

SECOND EDITION

RESILIENCE

The Science of
Mastering
Life's Greatest
Challenges



STEVEN SOUTHWICK
& DENNIS CHARNEY

Resilience

“Professors Southwick and Charney have nailed it. After serving for over 30 years as a SEAL leader, I see resilience as the one thing you never think of or learn about until you need it the most: then it becomes one of the most important things you wish you could master. Who we are is defined not only by what we achieve, but also by how we handle life’s curveballs. Every parent, coach, and organizational leader should read this now, and pass it on to those they care about the most.”

Rear Admiral Navy SEAL Scott Moore (retired)

“*Resilience: The Science of Mastering Life's Greatest Challenges* is a book for our time. At some point, all of us have to deal with stress and anxiety. Drs Southwick and Charney review the science, much of which has been conducted by them, that will enable all of us to not only get through tough times, but to also get stronger.”

Steven Hyman, Harvard University Distinguished Professor of Stem Cell and Regenerative Biology and Former Director of the National Institute of Mental Health

“How thrilling to read top-flight research that is both inspiring and pragmatic! Charney and Southwick are seasoned guides on the path to resilience. Their hopeful news is that each of us can build resilience in ourselves and across our communities. Our brains are wired for it.”

Jerry White, Professor of Practice, University of Virginia,
author of *Getting Up When Life Knocks You Down*

“*Resilience* is one of the most impactful books I’ve ever read in my life. It gave me a more informed understanding of my own life experiences and an even deeper appreciation for the ability to overcome adversity. This book was both personal and relatable: as my own resilience has not only been the difference between success and failure, but it has also been the difference between life and death. Thank you Dennis and Steven for the years of study it took to write this book.”

Curtis Martin – NFL Pro Football Hall of Famer 2012

“This special book is for everybody. We all face adversity in our lives. The authors, who are world-renowned experts, provide a roadmap for resilience and well-being in the face of both physical and emotional challenges. They do this through inspiring stories of incredible people and the latest science. This book has my highest recommendation.”

Deepak Chopra MD

Resilience

The Science of Mastering Life's Greatest Challenges

SECOND EDITION

Steven M. Southwick

Yale University School of Medicine

Dennis S. Charney

Icahn School of Medicine at Mount Sinai



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

79 Anson Road, #06–04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781108441667

DOI: [10.1017/9781108349246](https://doi.org/10.1017/9781108349246)

© Steven M. Southwick and Dennis S. Charney 2018

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published by Cambridge University Press 2012

Second edition Cambridge University Press 2018

Printed in the United States of America by Sheridan Books, Inc.

A catalog record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data

Names: Southwick, Steven M., author. | Charney, Dennis S., author.

Title: Resilience : the science of mastering life's greatest challenges / Steven Southwick, Yale University School of Medicine, Dennis Charney, Mt. Sinai School of Medicine.

Description: Second edition. | Cambridge, United Kingdom ; New York, NY : Cambridge University Press, 2018. | Includes bibliographical references and index.

Identifiers: LCCN 2017061573 | ISBN 9781108441667 (alk. paper)

Subjects: LCSH: Resilience (Personality trait) | Adaptability (Psychology)

Classification: LCC BF698.35.R47 S68 2018 | DDC 155.2/4–dc23

LC record available at <https://lcn.loc.gov/2017061573>

ISBN 978-1-108-44166-7 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

.....

Every effort has been made in preparing this book to provide accurate and up-to-date information that is in accord with accepted standards and practice at the time of publication. Although case histories are drawn from actual cases, every effort has been made to disguise the identities of the individuals involved. Nevertheless, the authors, editors, and publishers can make no warranties that the information contained herein is totally free from error, not least because clinical standards are constantly changing through research and regulation. The authors, editors, and publishers therefore disclaim all liability for direct or consequential damages resulting from the use of material contained in this book. Readers are strongly advised to pay careful attention to information provided by the manufacturer of any drugs or equipment that they plan to use.

Contents

<i>Preface</i>	<i>page vii</i>
<i>Acknowledgments</i>	<i>viii</i>
1 What Is Resilience?	1
2 Optimism: Belief in a Brighter Future	35
3 Facing Fear: An Adaptive Response	63
4 Moral Compass, Ethics, and Altruism: Doing What Is Right	85
5 Religion and Spirituality: Drawing on Faith	110
6 Social Support: Learning the Tap Code	136
7 Role Models: Providing the Road Map	158
8 Training: Physical Fitness and Strengthening	175
9 Brain Fitness: Challenge Your Mind and Heart	199
10 Cognitive and Emotional Flexibility	226
11 Meaning, Purpose, and Growth	251
12 The Practice of Resilience	268
Appendix 1: Further Information About Posttraumatic Stress Disorder	295
Appendix 2: Community Resilience	300
<i>Index</i>	<i>314</i>

Preface

The cover image of this book is taken from a painting by the great American artist Winslow Homer. *The Life Line*, painted in 1884, depicts an unconscious woman being rescued from a shipwreck by a courageous man during a treacherous storm. Homer's painting is a portrait of resilience complete with adversity, stoicism, and profound courage. The viewer's eye is drawn to the center of the painting where a red wind-blown scarf obscures the face of the rescuer. By choosing to keep the rescuer anonymous, Homer presents an act of selfless heroism: where the act, and not the actor, seems most important. In the authors' experience, veterans, first responders, firefighters, and police officers often adopt a similar stance. They don't like to be called heroes. They believe that their acts of bravery are simply part of their job and are directed toward someone in need and not toward honor and praise for themselves.

But resilience is not reserved for soldiers or first responders. Most of us are far sturdier than we know. Even though we may never be called upon to rescue someone at sea, we will be challenged again and again during our lives, and – like the anonymous rescuer – we can choose to step up and squarely face adversity with heart and soul.

Further Reading

Khan Academy. Homer, *The Life Line* (video). A conversation with Kahn Academy's Dr. Beth Harris and Dr. Steven Zucker. Accessed February 2, 2018 at www.khanacademy.org/humanities/art-americas/us-art-19c/realism-us/v/winslow-homer-the-life-line-1884

Acknowledgments

This book would not have been possible without the generous contributions of the many inspiring individuals who granted us permission to interview them and share portions of those interviews with our readers. These courageous men and women told us about extremely painful and trying experiences in their lives. Talking with us in depth about these experiences was extraordinarily difficult, but they chose to speak so that their stories and their insights might help others. Their stories and their advice make up the heart and soul of this book. It has been an honor and a privilege for us to interview and learn from these remarkable individuals. They have become our role models just as we hope they will become yours. They have taught us to look for light at the end of the tunnel; to view adversity as an opportunity for growth and wisdom; to live by our own highest moral and ethical standards; to foster strong personal relationships in which we both give and receive support; to rigorously train our physical, emotional, cognitive, and spiritual selves; and to assume responsibility for our own growth and resilience. They have shown us how to seek the very best in ourselves, and they have taught us that we are each far stronger and more resilient than we think.

We also wish to thank the editors and writers who helped to shape this book. Specifically, we acknowledge and express thanks to Lisa Berger, who partnered us in our early efforts to write about resilience. Lisa is an outstanding writer and editor. In addition, Cathy Shufro, Kara Baskin, and Marcia Southwick provided expert guidance in writing style and editing. We were also very fortunate to work with Elsa Peterson, who is an extremely talented scholar, writer, and editor. Elsa made enormous contributions to every aspect of the book – research, writing, and editing.

