the neuroscience TRAINING SUMMIT

a symphony of gifts from relational neuroscience

HOW UNDERSTANDING OUR EMBODIED BRAINS CAN SUPPORT LIVES OF HOPE & RESILIENCE

Bonnie Badenoch, PhD

SOUNDS TRUE

contents

introduction

New technologies have opened doors for us to just begin to glimpse the wondrous neural universe within. We are standing on the shore of new territory, and even with these little wisps of understanding, we are finding a different kind of foundation developing beneath our feet. At least two consistent patterns are emerging from these discoveries: our embodied brains are far more capable of recovery/rewiring than we ever imagined; and a cradle of safe, warm, responsive relationships provides the support most in tune with our brain's inherent developmental and healing processes. It turns out that neuroplasticity — the brain's ability to change in response to experience — abounds, and nonjudgmental, agenda-less presence is the soil in which healing and meaning grow.

Here, we will explore a small sample of these discoveries that are offering so much hope, and trust they will inspire you to ask more questions, to look further into the wisdom that embodied relational neuroscience is illuminating. There are some suggested reading/listening/viewing opportunities at the end of each section to whet your appetite. Some of these are the discoveries of individual scientists and some are perspectives arising out of the synthesis of the work of many researchers. I believe beginning to embody each of them might enliven the potential to shift our experience in a significant way toward the life-giving value of connection with one another, a possible antidote for the cultural pressures toward self-sufficiency and disconnection. We may also sense the depth of our vulnerability side by side with the profound resilience of our systems, particularly when we accompany one another along life's uncertain, emerging path.

BONNIE BADENOCH, PHD

our divided brains

OUR WAY OF ATTENDING CHANGES THE WORLD

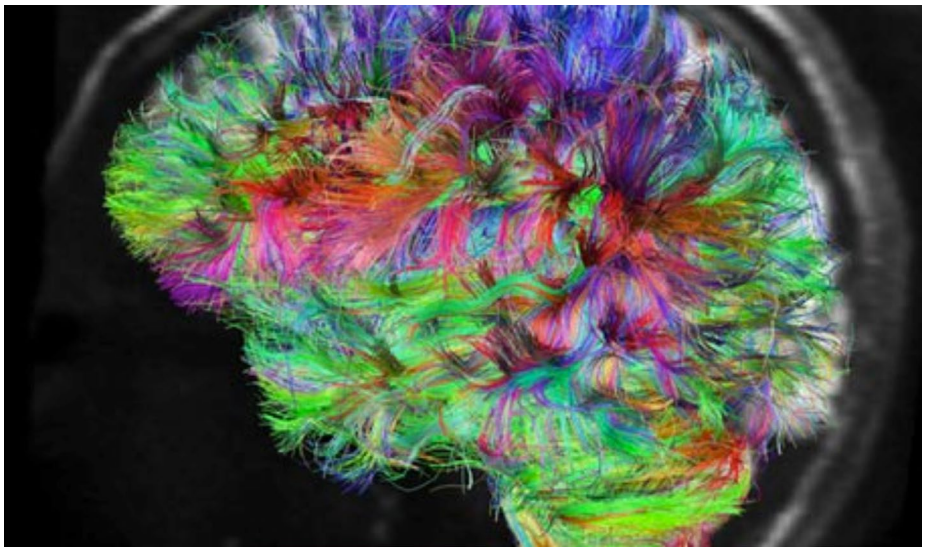
We're going to begin with the work of a man who was so put off by academia's dissection of poems in order to ascertain their meaning—an experience that was physically painful for him—that he left his English literature studies to become a doctor and a psychiatrist in order to better understand how our brains allow us to both hear the symphony of endless meanings in a poem and to dismember it to understand it. Twenty years of subsequent research underlie Iain McGilchrist's eloquent exploration of the two hemispheres in *The Master and His Emissary: The Divided Brain and the Making of the Western World.* This was a brave undertaking when we consider the checkered past of beliefs about the two halves of our brains. For a while, we talked about what the right and left each *do*—the left is rational, the right creative, for example. Then we found that both hemispheres fire for everything, so we began to wonder if there was any significant difference between the two. With Iain's work, we are invited to look at the hemispheres through a different lens. Instead of asking what each does, he encourages us to inquire about *how each attends to the world and how in that attending the world is changed*.

