Danny Wedding
Margaret L. Stuber
(Editors)

Behavior and Medicine

6th edition

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Behavior and Medicine

Dedicated to
my new grandson, Eli James Harrington Bach, with the hope and expectation that we will address the climate crisis in time for him to live his entire life in a world fit for human habitation.
– DW

Dedicated to
my children Ben and Emma, and my husband Larry, my inspiration and support for work in medical education.
– MS

Cover art:
Sparrow by Robert Pope (1989)
Used with permission © Robert Pope Foundation https://robertpopefoundation.com.

Robert Pope was a remarkable Nova Scotia artist who died at age 35 in 1992 from complications arising from his treatment for Hodgkin's disease. Reproductions of several of Pope's paintings are sprinkled throughout *Behavior and Medicine*. The following description of the painting *Sparrow* is taken from his book *Illness and Healing*.

> The view from the window of spring-time trees in first leaf and blossom, the atmosphere of burgeoning life, contrasts with the patient's sense of confinement and immobility. The world outside becomes a dream-like fantasy the patient longs to be a part of. Robert's sketchbook drawings done in Toronto in 1986 introduced the patient and window theme. The window introduces contrasts of interior/exterior, inactive/active, horizontal/vertical, human/animal. Robert also re-invents a theme that is dear to him: an animal giving voice to inexpressible feelings. The bird song suggests things the patient may not be able to see from his restricted vantage point, but can nonetheless hear. It was important for Robert to try to create images of hope as well as documenting all the struggles and challenges a patient faced. This is one of the artist's most hopeful images, as a result, it is also one of the most popular of the cancer series.

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Sixth edition

Editors

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Foreword to the 6th edition

It has been over 40 years since George Engel first proposed the biopsychosocial model of medicine (Engel, 1977). The model sought to expand our thinking to intentionally examine the interplay between biomedical factors with the psychological and socio-environmental. This transformative concept catalyzed a period – still in progress – of cognitive dissonance within medicine, and an ongoing search in medical education for how best to create educational programs that align fully with the biopsychosocial model. Despite much progress, much work remains. Although virtually all medical schools now have robust curricula in patient–physician communication and in core skills in behavioral medicine, these areas of instruction still represent the minority of what's taught in medical school. Further, within the culture of medical education, barriers to acceptance persist. It remains all too common for faculty to refer to such skills as a set of "soft skills," a pejorative that seeks to position these skills as inferior in importance to the "hard" knowledge and skills of biomedicine. Students find their attention to behavioral medicine increasingly distracted by the still heavy focus on biomedical content on the infamous Step 1 of the US Medical Licensing Examination (USMLE). The situation worsens in graduate medical education, where with some rare exceptions precious little time is devoted to these topics, whether in the classroom or at the bedside. In one observational study of inpatient rounds in internal medicine and pediatrics, social and behavioral science topics arose with virtually all patients (97%) yet were recognized or addressed only 38% of the time (Satterfield et al., 2014).

In the past decade, there have been some promising advances, including the publication by the National Academy of Medicine of the report, "Improving Medical Education: Enhancing the Behavioral and Social Science Content of Medical School Curricula" (Institute of Medicine US Committee on Behavioral and Social Sciences in Medical School Curricula, Cuff, P. A, & Vanselow, 2004). This substantive report provides a road map for the integration of behavior and social sciences throughout medical school. Also, the launch of the new Medical Colleges Admissions Test (MCAT) in 2015, with its inclusion of an entirely new section, "Psychological, Social, and Biological Foundations of Behavior," sent a very powerful message to pre-medical students about the importance of these topics in medicine (Association of American Medical Colleges, 2019). Further, it has stimulated many aspiring medical students to take undergraduate coursework in the behavioral and social sciences, which will almost certainly broaden their perspective as they enter medical careers.

With this context as backdrop, it becomes even more vital to have substantive, rigorous resources such as this book to help provide a sound and evidence-based foundation for teaching and learning in this domain. Now in its sixth edition, *Behavior and Medicine* is a tour de force, with a broad and diverse set of topics, all given rich and scholarly treatment. As such, it does justice to the important intersection between health, behavior, and medical care. As medical schools grapple with building or expanding their current emphasis on social and behavioral sciences, this book represents an ideal textbook and reference resource to support teaching, learning, and assessment. By placing a diverse set of topics in one book, it also reinforces the notion of integration, of how seemingly diverse topics and disciplines can be seen as intertwined. Motivational interviewing, for example, is not just a skill to be acquired and practiced, it's an essential strategy in working with patients with addiction. Social inequalities most certainly have ethical implications. Psychodynamic approaches are equally relevant and informative in approaching the intersection of stress and illness for patients as it is for understanding the well-being of trainees and practicing physicians, critical to addressing clinician burnout.

The journey to advance the role of the behavioral and social sciences in medicine and medical education most certainly takes another step forward with the publication of this new edition of *Behavior and Medicine*. It will become a vital resource for educators, a portal for learning for students, and an invaluable reference for practicing clinicians.

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Preface

Behavior and Medicine was first published in 1990. Since that time we have taught – and the book has been used by – tens of thousands of medical students. Some of the early users of the book are now physicians approaching their retirement years. Others who used more recent editions are just now launching their careers. We are confident that many of these readers are better doctors in part because of what they learned from our little book.

The two editors share a passion for convincing medical students that understanding human behavior is absolutely critical to their future practice, and we have been happy and congenial collaborators. We're proud that *Behavior and Medicine* has been used to educate medical students in Canada, Great Britain, Australia, New Zealand, South Africa, Thailand, Portugal, Scandinavia, and dozens of other countries as well as the original target group—medical students preparing to take the United States Medical Licensing Examination (USMLE).

Although the book clearly targets medical students, professors in training programs in nursing, dentistry, public health, social work, and psychology have adopted the book and found its content germane to their students.

All of the sample questions at the end of the book, designed to help students prepare for the Behavioral Science questions on the National Boards, have been updated and revised to reflect the current USMLE format. To help students optimize their learning, we have also added a box titled "Tips for the Step" at the end of each chapter in which the main learning targets are briefly highlighted. The student who reads the book and reviews the sample questions should have little trouble with the Behavioral Science section of the USMLE Step 1 examination. In fact, one of our most gratifying personal rewards as editors and medical educators has been the numerous students who have reported that they "aced" the Behavioral Science section of the USMLE after studying *Behavior and Medicine*.

We have highlighted all **key words, names,** and **phrases** by putting them in bold type, and we have emphasized all the *key concepts* that we think are likely to show up on the USMLE by putting them in italics. Thus, a student who does not have time to read each chapter (and, regrettably, this may include all too many medical students) can still prepare for class examinations and the Behavioral Science portions of the USMLE by reviewing the bold and italicized text.

We have worked hard to make this new edition *clinically relevant*, and almost all chapters include a Case Study illustrating the application of the principles being discussed. Every case draws on the clinical experience of the authors and illustrates how the principles of the chapter can be applied in a clinical setting.

Multiple interlocking themes link each chapter in the sixth edition. One theme is the simultaneous *poignancy and beauty of the transitions of life*. As children we were filled with awe and fascination; later we worked through the turmoil of adolescence; still later we each trembled at the touch of a lover. Some of us will be fortunate enough to grow old with someone we care about deeply. All of us will die. Those students who take time to appreciate the majesty of this unfolding will be better physicians and more effective healers.

A second theme of the book is the *salience of the sense of self*. Every cell in the body changes with age and time, but a continuing awareness of self, a continuity of personal identity, significantly shapes and influences our behavior.

