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MIND MATTERS

Turn Off Genetic Vulnerabilities by Reducing Stress

Because of its mechanistic and reductionist bias, mainstream medicine has always been slow to acknowledge that our minds play a vital role in our physical health. This was especially the case in the sixties and seventies, when there was an ongoing debate about whether or not our thoughts and feelings could directly influence our biochemistry. In those days, the materialists had the upper hand, but the rising tide of evidence eventually forced them to give ground. Toward the end of that era, my book *Mind as Healer, Mind as Slayer*, published in 1977 by Random House, was among the first to herald this once-elusive mind-body connection. In that book I defined stress as a condition that affects both

mind and body, and I showed how it contributes to four major types of chronic illness: heart disease, cancer, arthritis, and respiratory illnesses. Along with my other colleagues in the emerging field of integrative medicine, I have been able to demonstrate through my subsequent research and writing that we can reduce our chances of getting those and other degenerative diseases if we commit ourselves to managing our stress effectively.

In fact, I went even further in my research. I discovered that some people had the ability to *master* the connection of their mind and body. As I followed the thread of research, I met and studied adept meditators who—under strictly controlled conditions—were able to demonstrate that they could exert a remarkable degree of control over pain, bleeding, and infection once they had achieved a meditative state in the laboratory. These people were the pioneers, the exemplars, for those of us who aspire to turn our minds into lifelong allies for health and healing.

Jack Schwarz, a Dutch meditation teacher, was perhaps the most impressive of these masters. He had learned to control his own pain and bleeding when he was tortured as a prisoner in a Nazi concentration camp. When my colleagues and I first began to study him under exacting laboratory conditions at the University of California School of Medicine in San Francisco, Jack seemed ordinary at first. He exhibited perfectly normal baseline responses to pain and a normal bleeding time when he was not meditating. Next we asked him to meditate in the controlled conditions of the

lab. When I subjected him to pain during his meditation session, we were amazed to observe that his brain waves showed none of the electrical changes normally associated with pain. We then went so far as to ask him to subject himself to pain with a self-inflicted wound by pushing a sharpened, unsterile knitting needle entirely through his left bicep. We discovered to our surprise that he was able to reduce the bleeding by accelerating the time it took for his blood to clot.

In a later documentary film for the Canadian Broadcasting Corporation, Schwarz again pushed a sharpened knitting needle completely through his bicep without any display of discomfort. As astounding as that was to witness, he insisted that the real significance of his demonstration was that all of us—not just exceptional individuals—are able to wield such a profound influence over our body. That insight has remained a major theme in my work ever since.

Very few of us will become so adept that we can impale ourselves with knitting needles, nor would we want to of course! But I believe that we all have the mental, emotional, and spiritual capacity to fully manage the levels of stress we experience every day. When I first published my study of Jack Schwarz, it was controversial. Not everyone in the media or in the medical community accepted the idea that we could actually control our own nervous systems. But today the important truth that *all of us are born with a natural ability to self-regulate stress* is a cornerstone of modern medicine, or at least integrative medicine.

More recently, an unexpected and perhaps an even more

exciting chapter is unfolding. With the knowledge explosion in human genetics, the same debate is back again, but in a new form: Can our minds directly influence our genes? What's different this time is that genetic testing and retesting gives us an unprecedented ability to precisely monitor the biological effects of our mental and emotional states. In other words, this time we can prove—almost right away—that we can modify gene expression by cultivating relaxed, healthy, and positive states of consciousness and self-awareness. We don't need to wait for long-term studies or engage in a lifetime of meditation or other consciousness practices in a vague hope that we might one day succeed. All we need is a blood test to see exactly how our genetic biomarkers have changed in response to our current behavior.

Let's consider just a few examples of such influence among the many studies that pioneering researchers worldwide have carried out in recent years, beginning with a scientific look at the lifelong epigenetic effect of childhood stress.

Epigenetic Changes from Early-Life Trauma

Early-life stress matters—we have proof that it has a measureable epigenetic effect. Research shows that undue strain or abuse experienced during a child's development affects that young person's epigenome far into adulthood, altering patterns of stress response and often leaving the child with lifelong physical vulnerabilities or emotional disabilities that

require treatment. These early epigenetic influences literally burn trauma into the brain and body, or what I prefer to call *the body-mind*. In brief, here are three remarkable instances of how "mind as slayer" can bring about negative genetic alterations resulting from childhood trauma:

- A study of 448 Dutch soldiers showed that early-life trauma changed more than 45,000 genes in the hippocampus, causing these men to be more vulnerable to emotional stress and PTSD later in life. (The hippocampus is thought to be the brain's center of emotion and memory, and the heart of the autonomic nervous system.)

