NEURO DHARMA

New Science, Ancient Wisdom, *and* Seven Practices *of the* Highest Happiness

RICK HANSON, PhD

New York Times Bestselling Author of

Hardwiring Happiness, *Buddha's Brain*, and *Resilient*

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First Edition

Part One

EMBODIED PRACTICE

1

MIND IN LIFE

If, by giving up a lesser happiness,
one could experience a greater happiness,
a wise person would renounce the lesser,
to behold the greater.

DHAMMAPADA 290

> 've hiked a lot in the mountains, and sometimes a friend farther up the trail has turned and looked back and encouraged me onward. Such a friendly gesture: *Come join me . . . watch out for the slippery ice . . . you can do it!* I've often thought about those moments while writing this book, which is about the heights of human potential: about being as wise and strong, happy and loving, as any person can ever be. If those heights are like a great mountain, *awakening* is the magnificent journey that carries you along toward the top. Many real people have gone very far up—the great sages and teachers throughout history as well as others no one has heard about—and I imagine them turning with a sweet smile and beckoning us to join them.

Those who have climbed this mountain come from different cultures and have different personalities, but they all seem alike to me in seven ways. They are mindful; they are kind; they live with

contentment and emotional balance through even the hardest times; they are whole and authentic; they are present here and now; they speak of feeling connected with everything; and a light shines through them that does not seem entirely their own.

You might have your own examples of inspiring people you've heard about, or whose words you've read or listened to, or perhaps even met. These individuals are models to us of what is possible. I've known some of them myself. They are down-to-earth, humorous, realistic, and supportive—not the cartoonlike stereotype of exotic characters in caves making cryptic pronouncements. They have no interest in celebrity. Some have taken a spiritual approach, while others have been secular. Their realization is genuine, and it's the result of the *path* they've traveled, not some unique transformation that's unattainable for the rest of us. Through their own example, they demonstrate that wonderful ways of being lie ahead, that accessible paths lead onward, and that much as their own efforts were fruitful, ours can be, too.

And remarkably, you can see some of their qualities already deep down inside yourself, even if they're sometimes covered over by stresses and distractions. These ways of being are not reserved for the few. They are opportunities for all of us—and we'll be exploring how to develop them in these seven practices of awakening:

- steadying the mind
- warming the heart
- resting in fullness
- being wholeness
- receiving nowness
- opening into allness
- finding timelessness

There are many traditions, which are like many routes up the mountain of awakening. Nonetheless, on each of these routes, we find the same steps taken again and again: steps of steadiness, lovingness, fullness, wholeness, nowness, allness, and timelessness. This is some of the most profound and perhaps sacred territory there is. It is ultimately beyond science and logic, so words about it can be loose, metaphorical, and poetic.

The complete development of these seven ways of being marks the pinnacle of human possibility, which could be called enlightenment or full awakening. Meanwhile, even the first simple sense of them is very useful in everyday life. For instance, while dealing with stressful challenges, it's so good to rest in the fullness of feeling *already* peaceful, happy, and loved. And whether it is for the beginning of the path or its end, today we have an unprecedented opportunity to explore a kind of reverse engineering of awakening that is grounded in the living body.

Aiming High

Neuroscience is a young science. Still, we can study the examples of those who have gone far up the mountain and ask: How do you *do* that? What must be happening in your body so that you stay centered when things are falling apart around you? What changes in your brain help you be compassionate and strong when others are hurtful or threatening? What is the underlying neural basis for engaging life without any sense of craving, without any sense of greed, hatred, or delusion?

There aren't yet neurologically definitive answers to these questions. We don't know everything. But we do know more than

nothing, and emerging science can highlight and explain plausibly beneficial practices. And when the science is unclear, we can still use reasonable ideas and methods from modern psychology and the contemplative traditions.