Many of our friends and colleagues helped us as we formulated ideas about resilience. They also reviewed drafts of the book and provided valuable suggestions and edits. We wish to thank Jeanne Stellman and Christina Baker, who reviewed and edited the book. Paul Morrissey, Ron Duman, Eric Jackson, Jo Ann Thorp, Robb Pietrzak, Ann Graber, Catherine Chiles, Brian Iacoviello, Eric Nestler, and Lori Davis provided guidance and edits on specific chapters. We extend special thanks to Bernadette Lowthert for her depth of insight and for her creative approach to conceptualizing, organizing, and integrating all sections of the book.

Finally, we wish to thank the many professionals at Cambridge University Press who edited and published this book.

SMS and DSC



CHAPTER 1

What Is Resilience?

Most of us at some point will be struck by one or more major traumas: violent crime, domestic violence, rape, child abuse, a serious automobile accident, the sudden death of a loved one, a debilitating disease, a natural disaster or war. If you are very lucky, then you have never encountered any of these misfortunes; but most likely you will someday. It is estimated that up to 90 percent of us will experience at least one serious traumatic event during our lives (Norris & Sloane, 2007).

Indeed, since the first edition of this book the authors have experienced traumatic events in their own lives. One of us (Dennis Charney) lost a father and was the victim of a shooting with a shotgun that involved intensive rehabilitation. The other (Steven Southwick) lost both of his parents, helped his brother recover from the amputation of his leg, and is currently dealing with his sister's cancer and his own cancer. Both of us have found the approaches to resilience outlined in this book to be very helpful. We hope you, the readers, do as well. Traumatic events throw our lives into turmoil in unpredictable ways; no two people will respond to them in exactly the same manner. For some, the stress of the event will become chronic, lasting for years. They may undergo a dramatic change in outlook, becoming sullen, demoralized, withdrawn, cynical, and angry. Some will become depressed or develop posttraumatic stress disorder (PTSD). Horrific, intrusive memories and nightmares will haunt them for days, months, or even years, and they will feel unsafe in the world – hypervigilant – as if another serious danger lurks just around the corner. Some will take up drinking or drugs to numb their pain and dull their memories.

Nevertheless, many people will find ways to meet the challenge and continue with purposeful lives. For a period after their ordeal, they may become distressed, but in time they will bounce back and carry on. For some, it will

be almost as if the trauma had never occurred. For others, the distress will persist, but they will find healthy ways to cope. Some survivors will even grow stronger and wiser because of their trauma. These survivors may report that their tragedy has helped them to appreciate life more, to become closer to family and friends, to find greater meaning, and sometimes to embark on a new mission in life. In the words of Elisabeth S. Lukas (1984), a protégée of the neurologist, psychiatrist, and Holocaust survivor Viktor Frankl, “The forces of fate that bear down on man and threaten to break him also have the capacity to ennoble him.”

Resilience After 9/11

On the clear, balmy morning of September 11, 2001, 45-year-old Jimmy Dunne was playing golf in New York’s suburban Westchester County, looking forward to qualifying for the US Mid-Amateur Championship tournament. Along with the other golfers, he was stunned to learn that planes had crashed into the World Trade Center. Dunne’s shock was intensified by the fact that his own company, the financial services firm Sandler O’Neill, was located at Two World Trade Center (the “South Tower”). As details of the damage became available, his fears were confirmed: the plane that struck the South Tower burst into flames on the 78th through 84th floors, trapping hundreds on the floors above (Dwyer *et al.*, 2002). Sandler O’Neill was on the 104th floor.

While Dunne watched television in disbelief, thousands of employees, visitors, police, firefighters, emergency medical personnel, and concerned bystanders were fighting to save lives while they struggled to understand what was happening. One Sandler O’Neill survivor, Karen Fishman, had arrived at her office in the South Tower about 8:45 that morning – moments before the first plane struck the North Tower and sent a massive, blinding ball of flame shooting through the air outside her office window. Shaking, she got up from her desk, stepped out into the hallway, and quickly found herself headed for the stairs with two colleagues who had announced, “We’re getting the hell out of here” (Brooker, 2002, p. 56).

“I don’t know why I left,” Fishman said later. “I don’t know that it was a conscious decision. It was instinct. So much depended on who you saw right at that moment.” Several other Sandler O’Neill employees left, but others stayed in the office and made phone calls assuring family members and business associates that they were all right. Still, the horrors in the neighboring building had everyone so upset that CEO Herman Sandler told his workforce, “Whoever wants to leave can leave.”

Fishman had reached the 64th floor when she heard an announcement that only the North Tower was affected and there was no need to evacuate the South

Tower. But by then the stairwell was crowded, and turning back would have meant going against the tide of people headed down, so she continued.

Fishman was on the 62nd floor at 9:03 when United Airlines Flight 175 crashed into the South Tower. Forty-two stories above her, a Sandler O'Neill assistant was on the phone with her husband – “Oh, my God” were the last words he heard her say. A trader called his wife: “There is smoke everywhere. People are dying all around me” (Brooker, 2002, p. 57).

Survivors described how the building shook and twisted when the plane struck, causing paneling, duct work, and electrical wires to fall out of the walls and ceilings. The lights went out, and the building's sprinkler system activated in some areas, sending cascades of water down the pitch-dark stairwells as people groped their way down. Of course, neither Karen Fishman nor anyone else knew that the building was about to collapse. In a sense this was fortunate, for the evacuation was generally orderly and unhurried – some even commented later that they had paced themselves, aiming to lessen the risk of having to walk down dozens of flights with a sprained ankle (Clark, 2006).

Karen Fishman and another Sandler O'Neill employee, Mark Fitzgibbon, had reached street level and were making their way uptown at 9:59, when the South Tower collapsed. They were far enough away from the burning towers that the surrounding skyscrapers partially obscured their view. Like many who witnessed the event, they had no idea that the entire building was gone; they thought that they were seeing smoke from an explosion or a collapse affecting only the floors above the fire line. Fitzgibbon called to Karen, “Look. The top of our building is gone.” But she didn't look back (Brooker, 2002, p. 57).

A huge wave of ash and dust burst from the ruins and covered the area like a snowfall. Stunned survivors fled by themselves or in groups, some running, some walking purposefully, others wandering as if in a fog. By 10:28, when One World Trade Center and the adjoining Marriott Hotel collapsed, news organizations had begun to report a possible terrorist connection, and other landmark buildings such as the United Nations were evacuated. Not knowing whether further attacks were imminent, New York Mayor Rudy Giuliani ordered the evacuation of lower Manhattan. This released a swelling tide of pedestrians into the streets as people attempted to get home. Transportation was severely crippled: the subway service was suspended, as were the PATH trains connecting Manhattan with New Jersey. Commuter buses stopped running, as all bridges and tunnels connecting Manhattan with the outer boroughs and with New Jersey were closed to non-emergency traffic. One survivor described taking a ferry homeward to New Jersey:

...as we got parallel [to the World Trade Center site] we could look over and see that both towers were gone. It was just a surreal feeling. Disbelief. How could this happen? Of course, at the time we knew nothing about the planes being hijacked, nothing about the Pentagon, nothing about the plane going down in Pennsylvania, or the FAA getting

all planes out of the air. We were completely in the dark. But we could look off to the Trade Center on our right and see that this building I had worked in for 27 years was gone. It was a staggering thought. There was silence. People just couldn't believe it.

(Clark, 2006)

While these events were transpiring, Jimmy Dunne was on the phone, calling first his wife and then a series of friends and associates. He tried repeatedly to reach Chris Quackenbush, his business partner and closest companion; the two had been friends since childhood. And he kept trying to call his boss and mentor Herman Sandler, but could not reach him either. Had Chris and Herman made it out of the South Tower alive? After four or five hours without word on the whereabouts of Chris or Herman, Jimmy began to fear the worst. As painful as it was to imagine, perhaps his best friends and colleagues had been murdered by the terrorists. Perhaps he would never see them again.