- A study of 204 undergraduate women whose DNA was collected before and after a campus shooting had startling results. The specific epigenetic modifications created by this early trauma predicted which of these women would later suffer from PTSD-related symptoms as a result of experiencing or being in proximity to the shooting.

- In another study of early trauma, 25 people with a history of abusive childhoods who died by suicide were compared to 16 controls who had died suddenly but who did not have abusive histories. Genetic analysis focused on 23,551 hippocampal genes. The group that had experienced abuse showed extreme expression (either greater or lower methylation) in 362 neuronal genes. This result means that the functional ability of their genes to assess

and respond to danger had been radically changed by child abuse, and may in turn have resulted in their suicide. This unique study suggested that childhood trauma can alter the expression of genes that regulate neuronal function.[35]

The Impact of Early-Life Trauma and Stress on Telomeres

Can early-life trauma affect our telomeres? A 2012 study at Duke University suggests that it can, corroborating earlier studies that have found that children who are physically abused or bullied tend to have shorter telomeres. As discussed earlier, telomeres are the biochemical structures at the tips of chromosomes whose shrinkage has been linked to aging and disease; as cells divide, these structures grow shorter, limiting the number of times a cell can reproduce.

Previous research had already identified an association between stress and accelerated telomere loss. Plus, shortened telomeres were *sometimes* shown to correlate with other health problems including aging, smoking, obesity, mental illness, heart disease, and chronic fatigue. Telomere erosion has also been related to both oxidative stress and inflammation, but such links are not always present in telomere research. "There's a lot of doubt in the field," says Dr. Joao

35 B. Labonté et al., "Genome-Wide Epigenetic Regulation by Early-Life Trauma," *Archives of General Psychiatry* (July 2012) 69:722.

Passos, a cellular aging specialist at Newcastle University. "For as many studies that show telomere length as a good predictor of health outcomes, there are many that find no relationship."[36]

The Duke University study was more advanced in design than many previous efforts and led to a distinctive outcome. The Duke researchers used data from the Environmental Risk Longitudinal Twin Study, which followed British twins from birth. The team selected 236 of these children, half of whom had experienced at least one form of violence. Using DNA samples collected at ages 5 and 10, the investigators assessed how many times a particular gene had copied itself. Significantly, they found that gene replication was indeed lower among children who had experienced violence. The team not only noted a clear relationship between violence and shortened telomeres, but it also discovered a significant association between the *number* of violent experiences and the amount of telomere loss. According to one coauthor of the study, Dr. Avshalom Caspi, "Children who experience physical violence appear to be aging at a faster rate."[37]

Parents and caregivers may well wonder whether this process can be reversed once it is set in motion in childhood. Some studies suggest that making healthful lifestyle changes,

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36 http://www.sciencemag.org/news/2012/04/childhood-stress-leaves-genetic-scars.

37 I. Shalev et al., "Exposure to Violence during Childhood Is Associated with Telomere Erosion from 5 to 10 Years of Age: A Longitudinal Study," *Molecule Psychiatry* (May 2013), 18:576, https://www.nature.com/articles/mp201232.

such as reducing stress, eating well, and exercising, can slow down the rate of telomere loss. But much more research is needed in this important field.

Altering the Expression of Prostate Cancer Genes

There is little question that early-life trauma has a direct and enduring impact on our genes, but it's not a one-way street. Just as mental stress and adversity can affect our genes, so also is it possible to have a *positive* impact through the mind. That is when "mind as healer" becomes a reality. In fact, some research shows that intervening to reduce stress through the development of better habits can push our genes toward healthy expression and directly enhance our wellness and longevity.

For example, in part because of this insight about the biological influence of the mind, we have recently witnessed a sea change in the diagnosis and treatment of prostate cancer. In 2012, the U.S. Preventive Services Task Force advised against the routine prostate cancer screening that provides doctors with PSA readings, since positive results on this test often lead to premature and excessive medical interventions with major negative side effects. Significantly, this advisory was based on the finding that the onset of prostate cancer is reversible through lifestyle changes.

Along this line, one new direction in the treatment of prostate cancer involves an intensive lifestyle and nutrition

program focused on influencing the genes involved in prostate cancer. In 2008, a group of researchers at the UCSF School of Medicine in San Francisco enrolled 31 men with a low-risk form of prostate cancer who agreed to decline immediate surgery, hormonal therapy, or radiation while undergoing careful surveillance for the progression of their prostate tumors. Instead of the usual medical interventions, these men undertook an intensive, three-month program in which they followed a low-fat, plant-based diet and engaged in stress management practices. When comparing their PSA readings at the start and completion of the program, the researchers found these practices had decreased the expression of the genes associated with prostate cancer.[38]