One of the things I find most inspiring about the great teachers throughout history is their invitation for full awakening. The routes they've charted travel from the dusty plains into the foothills and mountains and then highest peaks of enlightenment. Even in the early stages, you can find real benefits for everyday well-being and effectiveness. I'm writing for people like me, "householders" (not monastics) who have limited time for formal practice and need tools they can use right now. While I've been meditating since 1974 and long for the heights, numerous people have gone farther up than I, and you'll see some of them quoted here. My focus is more on the process of practice than on the eventual destination, with the hope that you will find this useful on your own path. Still, the ultimate possibility is the complete liberation of mind and heart, with the highest happiness and most sublime peace.

As we move up the trail, it steepens and the air gets thinner. So it helps to have a guidebook. For this, sometimes I'll turn to the penetrating analysis of the mind offered by the Buddha. My own background is in the Theravadan tradition, which is practiced widely in Southeast Asia and increasingly in the West; it is sometimes called insight- or *vipassana*-oriented practice. This tradition is grounded in the earliest record of the Buddha's teachings, the Pali Canon (Pali is an ancient language related to Sanskrit). I also have deep respect for and much interest in how Buddhism has evolved in its Tibetan, Chinese, Zen, and Pure Land streams.

I'm not trying to present Buddhism as a whole, which is a rich and complex tradition that's evolved over many years. Rather, I'm adapt-

ing and applying key ideas and methods for our practical purposes here. For these and for everything else in this book, I think the Buddha himself had some lovely advice: *Come and see for yourself* what rings true and is useful over time.

A Neurodharma Perspective

The Buddha didn't use an MRI to become enlightened. Many other people have also gone far along their own paths of awakening without advanced technologies. Still, 2,500 years after he walked the dusty roads of northern India, scientists have discovered many things about the body and the brain. The Buddha and others have explored the *mental* factors of suffering and happiness. During the past couple of decades, we've learned a lot about the *neural* basis of these mental factors. To ignore this emerging understanding seems antithetical both to science and to Buddhism.

> The dharma—understanding, peering into the nature of reality—is not specific to Buddhism. The dharma is truth. And the only choice we really have is whether to try to be in relationship with the truth or to live in ignorance.
>
> Rev. Angel Kyodo Williams

When I use the word *dharma*, I simply mean the truth of things. This is both the way things actually are and accurate descriptions of them. Whatever the truth is, it is not the property of any tradition; it's for everyone. *Neurodharma* is the term I use for the truth of the

mind grounded in the truth of the body, particularly its nervous system. Neurodharma is of course not Buddhism as a whole. Nor is it necessary for Buddhist (or any other) practice. I just think it can be helpful. We will use this approach to:

- explore seven ways of being that are the essence of awakening
- learn about their basis in your own brain
- use this understanding to strengthen them in yourself.

Even a little knowledge about your brain can be very useful. It's a goofy metaphor, but I imagine driving a car and suddenly seeing clouds of steam coming out of the front with red lights flashing on the dashboard and needing to pull over and stop. If I don't know anything about what the car is made of and how it works, I'm pretty stuck. But if I know about the radiator and the type of fluid it needs to keep the engine cool, then there are things I can do to get back on the road and prevent this in the future. The car is like the body. Thousands of years ago, no one knew much about it. But today we can draw on the knowledge we've gained over the centuries about our neural "engine."

For starters, this knowledge is motivating: when you know that your practices are actually changing your brain, you're more likely to keep doing them. Really taking your body into account can also draw you into a sense of thankfulness for the physical processes that have led to this moment of consciousness. Understanding what is happening in your brain while experiences are moving through your mind sharpens your mindfulness and fosters insight. You can lighten up about the passing show of consciousness when you recognize that

it's being made by many tiny, swift cellular and molecular processes . . . without any sort of master engineer hiding in the background and continually flipping all the right switches.

In its basic design, we've all got the same brain. A neurodharma perspective offers a common framework for understanding the ideas and tools in clinical psychology, personal development (a broad term for other secular approaches), and the wisdom traditions. It can help us prioritize and use key tools we already have. For example, research on the brain's evolved *negativity bias*—which we'll learn more about in chapter 3—highlights the importance of emotionally positive experiences such as gladness and kindness. A greater understanding of the neural "hardware" can even suggest new approaches to our mental "software," such as neurofeedback. It also helps to individualize practice. When you consider your temperament—perhaps distractible, perhaps anxious—as a perfectly normal variation on the human brain, it's easier to be self-accepting and to find the practices that are most suited to you.

