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The Teenage Brain: An Overview

B. J. Casey
Sackler Institute for Developmental Psychobiology and Department of Psychiatry,
Weill Cornell Medical College

The teen brain has become something of a media darling. In part, this love affair is due to advances in neuroimaging techniques that provide a voyeuristic opportunity for us as adults to look under the hood of the adolescent brain. These methods, together with sophisticated animal studies, are providing new insights into why teenagers experience and respond to the world in unique ways.

Too often the teen brain is characterized by the media as one with no brakes or frontal lobe. This notion of a healthy adolescent brain being defective is incongruous with how we characterize other phases of typical development. As adolescent psychologist Larry Steinberg has observed (2012), we view infants' not being able to walk or talk as normal, but view adolescents' making a bad choice in the heat of the moment as a brain defect. The articles in this special issue on the teen brain provide the latest findings from human-imaging and animal studies on topics that range from self-control to peer influence to policy. Rather than depicting the teen brain as defective, the contributors paint a picture of a brain that is sculpted by both biological and experiential factors to adapt to the unique social, physical, sexual, and intellectual challenges of adolescence.

Two important approaches to understanding the teen brain are illustrated in this issue. The first is that of examining transitions across development. We cannot know which behavioral and brain changes are specific to adolescence if we don't know what they looked like before and after this period of development. Figure 1 illustrates this transitional approach. Adolescent-specific and adolescent-emergent development show inflections (or deflections) and peaks (or troughs) during the teen years, whereas adolescent-nonspecific changes are those that continue to show a steady increase or decrease from childhood to adulthood (Somerville et al., in press). Several articles in this issue show that heightened brain responses in limbic circuitry to socially relevant cues (positive and negative) are adolescent specific (see Albert, Chein, & Steinberg; Casey & Caudle; Galván; Pattwell, Casey, & Lee; Romeo; and Van Duijvenvoorde & Crone in this issue). Heightened sensitivity to socially relevant cues may be driven by hormonal influences on the brain during puberty that bias attention and actions toward social stimuli (see Peper & Dahl and De Lorme, Bell, & Sisk in this issue). A heightened sensitivity to socially relevant cues would seem to be a valuable tool for learning to meet the novel social challenges of adolescence. Despite the adaptive value of this social bias in adolescence, such a system may appear less than optimal when the pull by these cues leads to actions that threaten the well-being of the individual.

In contrast to adolescent-specific development, Luna and colleagues (this issue) show that prefrontal circuitry underlying the ability to flexibly regulate impulses and decisions (i.e., cognitive control) has a protracted course from childhood to adulthood. Specifically, using functional connectivity methods described by Dosenbach, Petersen, and Schlaggar (this issue), the researchers show that prefrontal connections emerge by adolescence but continue to be strengthened into adulthood (see Luna, Paulsen, Padmanabhan, & Geier, this issue). Taken together, these studies suggest that the teen brain reflects the interaction and tension among neural systems that have distinct developmental trajectories and functions.

The second approach illustrated in this issue is that of understanding adolescence by examining translations across species. Because adolescence is a critical developmental stage across mammalian species, we can use animal models to identify and test mechanisms that underlie brain changes during adolescence that would be impossible to test in humans. The contributions by De Lorme, Bell, and Sisk; Pattwell, myself, and Lee; Romeo; and Spear in this issue each provide examples of the utility of controlled manipulations of testosterone, alcohol use, and acute and sustained threat to examine aspects of adolescent behavior observed in humans. This animal work is important for disentangling the effects of age and puberty on brain and behavioral development. For example, De Lorme and colleagues provide evidence from rodent studies that social stimuli acquire rewarding properties during adolescence via activational effects of pubertal testosterone. In contrast, exploratory behavior and rewarding effects of alcohol appear to be more age specific (see Pattwell, Casey, & Lee and Spear in this issue). Similar animal experiments will help define the neural basis of these behavioral tendencies of adolescence. Clearly there is still much to learn about why teenagers do what they do.

This special issue concludes with a consideration of the societal implications of the teen-brain findings. Bonnie and Scott explore this topic in their article on the potential influence of adolescent brain science on law and public policy. They provide examples of policies related to alcohol use,

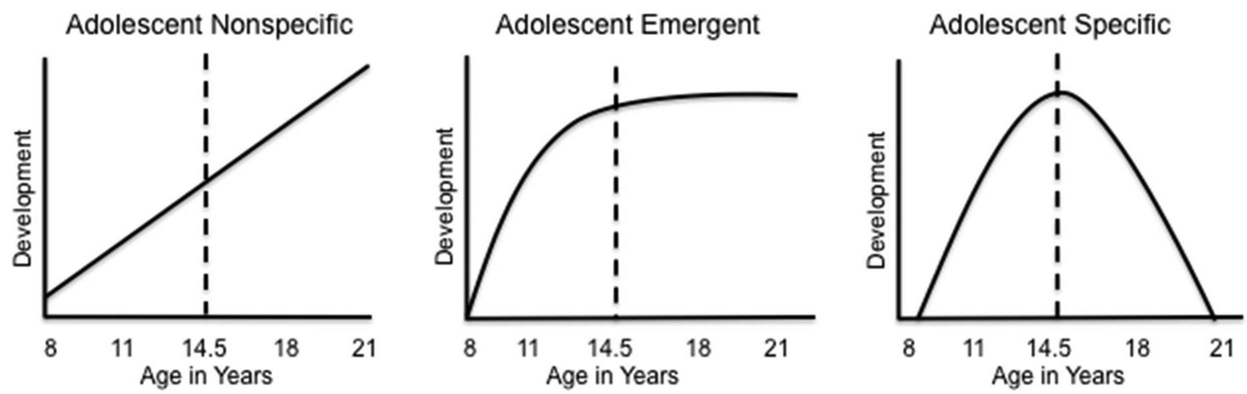

Fig. 1. Patterns of behavioral and brain development. Adolescent-specific and adolescent-emergent development shows inflections (or deflections) and peaks (or troughs) during the teen years, whereas adolescent-nonspecific changes are those that continue to show a steady increase or decrease from childhood to adulthood.

driver's licensure, and criminal justice. This last domain of criminal justice is particularly salient to me as I recently discovered that North Carolina, where I was born, is one of only two states in the nation that prosecute 16-year-olds as adults, regardless of the severity of the alleged crimes. The other is—you guessed it—my current home state of New York. It is my hope that current and continued work on the teen brain will inform and improve policies on the treatment of teens.

References

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