A third theme is reflected in the title of *Behavior and Medicine*. Morbidity and mortality are profoundly affected by how we behave; what we eat, drink, and smoke; whom we choose as our sexual partners; how often we exercise; and whether we take medicines as prescribed. Most people are aware of the factors affecting their

health and yet continue to engage in maladaptive and harmful behavior. Only the most naive health-care provider sees his or her job as simply telling patients how they *should* behave.

A final theme of the book is the *brevity of life and the certainty of death*. The art and poems that illustrate every chapter in the book often portray scenes or descriptions of death. We believe awareness and acceptance of death can make life richer, fuller, and more meaningful.

We have spent our entire professional lives as medical educators and practitioners, and we are grateful to have had careers that allowed us to combine clinical practice with research, writing, grant management, and teaching. However, as we look back on our careers, nothing has been more satisfying than our thousands of interactions with medical students, both in and outside the classroom. We are especially grateful for the many students who have told us that they became better doctors because of the classes we taught and the books we edited.

Resources for teachers, including an instructor's manual, are available via the publisher's website at https://www.hogrefe.com

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One of the pleasures in editing a book is the brief opportunity to thank the many people who contribute to it. We especially appreciate the chapter authors who were patient with our frequent queries and multiple revisions of their work. Every contributor is a seasoned medical educator, and all are prominent authorities in their respective fields.

We benefited tremendously from comments made by our colleagues in the Association of Directors of Medical School Education in Psychiatry (ADMSEP), the Association of Psychologists in Academic Health Centers (APAHC), and the former Association for the Behavioral Sciences and Medical Education (ABSAME). Many of these individuals use *Behavior and Medicine* as a text, and a significant number are chapter authors in the current edition. These colleagues made dozens of helpful suggestions that have been incorporated in this new edition.

Danny worked closely with Sue Edwards in preparation of the chapter on medical ethics. Sue is a world-class ethicist, and she collaborates with Danny in teaching medical ethics to students at the American University of the Caribbean in Sint Maarten. She has been a superb mentor and a cherished friend.

We appreciate the congenial support of Doug Pope and the Robert Pope Foundation. The Foundation helped us identify a series of new paintings we have included throughout the book, as well as the painting we selected for the cover. Other artists whose work has been used as covers for earlier editions of *Behavior and Medicine* include Norman Rockwell, Pablo Picasso, Jose Perez, Edvard Munch and Gustav Klimt.

Rob Dimbleby, our editor at Hogrefe Publishing, has been a wonderful friend and valued collaborator. We truly appreciate his support, good judgment, clear thinking, and consistent good humor. We also appreciate the careful editing of Lisa Bennett at Hogrefe, and her patience with our numerous queries, visions and revisions.

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Contents

Part 1

Mind–Body Interactions in Health and Disease

1 Brain, Mind, and Behavior

Daniel J. Siegel & Madeleine W. Siegel

> To speak, to walk, to seize something by the hand! . . .
> To be this incredible God I am! . . .
> O amazement of things, even the last particle!
> O spirituality of things!
> I too carol the Sun, usher'd or at noon, or as now, setting;
> I too throb to the brain and beauty of the earth . . .
>
> WALT WHITMAN
> Song at Sunset
> *Leaves of Grass*

What does a professional in the art of healing need to know about the science of the brain and the nature of the mind? How does knowledge about the brain and its influence on behavior enrich clinical practice? Why should a practitioner who works to help alleviate the suffering of others invest the time and energy into understanding the brain and behavior when there are so many other details to learn about illness and treatment? The simple answer to each of these questions is that in order to understand how to treat people, we need to understand how patients experience their illness, how they perceive their encounter with you, and their behaviors that may support a path toward healing. At the heart of a person's inner experience and outer behavior is the mind.

One dictionary definition states that the mind is "considered as a subjectively perceived, functional entity, based ultimately upon physical processes but with complex processes of its own: it governs the total organism and its interaction with the environment." The mind is often viewed as synonymous with the psyche, the soul, the spirit, and the intellect. From this perspective, the mind is not distinguished from the "heart," and thoughts are not separated from feelings. In this chapter we will explore the ways in which we can view the mind as the core of a person's evolving identity. The ways in which that person responds in an interview, a diagnostic test, or a discussion about potential illnesses, and his or her specific attitude and approach to treatment are each a function of that person's mind.

One aspect of the mind is a process that regulates the flow of energy and information. Your mind is taking in the information of these words at the moment you read them. You are investing energy in the reading of this

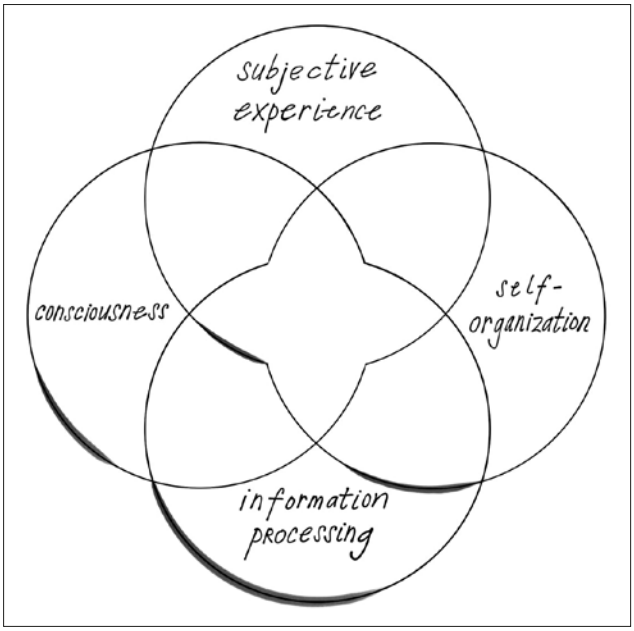


Figure 1.1 Four facets of mind. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

sentence, and the layers of information processing beneath your awareness are making linkages to ideas and facts you've thought of in the past. In fact, most of the flow of energy and information – the essence of our minds – is beneath our awareness. Mental activity, such as feeling and thinking, can enter conscious awareness and subsequently be shared within our own conscious mind and with other people. When the important feelings and thoughts in our nonconscious mental lives remain out of the spotlight of conscious attention, they can still influence our decisions, reactions, and behaviors. This is true whether we are professionals or patients.

In this chapter we'll be offering you a way to think about the mind at the center of human experience that includes subjective experience, consciousness, information processing, and the regulatory process of self-organization (see Figure 1.1). The benefit for you in reading through this chapter will be that you'll gain a new perspective into the minds of others, and perhaps even your own. This skill can be called "**mindsight**" and permits us to see and shape the internal world. Research has now clearly shown that knowing your own mind can help you in many important ways in your work as a clinician. Because of the necessary brevity of this discussion, only major concepts will be highlighted. If you are interested in further reading you may find the works cited in the Suggested Readings to be an excellent way to learn more about this fascinating topic.

> The separation of psychology from the premises of biology is purely artificial, because the human psyche lives in indissoluble union with the body.
>
> C.G. JUNG

Brain and Mind

You can see from the definition given above that the mind has the interesting quality of being "based ultimately upon physical processes" but that it also has "complex processes of its own." The mind is a subjective entity, meaning that we each experience within us the process of mind that may not be wholly available to objective, and especially quantitative, analysis. The reason we need to pay attention to subjective mental life is that objective research shows us that physical health is directly related to mental well-being. The subjective nature of the mind and the mind's well-being are, in fact, some of the most important contributors to physiological well-being. For example, studies have quantitatively proven that *how patients focus their attention during a medical treatment, such as "light therapy" for psoriasis, has a profound impact on the outcome of medical interventions.* People who practice a form of attending to the present moment, called **mindful awareness**, have been shown to have improved immune function, reduced inflammation by alterations in epigenetic regulation, and optimization of telomerase levels that help repair and maintain the ends of chromosomes. Physicians trained in mindful awareness also have diminished stress from their intense medical practices. The focus of attention literally means how you regulate the flow of information – i.e., how you regulate your mind. Our mental life directly affects medical states – such as those of the heart, immune system, and lungs.