This approach invites us to work backward from important experiences such as feeling happy and content and explore their basis in the brain. We can know ourselves both subjectively and objectively—from the inside out and from the outside in—and neurodharma is where these two meet. At the same time we can respect what we don't know and avoid merely intellectual practice. I try to remember the Buddha's advice to steer clear of the "thicket of views" about theoretical matters, and to focus instead on the practical *how* of ending suffering and finding true happiness here and now.

A Path That Progresses

The seven themes of this book—steadiness of mind, warmth of heart, and so forth—have been explored in many ways by many people in many traditions. They involve experiencing what is out in the open and not hidden: we can be more mindful and loving, we can afford to crave less, we are innately whole, this moment is the only moment there is, and each person exists interdependently with everything else.

These ways of being are accessible to all of us, and their essence is available without years of rigorous training. I'll offer suggestions for how you can have a greater sense of them in everyday life as well as guided meditations that will go deeply into these experiences. You can also weave them into activities you're already doing, such as going for a walk. You don't need a background in science or meditation to develop a greater sense of contentment or kindness, or the other ways of being we'll be exploring. Even ten minutes a day, spread out here and there, can make a difference—if you do the practice, day after day. As with anything, the more you put into it, the more you will get out of it. What gives me both trust and hope is that this is a *path* we can walk step after step through our own efforts, not a magical quick fix.

Unless you're already living on top of the mountain of awakening—and I'm not there myself—there remains something to do. How should we do it?

GOING WHILE BEING

There are two approaches to this question. One emphasizes a *gradual* process that includes reducing unhappiness and growing compassion, insight, and equanimity. The other focuses on recognizing an *innate* perfection in which there is nothing to gain. Both of these approaches are valid, and they support each other. We need to heal and grow, and we can stay in touch with our deep true nature along the way.

In the mind, it takes a while to uncover who we already are. There is a saying: "Gradual cultivation . . . sudden awakening . . . gradual cultivation . . . sudden awakening . . ." As Milarepa, the Tibetan sage, described his life of practice: *In the beginning nothing came, in the middle nothing stayed, and in the end nothing left.* Meanwhile, a sense of your innate wakefulness and goodness is inspiring and encouraging, and it helps you keep going when things are boring or hard.

> On the long, rough road,
> the sun and the moon
> will continue to shine.
>
> THICH NHAT HANH

In the brain, trauma and ordinary neurotic crud are embedded in neural circuitry, which takes time to alter. Developing happiness, emotional intelligence, and a loving heart also requires gradual physical changes. At the same time, when you are not rattled or distressed, your brain settles into its innate resting state. Then it recovers from bursts of activity and releases neurochemicals, such as serotonin and oxytocin, that support a positive mood and kindness

toward others. This is our neuropsychological home base: to be calm, contented, and caring. No matter how disturbed by stress and sorrow, we can always come home.

LETTING BE, LETTING GO, LETTING IN

Developing a greater sense of fullness, wholeness, and other aspects of awakening involves three kinds of practice. First, you can simply *be with* whatever you're experiencing: accepting it, feeling it, perhaps exploring it. As you be with it, your experience may change, but you're not trying to nudge it one way or another. Second, you can *release* what is painful or harmful, such as by easing tension in the body, venting feelings, challenging thoughts that aren't true or helpful, or disengaging from desires that hurt you or others. Third, you can *grow* what is enjoyable or useful: developing virtues and skills, becoming more resilient, grateful, and compassionate. In a nutshell: *let be, let go, let in.* If your mind is like a garden, you can observe it, pull weeds, and plant flowers.

Of these, letting be is most essential. It's where we start, and sometimes it's all we can do: just ride out the storm of fear or anger without making things worse. And as practice matures, increasingly we simply be with the next moment as it arises and passes away and becomes something else. But this is not the whole of practice. We can't only be with the mind, we must work with it as well. For example, most of the Eightfold Path in Buddhism involves letting go and letting in, such as releasing "unwise" speech and replacing it with wise speech. While there are pitfalls in working with the mind, such as getting caught up in "fixing" oneself, there are also pitfalls in *not* working with the mind. For instance, I've known people who are good at observing their own minds . . . and also chronically unhappy

as well as unskillful with others. We shouldn't work with the mind in order to avoid being with it, nor be with the mind to avoid working with it.

