Adrenaline, Cortisol, Norepinephrine: The Three Major Stress Hormones, Explained

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- Sarah Klein Senior Editor, Health & Fitness; Certified Personal Trainer

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Thanks to the work of our sympathetic nervous system, the "fight or flight" system that takes over when we're stressed, when you see your boss's name in your inbox late at night, your body reacts like there's a lion on the loose.

Behind the wide range of both physical and mental reactions to stress are a number of hormones that are in charge of adding fuel to the fire.

Adrenaline

What It Is: Commonly known as the fight or flight hormone, it is produced by the adrenal glands after receiving a message from the brain that a stressful situation has presented itself.

What It Does: Adrenaline, along with norepinephrine (more on that below), is largely responsible for the *immediate* reactions we feel when stressed. Imagine you're trying to change lanes in your car, says Amit Sood, M.D., director of research at the Complementary and Integrative Medicine and chair of Mayo Mind Body Initiative at Mayo Clinic. Suddenly, from your blind spot, comes a car racing at 100 miles per hour. You return to your original lane and your heart is pounding. Your muscles are tense, you're breathing faster, you may start sweating. That's adrenaline.

Along with the increase in heart rate, adrenaline also gives you a surge of energy — which you might need to run away from a dangerous situation — and also focuses your attention.

Norepinephrine

What It Is: A hormone similar to adrenaline, released from the adrenal glands and also from the brain, says Sood.

What It Does: The primary role of norepinephrine, like adrenaline, is arousal, says Sood. "When you are stressed, you become more aware, awake, focused," he says.

"You are just generally more responsive." It also helps to shift blood flow away from areas where it might not be so crucial, like the skin, and toward more essential areas at the time, like the muscles, so you can flee the stressful scene.

Although norepinephrine might seem redundant given adrenaline (which is also sometimes called epinephrine), Sood imagines we have both hormones as a type of backup system. "Say your adrenal glands are not working well," he says. "I still want *something* to save me from acute catastrophe."

Depending on the long-term impact of whatever's stressing you out — and how you personally handle stress — it could take anywhere from half an hour to a couple of days to return to your normal resting state, says Sood.

Cortisol

What It Is: A steroid hormone, commonly known as the stress hormone, produced by the adrenal glands.

What It Does: It takes a little more time — minutes, rather than seconds — for you to feel the effects of cortisol in the face of stress, says Sood, because the release of this hormone takes a multi-step process involving two additional minor hormones.

First, the part of the brain called the amygdala has to recognize a threat. It then sends a message to the part of the brain called the hypothalamus, which releases corticotropin-releasing hormone (CRH). CRH then tells the pituitary gland to release adrenocorticotropic hormone (ACTH), which tells the adrenal glands to produce cortisol. Whew!

In survival mode, the *optimal* amounts of cortisol can be life saving. It helps to maintain fluid balance and blood pressure, says Sood, while regulating some body functions that aren't crucial in the moment, like reproductive drive, immunity, digestion and growth.

But when you stew on a problem, the body *continuously* releases cortisol, and chronic elevated levels can lead to serious issues. Too much cortisol can suppress the immune system; increase blood pressure and sugar, decrease libido, produce acne, contribute to obesity and more.

"Ducks walk out of a lake, flap their wings and they fly off," says Sood. "When you face something stressful, particularly if it's not likely to repeat or doesn't have a huge long-term impact, you want to be able to shake it off and move on with life."

Of course, he adds, estrogen and testosterone are also hormones that affect how we react to stress, as are the neurotransmitters dopamine and serotonin. But the classic fight-or-flight reaction is mostly due to the three major players mentioned above. How do you react to stress? Let us know in the comments.

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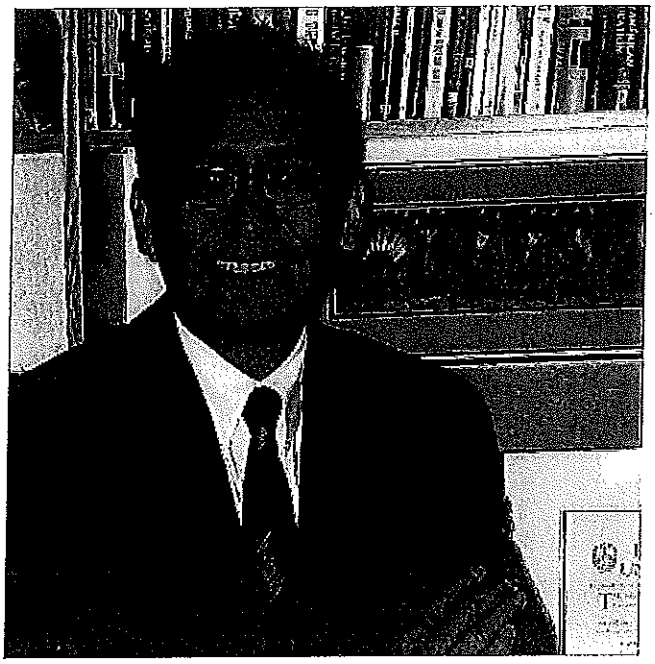
Trauma May Be Woven Into DNA of Native Americans

Trauma is big news these days. Mainstream media is full of stories about the dramatic improvements allowing science to see more clearly how trauma affects our bodies, minds and even our genes. Much of the coverage hails the scientific connection between trauma and illness as a breakthrough for modern medicine. The next breakthrough will be how trauma affects our offspring.

The science of epigenetics, literally "above the gene," proposes that we pass along more than DNA in our genes; it suggests that our genes can carry memories of trauma experienced by our ancestors and can influence how we react to trauma and stress. The Academy of Pediatrics reports that the way genes work in our bodies determines neuroendocrine structure and is strongly influenced by experience. [Neuroendocrine cells help the nervous and endocrine (hormonal) system work together to produce substances such as adrenaline (the hormone associated with the fight or flight response.] Trauma experienced by earlier generations can influence the structure of our genes, making them more likely to "switch on" negative responses to stress and trauma.

In light of this emerging science and how it works with the way we react to trauma, the AAP stated in its publication, Adverse Childhood Experiences and the Lifelong Consequences of Trauma, "Never before in the history of medicine have we had better insight into the factors that determine the health of an individual from infancy to adulthood, which is part of the life course perspective—a way of looking at life not as disconnected stages but as integrated across time," according to the AAP in their recent publication examining the role of Adverse Childhood Experience (ACES) on our development and health. The now famous 1998 ACES study conducted by the Centers for Disease Control (CDC) and Kaiser Permanente showed that such adverse experiences could contribute to mental and physical illness.

Folks in Indian country wonder what took science so long to catch up with traditional Native knowledge. "Native healers, medicine people and elders have always known this and it is common knowledge in Native oral traditions," according to LeManuel "Lee" Bitsoi, Navajo, PhD Research Associate in Genetics at Harvard University during his presentation at the Gateway to Discovery conference in 2013.



According to Bitsoi, epigenetics is beginning to uncover scientific proof that intergenerational trauma is real. Historical trauma, therefore, can be seen as a contributing cause in the development of illnesses such as PTSD, depression and type 2 diabetes.

What exactly is historical or intergenerational trauma? Michelle M. Sotero, an instructor in Health Care Administration and Policy at the University of Nevada, offers a three-fold definition. In the initial phase, the dominant culture perpetrates mass trauma on a population in the form of colonialism, slavery, war or genocide. In the second phase the affected population shows physical and psychological symptoms in response to the trauma. In the final phase, the initial population passes these responses to trauma to subsequent generations, who in turn display similar symptoms.

According to researchers, high rates of addiction, suicide, mental illness, sexual violence and other ills among Native peoples might be, at least in part, influenced by historical trauma. Bonnie Duran, associate professor in the Department of Health Services at the University of Washington School of Public Health and Director for Indigenous Health Research at the Indigenous Wellness Research Institute says, "Many present-day health disparities can be traced back through epigenetics to a "colonial health deficit," the result of colonization and its aftermath."

According to the American Indian and Alaska Native Genetics Research Guide created by the National Congress of American Indians (NCAI), studies have shown that various behavior and health conditions are due to inherited epigenetic changes.

