

# Pediatric Neuropsychiatry

A Case-Based Approach

Aaron J. Hauptman  
Jay A. Salpekar  
*Editors*

 Springer

---

# Pediatric Neuropsychiatry

---

Aaron J. Hauptman • Jay A. Salpekar  
Editors

# Pediatric Neuropsychiatry

A Case-Based Approach

 Springer

*Editors*

Aaron J. Hauptman  
Department of Psychiatry  
Boston Children's Hospital  
Boston, MA  
USA

Jay A. Salpekar  
Neuropsychiatry in Epilepsy Program  
Kennedy Krieger Institute  
Baltimore, MD  
USA

Harvard Medical School  
Boston, MA  
USA

Departments of Psychiatry and Neurology  
Johns Hopkins University  
School of Medicine  
Baltimore, MD  
USA

ISBN 978-3-319-94997-0      ISBN 978-3-319-94998-7 (eBook)  
<https://doi.org/10.1007/978-3-319-94998-7>

Library of Congress Control Number: 2018956170

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*Dedicated to Bruce Hauptman, MD and Jack  
Pellock, MD who would have enjoyed a book  
like this*

---

## Editors' Note

Thank you for selecting this book. Our intent is to provide a rich intellectual journey through the complex and fascinating world of pediatric neuropsychiatry. The cases that make up this text were chosen in order to instruct and enliven. The authors themselves grapple with facets of diagnosis, treatment, interpretation, and meaning. As is the case in the field generally, the cases presented here are not always tidy, and the outcomes are not uniformly positive or, in some instances, even determined. Always, the authors engage with the significance of neural correlates for behavior, emotion, cognition, and consciousness. Parts of the discourse may seem novel, and some may feel to be well-trodden terrain. Some may represent diagnostic assessment and treatment decisions that feel comfortable. Others may be cutting-edge or address old topics in new ways; and some address considerations with which readers may not always agree. We welcome that inquiry and are content to prioritize probing questions rather than unblemished answers. Through that process, we consider that true medical knowledge may be advanced. This book has been a wonderful experience to write and to edit; we thank you for joining us.

Aaron J. Hauptman  
Jay A. Salpekar

---

# Contents

## Part I The Frontal Lobes and Coordination of Movement and Thought

- 1 The Spectrum of Neurobehavioral Outcomes in Attention-Deficit/Hyperactivity Disorder . . . . .** 3  
Shereen E. Elmaghrabi and Francisco Xavier Castellanos
- 2 Phineas Re-enGage: Long-Term Psychiatric Follow-Up of Pediatric Traumatic Brain Injury . . . . .** 13  
Jeffrey E. Max, Erin D. Bigler, John R. Hesselink, Elisabeth A. Wilde, Tracy Abildskov, and Owen Wade
- 3 Tricky “Ticcy” Case: Tics/Tourette Syndrome with Co-occurring OCD . . . . .** 25  
Erica Greenberg, Angela Essa, and Jeremiah M. Scharf
- 4 “Depression” After Hypoxic-Ischemic Injury . . . . .** 37  
Tzvi Furer, Aaron J. Hauptman, and Lindsey Gurin
- 5 The Role of the Posterior Fossa in Pediatric Neuropsychiatry . . . . .** 47  
Katherine C. Soe, Cassie D. Karlsson, and David W. Dunn
- 6 Punch Drunk: Repetitive Concussions in an Adolescent Student-Athlete . . . . .** 57  
Shari Thomas and David I. Driver

## Part II Autism and Neurodevelopmental Syndromes

- 7 Fragile X: Autism in the Setting of a Known Genetic Syndrome . . . . .** 67  
Jessica Simberlund and Jeremy Veenstra-VanderWeele
- 8 Does a Diagnosis of Velocardiofacial Syndrome Mean Schizophrenia? . . . . .** 75  
Jonathan Picker
- 9 The Interface Between Rare Genetic Variation, Psychosis, and Trauma . . . . .** 83  
Alcy Torres, Catherine Brownstein, Anthony Deo, and Joseph Gonzalez-Heydrich

