

The Adolescent Brain

Development In Healthy Children And Teens

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Alcohol is especially toxic

to the adolescent brain.

AGE 20

Prefrontal Cortex

What neurology can teach us about protecting teens.

AGE 5

(Blue indicates

mature brain)

ne of the best pieces of parenting advice I ever received came from Louis Caplan, M.D., stroke expert, senior neurologist at Beth Israel Deaconess Medical Center in Boston, MA, and Fellow of the American Academy of Neurology. He explained the strategy he and his wife used to give their children the best chance for success: Keep them busy. "Busy doing what?" I asked. His answer: "Music and swimming." Research on how the brain develops provides evidence to support his advice.

This issue of *Neurology Now* includes a story on how alcohol affects the adolescent brain ("Buzz Kill," page 23). Each year, more than 10,000 young people in the United States are killed and 40,000 injured in alcoholrelated motor vehicle accidents, according to the National Institute on Drug Abuse. Young people are more likely to engage in other risky behaviors—including unprotected sex and criminal activity—when they are intoxicated.

Adolescence, defined by the World Health Organization as

the time between ages 10 and 19, is marked by physical and sexual maturation, a drive for independence, an increasing importance placed on fitting in with peers, and dynamic brain changes. Brain development helps explain the risky behaviors that are common to adolescents and provides clues about why drugs of abuse are especially dangerous during this time.

An important aspect of brain maturation is the development of brain connections or networks that link different parts of the brain to each other. Two important regions that develop strong connections during adolescence are the striatum, which recognizes and seeks out rewarding experiences; and the prefrontal cortex, which regulates the ability to control behavior, consider consequences, and overcome impulsiveness. (See illustration showing how radically the prefrontal cortex changes during adolescence.) The prefrontal cortex is able to dampen the immediate reward-seeking effects of the striatum when the network is fully developed. The striatum matures earlier than the prefrontal cortex and has a larger effect on adolescent behavior. This helps explain why young people have less self-control and often seek thrills.

Alcohol and other substances of abuse affect the developing brain differently than the mature brain. Adolescents experience fewer of the negative effects of alcohol compared to adults. It takes a higher dose of alcohol to reach similar blood-alcohol levels in adolescents than adults, and adolescents are less sensitive to the intoxicating effects of alcohol such as sedation. They are also less likely to suffer "hang-overs" than adults. These negative effects, which

help regulate excessive drinking, are muted in adolescents.

At the same time, alcohol is especially toxic to the developing brain. Excessive alcohol use damages brain cells and the fibers that connect brain regions, shrinks certain brain regions, and stops new brain cells from maturing. Some brain regions, such as the ones involved in memory, continue to make new neurons during adolescence through the expansion of neural stem cells. But alcohol specifically targets neural stem cells, so its nega-

tive impact is magnified in adolescents.

So what should parents and other caring adults do? Given the reality of brain development, eliminating adolescent risk-taking is probably impossible, which brings me back to Dr. Caplan's advice: Keep children busy in activities that promote discipline and teach the benefits of delaying gratification, such as playing sports or a musical instrument. Safe but exciting activities such as indoor wall climbing under controlled conditions can also help limit harmful risk-taking. Open communication with your adolescent and serving as a good role model don't hurt either.

If you have advice to share about surviving adolescence (as a parent or adolescent), please let us know.

Take good care,

Robin L. Brey, M.D. Editor-in-Chief