You may be wondering how a "subjective entity" such as the mind can affect the physical processes of the cardiovascular system, the regulation of genes, or the activity of the immune system. One way to explore this relationship between mental function and physiology is to take a look at the connection between the information and energy flow of the mind and the physical activity of the brain.

Many disciplines of science are concerned with understanding the mind. One of those fields is the fascinating area of neuroscience, the study of the structure and function of the nervous system. Branches of this field study specific aspects of neural functioning, such as how the activity of the brain is associated with thinking, emotion, attention, social relationships, memory, and even moral decision-making. Taken as a whole, the field of neuroscience has been exploding with new insights into the correlation between the brain's function and internal mental processes affecting the outward expression of behaviors. The numerous and expanding insights into brain-mind correlations have direct relevance for the clinical practitioner.

> Future generations, paying tribute to the medical advances of our time, will say: "Strange that they never seemed to realize that the real causes of ill-health were to be found largely in the mind."
>
> LORD PLATT
> Professor of Medicine, Manchester, UK
> *British Medical Journal*

Neural Activity Correlates With Specific Mental Processes

While science demonstrates correlations between activity in the brain and the subjective experience of the mind – as with emotion, memory, attention, and thought – we can only say at this point that these are associational findings. In other words, *neural activity in one area of the brain at one point in time correlates directly with mental activity of a certain type.* Here's one example: When you look at a picture of, say, the Golden Gate Bridge, we know that the posterior part of your brain, in the occipital lobe of the neocortex, will become active. You may already know that this back part of your brain has been called the **visual cortex** because of this association. We even know that if you *remember* the visual scene of the Golden Gate Bridge, that same area of the cortex will be activated. In fact, remembering anything you've seen will activate that posterior region.

But here's a new finding that puts a slight twist on what we should call that area. It's been known for some time that blind people use the occipital cortex to process what they feel with their fingers, including the raised letters of Braille. A study examined the brain function of people who volunteered to be blindfolded for five days and use only their fingers to feel their way around the controlled environment in which they lived during that period of time. Without the input of their optic nerves during that sightless period, the input from their fingers became dominant in influencing the activity of their occipital lobes, and their occipital lobes were activated whenever they touched something with their fingers.

What does this mean? This study proves that *the brain is an ever-changing, dynamic organ that is extremely responsive to experience*. Also, as this study reveals, the precious information-processing real estate of the brain is open to "the most competitive bidder." In the study just described, the now dominant input from the fingers to sense the spatial world came to be "processed" in the occipital lobe. In fact, some researchers have suggested that the visual cortex be renamed the "spatial cortex." For us, the important issue is that our five senses and where we focus our attention directly shape the neural architecture and function of the brain.

The overly simplistic view that the mind is "just the activity of the brain" can mislead us into reductionistic thinking and unhelpful conclusions. In the example given, our minds can be understood to harness any neural machinery necessary to create a three-dimensional perspective and image of the spatial world. In fact, a range of studies has demonstrated that how we harness the flow of energy and information – how our mind functions with the focus of attention – can directly shape the connections in the brain: "*Where attention goes, neural firing flows, and neural connection grows*" is one way to remember how the mind can change the brain. Some people even believe that the mind "uses the brain" to create whatever it needs. In this chapter, we embrace this open dimension of the associational and bi-directional influence of mind–brain relationships.

Mental Experience Occurs as Neurons Become Active

Mental processes occur when neurons fire. Whenever you think of "experience," try translating that, in part, into the idea of "neural firing in the brain." That is to say, every time you have an experience, there is specific activity occurring in your brain where only certain clusters of neurons are becoming active. The benefit of this thinking is that it helps you understand aspects of how the mind works. The firing of neurons can lead to a cascade of associated firings because the brain is an intricate, interwoven set of web-like neural circuits. Specific regions in the brain are devoted to specific forms of mental processing, such as spatial perception for the occipital regions, as we discussed earlier. Knowing a bit about brain anatomy can therefore inform us about the functional architecture of our mental lives. The more we can understand the underlying structure and function of our internal, mental lives the more we can understand ourselves and patients. In fact, studies of the doctor-patient relationship reveal that such an understanding of others' minds, called **empathy**, is one of the more important factors in determining the extent to which clinicians can help others with their difficulties.

To understand the mind in a deeper way, we are turning toward the brain for scientifically based insights that can build our capacities to be empathically sensitive to the subjective lives of others. Here we are starting with the principle that mental processes emerge as neurons fire in specific areas of the brain. What does **"neural firing"** really mean? Recall that the basic cell of the nervous system is the neuron. This long, spindly cell reaches out to other neurons to connect at a space called the **synapse**. Synaptic junctions are generally at the receiving neurons' **cell body** or its **dendrites**. The electrical current, known as an **action potential**, passing

down the length of the neuron, leads to the release of neurotransmitters from the pre-synaptic neuron to influence the firing of the post-synaptic neuron. Ultimately the summation of the excitatory versus inhibitory transmitters at the synaptic cleft will determine if the downstream (post-synaptic) neuron will in turn send an action potential down its membrane to influence further neural firing.

Here are the numbers that illuminate the fascinating complexity of the whole process*: The average neuron in your brain is connected directly to about ten thousand other neurons, and the estimated twenty to one hundred billion neurons in your brain allow for trillions of connections in a spider-web of soft neural tissue in your skull*. When we add to this the trillions of supportive cells, called glia, that have uncertain but likely contributions to information flow in the brain, then we can see how complex the neural processes are that influence our mental lives.

Head stripped from top to show ventricles and cranial nerves *J. Dryander* (1537). Courtesy of the National Library of Medicine. *Brain size and cranial capacity have not been demonstrated to be meaningfully related to intelligence in humans.*

Neurons That Fire Together, Wire Together

Before this seems too overwhelming, remember that there are several principles that make this intricate anatomy actually quite understandable, interesting, and relevant for clinical practice. One of these is our third general principle: *neurons that fire together, wire together.*

Described long ago, this underlying property of the nervous system has now been explored in great detail. The "linkages" among neurons, the synaptic connections interweaving numerous neurons to one another, is what we mean by the saying that "neurons wire together." The first part of the principle, "Neurons that fire together," means that when we have an experience the brain becomes activated in various regions. When neurons are activated at a given time, the connections among those simultaneously active neurons are strengthened. This is why if you've had an experience (remember, "neural firing patterns activated") say, of hearing a certain song when you've felt very happy, in the future you are likely to have the same feeling (neural firing of joy) when you hear that same song (neural firing in response to the sounds of the music). This is how learning and memory work. Neurons that fire together at one time are more likely to fire together in the future because the synaptic connections that link them together have become strengthened due to the experience.

In fact, it is these synaptic connections that shape the architecture of the brain, making each of us unique. Even identical twins will have subtle differences between their brains that are created by the unique experiences that shape the synaptic connections that directly influence how the mind emerges from the activity of the brain. Our inner mental life – a life of thoughts, feelings, and memories – is directly shaped by how our neurons connect with one another – which in turn has been directly shaped by our own experiences. In addition, our external behavior is directly shaped by the synaptic connections within our skulls. In short, the brain shapes both our minds and our behavior.

