

## PRAISE FOR THIS BOOK

“Dr. Brown more than fulfills his promise to provide an accessible summary that describes and integrates new facts and perspectives on ADHD. The book is comprehensive, current, and engagingly written. It will be a terrific resource for parents, educators, and clinicians as well as for patients themselves.”

**F. Xavier Castellanos, MD**, *Brooke and Daniel Neidich Professor of Child and Adolescent Psychiatry, Professor of Radiology and Physiology and Neuroscience, and Director, Center for Neurodevelopmental Disorders, New York University Langone Medical Center Child Study Center*

“Brown presents a comprehensive case for comprehending this disorder in terms of a wide range of executive functions, rather than on the basis of behavior and attention alone. Loaded with up-to-date research findings and synthetic in scope, this work is bound to challenge assumptions and pave the way toward new paradigms.”

**Stephen P. Hinshaw, PhD**, *Professor of Psychology, University of California, Berkeley, and Editor, Psychological Bulletin*

“Tom Brown’s book is placing cognitive changes at the heart of ADHD and drawing out the implications for clinicians and researchers. It is a welcome corrective to the overemphasis on disruptive behavior and it is written so clearly that it can be recommended to everyone who wants to understand the nature of this serious problem for adults and children.”

**Eric Taylor, FRCP, FRCPsych**, *Professor of Child and Adolescent Psychiatry, Institute of Psychiatry, University of London*

“A very intriguing read. Dr. Brown skillfully examines the diverse nature of executive functions, ADHD, and their overlap.”

**Timothy E. Wilens, MD**, *Associate Professor of Psychiatry, Harvard Medical School, and Director of Substance Abuse Services, Massachusetts General Hospital*

“Professionals and lay people looking for a synthesis of our current understanding of this condition will find Dr. Brown’s latest book a sensible, understandable, and very readable contribution.”

**Gabrielle A. Carlson, MD**, *Professor of Psychiatry and Pediatrics, and Director, Child and Adolescent Psychiatry, Stony Brook University School of Medicine*

“Dr. Brown presents a science-driven and cohesive way of re-conceptualizing the disorder, revitalizing the central role of executive functioning impairment in ADHD. This book translates recent advances in ADHD science into understandable words not only for mental health professionals, but for all those interested in this very prevalent disorder affecting individuals across the whole life cycle.”

**Luis Augusto Rohde, MD, PhD, President of the World Federation of ADHD, and Professor of Psychiatry, Federal University of Rio Grande do Sul, Brazil**

“Tom Brown’s newest book pulls from the latest research in ADHD to present a new explanatory paradigm. Research results are distilled to debunk myths and offer sound guidance on evaluation and effective treatment. This book is a must-read for any education, health, or mental health professional who encounters children or adults with ADHD. Its direct and clear language makes the explanations and conclusions accessible to parents and adult patients, too.”

**Mina K. Dulcan, MD, Osterman Professor of Child Psychiatry and Head, Department of Child and Adolescent Psychiatry at the Ann & Robert H. Lurie Children’s Hospital of Chicago; Professor of Psychiatry and Behavioral Sciences and Pediatrics, and Director, Child and Adolescent Psychiatry, Northwestern University Feinberg School of Medicine**

“This book presents a highly useful and current summation of the major findings concerning ADHD and the role of executive functioning in it. Clinicians, students, and laypeople will find here much valuable information on the disorder, its assessment and diagnosis, and its management.”

**Russell A. Barkley, PhD, Clinical Professor of Psychiatry and Pediatrics, Medical University of South Carolina**

“Thomas E Brown has produced a comprehensive reference. It extends our understanding of the impact of Attention Deficit Hyperactivity Disorder as that diagnosis assumes new borders in DSM 5.”

**Martha Bridge Denckla, MD, Professor of Neurology, Pediatrics, and Psychiatry, Johns Hopkins University School of Medicine, and Director, Developmental Cognitive Neurology, Kennedy Krieger Institute**

“Tom Brown is one of the true pioneers in our growing understanding of ADHD. Both a clinician and a researcher, he continues to deepen and enlarge our knowledge of ADHD. Dr. Brown is a dedicated doctor who’s written yet another brilliant book.”

**Edward Hallowell, MD, author of *Delivered from Distraction* and *The Childhood Roots of Adult Happiness***

## A NEW UNDERSTANDING OF ADHD IN CHILDREN AND ADULTS

For over 100 years, ADHD has been seen as essentially a behavior disorder. Recent scientific research has developed a new paradigm which recognizes ADHD as a developmental disorder of the cognitive management system of the brain, its executive functions. This cutting-edge book pulls together key ideas of this new understanding of ADHD, explaining them and describing in understandable language scientific research that supports this new model. It addresses questions like:

- Why can those with ADHD focus very well on some tasks while having great difficulty in focusing on other tasks they recognize as important?
- How does brain development and functioning of persons with ADHD differ from others?
- How do impairments of ADHD change from childhood through adolescence and in adulthood?
- What treatments help to improve ADHD impairments? How do they work? Are they safe?
- Why do those with ADHD have additional emotional, cognitive, and learning disorders more often than most others?
- What commonly held assumptions about ADHD have now been proven wrong by scientific research?

Psychiatrists, psychologists, social workers, and other medical and mental health professionals, as well as educators and those affected by ADHD and their families, will find this to be an insightful and invaluable resource.

**Thomas E. Brown**, PhD, is Associate Director of the Yale Clinic for Attention and Related Disorders and Assistant Clinical Professor of Psychiatry, Yale University School of Medicine. He is a Fellow of the American Psychological Association, developer of the *Brown ADD Scales for Children and Adults* (Pearson), and author of the prize-winning book, *Attention Deficit Disorder: The Unfocused Mind in Children and Adults*. Dr. Brown is also editor of the textbook, *ADHD Comorbidities: Handbook of ADHD Complications in Children and Adults* (American Psychiatric Publishing). Visit the author's website at [www.DrThomasEBrown.com](http://www.DrThomasEBrown.com).