Still, like so many others on that chaotic day, Jimmy held out hope and maintained what he referred to as a “we are going to find them” state of mind. As he recalls, “There was a hope that there were people who had gotten out, gotten to a hospital, gotten somewhere and maybe they just couldn't make a phone call.”

His hopes received a massive boost when he was told that a junior trader in the firm had been found.

There was an intern who worked with us. He was terrific. His name was Kevin Williams. After I left the golf course I spoke to his father, who told me they found Kevin. And I was euphoric. I remember physical euphoria when I learned that Kevin was alive. It also meant that if they found Kevin, maybe they would find Chris and Herman and the others. I was euphoric. Absolute joy.

By mid-afternoon, Jimmy learned that surviving employees of his firm were gathering in a small office that Sandler O'Neill maintained in midtown. He decided to take the train into Manhattan and meet with them.

I left for the train station with great hope. But on the way, I received a call that I will never forget as long as I live. It was Kevin's father. He said, “Jimmy, Jimmy, they found Kevin Williams – but not our Kevin Williams.” And I remember physically slouching down, almost collapsing. Fortunately, there was a chair right there. I've never had anything like that happen before.

By the time the train arrived in Manhattan, however, Jimmy was surging with energy. He ran from Grand Central Station, headed toward the midtown office.

And then I remember thinking, as soon as I get there everybody's gonna be looking at me, everybody's gonna be looking for direction from me. I want to set a very different tone, one of total calm. I remember I stopped running and I walked about four blocks before I got to the office.

Under normal circumstances, Jimmy saw himself as somewhat pessimistic. “I'm like the French Foreign Legion: I prepare for the worst and hope for the best.”

But on September 11, coming to terms with the news that the World Trade Center attack had been perpetrated by terrorists whose goal was to kill as many Americans as possible and create a sense of mass hysteria among the living, he remembered something his father had told him decades earlier. Jimmy and his father had been sitting together watching an Army–Notre Dame football game, and Notre Dame was crushing Army 40–7.

That’s when Jimmy’s father turned to him and said, “Now is the time that I would like to be a lineman on the Army squad.”

Jimmy didn’t understand.

Why would anyone want to be on Army? They’re being beaten 40–7! And we liked Notre Dame better than Army. Plus, being a lineman for Army, you’d be outweighed by something like 80 pounds. I can’t think of a less desirable position to be in. So, I asked my father, “Why?” And I remember what he said like it was yesterday: “Because the guy on the other side of the line is gonna find out what I’m made of. I would wreak holy hell on that guy.”

In his own way, after the destruction of September 11, that’s what Jimmy did.

The moment I heard what the terrorists wanted, I decided to do exactly the opposite. Osama Bin Laden wanted us to be afraid. I would show no fear. He wanted us to be pessimistic. I would be incredibly optimistic. He wanted anguish. I would have none of it.

The determination to “show them what I’m made of” served him well in the hours and days after the attacks, as the scope of the catastrophe became clear. As hard as he may have tried to prepare himself to face severe losses, the damage was unimaginable. Of 171 Sandler employees, 66 died (Kroft, 2001). Among them were Jimmy’s close friends and fellow managing partners, Chris Quackenbush and Herman Sandler. In all, the deaths of the firm’s workers left 46 widows and widowers, and 71 children under age 18 who had lost a father or mother. Furthermore, Sandler O’Neill was a small enough firm that its operations had been concentrated in the Two World Trade Center office. All of the company’s paperwork and computer systems were destroyed. As *Fortune* magazine reported, “Every phone number of every person Sandler’s traders had done business with over the years was vaporized” (Brooker, 2002, p. 60). Even more devastating was the loss of corporate memory.

Suddenly Dunne, who previously had shared responsibilities with Quackenbush and Sandler, was thrust into the role of chief executive and decision maker. The firm was so terribly crippled – should he simply dissolve it? If not, how could he possibly guide it to survival? Would an attempt to stay in business merely prolong the agony? How could so many traumatized employees manage to function and conduct business when they were grieving for their lost colleagues?

One of the first crucial decisions Dunne made was to “do right by the families” of those who had died (Nocera, 2006). He personally attended dozens

of funerals and delivered eulogies for many. Despite the financial burden, comprising a third of the firm's working capital, Sandler O'Neill paid the salaries of the deceased employees through December 31, 2001 (McKay, 2002). The company paid bonuses and extended family health-care benefits for five years. In addition, the firm set up a fund for the education of the children who had lost a parent, and it provided five years of psychological counseling for all family members and for surviving employees.

Another of Dunne's crucial decisions was that he would find a way to carry on with business. If the firm failed, it could no longer support his colleagues and their families. Failure would also mean success for the terrorists. Although there were rumors – including a CNBC report – that the firm was closing, Sandler's operations never came to a halt. As much as Dunne felt the profound pain of his colleagues, he knew that the firm's only chance for survival was to rebuild immediately.

Early on we got everyone together and they were in various levels of their pain. I said, "Look, everybody is re-evaluating their lives after 9-11." And I said, "That's fine. You can go ahead and re-evaluate your life. That's OK. And some of you may decide that coming to the city every day and chasing the dollar is not worth it, and that you should work in the post office and teach lacrosse. That's great. Some of you may want to go take a trip around the world. That's fine too. But I can tell you what I am gonna do. I'm gonna put on my Brooks Brothers suit every day and I am gonna come to work, and I am gonna rebuild this firm, and I am gonna pay for these benefits, and I am not gonna give in. That is what I have decided to do. Now for those of you who want to be doing the same thing, we have to be doing it *now*. And those of you who want to re-evaluate things and think differently, I wish you well. Go do it."

By September 17, the day the New York Stock Exchange reopened, the firm was set up in temporary office space donated by Bank of America and prepared to resume trading. Dunne and the other managers saw rebuilding the firm as a moral imperative. They were determined to honor their lost colleagues and make the trades that their colleagues no longer could. Several weeks later, after his first visit to Ground Zero, accompanying a colleague's widow who wished to view the site, Dunne commented to a co-worker, "... if I was determined before, I'm on fire now" (Brooker, 2002, p. 53). As founding partner Tom O'Neill told CBS's *60 Minutes*, "I don't think we appreciated the depth of [the terrorists'] hatred, but I think for every percentage that we might have underestimated them, I think they very much underestimated us" (Kroft, 2001). By the first anniversary of the attack, Sandler had hired 81 new employees and closed 59 deals, including 15 mergers worth \$2.7 billion.

Although immersing himself in work was a healing influence for Dunne in many ways, the emotional toll was still vast. A year after the attacks, Dunne told National Public Radio's Scott Simon, "I'm better when I'm busy, but the very first thing I think about when I wake up in the morning and the very last thing I think about at night are those planes" (Simon, 2002). Then-Chief Operating

Officer Fred D. Price, who had been away at a conference in Seattle on September 11, agreed:

When you are busy and active you don't think about it, but when it's quiet, when you are driving alone, or on weekends when you get up in the morning, that is when I vividly miss [my colleagues]. . . Some days, I feel bad and some days I feel good and I never know why. . . Weekends are tougher, and Sunday is my ugliest day. It's when I've got time on my hands. (Wayne, 2002)

The grief that Jimmy felt was unlike anything that he had experienced. Reflecting on the loss of his lifelong friend Chris Quackenbush and his mentor Herman Sandler, he likened it to the utter despondency that history tells us Thomas Jefferson experienced upon the death of his beloved wife Martha in 1782:

It was absolute grief, the kind of grief that Thomas Jefferson talks about, grief without a point. I felt that kind of grief at Chris's funeral after I spoke, and when I went to see [Herman's widow] Suki Sandler. When other people talk about their grief, sometimes you don't even know what they're talking about. You don't really know what real grief is. Now I think I know. I think I have a sense about absolute grief. Those are the times I just broke down.