Dramatic Genetic Changes from Massage

Direct body-mind interventions by caregivers can also positively change gene expression. For example, new research has revealed for the first time that the kneading of sore muscles by a massage practitioner can turn off genes associated with inflammation and turn on genes that help muscles heal. A unique study based on this hypothesis was designed and led by Dr. Mark Tarnopolsky, a neurometabolic researcher at McMaster University in Canada. Tarnopolsky had suffered a severe hamstring injury in an accident and had received

38 https://www.ucsf.edu/news/2015/11/253051/working-sweat-may-protect-men-lethal-prostate-cancer.

massage therapy as an essential part of his rehabilitation regimen. The massage therapy he received seemed to be so effective that Dr. Tarnopolsky set out to investigate the biochemistry behind it. He was surprised to find that, despite the widespread popularity of massage, researchers in that field knew surprisingly little about its molecular and genetic effects.

Two key benefits of massage had previously been well-documented: an increase in blood circulation in the massaged areas, and the general release of *endorphins* (which decreases pain and increases sensations of pleasure). Researchers knew these positive results were possible, but no one had yet explained how and why these effects occur. Dr. Tarnopolsky wanted to answer these and other questions.

Tarnopolsky and his colleagues designed and conducted their own study, recruiting 11 young men willing to undergo a grueling upright cycling session that left their muscles damaged and sore. Ten minutes later, a massage therapist massaged one of their legs. The researchers took tissue samples from the quadriceps of both legs of each of the volunteers at three points: once before the workout, once ten minutes after the massage, and once three hours after the workout. Then they compared the genetic profiles of each sample.

Samples taken before the massages but after the exercise were not a surprise. Researchers detected a greater presence of cell repair activity as well as acute inflammation in the post-workout samples than in the pre-workout samples; this was consistent with the established fact that exercise activates genes associated with these two processes. But

what did surprise them were the clear differences between the massaged legs and the unmassaged ones after the exercise. Massaged legs showed 30 percent more expression of a gene that helps muscle cells build mitochondria, the cellular engines that turn a cell's fuel into energy. Even more impressive, these men also had *three times less* amount of a chemical that turns on genes associated with inflammation.

Dr. Tarnopolsky's results prove that massage reduces inflammation caused by exercise and promotes faster healing of affected areas. Incidentally, the study found no evidence to support widely believed claims that massage removes lactic acid, a by-product of exertion long blamed for muscle soreness. Most important, this study underscores the truly amazing finding that the human touch during massage actually induces positive changes in gene expression, leading directly to muscle healing and improved body-mind health.

Managing Gene Expression in Schizophrenia

In recent decades, geneticists have discovered that schizophrenia is highly heritable. But the small size of some studies and the immaturity of the field of bioinformatics left doubt about the specifics of the perceived link between genes and this mental disease.

This dilemma was remedied in 2015 by a huge genome-wide association study of nearly 37,000 cases of schizophrenia

and 113,000 controls. The GWAS researchers identified 108 genetic loci linked to schizophrenia, 83 of which had not been reported previously.[39] (A loci, as noted earlier, refers to the fixed position—on a chromosome—of a gene or an epigenetic marker.) Most of these loci were located in brain cells that interact with dopamine or other neurotransmitters; intriguingly, some of these same gene locations are also involved in the body's immune response, which the scientists considered to be an important correlation because of previous research.

Many new potential therapeutic targets for nutrients or drugs are believed to have been identified because of these results. Further, the large size of this landmark study and the researchers' use of advanced statistical techniques lend weight to these findings. According to an article in *Nature* by the Schizophrenia Working Group of the Psychiatric Genomics Consortium, "This study supports the hypothesis that the biology of schizophrenia involves changes in neurotransmission that are affected by the acquired immune response. It also suggests that environmental agents might trigger the disease in individuals with genetic susceptibility since birth."[40]

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39 Schizophrenia Working Group of the Psychiatric Genomics Consortium, "Biological Insights from 108 Schizophrenia-Associated Genetic Loci," *Nature* (July 24, 2014): 511:421, http://dx.doi.org/10.1038/nature13595.

40 Ibid.

The Epigenetics of Phobias

It has long been known that anxiety disorders can result from inherited genetic susceptibilities. Research that builds on this fact is now looking at the epigenetics of specific phobias.

For example, one research group showed that a single gene might actually account for claustrophobia. In a 2012 study of this phobia, the researchers focused on the GPM6A gene, which was already known to be responsive to stress. Previous research had linked this gene to regulation of opioid receptors and serotonin transporters and indirectly to the so-called human panic response as well as to depression in schizophrenia. The research team went further, finding that claustrophobic individuals had significantly more abnormalities in this gene when compared to nonclaustrophobic individuals.[41]

In addition to this discovery, pioneering research points to the possibility that some phobias might actually be the result of "memories" passed down by means of transgenerational epigenetic inheritance from ancestors who had suffered from the same phobia.[42] (We introduced epigenetic inheritance in Chapter 1.) This finding contrasts with the belief long held by psychologists that phobias can only result from traumatic personal experiences in a person's own childhood.