In a very small and incomplete nutshell, when we attend from the right, we experience *the world of relationships as it is emerging in this moment*. We attend to the space between with open receptivity and far fewer judgments. This is the perspective that allows us to be truly present with one another in ways that are profoundly supportive of the health of both people and society as a whole. This way of seeing is the basis for parents and children securely attaching, and for each of us to feel seen and held in the midst of joy and suffering. It is also foundational for the sense of meaning that arises when we are connected with one another. Our right-hemisphere way of perceiving is comfortable with paradox and can embrace many different viewpoints at once, although at times it may feel tentative, uncertain, and unsettled as it tunes in to the emerging moment.

The left hemisphere's way of attending is entirely different. It is less engaged with current experience and more intent on taking what has already been learned, making it

static, taking it apart, and reassembling it into systems. It tends toward judgments and has no felt sense of being in relationship with others. Without a felt sense of "we," the left focuses more on tasks and behaviors, creating algorithms and, in the process, losing touch with what is individual and unique.

We can easily sample these two ways of experiencing by attending to our bodies from these different perspectives. Our left brain regards the body as an object to be run around the block and fed certain foods in order to look or feel a certain way. In those moments, it as though we are standing back and viewing our bodies as separate entities, judging them according to accepted criteria, and seeking to control and improve them. The right brain engages in a different kind of relationship with the body, listening to its language—which is sensation—as it emerges in this moment. In the diffuse and tentative way that is characteristic of the right, we may sense when it is time to stop exercising, when sleep is being requested, and even what foods the body needs right now. Instead of stepping apart, we step into our bodies as we would into a friendship. Let's see if we can move back and forth between the two ways of attending. Then we might also sense how these two experiences would literally foster different life experiences for us, and by extension for the culture at large.



It would be easy to make the left hemisphere the bad guy, but that is not the point. Neither hemisphere does well alone. For all the isolation, deadness, and rigidity that the left offers when cut off from the right, sometimes our right hemisphere is so filled with pain, fear, and overwhelm that when it is dominant, life is chaos. Even with a fairly healthy right, its focus on emergence leaves us without an anchor for functioning from day to day. As with so much else we are learning from neuroscience research, the

relationship between the hemispheres is all-important. When the right provides the vision and the left creates the systems to manifest that vision, we are on solid ground for long-term sustainable living. For example, the right is able to see and feel the strain on the environment caused by our current practices, while the left is skilled at developing processes to alter this potentially disastrous path—when, as Iain says, the right is the master and the left is the emissary (no gender reference intended). Right now, research from a number of sources suggests that about 75 percent of us are living in a left-centric way. However, the potential to shift toward whole-brain living is always there. In every area, we will see that our vulnerabilities are accompanied by inherent capacities that can lead toward health when they receive the support they need.

There seems to be much value in looking at our experience through this lens. Iain may be providing us with an opportunity to consider how we each might have a role to play in the survival of this culture and the world as a whole. I have found that as I deepen into what he is offering, I become more aware when I have moved into disconnection and can more easily find the roadway back toward relational living. One question he raises but doesn't answer is how we might strengthen the master and emissary relationship so that we move toward fulfilling, meaningful, sustainable lives as individuals and societies. What if we were all part of communities dedicated to deep listening and support for one another so that our wounds can be held and integrated rather than buried and then acted out in ways that hurt each other? What if we were then able to feed our always-hungry left hemispheres with wisdom drawn from the right hemisphere's way of seeing the world (something that interpersonal neurobiology offers in abundance)? Might we then be able to offer true presence to those around us, with the left hemisphere offering its wisdom and structure in support of the right's ongoing humane vision? I believe he is saying that it might be possible and that it is certainly essential.

The Master and His Emissary: The Divided Brain and the Making of the Western World (2009). A big book, with abundant research. Worth its weight and worth our attention. The concluding chapter is deeply moving and crucially important.

The Divided Brain and the Search for Meaning (2012). A small ebook that summarizes the big book. A very good place to begin.