<b>10</b>	<b>Growing Up with Autism: Incorporating Behavioral Management and Medication to Manage Self-Injurious Behavior</b> . . . . .	<b>93</b>
	Ahmad M. Almai and Aaron J. Hauptman	
<b>Part III Developmental Networks</b>		
<b>11</b>	<b>Two Sides to Every Story: Growing Up with Agenesis of the Corpus Callosum</b> . . . . .	<b>109</b>
	Jay A. Salpekar and Aaron J. Hauptman	
<b>12</b>	<b>Developmental Regression: The Power of Anxiety on the Maturing Brain</b> . . . . .	<b>119</b>
	Rebecca Laptook, Matthew Willis, and Kristin Anderson	
<b>13</b>	<b>Assessment and Treatment of Prenatally Exposed Infants and Children</b> . . . . .	<b>131</b>
	Amanda Lowell and Linda Mayes	
<b>14</b>	<b>A Diagnosis of Exclusion: Demystifying Neurodevelopmental Disorder Associated with Prenatal Alcohol Exposure</b> . . . . .	<b>145</b>
	Susan D. Rich	
<b>15</b>	<b>Accounting for Childhood Lead Exposure: New Directives Around an Old Problem</b> . . . . .	<b>153</b>
	Nasuh Malas, Crystal Cederna-Meko, and Lauren O’Connell	
<b>Part IV Epilepsy</b>		
<b>16</b>	<b>Psychogenic Nonepileptic Seizures and Comorbid Epilepsy in an Adolescent</b> . . . . .	<b>167</b>
	Sigita Plioplys and Amandeep Jutla	
<b>17</b>	<b>Switching Sides: A Case of Sepsis, Seizures, and Shifting Hemispheric Dominance</b> . . . . .	<b>179</b>
	Anupriya Razdan, Cynthia Salorio, Sarah Kelley, and Jay A. Salpekar	
<b>18</b>	<b>Epilepsy and Behavior: Response to an Integrative Treatment Paradigm Highlighting Complementary and Alternative Medicine</b> . . . . .	<b>189</b>
	V. Misra, V. G. Srivatsa, and E. S. Krishnamoorthy	
<b>19</b>	<b>When It’s Not Just a Febrile Seizure: Epileptic Encephalopathy</b> . . .	<b>205</b>
	Yoshimi Sogawa and Miya Asato	

**Part V Neuroinflammatory Conditions**

**20 When the Body Attacks the Brain . . . . . 213**  
 Jordan L. Nordquist, Owais Tirmizi, Siddhartha S. Nadkarni, and  
 Aaron J. Hauptman

**21 Pitfalls in the Diagnosis of Autoimmune Limbic Encephalitis . . . . . 227**  
 Sheldon Benjamin

**22 The Hidden Symptoms of Pediatric-Onset Multiple Sclerosis . . . . . 237**  
 Ashley Marie Clayton and Leigh E. Charvet

**23 PANDAS and PANS: An Inflammatory Hypothesis  
 for a Childhood Neuropsychiatric Disorder . . . . . 245**  
 Sarah O’Dor and Kyle Williams

**Part VI Hormonal Regulation, Arousal, and Sleep**

**24 Catatonia in an Adolescent Girl with Inflammatory  
 Bowel Disease: Complexity of Diagnosis, Treatment,  
 and 3-Year Outcome . . . . . 257**  
 Allan Michael Andersen and Lee Elizabeth Wachtel

**25 Hypothalamic Hamartoma . . . . . 275**  
 Nathaniel Hodoba, Raymond Bunch, Brianne Butcher,  
 P. David Adelson, Ruth Bristol, Varina Boerwinkle,  
 Angus Wilfong, and John F. Kerrigan

**26 More Than Just ADHD: Evaluation of Sleep Disorders  
 with Inattention . . . . . 293**  
 Janet Lam

**Part VII The Pediatric Neuropsychiatric Examination**

**27 Nuances of the Pediatric Neuropsychiatry Evaluation . . . . . 301**  
 Aaron J. Hauptman, Haley Duncanson, and Jay A. Salpekar