A NEW  
UNDERSTANDING OF  
ADHD IN CHILDREN  
AND ADULTS

Executive Function Impairments

*Thomas E. Brown*

 Routledge  
Taylor & Francis Group  
NEW YORK AND LONDON

First published 2013  
by Routledge  
711 Third Avenue, New York, NY 10017

Simultaneously published in the UK  
by Routledge  
27 Church Road, Hove, East Sussex BN3 2FA

*Routledge is an imprint of the Taylor & Francis Group, an informa business*

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*Library of Congress Cataloging in Publication Data*

Brown, Thomas E., 1942-

A new understanding of ADHD in children and adults : executive function impairments / Thomas E. Brown.

pages cm

Includes bibliographical references and index.

1. Attention-deficit hyperactivity disorder. 2. Attention-deficit disorder in adults. 3. Mental illness--Classification. I. Title.

RJ506.H9B7652 2013

618.92'8589--dc23

2013001384

ISBN: 978-0-415-81424-9 (hbk)

ISBN: 978-0-415-81425-6 (pbk)

ISBN: 978-0-203-06753-6 (ebk)

Typeset in Garamond  
by Saxon Graphics Ltd, Derby

The untangling of the complexity has barely begun... But even at its early stages, the whole business of the matter of the mind requires a global view if we are to get anywhere.

Gerald M. Edelman (1992)

*Bright Air, Brilliant Fire: On the Matter of the Mind*

Perhaps the most indispensable thing we can do as human beings, every day of our lives, is remind ourselves and others of our complexity, fragility, finiteness and uniqueness.

Antonio R. Damasio (1994)

*Descartes' Error: Emotion, Reason and the Human Brain*



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## ACKNOWLEDGMENTS

To my wife, Bobbie, with deep gratitude and love for all you are, all you give, and all we still share together. You are the light of my life! And with much appreciation to our family, Liza, Dave, Nancy, Abel, Noah, and Simone for your generous love, encouragement and continuing sunshine. I am also grateful to Philipp Reichel who served as my research assistant throughout this project; he provided not only research support, but also many helpful suggestions.

Thanks also to George Zimmar, my publisher, for his generous encouragement and support of this project, to Rob Brown for co-ordinating production, to Lorna Hawes for her careful copy editing, to Sally Beesley for the attractive cover design, to Jennifer Sefa-Boakye, for coordinating marketing, to Christopher Tominich for his management of countless details, and to all the others in the team at Routledge/Taylor and Francis who helped to complete the project and make it available to readers.

T. E. B.



# INTRODUCTION

The disorder currently identified as Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD) has been described in the medical literature with a variety of different labels for over 100 years. (In this book, the term ADHD is used to refer to Attention Deficit Disorder with and without hyperactivity). Throughout most of those years, the emphasis has been on behavior problems of young children who were seen as being overly active and not listening to others. The term “attention” as a central aspect of the syndrome was not introduced into diagnostic criteria until 1980 (American Psychiatric Association, 1980). Until recently, this syndrome was classified in the diagnostic manual as a “disruptive behavior disorder.” That old model of ADHD is now outdated. Rapidly it is being replaced by a new understanding of ADHD as a developmental impairment of the brain’s self-management system, its executive functions.

This book describes that new understanding and the recent clinical and neuroscience research that supports it. Here the reader will find, in clear and accessible language, information on how scientific research on functioning of the human brain has created this major shift in how ADHD is now understood. This discussion describes and elaborates many concepts and research findings about ADHD not included even in the description of ADHD provided in DSM-V, the most recent version of the psychiatric diagnostic manual. It moves beyond a simple listing of behavioral characteristics of those with ADHD and provides a more integrated understanding of the complex problems of brain development and cognitive functions that underlie the disorder at various points in the lifespan. Moreover, this volume offers a working definition of ADHD that highlights characteristics of this developmental impairment of the brain’s management system, its executive functions.

The purpose of this book is to provide an accessible summary that describes and integrates new facts and understandings of this disorder which have been

developed by a number of researchers and clinicians working at the cutting edge of the study of ADHD. The integrated understanding provided here is not new in the sense of totally original or never before seen. Concepts in the working definition proposed in this book are not the creation of any one individual. Much of the research and most of the key concepts have been disparately reported in many scientific journals, books and conferences by a number of researchers and clinicians over the past 15 years. What is new in this publication is the integration of these fragments of emerging research data and perspectives into an updated and readily understandable paradigm with a working definition for this complex syndrome.

Findings from neuroscience, brain imaging and various forms of clinical research have made the old understanding of ADHD as essentially a simple behavior disorder no longer tenable. A new paradigm has emerged to conceptualize this syndrome. This new model is not yet fully refined. Its language of executive function is barely mentioned in the description of ADHD provided in the most recent version of the official diagnostic manual. Yet this updated model increasingly is being recognized and used by many professionals in psychology, medicine, education and related fields.

This new paradigm can provide a useful way to put together many of the not yet integrated pieces of research on this puzzling syndrome which causes some children and adults to have great difficulty in focusing and managing many aspects of their daily life, while they can focus and manage a few other tasks or activities quite well. This new understanding provides a useful way to more readily recognize, understand, assess and treat this complex syndrome which impacts about 9% of children and almost 5% of adults.

Further research and increased clinical experience will eventually provide even better ways to conceptualize this disorder, its assessment and treatment. In the meantime, this book offers a new and, hopefully, helpful understanding for primary care physicians, psychologists, child and adult psychiatrists, pediatricians, advanced practice nurses, clinical social workers, and other medical and mental health professionals as well as educators, disability service providers and interested patients and family members who struggle with the complexities of ADHD.

Research has made it increasingly clear that ADHD is not essentially a behavior disorder and not limited to childhood years. The working definition offered in the second chapter of this book asserts that this syndrome known as ADHD is a complex developmental impairment of the brain's self-management system, its executive functions, which may emerge in boys or girls during early childhood, but often is not recognized until the affected individual encounters

the challenges of adolescence or adulthood. For some, impairments of ADHD diminish considerably as their brains mature over the mid to late adolescent years; for others, the disorder persists as a chronic impairment throughout their lifespan.

