



## CHANGING OUR SYSTEMS BY CHANGING OUR BRAINS: THE LEVERAGE IN MINDFULNESS

BY ELAINE B. JOHNSON

**A**ccording to recent findings in neuroscience, not only do sensory experiences and actions change the brain's physical structure, but so does thinking. Concentrating on reasons to be grateful can rewire the brain to incorporate an appreciative attitude. Imagining that you are playing a five-finger exercise on the piano can enlarge the space in your brain devoted to manipulating the fingers. In these ways, our thoughtful response to the context we inhabit at any moment has the power to shape our personalities and values as well as influence our actions.

This discovery that thought alone changes the brain's physical structure validates strategies that practitioners of systems thinking and organizational learning have long appreciated. These strategies—effective with everyone from primary school children in the Netherlands to employees in global corporations—include listening without judging, speaking honestly, looking for interrelatedness, nurturing relationships, and asking fresh questions. Brain research suggests that such mental awareness, attentiveness, and creative questioning can actually transform our brains from rigid, automated responders to thoughtful, alert, searching, and open creators of Self and the world.

### TEAM TIP

By exercising mindfulness in the workplace, you and your team may experience less stress and be more alert to new opportunities.

This article explains why *mindfulness*—being fully aware of the present moment and regarding it with openness and curiosity—is the compelling responsibility of all human beings. It explains why all of us are by definition obligated to examine and develop our *inner context*—the Self that thinks well, sees clearly, and decides intelligently. Our survival as individuals, organizations, and a species depends upon it.

### Our Inner and Physical Contexts

For the purposes of this discussion, I use “context” in two ways. Strictly speaking, the word “context” means “the situation that surrounds us, with its conditions.” I use it to designate *inner context*, the mental state inside our heads that envelops us—such as our ideas, tastes, attitudes, moral principles, social rules, and worries. Used this way, “context” is synonymous with “Self” or “Mind.”

I also use *physical context* to refer to the world surrounding us now. The Self is always moving from past to future in a physical space with its own conditions. We live among family, friends, teams, clubs, and neighbors. We occupy a workplace consisting of office furniture, equipment, tasks, deadlines, and colleagues who interact, apply knowledge, make choices, interpret events, and sometimes bring us coffee.

In the workplace—or in any physical context—people, objects, and events are woven together. Indeed, the word “context” comes from the Latin “contexere,” meaning “to weave together.” Woven together in our inner context, our Self, are all those attributes we refer to with the pronoun “I.” The Self, the Mind, emerges as brain cells (specifically, neurons) weave together

and connect. Brain cells connect as a result of our experiences. Daily life builds the brain, continuously, moment by moment. We make our Selves.

For example, humans are born with the capacity to distinguish every one of the sounds contained in the 6,000 languages spoken on earth. Particular neurons are genetically assigned to receive particular sounds. The more an infant hears a single sound, such as “gr,” the more that “gr” is wired into a tiny cluster of neurons in the brain's auditory cortex. The cluster of neurons holding “gr” comes alive with electrical activity when—and *only* when—that distinctive “gr” sound enters the child's ear and passes to the brain. Clusters of neurons—circuits—in your brain hold all the sounds of the language you speak. In this way, *experience* decides if Italian will make sense to you or sound like gibberish.

Experience also wires the brain for music. During the first few years of life, a child's brain can wire for any kind of music. Because in the United States children hear Western music, by the age of five, their brains have formed circuits that hold Western musical sounds. Five-year-old children know the customary chord progressions in Western music. These examples from music and speech demonstrate that use sculpts the brain.

Because personal experience generates the Self, therefore, one might well ask, “What experiences, what influences, made me the Self that I call ‘I?’” and “Will I, my Self, choose to rewire my brain by paying attention to new contexts that offer new experiences, or will I refuse?”

Perhaps the most obvious influence that shapes the human mind is culture, the context that envelops us from birth. Culture is, of course, a

social invention. This invention is communicated to us by our grandparents, parents, friends, teachers, colleagues, and others. These people form a social network that hands down rules of behavior. They give us opinions about education, political parties, right and wrong, the war in Afghanistan, and offshore drilling. They tell us what knowledge is worth learning. Culture wires circuits in our brains, and, miraculously, a Self emerges.