**Index . . . . . 319**

---

## Contributors

**Tracy Abildskov** Department of Psychology, Brigham Young University, Provo, UT, USA

**Ahmad M. Almai, MD** Yale University, School of Medicine, Department of Psychiatry, New Haven, CT, USA

Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates

**Allan Michael Andersen, MD** Department of Psychiatry, University of Iowa Hospitals and Clinics, Iowa City, IA, USA

**Kristin Anderson, MD** Department of Psychiatry and Department of Pediatrics, Alpert Medical School of Brown University, Hasbro Children's Partial Hospital Program Hasbro Children's Hospital/Rhode Island Hospital, Providence, RI, USA

**Miya Asato, MD** University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Department of Pediatrics, Division of Child Neurology, UPMC Children's Hospital of Pittsburgh, Pittsburgh, PA, USA

**Sheldon Benjamin, MD** Department of Psychiatry, University of Massachusetts Medical School, Worcester, MA, USA

**Erin D. Bigler, PhD** Department of Psychology, Brigham Young University, Provo, UT, USA

**Varina Boerwinkle, MD** Division of Pediatric Neurology and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**Ruth Bristol, MD** Division of Pediatric Neurosurgery and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital Phoenix, Phoenix, AZ, USA

**Catherine Brownstein, PhD** The Manton Center for Orphan Disease Research, Boston Children's Hospital, Boston, MA, USA

Division of Genetics and Genomics, Boston Children's Hospital, Boston, MA, USA  
Department of Pediatrics, Harvard Medical School, Boston, MA, USA

**Raymond Bunch, MD** Division of Child Psychiatry and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**Brianne Butcher, PhD** Division of Pediatric Neuropsychology, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**Francisco Xavier Castellanos, MD** Hassenfeld Children's Hospital at NYU Langone, Department of Child and Adolescent Psychiatry, Child Study Center, New York, NY, USA

NYU Child Study Center, NYU School of Medicine, New York, NY, USA

**Crystal Cederna-Meko, Psy.D** Department of Pediatrics and Human Development, Michigan State University College of Human Medicine, East Lansing, MI, USA

**Leigh E. Charvet, PhD** Department of Neurology, New York University School of Medicine, New York, NY, USA

**Ashley Marie Clayton, MA** Department of Neurology, New York University School of Medicine, New York, NY, USA

**P. David Adelson, MD** Division of Pediatric Neurosurgery and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital Phoenix, Phoenix, AZ, USA

**Anthony Deo, MD, PhD** Developmental Neuropsychiatry Research Program, Department of Psychiatry, Boston Children's Hospital, Boston, MA, USA

Department of Psychiatry, Harvard Medical School, Boston, MA, USA

The Broad Institute of Harvard and MIT, Cambridge, MA, USA

**David I. Driver, MD** Healthy Foundations Group, Bethesda, MD, USA

**Haley Duncanson, PhD** Harvard Medical School, Boston, MA, USA

Psychology Assessment Center, Massachusetts General Hospital, Boston, MA, USA

**David W. Dunn, MD** Departments of Psychiatry and Pediatrics, Indiana University School of Medicine and Riley Hospital for Children, Indianapolis, IN, USA

**Shereen E. Elmaghrabi, MD** Hassenfeld Children's Hospital at NYU Langone, Department of Child and Adolescent Psychiatry, Child Study Center, New York, NY, USA

**Angela Essa, BS** Psychiatric and Neurodevelopmental Genetics Unit, Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, USA

**Tzvi Furer, MD** Hassenfeld Children's Hospital at NYU Langone, Department of Child and Adolescent Psychiatry, Child Study Center, New York, NY, USA

**Joseph Gonzalez-Heydrich, MD** Developmental Neuropsychiatry Research Program, Department of Psychiatry, Boston Children's Hospital, Boston, MA, USA  
Department of Psychiatry, Harvard Medical School, Boston, MA, USA

**Erica Greenberg, MD** OCD and Related Disorders Program, Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA

**Lindsey Gurin, MD** Department of Neurology, New York University Langone Health, New York, NY, USA

**Aaron J. Hauptman, MD** Department of Psychiatry, Boston Children's Hospital, Boston, MA, USA

Harvard Medical School, Boston, MA, USA

**John R. Hesselink, MD** Department of Radiology, University of California, San Diego, CA, USA

**Nathaniel Hodoba, MD** Division of Pediatric Neurology and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**Amandeep Jutla, MD** Department of Child and Adolescent Psychiatry, Ann and Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, USA