Iain McGilchrist at Schumacher College: *Things Are Not What They Seem* (2011). https://www.youtube.com/watch?v=oXiHStLfjP0. A heartfelt, mesmerizing talk about how we experience life from the two hemispheres and what is happening in our culture. Many other talks are available on YouTube for your pleasure.

Podcast interview with David VanNuys/Shrink Rap Radio. *Brain Lateralization and Western Culture with Iain McGilchrist*. http://shrinkrapradio.com/?s=Iain+McGilchrist. For those who prefer listening to reading or viewing.

the polyvagal theory

LEANING TOWARD SAFETY & CONNECTION

As a teenager, Stephen Porges discovered that playing the clarinet helped him regulate his bodily state. As young as he was, he had become curious about how bodily feelings could disrupt social interactions and even cognitive functions. The ongoing internal dialog between these feelings and rational thinking really caught his attention. So he was fascinated to discover that his body calmed down considerably as he played, and it seemed that both the long exhalation and the way he was listening to the beautiful sounds helped make this change. By the time he was in graduate school, he began to attend to how quality of voice and facial expression were communicating something independent of the language being spoken. As he followed these trails, they eventually led him to the awareness that, "The linchpin was the detection of features of safety and how that actively changed autonomic state and fostered health, growth, and restoration as well as provided opportunities to connect and co-regulate." He noticed how we also telegraph danger to one another through face and voice. In other words, we are constantly looking toward one another for guidance about whether we are safe or not. What we discover there influences our autonomic nervous system (ANS) to respond adaptively to keep us safe. These ANS fluctuations underlie our bodily feelings and direct our behaviors. For the next twenty or so years, Steve studied the intricate details of how our autonomic system responds to emerging conditions, and named it the Polyvagal Theory.

As with the two hemispheres, perspectives on our ANS have changed

over the years. Research generally begins with curiosity about some experience we are having and then moves through stages of refinement. Originally, researchers identified two branches of the ANS — sympathetic for activation and parasympathetic for calming. They imagined that these systems needed to come into some kind of balance with each other. However, one of the viewpoints missing from this conceptualization is how dedicated this system is to fostering interpersonal connection.

The Polyvagal Theory supplies this missing element. The branches of our ANS are three rather than two, and work together not toward balance but according to a hierarchy of preference. They constantly respond to relational conditions. Stephen coined the word *neuroception* to indicate how our systems sense, below the level of conscious awareness, whether we feel safe or not in this emerging moment by drawing on cues in our internal and external environment. We attend both to what is coming in through our senses and what is arising in our internal world, and the two are entangled with one another. We can easily sense this if we recall a time when we felt our bodies respond to someone's face or voice by relaxing into a warm, calm state or felt a movement toward heightened alertness and agitation. Our earlier experiences are constantly being touched by the winds of current events, and our ANS automatically adjusts to provide for our protection.

When a neuroception of safety arrives, our *ventral vagal parasympathetic* system activates and we can settle down with one another in close and vulnerable relationship. In this state, our voices become melodic, our faces mobile, and we are able to focus on the meaning of the words being spoken to us. We are able to offer receptive, agenda-less attention that lets us be responsive to the needs of the other. People near us feel received and attended to. One person in this state becomes a magnet for others and soon we are in the beautiful co-regulating relationships that nourish our systems at every level. As early as 1994, Stephen's research showed that ventral vagal lateralizes to the right hemisphere. Here we see the overlap between the insights of Iain and Steve — when we are attending with the right in the lead, our autonomic system offers the possibility of opening to one another. We may be able to recall a recent time when we felt our bodies respond to such an offer of safe connection.

Only if we no longer feel safe does the *sympathetic system* activate (fight/flight/momentary freeze to prepare for taking action). The prosody of our voices changes, as

does the tension in our ears, so that we can listen to the broader environment for sounds of danger while losing our ability to attend to what another is saying. In the process, we disconnect from others and narrow our field of attention to scan for the source of the threat. People around us will also sense a lack of safety and their systems may well follow us into preparation for protecting themselves. If the threat escalates to the point that we feel helpless, the unmyelinated *dorsal vagal parasympathetic* pulls us into collapse and dissociation, feigning death to avoid death and conserving our metabolic resources.