Authors of the guide refer to a 2008 study by Moshe Szyf at McGill University in Montreal that examined the brains of suicide victims. Szyf and his team found that genes governing stress response in the victim's hippocampus had been methylated or switched off. Excessive trauma causes us to produce hormones called glucocorticoids which can alter gene expression. Chronic exposure to this hormone can inhibit genes in the hippocampus ability to regulate glucocorticoids. Szyf suggested that the genes were switched off in response to a series of events, such as abuse during childhood. All victims in the study were abused as children.

Nature or Nurture? It's Both!

Szyf, in collaboration with another scientist at McGill, Neurobiologist Michael Meaney, did research showing a significant difference in the hippocampus between adults rats raised by attentive and inattentive mothers. Adult offspring of inattentive rat mothers showed genes regulating sensitivity to stress to be highly methylated. The rats with attentive moms did not.

To test their research they switched the parents for rat babies born to bad and good mothers. The babies born to attentive moms but given to inattentive moms also developed highly methylated genes and grew to be skittish adults. The opposite proved true for babies born to bad moms but given to good moms. As adults the rat babies born to bad moms but raised by good mothers appeared calm.

This research seems to combine the historically polarizing theory of nature versus nurture in determining behavior. Nature is that which is inherited while nurture is the environmental influences.

Native researcher Teresa Brockie PhD, Research Nurse Specialist at the National Institute of Health suggests that such gene methylation is linked to health disparities among Native Americans. In her article in *Nursing and Research and Practice*, she and her research colleagues note that high ACE's (Adverse Childhood Experience) scores have been linked to methylation of genes that regulate the stress response. They further noted that endocrine and immune disorders are also linked to methylation of such genes.

The researchers found that Native peoples have high rates of ACE's and health problems such as posttraumatic stress, depression and substance abuse, diabetes all linked with methylation of genes regulating the body's response to stress. "The persistence of stress associated with discrimination and historical trauma converges to add immeasurably to these challenges," the researchers wrote.

Since there is a dearth of studies examining these findings, the researchers stated they were unable to conclude a direct cause between epigenetics and high rates of certain diseases among Native Americans.

One of researchers, Dr. Jessica Gill, Principal Investigator, Brain Injury Unit, Division of Intramural Research, National Institute of Nursing Research wrote in response to questions to the NIH's public affairs office, "Epigenetic studies provide a unique opportunity to characterize the long-term impact of stressors including historical trauma on the function of genes. The modification of gene function through epigenetic modifications can greatly impact the health of the individual and may underlie some of the health

disparities that we observe in populations including Native Americans. This line of research is of great promise for nurse scientists, as it will be instrumental in the promotion of the health and well-being of patients impacted by trauma and stress."

Although epigenetics offers the hope of creating better and more specific medicines and interventions for mental health problems, it also suggests the notion that Native peoples and other ethnic groups may be genetically inferior.

Researchers such as Shannon Sullivan, professor of philosophy at UNC Charlotte, suggests in her article "Inheriting Racist Disparities in Health: Epigenetics and the Transgenerational Effects of White Racism," that the science has faint echoes of eugenics, the social movement claiming to improve genetic features of humans through selective breeding and sterilization.

Inherited Resilience

Epigenetics is indeed a hot topic, and pharmaceutical companies are actively searching for epigenetic compounds that will help with learning and memory and help treat depression, anxiety and PTSD.

Many researchers caution, however, that the new science may be getting ahead of itself. "There is a lot of research that needs to be done before we will understand whether and how these processes work," says Joseph Gone, professor at the University of Michigan and member of the Gros Ventre tribe of Montana.

Scientific developments such as epigenetics can offer exciting new insights not only into how our bodies react not only to trauma but also how we manage to survive it.

Native peoples ability to maintain culture and sense of who they are in the face of such a traumatic history suggests an inherited resilience that bears scientific examination as well, according to Gone.

Isolating and nurturing a resilience gene may well be on the horizon.

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Full Name:
Mary Annette Pember

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How the trauma of life is passed down in SPERM, affecting the mental health of future generations

- **The changes are so strong they can even influence a man's grandchildren**
- **They make the offspring more prone to conditions like bipolar disorder**

By Emma Innes

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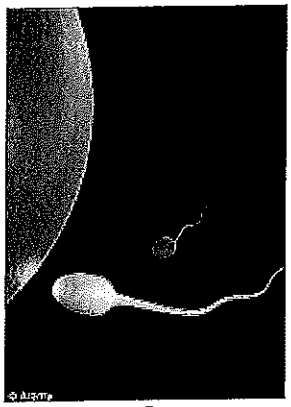

+2

When a man is traumatised changes occur in his sperm which are passed on to his children

The children of people who have experienced extremely traumatic events are more likely to develop mental health problems.

And new research shows this is because experiencing trauma leads to changes in the sperm.

These changes can cause a man's children to develop bipolar disorder and are so strong they can even influence the man's grandchildren.

Psychologists have long known that traumatic experiences can induce behavioural disorders that are passed down from one generation to the next.

However, they are only just beginning to understand how this happens.

Researchers at the University of Zurich and ETH Zurich now think they have come one step closer to understanding how the effects of traumas can be passed down the generations.

The researchers found that short RNA molecules – molecules that perform a wide range of vital roles in the body - are made from DNA by enzymes that read specific sections of the DNA and use them as template to produce corresponding RNAs.

Other enzymes then trim these RNAs into mature forms.

Cells naturally contain a large number of different short RNA molecules called microRNAs.

They have regulatory functions, such as controlling how many copies of a particular protein are made.

The researchers studied the number and kind of microRNAs expressed by adult mice exposed to traumatic conditions in early life and compared them with non-traumatised mice.

They discovered that traumatic stress alters the amount of several microRNAs in the blood, brain and sperm – while some microRNAs were produced in excess, others were lower than in the corresponding tissues or cells of control animals.

These alterations resulted in misregulation of cellular processes normally controlled by these microRNAs.

After traumatic experiences, the mice behaved markedly differently - they partly lost their natural aversion to open spaces and bright light and showed symptoms of depression.

+2

Men who have experienced traumatic events are more likely to have children with mental health problems

These behavioural symptoms were also transferred to the next generation via sperm, even though the offspring were not exposed to any traumatic stress themselves.

The metabolisms of the offspring of stressed mice were also impaired - their insulin and blood sugar levels were lower than in the offspring of non-traumatised parents.

'We were able to demonstrate for the first time that traumatic experiences affect metabolism in the long-term and that these changes are hereditary,' said Professor Isabelle Mansuy.

'With the imbalance in microRNAs in sperm, we have discovered a key factor through which trauma can be passed on.'

However, certain questions remain open, such as how the dysregulation in short RNAs comes about.

Professor Mansuy said: 'Most likely, it is part of a chain of events that begins with the body producing too many stress hormones.'

Importantly, acquired traits other than those induced by trauma could also be inherited through similar mechanisms, the researcher suspects.

The Atlantic

How Childhood Trauma Could Be Mistaken for ADHD

Some experts say the normal effects of severe adversity may be misdiagnosed as ADHD.

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REBECCA RUIZ | JUL 7, 2014 | HEALTH

TEXT SIZE

Dr. Nicole Brown's quest to understand her misbehaving pediatric patients began with a hunch.

Brown was completing her residency at Johns Hopkins Hospital in Baltimore, when she realized that many of her low-income patients had been diagnosed with attention deficit/hyperactivity disorder (ADHD).

These children lived in households and neighborhoods where violence and relentless stress prevailed. Their parents found them hard to manage and teachers described them as disruptive or inattentive. Brown knew these behaviors as classic symptoms of ADHD, a brain disorder characterized by impulsivity, hyperactivity, and an inability to focus.

When Brown looked closely, though, she saw something else: trauma. Hyper-vigilance and dissociation, for example, could be mistaken for inattention. Impulsivity might be brought on by a stress response in overdrive.

"Despite our best efforts in referring them to behavioral therapy and starting them on stimulants, it was hard to get the symptoms under control," she said of treating her patients according to guidelines for ADHD. "I began hypothesizing that perhaps a lot of what we were seeing was more externalizing behavior as a result of family dysfunction or other traumatic experience."

Inattentive, hyperactive, and

impulsive behavior may mirror the effects of adversity, and many doctors don't know how—or don't have time—to tell the difference.