Five years later, *New York Times* reporter Joe Nocera interviewed Dunne and noted that "his eyes would well up while his voice would start to crack" when he talked about his partners (Nocera, 2006). Yet, far from being a sign of weakness, Dunne's heartfelt emotion was the driving force in his rescue of the firm. Jimmy Dunne personifies resilience in his unwavering determination to bounce back from the brink of despair, and to grow in the process, becoming a more compassionate, dedicated leader than he had been in the past.

How We Became Interested in Resilience

Our interest in resilience evolved during nearly 20 years of treating and studying trauma survivors who came to us for help with conditions such as depression and PTSD. In our research, we examined the psychological, neurobiological, social, and spiritual impact of having lived through overwhelming traumas such as combat, child abuse, physical and sexual assault, and disasters including the World Trade Center disaster and Hurricane Ike (Charney *et al.*, 1993, 1996; Bremner *et al.*, 1993, 1999; Southwick *et al.*, 2006, 2007; Stellman *et al.*, 2008). We, and many other researchers, discovered alterations in psychological view of self and others, in the brain circuits that respond to frightening situations, and in feelings about one's purpose, meaning and place in the world. These alterations often had profound negative effects on the lives of our patients.

As we worked with traumatized individuals, we often wondered about survivors who seemed to somehow cope effectively with the negative effects of stress, those who did not develop stress-related symptoms, or who, if they developed symptoms, carried on successfully nevertheless. The term “resilient” (meaning having the capacity to bend without breaking, to return to an original shape or condition) described these survivors well. They had been “bent” by their traumatic experiences, but not broken.

Defining Resilience

What is resilience? In the physical sciences, materials and objects are termed resilient if they resume their original shape upon being bent or stretched. In people, resilience refers to the ability to “bounce back” after encountering difficulty. The American Psychological Association defines it as “the process of adapting well in the face of adversity, trauma, tragedy, threats and even significant sources of stress – such as family and relationship problems, serious health problems, or workplace and financial stresses.”¹ In his book *Aging Well*, Harvard University psychologist George Vaillant (2002) describes resilient individuals as resembling “a twig with a fresh, green living core. When twisted out of shape, such a twig bends, but it does not break; instead, it springs back and continues growing” (p. 285).

Resilience is complex, multidimensional and dynamic in nature (Bonanno, 2004, 2005; Carver, 1998; Layne *et al.*, 2007; Luthar *et al.*, 2000; Rutter, 1985). While experts define resilience in a variety of ways (Southwick *et al.*, 2014), a common thread in their definitions is the ability to weather adversity. This does not mean being impervious to adversity – a resilient person may be deeply affected by a traumatic event, and may experience psychological symptoms such as depression, recurrent intrusive memories, or hypervigilance – but it does mean being able to carry on with the important facets of one’s life in spite of painful and distressing symptoms or even full-blown PTSD. In some definitions, resilience also entails the ability to grow from adverse events and find meaning in them.

¹ American Psychological Association Help Center. Accessed October 13, 2017 at <http://www.apa.org/helpcenter/road-resilience.aspx>. It is worth noting that researchers have identified a coping style called hardiness which involves a constellation of personality characteristics associated with high performance under stressful conditions. These characteristics include commitment (the tendency to engage fully in life activities), perceived control (belief in one’s ability to exercise control over life circumstances), and challenge (the tendency to view adversity as a challenge). See, for example: Kobasa (1979), Kobasa *et al.* (1982), Bartone (1999), Maddi (2005), and <http://www.hardiness-resilience.com>

When faced with adversity, people may be more competent in some domains of their lives than in others, and during some, but not all, phases of their lives. For example, an individual may be remarkably sturdy in responding to adversity at work, but not so much in handling family or other interpersonal stresses. Or a person may demonstrate resilience to stress at a young age, but not as he or she grows older. It is important to note that healthy adaptation to stress depends not only on the individual, but also on available resources through family, friends, and a variety of organizations, and on the characteristics of specific cultures and religions, communities, societies, and governments – all of which, in themselves, may be more or less resilient (Southwick *et al.*, 2011).

Researchers have developed various tests to measure resilience; among them are the Connor–Davidson Resilience Scale (Connor & Davidson, 2003) and the Response to Stressful Experiences Scale (Johnson *et al.*, 2008).

These tests are self-report instruments with a five-point Likert scale (strongly agree, agree somewhat, etc.) and include statements such as the following:

- During and after life’s most stressful events, I tend to find opportunity for growth.
- I have at least one close and secure relationship that helps me when I am stressed.
- When there are no clear solutions to my problems, sometimes fate or God can help.
- During and after life’s most stressful events, I tend to calm and comfort myself.

Additional tests of resilience include the Dispositional Resilience Scale-15, which focuses on three dimensions – being fully engaged, having a sense of control over events, and being able to view adversity as a challenge – and the Resiliency Scale for Children and Adolescents, which assesses an array of attributes related to mastery, relatedness, and emotional reactivity (Bartone, 2007; Prince-Embury, 2008).

What Makes Some People Resilient?

When we began our research, we had many questions. Why do some survivors appear relatively unscathed by their trauma, while others develop debilitating disorders such as PTSD, depression and alcohol dependence? (For more information about PTSD, please see [Appendix 1](#).) And why do some survivors who develop trauma-related psychological symptoms continue to function well in spite of their symptoms? Do they differ genetically? Is there something unique about their nervous system? Have they been raised in a special manner? What about their personalities? Do they use

specific coping mechanisms to deal with stress? And if we learn more about how they dealt with stress and trauma, will these lessons be helpful to PTSD patients and to the general public? Can the average person learn to become more resilient?

These were the questions that we asked ourselves as we began to investigate social, biological, psychological, and spiritual factors associated with resilience to stress. And, of course, we also wondered whether these lessons would be helpful to us. Could we, ourselves, learn to become more resilient? We had many unanswered questions.

So, we made a decision to search actively for answers to our questions about resilience. We knew that our task would be daunting, because anyone who has spent time studying human behavior, or investigating the nervous system and brain, understands that thoughts, feelings, and behaviors are the complex products of genetic, biological, psychological, and social forces. Resilience is far more than a simple psychological trait or biological phenomenon. To truly understand it, researchers must approach it from multiple perspectives and examine it through a number of different scientific lenses. We did this by reviewing the available scientific research and popular literature on resilience, by initiating our own psychological and neurobiological research on the topic, and by conducting in-depth interviews with a large number of highly resilient individuals (Southwick *et al.*, 2005).

To conduct these interviews, we needed to step out of our traditional clinical and research settings, and to go into the community and recruit people who had clearly demonstrated resilience in the face of extreme stress. We turned to three groups of highly resilient individuals: former Vietnam prisoners of war (POWs), Special Forces instructors, and civilian men and women who had not only survived enormous stress and trauma, but had somehow endured or even thrived.

We Interviewed Former Vietnam POWs

We began by conducting detailed and lengthy interviews with more than 30 former Vietnam POWs. We chose to study former POWs for several reasons. First, the traumatic experiences they endured were extreme and of long duration; for some, the ordeal lasted for more than 8 years. Second, because their captivity took place decades ago, we could examine how their lives had unfolded over many years after the trauma. Third, we believed that the former POWs were good role models and that their methods of coping with stress and trauma would be highly instructive for anyone facing or recovering from their own stressors.

Most of these former POWs were pilots who were captured when their planes were shot down over North Vietnam. After ejecting from disabled burning fighter jets flying at speeds of greater than 400 miles per hour, they parachuted into the jungle. There they were captured by North Vietnamese.