A remarkable test of the hypothesis of the epigenetic

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41 A. El Kordi et al., "A Single Gene Defect Causing Claustrophobia," *Translational Psychiatry* (Apr. 30, 2013): 3:e254, http://dx.doi.org/10.1038/tp.2013.28.

42 R. Gray, "Phobias May Be Memories Passed Down in Genes from Ancestors," *Telegraph Sun* (May 24, 2015), 1–3, http://www.telegraph.co.uk/news/science/science-news/10486479/Phobias-may-be-memories-passed-down-in-genes-from-ancestors.html.

inheritance of a phobia was carried out by Dr. Brian Dias, a psychiatrist at the Emory University School of Medicine. Dias trained mice to fear the smell of cherry blossoms using electric shocks; later on they were permitted to breed.[43] To the great surprise of many, two subsequent generations of these mice showed fearful responses to this odor compared to a neutral odor, despite never having encountered these smells before. Autopsies of the brains of the trained mice and their offspring showed structural changes in regions that govern the sense of smell. Dias and his team concluded that the DNA of these animals carried epigenetic modifications on the associated genes.

"Our results," said Dias, "allow us to appreciate how the experiences of a parent before even conceiving offspring markedly influence both structure and function in the nervous system of subsequent generations. . . . Such a phenomenon may contribute to the etiology and potential intergenerational transmission of risk for neuropsychiatric disorders such as phobias, anxiety, and post-traumatic stress disorder."[44] Professor Marcus Pembrey, a pediatric geneticist at University College of London, strongly supports this controversial notion of the biological transmission of a phobia. "It is high time public health researchers took human transgenerational responses seriously. . . . I suspect we will not understand the rise in neuropsychiatric disorders or obesity,

43 https://www.nature.com/articles/nn.3594.

44 Ibid.; Gray, "Phobias May Be Memories Passed Down in Genes from Ancestors."

diabetes, and metabolic disruptions generally without taking a multigenerational approach."[45]

This and other research vividly points to the idea that transgenerational inheritance exists and is mediated by the epigenome. But much more research is needed to refine these insights.

Stress Hormones Can Cause Epigenetic Changes

For both mice and men, science is revealing the genetic and biochemical pathways through which chronic exposure to stress hormones can change gene expression.

During stressful situations, we produce beneficial hormones called *glucocorticoids* (GC) that affect many bodily systems. GCs are anti-inflammatory, but they also work in the body's immunity pathway. Because this class of hormones is known to be immunosuppressive, drugs containing pharmaceutical versions of this hormonal family are sometimes used to treat diseases caused by an overactive immune system, such as allergies and asthma.

Then again, too much of a good thing can cause new problems. Many past studies have found that an *excessive* amount of glucocorticoids can alter gene expression in the brain. And some researchers have suggested that such

45 Ibid.; Gray, "Phobias May Be Memories Passed Down in Genes from Ancestors."

influences extend even wider, in part because the distribution of the effects of GCs are mediated by what is known as the *hypothalamic-pituitary-adrenal axis* (HPA)—a network that links the hypothalamus and the pituitary gland in the brain with the adrenal glands near the kidneys. Thus, a more advanced question concerns how GCs affect the genes that regulate the entire HPA axis. A group led by Drs. James Potash and Gary Wand at the Johns Hopkins University set out to answer this question by testing the hypothesis that hormones affect the entire HPA axis through epigenetic modification.

The researchers added *corticosterone* (a glucocorticoid secreted by the adrenal gland) to the drinking water of mice for four weeks. After exposure, and again after a four-week recovery period without corticosterone, the scientists examined the expression levels of five HPA-axis genes. In particular, they measured the degree of methylation in each gene (a common form of epigenetic modification, as previously noted).

In the September 2010 issue of *Endocrinology*, the researchers reported that mice given corticosterone exhibited an altered expression of three of the five HPA-axis genes, which they attributed to decreased methylation.

Now, it turns out that methylation in these same genes has also in the past been associated with PTSD and mood disorders. These newer findings by the Johns Hopkins researchers suggest that epigenetic modification (through methylation) occurs because of the excessive secretion of the GC hormone. "This gets at the mechanism through

which we think epigenetics is important," says Potash. "Epigenetic marks added to DNA through life experience may prepare an animal for future events. If you think of the stress system as preparing you for fight or flight, you might imagine that these epigenetic changes might prepare you to fight harder or flee faster the next time you encounter something stressful."[46]

Those of us who face stressors such as unreasonable work deadlines are—unlike our cousins in the animal world—unable to fight or flee, and such chronic stress may lead these emotionally trapped humans to experience a variety of hormonal disorders that are then "baked in the cake" epigenetically. This new research suggests that epigenetic changes may play a key role in creating stress-related diseases, and could point to effective treatments.

