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Adolescent Brain Research and Drug Policy

David Walsh, Ph.D.
dwalsh@DrDaveWalsh.com
(612) 729-1707

Discoveries in neuroscience are revolutionizing many fields, including our understanding of adolescent behavior. It is important to incorporate the new insights into parenting, teaching, counseling, prevention, and treatment. While there is a great deal of art involved in working with youth, science can inform that art. *The smarter we get the more effective we'll be.*

Adolescents have a reputation for bad decisions. For most, their mistakes involve a poorly timed temper tantrum or missed curfew. For others the stakes are much higher involving, for example, auto accidents, unintended pregnancies or alcohol/drug abuse. Many a parent, teacher, and juvenile court judge, or counselor has been baffled trying to answer the question, "Why do they act that way?" For generations the thinking was that kids lacked the experience they needed to make better choices. Now we know that the real explanation is, "It's what going on in their brains."

The adolescent brain is not the finished product we thought it was. Until recently, scientists believed that the brain's physical development was finished by the age of twelve because that's when it reached its three pound adult size. Now we know that view of the brain was wrong. Although its mass doesn't increase, the adolescent brain is very much a work in progress. One key finding from the latest research concerns the part of the brain called the prefrontal cortex. It acts as the executive center of the brain, responsible for making decisions, assessing risk, and controlling emotional impulses and urges. It turns out that the prefrontal cortex is under construction during the teenage years and is not completely wired until the early 20s.

Another important revelation concerns what I call the brain's "acceleration center." The dramatic increase in growth hormones at puberty affects the emotional centers of the brain causing intense, volatile emotional swings. The combination of an underdeveloped prefrontal cortex and a racing cerebral accelerator explains why teens can be impulsive thrill seekers and foolish risk takers. If we were to compare the adolescent brain to an automobile it's as if the gas pedal is to the floor while the brakes are on back order. That's why many teens experiment with alcohol and drugs. Other discoveries, however, explain why teen use is so risky and why some teens get into serious problems with those substances.

The advances in brain research give us more reason than ever to redouble our efforts to prevent youthful chemical use. They should also inform how we treat young chemical abusers or addicts. We know that the adolescent brain is not the same as the adult brain so it should not surprise us that tobacco, alcohol and drugs affect it differently in three important ways.

1. *The young brain becomes more easily addicted.*

We have known for more than fifty years that the younger a boy or girl is when they start to smoke, drink or use the greater the risk for addiction. We used to think the reason was a lack of experience or maturity. Now we know that the risk is brain based. Tobacco, alcohol and drugs all trigger release of dopamine, the neurotransmitter that makes us feel good. When using, the growing brain immediately goes to work creating additional receptors for the drug as it adapts to its new chemical environment. When the receptors are filled with tobacco, alcohol or drug molecules the dopamine level is high creating a sense of pleasure. What the young drinker or user doesn't realize is that the brain has created more "docking stations" for the alcohol or drug. When they're filled the dopamine levels remain high. When they aren't filled, however, the dopamine level plummets resulting in negative feelings. There is a very strong temptation to restore the pleasurable feelings by smoking, drinking or using again. That process is more likely to happen in the young brain than in the mature brain.

2. *The damage that chemicals do is greater, on a dose for dose basis, than the same amount would do in the adult brain.*

Heavy alcohol provides the clearest example because it interferes with the encoding of new memories. That's why it's hard to remember what happened after a night of heavy drinking. Alcohol interferes with a neurotransmitter called glutamate, which aids the neurons in learning and in storing new memories. When neurons fire together, glutamate helps them wire together, and thus makes them more likely to fire together in the future. Without glutamate the neurons that fire together would not wire together. Alcohol makes it harder to learn and store new memories for anyone with a brain, young or old, but its effect on glutamate is *most* pronounced in the adolescent brain. Because adolescent brains are furiously blossoming, pruning, firing, and wiring, glutamate is even more crucial to adolescents than it is to people in other age groups. If glutamate effectiveness drops even a little bit, it can have a very negative effect on the

sensitive adolescent brain. Research shows that heavy alcohol use can impair adolescent memory function by as much as ten percent.

Additional evidence shows that heavy drinking adolescents have a smaller hippocampus, the brain structure key to the process of recording new memories, than non-drinkers. Thus, *adolescents who drink a lot of alcohol end up having more memory and learning impairment than adults who drink the same amount,* because their brains are more susceptible to damage.

3. Warning signals that the brain's being affected don't go off till later.

Young drinkers or users are *over* sensitive to damage and *under* sensitive to the warning signs. For reasons that we do not yet understand, the sedation effects are not as pronounced in the adolescent brain. The impairment of motor coordination is also delayed. That means that adolescents don't experience the two major warning signals that go off in the adult brain—sedation, or tiredness, and motor problems, like slurring words or stumbling—which indicate "Watch out!" It takes an adolescent longer before sedation and motor coordination problems take effect. By then, they can be dangerously in trouble. In the absence of warning signals that tell them to stop, adolescent drinkers tend to drink or use more and do more damage to themselves. Adolescents like to brag that they can "hold their liquor," but just because they're not showing outward signs of alcohol impairment doesn't mean they're *not* doing themselves serious damage.

Insights about the adolescent brain are helping parents, teachers, and professionals re-examine and rethink prevention and treatment approaches. The realization that an adolescent's brain is different from an adult's has implications across the entire continuum of services. Our prevention strategies should be based on sound science if we are to make progress in both setting up appropriate guardrails that can steer youth away from serious trouble. Our intervention and treatment strategies will be more effective if they incorporate insights from brain science. For example, there is encouraging evidence that teaching adolescents about how their brains work reduces risky, dangerous, and self-defeating behavior.

David Walsh, Ph.D. is author of the national best seller *Why Do They Act That Way? A Survival Guide to the Adolescent Brain for Your and Your Teen.*