Effect of Drugs and Alcohol on the Adolescent Brain

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Adolescence: The Search for New Experiences

- Adolescence is a time of new experiences, growth, exploration.
- Drug and alcohol exposure starts in adolescence for most:
  - Cigarettes/Nicotine
  - Alcohol
  - Marijuana
  - Other Drugs (Prescription Medications, Opioids)
Facts About Adolescent Drug Use

• Each day roughly 3,000 teens smoke their first cigarette.

• National Survey on Drug Use and Health
  – Illicit drug in the past month
    • 4% of 12- to 13-year-olds
    • 11% of 14- to 15-year-olds
    • 20% of 16- to 17-year-olds
    • 23% of 18- to 20-year-olds.
    • 64% of patients entering treatment for drug abuse started abusing drugs at age 20 or younger
    • A third of high school students who try smoking eventually become daily smokers

(SAMHSA, 2002)
Facts About Adolescent Drug Use

• Misuse of prescription drugs second now only to marijuana as most prevalent drug problem in U.S.
  – Rates of Non-medical Use of Pain Relievers (Past Year)
    • 18-25 y.o.: 11.8%
    • 12-17 y.o.: 7.5%
    • >26 y.o.: 3.1%
  – Risk of abuse or dependence greater for those who initiated use before age 16
    » (SAMHSA, 2006)
What does basic research tell us about problems of adolescent substance abuse?
Do Adolescents Have a Special Vulnerability to Substance Abuse?

- Adolescent brain is immature
- Human brain matures until about age 24
- Three structures maturing through adolescence are involved in drug/alcohol responses:
  - **Nucleus accumbens**: pleasure center where drugs/alcohol produce euphoria and pleasurable effects; modulates how much effort a particular reward is worth, adolescent NA selects for low effort, high excitement, e.g.: video games/substance use
  - **Amygdala**: controls emotional reaction to pleasurable and aversive experiences; in adolescents: responsible for explosive reactions rather than controlled responses
  - **Prefrontal cortex**: complex information processing; judgment, controls impulses, foreseeing consequences, making plans; in adolescents: poor judgment, impulsive behaviors
Activation of the reward pathway by addictive drugs

Cortex, PFC, NAc, Hipc, Thal, VTA, Amy, CBM

Cocaine, heroin, nicotine, alcohol, heroin
Are Adolescents More Vulnerable to Drug Abuse than Adults?

- Immature brain of adolescents associated with poor judgment, impulsivity, inability to contemplate consequences
- Greater feelings of social disinhibition with alcohol (less shyness in social settings reinforces use)
- Lower sensitivity to intoxicating effects of alcohol resulting in use of larger amounts
- Combination of these effects may contribute to initial decision to use and make experience rewarding enough to repeat
- May lead to substance use disorders—abuse and dependence
How do Drugs and Alcohol Affect Brain Development?

**Drug Exposure:**
- **Exposure to nicotine in adolescence:**
  - Associated with greater use of nicotine in adulthood
  - Greater stimulant response to cocaine administered to adults
- Adolescent exposure to nicotine may be associated with cognitive deficits in adulthood
- Adolescent animals respond differently than adults to tetrahydrocannabinol, the active chemical in marijuana (VYTP)
How do Drugs and Alcohol Affect Brain Development?

Alcohol Exposure

• Damage to frontal cortex: Cognitive deficits
• Damage to cerebellum: Coordination
• Smaller hippocampus: Damage to memory
Implications

Treatment:
• Understanding neurobiology leads to new targets for pharmacotherapy

• Psychotherapy can be targeted to level of brain maturation
Implications

Prevention:

• Age appropriate curriculum to educate about brain and its development; incorporate neurodevelopmental findings into educational materials

• Educate therapists to adjust therapeutic goals based on brain maturity—older adolescents can weigh pros/cons of unhealthy behaviors, younger adolescents need more concrete interventions

• Educational efforts with public advocates; delay of substance abuse; avoiding neurological damage by avoiding substance abuse in adolescence