Considered a heritable brain disorder, one in nine U.S. children—or 6.4 million youth—currently have a diagnosis of ADHD. In recent years, parents and experts have questioned whether the growing prevalence of ADHD has to do with hasty medical evaluations, a flood of advertising for ADHD drugs, and increased pressure on teachers to cultivate high-performing students. Now Brown and other researchers are drawing attention to a compelling possibility: Inattentive, hyperactive, and impulsive behavior may in fact mirror the effects of adversity, and many pediatricians, psychiatrists, and psychologists don't know how—or don't have the time—to tell the difference.

Though ADHD has been aggressively studied, few researchers have explored the overlap between its symptoms and the effects of chronic stress or experiencing trauma like maltreatment, abuse and violence. To test her hypothesis beyond Baltimore, Brown analyzed the results of a national survey about the health and well-being of more than 65,000 children.

Brown's findings, which she presented in May at an annual meeting of the Pediatric Academic Societies, revealed that children diagnosed with ADHD also experienced markedly higher levels of poverty, divorce, violence, and family substance abuse. Those who endured four or more adverse childhood events were three times more likely to use ADHD medication.

Interpreting these results is tricky. All of the children may have been correctly diagnosed with ADHD, though that is unlikely. Some researchers argue that the difficulty of parenting a child with behavioral issues might lead to economic hardship, divorce, and even physical abuse. This is particularly true for parents who themselves have ADHD, similar impulsive behavior or their own history of childhood maltreatment. There is also no convincing evidence that trauma or chronic stress lead to the development of ADHD.

For Brown, who is now a pediatrician at Montefiore Medical Center in the Bronx, the data are cautionary. It's not evident how trauma influences ADHD diagnosis and management, but it's clear that some misbehaving children might be experiencing harm that no stimulant can fix. These children may also legitimately have ADHD, but unless prior or ongoing emotional damage is treated, it may be difficult to see dramatic improvement in the child's behavior.

"We need to think more carefully about screening for trauma and designing a more trauma-informed treatment plan," Brown says.

Dr. Kate Szymanski came to the same conclusion a few years ago. An associate professor at Adelphi University's Derner Institute and an expert in trauma, Szymanski analyzed data from a children's psychiatric hospital in New York. A majority of the 63 patients in her sample had been physically abused and lived in foster homes. On average, they reported three traumas in their short lives. Yet, only eight percent of the children had received a diagnosis of post-traumatic stress disorder while a third had ADHD.

"I was struck by the confusion or over-eagerness–or both–to take one diagnosis over another," Szymanski says. "To get a picture of trauma from a child is much harder than looking at behavior like impulsivity, hyperactivity. And if they cluster in a certain way, then it's easy to go to a conclusion that it's ADHD."

A previous edition of the Diagnostic and Statistical Manual of Mental Disorders urged clinicians to distinguish between ADHD symptoms and difficulty with goal-directed behavior in children from "inadequate, disorganized or chaotic environments," but that caveat does not appear in the latest version. Unearthing details about a child's home life can also be challenging, Szymanski says.

It's not clear how many children are misdiagnosed with ADHD annually, but the number could be nearly 1 million.

A child may withhold abuse or neglect to protect his family or, having normalized that experience, never mention it all. Clinicians may also underestimate the prevalence of adversity. The Adverse Childhood Experiences Study, a years-long survey of more than 17,000 adults, found that two-thirds of participants reported at least one of 10 types of abuse, neglect, or household dysfunction. Twelve percent reported four or more. That list isn't exhaustive, either. The study didn't include homelessness and foster care placement, for example, and the DSM doesn't easily classify those events as "traumatic."

It's not clear how many children are misdiagnosed with ADHD annually, but a study published in 2010 estimated the number could be nearly 1 million. That research compared the diagnosis rate amongst 12,000 of the youngest and oldest children in a kindergarten sample and found that the less mature students were 60 percent more likely to receive an ADHD diagnosis.

Though ADHD is thought to be a genetic condition, or perhaps associated with lead or prenatal alcohol and cigarette exposure, there is no brain scan or DNA test that can give a definitive diagnosis. Instead, clinicians are supposed to follow exhaustive guidelines set forth by professional organizations, using personal and reported observations of a child's behavior to make a diagnosis. Yet, under financial pressure to keep appointments brief and billable, pediatricians and therapists aren't always thorough.

"In our 15-minute visits—maybe 30 minutes at the most—we don't really have the time to go deeper," Brown says. If she suspects ADHD or a psychological condition, Brown will refer her patient to a mental health professional for a comprehensive evaluation. "You may have had this social history that you took in the beginning, but unless the parent opens up and shares more about what's going on in the home, we often don't have the opportunity or think to connect the two."

Caelan Kuban, a psychologist and director of the Michigan-based National Institute for Trauma and Loss in Children, knows the perils of this gap well. Four years ago she began offering a course designed to teach educators, social service workers and other professionals how to distinguish the signs of trauma from those of ADHD.

"It's very overwhelming, very frustrating," she says. "When I train, the first thing I tell people is you may walk away being more confused than you are right now."

In the daylong seminar, Kuban describes how traumatized children often find it difficult to control their behavior and rapidly shift from one mood to the next. They might drift into a dissociative state while reliving a horrifying memory or lose focus while anticipating the next violation of their safety. To a well-meaning teacher or clinician, this distracted and sometimes disruptive behavior can look a

lot like ADHD.

TED STORY

, or Childhood Narcissism?

Kuban urges students in her course to abandon the persona of the "all-knowing clinician" and instead adopt the perspective of the "really curious practitioner."

Rather than ask what is wrong with a child, Kuban suggests inquiring about what happened in his or her life, probing for life-altering events.

Jean West, a social worker employed by the school district in Joseph, Missouri, took Kuban's course a few years ago. She noticed that pregnant teen mothers and homeless students participating in district programs were frequently diagnosed with ADHD. This isn't entirely unexpected: Studies have shown that ADHD can be more prevalent among low-income youth, and that children and adolescents with the disorder are more prone to high-risk behavior. Yet, West felt the students' experiences might also explain conduct easily mistaken for ADHD.

Kuban's course convinced West to first consider the role of trauma in a student's life. "What has been the impact? What kind of family and societal support have they had?" West asks. "If we can work on that level and truly know their story, there's so much power in that."

As a school official, West sometimes refers troubled students to a pediatrician or psychiatrist for diagnosis, and meets with parents to describe how and why adversity might shape their child's behavior. In her private practice, West regularly assesses patients for post-traumatic stress disorder instead of, or in addition to, ADHD.

Though stimulant medications help ADHD patients by increasing levels of neurotransmitters in the brain associated with pleasure, movement, and attention, some clinicians worry about how they affect a child with PTSD, or a similar anxiety disorder, who already feels hyper-vigilant or agitated. The available behavioral therapies for ADHD focus on time management and organizational skills, and aren't designed to treat emotional and psychological turmoil.

Instead, West teaches a traumatized child how to cope with and defuse fear and anxiety. She also recommends training and therapy for parents who may be contributing to or compounding their child's unhealthy behavior. Such programs can help parents reduce their use of harsh or abusive discipline while improving trust and communication, and have been shown to decrease disruptive child behavior.

Szymanski uses a similar approach with patients and their parents. "I think any traumatized child needs individual therapy but also family therapy," she says. "Trauma is a family experience; it never occurs in a vacuum."

Yet finding a provider who is familiar with such therapy can be difficult for pediatricians and psychiatrists, Szymanski says. Though some hospitals have centers for childhood trauma, there isn't a well-defined referral network. Even then, insurance companies, including the federal Medicaid program, may not always pay for the group sessions commonly used in parent training programs.

Faced with such complicated choices, Szymanski says it's no surprise when clinicians overlook the role of trauma in a child's behavior and focus on ADHD instead.

Inattentive and hyperactive behavior can be traced back to any number of conditions—just like chest pains don't have the same origin in every patient.

While there are few recommendations now for clinicians, that will likely change in the coming years. The American Academy of Pediatrics is currently developing new guidance on ADHD that will include a section on assessing trauma in patients, though it won't be completed until 2016.

Dr. Heather Forkey, a pediatrician at University of Massachusetts Memorial Medical Center, who specializes in treating foster children, is assisting the AAP. Her goal is to remind doctors that inattentive and hyperactive behavior can be traced back to any number of conditions—just like chest pains don't have the same origin in every patient. Ideally, the AAP will offer pediatricians recommendations for screening tools that efficiently gauge adversity in a child's life. That practice, she says, should come before any diagnosis of ADHD.