Meditation Positively Alters Gene Expression

Today's popular mindfulness and meditation practices come in many forms and are now known to have more than a few measurable effects on mental health. For example, the secular meditation-training program known as *mindfulness-based stress reduction* (MBSR) has long ago been shown to reduce depressive symptoms.

More recently, MBSR researchers at Duke University

46 https://www.nih.gov/news-events/nih-research-matters/stress-hormone-causes-epigenetic-changes.

wanted to know how the beneficial effects of this practice on depressives might vary according to demographics. For example, what happens if we factor in a person's religious belief system? Or, how does age or gender modify the effect of MBSR on depression?

To answer such questions, a team of researchers led by Dr. Jeffrey M. Greeson of the Duke Integrative Medicine Center studied the variations in depressive symptom outcomes among 322 adults who enrolled in an eight-week MBSR program. Remarkably, they discovered that depressive symptom severity decreased significantly, showing statistically significant reductions across all the identified subgroups—including religious affiliation, intention for spiritual growth, gender, and baseline symptom severity.

The discussion of their findings by Greeson and his colleagues is worth paraphrasing in detail:

The current results suggest that changes in depressive symptoms following MBSR are explained, in part, by increased mindfulness of thoughts and feelings and by an enhanced perception of spirituality in daily life. Given the connection between spirituality and mental health, mindfulness practice could parallel religious and spiritual practices, such as prayer and meditation. . . . Other MBSR outcome studies have reported that reduced depressive symptoms may be partially explained by lower levels of rumination, a known risk factor for depression. . . . Equally likely, the decrease in depressive symptoms may arise from the practice of

disengaging from depressive thoughts and recognizing that they are just mental events rather than truth—a core skill called decentering.[47]

Because of this significant link to the reduction of depression, I would suggest that the next logical step for Greeson's team should involve research into the epigenetic effects of MBSR.

In fact, such an epigenetic link has already been discovered in a related form of meditation. The well-known form of meditation known as the *relaxation response technique* has recently been shown to not only have measurable psychological benefits but also discernible effects on gene expression.

Nearly 40 years ago, Dr. Herbert Benson of Harvard Medical School identified a discrete mind-body process that he named the *relaxation response* and showed it to be the physiologic opposite of the well-known *fight-or-flight response*. Benson describes it as a state of deep rest attained through breathing, meditation, yoga, and related practices. His so-called relaxation-response meditation technique is now widely used to help patients manage a variety of medical conditions from anxiety and chronic pain to cancer.

In an important additional breakthrough in 2013, researchers led by Benson at the Massachusetts General Hospital and Beth Israel Deaconess Medical Center reported that the relaxation response triggers changes in gene expression that can

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47 Jeffrey M. Greeson, Moria J. Smoski, Edward C. Suarez, Jeffrey G. Brantley, Andrew G. Ekblad, Thomas R. Lynch, and Ruth Quillian Wolever, *Journal of Alternative and Complementary Medicine* (March 11, 2015) 21(3): 166–174, doi:10.1089/acm.2014.0285, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4365440/.

affect the body's immune function, energy metabolism, and insulin secretion.

One of Dr. Benson's collaborators at Beth Israel Deaconess is Dr. Towia Libermann, the co-senior author of the study. According to Libermann, the evidence arising from their study clearly links the relaxation response to *rapid* changes in gene expression. Libermann reported that genes involved both in immune disturbances and inflammation pathways were repressed after participants practiced the relaxation technique, while another set of pathways involved in mitochondrial function and energy production were epigenetically enhanced.[48]

In the study, 26 participants were longtime practitioners of the relaxation response and 26 others who had never experienced it before were trained in the technique. Researchers used gene profiling to identify changes in these subject's gene expression. "These changes," Libermann said, "occurred in both groups but were more pronounced among the long-time relaxers." Libermann, who had worked with Benson for the previous decade, says he was drawn to this research "to convince myself that there's really something going on here, and it's not just a placebo effect. . . .I'm [now] pretty convinced." He and Benson are currently investigating whether the relaxation response triggers molecular-level changes in people with hypertension, inflammatory bowel disease, irritable bowel syndrome, and other diseases.[49]

In a 2008 study that had focused on the long-term practice

48 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0062817.

49 http://commonhealth.legacy.wbur.org/2013/05/genes-altered-after-relaxation-practice.

of the technique, Benson and Libermann also discovered changes in stress-response genes. Blood samples from participants were analyzed to determine effects on 22,000 genes, and revealed significant changes in the expression of several important groups of genes over time. In particular, genes that manage energy metabolism were found to be upregulated because of the relaxation response, and pathways controlled by the activation of a protein called NF-κB—which is known to play a prominent role in inflammation, stress, trauma, and cancer—were suppressed by the practice.