**Cassie D. Karlsson, MD** Departments of Psychiatry and Pediatrics, Indiana University School of Medicine and Riley Hospital for Children, Indianapolis, IN, USA

**Sarah Kelley, MD** Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, USA

**John F. Kerrigan, MD** Division of Pediatric Neurology and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

University of Arizona College of Medicine, Phoenix, AZ, USA

Pediatric Epilepsy Program and Clinical Neurophysiology Laboratory, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**E. S. Krishnamoorthy, MD, PhD** Neurokrish, Chennai, India

**Janet Lam, MD MHS** Kennedy Krieger Institute, Department of Neurology and Developmental Medicine, Baltimore, MD, USA

**Rebecca Laptook, PhD** Department of Psychiatry and Human Behavior, Hasbro Children's Partial Hospital Program, Hasbro Children's Hospital/Rhode Island Hospital, Alpert Medical School of Brown University, Providence, RI, USA

**Amanda Lowell, PhD** Yale University School of Medicine, Yale Child Study Center, New Haven, CT, USA

**Nasuh Malas, MD MPH** Departments of Psychiatry and Pediatrics, University of Michigan Medical School, Ann Arbor, MI, USA

**Jeffrey E. Max, MD** Department of Psychiatry, University of California, San Diego, CA, USA

Neuropsychiatric Research, Rady Children's Hospital, San Diego, CA, USA

**Linda Mayes, MD** Yale University School of Medicine, Yale Child Study Center, New Haven, CT, USA

**V. Misra, MS** Neurokrish, Chennai, India

**Siddhartha S. Nadkarni, MD** Department of Neurology, NYU Langone Medical Center, New York, NY, USA

**Jordan L. Nordquist, MD** Child and Adolescent Psychiatrist, Avera McKennan Hospital and University Health Center, Sioux Falls, SD, USA

Department of Psychiatry, Sanford School of Medicine – University of South Dakota, Sioux Falls, SD, USA

**Lauren O’Connell, MD, MSc** Department of Pediatric Behavioral Health Services, Michigan State University College of Human Medicine, East Lansing, MI, USA

**Sarah O’Dor, PhD** Department of Psychiatry, Harvard Medical School, Boston, MA, USA

Pediatric Neuropsychiatry and Immunology Program, Massachusetts General Hospital, Boston, MA, USA

**Jonathan Picker, MBChB, PhD** Division of Genetics and Department of Child and Adolescent Psychiatry, Boston Children’s Hospital, Boston, MA, USA

**Sigita Plioplys, MD** Pediatric Neuropsychiatry Clinic, Department of Child and Adolescent Psychiatry at Lurie Children’s Hospital, Psychiatry and Behavioral Sciences, Northwestern University, Chicago, IL, USA

**Anupriya Razdan, MD** Johns Hopkins University School of Medicine, Baltimore, MD, USA

**Susan D. Rich, MD, MPH, DFAPA** Therapeutic & Learning Centers, P-LLC, 7th Generation Foundation, Inc., Potomac, MD, USA

**Cynthia Salorio, PhD** Kennedy Krieger Institute, Johns Hopkins University School of Medicine, Baltimore, MD, USA

**Jay A. Salpekar, MD, FANPA, FAES** Kennedy Krieger Institute, Johns Hopkins University School of Medicine, Baltimore, MD, USA

**Jeremiah M. Scharf, MD, PhD** OCD and Related Disorders Program, Department of Psychiatry, Massachusetts General Hospital, Boston, MA, USA

Psychiatric and Neurodevelopmental Genetics Unit, Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, USA

Division of Movement Disorders, Department of Neurology, Massachusetts General Hospital, Boston, MA, USA

Division of Cognitive and Behavioral Neurology, Department of Neurology, Brigham and Women’s Hospital, Boston, MA, USA

**Jessica Simberlund, MD** New York-Presbyterian Hospital associated with Weill Cornell Medical College and Columbia University College of Physicians and Surgeons, New York, NY, USA