Culture encompasses more, of course, than the social inventions of people inhabiting a broad geographical region. The term also alludes to narrow contexts, such as universities, reading groups, and NASCAR races. Economics, for example, is an academic discipline with its own culture. This academic discipline's culture does not train economists to be ethicists who ask, "How can the economy be made to serve society?" Nor does the culture of economics departments train economists to be historians disposed to ask, for instance, "Should the Federal Reserve System, created in 1913 as an entity privately owned by the nation's leading banks, continue to exist in its present form and continue to issue all U.S. currency, so that the federal government must borrow money from the Federal Reserve Bank to meet its financial obligations?"

Rather than consult history, economics departments focus on designing theories, abstract models divorced from ethical and historical contexts. Their models deal with describing, analyzing, and preserving the current economy, which, for better or worse, depends on market activity leading to continuous growth. The product of a narrow culture, the economist sees through a special lens. *So do we all.*

### User's Guide to Life

Each of us perceives reality through the unique lens of our personal values and ideas. These values and beliefs are part of us, just as surely as an arm is part of us. And just as we are unwilling to part with an arm and will fight to protect it, so we are unwilling to part with the ideas, customs, and practices that constitute the Self, our "User's Guide to Life."

Protective of their "User's Guide to

Life," people who hear of a discovery that challenges their way of thinking typically say immediately, automatically, "It is not true. It is impossible." Eventually they may admit, "Well, *perhaps* it is possible." Faced with irrefutable evidence, they concede, "Ah, it is true." In time, they incorporate that new information into their own "User's Guide to Life," saying, "I thought so all along." If it is a popular discovery, invention, idea, or procedure, some might even claim, "I thought of it first."

When culture produces results no one wants, people automatically distance themselves from those outcomes. We treat unwanted results as if they had an independent existence of their own. For example, human beings have degraded 21 percent of the topsoil in the world's arable land and have reduced 80 percent of humankind to poverty, and yet we automatically disavow responsibility for these conditions. We claim to be prisoners of systems and powerless to alter them. We say we can do nothing.

Not just when our "User's Guide to Life" faces a daunting or unwanted context, but in *any* context—familiar or novel—we humans tend to run on automatic pilot. In a meeting with colleagues, the Self automatically downloads a reaction: "Seen it before, know it well." Relying on customary thoughts, we make customary judgments. As Ellen Langer, a Harvard psychologist, points out, instantly we interpret events, hastily we decide what they mean, immediately we judge and reach conclusions about what is going on around us. We defer to authority, continue the same old practices, and fiercely, sometimes violently, protect a long-held idea.

### Protecting What We "Know"

It is understandable, profoundly regrettable, but by no means inevitable that human beings regularly function on automatic pilot and fight to preserve familiar ideas. Brain research suggests three reasons for this determination to protect what we know, freeze thought, and close the Self.

**Need to Belong.** One reason we seek to retain the lessons of culture and per-

sonal experience is that the brain is a social organ. It loves the company of other brains. Indeed, it demands the company of other brains. To survive and flourish, it must *belong*. Belonging is so important to the brain that it spends its downtime—when it is thinking of nothing in particular—rehashing relationships, asking, "Did I belong? Was I accepted? Did they like me?"

"Social to the core," as Michael S. Gazzaniga put it in *Human: The Science Behind What Makes Us Unique*, the brain also delights in gossip because gossip makes it feel included. Men and women alike spend hours gossiping. Cell-phone conversations are rarely about Tolstoy or astrophysics. They're about personal matters. Women spend one-third of their conversation talking about themselves. "My friend gave me roses." "I really do want that facelift." "We meet every winter to ski." Keenly interested in others, women spend two-thirds of their conversation talking about other people. "The last time I saw her, she looked upset." Men also love to gossip. They call it "exchanging information" or "networking," but it's still just gossip. Furthermore, men spend two-thirds of their time talking about themselves: "I beat my own personal best in that marathon." "I convinced the boss to use my design." "I think she likes me."