When speaking to traumatized children inappropriately diagnosed with ADHD, she offers them a reassuring explanation of their behavior. The body's stress system, she says, developed long ago in response to life-or-death threats like a predatory tiger. The part of the brain that controls impulses, for example, shuts off so that survival instincts can prevail.

"What does that look like when you put that kid in a classroom?" Forkey asks. "When people don't understand there's been a tiger in your life, it looks a lot like

ADHD to them."

This story was produced for ACEs Too High

LATEST VIDEO

The Millionaire Turned Shoeshine Man

He lives in Auckland, New Zealand, and calls himself "Mr. Sunshine."

ABOUT THE AUTHOR

Rebecca Ruiz is a reporter based in Oakland. She has written for *NBC News*, *Forbes*, and *The American Prospect*.

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FROM THE MAY 2013 ISSUE

Grandma's Experiences Leave a Mark on Your Genes

Your ancestors' lousy childhoods or excellent adventures might change your personality, bequeathing anxiety or resilience by altering the epigenetic expressions of genes in the brain.

By Dan Hurley | Thursday, June 25, 2015

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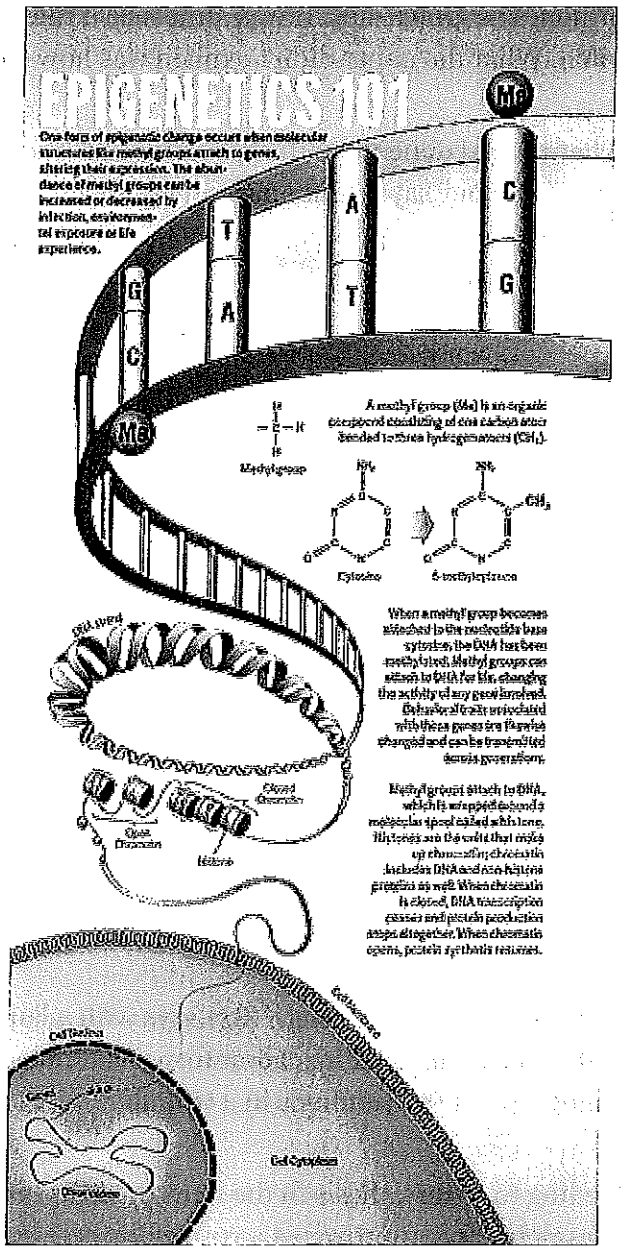
Voodoo Genetics



Twenty years after helping to set off a revolution, Meaney sits behind a wide walnut table that serves as his desk. A January storm has deposited half a foot of snow outside the picture windows lining his fourth-floor corner office at the Douglas Institute, a mental health affiliate of McGill. He has the rugged good looks and tousled salt-and-pepper hair of someone found on a ski slope — precisely where he plans to go this weekend. On the floor lies an arrangement of helium balloons in various stages of deflation. "Happy 60th!" one announces.

"I've always been interested in what makes people different from each other," he says. "The way we act, the way we behave — some people are optimistic, some are pessimistic. What produces that variation? Evolution selects the variance that is most successful, but what produces the grist for the mill?"

Meaney pursued the question of individual differences by studying how the rearing habits of mother rats caused lifelong changes in their offspring. Research dating back to the 1950s had shown that rats handled by humans for as little as five to 15 minutes per day during their first three weeks of life grew up to be calmer and less reactive

Jay Smith/DISCOVER

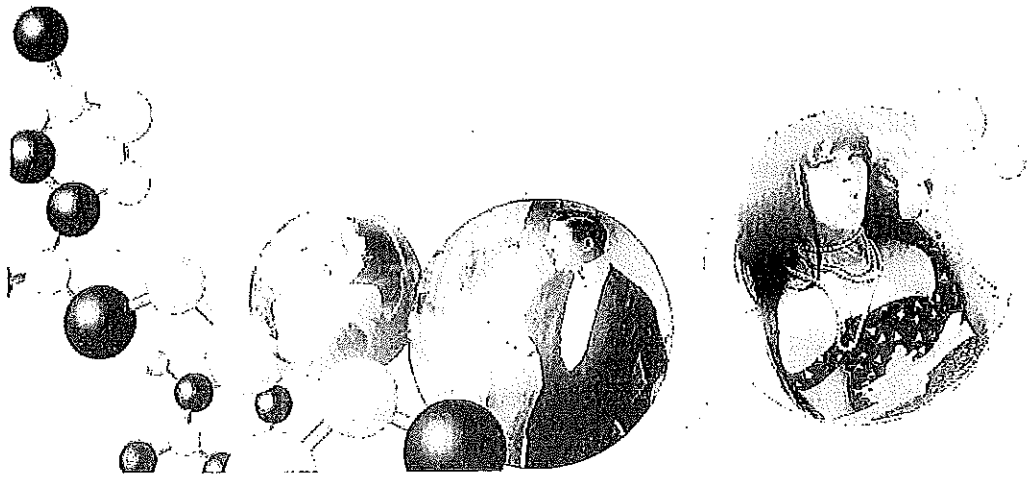
to stressful environments compared with their non-handled littermates. Seeking to tease out the mechanism behind such an enduring effect, Meaney and others established that the benefit was not actually conveyed by the human handling. Rather, the handling simply provoked the rats' mothers to lick and groom their pups more, and to engage more often in a behavior called arched-back nursing, in which the mother gives the pups extra room to suckle against her underside.

"It's all about the tactile stimulation," Meaney says.

In a landmark 1997 paper in *Science*, he showed that natural variations in the amount of licking and grooming received during infancy had a direct effect on how stress hormones, including corticosterone, were expressed in adulthood. The more licking as babies, the lower the stress hormones as grown-ups. It was almost as if the mother rats were licking away at a genetic dimmer switch. What the paper didn't explain was how such a thing could be possible.

"What we had done up to that point in time was to identify maternal care and its influence on specific genes," Meaney says. "But epigenetics wasn't a topic I knew very much about."

And then he met Szyf.



Alison Mackey/DISCOVER

Postnatal Inheritance

"I was going to be a dentist," Szyf says with a laugh. Slight, pale and balding, he sits in a small office at the back of his bustling laboratory — a room so Spartan, it contains just a single picture, a photograph of two embryos in a womb.

Needing to write a thesis in the late 1970s for his doctorate in dentistry at Hebrew University of Jerusalem, Szyf approached a young biochemistry professor named Aharon Razin, who had recently

made a splash by publishing his first few studies in some of the world's top scientific journals. The studies were the first to show that the action of genes could be modulated by structures called methyl groups, a subject about which Szyf knew precisely nothing. But he needed a thesis adviser, and Razin was there. Szyf found himself swept up to the forefront of the hot new field of epigenetics and never looked back.

Until researchers like Razin came along, the basic story line on how genes get transcribed in a cell was neat and simple. DNA is the master code, residing inside the nucleus of every cell; RNA transcribes the code to build whatever proteins the cell needs. Then some of Razin's colleagues showed that methyl groups could attach to cytosine, one of the chemical bases in DNA and RNA.