The Mind Can Shape the Connections in the Brain

The fascinating relationship between brain and mind goes even deeper than the one-way street of the brain leading to mental activity and behavioral output. A fourth principle reveals the bi-directionality of mental process and neural firing: *the mind shapes the connections in the brain.* Recall that an important aspect of the

mind is the regulation of energy and information flow. Also consider the fact that the mind has "processes of its own," beyond the physical processes of the brain from which it emerges. Researchers have clearly established the mind's power to shape neural firing patterns.

Try this out: think of what you had for dinner last night. Now try to imagine, using visual imagery, what you'll have for dinner tonight. In this simple exercise, you have chosen (with a little suggestion from these words, but ultimately of your own volition) to use your mind in ways that involve aspects of memory and visualization in your occipital region. Now consider this question: did your mind cause your brain to become active in these areas, or did your brain activate first followed by your mind? The force of mental power to activate the brain gives us a profoundly important insight into how our minds can directly shape the physical state of our bodies. In this exercise, the information flowing from these printed words to your eyes directly influenced your mind – the flow of energy and information within you.

It is helpful in life and in clinical work to realize that a person's "mental will" and "intention" are both mental processes that can shape how neurons fire. In turn, how neurons fire shapes how they alter their connections with each other. As those neural connections change, the patterns of the mind – ways of thinking, feeling, and behaving – can change. In other words, the mind directly shapes the physical properties of the brain, which in turn alter how our bodies, including the brain, function. These somatic and neural changes in turn can directly influence how our minds function, and how we feel and how we interact with others. As we'll see, *the mind and the brain are profoundly social.*

One way of envisioning the connections among mind, embodied brain, and interpersonal relationships is to view them within a triangle of energy and information flow (see Figure 1.2). The mind is the regulation of that flow, the brain is the mechanism shaping that flow, and relationships are how we share energy and information flow with one another.

Consciousness Permits Choice and Change

This raises the fifth and final principle for this section*: With consciousness comes the possibility of choice and change.* Neural connections in the brain allow for certain patterns of thinking, feeling, and behaving to be enacted. In the course of normal living, these mental activities are often on "automatic pilot," and are likely shaped largely by the neural connections that then directly influence mental processes. With conscious awareness, however, something new appears to enter this otherwise automatic self-fulfilling brain prophecy. With focal attention – the focusing of awareness onto a process – the power of the mind can be engaged to actually alter old habits of behaving, emotionally responding and thinking. With consciousness there is the possibility to "wake up" and change old patterns. Studies reveal how carefully paying attention may even lead to the secretion of neurochemicals that actually promote **neuroplasticity** – how the brain changes in

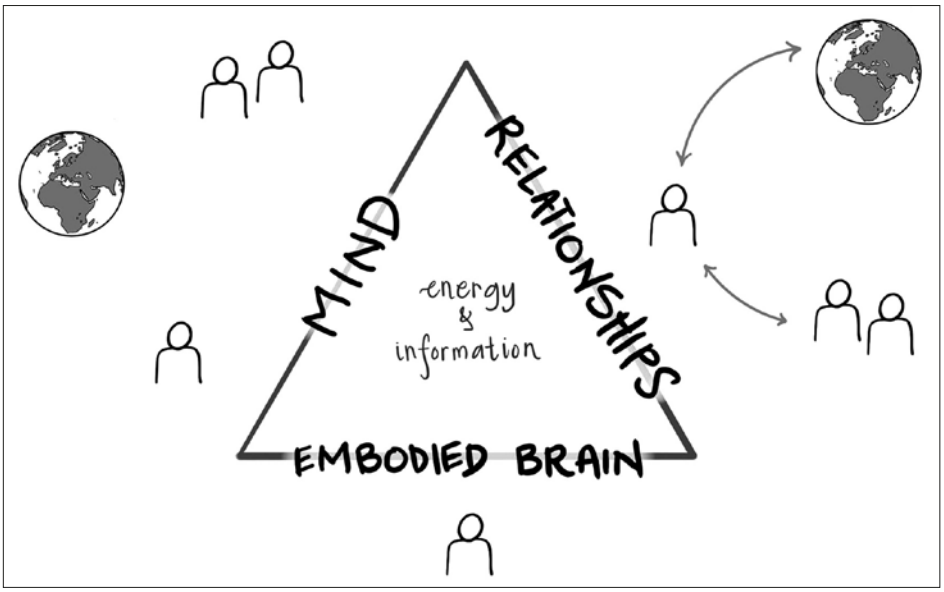


Figure 1.2 A "triangle of human experience" that reveals how energy and information flow is shared in empathic relationships, regulated by a coherent mind, and flows through the neural connections of an integrated "embodied brain" – the brain and its extensive interconnections throughout the embodied nervous system. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

response to experience. With practice in living *intentionally,* these new mentally activated neural firings can create the changed neural wiring that will make these new patterns of mind more likely to occur, even automatically. In other words, what initially required deliberate conscious attention – what is called "focal attention" – to change old patterns can become a new and less energy consuming set of behaviors in the future. Nonfocal attention is how our minds direct information flow outside of awareness. Sometimes our attention is pulled by extraneous stimuli, such as by our smartphones or noises from out in the hallway during a patient visit, and at other times we can guide the focus of attention. This is the essence of new learning and how it becomes embedded in new synaptic linkages in the brain itself (see Figure 1.3 and Figure 1.4). These attentional processes involve distinct networks of attention in the brain.

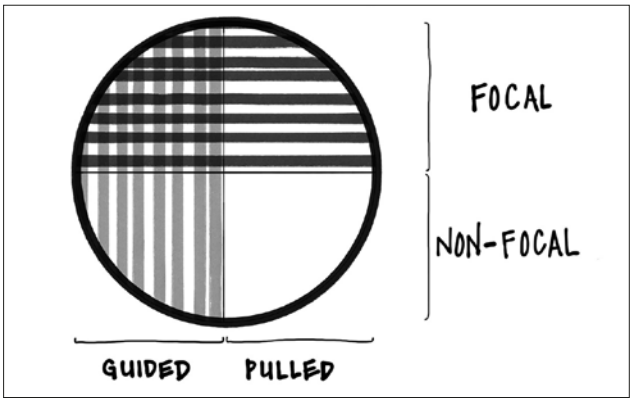


Figure 1.3 Types of attention. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

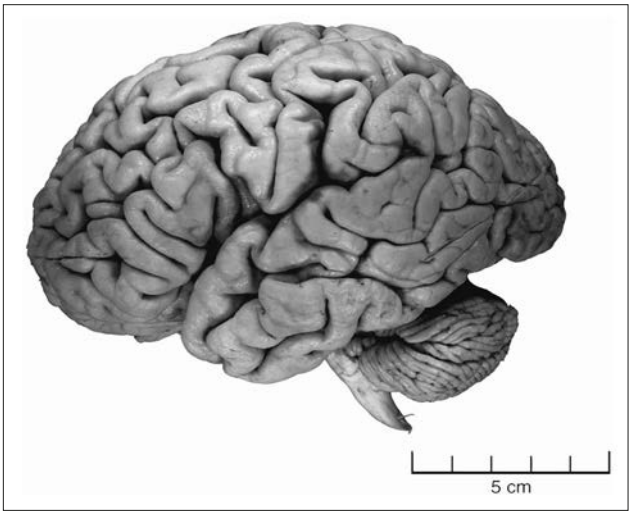


Figure 1.4 The human brain. Courtesy of the University of Wisconsin-Madison Brain Collection (see also www.brainmuseum.org). *Few of us pause to reflect on the majesty of the human brain, or the extent to which it is an integral part of what we call the self.*

Experience and Genes Shape the Brain: Relationships, Culture, and Lifelong Development

As you've seen in our earlier discussion, experience not only involves neural firing, but it also shapes neural connections. This may come as a surprise to many who thought that genes solely dictate the structure of the brain. The fact is that both genes and experience shape the brain's structural properties – the ways that neurons are synaptically connected to each other. About one third of our genes directly determine neural connections, and another one sixth indirectly influence synaptic connections. That's one half of our genome influencing neural architecture. In the womb, genes play a major role in shaping the basic foundation of the brain. Even after birth, genes continue to influence how our neurons link up to one another. However, both the environment in the womb and our experiences after birth influence the synaptic linkages within our brains. When a baby is born, the distinct neural patterns emerging from these pre-birth influences contribute to what is called our innate **temperament**. These constitutional patterns of responding and perceiving can make some of us shy and others outgoing. Some may be quite sensitive to stimuli and become overwhelmed easily, while others thrive with intense sounds and sights.