This book begins with a review of multiple widely-held, but mistaken assumptions about ADHD; it also presents scientific facts from research findings that contradict those myths. It then offers and explains a new working definition of ADHD based on the emerging facts and paradigm. The four chapters following that description describe and explain in more detail the nature of the disorder, how it can be effectively assessed, how it can be effectively treated, and why many learning and psychiatric disorders often co-occur with ADHD.

Chapter 1 presents 35 commonly held myths about ADHD that are challenged by findings developed from scientific research. Listed after each of those myths is a brief summary of facts that contradict that mistaken assumption and citations to specific pages of this book where more detailed information on relevant research can be found.

Chapter 2 proposes and explains a working definition of the new paradigm that is based upon facts of ADHD developed in research. It also highlights the developmental nature of the disorder and the puzzling fact that individuals with ADHD all tend to have a few specific activities and situations in which they have no difficulty deploying those executive functions in which they are usually significantly impaired. That chapter also describes similarities and differences between the old and new models and summarizes findings regarding the prevalence of ADHD in various age groups.

In Chapter 3 are reviews of research describing specific ways in which individuals with ADHD at various stages of life tend to be impaired in brain development, cognitive functioning, and their self-management for many activities of daily living. Recent findings on differences in rates of brain maturation, brain structure, and functional connectivity of brain components are included to address the question: "Is the ADHD brain structured or wired differently?" This chapter also describes research on the role of emotion and motivation in ADHD. It explains why ADHD impairments are found among persons along the full spectrum of IQ, including some who are extremely bright. A concluding section reviews genetic research seeking to explain the very high rate of familial heritability for ADHD coupled with information about environmental factors that can also impact this disorder.

Chapter 4 presents research findings on how impairments of ADHD understood in this new model can be adequately assessed and diagnosed at

various points across the lifespan. It challenges the assumption that impairments of ADHD can be adequately assessed with traditional neuropsychological “tests of executive functions” and explains how clinicians can use clinical interviews and rating scales to assess ADHD as it is now understood in this new model. It also points out limitations of some ineffective assessment methods in current use.

Chapter 5 reviews research on the uses and limitations of approved medications and various psychosocial treatments for ADHD. It reports research regarding how medications for ADHD can improve brain function and describes the ways medications can affect various aspects of the self-management system of the brain. It also summarizes scientific findings regarding possible side effects to medication treatments for ADHD and reports on which psychosocial treatments for ADHD are helpful for various cognitive and behavioral functions in different age groups.

The sixth chapter of the book describes research showing how and why most individuals with ADHD suffer also from one or more additional learning or psychiatric disorders. It argues that executive function impairments of ADHD underlie and are foundational to dyslexia and other learning disorders, anxiety and depressive disorders, bipolar disorders, oppositional defiant and conduct disorders, obsessive-compulsive and hoarding disorders, substance use disorders, and Autistic Spectrum disorders. It suggests that ADHD is not like having a problem with one software program that interferes with only one type of functioning of a computer. It presents ADHD as more like a problem with the operating system of the computer, a broader, more foundational impairment that impacts a wide range of cognitive functioning.

## 35 MYTHS ABOUT ADHD AND WHY THEY ARE WRONG

This book describes a new understanding of ADHD (Attention Deficit Hyperactivity Disorder) based upon facts demonstrated in empirical research. This new understanding is summarized in a new definition and model described in Chapter 2. It challenges a number of widely-prevalent myths, mistaken assumptions about ADHD, that are still held by many lay people and some professionals. This chapter lists 35 of those assumptions, provides a brief summary of science-based facts that contradict each of these myths, and refers the reader to the more substantial evidence in Chapters 2 through 6 that challenges each mistaken assumption.

### **1. A person who has ADHD always has difficulty with executive functions such as focusing on a task and keeping things in mind, regardless of what they are doing.**

Clinical data indicate that executive function impairments characteristic of ADHD are situationally-variable; each person with ADHD tends to have some specific activities or situations in which they have no difficulty in utilizing those executive functions that, for them, are significantly impaired in most other situations. Typically these are activities in which they have strong personal interest or where they believe that something very unpleasant will follow quickly if they do not take care of this task right here, right now (Chap. 2, pp. 32–33). Research findings indicate that intra-individual variability in performance from one context or time to another is the essence of ADHD. Multiple studies have shown that performance of persons with ADHD is highly sensitive to contextual factors, e.g. reward, nature of the task, and internal cognitive and physiological factors (Chap. 3, pp. 58–63).

**2. Everyone has impairments of executive functions; those with ADHD are just like everybody else.**

Although everyone suffers from executive function impairments sometimes, only those individuals who are significantly and chronically impaired by this syndrome of impairments qualify for the diagnosis of ADHD. Epidemiological research in the U.S. indicates that about 9% of children aged 6 to 17 years, 8.7% of adolescents aged 13 to 18 years, and 4.4% of adults qualify for an ADHD diagnosis under current diagnostic criteria. A pooled estimate from 102 studies of children up to age 18 years in diverse cultures around the world yields a more conservative estimate of 5.29% (Chap. 2, 40–41). Comparisons of individuals with ADHD versus matched groups in multiple aspects of brain development, brain structure and brain functioning have demonstrated significant differences between those who have ADHD and those who do not (Chap. 3, pp. 63–70).

**3. If a person with ADHD really wants to focus and work effectively on a task they can make themselves do it. Using executive functions is just a matter of “willpower.”**

Because persons with ADHD can typically exercise their executive functions very well on specific activities or tasks that interest them or which cause them to fear some very unpleasant outcome quite soon if they do not accomplish that task, it is easy to assume that individuals with ADHD can exercise those same functions equally well in other situations which they or others consider important—if only they will exercise a presumed internal force called “willpower.” This new model of ADHD challenges that assumption on the grounds that most operations of executive functions are unconscious, not in the psychoanalytic sense of repression, but in the more modern sense of “automaticity.”