All three of these states are adaptive, and come online on our behalf from moment to moment. Their hierarchical arrangement, with ventral vagal and social engagement in the lead, also points toward how we can become safe and healing landing strips for one another if we cultivate our own ventral capacities. That is why Stephen says to us therapists, "Safety IS the treatment." We might second that in regard to all our relationships — family, friends, business, and nations. Currently, cultural conditions that include speed, information overload, increasing amounts of screen time, focus on tasks and behavior over relationship, the push toward success — all of which are mutually reinforcing — have a tendency to keep us in persistent sympathetic activation.

However, two aspects of these discoveries offer us substantial hope. One is that we are always leaning toward ventral, even when we are strongly activated. Our systems continually ask, "Are you with me?" As soon as we have a felt sense that someone is nonjudgmentally, receptively present, our system will move toward ventral as well. The second hopeful piece is that as we deepen into our embodied awareness of the workings of our ANS, we seem to have fewer judgments about ourselves and others. Our ANS and the behaviors that accompany its activation are automatic and not motivated by

anything but the need to protect and move toward safety. They are not calculated and not truly chosen. If my friend can't connect with me on a particular day, it isn't because she planned it, but simply because her ANS is being drawn to orient more toward the sense of danger in those particular moments. The possibilities for increased compassion are almost endless here, along with the encouragement to make ongoing offers of connection.

I often imagine what the world might be like if leaders at every level began to understand and embody the meaning of what Steve is saying about safety being the linchpin for every system — from individuals to nations — developing in a healthy, interdependent way. Schools might focus on connection before curriculum—as my friend, Kirke Olson (author of *The Invisible Classroom)* says—to foster both better learning and the development of our children's relational capacities. How respectful and productive might Congress become if the first concern was establishing relational safety before beginning to consider legislation? On a much smaller scale, I have seen so much change for feuding couples when they begin to ask the question, "How safe are we feeling right now?" This open curiosity leads them away from judgment and blaming toward connection with one another. From that place, so much becomes possible that is otherwise out of our reach.

Neuroception: A Subconscious System for Detecting Threats and Safety (2004). Available at http://www.frzee.com/neuroception.pdf. A paper on Polyvagal Theory written for parents.

The Polyvagal Theory: New Insights into Adaptive Reactions of the Autonomic Nervous System (2009). Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3108032/. A more technical paper, and well worth reading and rereading.

Many talks on YouTube — from technical to Dr. Drew.

Podcast interview with David VanNuys/Shrink Rap Radio. *The Polyvagal Theory with Stephen Porges, PhD.* http://shrinkrapradio.com/?s=stephen+porges. For those who want to hang out on the treadmill with Steve.

social baseline theory

BUILT FOR INTERDEPENDENCE

What Iain and Steve have given us converges with other ongoing research that increasingly points to the healthy benefits of our radical interdependence throughout life. While I don't know the personal stories that might let us glimpse what underlies this research, Social Baseline Theory—the work of Lane Beckes and James Coan—tells us that (for most of us), when we are in a challenging situation, the presence of another — often even a stranger — calms our systems so that we use fewer somatic and emotional resources to deal with upset than if we were managing the situation on our own. They say, "Social Baseline Theory (SBT) proposes that the primary ecology to which human beings are adapted is one that is rich with other humans. In our view, the human brain is designed to *assume* that it is embedded within a relatively predictable social network characterized by familiarity, joint attention, shared goals, and interdependence." That is a powerful statement that flies in the face of our culture's emphasis on autonomy, self-regulation, and individual success — values that arise from an isolated left-hemisphere orientation, which deprives us of having a felt sense of each other. Such focus on going it alone is an actual violation of our inherently relational nature.

Instead, the wisdom of our embodied system is that we flourish most when we are in safe proximity with each other. If we have some sort of mountain to climb, whether that involves taking on an actual challenging task or the unexpected need to persevere

through physical pain, the arrival of another changes our perception of the difficulty or the degree of pain without changing the facts of the situation. The closer and more trusted the person is, the greater the help. The most astonishing part of this discovery is that our brain's regulatory circuits don't begin to fire more strongly when a friend arrives, as we might expect. The study's unexpected results showed that they *actually fire less*, and much less if a trusted beloved is accompanying us. If I have a felt sense that you have my back, my system simply isn't as afraid, even if there's nothing you can actually do about the challenging situation. In this way, being accompanied frees our neural resources for exploration, relating, creativity, and anything else meaningful to us. I am imagining that each of us can recall moments in which we felt our nervous systems settle, our widened eyes relax, our hearts calm, and our muscles let go a little bit when a friend arrived to just be with us in moments of suffering. Given the left-shifted nature of our culture, we all need relationships and communities where we advocate for and support one another's inborn interdependence every day.