It was Razin, working with fellow biochemist Howard Cedar, who showed these attachments weren't just brief, meaningless affairs. The methyl groups could become married permanently to the DNA, getting replicated right along with it through a hundred generations. As in any good marriage, moreover, the attachment of the methyl groups significantly altered the behavior of whichever gene they wed, inhibiting its transcription, much like a jealous spouse. It did so, Razin and Cedar showed, by tightening the thread of DNA as it wrapped around a molecular spool, called a histone, inside the nucleus. The tighter it is wrapped, the harder to produce proteins from the gene.

Consider what that means: Without a mutation to the DNA code itself, the attached methyl groups cause long-term, heritable change in gene function. Other molecules, called acetyl groups, were found to play the opposite role, unwinding DNA around the histone spool, and so making it easier for RNA to transcribe a given gene.

By the time Szyf arrived at McGill in the late 1980s, he had become an expert in the mechanics of epigenetic change. But until meeting Meaney, he had never heard anyone suggest that such changes could occur in the brain, simply due to maternal care.

"It sounded like voodoo at first," Szyf admits. "For a molecular biologist, anything that didn't have a clear molecular pathway was not serious science. But the longer we talked, the more I realized that maternal care just might be capable of causing changes in DNA methylation, as crazy as that sounded. So Michael and I decided we'd have to do the experiment to find out."

Actually, they ended up doing a series of elaborate experiments. With the assistance of postdoctoral researchers, they began by selecting mother rats who were either highly attentive or highly inattentive. Once a pup had grown up into adulthood, the team examined its hippocampus, a brain region essential for regulating the stress response. In the pups of inattentive mothers, they found that genes regulating the production of

glucocorticoid receptors, which regulate sensitivity to stress hormones, were highly methylated; in the pups of conscientious moms, the genes for the glucocorticoid receptors were rarely methylated.

Thinkstock

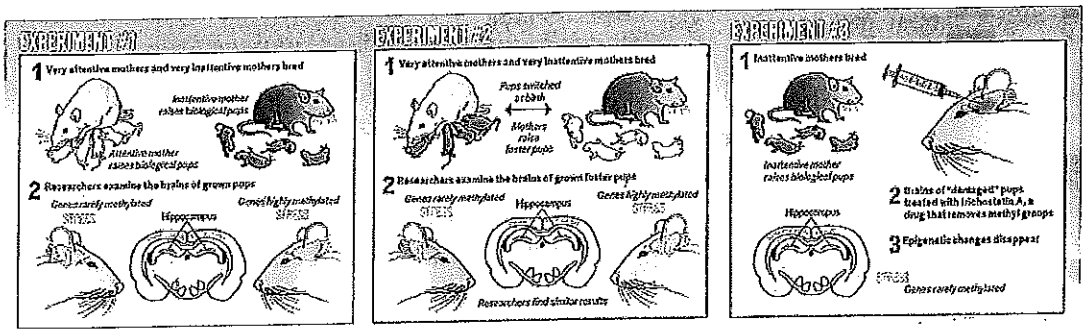
Methylation just gums up the works. So the less the better when it comes to transcribing the affected gene. In this case, methylation associated with miserable mothering prevented the normal number of glucocorticoid receptors from being transcribed in the baby's hippocampus. And so for want of sufficient glucocorticoid receptors, the rats grew up to be nervous wrecks.

To demonstrate that the effects were purely due to the mother's behavior and not her genes, Meaney and colleagues performed a second experiment. They took rat pups born to inattentive mothers and gave them to attentive ones, and vice versa. As they predicted, the rats born to attentive mothers but raised by inattentive ones grew up to have low levels of glucocorticoid receptors in their hippocampus and behaved skittishly. Likewise, those born to bad mothers but raised by good ones grew up to be calm and brave and had high levels of glucocorticoid receptors.

Before publishing their findings, Meaney and Szyf conducted a third crucial experiment, hoping to overwhelm the inevitable skeptics who would rise up to question their results. After all, it could be argued, what if the epigenetic changes observed in the rats' brains were not directly causing the behavioral changes in the adults, but were merely co-occurring? Freud certainly knew the enduring power of bad mothers to screw up people's lives. Maybe the emotional effects were unrelated to the epigenetic change.

To test that possibility, Meaney and Szyf took yet another litter of rats raised by rotten mothers. This time, after the usual damage had been done, they infused their brains with trichostatin A, a drug that can remove methyl groups. These animals showed none of the behavioral deficits usually seen in such offspring, and their brains showed none of the epigenetic changes.

"It was crazy to think that injecting it straight into the brain would work," says Szyf. "But it did. It was like rebooting a computer."



Jay Smith/DISCOVER

Despite such seemingly overwhelming evidence, when the pair wrote it all up in a paper, one of the reviewers at a top science journal refused to believe it, stating he had never before seen evidence that a mother's behavior could cause epigenetic change.

"Of course he hadn't," Szyf says. "We wouldn't have bothered to report the study if it had already been proved."

In the end, their landmark paper, "Epigenetic programming by maternal behavior," was published in June 2004 in the journal *Nature Neuroscience*.

Meaney and Szyf had proved something incredible. Call it postnatal inheritance: With no changes to their genetic code, the baby rats nonetheless gained genetic attachments due solely to their upbringing — *epi*genetic additions of methyl groups sticking like umbrellas out the elevator doors of their histones, gumming up the works and altering the function of the brain.

The Beat Goes On

Together, Meaney and Szyf have gone on to publish some two-dozen papers, finding evidence along the way of epigenetic changes to many other genes active in the brain. Perhaps most significantly, in a study led by Frances Champagne — then a graduate student in Meaney's lab, now an associate professor with her own lab at Columbia University in New York — they found that inattentive mothering in rodents causes methylation of the genes for estrogen receptors in the brain. When those babies grow up, the resulting decrease of estrogen receptors makes them less attentive to *their* babies. And so the beat goes on.

As animal experiments continue apace, Szyf and Meaney have entered into the next great step in the study of behavioral epigenetics: human studies. In a 2008 paper, they compared the brains of people who had committed suicide with the brains of people who had died suddenly of factors other than suicide. They found excess methylation of genes in the suicide brains' hippocampus, a region critical to memory acquisition and stress response. If the suicide victims had been abused as children, they found, their brains were more methylated.

Alison Mackey/DISCOVER

Why can't your friend "just get over" her upbringing by an angry, distant mother? Why can't she "just snap out of it"? The reason may well be due to methyl groups that were added in childhood to genes in her brain, thereby handcuffing her mood to feelings of fear and despair.

Of course, it is generally not possible to sample the brains of living people. But examining blood samples in humans is routine, and Szyf has gone searching there for markers of epigenetic methylation. Sure enough, in 2011 he reported on a genome-wide analysis of blood samples taken from 40 men who participated in a British study of people born in England in 1958.

All the men had been at a socioeconomic extreme, either very rich or very poor, at some point in their lives ranging from early childhood to mid-adulthood. In all, Szyf analyzed the methylation state of about 20,000 genes. Of these, 6,176 genes varied significantly based on poverty or wealth. Most striking, however, was the finding that genes were more than twice as likely to show methylation changes based on family income during early childhood versus economic status as adults.

Timing, in other words, matters. Your parents winning the lottery or going bankrupt when you're 2 years old will likely affect the epigenome of your brain, and your resulting emotional tendencies, far more strongly than whatever fortune finds you in middle age.

Last year, Szyf and researchers from Yale University published another study of human blood samples, comparing 14 children raised in Russian orphanages with 14 other Russian children raised by their biological parents. They found far more methylation in the orphans' genes, including many that play an important role in neural communication and brain development and function.

"Our study shows that the early stress of separation from a biological parent impacts long-term programming of genome function; this might explain why adopted children may be particularly vulnerable to harsh parenting in terms of their physical and mental health," said Szyf's co-author, psychologist Elena Grigorenko of the Child Study Center at Yale. "Parenting adopted children might require much more nurturing care to reverse these changes in genome regulation."

A case study in the epigenetic effects of upbringing in humans can be seen in the life of Szyf's and Meaney's onetime collaborator, Frances Champagne. "My mom studied prolactin, a hormone involved in maternal behavior. She was a driving force in encouraging me to go into science," she recalls. Now a leading figure in the study of maternal influence, Champagne just had her first child, a daughter. And epigenetic research has taught her something not found in the *What to Expect* books or even her mother's former lab.