From this view, most operations of these executive functions are not under conscious control any more than is erectile dysfunction. Research on motivational influences impacting decisions of “Will you do it and, if so, how and when?” has shown that such decisions result primarily from complex and dynamic interactions of memory-influenced emotions with inborn patterns of reactivity that operate instantaneously with relatively insignificant conscious input, despite our assumptions to the contrary (Chap. 2, pp. 33–37).

**4. Anyone who has ADHD will show clear signs of it during early childhood and will continue to have difficulties with executive functions for the rest of his/her life.**

For decades ADHD, under various names, has been seen as essentially a disorder of childhood; DSM-IV (Diagnostic and Statistical Manual of Mental Disorders-IV) diagnostic criteria stipulated that, for diagnosis, at least some of the symptoms must be noticeable by age seven years. More recent research has shown that many with ADHD function quite well during childhood and do not manifest any significant symptoms of ADHD until adolescence or later when greater challenges to executive function are encountered (Chap. 4, pp. 77–78). Over the past decade research has shown that impairing symptoms of ADHD often persist well into adulthood (Chap. 2, pp. 29–31; Chap. 3, pp. 46–51). However, longitudinal studies have also shown that some individuals with ADHD during childhood experience significant reductions in their ADHD impairments as they grow older (Chap. 3, pp. 52–55).

**5. Impairments of executive function are best assessed by neuropsychological “tests of executive function” administered by a neuropsychologist.**

“Tests of executive function” used by neuropsychologists are not useful for assessing impairments of executive function associated with ADHD. Some with ADHD do poorly on a battery of such tests, but many who clearly meet diagnostic criteria for ADHD perform adequately or even quite well on such measures, despite their impairments of executive function (EF). The most effective measure for assessment of ADHD is use of a normed ADHD/EF rating scale in the context of a semi-structured clinical interview done by a clinician experienced with such disorders. These measures should inquire about how well the individual is able to manage relevant tasks of daily life as well as assessing for other possible causes of the symptoms and for possible comorbid difficulties. Unlike neuropsychological tests that attempt to infer dynamic patterns of functioning from just 5 to 20 minutes of behavior in an artificial laboratory setting, rating scales inquire over much wider time frames in a variety of settings and tasks (Chap. 4, pp. 88–92).

**6. Persons with high IQ are not likely to have executive function impairments of ADHD because they are smart enough to overcome such difficulties.**

Intelligence measured by IQ tests has virtually no systematic relationship to the syndrome of executive function impairments described in the new model of ADHD. Studies have shown that even extremely high IQ children and adults can suffer impairments of ADHD which significantly impair their ability to deploy their strong cognitive skills consistently and effectively in many situations of daily life. Clinical observations indicate that often high IQ individuals with ADHD face lengthy delays before they obtain a correct diagnosis and appropriate treatment. This is due largely to uninformed teachers, parents, clinicians, and patients themselves assuming that high IQ precludes ADHD (Chap. 3, pp. 70–72).

**7. Modern imaging techniques such as PET and fMRI scans or computerized tests can provide objective evidence to diagnose executive function impairments associated with ADHD.**

Many claim that “objective” measures such as positron emission tomography (PET), single photon emission computed tomography (SPECT) or functional magnetic resonance imaging (fMRI) scans can determine whether an individual has ADHD or not. Although these measures are useful research tools, they are not sufficiently developed or normed to make them useful or valid for assessment to make or deny an ADHD diagnosis for any specific individual. The same limitations apply to computerized “tests of attention” and to quantitative electroencephalography (EEG) tests. All of these measures provide only snapshots of brain functioning in brief moments of time and do not adequately capture the wide situational variability in functioning characteristic of most individuals with ADHD. This complex disorder can be effectively assessed and validly diagnosed only by a clinical interview that assesses longer term patterns of functioning in multiple contexts. This task requires a clinician skilled and experienced in this field (Chap. 4, pp. 94–95).

**8. Executive function impairments of ADHD usually are outgrown when the person reaches their late teens or early twenties.**

Some children with ADHD gradually outgrow their ADHD-related impairments as they get into middle childhood or adolescence. For them ADHD is a variety of developmental lag. Most often hyperactive and/or

impulsive symptoms improve as the individual reaches adolescence while the broad range of inattention symptoms persist and sometimes get worse. Often the most problematic period is during junior high, high school and the first few years of university; that is the time when the individual faces the widest range of challenging activities without opportunity to escape from the ones in which they have little interest or ability. After that period some with ADHD are fortunate enough to get employment and a life situation where they can build on their strengths and find ways to work around their cognitive weaknesses; others are not similarly fortunate (Chap. 3, pp. 52–55).

**9. Modern research methods have established that executive function impairments are localized mainly in the prefrontal cortex.**

Executive functions are complex and involve not only the prefrontal cortex, but also many other components of the brain. Those with ADHD have been shown to differ in the rate of maturation of specific areas of the cortex, in the thickness of cortical tissue, in characteristics of the parietal and cerebellar regions, as well as in the basal ganglia, and in the white matter tracts that connect and provide critically important communication between various regions of the brain. Recent research has also shown that those with ADHD tend to have different patterns in functional connectivity, patterns of oscillations that allow different regions of the brain to exchange information (Chap. 3, pp. 63–70).

**10. Emotions and motivation are not involved in executive functions associated with ADHD.**

Although earlier research and diagnostic criteria for ADHD gave little attention to the role of emotion and motivation in this disorder, more recent research has highlighted their critical importance. Some research has focused solely on the problems of many with ADHD in regulating expression of their emotions without sufficient inhibition or modulation. However, research has also demonstrated that a chronic deficit in emotions that comprise motivation is a critically important aspect of impairments for most individuals with ADHD. Studies have shown that this is related to measurable differences in the operation of the reward system within the brains of those with ADHD. Those with ADHD tend to have abnormalities in the anticipatory dopamine cell firing in the reward system; this makes it difficult for them to arouse and sustain motivation for activities that do not provide immediate and continuing reinforcement (Chap. 3, pp. 55–62).

