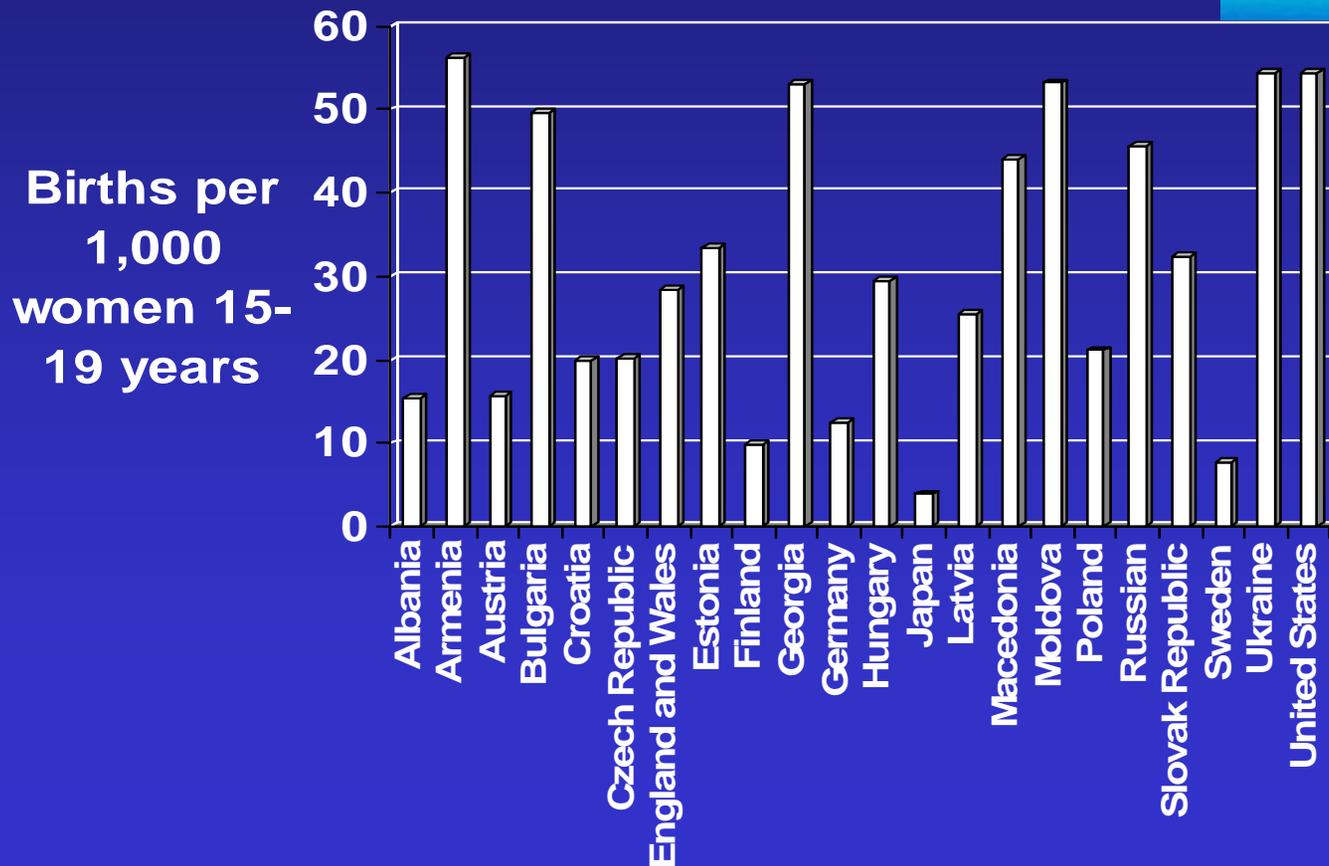
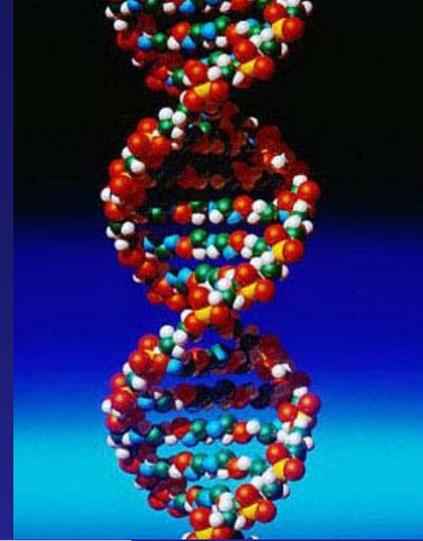
Weapon Carrying in the Last Year: International Comparison