Letting be, letting go, and letting in form a natural sequence. Perhaps you recognize that you've gotten resentful about something, and you explore this experience and let it be as it is. At some point it feels natural to shift into deliberately letting go, and you relax your body, help feelings flow, and step back from troublesome thoughts. Then, in the space made by what you've cleared away, you can let in what could be beneficial, such as self-compassion. Over time, the strengths you develop inside yourself will help you let be and let go even more fully. And to explore this further, you might like to try the meditation in the box, which also contains suggestions for doing experiential practices in general.

LET BE, LET GO, LET IN

In this meditation and in the other practices in this book, I'll offer different ways to relate to your experiences and to have ones that could be beneficial. Not all of my suggestions will click for you, and please find approaches that do work for you. For example, you might like to move your body to evoke a particular feeling, or to focus on certain images, or to use words that are different from mine. What's important are the *experiences* we're having, not the methods we use to find our way into them. If it's challenging to have an actual sense of something—such as the feeling of letting go—that is

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very normal. I've had these challenges myself. If you feel frustrated or self-critical, this is normal, too. You can simply acknowledge it to yourself—such as "frustrated with this" or "being self-critical"—and then return to whatever you are practicing.

If it is hard to get in touch with something, just make a note of it and, if you like, come back to it later. It takes time and repetition to experience the ways of being that we'll be exploring—especially their depths. It really is like climbing a mountain. It's slow at times because it's steep! Not because you're doing it "wrong" or because you can't keep making your way up. Please go at your own pace and, as a teacher told me many years ago, keep going.

You could do the practice below as a kind of meditation. You can also do it informally, in the flow of life, when something—I'll call it the "issue"—is stressful or upsetting. Adapt it to your needs, and take as much time as you like.

LET BE

Find something simple that helps you stay present, such as the feeling of breathing. Take some moments to feel increasingly centered. Let sounds and sensations, thoughts and feelings, pass through awareness. Know what it's like to be with experiences without resisting or holding on to them.

When you're ready, focus on the issue, especially your experiences related to it. Be aware of thoughts you have about it . . . emotions related to it . . . perhaps naming them softly to yourself, such as "tightening . . . worry . . . irritation . . . softening . . ." Accept these thoughts and feelings, letting them flow, letting them be . . .

Whether it's pleasant or painful, try to accept your experience as it is. If something is overwhelming, focus on breathing or anything else that is calming and soothing . . . You are still here, you are okay . . .

Be aware of body sensations related to the issue . . . wishes and wants and plans related to it . . . Letting them be, letting them flow . . .

You can explore deeper layers, such as hurt or fear beneath anger . . . younger parts of yourself . . . Feeling it all . . . letting it all be . . .

LET GO

When it feels right, shift into releasing. Be aware of any tension in your body related to the issue, and let it ease and soften and relax. Let feelings flow . . . perhaps imagining them leaving you like a little cloud each time you exhale . . . Recognize any inaccurate, exaggerated, or limiting thoughts, and disengage from them . . . letting go . . .

Be aware of desires related to the issue, such as unrealistic goals or understandable longings that are just not going to be fulfilled . . . and breath after breath, let these go . . . You can also let go of unhelpful ways of speaking or acting . . . Breath after breath, let it go . . . let it all go . . .

LET IN

Then focus on what could be useful, wise, or enjoyable. Perhaps there is a sense of comfort or reassurance that would feel good to open to . . . or gratitude, love, or self-

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conditioned ordinary reality. The chapter on finding timelessness includes all three approaches. This is the deepest practice of all, and you are welcome to engage it in any way you like.

Each of these subjects could be a book of its own. I've focused on what I think are key aspects for personal practice, particularly those for which there's relevant neuroscience, and placed many comments and citations in the reference notes. There's a vast literature about these topics that's full of strong opinions, including about the proper translations of important words. In these chapters you'll see the path I've taken, and you can find other approaches in the notes.