The North Vietnamese treated American prisoners as war criminals, not as POWs protected by the Geneva Conventions. Often captured Americans were paraded through crowds of hostile villagers before being imprisoned, interrogated, beaten, and tortured. The largest and most infamous facility where POWs were held was Hoa Lo Prison in Hanoi, which the Americans sarcastically nicknamed the “Hanoi Hilton.” Here prisoners were subjected to interrogation techniques like the “rope trick,” in which both arms are tied behind the back and then gradually lifted higher and higher until one or both shoulders are pulled out of their sockets. At other times, guards wrapped a rope around the prisoner’s throat, stretched the rope behind his back, and tied it to his ankles, so that if he relaxed his arched back, he would choke.

POWs were also starved. Typically, they were given meager portions of barely edible food: swamp grass or cabbage soup, a chicken head floating in grease, pumpkin soup, a piece of bread covered with mold, the hoof of a cow, an occasional tiny piece of pig fat, or a handful of rice that might be full of rat feces, weevils, or small stones. Even prisoners in solitary confinement rarely dined alone. Colonel Larry Guarino (1990, p. 45) describes his “dinner guests”:

A new civilian guard brought food, and as he set it down on the far bunk, a horde of hungry ants rushed out from the block mounts of the leg irons and swarmed into the tin plates. . . . While eating, I was startled by two lightening-fast brown rats who darted around the cell and between my feet looking for food . . . I had more visitors. Arriving under the door were two huge scorpions . . . The scorpions came in with raised stingers, but when they sensed my presence, they backed out into the cement channel where the pickings were presumably better . . . Mosquitoes by the hundreds lived under the cement bunks, where it was very damp. I sat swinging my legs and swatting mosquitoes until my hands were swollen. Suddenly, I saw a huge gray-white, web-footed rat poking his head under the door. He was so big he couldn’t get under the door to enter the cell. He sniffed about, showing me inch-long white fangs, then swirled his head under the door, still trying to get in. His tail was over an inch thick! No doubt this rat and his friends were the producers of the huge turds that covered the outside yard. What a disgusting and frightening creature. My heart pounded so, it was difficult for me to breathe, even as I told myself to calm down and take it easy.

In *Glory Denied: The Saga of Vietnam Veteran Jim Thompson, America’s Longest-Held Prisoner of War*, Captain Thompson describes one of his “accommodations”:

I was put into a horizontal cage maybe two feet wide, two feet high, and five feet long. There I was kept for four months, chained hand and feet. The leg irons were a nasty device, a U-bolt with a rusted rod through the back, much too small for American legs. Every time they put the thing on it took a chunk of flesh. This cage sat in the back room of a house in complete darkness. They had a bamboo wall around it so I saw nothing. I was not let out for exercise. For ten minutes a day I could use the latrine and wash up. Then they would stick me back in and put the leg irons back on.

(Philpott, 2002, p. 147)

In this environment, it is not surprising that many POWs developed serious illnesses and were sick during much of their time in prison. They described skin infections, malnutrition, extreme weight loss, open untreated wounds, broken and dislocated bones, dysentery, malaria, depression and symptoms of posttraumatic stress, such as terrifying nightmares. Plagued by dysentery and needing to defecate dozens of times each day, some prisoners became severely dehydrated. Others described boils and skin diseases, where pus and blood attracted jungle flies and mosquitoes, and where maggots thrived.

All of the POWs we interviewed were deeply affected by their prison experience. A substantial number developed trauma-related depression and/or PTSD and experienced difficulty adjusting to civilian life. However, despite their wartime experiences, these former POWs went on to live productive lives after their release. In fact, many of them reported having a greater appreciation of life, closer connections with family, and a newfound sense of meaning and purpose because of their prison experience.

We Interviewed Special Forces Instructors

The second group of people we interviewed were members of the Special Forces (SF). The Special Forces is an elite command within the US Army. The Army selects these soldiers and trains them to be among the hardest, most resilient men and women on the planet. In the world today, there are perhaps no groups that are better conditioned to handle stress than are SF troops and Navy Seals. They benefit from the US Military's constant refinement of its combat and training programs. SF soldiers are rigorously trained to deal with hardship and life-and-death situations. They are intelligent, agile, resourceful, and exceptionally well-prepared for covert missions related to reconnaissance, counter-intelligence, unconventional warfare, and foreign internal defense.

All of the SF members we interviewed were instructors. To become an instructor, one must first serve as an SF soldier. After completing tours of duty stationed around the globe, the instructor's job is to assess and train the next generation of elite soldiers. We chose to interview instructors in order to

learn about their philosophy of training and about the actual principles and techniques they use to enhance resilience. These men had all served as instructors at the rigorous SERE course (Survival, Evasion, Resistance, Escape), which is designed to teach soldiers survival fieldcraft so that they can maneuver in enemy-controlled areas, escape detection, and return unharmed to friendly forces. They participate in a grueling war game with a well-equipped “enemy” while they have no food, water, or weapons. They learn how to live for several days with nothing but a knife and canteen and to overcome food aversions so they can eat snakes, insects, worms, and dead animals. During the last segment of the course, trainees are taken captive and held in a mock POW camp. Here they are stripped of their uniforms and identity, and deprived of food and sleep. As SERE graduates who teach soldiers in this course, the SF instructors are real-life experts in how to cope with high levels of emotional and physical stress; in how to become emotionally and physically stronger.

Retired four-star general Henry Hugh Shelton, former Chairman of the Joint Chiefs of Staff, also talked with us about resilience. Early in his military career, he trained as an Army Ranger and later served as head of the Special Operations Command for all of the Armed Forces. He told us that his Ranger training gave him the tools that he needed to overcome the personal and professional traumas in his adult life.

Special Forces instructor Bruce Norwood described a mission that particularly stood out in his memory. He and his wife were living in Puerto Rico when his beeper went off one night and he was told to drive to his office immediately. Thirty minutes later, he and four team members were on board a Black Hawk helicopter, flying to Venezuela. As they approached their destination, in heavy rain and violent gusts of wind, the pilot directed the chopper’s searchlight to the road below. There they could see scores of people being swept away by the torrential flood waters.

Once the pilot located a cluster of terrified survivors, Norwood and his colleagues slid down a rope while the Black Hawk hovered above. Norwood’s left boot struck a firm but spongy object as he stepped onto the slippery terrain. It was an infant girl who had died in the flood.

We worked for forty straight hours and saved hundreds of people, maybe as many as 1500. Most people don’t know it, but at least 50 percent of our missions are humanitarian. They call us the Peace Corps with guns. Even when we’re on a foreign international defense mission, the SF medics will go out to the front gate and treat whoever shows up. Some poor campesinos bring their dead baby that they carried across the mountains for three days, and they’ve never seen a doctor before. The SF medics will be out there five, six, seven hours a night on their off-time treating the locals. The engineers will go down to the nearest town and see what they can do for the schools, the churches. They’ll put a new roof on. They’ll build a new school, a new church.

We Interviewed Resilient Civilians from Many Walks of Life

The third group we interviewed consisted of civilian men and women who have gone on to lead productive and accomplished lives after experiencing severe psychological traumas, such as congenital medical problems, childhood sexual abuse, death of parents at an early age, abduction and rape, loss of a limb, and cancer.

Eleanor Jensen, for example, lost her parents in an automobile accident when she was eight. Eleanor remembers sitting with her sister on the front porch of their house, waiting to find out where and with whom they would live. After temporary placement with relatives, they were adopted by a childless couple who lived in another region of the country.

Soon Eleanor's new stepfather began to show "special" interest in her and started to touch her. One night, when her stepmother was out of the house, Eleanor's stepfather came into her room and asked her to sit with him.