**11. Impairments of executive function occur only if the person has inherited ADHD.**

There are many ways in which executive functions can become impaired. Traumatic brain injuries, strokes, and Alzheimer's dementia are just a few of the many ways in which some individuals with previously adequate executive functions can become impaired in those functions. ADHD impairments of executive function are different. They are highly heritable, and they are *developmental* in the sense that they do not unfold and "come on line" for the individual in the way that occurs for most others of the same age. A number of imaging studies have demonstrated that children and adolescents with ADHD tend to show a lag of three to five years in the development of the brain infrastructure for executive functions relative to their peers. For some, delays in development of some specific aspects of the brain continue into adulthood (Chap. 2, pp. 28–31; Chap. 3, pp. 63–66, 72–76).

**12. Usually executive functions of ADHD are problematic only while a person is in school. Once they get out of school, executive function impairments are not much of a problem.**

Impairments of executive function associated with ADHD are often noticed first in school because academic and behavioral requirements of the classroom are difficult for many children with ADHD to meet in an age-appropriate way. Some with ADHD manage to meet these requirements quite adequately during the early years of school, but later find that their executive functions significantly interfere with the increasing demands for self-management and more complex learning and academic output in upper grades, especially during secondary and post-secondary education. However, studies of adolescents and adults with ADHD indicate that long after school years, many continue to have significant problems in their work, social relationships, sleep, family life, household management, driving, and many other aspects of daily life (Chap. 3, pp. 49–55).

**13. The new model of ADHD as developmentally impaired executive function is completely different from the older model of ADHD.**

The new model of ADHD differs in many ways from the earlier model of this disorder as essentially a cluster of behavior problems in young children. The new model is truly a shift of paradigm for understanding this syndrome. It applies not only to children, but also to adolescents and adults. It focuses on a

wide range of self-management functions that are not limited to readily observable behaviors; functions included are linked to complex operations of the brain. However, there are still substantial and important points of overlap between the old and new models. The new model is an extension and expansion of the old model. Most individuals who meet diagnostic criteria for the new model will also meet the diagnostic criteria for the older model. The old model is no longer tenable not because it identifies individuals with a totally different disorder; the old model is no longer tenable because it does not adequately capture the wide breadth, complexity and persistence of this syndrome as it is found across the lifespan. (Chap. 2, pp. 39–40).

#### **14. ADHD is a problem that occurs mainly in males and rarely in females.**

On average, about three boys are diagnosed with ADHD for every one girl. This higher rate of ADHD among boys may be due to greater likelihood of behaviors that disturb teachers and parents during childhood and adolescence, prompting more referrals. Among adults, the ratio obtained in epidemiological studies is 1.6 males for every 1 female. In clinics providing assessment for ADHD in adults, the ratio of males to females tends to be more equal. ADHD is neither rare nor insignificant among females. Girls identified with ADHD in childhood or adolescence have been found to suffer from ADHD impairments fully comparable to those found among boys. It is not yet known whether the prevalence ratio will change if epidemiological studies of ADHD employ a model similar to that described in Chapter 2 for studying both genders at various ages. Since the new model is focused primarily upon cognitive impairments rather than on disruptive behavior, it seems likely that the ratio of males to females will be found to be more equal. Some rating scale studies of executive function impairments in adults have shown little significant difference between overall scores for the two genders (Chap. 2, pp. 40–43).

#### **15. If a person with ADHD is hyperactive and impulsive during childhood, they are likely to continue that way into adulthood.**

Many individuals with ADHD never manifest excessive levels of hyperactivity or impulsivity in childhood or beyond. Among those with ADHD who do tend to be more “hyper” and impulsive in childhood, a substantial percentage tends to outgrow those symptoms by middle childhood or early adolescence. However, symptoms of impairments in focusing and sustaining attention, organizing

and getting started on tasks, managing emotions, utilizing working memory, etc. tend to persist and often become more problematic as the individual with ADHD gets into adolescence and adulthood (Chap. 3, pp. 47–48, 52–53).

**16. ADHD-related executive function impairments are due primarily to a “chemical imbalance” in the brain.**

The term “chemical imbalance in the brain” is often used to explain impairments of ADHD. This suggests that there are chemicals floating around in the cerebral spinal fluid that surrounds the brain that are simply not in correct proportions, as though there were too much salt in the soup. This assumption is simply wrong. Impairments of ADHD are not due to a global excess or lack of a specific chemical within or around the brain. The primary problem is related to chemicals manufactured, released, and then reloaded at the level of synapses, the trillions of infinitesimal junctions between certain networks of neurons that manage critical activities within the brain’s management system. The brain is essentially a huge electrical system that has multiple subsystems that need to communicate with one another constantly to get anything done. This system operates on low voltage electrical impulses that carry messages from one tiny neuron to another in fractions of a second. However, these neurons are not physically connected; there are gaps at each point of connection. To get messages from one neuron to another, an electrical message needs to jump the gap. Arrival of the electrical impulse causes tiny “micro-dots” of a neurotransmitter chemical to be released. This works like a spark plug to carry the message across the gap and further down the circuit. Persons with ADHD tend not to release enough of these essential chemicals, or to release and reload them too quickly, before an adequate connection has been made. Medications used to treat ADHD help to improve this process (Chap. 5, pp. 99–104).

**17. There is no real evidence of significant differences in brain development and functioning in those with executive function impairments of ADHD compared to those without ADHD.**

Modern imaging techniques have provided a lot of evidence of differences between persons with ADHD and those who do not have ADHD in their processes of brain development and functioning. These include evidence that while most aspects of brain maturation in children with ADHD are identical to typically developing children, there are several specific areas of brain that tend to take three to five years longer to mature in the brains of most children

with ADHD; those specific areas of brain are especially important for age-appropriate executive functions. Other areas of difference include thickness of cortical tissue, global reductions of gray matter, atypical development of white matter connections across various regions of the brain, less efficient communication over white matter circuits linking various brain regions, and differences in rates of oscillations critical for linking communication from one region of brain to another. There is also evidence of differences between persons with ADHD and those without in their ability to suppress and sustain suppression of default-mode oscillations when necessary to facilitate sustained attention (Chap. 3, pp. 63–70).