As we grow, our temperamental features interact with our experiences in shaping the person that we become – what some call our **personality**. One of the earliest types of experiences that shape us is our relationship with our caregivers. Known as **attachment**, these early child–caregiver experiences are thought to directly shape the circuitry of the brain responsible for how a child comes to regulate emotions, govern thoughts, and engage with other people. But while early attachment is extremely important, *the brain proves to be open to change throughout the lifespan*. Understanding the impact of early life experiences on how you grew up has scientifically been proven to be an important aspect of how the mind can "wake up" and *not* repeat unhelpful learned patterns from the past. These attachment studies resulted in two important findings: (1) It is never too late to make sense of one's early life experiences and become the person one may truly want to be and

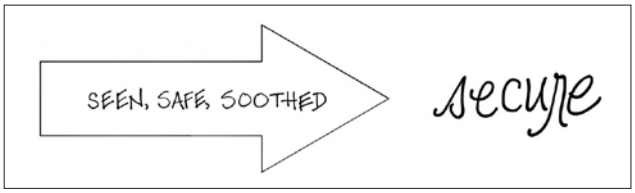


Figure 1.5 The four S's of attachment. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

(2) without such understanding, individuals often live on "automatic pilot" and repeat suboptimal ways of relating to others within their personal and professional lives. In certain ways, the physician–patient relationship may have elements of attachment in which the doctor can "see" the inner life of patients, soothe their distress, and attempt to keep them safe so that they feel a sense of security (see Figure 1.5).

Given that the brain continues to make new connections and possibly even grow new neurons throughout its lifespan, *each of us can use the power of our mind to alter the connections in our brains*. Who we are – what our personality is – can change throughout the lifespan. The experiences we continue to have within the specific culture in which we live can continue to shape how our brains are changing in response to experience. Becoming aware of the impact of these cultural and personal experiences on our continually changing brains can help us understand the ways in which our external environment shapes our internal world and who we are.

Becoming aware of ourselves and waking up means becoming conscious of the power of the mind to make choices that may have previously been considered impossible. Neither our genes nor our early life experiences permanently restrict our minds. The key for clinicians is learning how to teach patients scientifically grounded facts about how central the mind is in shaping its own pathway.

Central Organizing Principles

Self-Regulation

These are powerful ideas that are not easily taken in and understood by either professionals or patients. Fortunately, there are a few central principles that can help organize these ideas about brain, mind, behavior, experience, and physiology. One of these principles has to do with *self-regulation*. In physiology we learn about the process of **homeostasis** and a related response to challenge called **allostasis**, how the body maintains its various systems in balance for optimal functioning. Whether it is the renal system, the cardiovascular system, or the respiratory system, we can examine how homeostasis is maintained to achieve a state of health and well-being. *Whenever a system is stressed, homeostasis is challenged and we have an **allostatic load**.* Some stressors lead to high-energy processes that strive to regain homeostasis; other stressors can lead to overwhelming imbalance and devastation that can cause a massive shutting down of normal functioning and even death resulting from an allostatic load that was beyond recovery.

The brain also functions as a self-regulatory system that achieves balance by using a number of domains of functioning. In the simplest terms, *the brain moves toward neural homeostasis by alternately using internal and external factors.* Internal components of the nervous system would include the synaptic connections in the brain itself, or the level of firing in particular regions. External factors of the nervous system would involve input from the environment, such as altering the signals being received from other people. For example, a newborn who is overwhelmed with stimuli from the external environment will fall asleep in order to maintain balance. In other words, the mind can utilize its different internal and interpersonal capacities to alter its functioning in order to maintain equilibrium in the long-run. *Homeostasis of the body parallels equilibrium of the mind*. The concept of **self-regulation** implies that this equilibrium is achieved by altering internal elements, such as how you think or feel, and external interpersonal elements, such as the people you communicate with during a stressful period. Self-regulation in our lives entails modifying both individual and relational elements to achieve equilibrium in mind, brain, and relationships. Being aware of these important internal and interpersonal factors that can serve as crucial resources of well-being as a medical student progresses into training and then practice can be crucial to avoid the burnout and anxiety that can arise from the everyday stressors of being a physician.

Out of the Balanced Flow: Chaos or Rigidity

Our brain achieves balance by directing the flow of energy and information within its neural firing patterns to optimize functioning. One way to describe this neural equilibrium is to use the metaphor of a river. Each

bank represents the extreme poles of brain balance: one bank is a state of chaos; the other bank is a state of rigidity. Down the middle between rigidity and chaos flows the river of well-being which can be defined as harmony. *In this harmonious state, one is **f**lexible, **a**daptive, **c**oherent, **e**nergized, and **s**table*. Using the acronym **FACES** can be used to remember these five qualities of neural equilibrium and mental well-being.

The neurons encased in the skull achieve equilibrium through a process called **neural integration**. Integration means the linking together of differentiated components into a functional whole. Neural integration is what the brain naturally strives to do. When a brain is integrated, it is able to achieve the most flexible, adaptive, and stable states of functioning, the "FACES" flow of the mind and brain that occurs when information and energy are flowing in a harmonious manner. When the brain cannot achieve such integration, a person can experience states of either chaos or rigidity. The brain may become inflexible, maladaptive, incoherent, depleted of energy, and unstable. You may notice such a stressed neural or mental system in yourself or others by observing how internal mental processes, such as thoughts or feelings, or external behaviors, such as reactions to others, occur in response to the extremes of rigidity or of chaos.

As a general starting point, this central organizing principle of self-regulation emerging from the brain's natural drive toward integration helps us see when the everyday challenges of life become overwhelming and when stress has produced a mental pathway that is rigid or chaotic. As a professional, the river metaphor can help you understand how you, your colleagues, or your patients may be adapting to life's daily challenges to neural homeostasis and mental well-being (see Figure 1.6).