"The thing I've gained from the work I do is that stress is a big suppressor of maternal behavior," she says. "We see it in the animal studies, and it's true in humans. So the best thing you can do is not to worry all the time about whether you're doing the right thing. Keeping the stress level down is the most important thing. And tactile interaction — that's certainly what the good mother rats are doing with their babies. That sensory input, the touching, is so important for the developing brain."

The Mark Of Cain

The message that a mother's love can make all the difference in a child's life is nothing new. But the ability of epigenetic change to persist across generations remains the subject of debate. Is methylation transmitted directly through the fertilized egg, or is each infant born pure, a methylated virgin, with the attachments of methyl groups slathered on solely by parents after birth?

Neuroscientist Eric Nestler of the Icahn School of Medicine at Mount Sinai in New York has been seeking an answer for years. In one study, he exposed male mice to 10 days of bullying by larger, more aggressive mice. At the end of the experiment, the bullied mice were socially withdrawn.

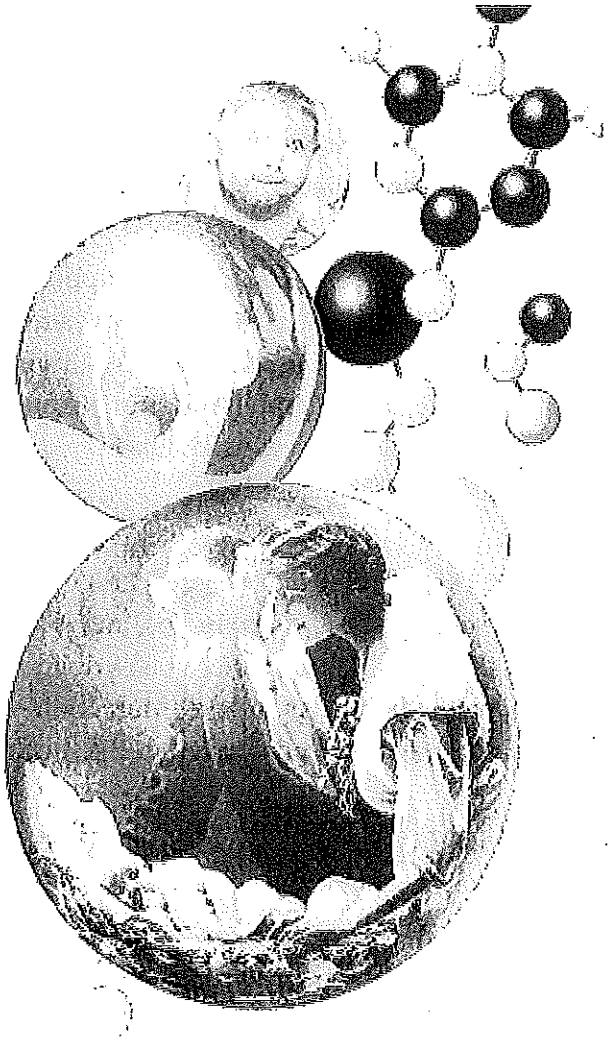
To test whether such effects could be transmitted to the next generation, Nestler took another group of bullied mice and bred them with females, but kept them from ever meeting their offspring.

Despite having no contact with their depressed fathers, the offspring grew up to be hypersensitive to stress. "It was not a subtle effect; the offspring were dramatically more susceptible to developing signs of depression," he says.

In further testing, Nestler took sperm from defeated males and impregnated females through

in vitro fertilization. The offspring did not show most of the behavioral abnormalities, suggesting that epigenetic transmission may not be at the root. Instead, Nestler proposes, "the female might know she had sex with a loser. She knows it's a tainted male she had sex with, so she cares for her pups differently," accounting for the results.

Despite his findings, no consensus has yet emerged. The latest evidence, published in the Jan. 25 issue of the journal *Science*, suggests that epigenetic changes in mice are usually erased, but not always. The erasure is imperfect, and sometimes the affected genes may make it through to the next generation, setting the stage for transmission of the altered traits in descendants as well.



Alison Mackey/DISCOVER

What's Next?

The studies keep piling on. One line of research traces memory loss in old age to epigenetic alterations in brain neurons. Another connects post-traumatic stress disorder to methylation of the gene coding for neurotrophic factor, a protein that regulates the growth of neurons in the brain.

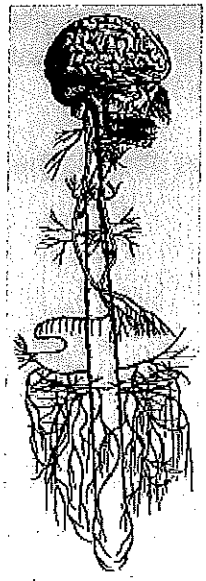
If it is true that epigenetic changes to genes active in certain regions of the brain underlie our emotional and intellectual intelligence — our tendency to be calm or fearful, our ability to learn or to forget — then the question arises: Why can't we just take a drug to rinse away the unwanted methyl groups like a bar of epigenetic Irish Spring?

The hunt is on. Giant pharmaceutical and smaller biotech firms are searching for epigenetic compounds to boost learning and memory. It has been lost on no one that epigenetic medications might succeed in treating depression, anxiety and post-traumatic stress disorder where today's psychiatric drugs have failed.

But it is going to be a leap. How could we be sure that epigenetic drugs would scrub clean only the dangerous marks, leaving beneficial — perhaps essential — methyl groups intact? And what if we could create a pill potent enough to wipe clean the epigenetic slate of all that history wrote? If such a pill could free the genes within your brain of the epigenetic detritus left by all the wars, the rapes, the abandonments and cheated childhoods of your ancestors, would you take it?

Function of the Vagus Nerve

Psted by ***Dr Sircus*** *on December 26, 2014 | Filed under Medicine*



Human Beings have an Autonomic Nervous System (ANS) that is actually comprised of three separate subsystems, the Parasympathetic Nervous System (PNS), the Sympathetic Nervous System (SNS) and the Enteric Nervous System (ENS). The enteric nervous system has been described as a "second brain," which communicates with the central nervous system (CNS) through the parasympathetic (e.g., via the vagus nerve) and sympathetic nervous systems. However, vertebrate studies show that when the vagus nerve is severed, the enteric nervous system continues to function.

We now know that the ENS is not just capable of autonomy but also influences the brain. In fact, about 90 per cent of the signals passing along the vagus nerve come not from above, but from the ENS and that is why many consider it as a backup brain centered in our solar plexus. Our gut instincts are not fantasies but real nervous signals that guide much of our lives.

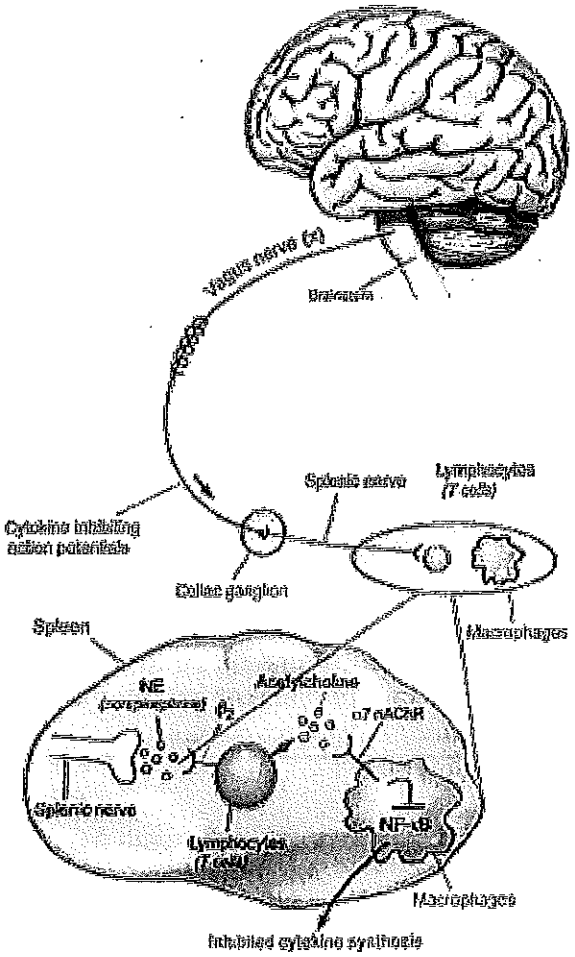
It is our vagus nerve that provides the gateway between the two parts of the autonomic systems. The vagus acts as a bio-informational data bus that routes impulses going in two directions. Since the vagus nerve acts as the central switchboard it should come as no surprise that impaired functioning of this one nerve can lead to so many different conditions and problems. Some neurological diseases actually come up from the gut spreading to the brain via the vagus nerve.