**18. For some individuals with ADHD, prescribed medications can cure their ADHD impairments so they do not need to keep taking the medication.**

Medications for ADHD cure nothing. They are not like antibiotics that may cure an infection if the medication is taken consistently for a few days or weeks. ADHD medications are more like eyeglasses that may improve or even normalize a person's vision while the glasses are worn, but the eyeglasses cannot fix the problem with the person's eyes. When the eyeglasses are taken off, the person's vision returns to whatever it was previously. Most medications for ADHD currently available last for somewhere between 2 and 12 hours, then they gradually stop being helpful. Some persons who take medications for ADHD find that there is a point where they no longer need to take that medication; they are able to function reasonably well without it. Sometimes this is due to increased development of their brain as they get older; the processes of natural maturation that were a bit slower in them than for their contemporaries eventually kick in. In other cases such an improvement may be due to some change in the situation, a new teacher who is more supportive, a new job that is not as demanding of executive functions as the previous job, or added sources of support. Such improvements without medication may be temporary or quite long-lasting (Chap. 5, pp. 104–113).

**19. Most countries outside the U.S. do not have many persons with ADHD; this is primarily a problem in the U.S.**

For many years it was assumed that ADHD was a problem unique to the U.S. because the estimated incidence in other countries was much lower. Subsequently it became clear that most of the reported differences were based upon different diagnostic criteria being used in many other countries. More

recent studies comparing estimates based on similar diagnostic criteria indicate somewhat lower, but roughly similar prevalence rates in many countries with widely differing cultures and economic strata. A meta-analysis of 102 studies involving 171,000 children from all regions of the world yielded a pooled estimate of 5.29% for children 18 years or younger. Thus far there are few studies outside the U.S. estimating prevalence of ADHD among adults; many countries outside North America do not yet recognize ADHD in adults as a legitimate disorder, but this is gradually changing. Within the U.S., current estimates of ADHD incidence rates based on DSM-IV criteria are about 9% for children and adolescents; for adults estimated incidence is about 4.4% (Chap. 2, pp. 38–43).

**20. Stimulant medications used to treat ADHD-related executive functions are highly addictive and carry considerable risk of dangerous cardiovascular problems.**

Stimulants are the most widely used medications for treatment of ADHD; some types have been available since the late 1930s, others since the late 1950s. Newer versions tend to be essentially these same active ingredients formulated in more modern delivery systems. There is an extensive body of research on use of these medications for treatment of ADHD. Stimulants are classified as Schedule II medications in the U.S., similar to pain medications. This is because, if taken in excessive quantities or otherwise misused, they can be addictive. However, the incidence of addiction to stimulant medications for ADHD is extremely low, so long as the medications are taken orally, not by injection, and are used as prescribed, even over many years. Large studies of children and adults with ADHD taking stimulants compared with others of similar age have shown that the rate of serious adverse cardiovascular events such as severe hypertension, heart attacks or strokes is no greater among those treated with stimulants than in the general public of the same age without such treatment (Chap. 5, pp. 116–120).

**21. The dose and timing of medications used to treat executive function impairment are quite similar for persons of similar age and body mass.**

Although some medications can be appropriately prescribed in doses directly related to the patient's age, weight, or severity of symptoms, this is not true for stimulants used to treat ADHD. Fine-tuning of dose and timing of stimulants for ADHD is very important because the most effective dose depends on how

sensitive the particular patient's body is to that specific medication. Usually that needs to be determined by trial and error, starting with a very low dose and gradually tapering up until an effective dose is found, significant adverse effects occur, or the maximum recommended dose is reached. Often the dose needs to be higher in the morning and gradually tapered over the course of the day, but sometimes exactly the opposite dosing pattern works better. Some adolescents and adults need smaller doses than what is usually prescribed for young children and some young children need much larger doses than most of their peers. Some of the non-stimulant medications for ADHD are prescribed according to weight because they operate in a different way (Chap. 5, pp. 101–104).

**22. There is no evidence that medications for ADHD actually improve executive function impairments or that any improvements last.**

There are three different types of evidence that demonstrate the effectiveness of specific medications for ADHD improving impaired executive functions. First, imaging studies have shown that stimulants improve, and may normalize, the ability of individuals with ADHD to get activated for assigned tasks, to minimize distractibility while doing tasks, to improve functional connections between various regions of brain involved in executive functions, to improve working memory performance, to reduce boredom during task performance, and, in some cases, to normalize some structural abnormalities in specific brain regions of those with ADHD (Chap. 5, pp. 104–106).

Second, experiments comparing performance of children with ADHD with matched controls or when on placebo in comparison to prescribed medication have shown that when on appropriate medication, children with ADHD tend to minimize inappropriate classroom behavior and control their behavior more like typical children in their class. Experiments have also shown that medication can help those with ADHD to improve their speed and accuracy in solving arithmetic problems; they increase their willingness to persist in trying to solve frustrating problems; they improve their working memory, and increase their motivation to perform and execute more adequately a wide variety of tasks associated with executive functions. These results do not mean that all children on such medications display these results, but group data demonstrate statistically significant improvements. However, it should be noted that these results are found only during the time the medication is actually active in the person's body (Chap. 5, pp. 106–108).

Third, a very large number of clinical trials comparing the effectiveness of ADHD medications versus placebo for alleviation of ADHD impairments in both children and adults have demonstrated that these medications (both stimulants and some non-stimulants) produce robust improvements in a large percentage of patients with ADHD. Most of these clinical trials have used DSM-IV diagnostic criteria for ADHD, but some have tested medications against the wider range of ADHD symptoms included in the new model described in Chapter 2. Similar effectiveness results have been shown in symptoms from both old and new models (Chap. 5, pp. 108–111–113).