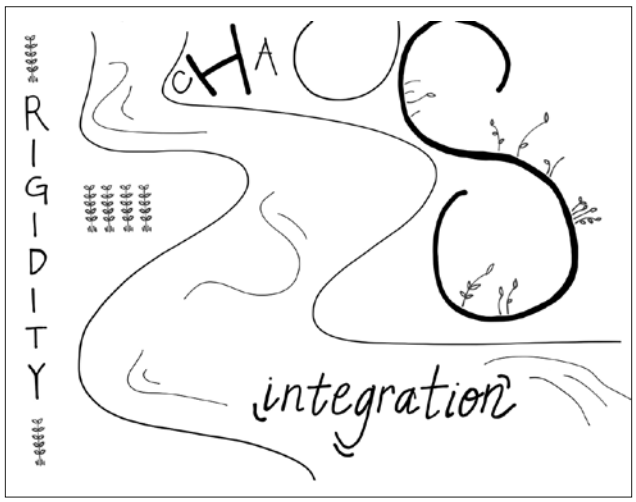


Figure 1.6 River of integration. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

The Brain in the Palm of Your Hand

We've now seen that behavior emanates from the neural firing patterns of the brain and other areas of the body and its nervous system in creating the mind. Mental processes emerge, in part from the firing patterns of particular clusters of neurons. Knowing a bit about these neural regions can be helpful in getting a sense of the relationships between brain and behavior. We've explored the notion that mental well-being and neural equilibrium flow like a harmonious, coherent river with rigidity and chaos on either side. In this flow, however, there are twists and turns as the body attempts to integrate its differentiated components to achieve these pathways. As we explore the different regions of the brain, keep in mind that this neural integration involves how differentiated, specialized areas are brought together as a functional whole. This is what neural integration is – the ways that the brain links disparate areas together as a functional whole. When integration is achieved, equilibrium is possible and that state of a coherent and harmonious mind can occur. When integration is impaired, the mind moves into rigid or chaotic states that are not adaptive.

The Logical Left and Nonverbal Right Hemisphere

One way that we can see the nature of how the overall mental system functions is through examining the emotional state of a person. Emotions involve subjective internal feelings, physiological changes in the body, and often, but not always, nonverbal communication. Nonverbal expressions include eye contact, facial expressions, tone of voice, gestures, posture, timing, and intensity of responses. You can remember these seven nonverbal signals by pointing to your eyes, circling your face, pointing to your voice box, gesturing with your hands, pointing to your body, and then pointing to your watch. Interestingly, *these nonverbal expressions are both sent and received primarily by the nonverbal right hemisphere of your brain*. In contrast, words are most often sent and received by your left hemisphere, the seat of logic and linear thinking. The right hemisphere,

however, appears to be more closely linked to our emotional limbic areas that register autobiographical memory and receive an integrated map of the body, including input from the heart and intestines. *The right hemisphere has a broad focus of attention and takes in the context of a situation while the left hemisphere has a narrower focus of attention, deeply attending to specific details.* For interpersonal communication and self-awareness, we need each hemisphere's important roles – leave one out and the relational connection and self-understanding may be incomplete.

The Subcortical Brainstem and Limbic Regions

In addition to having two halves of the brain that are separated in the cortex and the limbic areas but are connected via the corpus callosum, we also have other important regions of the brain. If you put your thumb in the middle of your palm and fold your fingers over the top, you'll have a pretty handy model of the brain and a useful way to visualize some major brain regions (see Figure 1.7). Your wrist is the representation of the spinal cord coming up your back and connecting to the brain at the base of the skull. The first of three major areas we'll be examining in this model is the **brainstem**, located in the middle of the palm of your hand. The brainstem carries out basic physiological regulation functions, such as heart rhythms and sleep-wake cycles. The brainstem is also responsible for the survival reflexes of fight, flight, freeze, or faint in reaction to threat. The next major region is represented by your thumb and is the **limbic area**. (Ideally, we'd have two thumbs, a left and right limbic area). In this region are the areas of the brain responsible for generating emotion from input of the brainstem and body's organs, motivation, the appraisal of the meaning of experiences, and attachment relationships. Evolved in our mammalian heritage, these limbic areas include the **amygdala**, responsible for the fear response, and the **hippocampus,** which is involved in certain forms of memory.

The Cortex

If you fold your fingers over the limbic thumb area, you'll find the location of the **cortex**, which also developed during our journey into mammalian life. This "outer bark" of the brain is in general responsible for complex representations, such as perception and thinking. In general, the posterior lobes of the cortex carry out perception. The frontal lobes, located from the second-to-last knuckles to your fingertips, represent the

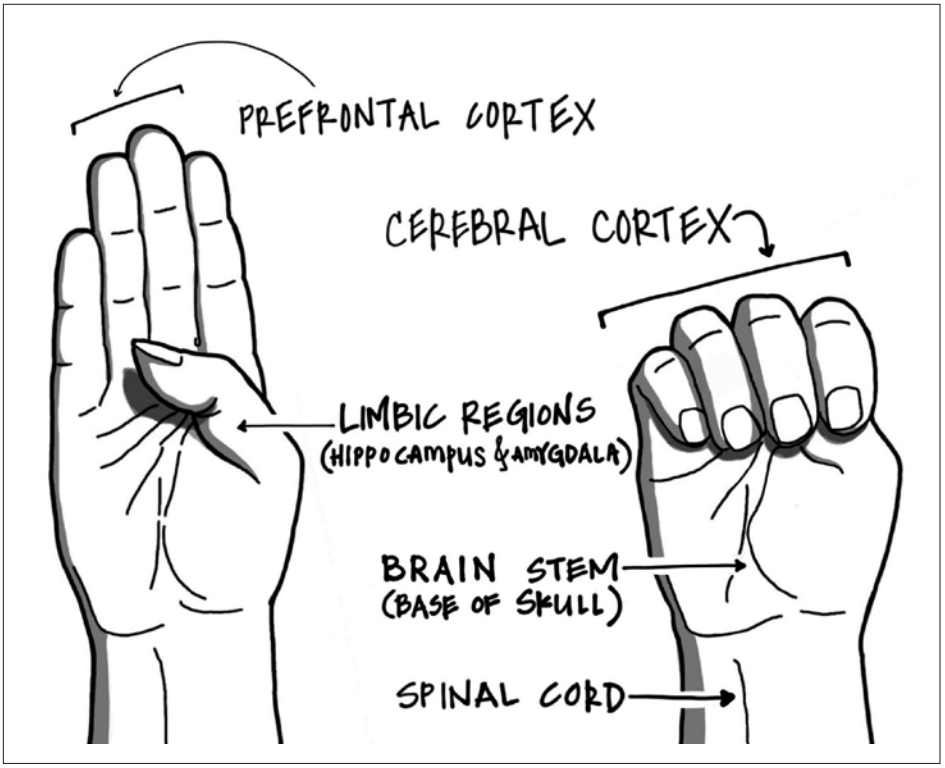


Figure 1.7
Hand model of the brain. Illustration by Madeleine Siegel, © Mind Your Brain, Inc. First published in Siegel (2018).

regions responsible for motor action and planning as well as more complex thinking and reasoning. The front most part of this area is represented from your last knuckles down to your fingernails and is called the prefrontal cortex. As you'll see, the prefrontal cortex is important for many functions relevant for understanding the connections among mind, brain, and behavior.

The Prefrontal Cortex

The prefrontal cortex has many regions that can be divided into two areas: a side part and a middle part. Naturally the whole brain could be divided ultimately into at least one hundred billion parts, the neurons in the brain. But the brain's numerous neurons are clustered into groupings that work together as differentiated regions that carry out specialized functions. As we've seen, the brain strives toward integration of these differentiated areas – an interconnectedness studied as the "**connectome**" of the brain. The prefrontal regions' anatomic location actually makes them quite important in connecting separate areas to each other. The side part, called the **dorsal lateral prefrontal cortex**, is important in creating working memory. Acting like the "chalkboard of the mind," this side region links its activity with other activated areas to create the experience of conscious awareness. When we say, "put [something] in the front of your mind," we are inviting the dorsal lateral prefrontal cortex to link its activity with whatever that something is, whether an abstract thought to a bodily sensation.