Because of these positive results, Benson and Libermann have concluded that "relaxation causes multiple gene-expression changes that create 'mitochondrial resilience' by stabilizing key cellular processes during the adaptation to oxidative stress and by enhancing cell survival and function. The rapidity of these changes is noteworthy, as is the finding that more changes occur with more practice."[50]

Building on these results, researchers have demonstrated with convincing evidence that mindfulness meditation can induce *immediate and direct* modification of gene expression. Previous studies had shown dynamic epigenetic responses to diet or exercise within just a few hours, but for the first time, two new studies have demonstrated evidence of epigenetic changes following a single period of mindfulness practice.

The first is a landmark study published in 2014 in *Psychoneuroendocrinology* by researchers in Wisconsin, Spain, and

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50 Ibid.

France that provides evidence of gene changes following a daylong period of mindfulness practice. After eight hours of disciplined sitting, meditators showed a range of genetic and molecular alterations, including reduced levels of pro-inflammatory gene expression that were not observed in the non-meditating control group.

"Most interestingly," writes Dr. Perla Kaliman of the Institute of Biomedical Research in Spain, who was the first author of the article, "the changes were observed in genes that are the current targets of anti-inflammatory and analgesic drugs. . . . Our findings set the foundation for future studies to further assess meditation strategies for the treatment of chronic inflammatory conditions." Another leader of the study, Professor Richard J. Davidson, founder of the Center for Investigating Healthy Minds at the University of Wisconsin-Madison, noted, "We can think of genes possessing a molecular volume control that ranges from low to high that will govern the extent to which the gene produces the protein for which it is designed. The genes that we found to be down-regulated with mindfulness mediation practice are those implicated in inflammation."[51]

Just as remarkable is a 2013 study from Harvard Medical School that showed immediate effects from a far briefer period of meditation.

In this study, gene profiles were analyzed in 26 long-term meditators before and after a mere 20-minute practice

51 https://www.psychologytoday.com/blog/the-athletes-way/201312/meditation-has-the-power-influence-your-genes.

session. These profiles were compared to 26 novices who were not meditators. In the long-term meditators, there was an increased expression of genes involving energy metabolism, mitochondrial function, insulin secretion, and repair of telomeres. Additionally, the genes involved in inflammatory response and oxidative stress were suppressed or turned off. Researchers were amazed that such changes could take place after only 20 minutes of practice by skilled meditators. Clearly, the changes in the state of consciousness in the minds of the meditators created a cascade of biological events that led to altered gene expression, which in turn changed specific biochemical pathways that govern their health and illness.

With these important studies, we now have compelling evidence of the power of the mind to move our genes and body chemistry toward optimal states of health and longevity.

The Pioneering Insights of Bruce Lipton

Dr. Bruce Lipton, formerly a research microbiologist and professor at the University of Wisconsin Medical School, goes yet another step further in his claims about the relationship of human consciousness and our epigenome.

This renowned and pioneering author of *The Biology of Belief* has long argued that our epigenome is altered by our ordinary perceptions and life experiences—which in turn are controlled by our beliefs. According to Lipton,

genes can display a large degree of plasticity because our perceptions directly affect our blood chemistry, which in turn alters gene expression. But, says Lipton, another factor is even more important: Our perceptions and experiences *are shaped far more by unconscious beliefs than most of us think possible*.

Our mind, according to Lipton, always seeks unity and consistency. "The function of the mind is to create coherence between our beliefs and the reality we experience," writes Lipton. "What that means is that our mind will adjust the body's biology and behavior to fit with our beliefs." Again, the key factor in this equation is that the most powerful beliefs are unconscious. Ultimately, the state of our biology comes down to how the subconscious mind—which contains our deepest beliefs—has been programmed in childhood.[52] In this paraphrase of a recent interview, Dr. Lipton summarizes this point:

The major problem is that people are aware of their conscious beliefs and behaviors, but not of subconscious beliefs and behaviors. Most people don't even acknowledge that their subconscious mind is at play, when the fact is that the subconscious mind is a million times more powerful than the conscious mind and that we operate 95 to 99 percent of our lives from subconscious programs. . . . Your subconscious beliefs are working either for you or against you, but the truth is that you are not controlling

52 https://www.brucelipton.com/resource/article/epigenetics.

your life, because your subconscious mind supersedes all conscious control. So when you are trying to heal from a conscious level—citing affirmations and telling yourself you're healthy—there may be an invisible subconscious program that's sabotaging you.[53]