He started feeling me, French kissing me. And I didn't know what was happening. . . I was still. Dead. A robot.

The situation became chronic.

My stepmother put a lock on my door, a screw and hook, and I could hear him come up the steps and scratch at the door. He would work on the lock with this little ruler until it opened. Then my stepmother tried a slide lock, and he'd work on it until he eventually got in, then a bolt lock, then a twist lock. There were about 4–5 locks on the door. I'd always be afraid to be home alone. One time when the dog got away and ran down the road and I was running after it, he drove in the car after me and told me to get in and I froze. I could not move my muscles. He said, "I'm sorry, I'm sorry, I won't touch you, I promise. Get in the car, I'll take you home." There was always this tension in being alone, and I'd panic.

As a teenager, Eleanor was sent to a boarding school where she was safe. Although the memories of abuse haunted her for years, she was eventually able to forgive her stepfather. Eleanor went on to become a highly respected nurse practitioner and psychotherapist specializing in treating PTSD.

Additional examples of ordinary people who found constructive ways to cope with their trauma include, among others:

- Deborah Gruen, who, despite a serious congenital neurological condition, won bronze medals in swimming in the 2004 and 2008 Paralympics, competed as a member of the Yale University Women's Varsity Swim Team and graduated summa cum laude from Yale with a major in economics,

attended Georgetown University Law School and went on to a career with a prestigious law firm.

- Angela Diaz, who grew up in an impoverished, fragmented family in the Dominican Republic, emigrated to the United States as a teenager, was accepted to Columbia Medical School, became Director of the Adolescent Health Center at Icahn School of Medicine at Mount Sinai, and donated a kidney to a friend's husband.
- Elizabeth Ebaugh, who was kidnapped, raped, and thrown over a bridge into a freezing river only to survive and, over the ensuing years, build a thriving clinical social work practice that focuses on holistic approaches to helping survivors of trauma and tragedy.
- Jerry White, who lost his leg to a landmine while hiking in Israel as a college student, and then slipped into depression. Years later he co-founded Landmine Survivors Network and played a leading role in the International Campaign to Ban Landmines coalition, which was awarded the Nobel Peace Prize in 1997.

What We Found: Ten Resilience Factors

During our interviews, we kept hearing a number of recurrent themes. Although their circumstances differed greatly, the resilient people we interviewed tended to use the same or similar coping strategies when confronted with high levels of stress. By conducting a detailed analysis of the interviews, we identified ten coping mechanisms that proved to be effective for dealing with stress and trauma. Throughout the book, we refer to these coping mechanisms as “resilience factors.” In response to stress, all of the individuals we interviewed confronted their fears, maintained an optimistic but realistic outlook, sought and accepted social support, and imitated sturdy role models. Most also relied upon their own inner moral compass, turned to religious or spiritual practices, and found a way to accept that which they could not change. Many attended to their health and well-being, and trained intensively to stay physically fit, mentally sharp, and emotionally strong. And most were active problem solvers who looked for meaning and opportunity in the midst of adversity and sometimes even found humor in the darkness. Finally, all of the resilient people we interviewed accepted, to an impressive degree, responsibility for their own emotional well-being, and many used their traumatic experiences as a platform for personal growth.

We recognize that this list of what we call “resilience factors” (i.e. realistic optimism, facing fear, moral compass, religion and spirituality,

social support, resilient role models, physical fitness, brain fitness, cognitive and emotional flexibility, and meaning and purpose) is by no means definitive or complete and that other factors certainly contribute to stress hardiness. We focus on the above-mentioned resilience factors because they were the ones most often described as crucial, and sometimes even life-saving, for the individuals we interviewed. In upcoming chapters, we will discuss each of these factors in greater detail.

Most of us will never become a prisoner of war or step on a landmine, but we will inevitably face our own stressors, traumas, and tragedies. Today, for example, many people throughout the world face prolonged unemployment, financial distress, poverty, homelessness, separation from loved ones, medical and mental illness, and a host of other challenges. Fortunately, to withstand, overcome, and grow from these experiences, we don't need to have superior genes, take a "tough as nails" approach to life, or train with the Special Forces. But we do need to prepare ourselves, for life has a way of surprising us with adversity when we least expect it. As journalist Diane L. Coutu learned from her research on resilience for a *Harvard Business Review* article, top-level business executives invariably prize resilience in people they seek to hire. One CEO underscored its importance this way: "More than education, more than experience, more than training, a person's level of resilience will determine who succeeds and who fails. That's true in the cancer ward, it's true in the Olympics, and it's true in the boardroom" (Coutu, 2002, p. 47). We know of no better way to learn about tried-and-true methods for becoming more resilient than to listen to, be inspired by, and follow the advice of resilient people who have already "been there."

How Resilient Are We?

Where are we today? How resilient are we as individuals, communities, and societies? In the world today, as throughout history, millions of people who are exposed to stress and trauma respond with extraordinary resilience. Recent inspiring examples include individual, family, community, national and even international responses to tragedies such as the World Trade Center terrorist attack of 9/11; the 2004 Indian Ocean earthquake and tsunami; Hurricane Katrina; the Japan earthquake, tsunami, and resulting nuclear crisis; the Boston Marathon bombing; and the mass shooting at the Pulse nightclub in Orlando.

Despite such impressive displays of strength and hardiness, some social critics point to recent trends in attitudes and behaviors that raise questions about the value that some societies place on building and maintaining resilience.

Consider these lifestyle statistics in the United States:

- 80 percent of American adults don't get the recommended amount of exercise (at least 2.5 hours of moderate-intensity aerobic exercise each week or 1.25 hours of vigorous-intensity activity, or a combination of both; as well as muscle-strengthening activity like weight-lifting or push-ups at least twice per week). About 40 percent of American adults engage in no regular physical exercise, and about half of the 60 percent who do exercise say their exercise is only moderate, as opposed to vigorous (Saad, 2008).
- More than one-third of American adults are obese (body mass index [BMI] 30 or higher), and another third are overweight (BMI 25–29.9) (Ogden *et al.*, 2014). Among children and adolescents, 17 percent are obese (Ogden *et al.*, 2014).
- The 2014 United States Report Card on Physical Activity for Children and Youth gave them a D–. For sedentary behaviors they got a D, spending over 7 hours per day at sedentary activities. A 2003 study found that school physical education classes provide an average of just 25 minutes per week of vigorous activity for third-graders. The study recommended 60 minutes of moderate-to-vigorous physical activity per day, but only one-quarter of youth ages 6–15 met those guidelines.
- Approximately one-third of Americans have abused or been dependent on alcohol at some time in their lives (Hasin *et al.*, 2007).
- For many years, the American Academy of Pediatrics (2001, 2013) has recommended no more than 1–2 hours a day of total entertainment screen time (television, computer, etc.) for children aged 2 and older, and no screen time for children under age 2; but a 2010 Kaiser Family Foundation report found children spending an average of 7.5 hours per day watching television, playing video games, and using computers. Further, that same report found that children and teens said their parents had “no rules” about how much time they spent with electronic devices.
- A 2009 study found that 70 percent of US children have insufficient levels of vitamin D, the “sunshine vitamin,” which we get from being outdoors and which has a protective effect against cardiovascular problems (Kumar *et al.*, 2009).

The lack of resilience is so striking that it has been framed as a national security weakness. In 2009 and 2010, a nonpartisan nonprofit national security organization of retired generals, admirals, and other military leaders released reports titled *Ready, Willing, and Unable to Serve*, and *Too Fat to Fight*, citing a

startling statistic: Approximately 75 percent of Americans age 17 to 24 are no longer eligible to join the military. The three most common reasons for ineligibility are poor physical fitness (e.g., obesity), failure to graduate from high school, and a criminal record. Military leadership is concerned that our country's military readiness will be at risk unless we find a way to increase resilience in American youth.

