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THE TERRIBLE TEENS

What's wrong with them?

By Elizabeth Kolbert

C57BL/6J mice are black, with pink ears and long pink tails. Inbred for the purposes of experimentation, they exhibit a number of infelicitous traits, including a susceptibility to obesity, a taste for morphine, and a tendency to nibble off their cage mates' hair. They're also tipplers. Given access to ethanol, C57BL/6J mice routinely suck away until the point that, were they to get behind the wheel of a Stuart Little-size roadster, they'd get pulled over for D.U.I.



In adolescence, the brain is wired to experience pleasure more intensely than before or after.

ILLUSTRATION BY ÉDITH CARRON

Not long ago, a team of researchers at Temple University decided to take advantage of C57BL/6Js' bad habits to test a hunch. They gathered eighty-six mice and placed them in Plexiglas cages, either singly or in groups of three. Then they spiked the water with ethanol and

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Half of the test mice were four weeks old, which, in murine terms, qualifies them as adolescents. The other half were twelve-week-old adults. When the researchers watched the videos, they found that the youngsters had, on average, outdrunk their elders. More striking still was the pattern of consumption. Young male C57BL/6Js who were alone drank roughly the same amount as adult males. But adolescent males with cage mates went on a bender; they spent, on average, twice as much time drinking as solo boy mice and about thirty per cent more time than solo girls.

The researchers published the results in the journal *Developmental Science*. In their paper, they noted that it was “not possible” to conduct a similar study on human adolescents, owing to the obvious ethical concerns. But, of course, similar experiments are performed all the time, under far less controlled circumstances. Just ask any college dean. Or ask a teen-ager. I happen to have three adolescent sons and in this way recently learned about a supposedly fun pastime known as a “case race.” Participants form teams of two and compete to see which pair can drink its way through a case of beer the fastest. (To get the most out of the experience, I was told, it’s best to use a “thirty rack.”)

Every adult has gone through adolescence, and studies have shown that if you ask people to look back on their lives they will

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“reminiscence bump.”) And yet, to adults, the adolescent mind is a mystery—a Brigadoon-like place that’s at once vivid and inaccessible. Why would anyone volunteer to down fifteen beers in a row? Under what circumstances could Edward Fortyhands, an activity that involves having two forty-ounce bottles of malt liquor affixed to your hands with duct tape, be construed as enjoyable? And what goes for drinking games also goes for hooking up with strangers, jumping from high places into shallow pools, and steering a car with your knees. At moments of extreme exasperation, parents may think that there’s something wrong with their teen-agers’ brains. Which, according to recent books on adolescence, there is.

Frances Jensen is a mother, an author, and a neurologist. In “The Teenage Brain: A Neuroscientist’s Survival Guide to Raising Adolescents and Young Adults” (HarperCollins), written with Amy Ellis Nutt, she offers a parenting guide laced with the latest MRI studies. By her account, adolescents suffer from the cerebral equivalent of defective spark plugs.

“When we think of ourselves as civilized, intelligent adults, we really have the frontal and prefrontal parts of the cortex to thank,” she writes. But “teens are not quite firing on all cylinders when it comes to the frontal lobes.” Thus, “we shouldn’t be surprised by the daily stories we hear and read about tragic mistakes.”

“The Teenage Brain” retails a number of such stories, including several involving Jensen’s sons, Andrew and Will. One is about Will’s totalling of the family’s Dodge. (He miscalculates the time he has to make a left turn.) Another features Andrew, his girlfriend, and another girl, who has passed out in the back of their car. The two conscious adolescents keep hoping the third

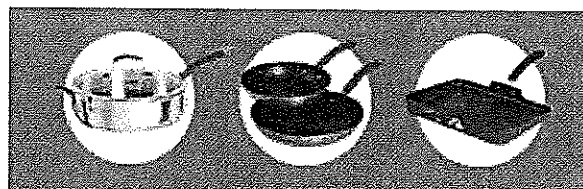
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has downed seventeen Jell-O shots—perhaps more, she can't really remember. Then, there's the story of Dan, "an all-around great kid," who, one summer night, gets drunk and, together with a bunch of friends, scales the fence at the local tennis club to take a 3 A.M. swim. The friends get out, get dressed, and rescale the fence, only to discover that Dan is no longer with them. When they return to the pool, they find him lying face down in it. (Readers will be reassured to learn that Will and Andrew, at least, made it through high school in one piece and went on to graduate from Harvard and Wesleyan, respectively.)