The upshot is that our subconscious mind determines our biology and chemistry, which changes the gene expression of our cells. "Cells are like miniature people [in the sense that they have] similar functions, including digestive, reproductive, immune, and nervous systems. Each cell, like every human, has receptors built into its skin so it can become aware of the environment. If a person is in a stressful environment, every one of our cells is also experiencing that stress via the electromagnetic vibrations sent throughout our body [by the stress response]. Similarly, if we are happy, our cells are happy and in harmony."[54]

Psychologists generally agree that our habitual patterns of behavior are programmed from childhood up until around the age of six, after which our life is more or less controlled by those habits. If in our childhood we suffered from negative influences, we will need to make a conscious effort in adulthood to unlearn how we were programmed to think and behave as a child and to not rely on such maladaptive habits. According to Lipton, there are three ways that are effective in changing, limiting, or sabotaging beliefs in the subconscious

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53 Ibid.

54 Ibid.

mind: mindfulness meditation, clinical hypnotherapy, and a new healing modality known as "energy psychology."[55]

Two Effective Stress-Management Techniques

Based on the research we have sampled in this chapter, there is no doubt that meditation and stress management techniques offer benefits in developing a healthy epigenome. These methods are clearly a means to directly and positively influence our genes. Further, it appears that our cells swim in an "ocean" of biochemical influences that are governed, often negatively, by our perceptions and beliefs—which are in turn deeply conditioned by childhood programming. We can't see these issues because they lurk in our unconscious "shadow" self, and many of us remain in such denial of these effects that we fail to seek psychological or spiritual healing. Further, research shows that meditation practice alone may not solve these more intractable personal issues.

But for the purposes of this introductory chapter, let's turn back to the proven benefits of the simple practice of meditation or stress management, one of Lipton's three methods

55 According to Doc Childre, the founder of a popular energy psychology technique known as HeartMath, "'an energetic connection or coupling of information' occurs between the DNA in cells and higher dimensional structures—the higher self or spirit. 'The heart serves as a key access point through which information originating in the higher dimensional structures is coupled into the physical human system (including DNA), and states of heart coherence generated through experiencing heartfelt positive emotions increase this coupling.'" See Christina Sarich, "How Your DNA Is Affected by Quantum Intelligence," wakingtimes.com (Feb. 16, 2018), https://tinyurl.com/y9t84otg.

of psychological deprogramming. For those who desire to look into hypnotherapy and energy psychology, I refer you to Lipton's writings.

At a minimum, I often teach my patients two stress-management techniques they can practice anywhere and anytime. One focuses on breathing, while the other—known as *autogenic training*—is focused on the experience of heaviness and warmth. These techniques allow them to manage stress to attain a balanced, regenerative state that maximizes the efficiency of the seven pathways. Under ideal conditions, the pathways naturally work well, but as we have seen, daily stress, anxiety, or depression can interfere with their proper function. The truth is that meditation is actually deceptively simple, as you will see below. So, inspired by the profound findings of recent epigenetic research regarding such techniques, let's take a few minutes for some basic instructions. The form of mindfulness practice I recommend has been the basis for virtually all of the research I have cited. Those of you who have a solid meditation practice may skip this next section, but the following section on autogenic training is likely to be new to most readers.

Mindfulness Meditation—How to Get Started

Find a good spot in your home or apartment, ideally one with a minimum of clutter that affords some quiet. Leave the lights on or sit in natural light. You can even sit outside if you like,

but be sure to choose a place with little distraction. Any quiet place is good, even a park bench or a sand dune at the beach.

At the outset, it helps to set the amount of time you are willing to commit by simply using a kitchen timer or the timer on your cell phone. Otherwise, you may occupy yourself over deciding when to stop. If you're just beginning, it can help to choose a very short time in your early sessions. Even starting with one minute is fine! Eventually you will be able to sit for ten minutes, and at some point twice as long as that. Ultimately you may decide to meditate for up to 40 minutes or even an hour.

I recommend that you do one session in the morning and one in the evening. But if you feel that your life is too busy for a morning and evening session of, say, twenty minutes—doing one meditation each day is better than none at all, even if it is short.

A proper meditation requires that you assume a good upright posture in a chair or on some kind of cushion on the floor. If you prefer the floor, you can start with a pillow or a folded blanket, and later on you might purchase a meditation cushion that will last you a lifetime. Sit with your feet flat on the floor if you are in a chair, or loosely cross-legged in lotus posture if you are on the floor. Any comfortable position is fine, but make sure you are stable and erect. If the constraints of your body prevent you from sitting erect, find a position you can stay in for a while. All that said, what follows is some basic instruction:

Straighten but don't stiffen your upper body. There is a natural curvature to the spine, so just relax until you feel that soft curve in your lower back. Your head and shoulders

should feel balanced so that they rest comfortably at the top of your spine; it should not feel like you are holding them there, but rather balancing them. Keep adjusting your posture until it feels comfortable without holding yourself rigidly or with tight muscles.

