# Harnessing the Incredible Learning Potential of the Adolescent Brain

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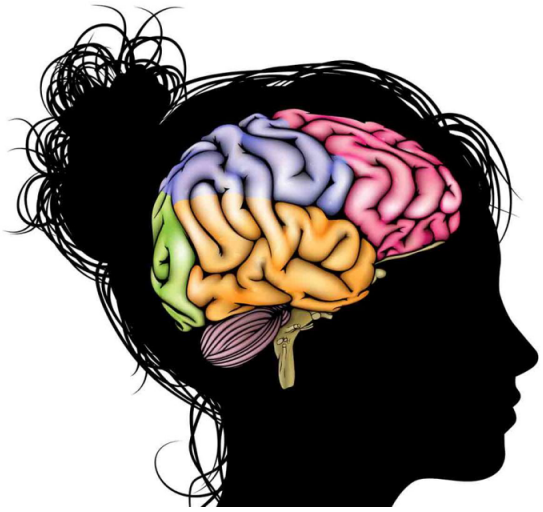

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It has become a cultural cliché that raising adolescents is the most difficult part of parenting. It's common to joke that when kids are in their teens they are sullen, uncommunicative, more interested in their phones than in their parents and generally hard to take. But this negative trope about adolescents misses the incredible opportunity to positively shape a kid's brain and future life course during this period of development.

"[Adolescence is] a stage of life when we can really thrive, but we need to take advantage of the opportunity," said Temple University neuroscientist Laurence Steinberg at a Learning and the Brain conference in Boston. Steinberg has spent his career studying how the adolescent brain develops and believes there is a fundamental

disconnect between the popular characterizations of adolescents and what's really going on in their brains.

Because the brain is still developing during adolescence, it has incredible plasticity. It's akin to the first five years of life, when a child's brain is growing and developing new pathways all the time in response to experiences. Adult brains are somewhat plastic as well -- otherwise they wouldn't be able to learn new things -- but "brain plasticity in adulthood involves minor changes to existing circuits, not the wholesale development of new ones or elimination of others," Steinberg said.

Adolescence is the last time in a person's life that the brain can be so dramatically overhauled.

"The adolescent brain is exquisitely sensitive to experience," Steinberg said. "It is like the recording device is turned up to a different level of sensitivity." That's why humans tend to remember even the most mundane events from adolescence much better than even important events that took place later in life. It also means adolescence could be an extremely important window for learning that sticks. Steinberg notes this window is also lengthening as scientists observe the onset of puberty happening earlier and young people taking on adult roles later in life. Between these two factors, one biological and one social, adolescence researchers now generally say the period lasts 15 years between the ages of 10 and 25.

"When adolescence is this long, we can't look at it as something to just survive," Steinberg said.

Teenagers get a bad reputation as risk-takers because parts of their

brains are more plastic than others, creating an imbalance. The prefrontal cortex, which controls things like planning, thinking ahead, weighing risk and reward, and logical reasoning is the most malleable during adolescence. Meanwhile, sex hormones released by puberty affect brain functioning by adding more dopamine to the system. Every time an adolescent feels good about something he gets a dopamine squirt. That's why adolescents seek out pleasurable experiences, despite the risks.

"Nothing will ever feel as good to you for the rest of your life as it did when you were a teenager," Steinberg said. The imbalance between an aroused dopamine system and a still developing prefrontal cortex, which would inhibit some of the risky pleasure-seeking behaviors, is why adolescence is such a dangerous time. While adolescents are extremely healthy, mortality rates increase by 200-300 percent due to risky behavior. Scientists have also shown that reward pathways are activated when an adolescent is with a group of peers, which is why kids take extra risks when with friends that they might not take when alone.

The imbalance between aroused dopamine systems and self-regulation systems sounds like a scary story, but it also represents a unique opportunity to reach adolescents with positive stimuli that will be hard-wired in high definition years later. Unfortunately, American high schools are by and large not taking advantage of this opportunity.

"Our high school students are among the worst in the developed world," Steinberg said. The high school math and reading scores on the National Assessment of Educational Progress (NAEP) have been flat for 40 years. In contrast, both elementary school students and

middle school students have improved. And U.S. schools tend to spend more money on high schools, those teachers make more money, and on the whole elementary schools enroll more low-income kids than high schools. Steinberg contends that the traditional arguments for why schools fail don't explain everything that's going on.

"It's because our high schools are so boring," Steinberg said. He notes U.S. high school students who study abroad report their experiences were more interesting and more challenging, while foreign students who study in the U.S. say American high school is more boring.

Steinberg believes part of the reason school is so boring for teens is that it doesn't challenge them; they're bored. Students themselves report that they can get by in school without doing much. "When we are not challenging our kids in high school, not only are we hindering their academic development, but we also aren't taking advantage of the plastic prefrontal cortex," Steinberg said. The prefrontal cortex is strengthened by challenge and novelty.

"This is when we want them to be challenged and pushed because this is when we can develop advanced thinking, as well as self-regulation," Steinberg said.

Teachers often say their students struggle with work that is below grade level and must catch up before they can take on more challenging tasks. But scaffolding can ensure that even the catch-up process is challenging in an interesting way. Consistently providing students with work that is slightly more challenging than their current level keeps them engaged. If the work is too easy, they will disengage

and become frustrated.

The problem is that many high schools confuse "challenging work" with "amount of work." Students are stressed out by the volume of tasks they must complete each night or week, but that isn't the same thing as being challenged by the work. Steinberg points out that hours of repetitious work that is not challenging do nothing but make kids hate school.

"Rates of anxiety disorders among adolescents are at record levels," Steinberg said. "We are raising generations of students who we are driving crazy with what we are asking of them." Recognizing this pitfall is not only important for maximizing the opportunity to make a lasting impact on students' extremely malleable developing brains, but also because a plastic brain is also vulnerable to the wrong influences.

Adolescence is the most likely time for mental illness to develop, and substance abuse is 10 times worse if a student starts using before the age of 15. "It's not just the type of people who begin using earlier, it's the way the adolescent brain is responding to the use," Steinberg said. The aroused dopamine system in the adolescent brain craves drugs, nicotine or alcohol in a different way than at other times in life.

Stress also has a big impact on adolescent brains. A recent study from UC Berkeley showed that growing up as an adolescent during wartime took years off people's lives. "[Stress] takes more years off of your life if you are a teenager than if you are a child or an adult," Steinberg said.

## TAKING ADVANTAGE OF A MALLEABLE BRAIN

Understanding the neuroscience at work in the adolescents populating

classrooms can help teachers develop lessons that challenge, engage and satisfy the search for novelty in teens. Those experiences in turn could be some of the most meaningful ones in their lives. If educators and parents don't take note of this research, kids will continue to tune out, seek pleasure in risky places and continue on into college-level courses unprepared.

Research has shown that targeting prefrontal cortex development in adolescents does help. Despite being a bit clichéd, Steinberg pointed to initial research findings that mindfulness in schools can improve self-regulation, the single most important quality to leading a successful life. Steinberg says that statistically there are four things everyone has to do to have a good life: graduate high school, don't have a child until being married, don't get in trouble with the law and don't be idle.

"If you play by those rules you will be guaranteed a basically decent life," Steinberg said. "This is not a moral thing, this is a statistical fact."

Self-regulation and delayed gratification are important skills to clear those four hurdles. Steinberg basically says that if educators and parents can teach kids self-regulation, they can reduce poverty.

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