prevention Tactics

Under Construction:

Adolescent Brain Development and its Implications for Preventing Alcohol and Drug Abuse

By Ken C. Winters, Ph.D. and Tamu Mitchell

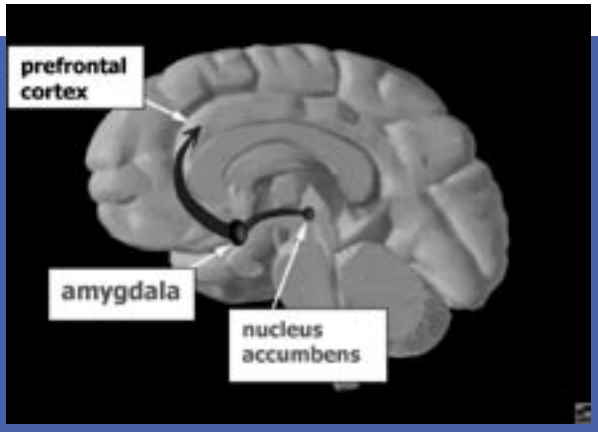
Why do teens act the way they do?
What are they thinking?
Why do they use drugs, drink and smoke when they know the risks?

Counselors, teachers, and parents alike share their exasperation over these common questions about today's teens, just as their counselors, teachers, and parents asked similar questions a generation ago, and just as today's teens will be asking them at some point in their lives. Conventional wisdom used to explain that moodiness and poor judgment were just part of any teenager's normal developmental process – managing surging hormones while trying to fit in with the crowd.

Recent scientific discoveries, however, have uncovered a more complex tale. Not only is it insufficient to blame adolescent problems on their hormones or peer pressure, to truly understand what is going on requires some knowledge of the brain and how it develops. While it is true that one can legally drive at 16, vote and serve their country at 18, and purchase alcohol at 21, we now know that the brain is still maturing into the early 20s. It should not come as a surprise that car rental companies will not allow customers under the age of 25 to rent their vehicles. Because our ability to make sound judgment calls depends on a fully mature brain, adolescents are inherently at an elevated risk for numerous problems, including choices around substance use.

Work in progress

Advancing technology in brain imaging has provided a window into the developing brain. Scientists are reaching a new understanding of the changes in pre-adolescent and adolescent brains. We once believed that the brain was fully formed at puberty, but mounting evidence is convincing us otherwise: the brain continues to mature in some very important ways until about age 24.



These brain changes are relevant to adolescent behavior.
Prefrontal cortex (PFC) is pruned; not fully developed until mid-20's (Judgement)
Amygdala (and n.a.) show less pruning and tend to dominate the PFC (Reward System)

There are three structures in the brain that continue to mature during youth: the nucleus accumbens, amygdala and prefrontal cortex. These structures are noteworthy because of their implications for understanding adolescent behavior. While scientists caution about making definitive links from neurodevelopmental findings to behavior, the discovery that brain construction is still a work in progress during adolescence provides us with the opportunity to consider some useful hypotheses.

The nucleus accumbens

Every living thing is willing to spend a certain amount of effort in order to seek rewards. The nucleus accumbens is the structure in our brain that directs our behavior when we are motivated to seek a reward. The nucleus accumbens in the teenage brain has not fully matured, leading us to believe that in

prevention Tactics 8:8 (2005)

Tactics (tak´tiks) n. **1.** a plan for promoting a desired end. **2.** the art of the possible.

teenagers, there is still a disconnect between how much effort one is willing to expend to acquire a reward. Teenagers tend to prefer activities that require relatively low effort yet produce high excitement. Real-world observations bear this out: teenagers tend to favor activities such as playing video games, skateboarding, and, unfortunately, substance use.

The amygdala

When we are faced with a pleasurable experience, our amygdala aids us in reacting favorably. When we are faced with a dangerous experience, our amygdala likewise aids us in reacting to protect ourselves. Essentially, our amygdala is the tiny, tucked away brain structure that helps us respond emotionally to our entire range of experiences. While this structure is maturing, however, it can sometimes create more of a hindrance than a help. Perhaps you have noticed that teenagers are more likely to react to a negative situation in a heated way; as they and their brains mature, the same situation has a better chance of being responded to with controlled emotions. The maturing amygdala may be responsible for this automatic "hot" rather than "cool" response. It is also implicated in the propensity for youth to mis-read neutral or inquisitive facial expressions of others as a sign of anger. This means they likely feel that they live in a more hostile or dangerous world than adults live in, and their "hot" response to this world may include fights or other aggressive behavior.

The prefrontal cortex

The next time you make a good decision, thank your prefrontal cortex. Located just behind the forehead, this structure is one of the last areas to mature. It's the area of the brain responsible for the complex processing of information – making judgments, controlling impulses, foreseeing the consequences of our actions, and setting goals and plans. **An immature prefrontal cortex is thought to be the neurobiological explanation for why teenagers show poor judgment and too often act before they think.**

The developing brain and drug use

Scientists are now beginning to explore how these new discoveries of neurodevelopment affect what we know about adolescent drug use and related impulsive behaviors. This is an important issue given that adolescence is a time of experimentation and novelty seeking. The 2003 Monitoring the Future study found that 70.1% of high school seniors had used alcohol in the past year and 34.9% had used marijuana. Over half had tried an illicit drug at least once in their lifetime. Even among 8th graders, 45.6% had already tried alcohol and 22.8% reported illicit drug use in their lifetime (Johnston et al., 2003). And we know that most adults who smoke regularly or meet alcohol abuse or dependence criteria took up their habit in adolescence (Clark et al., 1998).

Are adolescents more vulnerable than adults to abuse drugs?

A developing prefrontal cortex increases the propensity of teenagers to act impulsively and then to shrug off the negative consequences of their behavior. Additionally, a developing nucleus accumbens increases the adolescent's tendency to seek out activities that are exciting but require little effort. And a developing amygdala may be responsible for the heightened pleasurable social experience while drinking alcohol that adolescents report compared to their adult counterparts. All of these effects of the developing brain – **poor impulse control, favoring low-effort yet thrilling experiences, and heightened sensitivity to the social benefits of intoxication – may contribute to an initial decision to use drugs and make the experience rewarding enough to repeat it.** While we must use extreme caution in drawing conclusions for humans from rat studies alone, the human and rat brains are undeniably similar and rat studies can offer some insights (Panksepp, 2004). It may be telling that, in studies of adolescent rats, they are observed to be less sensitive to the effects of intoxication than adult rats.