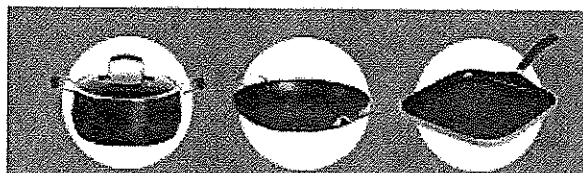
The frontal lobes are the seat of what's sometimes called the brain's executive function. They're responsible for planning, for self-awareness, and for judgment. Optimally, they act as a check on impulses originating in other parts of the brain. But in the teen years, Jensen points out, the brain is still busy building links between its different regions. This process involves adding myelin around the axons, which conduct electrical impulses. (Myelin insulates the axons, allowing impulses to travel faster.) It turns out that the links are built starting in the back of the brain, and the frontal lobes are one of the last regions to get connected. They are not fully myelinated until people are in their twenties, or even thirties.

This is where parents step in. "You need to be your teens' frontal lobes until their brains are fully wired," Jensen writes. By this she

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and, whenever Will and Andrew screw up, she uses it as an opportunity to remind them that they, too, could wind up floating face down in a pool. (After the unconscious girl has been dropped off at the hospital, Jensen relates, she sits Andrew and his girlfriend down at the kitchen table and lectures them about “blood alcohol levels and the effects on coordination and consciousness.”) As a matter of principle, Jensen has attached a lock to the liquor cabinet in her own home. When her sons are invited to someone else’s house, she calls the kid’s parents to make sure there will be no unsupervised fun.

I feel compelled to confess that whenever I hear a grisly story involving a dead or maimed teen-ager, I, like Jensen, pass it on to my sons. However, I also feel I should point out that, in a book packed with charts and statistics, Jensen provides no empirical evidence that scare tactics work. From personal experience, I can say that the immediate response is not always encouraging. When I asked my sixteen-year-old twins how they’d react if I called their friends’ moms to enforce safe-party protocols, one of them said, “Why even have kids if you’re going to do that?”

Laura Steinberg is a professor of psychology at Temple, a father, and the lead researcher on the inebriated-mouse study. He is also the author of “Age of Opportunity: Lessons from the New Science of Adolescence” (Houghton Mifflin Harcourt). Like Jensen, he believes that teen-age brains are different from yours and mine. But, where Jensen identifies the problem as loosely connected frontal lobes, Steinberg sees it as an enlarged *nucleus accumbens*.

Consider the following scenario. One afternoon, you’re sitting in your office with wads of cotton stuck up your nose. (For the present purposes, it’s not important to know why.) Someone in

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notice and continue working. Suddenly you sneeze, and the cotton gets dislodged. Now the smell hits, and you rush over to gobble up one cookie, then another.

According to Steinberg, adults spend their lives with wads of cotton in their metaphorical noses. Adolescents, by contrast, are designed to sniff out treats at a hundred paces. During childhood, the *nucleus accumbens*, which is sometimes called the “pleasure center,” grows. It reaches its maximum extent in the teen-age brain; then it starts to shrink. This enlargement of the pleasure center occurs in concert with other sensation-enhancing changes. As kids enter puberty, their brains sprout more dopamine receptors. Dopamine, a neurotransmitter, plays many roles in the human nervous system, the sexiest of which is signalling enjoyment.

“Nothing—whether it’s being with your friends, having sex, licking an ice-cream cone, zipping along in a convertible on a warm summer evening, hearing your favorite music—will ever feel as good as it did when you were a teenager,” Steinberg observes. And this, in turn, explains why adolescents do so many stupid things. It’s not that they are any worse than their elders at assessing danger. It’s just that the potential rewards seem—and, from a neurological standpoint, genuinely are—way,

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they don't know any better is ludicrous," Steinberg writes.

Teen-agers are, as a rule, extremely healthy—healthier than younger children. But their death rate is much higher. The mortality rate for Americans between fifteen and nineteen years old is nearly twice what it is for those between the ages of one and four, and it's more than three times as high as for those ages five to fourteen. The leading cause of death among adolescents today is accidents; this is known as the "accident hump."

Steinberg explains the situation as the product of an evolutionary mismatch. To find mates, our primate ancestors had to venture outside their natal groups. The reward for taking chances in dangerous terrain was sex followed by reproduction, while the cost of sensibly staying at home was genetic oblivion.

Adolescents in 2015 can find partners by swiping right on Tinder; nevertheless, they retain the neurophysiology of apes (and, to a certain extent, mice). Teen-agers are, in this sense, still swinging through the rain forest, even when they're speeding along in a Tundra. They're programmed to take crazy risks, so that's what they do.

This is especially the case when teen-agers get together. A teen driving with other teens in the car, for example, is four times as likely to crash as a teen driving alone. (The risk for adult drivers, by contrast, remains constant with passengers or without them.) This effect is often attributed to distraction or peer pressure; kids, the story goes, egg each other on, until, finally, they wind up in the E.R. But Steinberg, who has conducted all sorts of experiments on adolescents, both human and rodent, sees the problem as more fundamental. What matters is the mere presence of peers, or really even just the idea of them.