**Katherine C. Soe, MD** Departments of Psychiatry and Pediatrics, Indiana University School of Medicine and Riley Hospital for Children, Indianapolis, IN, USA

**Yoshimi Sogawa, MD** University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

Department of Pediatrics, Division of Child Neurology, UPMC Children's Hospital of Pittsburgh, Pittsburgh, PA, USA

**V. G. Srivatsa, MBBS** Neurokrish, Chennai, India

**Shari Thomas, MD** Healthy Foundations Group, Bethesda, MD, USA

**Owais Tirmizi, MD** Department of Veteran's Affairs/UT-Dell Medical School, Austin, TX, USA

**Alcy Torres, MD** Department of Neurology, Boston University Medical Center, Boston, MA, USA

**Jeremy Veenstra-VanderWeele, MD** Center for Autism and the Developing Brain, New York-Presbyterian Hospital, New York, NY, USA

Sackler Institute for Developmental Psychobiology, Department of Psychiatry, Columbia University, New York State Psychiatric Institute, New York, NY, USA

**Lee Elizabeth Wachtel, MD** Department of Psychiatry, Johns Hopkins University School of Medicine, Baltimore, MD, USA

Neurobehavioral Unit, Kennedy Krieger Institute, Baltimore, MD, USA

**Owen Wade, BA** Department of Psychiatry, University of Iowa, Iowa City, IA, USA

**Elisabeth A. Wilde, PhD** Department of Neurology, University of Utah, Salt Lake City, UT, USA

**Angus Wilfong, MD** Division of Pediatric Neurology and Hypothalamic Hamartoma Program, Barrow Neurological Institute at Phoenix Children's Hospital, Phoenix, AZ, USA

**Kyle Williams, MD, PhD** Department of Psychiatry, Harvard Medical School, Boston, MA, USA

Pediatric Neuropsychiatry and Immunology Program, Massachusetts General Hospital, Boston, MA, USA

**Matthew Willis, MD** Department of Psychiatry and Human Behavior, Hasbro Children's Partial Hospital Program, Hasbro Children's Hospital/Rhode Island Hospital, Alpert Medical School of Brown University, Providence, RI, USA

---

## Introduction

“Wherever the art of medicine is loved, there is a love of humanity.”

-Hippocrates

How many times have we each approached colleagues saying, “I saw a really interesting patient today,” or “I have never seen anything quite like this...” This is a standard practice for clinicians, as we all reach out to our professional community for explanation, teaching, guidance or the shared sense of fascination about the experiences of the individuals we treat. As neurologists, psychiatrists, and ultimately, as neuropsychiatrists, we take care of individuals whose complicated conditions challenge us to think deeply about how neuroscience, development, and environment connect the mental and physical functions of the brain. Much of the time, our patients bring unique insights into mind-body connectivity that are on the cutting edge of today’s clinical knowledge. As such, evidence or even precedent for management of these illnesses is not common in the medical literature. To work in neuropsychiatry is to live at the deeply fascinating, but often uncomfortable, gray line between the mental and the physical, at the forefront of the exploration of consciousness.

Classically, a case conference has always been the way that physicians do medicine. We see patients with complicated conditions and then discuss clinical experiences at national meetings, local grand rounds, or within our departments with colleagues in order to facilitate our own understanding and that of the community. The insights afforded to clinicians in these settings are valuable; each practitioner can apply a unique perspective to challenging cases, and, in the world of neuropsychiatry, most cases are challenging.

In modern times, the opportunities to meet and discuss cases have been significantly constricted given the increased pressure to see as many patients as possible and “manage” versus to think deeply and carefully about larger neuroscientific theories. Movements to routinize care also work against the field, often streamlining procedures in ways that undercut the exploration that is at the heart of neuropsychiatric medicine. Despite financial pressures in the modern era, most researchers and clinicians acknowledge that the intellectual appeal of a neuropsychiatric mode of thinking has never been greater. The contrast today between the growth of factual knowledge available about the brain and the contraction in allotted time to avail oneself of that knowledge represents a conundrum that is unresolved.