Christopher Bergland, writing for Psychology Today, said, "The vagus nerve is the commander-in-chief when it comes to having grace under pressure. The autonomic nervous system is comprised

of two polar opposite systems that create a complementary tug-of-war, which allows your body to maintain homeostasis (inner-stability). The sympathetic nervous system is geared to rev you up like the gas pedal in an automobile – it thrives on adrenaline and cortisol and is part of the fight-or-flight response. The parasympathetic nervous system is the polar opposite. The vagus nerve is command central for the function of your parasympathetic nervous system. Unfortunately, the vagus nerve's reflexive responses can backfire and turn it from comrade into saboteur."

The vagus nerve is known as the "wandering nerve" because it has multiple branches that diverge from two thick stems rooted in the cerebellum and brainstem that wander to the lowest viscera of our abdomen touching our hearts and most major organs along the way. Vagus means "wandering" in Latin. It meanders all the way down, into the belly, spreading fibers to the tongue, pharynx, vocal chords, lungs, heart, stomach, intestines and glands that produce anti-stress enzymes and hormones (like Acetylcholine, Prolactin, Vasopressin, Oxytocin), influencing digestion, metabolism and the relaxation response.

Dr. Peter Levine talks about how the vagus reaches down to the genitals and about healing sexual stress and trauma through opening up the vagus.



The vagus nerve uses the neurotransmitter, acetylcholine. If our brain cannot communicate with our diaphragm via the release of acetylcholine from the vagus nerve then you will stop breathing.

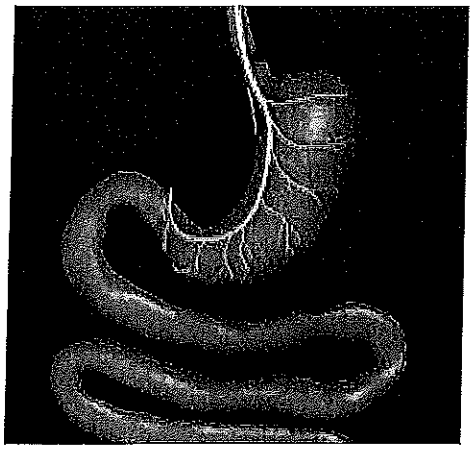
Botox is a toxic substance that has the power to damage the nervous system and shut down the vagus causing death.

It is interesting to note that the heavy metal mercury blocks the action of acetylcholine, the neurotransmitter that passes the nerve impulse from the vagus nerve to the heart muscle. Both acetylcholine and the nerve receptors in the heart muscle contain thiol (sulfur/hydrogen) proteins. When mercury attaches to the thiol protein in the heart muscle receptors and in the acetylcholine, the heart muscle cannot receive the vagus nerve electrical impulse for contraction. Mercury accumulates in the heart muscle and heart valves, causing damage by attaching to thiol (SH-) proteins. This damage is indicated by EKG and confirmed by histologic study.

The frequently observed rocking and swinging behaviors in autistic individuals may reflect a naturally occurring bio-behavioral strategy to stimulate and regulate a vagal system that is not efficiently functioning.
Dr. Stephen Porges

In this video, Dr. Stephen Porges talks about how vagus disturbances are found in Autistic children. Many practitioners have related the advent of autism to vaccines containing the highly toxic mercury containing substance called Thimerosal. In addition, the public have been highly contaminated with mercury used in dental amalgam, which dentists routinely place only inches from the brain. Moreover, more than 3,000 tons of mercury are put into the atmosphere each year contaminating the entire biosphere of our planet but the government nonsensically worries more about CO2 emissions from coal-fired smokestacks instead of the huge amount of neurotoxic mercury.

The vagus nerve is one of the largest nerve systems in the body. Only the spinal column is bigger. Sometimes this nerve is referred to as cranial nerve X, the 10th cranial nerve. The vagus is used to send a variety of signals throughout the body, but will also transfer signals back to the brain. The vagus nerve is constantly sending updated sensory information about the state of the body's organs "upstream" to your brain via afferent nerves. In fact, 80-90% of the nerve fibers in the vagus nerve are dedicated to communicating the state of your viscera up to your brain.



Vagus Nerve in Yellow

The vagus nerve helps manage the complex processes in your digestive tract, including signaling the muscles in your stomach to contract and push food into the small intestine. A damaged vagus nerve cannot send signals to your stomach muscles. This may cause food to remain in your stomach longer, rather than move normally into your small intestine to be digested, which is part of the GERD complex.

Because the vagus nerve supplies motor parasympathetic fibers to every organ from the neck down to the second segment of the transverse colon (except the adrenal glands), its effect can be far reaching. Stress can raise the body's level of epinephrine and norepinephrine, which stimulates the sympathetic nervous system to over-ride the parasympathetic nervous system, of which the vagus nerve is the main component.

The vagus nerve is used to regulate the heartbeat and the muscle movement necessary to keep you breathing. This nerve also regulates the chemical levels in the digestive system so that the intestines can process food and keep track of what types of nutrients are being gained from the food that is taken in.

There are two main types of vagus nerve disorders. One is caused by an under-active or inactive vagus nerve, while the other is caused by a vagus nerve that overreacts to ordinary stimuli. Vagus nerve disorders that stem from an under-active vagus nerve often lead to a condition known as gastroparesis which is a frequent and severe complication of diabetes. Patients suffering from this disorder may experience pain in the stomach, nausea, heartburn, stomach spasms, and weight loss. Patients with under-active vagus nerves often experience severe gastrointestinal problems. Those with overactive vagus nerves may faint.

Testimony: I just recently developed my vagus nerve condition a few months ago even though I now believe it started over a year ago with IBS symptoms. This disorder is absolutely crazy with so many symptoms that do not show up in testing by physicians except when certain symptoms get really bad that it's hard to get the diagnosis.

My journey with vagus nerve disorder started one night when I was at my computer and bent over to move a shoe out of the middle of the floor. I passed out and woke up in a sweat thinking I was having a heart attack. I woke up in kind of a dream state wondering why I was laying down on the ground.

As the weeks passed, more symptoms started to appear. **Weird sensations in certain parts of my body,** more passing out episodes, shortness of breath and fast heart rates. I went to the doctor and he said all my vitals and internal numbers were healthy but I felt like my body was not working right. I took some nerve calming drugs and that helped for a couple of weeks then they did not work and arrhythmia bouts set in. I would get arrhythmia for 8 to 12 hours and was up all night wondering why my heart was kicking my behind like this when it was running smoothly several weeks ago.

Acupuncturist Jill Blakeway asks, "So how does the vagus nerve get irritated in the first place? Any kind of GI distress can put pressure on the nerve and irritate it, with a hiatal hernia being a frequent culprit. Poor posture along with muscular imbalances can also cause the vagus nerve to misfire, as can excess alcohol or spicy foods. Stress can inflame the nerve, along with fatigue and anxiety."

Blakeway recommends:

Many of the patients who present with symptoms of an irritated vagus nerve have what could be described as a Gall Bladder and Heart Complex in Chinese medicine. This traditionally has been a diagnosis used to describe a collection of symptoms such as esophagitis, hiatal hernia, gastritis, insomnia, palpitations, fearfulness, being easily startled, chest fullness, and a bitter taste in the mouth. In these patients, I have found that accessing the Gall Bladder Divergent Channel can bring almost immediate relief. I usually use the separating and convergent points of the channel GB 30 and GB 1, along with GB 34, LIV 3, PC6, SP 4, LIV 14, and UB 19.

How can patients suffering from an irritated vagus nerve help themselves? Here is the advice I give my patients, with one caveat: Because these symptoms can be caused by so many disorders, I always refer my patients to their MD to rule out more serious pathologies before giving self-help suggestions.