Despite the fact that the direct effects of medication do not last beyond the duration of the medication's action each day, the improved functioning made possible by the medication has been shown to result in better school classroom and test performance, reduced rates of school dropout, increased rates of graduation and other achievements which can have lasting effects. Medications may also help to support a person's adaptive performance while they await further brain development, enter into employment for which they are better suited, and/or improve their learning of concepts and skills they would otherwise be unlikely to master without the support of medication.

### **23. It is quite risky to administer medications for ADHD problems to preschool-aged children.**

While many children with ADHD do not show significant impairments until they begin elementary school, there are some preschoolers who manifest serious, and sometimes dangerous, behavior problems between the ages of three to six years. Research with children aged three to five and a half years has shown that a majority of children in this age group with moderate to severe ADHD show significant improvement in their ADHD symptoms when treated with stimulant medications. With this younger age group, side effects are slightly more common than is usually seen in older children, though such effects were still minimal. In 2012 the American Academy of Pediatrics recommended that children aged four to five years old with significant ADHD impairments should be treated first with behavior therapy and then, if that is not sufficiently effective within nine months, they should be treated with stimulant medications for ADHD (Chap. 5, pp 110–111).

**24. There is no evidence that medication treatment for ADHD executive function impairments improves learning or academic achievement.**

Longitudinal studies have shown that children with ADHD tend, as a group, to have lower scores for reading achievement, take fewer advanced classes, have increased rates of absenteeism, more grade retention, are rated by their teachers as having poorer performance, and drop out of school before graduation more than do groups of children without ADHD, even when IQ is not included in the analysis. However, children treated with stimulant medication had higher scores for reading and lower rates of absenteeism when compared to students with ADHD who were not treated with medication. Additional factors such as level of parents' education and presence or absence of comorbid disorders also impacted these outcomes. Another large study in a different country showed that teacher-reported inattention problems in the years from kindergarten through age 12 are associated with the highest rates of dropping out of high school before graduation.

Other studies have shown that duration of treatment with medication also affects outcome. Students with ADHD who receive at least a year of medication achieved better scores on nationally standardized tests of reading, writing and math as well as better report card grades than children with ADHD who did not receive at least that minimal duration of treatment. Another study demonstrated that children with ADHD whose medication starts earlier in their school career tend, on average, to score better on national exams than children whose medication for ADHD is not started until later in their school career (Chap. 2, pp. 37–38; Chap. 3, pp. 47–48; Chap. 5, pp. 111–113).

**25. Behavior modification and other psychosocial methods are just as effective for treating executive function impairments of ADHD as are medications.**

Studies of the effectiveness of psychosocial methods such as behavior modification and cognitive-behavioral therapy versus medication alone indicate that medication treatment seems to be the critical ingredient for treating most patients with ADHD. Training parents and teachers of young children with ADHD in operant conditioning techniques has been shown to reduce disruptive behavior and to increase attention to tasks. However, psychosocial interventions have not been shown to produce lasting changes in such problematic behaviors any more than medication alleviates symptoms of ADHD after the dose has worn off. Moreover, behavioral interventions have

not been shown to improve cognitive impairments such as working memory, sustaining focus, or similar higher cognitive functions at the core of the new model of ADHD impairments (Chap. 5, pp. 120–126).

**26. Individuals with ADHD have no more likelihood of having depression, anxiety problems, Obsessive-Compulsive Disorder or other psychiatric problems than anyone else of the same age.**

Several epidemiological studies have demonstrated that children and adults with ADHD have a much greater likelihood of having one or more additional psychiatric and/or learning disorders at some time in their life than do those without ADHD. A meta-analysis of 21 studies showed that the likelihood of anxiety disorders, depressive disorders, or conduct/oppositional disorders among children with ADHD was respectively about 3 times, 5.5 times or 10.7 times in prevalence of those disorders among children with ADHD. Among adults with ADHD, the likelihood of their having one or more additional psychiatric disorders by age 44 years was more than six times greater than the likelihood for adults without ADHD. These elevated rates of comorbid disorders among persons with ADHD may be due partially to genetic factors. However, since executive function impairments of ADHD occur in many other learning and psychiatric disorders, it has been proposed that ADHD may be not just one additional psychiatric disorder. It may be a foundational disorder that underlies most other disorders (Chap. 6, pp. 128–135, 162–164).

**27. Learning disorders like dyslexia, math disorder and disorder of written expression are quite separate from the executive function impairments of ADHD. They require special education, not medication treatments.**

Specific learning disorders such as dyslexia, math disorder, and disorder of written expression have been seen as totally separate from ADHD for decades. More recent research has demonstrated that impairments of executive function associated with the new model of ADHD play an important role in each of the primary learning disorders and that children with ADHD tend to have a greatly increased likelihood of one or more learning disorders relative to students without ADHD. Impairments of ability to focus and sustain attention, to engage with the task, and to utilize working memory are critical elements of being able to read, do math, and give written expression to thoughts. Many students with ADHD have chronic difficulties with one or more of these three basic domains of learning and academic work. For some, their executive

function impairments combine with impairments of specific learning abilities to cause difficulties severe enough to warrant diagnosis of a specific learning disorder (Chap. 6, pp. 136–140).

**28. Most children with ADHD also have behavior problems of Oppositional Defiant Disorder which usually leads to the more severe delinquent behaviors of Conduct Disorder.**

Among children with ADHD, reported incidence of Oppositional Defiant Disorder ranges from 40% to 70%; these higher rates are usually for persons with the combined type of ADHD rather than the inattentive type. This disorder is characterized by chronic problems with negativistic, disobedient, defiant and/or hostile behavior toward authority figures. It tends to involve difficulties with management of frustration and anger and often involves impulsive negative reactions when frustrated. Typically Oppositional Defiant Disorder onsets at about 12 years and persists for approximately 6 years and then gradually remits. More than 70% of children diagnosed with this disorder never go on to meet diagnostic criteria for Conduct Disorder, a diagnosis that reflects much more severe behavior problems and seriously delinquent activities (Chap. 6, pp. 146–148).