Social Baseline Theory: The Role of Social Proximity in Emotion and Economy of Action (2011). Available at https://lifespanlearn.org/documents/SocialBaselineTheory.pdf. A statement in scientific terms of the importance of supportive relationships.

the seven emotional-motivational systems

SEEKING CONNECTION FIRST

A man in a white lab coat gently picks up a white rat and strokes him, then rolls him over and begins to tickle him. At first, the rat makes hardly any sounds and the man speculates that this rat hasn't been handled for awhile—which others in the lab confirm. So he continues to cuddle the little guy while talking to the interviewer about how the circuits of emotion are buried deep in the midbrains of all mammals. On another day, with a rat who is handled regularly and is familiar with his surroundings, the little guy easily and joyously laughs as soon as he is put on his back and tickled—high chirping sounds and kicking feet. This rat tickler is Jaak Panksepp, who has been studying the roots of emotion for decades.

The significance of his work for me is twofold. At the theoretical-experiential level, we now know that we have inherent emotional systems that are not dependent on higher cortical functions. We may need our cortex to name them, but we don't need it to experience and be conscious of emotion and share in vivid, emotion-based relationships. This might speak to how we relate with people who suffer severe cognitive decline. At the practical level, an understanding of Panksepp's work might support our efforts to parent in ways that help our children develop neural resources for resilient, meaningful, and joyous lives filled with sustaining relationships.

Let's begin by exploring the seven systems a bit. Jaak capitalizes them to indicate that these words stand for specific circuits in the midbrain, even though they are also commonly used terms. The first, the grandmother of them all, is the SEEKING system. Supporting curiosity and exploration, this urge leads to us find resources that are most meaningful for our survival. For we humans, that means connection with other humans (see Social Baseline Theory above). When we experience disconnection, SEEKING joins three systems that are available to help us draw in support. The first is SEPARATION DISTRESS/ PANIC/ GRIEF and leads to the biologically helpful behavior of clinging. If our distress is met with connection, this system subsides into the more

relaxed state of holding and being held. If it isn't met, then the next system to activate may be FEAR — with particular facial expressions and sounds that are meant to elicit the response to connect in others. If that doesn't draw another to us, then the next system to activate may well be RAGE. As our SEEKING system tries and tries to draw in help, but no one responds, frustration builds toward needing release.

We can hear this movement from system to system in the cries of babies — the whimpering request of DISTRESS moving to the escalating cry of FEAR, and finally to the screams of RAGE. However, as someone whose CARE system has been touched by these cries comes with the intention of providing comfort and connection, those wails suddenly or gradually subside to be replaced by the cooing, responsive sounds of being together. Once connection is established, the PLAY system comes alive and the SEEKING system is free to move toward whatever is of most interest in the moment. A felt sense of disconnection requires our SEEKING system to focus its resources toward regaining contact and a felt sense of connection opens our systems to joyous engagement with those around us. In our teen years, that free-ranging exploration includes the seventh system, LUST, as we seek not only to procreate, but to honor a deeper connection through the inclusion of sexuality.

Most meaningful for me in all of this is that the signs of disconnection — clinging, fear, and rage — are generally considered maladaptive/bad behavior in a left-shifted society, and many of our young ones are shamed or punished for exhibiting them. This isn't meant to blame parents. These norms are deeply rooted in our culture. According to Carol Gilligan, an author dedicated to the well-being of our young ones, research suggests that clinging and fear are discouraged in many young boys by the age of three, leaving them with only rage to express their losses. In many girls, this same suppression happens, but not until about thirteen when their peers begin to consider it improper.