I'm writing from the limited perspective of a middle-aged, middle-class, white American man, and there are many other ways to talk about and practice with this material. I have inevitably left out important approaches to practice, but this does not mean I don't value them. If you recognize points I've written about elsewhere, just skim them or take a fresh look. The first time a key term is used, it's italicized. When you see a non-English word as the source for a quotation—such as Dhammapada or Itivuttaka—it is from the Pali Canon. The chapters conclude with a section called Good Practice, which offers additional suggestions for everyday life; the exception is the last chapter, which is all about applying what you've explored in the days to come.

This book is structured like a retreat, with both presentations of ideas and guided meditations. The ideas are important because they help us understand ourselves better, bringing insights that free us from needless suffering and conflict. This understanding is about deep matters, so it can take time and effort. I first heard many of these teachings more than forty years ago, and they still perplex and fascinate me. I'm still chewing on them.

The meditations are very important, too, and I encourage you to do them. You could read them slowly and take time to get a feeling for them. Or record them in your own voice for yourself, or perhaps listen to me in the audio version of this book. In later meditations, I usually won't repeat basic instructions given in the earlier ones; if you have any difficulty, just look back at the first chapters. The more often you have a beneficial experience and the longer and deeper these experiences are, the more you'll build up the neural substrates of happiness, love, and inner strength.

FURTHER READING

Buddha's Brain (Rick Hanson with Richard Mendius)

The Hidden Lamp (Florence Caplow and Susan Moon, eds.)

Mind in Life (Evan Thompson)

Realizing Awakened Consciousness (Richard P. Boyle)

Reflections on a Mountain Lake (Ani Tenzin Palmo)

As you practice, sometimes you'll be trying to get something going in your own mind—such as a stability of attention—while observing what actually happens. It's normal to struggle occasionally; this is why we must practice. I've seen teachers underestimate their students, and I don't want to do that. I have taken many friends up into the mountains, and the essence is similar: *Check it out, where we're going is pretty amazing . . . here is our route, it's a good one . . . we've got*

to climb it ourselves, we better get moving. Our pace is going to be brisk, but these paths have been walked by many others before you, and you can have confidence that you can walk them yourself. I've been walking them, too—and sometimes falling off!—and I'll share my own bumps and lessons. Occasionally you'll want to slow down and catch your breath, to ponder and reflect and let the view sink in. This is how it's been for me, for sure. That the path is steep in places is part of what tells you it will bring you to wonderful heights.

Along the way, take care of yourself. When you open to the immediacy of this moment of experience, sometimes painful thoughts and feelings can arise. As your practice deepens and the edges soften between you and all things, you might feel disoriented. The more intense and far-reaching the territory you're exploring, the more important it is to be grounded and resourced internally. It's fine to slow down, step back, and focus on whatever feels stable, comforting, and nurturing. Some people are disturbed or distressed by psychological practices such as mindfulness, especially if there are underlying issues with depression, trauma, dissociation, or psychotic processes. Mindfulness, meditation, and the other practices in this book are not appropriate for everyone, not a treatment for any disorder, and not a substitute for professional care.

There is a process here, and you can take your time with it. Let it work on you in natural ways . . . let it work *with* you, and lift you and carry you along. Awakening proceeds with its own rhythms: sometimes slow growth, sometimes a plateau, sometimes sliding downhill, sometimes a breakthrough. And all the while there is the deep true nature of each one of us, whether it is gradually uncovered or suddenly revealed: aware, wise, loving, and pure. This is your true home, and you can trust it.

Good Practice

Here are some suggestions for bringing the ideas and methods in this chapter into your daily life. (I mean "good practice" generally—not as one single good practice.) These are not the only ways to explore this material, and you are welcome to add other practices of your own. In particular, please consider how you could add some of what I have not included myself, such as physical activities, spiritual or religious practices, teachings and tools from indigenous people around the world, making art, spending time in wilderness, music, and service.