**29. Obsessive-Compulsive Disorder is rarely associated with ADHD.**

Recent research has shifted understanding of Obsessive-Compulsive Disorder from the long-held notion of its being an anxiety disorder toward recognizing this as a disorder which involves primarily impairment of the ability to inhibit or “put the lid on” thoughts or actions that are intrusive, irrational and/or “magical” and cause considerable distress to the affected person. Affected persons tend to get “stuck” in focusing upon specific worries or patterns of action and have great difficulty in letting go of that preoccupation so they can move on to other concerns; they have considerable difficulty in keeping the broader picture, the context, of the situation in mind. In clinical samples of children and adolescents seeking treatment for Obsessive-Compulsive Disorder, 26% to 59% were found to have ADHD (Chap. 6, pp. 148–152).

**30. Recent research has identified a gene that causes executive function problems in persons with ADHD.**

Despite extensive exploration of the genome and the high heritability rate of ADHD, no single gene or genes have been identified as a cause of the syndrome of impairments known as ADHD. Recent research has identified two different groupings that together are associated with, though not definitively causal of, ADHD. This combination of some common variant genes and a group of deletions or duplications of multiple rare variants offers some promise of further progress in the search for genetic factors contributing to ADHD. However, at this point, the complexity of the disorder is likely to be associated only with multiple genes, each of which, in itself, has only a small effect upon development of ADHD (Chap. 3, pp. 72–76).

**31. If a child or adolescent with ADHD is treated with stimulant medications, they are being put at increased risk of developing a substance use disorder.**

There is strong evidence that a child with ADHD, in comparison with peers, has more than double the likelihood of developing a substance use disorder at some point in their adolescent or early adult years. This does not mean that all individuals with ADHD will eventually have a substance use disorder. Rather, it means that those with ADHD are at much greater risk. The substances most commonly abused are cigarettes, marijuana and alcohol. These elevated risks of substance use disorder seem to be related to both genetic vulnerabilities and to chronic frustrations and social pressures resulting from trying to cope with the demands of schooling while struggling with untreated or inadequately treated executive function problems of ADHD. Effective treatment of ADHD with appropriate medication tends to reduce the risk of substance use disorder during adolescence (Chap. 6, pp. 152–157).

**32. An individual with an Autistic Spectrum Disorder should not be diagnosed with ADHD and vice versa. These are completely separate disorders which require totally different treatments.**

While diagnostic criteria for ADHD in DSM-IV stipulated that a diagnosis of ADHD should not be made for persons diagnosed with Autistic or Pervasive Developmental Disorders, this requirement has been challenged by multiple clinical and some epidemiological studies. Research has demonstrated that many individuals with ADHD also have significant traits related to Autistic

Spectrum Disorders and that many persons diagnosed with disorders on the Autistic Spectrum also meet diagnostic criteria for ADHD. Studies have also shown that ADHD medications can be helpful in alleviating ADHD impairments in individuals on the Autistic Spectrum. Moreover, ADHD medications can also help those on the Autistic Spectrum with ADHD to improve on some of their impairments in social interactions, social perspective taking, and other related problematic characteristics (Chap. 6, pp. 157–162).

### **33. Problems with lack of adequate sleep often cause impairments of ADHD-related executive functions.**

Significant lack of adequate sleep tends to reduce the effective functioning of anyone with or without ADHD. However, the chronic executive function impairments of ADHD are not caused by inadequate sleep. For most affected persons, problems in regulating sleep and awakening are a significant and often impairing aspect of ADHD. Research has shown that a majority of children, adolescents and adults with ADHD tend to have chronic difficulty in getting to sleep at an adequate time, in getting themselves awake and started in morning routines, and in sustaining adequate levels of alertness during the day, especially when they are not physically moving or talking a lot (Chap. 3, pp. 51–52).

### **34. ADHD impairments sometimes last into early adulthood, but then they usually diminish before middle age.**

Impairments of ADHD are determined not solely by the individual's symptoms, but by discrepancies between the demands of daily life facing the individual and their capacity to meet them. A business or professional person with ADHD might function very well in their daily life if they are fortunate enough to have a job that fits their talents, and co-workers, a secretary or others, who are able and willing to take care of functions that are difficult for the person with ADHD. Yet, if that adult is transferred to a different job where there are increased demands and insufficient support, their ADHD impairments may become much more conspicuous and problematic. Likewise, if an adult with ADHD is living with a partner who is able and willing to carry much of the responsibility of planning and preparing meals, managing finances, and attending to household routines, that person with ADHD may live comfortably and contribute to the household in other ways. However, if the help and support of that other person is lost due to illness, separation, divorce or death, the person with ADHD may suddenly be faced with multiple problems that are very difficult to cope with.

While many individuals find their ADHD impairments becoming less problematic as they get older, due to maturation of the brain or changing environmental demands, there are many for whom significant impairment persists well into their adult years. Research has shown that many individuals with ADHD find their functional impairments persist well into middle age and often beyond. In addition, bodily changes may cause late onset of ADHD-like impairments, e.g. for women during and after menopause, and for both men and women as their bodies age. Extension of ADHD impairments into middle and later years of life has not yet been adequately studied (Chap. 2, pp. 43–45; 52–55).

### **35. ADHD is just one of many psychiatric disorders.**

Although ADHD is one of many different disorders listed in the diagnostic manual for psychiatry, it differs from many others in that it cross-cuts many other disorders. The executive function impairments which constitute ADHD as it is conceptualized in the new model described in this book underlie many other disorders as well. Many other learning and psychiatric disorders could be compared to problems with specific computer software packages which, when not working well, interfere just with write text, making slides, or doing book-keeping. In this new model, ADHD might be compared instead to a problem in the operating system of the computer which is likely to interfere with effective operation of a wide variety of different programs and functions (Chap. 6, pp. 162–164).