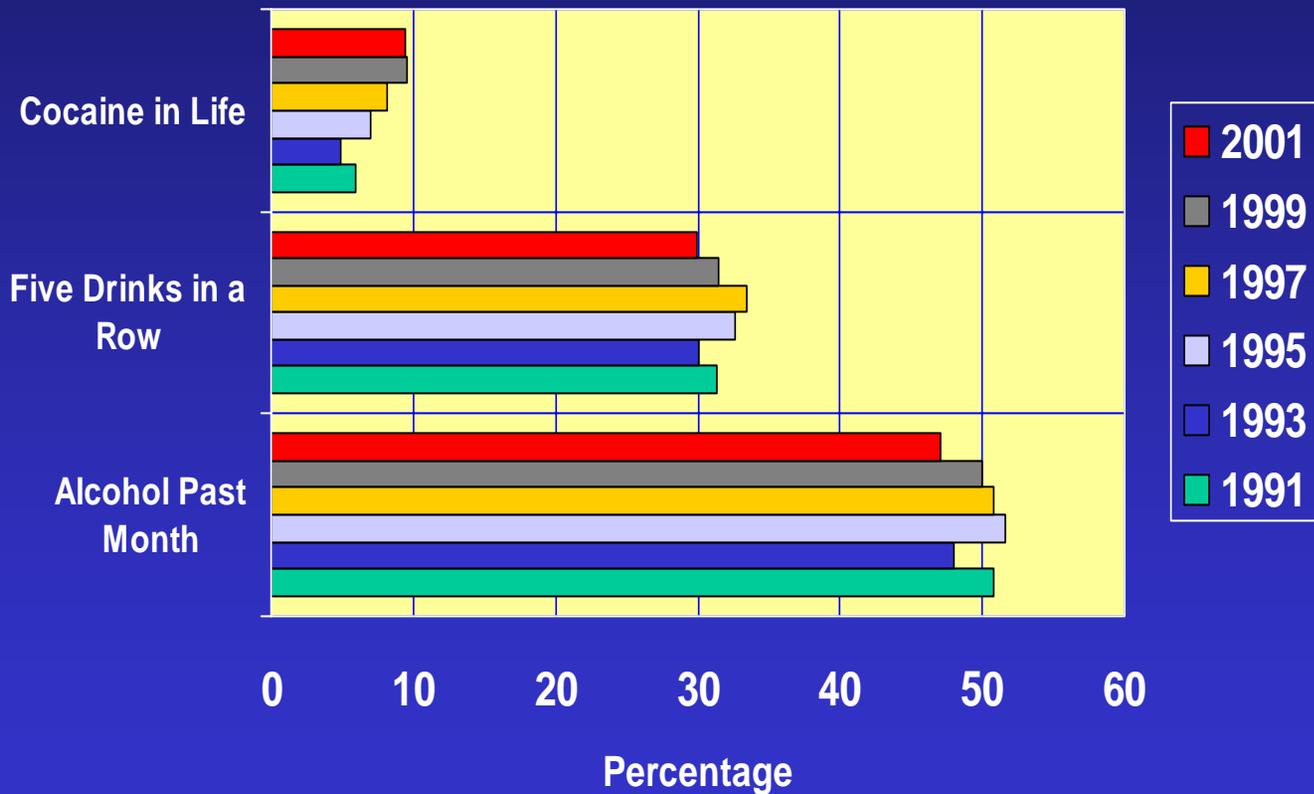
Source: Junger-Tas, et al. *Delinquent Behavior Among Young People in the Western World*. Kugler Pubs, 1994.

Youth Risk Behaviors

Adolescent Birth Rates: International Comparison



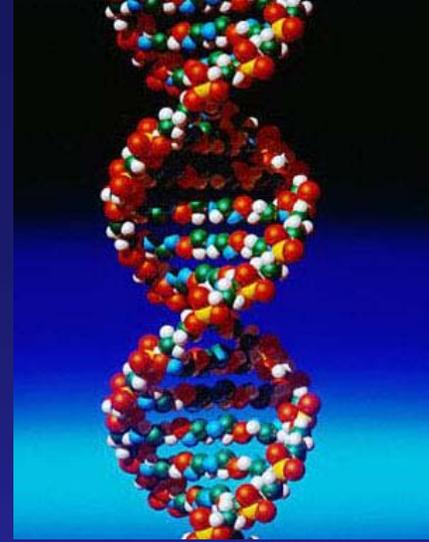
Youth Risk Behaviors: Substance Use



Source: Youth Risk Behavior Surveillance System, CDC, 2003

Behavioral Patterning

Clues to Genetics

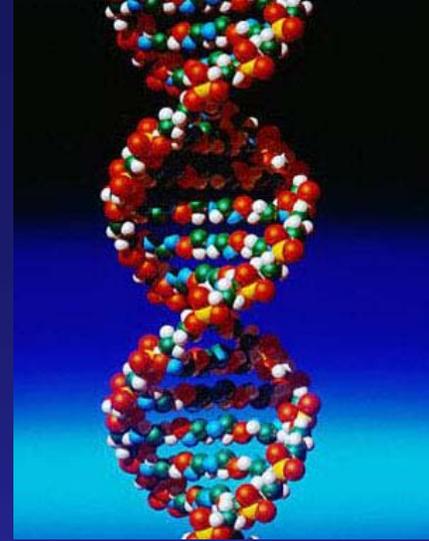


- **Stereotypic changes with age**
- **Constancy across populations**
- **Association with known genetic syndromes/genotypes**