Try to approach each day as an opportunity for *practice.* It's a chance to learn about yourself, manage your reactions, heal and grow. When you first wake up, you could establish the intention to practice that day. Then, as you go to sleep, you could appreciate how you practiced that day.

Bring to mind someone you respect. Perhaps it's someone you know personally, or whose words you've heard or read. Pick something that you find admirable about this person. Then see if you can get some sense of this quality already present in *yourself.* It might feel subtle, but it's real and you can develop it. For a day or longer, focus on bringing this quality into your experience and actions, and see how this feels. And then try this practice using other people you respect and other qualities you'd like to develop.

Every so often, slow down to recognize that life in general, and your body and brain in particular, are making this moment's experience of hearing and seeing, thinking and feeling. Wow!

When you want, just be with your experiences for a minute or

more, without trying to change them in any way. This is the fundamental practice: accepting sensations and feelings and thoughts as they are, adding as little as possible to them, and letting them flow as they will. Overall, a growing sense of simply letting be can fill your day.

Poignantly, much of our suffering is *added* to life. We add it when we worry needlessly, criticize ourselves to no good purpose, or replay the same conversation over and over again. We add it when we freeze up around an authority figure or feel ashamed of some minor fault. Life has unavoidable physical and emotional pains, and then we add suffering to them: thus the saying "Pain is inevitable, suffering is optional." For example, we get embarrassed about having an illness or drink too much to numb old wounds.

This add-on suffering is not accidental. It has a source: "craving," the sense of something missing, something wrong, something we must get. Most craving does not look like an addict searching for a fix. It includes getting attached to our own point of view, driving toward goals that are not worth the price, and holding on to grievances with others. It is chasing pleasure, pushing away pain, and clinging to relationships. This is the Buddha's Second Noble Truth—but happily we're not stuck there. Because we are the ones who make much of our own suffering, we are also the ones who can make it come to an end. This hopeful possibility is the Third Noble Truth, and the Fourth Noble Truth describes a path of practice that fulfills this promise.

These four truths begin with a clear-eyed look at the realities of life, whether in rural India thousands of years ago or in high-tech cities today. I grew up in Los Angeles, and in its entertainment culture and then later in parts of the self-help world, so I've seen a fair amount of happy-smiley pretense, fake it till you make it. But we need to be honest enough and strong enough to see the truth of our experience, the whole truth, including the discontent, loneliness, and unease, and the unfulfilled longings for a reliable, deep well-being. I once asked the teacher Gil Fronsdal what he did in his own practice. He paused and then smiled and said, "I stop for suffering."

This is where practice begins: facing suffering in ourselves and others.

But it's not where practice ends. The Buddha himself was described as "the happy one." As we'll see, wholesome, enjoyable experiences such as kindness are skillful means for both ordinary functioning and full awakening. When suffering falls away, what is revealed is not a big blank but a natural sense of gratitude, good wishes for others, freedom, and ease. The people I've known who are clearly far along are straightforward and fearless, endlessly patient, and openhearted. Whether their words are humorous or serious, soft or fiery, you sense behind them an undisturbable stillness. They stay engaged with the world and try to make it better while also feeling at peace in the core of their being.

The Natural Mind

How did they get this way? More to the point, how can *we* get this way? Let's look into our bodies for some answers.

The human body is the result of several billion years of biological evolution. About 650 million years ago, multicelled creatures began to appear in the primordial seas. By 600 million years ago, these early animals had become complicated enough that their sensory systems and motor systems needed to communicate quickly with one another: "Could be food . . . swim forward." So a nervous system began to evolve. Whether in an ancient jellyfish or in us today, the nervous system is designed to process *information.*

The "mind," as I mean it in this book, consists of the experiences and information that are represented by a nervous system. This

might seem puzzling at first, but we are surrounded by examples of information being represented by something physical, such as the meanings of the squiggly shapes your eyes are scanning right now (or the meanings of sounds if you're listening to this book). As the Nobel Prize winner Eric Kandel put it:

> Brain cells have particular ways of processing information and communicating with one another. . . .
>
> . . . Electrical signaling represents the language of mind, the means whereby nerve cells . . . communicate with one another. . . .
>
> . . . All animals have some form of mental life that reflects the architecture of their nervous system.