In his 2003 book *The Progress Paradox: How Life Gets Better While People Feel Worse*, Brookings Institution fellow Gregg Easterbrook points out that while in material terms the Western standard of living has improved greatly in recent decades, our subjective well-being and happiness have declined. Psychologists Jean Twenge and W Keith Campbell address an attitudinal change in *The Narcissism Epidemic: Living in the Age of Entitlement* (2009), pointing to a societal increase in a “me first” attitude, a lack of caring relationships, and a need for attention and material wealth that is somehow never satisfied.

Other authors – Robert Putnam in *Bowling Alone*, Christopher Lasch in *The Culture of Narcissism*, and David Riesman in *The Lonely Crowd*, to name a few – have expressed concern about the lack of social connections and community spirit in today's society. Dutch researcher Geert Hofstede, among other social psychologists, has categorized the United States as a highly individualistic society, where becoming a “self-made” man or woman is more highly valued than contributing to the common good. While this individualistic spirit may have roots extending back to the early days of the American republic, it seems to be enacted in a more literal way today than in the past. According to the US Census Bureau (2006), the proportion of single-person households increased from 17 percent in 1970 to 26 percent in 2005. In 2005, only 1 in 10 of the nation's households contained five or more people, down from 1 in 5 in 1970. The decrease in household size has been accompanied by dwindling membership in service clubs, religious congregations, and workers' organizations. Psychologist Shigehiro Oishi (2010) refers to “duty-free friendships” as a byproduct of our decreased investment in interpersonal relationships. As *New York Times* columnist Roger Cohen wrote in 2010:

Community – a stable job, shared national experience, extended family, labor unions – has vanished or eroded. In its place have come a frenzied individualism, solipsistic screen-gazing, the disembodied pleasures of social networking and the à-la-carte life as defined by 600 TV channels and a gazillion blogs. Feelings of anxiety and inadequacy grow in the lonely chamber of self-absorption and projection.

So how resilient are we? Are we becoming too self-absorbed and too ready to complain about the unfairness of life instead of equipping ourselves to take action to improve our lives and the lives of those around us? Are we adequately preparing ourselves, our families, our children, and our

communities to weather the inevitable storms ahead and to thrive in times of stress and hardship?

Applying the Science of Resilience

In this book, we want to share with readers what we have learned from our interviews and from academic research about resilience. We believe that this book can benefit readers from all walks of life, including those who are currently coping with a trauma and those who have a loved one coping with a trauma; teachers, counselors, therapists, and medical professionals; and anyone who understands the need to prepare for the inevitable stresses and traumas of life.

We have organized the book into chapters focusing on specific resilience factors: facing fear, optimism, social support, and so on. Although these resilience factors overlap and interact with one another, we found it helpful to examine each one separately. The factors are described through the experiences and personal reflections of the highly resilient survivors whom we interviewed. Survivors also describe real-life methods for implementing, practicing, and benefiting from the resilience factors. In addition to providing excerpts and insights from our interviews, we interweave the latest relevant scientific research on the topic. The evidence we cite comes from the fields of psychology, sociology, neurobiology, and medicine. This evidence lends support to the strategies and recommendations for enhancing resilience that our interviewees described. It also helps to demystify the process of physical, cognitive, and emotional strengthening. There is a science behind resilience training, and by learning and practicing what is currently known, people can increase their ability to cope well in the face of stress and adversity.

Resilience and Human Physiology

Since resilience is fundamentally related to the experience and management of stress, throughout this book we refer to various parts of the brain, the nervous system, and the endocrine system: critical components of the stress response. We will discuss the following key brain regions:

- The amygdala, which is associated with fear and alarm; it plays a central role in fear conditioning and in triggering raw emotions and the “fight or flight” response.
- The prefrontal cortex, which is often referred to as the brain’s “executive center,” facilitates planning and rational decision-making; it helps to

- regulate emotions and acts to keep the amygdala (the “fear and alarm center”) in check.
- The hippocampus, which plays a critical role in learning, forming new memories, and regulating the stress response; more so than many other brain structures, it is vulnerable to the effects of chronic stress.
 - The anterior cingulate cortex, which plays an important role in our ability to focus attention, detect and monitor errors and conflicts, assess the importance of emotional and motivational information, and regulate emotions; it is connected both to the prefrontal cortex and the amygdala.
 - The anterior insula, which is located in the fold of the cerebral cortex that marks the boundary between the frontal and temporal lobes; it is involved in functions related to emotions, and aids in the brain’s awareness of the body’s internal physical state.
 - The nucleus accumbens, sometimes referred to as the “pleasure center,” plays a central role in the brain’s reward circuitry; in association with the ventral tegmental area, it mediates the experience of reward and punishment, and is associated with the pleasurable effects of food, sex, and drug abuse.

We occasionally also mention the limbic system. This term refers to the inner portion of the brain – located beneath the cortex – which is involved in emotion, memory, and other functions. It includes the amygdala, hippocampus, and a number of other structures and regions. Although the limbic system is technically neither a system nor a structure, the term provides a useful shorthand for referring to this area of the brain.

In addition to these brain regions, there are several other major systems in the body that respond to stress. One is the autonomic nervous system, which is composed of two parts: the sympathetic nervous system (SNS), which mobilizes the body under conditions of stress; and the parasympathetic nervous system (PNS), which conserves resources and maintains functioning under normal nonstressful conditions. For healthy functioning, it is beneficial for the SNS to have a robust response to stress and challenge, but also for the SNS to return to baseline rapidly after the stressful event is over. Another major system is the hypothalamic–pituitary–adrenal axis (HPA axis), which responds to stress with a complex set of reactions involving the hypothalamus, the pituitary gland, and the adrenal glands.

Throughout the book we will also refer to various hormones and neurotransmitters that are involved in the stress response and resilience (McEwen, 2007; Southwick *et al.*, 2008):

- Cortisol is a stress hormone released through activation of the HPA axis. It produces energy by converting food into fat and glucose (a form of sugar). It also temporarily bolsters the immune system.

- Epinephrine, also known as adrenaline, is part of the SNS. It is released by the adrenal glands under conditions of stress and accelerates heart rate, constricts blood vessels and dilates air passages as part of the SNS fight-or-flight response.
- Norepinephrine, also known as noradrenaline, is also part of the SNS. It facilitates alerting and alarm reactions in the brain and is critical for responding to danger and for remembering emotional and fearful events.
- Serotonin is involved in the regulation of mood, as well as sleep, appetite, and other functions.
- Dopamine is associated with pleasurable feelings and plays a key role in the reward systems of the brain. For this reason, it is an important factor in cravings and addictive behaviors.
- Neuropeptide Y (NPY) is associated with decreasing anxiety and hastening return to baseline after the nervous system reacts to stress.
- Oxytocin is associated with maternal behaviors, pair bonding, social communication, trust, social support, and anxiety reduction.
- Brain-derived neurotrophic factor (BDNF) acts to support the nervous system through the repair of existing neurons and growth of new ones.

Genetics

Genes play a central role in how we respond to stress. In a longitudinal study involving 7,500 adult twins – both identical (monozygotic) and fraternal (dizygotic) – Ananda Amstadter, John Myers, and Kenneth Kendler of Virginia Commonwealth University (2014) assessed resilience and response to stressful life events (SLEs). They found that genes and environmental events each contributed to resilience; in fact, the magnitude of their respective contributions was approximately equal. “Roughly half of the contribution of variation in the latent level of resilience could be accounted for by [events and actions taken by the individual] that had an enduring effect” (p. 278). In addition, mildly stressful experiences (“certain doses of stress” [p. 279]) can have the effect of building resilience, similar to how physical exercise builds muscle.