Belonging is so important that not belonging generates actual pain. When we do not belong—when we feel rejected, ignored, mocked, or reprimanded—we experience the same hurt that physical pain causes. Two brain regions respond to physical pain. The same two regions also respond to social pain. These two regions—the anterior cingulate cortex and the right ventral prefrontal cortex—react to the pain of a broken arm, and they react to the pain of social distress. When you break your arm, or when you are ignored, your anterior cingulate cortex immediately sends out an alarm: "Pain . . . something is terribly wrong." This alarm serves to alert the right ventral prefrontal cortex to dampen the pain as much as possible.

The pain of not belonging is so intense that we try hard to avoid it. To avoid the pain of not belonging, we

conform. We repeat the same ideas our friends and colleagues voice. We accept culture's dictates. Willingly, we become prisoners of context, physical and mental.

**Search for Meaning.** A second major reason that humans automatically struggle to protect their values and convictions is that in order to survive, the brain requires *meaning*. In its perpetual quest for meaning, the brain looks for patterns and order in everything. Troubled by randomness, for example, it tries to make sense of life, asking, "Is my job worth doing?" "Why did those teenagers have to die in a car crash?" In its quest for meaning—for order, significance, and purpose—the brain protects, apparently, the beliefs and practices it has long known and resists anything that does not fit its patterns. Ironically, protecting meanings causes us to *miss* the new meaning that an immediate physical context offers us now, as we inhabit the moment.

**Habit.** A third major reason that human beings struggle to protect customary thoughts and practices is that *habit* grips the human brain. Gipsie Ranney provided a fine instance of the power of habit when she said that many CEOs insist that "increases in external incentives will enhance performance." They make this claim despite compelling evidence showing that external incentives actually squelch creativity, discourage risk taking, and increase conformity. These CEOs cling to their belief in external incentives because, often reinforced, it has become habitual. Once a thought becomes habitual, it occupies physical space in the brain.

### The Brain's Habit Center

The habit center of the brain consists of interconnected clusters of neurons located near the core of the brain and called the basal ganglia. Scientists have long known that parts of the basal ganglia affect movement. They now realize that the basal ganglia is also implicated in storing habits. For example, when an activity is practiced so long that it becomes habitual, like leaving the house at six every morning to go jog-

ging, the habit is stored in the basal ganglia. Habits of thought seem also to be held in parts of the basal ganglia. If throughout childhood you were treated kindly, and if you were always encouraged to practice kindness, then neurons in your basal ganglia became wired to form circuits holding the habit of kindness. Embedded in your brain and emerging in your personal Self is the habit of always doing the kind act.

Habits—good and bad alike—are hard to break. One reason habits are hard to break is that they occupy physical space in the brain. The more a habit is practiced, the more real estate it usurps.

Habits are also hard to break because when we try to get rid of a habit, one part of the brain, the orbital frontal cortex, sends out an error message. The orbital frontal cortex, located just above and behind the eyes, is the brain's error detector, constantly appraising situations to see how things are going. When expectations are thwarted, the orbital frontal cortex sends out an error alert—like a flashing orange hand at a crosswalk that warns pedestrians to rush to the safety of the curb. This error message says, "Something is not right."

When a healthy person tries to break a habit, the orbital frontal cortex resists doing so, in effect declaring, "Breaking this habit is wrong." The error message at the same time triggers overwhelming emotions strong enough to vanquish rational thought. Overpowered by these emotions, the brain does not want to listen to reason. The brain wants victory, not truth. It wants to defend its interests, even if what it defends is illogical and unsubstantiated.

The following two versions of the "Trolley Game" illustrate the tendency of emotion to vanquish reason. While the first version favors reason, the second defers to emotion.

**Version 1.** You are on a bridge watching as an out-of-control train hurtles toward five unsuspecting workers on a track. There is a switch near you that you can use to divert the train onto a different track, where only one worker is standing. Would you divert the train to hit one person in order to

save five? Most people answer, "Yes." It's a question of logic. The part of your brain that reasons does the math. It tells you to sacrifice one to save five.