The middle part of the prefrontal cortex is also in a unique position to integrate widely separated areas into a functional whole. Take a look at where the middle two fingernail regions rest in your hand-model of the brain. Notice how this middle aspect of the prefrontal cortex "touches everything" just as *this area of the brain links the brainstem, limbic areas, and cortex into a functional whole.* As we'll see below, this area also links the input of the body and the input from the social world, binding together somatic, cerebral and social functions into an integrated process.

The middle parts of the prefrontal cortex consist of the regions called the **orbitofrontal cortex**, located just behind the eyes, the **anterior cingulate**, just behind it, and the **ventrolateral** and **medial prefrontal cortex** behind the forehead to the side and front. Together, these four regions carry out very important integrative functions. Here is a list of nine functions mediated by these middle prefrontal regions extracted from the research literature on the human brain:

1. *Bodily Regulation:* This area regulates the two branches of the autonomic nervous system, and it keeps the sympathetic ("accelerator") and parasympathetic ("brakes") branches in balance.
2. *Attuned Communication:* When we lock eyes with someone and align our own state of mind with another person, this resonant state involves the activation of the middle aspects of the prefrontal cortex.
3. *Emotional Balance:* The lower limbic areas involved in generating emotion are able to achieve enough arousal for creating meaning in life but are kept from becoming excessively aroused and disabling a person's information processing. This is achieved by the inhibitory action of the fibers from the prefrontal regions that extend to the limbic areas such as the amygdala.
4. *Response Flexibility:* Our ability to take in multiple channels of stimuli and pause before acting long enough to choose from a range of adaptive responses is mediated by this region.
5. *Extinction of Fear:* Studies have revealed that the prefrontal region sends **GABA** (the inhibitory neurotransmitter **gamma amino butyric acid**) fibers downward to the fear-generating amygdala to inhibit the amygdala generated fear response.
6. *Empathy:* Putting yourself in the mental perspective of another person, seeing through another's eyes, involves prefrontal activity along with other areas of the brain.
7. *Insight:* Having the capacity to reflect on your past, link it to the present, and anticipate and plan for the future are prefrontal activities.
8. *Morality:* Studies of individuals with damage to the prefrontal region reveal that moral reasoning appears to be processed via the integrative circuitry of this region. When the prefrontal cortex is damaged, people may become amoral, no longer able to consider the larger good for others when thinking through a problem.
9. *Intuition:* The input of our body's organs, such as the physiological state of the intestines and heart, find their way to the middle aspects of the prefrontal region. These organs appear to have neural processors surrounding them that act as a kind of "peripheral brain" in which our gut and heart's responses actually process information about the social and personal worlds. These are the evolutionary first "brains" that came before the brain in our head. Intuition may involve paying attention to these important nonverbal sources of knowledge.

Case example: Neurobiology and Personality

Accounts of a documented brain injury suffered by one Phineas Gage in 1848 when an iron pole was accidentally blasted through his head, irrevocably damaging his prefrontal and orbitofrontal cortex, revealed how the prefrontal regions of the brain play a crucial role in mediating our personality (he miraculously survived this massive injury, but his personality altered). This middle prefrontal region, as we've seen above, also plays an essential role in facilitating our healthy relationships with others – and even with ourselves – as the following case reveals.

Barbara was a forty-year old mother of three who sustained substantial trauma to the area just behind her forehead when her car was hit head-on by a drunk driver; the lesions followed the upper curve of her car's steering wheel. This area is a profoundly integrative region of the brain, linking widely disparate brain regions to each other. The important functions of the middle prefrontal area discussed above – from attuning to others and balancing emotions, having insight and acting morally – were compromised following the accident, subsequent brain surgery, and rehabilitation.

Cortical activity creates neural firing patterns that enable us to form representations – or "maps" – of various aspects of our world. Maps serve to create an image in our minds. For example, when we take in the light reflected from a bird sitting in a tree, our eyes send signals back to our occipital cortex, and the neurons there fire in certain patterns that permit us to have the visual picture of the bird.

The prefrontal cortex, the most damaged part of the frontal lobe of Barbara's brain, makes complex representations that permit us to create concepts in the present, think of experiences in the past, and plan and make images about the future. The prefrontal cortex is also responsible for the neural representations that enable us to make images of the subjective mental life of others and of ourselves. These representations of our mental world can be called "mindsight maps." After Barbara emerged from her coma, her impairments seemed to result in a new personality. Some of her habits, like what she liked to eat and how she would brush her teeth, remained the same. There was nothing significantly changed in how her brain mapped out these basic behavioral functions. But the ways in which she thought, felt, behaved, and interacted with others were profoundlyaltered. Like Phineas Gage, Barbara's personality was changed forever, as the damage was far too extensive for recovery.

Above all, Barbara seemed to have lost the very map-making ability that would enable her to honor the reality and importance of her own or others' subjective inner lives. Her mindsight maps were no longer forming amidst the now jumbled middle prefrontal circuitry upon which they depended for their creation. This middle prefrontal trauma had also disrupted communication between Barbara and her family – she could neither send nor receive the connecting signals enabling her to join minds with the people she had loved most. Barbara had lost the vital capacity for mindsight that would allow her family members to "feel felt" by her, to feel that their minds were inside of Barbara's own mind. While she could still see the objective, outside world well, the inner world of the mind had disappeared from her sense of what existed.

These prefrontal areas damaged after Barbara's accident play a vital role in integrating the various regions of the brain. This important function of neural integration brings together the processing of emotional, social, and bodily inputs in the creation of patterns of perception, thinking, and behavior that we call personality. Neural integration is also what enables us to see one another's minds – and to connect with one another in empathic, caring relationships.

How Presence and Attunement Promote Neural Integration and Well-Being

The nine functions carried out via the integrative fibers of the middle prefrontal regions reveal that our brains are involved in linking together bodily, social, and mental processes into one set of integrated functions. Research suggests that secure parent–child relationships early in life may promote at least the first eight of these listed middle prefrontal functions. Mindful awareness practices, such as mindfulness meditation, also promote many of these same integrative functions. What might loving relationships between parent and child and mindful awareness share in common? With mindful awareness what is created is a state of attending to moment-by-moment experience without being swept up by judgments and reactivity. This is a form of "internal attunement." With empathic relationships, a parallel kind of acceptance but this time directed toward another person, just as he or she is, is part of the "interpersonal attunement" at the heart of secure attachment and healthy relationships in general. A range of research suggests that these inner and interpersonal forms of attunement promote the growth of the integrative fibers of the brain – especially in the prefrontal region as well as in the healthy growth of the corpus

callosum and a more interconnected connectome. At the heart of such integrative internal and interpersonal states is what can simply be called "presence." With mental presence, integration within us and between us is made possible. When working with patients, our own presence helps us to have the empathy and compassion that will help promote this integrative sense of harmony and well-being. And, when relating to yourself as a physician, *learning to be mindful has been shown to help prevent burnout, reduce stress, and increase empathy for patients and self-compassion*. Practicing mindfulness techniques can help you develop more presence and keep your self-regulating and integrating prefrontal circuits well-functioning (see Box 1.1).

Box 1.1 The importance of self-care for primary-care physicians

An important study demonstrated the benefits of mindfulness for primary care physicians. A continuing medical education course was provided for clinicians to improve well-being and decrease burnout. During a period of two months, practicing physicians met once a week to learn mindfulness meditation, reflective communication, and self-awareness skills. During these sessions, the practicing doctors met in small groups to discuss their thoughts and feelings regarding patient care and to reflect on the value of being a clinician. After a 10-month follow-up phase, the clinicians experienced improved attitudes toward their patients and an enhanced sense of well-being.