DNA research is beginning to investigate how variations in our genes affect the way that we respond to stress. Researchers have found preliminary evidence that certain genes are associated with resilience, including genes related to the SNS and to the HPA axis. For example, there is evidence that the SNS response to stress in the form of noradrenaline is influenced by variations of the alpha-2 adrenoreceptor gene. In a study of healthy volunteers, Alex Neumeister and colleagues (2005) found that some individuals inherit a specific variation of

the alpha-2 adrenoreceptor gene (i.e. alpha-2cDel322–325-AR). People with this gene variation, compared with other people, had higher levels of norepinephrine at baseline, a greater increase in norepinephrine and anxiety when stressed, and a slower return of norepinephrine to baseline after termination of stress. The unusually robust activity of norepinephrine, and the slow return to baseline, in individuals with this genetic variation could make them more vulnerable to stress and thus less resilient.

The norepinephrine response to stress may also be affected by variations in the neuropeptide Y gene. In one study, individuals with a particular variation in this gene, a variation that is associated with low production of neuropeptide Y, experienced greater activation of the amygdala and greater anxiety when exposed to threat-related stimuli compared to subjects without this gene variation (Zhou *et al.*, 2008). As noted above, neuropeptide Y is associated with decreasing anxiety and restoring calm after stress. When stress is high, neuropeptide Y is released; this helps to inhibit the further release of norepinephrine so that the SNS does not “overshoot” and instead rapidly returns to baseline.

Israel Liberzon and colleagues at the University of Michigan (Liberzon *et al.*, 2014) reported a pair of longitudinal studies comprising nearly 3,000 subjects that identified a specific gene–environment interaction related to PTSD. Two different variants of a gene called *ADRB2* were found to have different effects on how people responded to and recovered from childhood adversity (physical abuse, sexual abuse, emotional abuse, and witnessing violence between parents). *ADRB2* is a gene for producing the beta-2 adrenergic receptor in the SNS, a major transducer of the fight-or-flight response. People who had inherited one variation of this gene, and who were exposed to childhood adversity, had increased likelihood of developing PTSD after experiencing a trauma in adulthood. Conversely, people who had inherited the other type were more resistant to developing PTSD, displaying greater resilience after exposure to trauma in adulthood, even if their childhood adversity was significantly worse than that of people in the “vulnerable” group. The “resilient” variant of the gene helps to prevent overaction of norepinephrine in the fight-or-flight response, a key component of PTSD.

Continuing in this line of research but focusing on the HPA axis, Laura Watkins and our research team at the National Center for PTSD (2016) assessed more than 1500 military veterans who reported a history of child abuse. They found that variants of a gene called *FKBP5* had similar effects: individuals with the “resilient” variant of this gene were less likely to develop PTSD after a trauma in adulthood, compared to those with the “vulnerable” variant. The *FKBP5* gene is involved in regulating the HPA axis and is related to the rate at which cortisol returns to normal after a stressor. Apparently the “resilient” gene variant helps people to turn down their stress response and recover more quickly after a stressful experience.

In addition to gene variants that affect the SNS and HPA axis, variants affecting the serotonin and dopamine systems have also been investigated in relation to traumatic stress and resilience. Gene variants related to these systems may affect the relative efficiency of the stress response (Mehta *et al.*, 2011; Skelton *et al.*, 2011). In general, an optimal stress response activates rapidly in response to threat, rises high enough to respond appropriately to danger but not so high as to cause incapacitating anxiety and fear, and then deactivates in a timely fashion. Hypoactive or hyperactive neurobiological stress systems tend to be maladaptive (Feder *et al.*, 2009).

It is important to emphasize that resilience to stress and susceptibility to develop PTSD undoubtedly result from complex interactions between multiple genes and multiple environmental factors rather than any single gene variant (Norrholm & Ressler, 2009).

Epigenetics

In recent years researchers have made gains in understanding exactly how the environment influences our genes through the study of epigenetics. A variety of internal and external environmental events (e.g. stress, social support, fears) can trigger biochemical reactions (e.g. methylation) that then turn genes on or turn them off. These processes are dynamic and potentially reversible.

When a gene is “turned on” it directs the making of gene products (e.g. proteins). However, when a gene is “turned off” these gene products are no longer produced. In other words, various stimuli in our internal and external environment can initiate biochemical processes that either activate our genes or silence them.

For example, recent animal studies (Zhang, 2012) have shown that if a mother rat provides only low levels of licking and grooming to her pups – the equivalent of neglectful parenting in the rat world – the pups will exhibit increased susceptibility to stress throughout their lives. On the other hand, attentive maternal care, as reflected by high levels of licking and grooming, can contribute to later stress resilience. The effects of maternal licking and grooming appear to be mediated, in part, by epigenetic changes in gene expression. In research conducted in the laboratory of Michael Meaney, variations in maternal care have been associated with variations in expression of glucocorticoid receptors and hippocampal sensitivity to stress (Zhang, 2012). Similar epigenetic effects of maternal care – and other lifetime experiences – on later vulnerability or resilience to stress are likely to “hold up in humans” (Nestler, 2012).

A variety of environmental events, including stress, social interactions, and drug use, can cause epigenetic changes in gene expression (Dudley, 2011).

Although much remains to be learned, the rapidly expanding field of epigenetics may soon help us to better understand the origins of stress vulnerability and discover ways to manage it (Nestler, 2012). It may also help us to better understand resilience and the mechanisms by which training can enhance factors associated with resilience (e.g. exercise, social support, cognitive reframing). And as noted by psychopharmacologist Steven Stahl (2011), “psychotherapy can now be conceptualized not only by its classic psychodynamic principles, but also indeed as a neurobiological probe capable of inducing epigenetic changes in brain circuits, not unlike the ultimate actions of psychotropic drugs.”

Neuroplasticity

In several chapters of the book, we mention neuroplasticity. Neuroplasticity refers to “the ability of the nervous system to respond to intrinsic or extrinsic stimuli by reorganizing its structure, function and connections” (Cramer *et al.*, 2011). While many of us think of the brain as an organ that remains essentially unchanged during adulthood, neuroscientists have found that brain structure changes from moment to moment, hour to hour, day to day. Brain structure is neither fixed nor static but instead highly plastic, and like muscles in the body, the brain can be strengthened or weakened depending on how it is used. When cells in the brain are actively used, they transmit their messages more efficiently and form more connections with other cells. On the other hand, when brain cells are not stimulated, they die and are pruned away. As with other regions of the body, the well-known adage “use it or lose it” also applies to the brain.

In research dating back to the mid-1990s, neuroscientists have found strong evidence of plastic changes in the brain among professional musicians and others with extensive musical training (Münste, Altenmüller & Jäncke, 2002). For example, Elbert and colleagues (1995) found that in professional players of string instruments (violin, viola, cello, and bass) “the cortical representation of the digits of the left hand (the fingering hand) was larger” than in control subjects, whereas the right hand (which holds the bow and is not involved in fingering) did not display such differences. Studying brain activity in string players as well as keyboard players and nonmusicians, Rüber, Lindenberg, and Schlaug (2015) found differences in the structure of not just gray-matter motor areas, but white-matter fibers that connect brain areas. In string players, these were larger in the right hemisphere (controlling the left hand), but in keyboard players they were larger in both brain hemispheres. Choi *et al.* (2015) studied wind instrument players and found enlargement in areas of the brain responsible for lip movement. Further, the greater the number of years of musical training, the more pronounced were the brain changes.