Introduction

**Y**oung people in adolescence are close to a lifelong peak of physical health, strength, and mental capacity, and yet, for some, it is a hazardous age. Mortality rates jump between early and late adolescence. Rates of death by injury between ages 15 to 19 are about six times that of the rate 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 factors that contribute to risky behavior. Genes, childhood experience, and the environment in which a young person reaches adolescence all shape behavior.

The Visible Brain

**S**cientists did brain scans of children as they grew from early childhood through age 20. The scans revealed unexpectedly 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 and gray matter is made up of the cell bodies that create synapses. Creating synapses allow for learning.

**W**hile the details behind the changes in volume on 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.

**T**he scans also suggest that different parts of the cortex mature 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 controlling 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.

Changes in Gray Matter

* **E**vidence suggests that the brain circuitry involved in emotional responses is changing during the teen years. Functional brain imaging studies, for example, suggest that the responses of teens to emotionally loaded images and situations are heightened relative to younger children and adults. The changes underlying this pattern of heightened activity involve parts of the brain that are involved in the reward system with which the brain motivates behavior. These age-related changes influence how different parts of the brain are activated in response to experience as well as the urgency and intensity of emotional reactions.
* **E**normous hormonal changes take place during adolescence. Reproductive hormones shape not only sex-related growth and behavior, but overall social behavior. Hormone systems involved in the brain's response to stress are also changing during the teens. As with reproductive hormones, stress hormones can have complex effects on the brain and, as a result, behavior.
* **R**esearch suggests that adolescence brings with it brain-based changes in the regulation of sleep that may contribute to teens' tendency to stay up late at night. Along with the obvious effects of sleep deprivation, 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.