When you are smelling coffee or remembering where you put your keys, your whole body is involved with making these experiences. At the same time, it is connected with the wider world. Still, the most immediate physical basis for our thoughts and feelings is the nervous system—particularly its headquarters, the brain.

Exactly how this happens—how patterns of light falling on a retina become patterns of neural activity representing patterns of information that become the sight of a friend's face—is still an open question. Nonetheless, thousands of studies on humans and other animals have established tight linkages between what we are feeling and what the brain is doing. In terms of the *natural* processes in ordinary reality, all of our experiences depend upon neural activity.

Every sensation, every thought and desire, and every moment of awareness is being shaped by three pounds of tofu-like tissue inside your head. The stream of consciousness involves a stream of

information in a stream of neural activity. The mind is a natural phenomenon that is grounded in life. Major causes of both suffering and its end are rooted in your own body.

Mind Changing Brain Changing Mind

Scientists have been finding connections between helpful, even transformational experiences and underlying neural activity—and we can use these links between mind and body in practical ways. For example, in later chapters, I'll explain how you can activate neural factors of present-moment awareness, calm strength, and compassion. Over time, these useful mental *states* can be gradually hardwired into your nervous system as positive *traits*.

This process of physical change occurs because all of our experiences involve patterns of neural activity. And patterns of neural activity—especially when repeated—can leave lasting physical traces behind. This is *neuroplasticity*, the capacity of the nervous system to be changed by the information flowing through it. (For major mechanisms of this process, please see the box that begins on the following page.) In a saying from the work of the psychologist Donald Hebb, *neurons that fire together wire together*. This means that you can use your mind to change your brain to change your mind for the better.

MECHANISMS OF NEUROPLASTICITY

It's long been recognized that any kind of learning—whether a child starting to walk or an adult becoming more patient—must involve changes in the brain. Neuroplasticity is not breaking news. But what *has* been revelatory is the recent discovery of how rapid, extensive, and enduring this neural remodeling is. These are the main ways it happens:

- sensitizing (or desensitizing) existing synaptic connections between neurons
- increasing (or decreasing) the excitability of individual neurons
- altering the expression of genes in the nuclei of neurons (*epigenetic* effects)
- making new connections between neurons
- birthing new neurons (*neurogenesis*) and weaving them into existing networks
- increasing (or decreasing) activity in specific regions
- reshaping particular neural networks
- changing the *glial cells* in the brain that support neural networks
- changing ebbs and flows of neurochemicals such as serotonin
- increasing *neurotrophic* factors that help neurons survive, grow, and connect with one another
- rapid changes in the *hippocampus* and *parietal* cortex in the first stages of new learning

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caught up in "self-referential processing" (for example, Why'd they look at me that way? What's wrong with me? What should I say next time?). Consequently, greater control over the PCC means less habitual mind wandering and less preoccupation with oneself.

People in longer trainings that span a couple of months, such as Mindfulness-Based Stress Reduction (MBSR), develop greater top-down control over the *amygdala*. This almond-shaped region is close to the center of your brain, and it's continually monitoring your experiences for their relevance to you. The amygdala reacts like an alarm bell to anything that's painful or threatening—from an angry face to bad news on a medical test—and triggers the neural/hormonal stress response, so getting more control over it reduces overreactions. People in these trainings also grow more tissue in their hippocampus, a nearby part of the brain shaped like a little seahorse that helps us learn from our experiences. Activity in the hippocampus can calm down the amygdala, so it's not surprising that after a mindfulness training, people produce less of the stress hormone *cortisol* when they're challenged. They've become more resilient.

More experienced mindfulness meditators, typically with years of daily practice, have thicker layers of neural tissue in their prefrontal cortex, which supports their *executive functions*, such as planning and self-control. They also have more tissue in their *insula*, which is involved with self-awareness and empathy for the feelings of others. Their *anterior* (frontal) *cingulate cortex* is also strengthened. This is an important part of your brain that helps you pay attention and stay on track with your goals. And their *corpus callosum*—which connects the right and left hemispheres of the brain—also adds tissue, suggesting a greater integration of words and images, logic and intuition.

