

Lecture Topic: “Alcohol and the Adolescent Brain”
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Date: May 2, 2007
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This report was prepared from both my own notes and Dr. White’s slides.

SUMMARY:

Dr. Aaron White presented many threads of current research into the effects of alcohol on the developing adolescent brain. Although this research is in its infancy, and has been performed on non-human subjects, the evidence is overwhelming that there is a tremendous amount of brain development occurring during adolescence, contrary to previous assumptions. The preliminary data suggests that the adolescent brain is particularly vulnerable to the long-lasting effects of alcohol-induced cognitive impairment.

Dr. White is a biological psychologist interested in a wide variety of topics, including issues surrounding adolescent brain and psychological development and underage drinking. He helped create a successful online alcohol education course for college students, AlcoholEdu, which has been completed by over 500,000 students in the past few years. He works with Mothers Against Drunk Driving (MADD) to create education and prevention programs for elementary and high school students, and his research has been discussed in many news outlets, including Discover magazine, USA Today, CNN and others.

OUTLINE:

I. Adolescence: The Context of Teen Drinking

- A. Adolescence is roughly defined as the second 10 years of life, a long, protracted transitional stage from child to adult. It is a collection of changes that help children to survive on their own. Most important developmental changes don’t even begin until after the age of 10.
- B. Alcohol, video games, TV, and lack of exercise can all disrupt functioning and derail development.
- C. What does a “normal” adolescence look like:
 1. Increased time with peers, which serves to draw the child out of the home, which coincides with decreased time spent with the family. This is perfectly adaptive, since in order to co-exist with their peers as adults they need to spend time with their peers as teens. The formation of social network is crucial to survival.
 2. Increased risk-taking and novelty-seeking – the meat of the problem. This includes experimenting with altered states of

consciousness via drugs and alcohol. It's critical to species survival that adolescents learn to take chances and learn new skills. Goal is to create an atmosphere that encourages taking "healthy" risks, rather than trying to fight biology by insisting on "no risks."

3. Increased conflicts with authority, including parents. This is a necessary step to maturation, in order to propel the child out into the larger world. Larger separations are required. Competition for mates and resources is part of human nature, and positioning oneself involves conflict.
 - a. Male conflict is generally more overt, or physical.
 - b. Female conflict involves sabotage and manipulation.
 4. Sleep changes, typically staying up later and sleeping in longer; sleep patterns are fragmented.
 5. Puberty, consisting of the physiological changes necessary to become sexually mature.
 6. Changes in brain physiology, discussed below.
- D. Every wave of adolescence is different because of new technologies and new cultures. In that respect, adolescence is a uniquely environmental phase of development.

II. Role of Environmental Factors Affecting Kids

- A. It's vital for parents to model more responsible decision-making.
- B. Various biological wedges drive themselves between child and adult. The tendency is to move away from the family, to be cranky, cantankerous. The adolescent is built to disengage.
- C. While moving away, though, an adolescent needs a solid, authoritative, stable home base. Risk-taking is a necessary, adaptive, valuable behavior but it also needs grounding.

III. Adolescent Brain Development

- A. During adolescence, the brain is quite plastic, and the neural substrates underlie many changes. These structural and functional developmental changes are particular to adolescence. Although the physical body develops to maturity, the nervous system is still developing.
 1. The neural circuits that help us plan, make decisions, control impulses, create memory, govern our sleeping and eating habits are all redrawn during adolescence.
 2. The remodeling of the adolescent brain is greatly influenced by environment, much more so than an adult brain.
- B. A substantial number of cortical synapses are pruned during adolescence. Some of the most intriguing changes take place in the frontal lobes. Frontal lobes distinguish us from other mammals, enabling us to live in the past, present and future.
 1. Frontal lobes have a key role in memory, voluntary motor behavior, impulse control, decision-making, planning and other

higher-order cognitive functioning. Developed frontal lobes enable an adult to think about the future and regulate their feelings.

2. This is very different from children, who are largely emotional learners (from interactions, not logic).
 3. Frontal lobe gray matter volumes increase throughout childhood and do not peak until around age 12, at which point they decline throughout adolescence, reflecting synapse elimination and increased myelination. Neurons branch out and make contact with other neurons, growing the gray matter.
 4. “Frontalization” refers to the increased dependency on the frontal lobes for controlling behavior, coming “online” using reason. This is a learning process, molded by experiences.
- C. Additional changes throughout the cortex during adolescence.
1. Gray matter increases in the parietal lobes, which are involved in processing sensory information and evaluating spatial relationships, peak around age 11 and decrease throughout adolescence.
 2. Gray matter volumes in the occipital lobes, which are involved in processing visual information, increase throughout adolescence and into the early 20s.
 3. Gray matter volumes in the temporal lobes, which are involved in memory formation and visual and auditory processing, do not reach maximum until 16-17.
 4. The corpus callosum, a thick bundle of axons that allows the two cerebral hemispheres to communicate with each other, increases in size during adolescence.
- D. The opportunity to mold learning closes by early 20s. Anything that we put into an adolescent’s brain is permanent. Adolescence determines what type of primary role we will take on as adult citizens. Healthy choices, healthy modeling is very important.
- E. A child’s brain enters adolescence with loads of neural contact from the tremendous gray matter increases of childhood. These contact points are then weeded by adolescent experiences, which is why we will always define ourselves by who we hung out with in high school. Every experience leaves an indelible imprint.
- F. The amount of flexibility in our behavior decreases with age – as adults, we’re lost! – but there’s hope. It’s important to internalize a sense of responsibility to create healthier communities – it’s all about decision-making.

