The Neuroscience of Adolescence

As scientific inquiry and public interest in the adolescent brain grow, so too does the need for an accessible textbook that communicates the growing research on this topic. *The Neuroscience of Adolescence* is a comprehensive educational tool for developmental cognitive neuroscience students at all levels as it details the varying elements that shape the adolescent brain. Historical notions of adolescence have focused on the significant hormonal changes that occur as one transitions from childhood to adolescence, but new research has revealed a more nuanced picture that helps inform our understanding of how the brain functions across the lifespan. By emphasizing the biological and neurobiological changes that occur during adolescence, this book gives students a holistic understanding of this developmental window and uniquely discusses the policy implications of neuroscience research for the lives of young people today.

Adriana Galván is an Associate Professor of Psychology at University of California, Los Angeles (UCLA), where she is also the Jeffrey Wenzel Term Chair in Behavioral Neuroscience and the director of the Developmental Neuroscience Laboratory. Galván's research focuses on adolescent brain development and has informed public policy on teenage driving, sleep, and juvenile justice. She received the American Psychological Association (APA) Early Career Distinguished Scientific Contribution Award, the APA Boyd McCandless Early Career Award, the William T. Grant Scholars Award and the Cognitive Neuroscience Society Young Investigator Award, and serves as a Network Scholar for the MacArthur Foundation Research Network on Law and Neuroscience. Her research has been funded by the National Science Foundation, the MacArthur Foundation, the National Institutes of Health, the Jacobs Foundation, and the William T. Grant Foundation. She regularly teaches a popular UCLA undergraduate course on the developing brain.

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The Neuroscience of Adolescence

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To the past and current students of Psych 161 at UCLA

To my parents and sisters, t.k.m.

To my future adolescents, Gustavo and Lucia

To my inspiring husband Bill

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Preface

The explosion of research on the adolescent brain in recent years has triggered enthusiastic media attention on this topic. Popular outlets such as *Time*, *The Wall Street Journal*, *National Geographic*, and *The New Yorker* have all featured research on the adolescent brain. The rationale for writing this book is twofold. First, this book will fill a growing need in the area of developmental cognitive neuroscience. Although there are numerous textbooks on cognitive neuroscience and a couple of popular textbooks on adolescent psychology, there is currently no single textbook that merges these two disciplines together from a developmental cognitive neuroscience perspective. As scientific inquiry and public interest in the adolescent brain has grown, so too has the need for a comprehensive and accessible textbook that communicates extant neuroscience research on this topic. This book was motivated by my own frustration at failing to find a suitable textbook for an upper-division undergraduate course on the developing adolescent brain. The goal is for the book to serve as an educational tool for developmental cognitive neuroscience students and trainees at all levels. Second, the book will describe the multifaceted elements that shape the adolescent brain. Historical notions of the adolescent have focused on the significant hormonal changes that occur as individuals transition from childhood to adolescence. However, new research using cutting-edge technology to visualize the healthy human brain presents a more nuanced picture of adolescence. Tools such as structural and functional magnetic resonance imaging (sMRI and fMRI) have informed our understanding of how the brain functions across the lifespan. By emphasizing both biological and neurobiological changes that occur during adolescence, this book will introduce readers to a more holistic understanding of this important developmental window.

Woven into empirical data and research approaches are the latest neurobiological and psychological models that have been proposed to explain adolescent behavior. The general premise of these models is that the brain regions we rely on for decision-making and judgment develop along different developmental trajectories: the motivational and emotional systems outpace maturation of the prefrontal cortex, which is important for regulating behavior and goal-planning. The book describes these models in detail and then provides the most up-to-date take on their relevance, utility, and limitations.

An innovative aspect of this book is that it was written with an eye toward the policy implications of research on the adolescent brain. These themes are woven through the chapters and then described in greater detail in Chapter 8 on policy. The main topics discussed are the role of adolescent neuroscience on the juvenile justice system, teenage driving, teenage sleep, and health decisions.

How to Use this Book

The book is intended to introduce an academic audience, with some background in developmental psychology, cognitive neuroscience, and/or neuroimaging, to the burgeoning field of developmental cognitive neuroscience in general and the adolescent brain in particular.

The book is organized by cognitive domains. Each chapter discusses the development of a particular construct, such as social processing or cognition during adolescence. Particular brain regions tend to be implicated in particular constructs (the prefrontal cortex, for instance, is considered the most important hub of high cognition), so each chapter focuses on the relevant brain region(s). However, this is not intended to imply that there is a one-to-one correspondence between one brain region and one cognitive domain. The brain works as an entire network, so even brain regions that are not explicitly mentioned in particular chapters may play a role in supporting the construct of interest. As such, there is reference to other chapters within each chapter but it is written so that the book can be used flexibly and not necessarily taught in sequential order.

Each chapter ends with a bulleted list of major themes in the chapter, a set of review questions to help guide comprehension, and a list of suggested further readings. There are too many great articles to list so only a select few, usually review papers, are listed. Sprinkled throughout the chapter you will find images of concepts or data from the empirical research reviewed in the chapter. Space constraints limit our ability to include all the important data figures that are germane to the central themes, so students are encouraged to read the original articles.

The final chapter on policy aims to introduce students to the important strides adolescent brain research has made in informing public policy and legal sanctions related to adolescent development. It is by no means an exhaustive inventory of adolescent policy but is simply meant to be a primer of this important topic.