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risks when their friends were around—by, for instance, running yellow lights—whether or not they could communicate with them. In another experiment, Steinberg told his subjects that their actions were being watched by other adolescents, in another room, when in fact the other room was empty. The results were the same. Mice, for their part, can't taunt other mice or call them wusses; still, the presence of peers is enough to stimulate risky behavior. Brain-imaging studies show that being watched by friends activates teens' reward centers; this, Steinberg theorizes, primes them to seek out still more rewards, which leads them to do things like duct-tape malt-liquor bottles to their hands. "In fact, the recklessness-enhancing effect of being around peers is strongest when adolescents actually know there is a high probability of something bad happening," he writes.

My twins spent most of the month of August attending a driver's-ed course at the local high school. We live in western Massachusetts, and state law requires kids to have thirty hours of classroom instruction before they take the road test, though if they are willing to wait until they turn eighteen they can skip the course. My twins are now old enough to have sex legally in Massachusetts, but across the border in New York the age of consent is seventeen. Here, I am happy to report, they cannot possess a handgun; up the road a couple of miles, in Vermont, a sixteen-year-old can. A year from now, my kids will, with my permission, be able to join the Army. But they still won't be able to vote, or operate a forklift, or get a job at a sawmill, or buy a pack of cigarettes. It will be more than four years before they can sit down at a bar and order a beer.

The tangle of laws that apply to adolescents bespeaks a generalized confusion. Lawmakers can't seem to decide whether they think teen-agers are under-informed or overly impulsive or

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that either teens or legislators would be happy about.

Take my kids' driver's-ed classes. From Steinberg's perspective, allowing sixteen-year-olds to get a license in return for sitting through lectures and doing some practice driving completely misses the point. Sixteen-year-olds are dangerous drivers. Their rate of fatal crashes per mile is three times as high as the rate for drivers age twenty and over, and nearly twice as high as the rate for drivers eighteen and nineteen. Sixteen-year-olds will still be a hazard after listening (or, more likely, not listening) to thirty hours' worth of cautionary tales. They actually do understand that driving is dangerous; the problem is that they're having too much fun to care. The only way to bring down their accident rate is to prevent them from getting behind the wheel.

"If we were genuinely concerned about improving adolescents' health, raising the driving age would be the single most important policy change we could make," Steinberg writes. He favors a minimum age of eighteen.

Much the same logic applies to drinking, smoking, and doing drugs. Each year, the U.S. spends hundreds of millions of dollars on public-service campaigns designed to alert adolescents to the perils of such dissipations. Hundreds of millions—perhaps billions—more are spent reiterating this message in high-school health classes. The results have been, to put it kindly, underwhelming. A 2006 study by the Government Accountability Office found that \$1.4 billion that the federal government had allocated to an anti-drug media campaign aimed at young people had had no perceptible impact. According to Steinberg, this sort of money would have been better spent on sports or arts programs that keep adolescents busy and under adult supervision.

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They peak at age eighteen and then start to fall again. When the statistics are presented in the form of a graph, the result—the so-called age-crime curve—looks like the Matterhorn. This pattern has been noted for more than a century (it was described back in 1904, by G. Stanley Hall, a psychologist who is sometimes credited with having “invented” adolescence), and it holds true not just in the U.S. but wherever crime figures are kept.

Both Steinberg and Jensen make the case that the violence hump, too, is a function of weak frontal lobes and oversensitive pleasure centers. And both argue against decades-long sentences for youthful offenders. Steinberg maintains an active side career as an expert witness for the defense; Jensen is a co-author on a brief submitted in a 2012 Supreme Court case involving two fourteen-year-olds who had been convicted of murder. In the brief, she and her colleagues asserted that “adolescent criminal conduct frequently results from experimentation with risky behavior and not from deep-seated moral deficiency reflective of ‘bad’ character.” The Supreme Court ultimately ruled that states could not impose mandatory sentences of life without parole on defendants under eighteen, though courts could impose such sentences on convicted murderers if they chose to.

Many recent innovations—cars, Ecstasy, iPhones, S.U.V.s, thirty racks, semi-automatic weapons—exacerbate the mismatch between teen-agers’ brains and their environment. Adolescents today face temptations that teens of earlier eras, not to mention primates or rodents, couldn’t have dreamed of. In a sense, they live in a world in which all the water bottles are spiked. And so, as Jensen and Steinberg observe, they run into trouble time and time again.

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way is to peer through the wrong end of the MRI machine. Yes, adolescents in the twenty-first century pose a great risk to others and, statistically speaking, an even greater risk to themselves. But this is largely because other terrifying risks—scarlet fever, diphtheria, starvation, smallpox, plague—have receded. Adolescence evolved over a vast expanse of time when survival at any age was a crapshoot. If the hazards are new, so, too, is the safety. Which is why I will keep telling my kids scary stories and why they will continue to ignore them. ♦



Elizabeth Kolbert has been a staff writer at The New Yorker since 1999. She won the 2015 Pulitzer Prize for general nonfiction for “The Sixth Extinction: An Unnatural History.” [MORE](#)

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