Now, while maintaining your best posture, begin to pay attention to your breathing. Many meditation teachers say to follow your breath as you breathe in and breathe out, while others say to put more emphasis on the outbreath.

Inevitably, your attention will leave your breath and wander to thoughts, sensations, and distractions. When you get around to noticing that you have wondered off, simply return your attention to the breath. Don't bother judging yourself for forgetting your breathing or for getting concerned over the content of your thoughts. Just come back to following your breathing as your primary focus of attention. You'll often fall away from your focus, but you can gently come back. Soon you will settle into a relaxed state of mind in which you are simply witnessing the thoughts and feelings that arise while maintaining a single-pointed concentration on your breath.

This, then, is the most basic form of mindfulness practice. It is amazingly simple, but it's not necessarily easy to maintain. Our real work is to just keep doing it often, many times per week. Results will accrue, both in your sense of well-being and concentration and in terms of positive epigenetic changes.

The Technique of Autogenic Training

Autogenic training is a relaxation technique developed by German psychiatrist Dr. Johannes Heinrich Schultz in the 1930s. The technique can be used to alleviate many types of stress-induced psychophysiological disorders. This method involves the daily practice of sessions lasting several minutes that are usually done in the morning, but can be practiced at any time. During each session, the individual carries out a simple set of self-hypnosis instructions to induce a state of relaxation. They learn to bear in mind two key words—"heavy," which is the subjective sensation of muscles relaxing, and "warm," the sensation of increasing blood flow to the hands and feet, an indicator of overall relaxation.

Each session can be practiced in a position chosen from a set of recommended postures that include lying down or sitting upright, or any other relaxed and balanced position.

Autogenic training was popularized in North America particularly by Dr. Wolfgang Luthe, who coauthored, with Schultz, a multivolume tome on autogenic training. According to Wikipedia, in 1963 Luthe discovered the significance of "autogenic discharges," which he described as "paroxysmic phenomena" of a motor, sensorial, visual, and emotional nature related to the traumatic history of the patient.

There are many parallels between autogenic training and mindfulness meditation, both in its practice and in their positive outcomes. Here's a basic instruction for getting started:

• Find a quiet place free from distractions. Lie on the floor or sit relaxed in a chair. Loosen any tight clothing and remove glasses or contacts. Rest your hands in your lap or on the arms of the chair.

• Take a few slow, even breaths. If you have not already, spend a few minutes practicing breathing slowly and deeply into your diaphragm.

• Silently or quietly say to yourself, "I am completely calm."

• Focus attention on your arms. Silently or quietly and slowly repeat to yourself six times, "My arms are very heavy." Then silently or quietly say to yourself, "I am completely calm."

• Refocus attention on your arms. Silently or quietly and slowly repeat to yourself six times, "My arms are very warm." Then silently or quietly say to yourself, "I am completely calm."

• Focus attention on your legs. Silently and quietly and slowly repeat to yourself six times, "My legs are very heavy." Then silently or quietly say to yourself, "I am completely calm."

• Refocus attention on your legs. Silently or quietly and slowly repeat to yourself six times, "My legs are very warm." Then silently or quietly say to yourself, "I am completely calm."

- Silently or quietly and slowly repeat to yourself six times, "My heartbeat is calm and regular." Then silently or quietly say to yourself, "I am completely calm."

- Silently or quietly and slowly repeat to yourself six times, "My breathing is calm and regular." Then silently or quietly say to yourself, "I am completely calm."

- Silently or quietly and slowly repeat to yourself six times, "My abdomen is warm." Then silently or quietly say to yourself, "I am completely calm."

- Silently or quietly and slowly repeat to yourself six times, "My forehead is pleasantly cool." Then silently or quietly say to yourself, "I am completely calm."

- Enjoy the feeling of relaxation, warmth, and heaviness.

- When you are ready, silently or quietly say to yourself, "Arms firm, breathe deeply, eyes open."

In addition to following these instructions, you may consider using a voice recording, such as the free MP3 audio file offered by McMaster University that provides helpful directions for your practice of this technique. Following this audio recording will assist you in fully relaxing so you can concentrate on the technique.

In this chapter I have provided a small sample of key studies from a large and growing body of research. The import of these findings is that our conscious and unconscious beliefs,

intentions, attitudes, and emotions—plus any traumatic experiences in our lives or even in the lives of our ancestors—can have a direct, causal, and enduring impact on the DNA of every cell in our bodies. Once a pathway is established in our mental or emotional life through habitual behaviors, it is self-perpetuating and continues its positive or negative influence on our physical and mental health until we intervene to change it. If your aim is to achieve optimal health, it is my firm belief that you must intervene on the side of creating positive changes to your present state of consciousness, which we now know can have long-lasting biological effects.