**Version 2.** You are standing on a bridge watching the train aim at five people. There is no way to divert the train. However, standing next to you on the bridge is a massively overweight stranger. If you push him off the bridge and onto the track, he will stop the train. You will kill him and save five. Will you push the stranger off the bridge?

Most people will not push the stranger. Simple logic says, "Kill one; save five." But now emotion is involved. It feels bad to push a stranger to his death. Emotion defeats reason.

Emotion also trumps reason in a well-known experiment called the "Ultimate Bargaining Game," involving sharing. Two players are given a chance to split money. One player receives \$100.00 and is invited to propose a split. The other player is allowed to accept or reject the offer. If he rejects it, neither player gets anything. Pure logic says, "Having money is desirable." Therefore one expects the first player to offer the worst possible split. Logic also says, "A little money is better than none." Therefore one expects the second player to take whatever is offered. However, typically players in the experiment defy logic. The person proposing the split frequently offers almost a fifty-fifty sharing, which is illogical. Such a split is normally accepted. However, when the first player offers significantly less than a fifty-fifty split, the second player rejects the offer. The second player's feelings of insult, anger, and unfairness trump logical self-interest. Emotions sometimes help us make good decisions, sometimes not.

### Mirror Neurons for a Change

Fortunately, we are not trapped in an overwhelmingly emotional, habit-ridden, culture-molded Self. We are capable of opening our minds, hearts, and wills, as systems thinkers and management theorists Otto Scharmer and Peter Senge so emphatically encourage us to do. We are capable of learning from one another, paying attention, thinking well, and seeing clearly.

Mirror neurons are the cells in the brain that make it possible for us to know what it is like to be another person. Giacomo Rizzolatti and his colleagues at the University of Parma discovered mirror neurons in 1996. They were studying how the brains of monkeys buzzed with activity when the animals picked up different objects. Astonishingly, when a trainer picked up some nuts and the monkeys just sat watching, the monkeys' neurons began to buzz—as if they were picking up the nuts. Watching the scientists grasp food had activated in the monkeys' brains the identical neurons that had buzzed earlier when the monkeys picked up food. Just watching caused neurons to fire and create circuits.

Human brains behave the same way. We, too, have mirror neurons. Mirror neurons look like any other neuron, but they have a surprising and unique double function. These neurons fire both when you *do* something—that is, when you perform an action or feel an emotion—and when you *watch* someone else do something—when you watch someone else perform an action or feel an emotion. Mirror neurons cause you to imitate that action or feeling in your brain.

For example, when someone else kicks a ball, your brain kicks the ball. When you see someone else feel an emotion, then your mirror neurons cause you to feel that same emotion. Your brain makes circuits that hold that feeling. When you observe a woman smile in happiness, then your mirror neurons cause you to feel that same happiness. Because of mirror neurons, you do not have to reason to yourself, “That woman looks happy; therefore she must be happy.” Mirror neurons let you just *know* the person is happy.

Furthermore, suppose that you are with a friend who is anxious. As you watch your friend feeling anxious, your mirror neurons wire to imitate your friend's emotion. You “catch” his anxiety. Now you feel anxious, too. Furthermore, your anxiety causes your *own* body to react. In effect, secondhand emotion affects us physically. When we see an emotion on another's face, that sight affects both brain and body.

Mirror neurons are sometimes called “empathy neurons” because they let us empathize. They let us unite with another, understanding another's experience completely and compassionately.

The fact that human beings are equipped with these powerful mirror neurons changes our view of human nature. By nature, human beings seek intimacy and form close ties with others. By nature, humans are highly social, cooperative, and collaborative. By nature, humans are an “empathic species,” born equipped with neurons that unite us. It is possible that, given this capacity for empathy, human beings have survived not primarily by being aggressive, self-sufficient, independent competitors fighting tooth and claw to gain every advantage. On the contrary, it seems that we have survived by seeing with another's eyes and feeling with another's heart. Neuroscientist Richard Restak says, “If we try to think in a compassionate manner about the other person—no matter how difficult that may be—we then become capable of empathizing—of thinking and feeling *as that person does*.” We become one with the person, united.