Behavioral Genetics

Illicit Substance Use

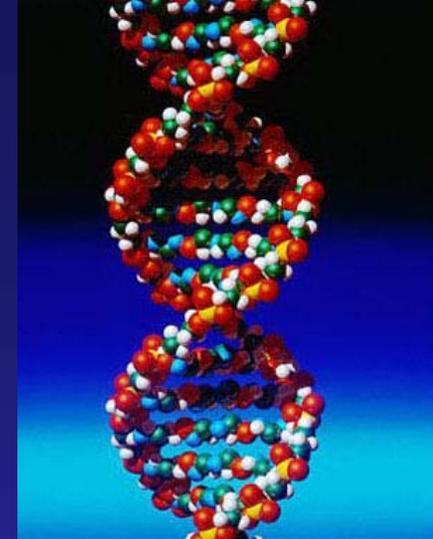
- Harvard Twin Study suggests that 38% of variance in sedative drug use and 44% of variance in stimulant use explained by genetics.
- 74% of cocaine, 57% of opioid, and 68% of MJ addiction explained by genetic factors.
- Transition to regular use appears highly genetically-related.



Behavioral Genetics

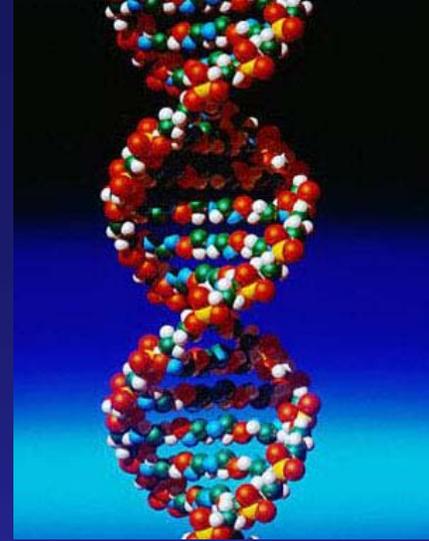
Dietary Behaviors

FACTOR	Genetic Association
Stomach Content	40%
Meal Time	37%
Perceived Hunger	31%
# People at Meals	20%
Meal Nutritional Composition	8%



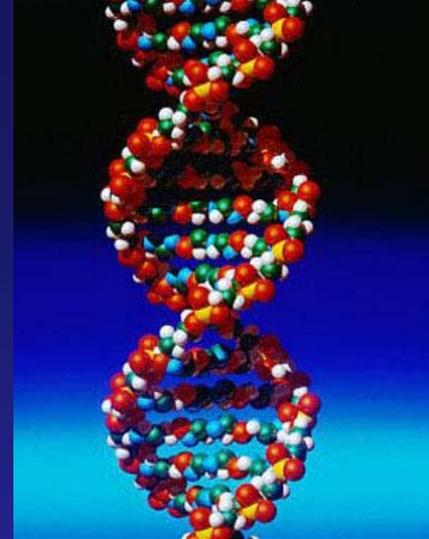
Behavioral Genetics

Sensation-Seeking

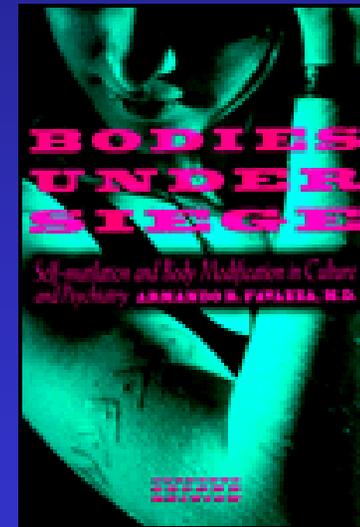


- **Heritability estimates range from 34-68% depending on the dimension of sensation-seeking.**
 - e.g. Novelty seeking; extraversion; impulsivity
 - Serotonin and perhaps dopamine alleles involved
- **Sensation-seeking also linked to substance use and other risky behaviors**

Self-Mutilation



- Self-mutilation has strong association with sexual abuse in girls and perhaps physical abuse in boys.
- Consistent rate of 4% in general adolescent populations.
- Personality issues and depression have been most closely associated.



Armando R. Favazza