IV. The Brain’s “Reward System”

- A. Deep inside the brain is the nucleus accumbens, “the nucleus that leans.” This is where we perceive things to feel good, that make us want to do them again and again. It’s a system that leads to our betterment, but it also plays a key role in addictive behaviors.

1. Drugs, painkillers, alcohol, even donuts – we like what these do to our reward system, which becomes activated, leading us to seek them out time and again.
 2. Behavioral patterns are then built around these feel-good events.
- B. Addictions are learning-related pathologies. Adults use developed frontal lobe functioning to control the impulses aroused by the activated reward system. But an adolescent's frontal lobe isn't as developed, so there aren't any brakes applied to the reward system. This is why drug abuse typically starts in adolescence.
- C. Messages that frighten adults don't frighten adolescents. Parents cannot count on their teens to consider negative consequences to their behavior.
- D. The key is to build momentum prior to adolescence, helping your child to learn how to control impulses and choose healthy lifestyles. Starting in middle school is starting too late – better to begin while they are in elementary school.
1. Withhold short-term satisfactions with young children. Strike a balance of positive and negative reinforcement.

V. Alcohol: America's Drug of Choice

- A. People have been drinking alcohol for over 9,000 years.
- B. Alcohol is a \$120,000,000,000 per year industry, with underage drinkers representing 20% of the market. It is big business on college campuses, \$5,500,000,000 per year.
- C. Alcohol use in the past year, by age of first use of alcohol:
1. <14, 16.4%
 2. 15-17, 9.4%
 3. 18-20, 4.9%
 4. 21+, 2.1%
- D. Alcohol is woven intimately into the fabric of our world.
- E. Are American kids different from their European counterparts? Is there any truth to the notion that European teens “handle” their alcohol consumption in a more mature fashion? No – the reality is that you can't culturally mitigate the physiological effects of alcohol on the body and brain.
1. Percent of teens (15-16 y.o.) that binged (5+ drinks/night) at least once in the past 30 days: Denmark(60%); Ireland (57%); Germany (57%); UK (54%); Norway (47%); Switzerland (41%); Finland (40%); Greece (39%); Russia (39%); Sweden (37%); France (26%); Portugal (25%); Poland (23%); US (22%); Turkey (15%).

VI. Marketing Alcohol to Tweens, Teens and Young Adults

- A. If you teach behavior about alcohol to an adolescent, it's there forever. That's why the alcohol industry pitches its products to kids.

- B. The universal message in beer commercials to adolescent males is Beer + You = You + Hot Women. Alcohol is also constantly tied to sports and celebrities.
- C. There should be restrictions on alcohol advertising. Where are the warning labels, the disclaimers, just like on other drugs sold over-the-counter?
- D. In Australia, every container of alcohol has to have serving size information on the label, which is important, since most people have no idea what how large a serving of alcohol should be. You can't drive in the US at .08% blood alcohol, you're intoxicated at .1%, and people die at .35%

VII. Alcohol's Effect on the Adolescent Body

- A. Alcohol is a poison, a toxin, and the human body responds to it as such. Although there is nothing wrong with small quantities of alcohol for adults, it is devastating in larger quantities for adults and in any quantity for children and adolescents. Alcohol is a carcinogen, causing head, neck and breast cancers.
- B. Current research points to the assertion that alcohol probably damages the adolescent brain. Once drinking, teens are uncomfortable without chemically altering their brains. Since an adolescent's sense of self develops around alcohol, if you remove the alcohol, there's a void.
- C. Alcohol affects teens differently than adults, leading to bigger memory impairments, less plasticity. There is also less sedation and smaller motor impairments with teen alcohol use. Alcohol slows down cell birth.
- D. Blackout result when the brain's plasticity grinds to a halt. Blackouts are the inability of the brain to change with experience due to intoxication. Femaleness is a risk factor in blackouts. They are frighteningly common.
 - 1. 25% of college-age females are sexually assaulted by the time they leave college, most due with alcohol involved. Consent cannot be given if a woman is intoxicated.
- E. Alcohol slows hippocampus cell firing, which is critical for making memories and exhibits a tremendous amount of neural plasticity. As the dose of alcohol goes up, the magnitude of the memory impairments goes up, as well.
 - 1. Is there a desire for the blackout to escape responsibility?
- F. Memory and attention are 2 abilities necessary for negotiating the tasks of adolescence and successfully making the transition to adulthood.