If we are able to hear what Jaak is saying, we might find the strength to buck the tide of society and hear these signals welling up from deep within the brains of our children as pleas for connection. We might welcome their clinging and respond with holding them until the emotional storm subsides. We might even welcome their rage. With the release complete and connection reestablished, the other systems of CARE and PLAY that lead to cooperation will come online naturally. If instead we send them for time out or punish them with shaming looks and lectures about behavior, we only create more pools of traumatic isolation within their developing brains.

Jaak's work also supports a different way of caring for those who experience cognitive decline with aging. We are so used to valuing ourselves and one another according to our cognitive capacities that when those slip away, we feel we have lost the person. It turns out that what we've lost is really a small slice of what makes us human — and not the most significant capacity, which is finding meaning through connection. I hope if the day comes that I no longer remember my daughter's name, she will feel how much I recognize and am comforted by her touch, her eyes, the sound of her voice. Jaak points us toward a kinder world for all of us at every stage of life.

Jaak Panksepp — in the lab of happy rats. https://www.youtube.com/watch?v=WLfubEzV23M. A small introduction to his work, while watching him cuddle a rat. Jaak goes toward considering pharmacological means of using this knowledge to support the systems, but we also now understand that relationships may be able to influence epigenetics and neurochemicals so that these systems come online again without medical intervention.

How rats laugh. https://www.youtube.com/watch?v=ieP3lpyOHtU. A familiar rat goes immediately to playfulness — SEEKING and PLAY systems easily responding to Jaak's overtures.

Archaeology of Mind: Neuroevolutionary Origins of Human Emotions (2012). His most recent and detailed book, written with Lucy Biven, about the seven emotional-motivational systems. Well worth the read and reread to begin deepening into the sense of these systems in ourselves.

Affective Neuroscience with Jaak Panksepp. Brain Science Podcast with Ginger Campbell, MD. http://brainsciencepodcast.com/bsp/2010/1/13/affective-neuroscience-with-jaak-panksepp-bsp-65.html. A very knowledgeable interviewer on neuroscience. For those who want to take Jaak for a brisk walk.

memory reconsolidation

CHANGING THE FELT SENSE OF OUR IMPLICIT MEMORIES

Bruce Ecker, with his colleagues Laurel Hulley and Robin Ticic, has collected the research on memory reconsolidation and illuminated a pathway toward permanently changing the quality of life for those of us who have suffered traumas large and small. Each of us may apply this emerging research according to our own paradigm of practice, but the underlying science can support all of us.

For many decades, it was generally believed that we could only regulate our degree of discomfort from unhealed and unintegrated implicit memories arising in our bodies, but not actually change the core felt sense. When these old experiences arise, they change our perception of the world around us, stimulate our autonomic nervous system, influence our digestion, often strongly affect how we are relating to others, and so much else. Our suffering is much more influenced by these implicit arisings than by the cognitive memory of what happened to us.

In the last couple of decades, evidence has accumulated that it is possible to change these memories at their core — not what explicitly happened, but what implicitly lingers within us from these events. When we experience something frightening or painful and don't have the internal resources (circuitry based on previous co-regulation) or external resources (other people) to help us integrate it, certain chemicals are released that allow us to store these memories primarily in neural networks in our bodies

and limbic system. They quickly become molecularly locked into long-term memory. Reminders of the trauma can touch and awaken these memories, and then they wash through our bodies with the feeling that the experience is happening again right now. *Each such arising may be a request for help in resolving and integrating these sufferings*. One of the significant contributions of Coherence Psychotherapy, the paradigm of Bruce and colleagues, is their realization, based on the research, that our symptoms make sense in light of what is being implicitly held out of awareness. This enables us to come from a place of trusting that our clients (and ourselves) were always adapting in response to experience rather than becoming disordered. The mutual respect that arises from this understanding is of inestimable help in healing.

Based on this science, which works within any paradigm, I will tell the rest of the story from the viewpoint of my own experience with it — for myself and with my clients. The key to change lies in two experiences happening at once. First, we need to be in embodied contact with the implicit memory. This means feeling it in our bodies, not just thinking about it. The intensity of the embodied memory needs to also be within the combined window of tolerance that blossoms when we are with someone we trust, so that we still feel connected to that person even if the emotions are intense. This in itself does not open the neural network holding the trauma. That happens only with the arrival of a disconfirming, reparative experience most often embodied in the other person. If we are afraid, a sense of safety and protection from another provides this disconfirmation. If we are feeling shame, nonjudgmental acceptance is needed, and so on. Then our circuits open to let in this new information, which includes internalizing the sense of accompaniment along with whatever new experience is being offered. It is as though this memory has been awaiting the arrival of such support.