### A New Responsibility

Understanding the power of mirror neurons as well as the fact that daily life shapes the brain brings with it great responsibility. We now realize that those watching our actions and displays of emotion will “catch” our behavior, performing it in their own brains. Surely we must take care, then, that our behavior is worthy of emulation. We must also be careful of what we are willing to observe. When we observe the actions and feelings of others, especially for a sustained period, our brains perform those same actions and feelings. What behavior do we want our brains to replicate?

And what truth does knowledge of mirror neurons and the brain's plasticity permit us to confidently promulgate? How do we know that our own peculiar daily life and interactions have led us to truths?

Culture gives us, of course, its version of truth. For example, virtually all cultures teach a few universal moral principles.

1. **Do no harm.** Be compassionate, empathize, oppose cruelty, alleviate suffering.
2. **Be fair.** Give everyone an equal chance. Punish cheaters; repay kindnesses. Do unto others as you would have them do unto you.
3. **Support the community.** Share, be generous, collaborate, volunteer.
4. **Respect authority.** Show respect for those in authority. Fulfill duties and obligations.
5. **Be pure.** Reject things that contaminate, such as incest and polygamy.

The trouble is that interpretations of these universal principles are local. In some countries and in some religions, *do no harm* permits stoning a woman to death for having sex out of wedlock. Surely we must be wary of judging right and wrong based upon universal moral codes that yield widely divergent interpretations.

But if we can't trust local interpretations of universal moral codes, what foundation does allow us to make moral judgments? Science might help. For example, as Professor Will Keepin explains, “In field after field, in biology, physics, nonlinear dynamics, artificial life, complexity theory . . . [is] a new idea . . . that beyond the physical realm, there exist invisible patterns and principles that somehow organize what we observe and experience.” Apparently there exists “a realm beyond the observed, material, empirical world . . . Something transpires behind that which appears.” Might an ethic be drawn from that observation? What might a new moral code be? Perhaps a new moral code will emerge from our capacity to empathize.

The point is that definitive concepts of right and wrong are elusive. Achieving the fullest understanding possible about ethical and other matters is exceedingly difficult. Because it is so difficult, each of us has a responsibility to open our minds and hearts to every single context we inhabit, always searching for truth. To open our minds intelligently demands, among other things, thinking well and paying attention.

**Thinking Well.** Thought alone—just thinking—can actually connect neurons in emotional regions of the brain



so that they hold a positive outlook. If we begin each morning writing down three reasons to be grateful, we will in time weave brain circuits that hold a grateful attitude. Buddhists meditate on compassion and as a result generate brain circuits in which compassion is embedded.

**Paying Attention.** Thinking well requires paying attention. Paying attention in a disciplined way intensifies the brain's response to any thought or sensation. To understand the force of paying attention, consider that all objects possess shape and color. Take a chair, for example. The shape of the chair is processed by distinctive circuits of neurons. The color of the chair is processed by an entirely different circuit of neurons. Neurons that process the shape of the chair have nothing to do with those that process the chair's color. Therefore, if you choose to pay attention only to an object's shape, then you strengthen only the neurons that specialize in shape. If you then focus on the object's color, you will bolster the neurons that specialize in color.

Targeting an object, taking aim, is the first step in paying attention. Having chosen the target, concentrate on it. Ignore distractions and irrelevancies. Return wandering attention to the target, re-aim. This process wires the target into the brain's circuitry, thus changing the brain's physical structure.

Paying attention is of huge importance to anyone interested in context because it makes the brain alert and vigilant. Otherwise, we might end up in this situation:

- "What big eyes you have Grandma," Red Riding Hood said, oblivious of the countless past visits when her Grandma's eyes did not seem big.
- "What big ears you have, Grandma," she said matter-of-factly. Had she concentrated, Red Riding Hood would have recalled that her grandma's ears had never looked big, furry, and pointed.
- "What a deep voice you have, Grandma," she said blandly, as if her Grandmother's voice had always sounded deep and low.
- "What big teeth . . ." At last paying attention—too late—Red Riding

Hood realized that she had been talking to a wolf.