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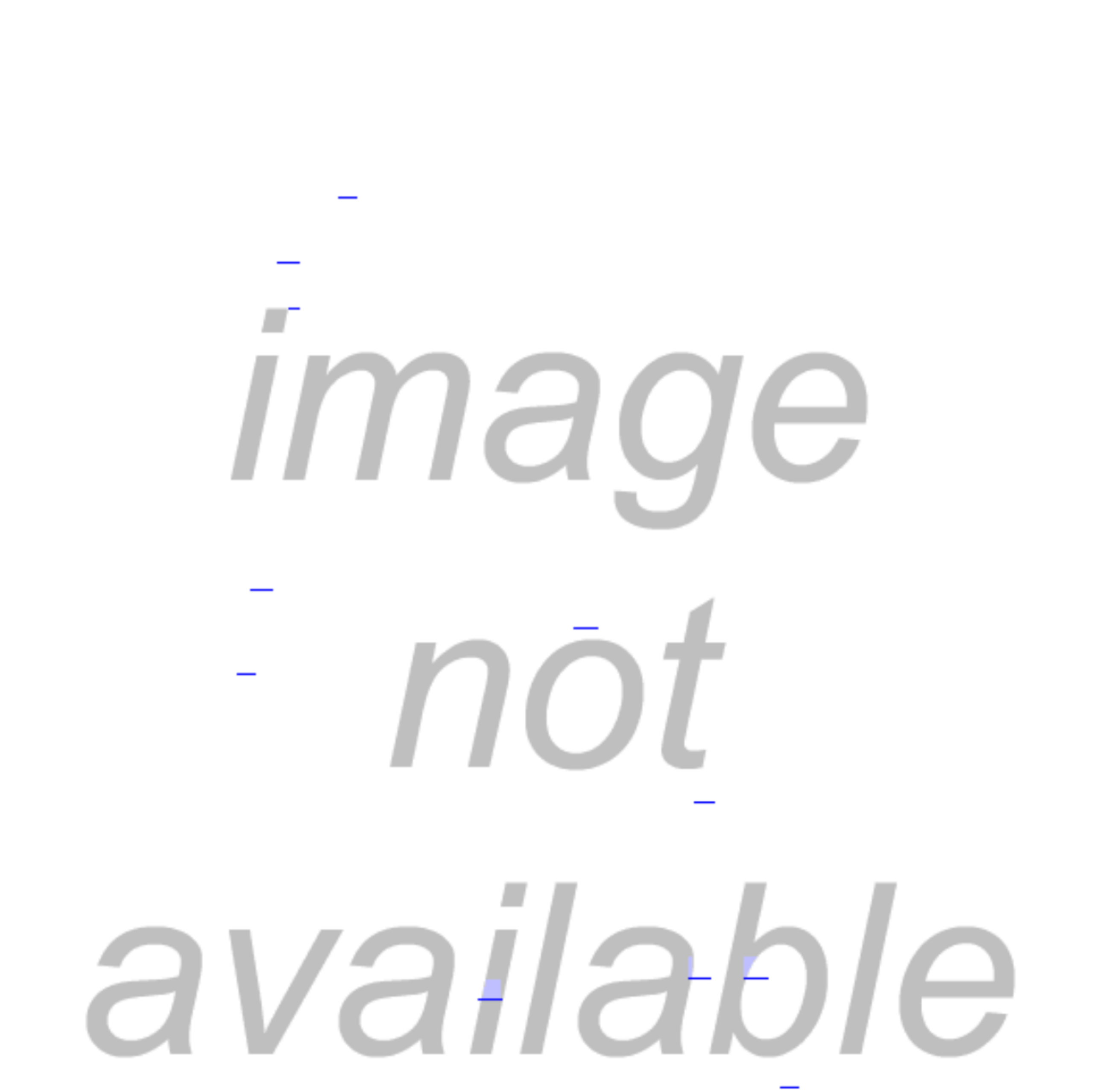
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