The Teen Brain

Teens and the Brain: More Questions for Research

Scientists continue to investigate the development of the brain and the relationship between the changes taking place, behavior, and health. The following questions are among the important ones that are targets of research:

- How do experience and environment interact with genetic preprogramming to shape the maturing brain, and as a result, future abilities and behavior? In other words, to what extent does what a teen does and learns shape his or her brain over the rest of a lifetime?

- Why is it so often the case that, for many mental disorders, symptoms first emerge during adolescence and young adulthood?

This last question has been the central reason to study brain development from infancy to adulthood. Scientists increasingly view mental illnesses as developmental disorders that have their roots in the processes involved in how the brain matures. By studying how the circuitry of the brain develops, scientists hope to identify when and for what reasons development goes off track. Brain imaging studies have revealed distinctive variations in growth patterns of brain tissue in youth who show signs of conditions affecting mental health. Ongoing research is providing information on how genetic factors increase or reduce vulnerability to mental illness and how experiences during infancy, childhood, and adolescence can increase the risk of mental illness or protect against it.

Alcohol and the Teen Brain

Adults drink more frequently than teens, but when teens drink they tend to drink larger quantities than adults. There is evidence to suggest that the adolescent brain responds to alcohol differently than the adult brain, perhaps helping to explain the elevated risk of binge drinking in youth. Drinking in youth, and intense drinking are both risk factors for later alcohol dependence. Findings on the developing brain should help clarify the role of the changing brain in youthful drinking, and the relationship between youth drinking and the risk of addiction later in life.

The Adolescent and Adult Brain

Scientists emphasize that the fact that the teen brain is in transition doesn’t mean it is somehow not up to par. It is different from both a child’s and an adult’s in ways that equip youth to make the transition from dependence to independence. The capacity for learning at this age, an expanding social life, and a taste for exploration and limit testing may all, to some extent, be reflections of age-related biology. Understanding the changes taking place in the brain at this age presents an opportunity to intervene early in mental illnesses that have their onset at this age. Research findings on the brain may also serve to help adults understand the importance of creating an environment in which teens can explore and experiment while helping them avoid behavior that is destructive to themselves and others.

Questions for Research

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The research has turned up some surprises, among them the discovery of striking changes taking place during the teen years. These findings have altered long-held assumptions about the timing of brain maturation. In key ways, the brain doesn’t look like that of an adult until the early 20s. An understanding of how the brain of an adolescent can change may help explain a puzzling contradiction of adolescence: young people at this age are close to a lifelong peak of physical health, strength, and mental capacity, and yet, for some, this can be a hazardous age. Mortality rates jump between early and mid adolescence. Rates of death by injury between ages 15 to 19 are about six times that of the rates between ages 10 and 14. Crime rates are highest among young males and rates of alcohol abuse are high relative to other ages. Even though most adolescents come through this transitional age well, it’s important to understand the risk factors for behavior that can have serious consequences. Genes, childhood experience, and the environment in which a young person is reared all shape behavior. Adding to this complex picture, research is revealing how all these factors act in the context of a brain that is changing, with its own impact on behavior.

The more we learn, the better we may be able to understand the abilities and vulnerabilities of teens, and the significance of this stage for lifelong mental health.

The fact that so much change is taking place beneath the surface may be something for parents to keep in mind during the ups and downs of adolescence.

Adolescents and adults seem to engage different parts of the brain to different extents during tests requiring calculation and impulse control, or in reaction to emotional content. Research suggests that adolescence brings with it changes in brain function such as fatigue and difficulty maintaining attention, inadequate sleep is a powerful contributor to irritability and depression. Studies of children and adolescents have found that sleep deprivation can increase impulsive behavior; some researchers report finding that it is a factor in delinquency. Adequate sleep is central to physical and emotional health.

One of the ways that mental tasks is by studying the development of the brain from both to adulthood. Powerful new technologies have enabled them to track the growth of the brain and to investigate the connections between brain function, development, and behavior.

Connections between different parts of the brain increase throughout childhood and well into adult- hood. As the brain develops, the fibers connecting nerve cells are wrapped in a protein that greatly increases the speed with which they can transmit impulses from cell to cell. The resulting increases in connectivity—little like providing a growing city with a fast, integrated communi- cation system—shapes how different parts of the brain work in tandem. Research is finding that the extent of connectivity is related to growth in intellectual capaci- ties such as memory and reading ability.

One of the ways that changes in the teen brain came from studies in which scientists did brain scans of children as they grew from early childhood through age 20. The scans revealed unexpected late changes in the volume of gray matter, which forms the thin, folding outer layer or cortex of the brain. The cortex is where the processes of thought and memory are based. Over the course of childhood, the volume of gray matter in the cortex increases, reaching a peak in early adulthood. A decline in volume is normal at this age and is in fact a necessary part of maturation. The assumption for many years had been that the volume of gray matter was highest in very early childhood, and gradually fell as a child grew. The more recent scans, however, revealed that the high point of the volume of gray matter occurs during early adolescence.

While the details behind the changes in volume scans are not completely clear, the results push the timeline of brain maturation into adolescence and young adulthood. In terms of the volume of gray matter seen in brain images, the brain does not begin to resemble that of an adult until the early 20s.

The scans also suggest that different parts of the cortex develop at different rates. Areas involved in more basic functions mature first: those involved, for example, in the processing of information from the senses, and in control- ling movement. The parts of the brain responsible for more “top-down” control, controlling impulses, and planning ahead—the hallmarks of adult behavior—are among the last to mature.

What’s Gray Matter? The details of what is behind the increase and decline in gray matter are still not completely clear. Gray matter—made up of the cell bodies of neurons, the nerve fibers that project from them, and support cells. One of the features of the brain that may explain these changes is an early blooming of synapses—the connections between brain cells or neurons—followed by pruning as the brain matures. Synapses are the ways over which neurons communicate with each other and are the basic blocks in the working circuitry of the brain. Already more numerous than an adult’s at birth, synapses multiply rapidly in the first months of life. By age 5 or 6, a child’s brain has as many synapses as an adult. For an idea of the complexity of the brain: a cube of brain matter, 1 millimeter on each side, can contain between 35 and 70 million neurons and an estimated 500 billion synapses. Scientists believe that the loss of synapses as a child matures is part of the process by which the brain becomes more efficient. Although general play a role in the cells are wrapped in a protein that greatly increases the speed with which they can transmit impulses from cell to cell. Thus, the age-related changes shape how much different parts of the brain are activated in response to experience, and in terms of behavior, the urgency and intensity of emotional reactions.

The Changing Brain and Behavior in Teens One interpretation of all these findings is that in teens, the parts of the brain involved in emotional responses are fully online, or even more active than in adults, while the parts of the brain involved in keeping emotional, impulsive responses in check are at reaching maturity. Such a changing balance might provide clues to a youthful appetite for novelty, and a tendency to act on impulse—without regard for risk.

While much is being learned about how the brain of an adolescent is changing may help explain a puzzling contradiction of adolescence: young people at this age are close to a lifelong peak of physical health, strength, and mental capacity, and yet, for some, this can be a hazardous age. Mortality rates jump between early and mid adolescence. Rates of death by injury between ages 15 to 19 are about six times that of the rates between ages 10 and 14. Crime rates are highest among young males and rates of alcohol abuse are high relative to other ages. Even though most adolescents come through this transitional age well, it’s important to understand the risk factors for behavior that can have serious consequences. Genes, childhood experience, and the environment in which a young person is reared all shape behavior. Adding to this complex picture, research is revealing how all these factors act in the context of a brain that is changing, with its own impact on behavior.

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