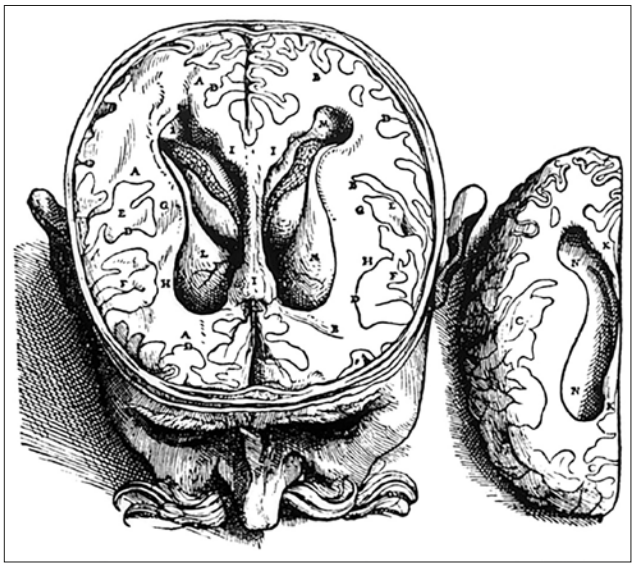
Learning the skills of mindful awareness and the importance of reflection can save clinicians from disabling stress and emotional burnout. Remembering the personal meaning of your clinical profession can also help you maintain a sense of purpose and value in your work. Before caring for others, one must first learn to care for oneself. This study demonstrates the importance of presence, internal attunement, self-awareness, and self-care for the health of practicing physicians.

Repairing Ruptures: The High Road and the Low Road

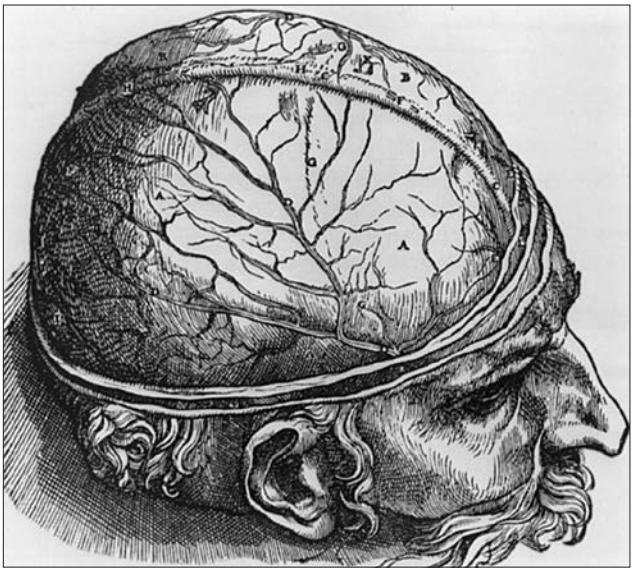
As the case of Barbara above reveals, neurological damage to the middle prefrontal region may result in impairment of a range of the functions. In addition, it appears that under conditions of emotional stress many people may be at risk of moving from this integrated, "higher mode" or high road of functioning in which these nine processes are intact to a nonintegrated, "lower mode" or low road of functioning in which some or all of these processes may be temporarily impaired. You can picture this movement from the high road to the low road in your hand model by taking your hand-brain and lifting up your cortical fingers to expose the thumb-limbic areas. With intense emotion it may be possible to flood the middle prefrontal cortex and temporarily disable the integrative fibers of this region from performing their important functions. In such a lower mode of processing, the brain produces a rigid or chaotic state of mind. This temporary "flipping your lid" can involve any or all of the following: loss of regulation of bodily functions, disconnection from others, emotional imbalance causing rigid shutting down or chaotic flooding, inflexible knee-jerk reflexes instead of adaptive thoughtful responses, loss of empathy for others, lack of insight, return of deep fears, being out of touch with intuition, and amoral behavior.

Temporarily losing our coherent minds when our brains become nonintegrated can be both confusing and frightening to ourselves and to those around us. This can be seen in how we "flip our lids" under conditions of stress and lose the integrative balance and coordination of our middle prefrontal region. Understanding the emotional triggers that activate such low road states can be an important step in making sense of such sudden shifts in an otherwise well-functioning individual. Whether it happens in yourself, your colleagues, or your patients, seeing the human aspect of such common lower mode activities can be an important step in bringing compassion to the experience. Each of us can lose our minds; what is important is to make the repair with others that is necessary to reestablish an open, trusting connection in which we resonate with each other, feeling one another's feelings while not becoming the other person. That's an integrative relationship, honoring differences while promoting compassionate linkages. Such repair re-establishes interpersonal integration and is one of the key ingredients to healthy relationships of all sorts, from friendships or child–parent attachments to the relationship between patient and doctor. *This is how we play our important part in a relationship with presence, attunement, resonance, and trust*.

In addition to repairing relationships that may have been affected by low road experiences, it is also important to try to understand the triggers that may have caused them in the first place. Examining the experiences of the person in the hours and days before the event may be important to establish a background state of mind of the person. Trying to determine the trigger is akin to finding the "straw that broke the camel's back," the final piece of an emotional puzzle that



Horizontal view of the brain exposing the lateral ventricles Woodcut from Andres Vesalius' anatomy text *De humani corporis fabrica* (1543). Courtesy of the National Library of Medicine.



Head with scalp exposed to show dura mater and middle cerebral artery Woodcut from Andres Vesalius' anatomy text *De humani corporis fabrica* (1543). Courtesy of the National Library of Medicine.

destroyed the middle prefrontal area's ability to cope. Often, triggers are related to the context of what was occurring in a person's life and relationships. Feeling frustrated, misunderstood, helpless, threatened or ignored are common emotional states that may trigger low road states. When we are reactive, we may move rapidly into a fight-flight-freeze-or-faint mode mediated by our brainstem's survival reflexes. Even as physicians we may be prone to entering such states under stress. Sometimes these emotional states are related to things from the past stored in various forms of memory. We'll turn in our next chapter (Chapter 2: Memory, Emotion, and Mirror Neurons) to learning about how the brain remembers in order to understand more about brain–behavior relationships.

The Scientifically Established Role of Subjective Experience in Clinical Practice

The Stories of Our Lives

Ultimately the movement toward well-being involves helping patients adapt by integrating the wholeness of their social, mental, and somatic selves. Linking the two halves of the brain and its lower and higher regions to one another is one step in bringing this integrated state of wellness into being. Often we must first start with ourselves in learning what this integrated left-right, up–down connection feels like. One way to feel that sense of wholeness is in helping the stories of our lives become coherent, i.e., making sense of our life experiences.

As the left side of our brains has a drive to use language to tell the linear story of the events of our lives, many authors see the left hemisphere as the narrative drive for our species to tell stories. But when we realize that the autobiographical details of our lives are stored in the right hemisphere along with the affective meaning and texture of our internal and interpersonal lives, then it becomes clear that to tell a coherent and meaningful story of our lives we must come to integrate the left and the right sides of the brain. When we open to all the signals of the subcortical regions and the signals from our body's organs, listening to our heart and gut, we literally "make sense" – open to all our senses – of our lives. This is how we deepen our self-understanding.

In your own life it may be helpful to reflect to yourself, in a journal or with close friends, on how the events of your own life have brought you to where you are now in your life's journey. When you come to understand yourself in this open and coherent way, you may find that nonverbal memories in the form of pictures and bodily sensations in your mind become activated and then sorted through by the linguistic, logical, linear processing of your left hemisphere. As you come to put words to the previously word-less images in your head,