Poor Red Riding Hood. No one taught her to concentrate, so she wasn't vigilant. Clearly William James was right when he said, "An education that would improve attention would be the education par excellence."

### A Work in Progress

We human beings are capable of exercising mindfulness—of paying attention and thinking well. We are able to suspend disbelief, listen, learn, and deepen understanding.

- Shall we, then, in any context strive intentionally to cultivate compassion, patience, and love?
- Shall we perhaps apply the term "social" not only to relationships among human beings, but to relationships among every living thing?
- Shall our values serve not only our own ends, but those of all life?

The Self, a work in progress until the day we die, has the power to grow and learn in all the contexts it inhabits. What's more, it has the power to transform these contexts and, in so doing, perhaps even save the world. Let's use our knowledge of the brain to cultivate reason, curiosity, mindfulness, and empathy now, in today's context, so that our wise decisions enable human beings and Earth to flourish always. ■

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businesses and schools. She is currently writing a book about the brain tentatively called *Love Your Brain, Improve Your Life*.

**AUTHOR'S NOTE:** The material in this article is based on numerous studies that, in an academic journal, would be scrupulously documented. For this publication, space permits mentioning only a few major sources: Sharon Begley, *Train Your Mind, Change Your Brain* (New York: Ballantine Books, 2007), pp. 156-160; John B. Cobb, Jr., "Capital," a paper written for a conference in Suzhou, China, January 2009, pp. 4-13; David Dobbs, "A Revealing Reflection," *Scientific American Mind*, April/May 2006, pp. 22-27; Michael Gazzaniga, *Human* (New York: HarperCollins, 2008); Marco Iacoboni, *Mirroring People: The New Science of How We Connect with Others* (New York: Farrar, Straus and Giroux, 2008), pp. 1-46; Will Keepin, "Science and the Spirit: Integrating the Sacred and the Secular," *Time-line*, September/October 1998, p. 15; Ellen J. Langer, *The Power of Mindful Learning* (Cambridge: Perseus Books, 1997), pp. 1, 4, 16-18, 100, 103-105; Daniel J. Levitin, *This Is Your Brain on Music* (New York: Plume/Penguin, 2007), pp. 26-27, 40-43; Gipsie B. Ranney, "The Trouble with Incentives: They Work," Ongoing Discussion Thought Piece for Pratt and Whitney Rocketdyne's Enterprise Thinking Network, pp. 5-7; Richard Restak, *The Secret Life of the Brain* (New York: Dana Press & The Joseph Henry Press), 2001, pp. 44-45; C. Otto Scharmer, *Theory U* (San Francisco: Berrett-Koehler, 2009), 119-121; *Theory U's* Foreword by management theorist Peter Senge, p. xiii; Jeffrey M. Schwartz, M.D., and Sharon Begley, *The Mind and the Brain* (New York: Harper Collins, 2002), pp. 59-73; Daniel Siegel, *The Mindful Brain* (New York: W.W. Norton & Company, 2007), pp. 110-118. For the relationship of emotion to reason, see Antonio Damasio, *Descartes' Error* (New York: Avon Books, 1994), pp. 70-71, 159-160. Matthew Lieberman and Naomi Eisenberger, working at UCLA, discovered that emotional pain is comparable to physical pain.

### NEXT STEPS

At every moment, *context* gives us a chance grow. To do so—to make the mind wide open—we must ask questions. For example:

- Rather than ask an old question, such as, "How can we solve the problem of hunger?" frame a different question: "How can we and our neighbors fund and operate a food cart to provide warm food for the homeless?"
- Ask about meaning: "What meaning does this moment hold for me? What understanding can I take away?"
- Ask about people: "What does *he* like to do? What does *she* worry about?" Wonder what it is like to be that person.