Often, the most immediate change people experience is from a feeling of "me alone in this suffering" to a sense of "we are together here." Each of us can perhaps feel the relief that brings as we imagine it. It is possible for some implicit memories to change through a single disconfirming experience, but for many of us who have experienced considerable trauma, the complexities of these neural networks means they need a period of support before there is a sense of something resembling completion.

Holding the possibility of this change in my own body, mind, and heart when I am with my clients brings a quality of hope into the room that wasn't there quite as fully

before, and also opens me to greater change in my own ongoing healing. As we will see when we visit resonance circuitry in the next section, we have neural pathways that respond in microseconds that help us provide such healing experiences for others even when we aren't in the therapy room.

Unlocking the Emotional Brain: Eliminating Symptoms at Their Roots Using Memory Reconsolidation (2012) A very thorough summary of the science of memory reconsolidation as well as how Ecker and his companions practice it.

Memory Reconsolidation: Key to Transformational Change in Psychotherapy. https://www.youtube.com/watch?v=_V_rI2N6Fco. A "quick start" guide to the principles of implicit change.

Coherence Therapy website: www.coherencetherapy.org

resonating with one another

INTERNALIZING EMPATHIC INNER COMPANIONS

A monkey eats a raisin and certain circuits light up in his brain. Later, a researcher eats a raisin and similar circuits light up—not only in the researcher, but also in the monkey. After numerous repetitions to make sure that it isn't an equipment error, Giacomo Rizzolatti, Vittorio Gallese, and their colleagues realize they are seeing, for the first time, what they would name mirror neurons. A number of years later, Marco Iacoboni and his group found signs of mirror neurons in humans, and in 2010, encountered them through direct observation of single cells in additional locations in the brain.

Many now believe that these neurons form the beginning of a chain of neural events that help us pass on so much of our culture, from language to the capacity for empathy. If I see your sad face, I may first resonate with it and feel sadness myself (that's the work of strictly congruent mirror neurons). Next, I may feel the desire to comfort you rise up in my body automatically (that's a gift from the broadly congruent ones). And deep within, below conscious awareness, my inner world will be able to distinguish between your sadness and my own so that I'm not overwhelmed (thanks to a group called "inhibitory"). If I have a lot of unprocessed sorrow, I may not be able to get to the full experience of empathy, but instead be stopped at the stage where my feelings echo yours and we'll both be sad together. In any case, *there is a kind of interpersonal oneness available to us so that we aren't isolated from each other*—an experience some authors have called hell.

In addition to being neural bridges that allow us to respond to one another from

a felt sense of each other's inner landscape, it is possible that this resonance circuitry brings people outside us into our inner world in a most intimate way. It appears that after the initial arrival of information from our relationships stimulates our mirror neurons, other circuits pick up the intention, bodily sensations, and emotions of the other person and encode them, intertwined with our own felt sense experience at that moment. At the same time, our sensory experience of the person is being added — how this person sounds, looks, tastes, smells, and touches. In this way, through mutual internalization, we become inner communities for one another.

When our repeated experience with someone is warm and responsive, we will carry that relationship in our very bodies as a resource for the rest of our lives. My smiling, playful father tosses me in the air and we both laugh with delight — and that implicit memory lives in my body right now as I write these words. These dear ones become part of our regulatory process, an inner referent for reassurance that builds resilience. *There may be no such thing as pure self-regulation, but instead co-regulation moving from the outside to the inside.* If our experiences with another are painful or frightening, a chemical chain of events buries them in limbic-centric circuits to await the arrival of enough safe support to heal these inner ones. Because we are woven together by this invisible net of neural firings, we have the possibility of that depth of healing throughout our lives.