Now, nearly two decades after the end of the “Decade of the Brain” in the 1990s, exploration into brain anatomy and function has soared. We think about networks and coordinated systems not only fixed anatomical brain structures and the roles of individual neurotransmitters. The knowledge of concussions and degenerative conditions has changed how we think about brain injury and cognitive processing. We have an increased understanding of the fragility of brain parenchyma as well as new appreciation for its tremendous capacity for recovery. We have windows into the vast connectivity of the brain with imaging of white matter tracts in diffusion tensor imaging and electrical dipoles as shown by magnetic encephalograms.

Adult neuropsychiatry is now a well-established field with numerous practitioners and reasonable representation in the medical literature. There are increasingly formalized ways to train practitioners for a career in adult neuropsychiatry including residencies, fellowships, national and international conferences, and medical board examinations. While this is a superb development for the field, clinicians who work with children routinely note how the analogous knowledge base and integrated approach in the pediatric world is much less established. Neuroscience education and clinical emphasis on neurologic comorbidities typically are not prominent components in pediatric and child/adolescent psychiatry training programs.

This is an unfortunate development because studying a pediatric population has inherent advantages when it comes to neuropsychiatry. Young brains are designed for growth, recovery, and resilience. Significant vulnerability exists of course, but repair is possible well beyond what may occur later in the life span. In pediatrics, every case of neuropsychiatric illness is contextualized by brain development. Whereas in adult neuropsychiatry, the insult to the brain is framed by mature substrate, in children, not only is function in the moment affected but the ongoing process of development is jarred from its trajectory as well. As such, we can readily gain insights into brain development by monitoring how symptoms change over time and how treatment may influence that change.

Our aim with this text is to highlight the developing brain with a diverse cohort of children and adolescents with neuropsychiatric illnesses. We include some conditions that are common, bread-and-butter child psychiatry and neurological cases, such as ADHD, epilepsy, and Tourette’s syndrome. But we have gone out of our way also to include cases that may be a little bit messy and that frame the expected condition in the context of life stress, comorbid developmental disorders, and other neurologic illness. We tried to organize the cases around similar themes but fully recognize that content overlaps between sections. We also intermix cases of conversion disorder, such as psychogenic non-epileptic events, within the sections on the associated conditions. In pediatrics, conversion symptoms may be subtly nested within the context of comorbid neurological disorders and developmentally tinged emotional stressors. As such, we did not want to isolate conversion from related neurologic symptoms even if the etiologies were varied.

Additionally, we want this text to help fill the knowledge gap that currently exists between adult and pediatric neuropsychiatry. We aspire to provide a sense of how to think through aspects of brain dysfunction by means of the oldest tradition in medicine: case-based learning. By highlighting patients’ stories, we hope to provide a

broad “case conference” that will generate thought and insight to assist other clinicians facing the daunting and energizing task of deciphering neuropsychiatric illness in children and adolescents. Although the paradigmatic approach utilized in adult neuropsychiatry does not yet have an equivalent in the pediatric realm, there is tremendous interest in its advance, and we hope this type of casebook will contribute toward that goal.

Above all, we want to capture intrigue and express the delight in working as neuropsychiatrists with this age group. Children and adolescents with neuropsychiatric illness are very common yet often struggle in finding professionals adept in diagnosis, treatment, and overall support. We continue to be humbled by this complex field and endeavor to make progress in learning how best to be available for our patients as clinical neuroscientists.

Ultimately, this book is about those patients, telling their stories and, in doing so, teaching us new remarkable insights into brain and behavior relationships. Where possible, our patients and their families have provided personal reflections of their experiences. Their voices, expressing their struggles and successes, are profound reminders of the person-centered nature of this work. We are privileged to have this opportunity and to work alongside our patients in bearing witness into the limitless inner workings of the brain.

Boston, MA, USA  
Baltimore, MD, USA

Aaron J. Hauptman  
Jay A. Salpekar

---

## Part I

# The Frontal Lobes and Coordination of Movement and Thought

---

### Introduction

The brain is wider than the sky,  
For, put them side by side,  
The one the other will include,  
With ease, and you beside.  
Emily Dickinson, 1924

This section focuses on prefrontal cortical (PFC) circuits and their diverse structural and functional connections throughout the brain. Discussion of the frontal lobes, responsible for attention, working memory, executive function, and so much of what defines human emotional and neurocognitive function, quickly gives way to an exploration of subcortical structures such as basal ganglia and limbic regions. The prefrontal cortex doesn't do its work alone, and the section emphasizes the large-scale, circuit-based nature of so many of the functions thought of as “belonging” to the PFC.

These cases focus on frontal-parietal connections in executive function, frontal-striatal-thalamocortical loops in movement, mood and salience detection, and the increasingly appreciated functions of the cerebellum's interaction with other brain regions in cognition and thought processing. Concepts will be introduced crucial to understanding regions of the brain that will come up again and again in subsequent chapters, whether in the discussion of developmental disorders, white-matter connectivity in pediatric multiple sclerosis, the neuropsychiatric aspects of neuroimmunological conditions, epilepsy, or altered mental status.

The first chapter in this section follows three patients with ADHD for decades; their diverse developmental trajectories bring a longitudinal, outcome-driven perspective on a condition often thought of exclusively in its pediatric context. This also provides a broad overview of PFC circuitry and connectivity that scaffolds subsequent discussion of frontal-subcortical and frontal-cerebellar connections. Next is an exploration of traumatic brain injury (TBI) and its potentially devastating effects on mood, personality, and a wide range of emotional and neurocognitive

functions. The chapter also places an emphasis on modes of recovery and approaches for management and shows a pathway toward success in the face of ongoing challenges. A review of tics and Tourette syndrome moves into an exploration of the deeper structures of the telencephalon in the management of a particularly complex case. This entry into frontal-subcortical machinery shifts solidly into a discussion of subcortical structures explored through a case of substance-induced hypoxia in which parkinsonism in an adolescent was confused for a mood disorder. The section then moves on to the cerebellum. This brain area, once viewed as being almost exclusively involved in smoothing of movement, is increasingly seen as playing a significant role in emotional and thought processing and is implicated in a broad range of neurological and psychiatric conditions ranging from autism to schizophrenia to affective disorders. The final case addresses the common question of adolescent concussion with psychiatric sequelae, addressing the overarching concern of long term sequelae following multiple episodes of mild traumatic brain injury.



# The Spectrum of Neurobehavioral Outcomes in Attention-Deficit/Hyperactivity Disorder

1

Shereen E. Elmaghrabi and Francisco Xavier Castellanos

## Cases

The following cases illustrate three trajectories of individuals who would have been diagnosed with attention-deficit/hyperactivity disorder (ADHD) in childhood, had the contemporary diagnosis existed when they were first evaluated. These cases (with details modified to protect confidentiality) were obtained from a prospective, 33-year longitudinal study conducted by Klein et al. investigating the long-term outcomes of childhood hyperactivity [1]. Probandes were predominately middle and lower-middle socioeconomic status males aged 6–12 upon entering the study between 1970 and 1978. They were recruited from a psychiatric research clinic in Queens, NY, to which they had been referred for behavioral issues by their respective schools. Follow-up assessments were conducted at mean participant ages of 18, 25, and 41 years.

## Case One: Charlie

Charlie was born full-term at 9 lbs 10 oz. From a young age, he experienced difficulties at school and home. By the second grade, he was in danger of failing several subjects despite receiving individualized instruction. His second grade teacher

---

S. E. Elmaghrabi

Hassenfeld Children's Hospital at NYU Langone, Department of Child and Adolescent Psychiatry, Child Study Center, New York, NY, USA  
e-mail: [Shereen.Elmaghrabi@med.nyu.edu](mailto:Shereen.Elmaghrabi@med.nyu.edu)

F. X. Castellanos (✉)

Hassenfeld Children's Hospital at NYU Langone, Department of Child and Adolescent Psychiatry, Child Study Center, New York, NY, USA

NYU Child Study Center, NYU School of Medicine, New York, NY, USA  
e-mail: [Francisco.Castellanos@nyumc.org](mailto:Francisco.Castellanos@nyumc.org)

© Springer Nature Switzerland AG 2019

A. J. Hauptman, J. A. Salpekar (eds.), *Pediatric Neuropsychiatry*,  
[https://doi.org/10.1007/978-3-319-94998-7\\_1](https://doi.org/10.1007/978-3-319-94998-7_1)