This sense of our profound interconnectedness through resonance brings us full circle to the beginning of our explorations. With each discovery, we find inherent within us all the resources we need to engage in ways that will save our planet from being used up to the point that it discards us and, at the other end of the spectrum, to support our little ones in establishing a firm neural foothold on a life of resilience, meaning, and flourishing interdependence. Even though the challenge to this way of living is strong right now in our culture, a growing understanding of relational neuroscience may help us have the strength to quietly embody this vision from moment to moment.

Imitation, Empathy, and Mirror Neurons (2009), Marco Iacoboni. Available at https://consciousmovements.com/wp-content/uploads/2013/08/iacoboni/annurevpsychol_2009.pdf. A beautiful summary of 10 years of work with mirror neurons.

coda

BELLY BRAINS & GENE PLASTICITY

This small composition would feel unfinished without at least a brief mention of the nascent exploration of our belly brain (100 million neurons) and its resident microbiota (40 trillion gut bacteria). If the ’90s were the Decade of the Brain, this is the Decade of the Gut. At this very early stage, we know that what is unfolding along the enteric nervous system and living and dying in our bellies has as much to do with mood as digestion—that these systems are intricately interwoven with the brain in our skulls and dynamically influenced by our internal and external environment. Here is a reference that tells the intriguing story of microbiota research. This is a tale worth following.

Peter Andrey Smith, *Can the Bacteria in Your Gut Explain Your Mood?* (2015). Available at http://www.nytimes.com/2015/06/28/magazine/can-the-bacteria-in-your-gut-explain-your-mood.html?_r=0. A well-written summary of where we are in research about our microbiota and its many connections.

A second story that holds so much promise for the possibility of change at the deepest levels is that the expression of our genes is always being altered by experience. We once thought that genes were destiny in many ways, but now we know that is a limited truth, and that through new experiences, epigenetic switches turn genes on and off. We humans are so focused on relationships that warm, responsive care can play a vital role in altering how our genes shape perception, emotion, and behavior. Each new discovery seems to illuminate the beautiful possibility that we are meant to heal one another when there has been

wounding, and meant to develop one another gloriously when relationships are safe and responsive. Here is an interesting documentary as a starting place with this vast subject and an article about the process of discovery.

The Ghost in Your Genes (NOVA documentary). Available at https://www.youtube.com/watch?v=2XzxNGkZsbI. Groundbreaking exploration of epigenetic inheritance.

Dan Hurley, *Grandma's Experiences Leave a Mark on Your Genes* (2013). Available at http://discovermagazine.com/2013/may/13-grandmas-experiences-leave-epigenetic-mark-on-your-genes. Fascinating article about the history of epigenetic discovery.

As this symphony has emerged, I am aware that there are at least three people who have made the idea and experience of neural music available to me, and none of them are directly mentioned in this piece. Dan Siegel, Allan Schore, and Lou Cozolino, the fathers of interpersonal neurobiology, are the foundation on which I am blessed to stand as I look out over these discoveries and sense which ones are touching me most deeply right now. Utmost gratitude to the three of you for the depth of your relational vision.

It also seems important to say that any of us undertaking the task of writing this article would choose a different group of discoveries based partly on our own life experiences and how they guide us toward what matters most. For me, a history of abuse and shattered attachments coupled with ongoing recovery in the embrace of loving, nonjudgmental relationships of all sorts has led to a particular preoccupation. My attention is always drawn to anything that tells us more about how—in warm, responsive relationships—we continually shape one another's brains toward a better quality of life in every way.

Our physical health improves as we feel safe and welcomed. Inflammation decreases, cortisol levels out, our bellies remember how to digest, and more oxytocin (and other neurochemicals) bathe us in well-being. Our emotions, once tangled in the roots of the implicit forest growing underground, now find a more peaceful relationship with these same roots, and we can experience a wider range of emotions without feeling torn. We are more drawn to find companions in our distress so we can help one another integrate what hurts us. Our minds can let go of the some of the elaborate system of protections that were needed to guard us against the unhealed past, so there is more room for responding and relating, as well as exploration and creativity. Spiritually—well, that is

a very individual matter, but in my experience, many find themselves drawn toward a kinder and often more relational sense of the sacred than ever before. In the presence of such relational nourishment, every part of us is fed and reassured. So, in both joy and suffering, we are both sustaining and sustained.