- Regular acupuncture reduces the inflammation that is often at the root of this disorder and calms the irritated nerve.
- During an attack, patients often find that moving, stretching and/or burping can relieve the pressure and calm the heart.
- During an episode of tachycardia, vagal maneuvers can be used to slow the heart rate. These simple maneuvers stimulate the vagus nerve to slow down the electrical impulses through the atrioventricular (AV) node of the heart. Vagal maneuvers that you can try to slow a speedy heart rate include: Herbal formulas that support digestion (and calm the heart) along with probiotics and digestive enzymes can really help remove the GI inflammation that is part of this syndrome.
    - Gagging
    - Holding your breath and bearing down (Valsalva maneuver)
    - Immersing your face in ice-cold water (diving reflex)
    - Coughing
- Likewise, diaphragmatic breathing, yoga, and meditation help the parasympathetic nervous system over-ride the sympathetic nervous system and calm the vagus nerve.

Researchers confirm that daily habits of mindset and behavior along with conscious breathing and yoga can create a positive snowball effect through a feedback loop linked to stimulating your vagus nerve. In order to maintain homeostasis, the central nervous system responds constantly, via neural feedback, to environmental cues. Stressful events disrupt the rhythmic structure of autonomic states, and subsequently, behaviors. Since the vagus plays such an integral role in the regulation of heart rate and heart rate variability it follows that how we breathe when under stress makes all the difference in the world.

Dr. Stephen Porges, gives us a great clue to the connection between the sensory nervous system and the very center of our emotional makeup. Darwin (1872) noted in *The Expression of Emotions in Man and Animals* the importance of the bi-directional neural communication between the heart and the brain via the "pneumogastric" nerve, now known as the vagus nerve. According to Dr. Porges, "Darwin's statement is important, because it emphasized two points: 1) afferent feedback from the heart to the brain through the vagus was independent of the spinal cord and the sympathetic nervous system, and 2) the vagus played a regulatory role in the expression of emotions. The Darwinian description of the vagus, emphasizing the bi-directional communication between the periphery and central nervous system, assumes that the vagus is part of a feedback system. Implicit in this "vagal system" are motor pathways to change visceral state, sensory

pathways to monitor visceral state, and brain structures involved in the evaluation of the input and the regulation of the output."

We all have an internal assessment mechanism thought to be housed in the amygdala, the hypothalamus or mid-brain which acts as a central intelligence agency challenging every situation, scanning every perception; reacting instantly to the one key question, will it hurt "me." Will it make "me" feel more or less secure? Will it fulfill or deny me my basic needs? Will it enrich my life or lead to separation and life alienating feelings? The heart is the center that houses our sense of self, the "me" or the ultimate "I."

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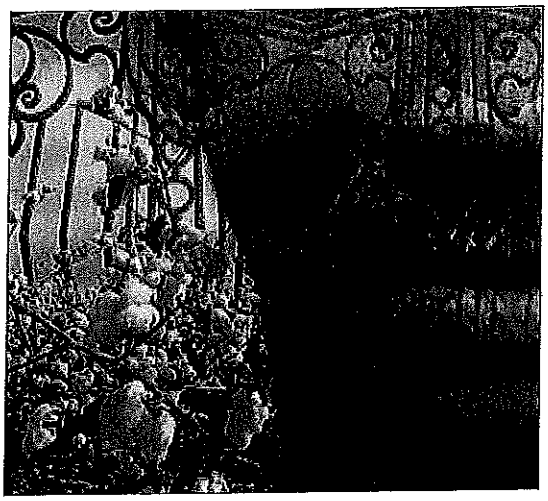

Culture » March 10, 2006

Post Traumatic Slave Syndrome

Dr. Joy DeGruy Leary talks about her provocative new book

BY Silja J.A. Talvi

Racism erodes our very humanity. No one can be truly liberated while living under the weight of oppression, argues Dr. Joy DeGruy Leary in her new book, *Post Traumatic Slave Syndrome: America's Legacy of Enduring Injury and Healing*.

Leary, who teaches social work at Portland State University, traces the way that both overt and subtle forms of racism have damaged the collective African-American psyche--harm manifested through poor mental and physical health, family and relationship dysfunction, and self-destructive impulses.

Leary adapts our understanding of Post Traumatic Stress Disorder to propose that African Americans today suffer from a particular kind of intergenerational trauma: Post Traumatic Slave Syndrome (PTSS).

The systematic dehumanization of African slaves was the initial trauma, explains Leary, and generations of their descendents have borne the scars. Since that time, Americans of all ethnic backgrounds have been inculcated and immersed in a fabricated (but effective) system of race "hierarchy," where light-skin privilege still dramatically affects the likelihood of succeeding in American society.

Leary suggests that African Americans (and other people of color) can ill afford to wait for the dominant culture to realize the qualitative benefits of undoing racism. The real recovery from the ongoing trauma of slavery and racism has to start from within, she says, beginning with a true acknowledgment of the resilience of African-American culture.

"The nature of this work," Leary writes in her prologue, "is such that each group first must see to their own healing, because no group can do another's work."

What kind of reaction have you received to your book? And has that reaction differed based on who is in the audience?

Overall, the response has been very positive, although I'm sure the naysayers are out there. The difference in reaction is noticeable when I deal with grassroots folks in the African-American community. With them, the response has been extremely emotional. It's as though I'm speaking people's personal stories, which seems to give them a feeling of hope.

Of course, I'm not the first person to initiate this kind of work into the intergenerational nature of trauma in the African-American community ... What I did differently is that I pulled from many different historical sources and scholarly disciplines. In essence, I created a "map" of knowledge so that people could see how African-American self-perception has been shaped.

Throughout your book, you emphasize that an acute, social denial of both historical and present-day racism has taken on pathological dimensions. You write that this country is "sick with the issue of race."

The root of this denial for the dominant culture is fear, and fear mutates into all kinds of things: psychological projection, distorted and sensationalized representations in the media, and the manipulation of science to justify the legal rights and treatment of people. That's why it's become so hard to unravel.

Unfortunately, many European Americans have a very hard time even hearing a person of color express their experiences. The prevailing psychological mechanism is the idea, "I've not experienced it, so it cannot be happening for you."

Truly, how can anyone tell me what I have and have not experienced? This is a very paternalistic manifestation of white supremacy, the idea that African Americans and other people of color can be told, with great authority, what their ancestor's lives were like and even what their own, present-day lives are like. The result for those on the receiving end of this kind of distortion is an aspect of PTSS. People begin to doubt themselves, their experiences, and their worth in society because they have been so invalidated their whole lives, in so many ways.

Attempts to encourage European Americans to join in on a more honest, national dialogue about "race" and racism often results in defensive posturing and positioning. Common responses include "slavery happened a long time ago," or people saying that they're tired of being made to feel guilty about something they didn't do. How do we respond to this detachment from the crucial issues of the legacy of slavery?

It's irrelevant that you weren't alive during slavery days. I wasn't there either! But what we as a nation face today has been heavily impacted by our history, whether we're talking in the gulf between the haves and have-nots; education gaps between white and black children; or the racial disparities in our prisons.

I don't believe in making people feel "guilty." We have to recognize that remnants of racist oppression continue to impact people in this country.

Much of my work really is about black people looking at ourselves and understanding how our lives have been shaped by what we've been dealt. I don't want to wait for permission to examine this or to hear that looking back into our histories is somehow counterproductive.

An eye-opening experience for you was your first visit to New York's largest and most overpopulated jail facility, Rikers Island. What kinds of insights did you gain about PTSS from talking to imprisoned African-American young men about their lives?

It was remarkable to see their physical disposition. They walked into the room with their heads held low, shuffled in ... for lack of a better word, [they looked like] slaves. They had lost their way, and there was no light in their eyes whatsoever. Young people typically have a high level of energy. While there was a feeling of angry rebelliousness, the prevailing feeling of hopelessness was staggering.

It's also significant that it took about a half-hour for them to realize that I was talking to them, not at them. In that brief moment, I felt as though I gave them hope. Their body language had already changed by the time they were getting ready to leave. They had become students by the end of our time together.

These young people are being raised by these institutions, and then unleashed back into their communities to wreak havoc. Most of these young men grew up in poverty, and they have the experience of being black and poor in a materialistic society that says if you have nothing, you are nothing. In comparison, when I was in Africa I witnessed incredible poverty unlike anything I had ever seen before. I always talk about how tall and proud the people walked. Their greatest shame was their lack of education, not their lack of wealth. But in America, you are what you have, what you wear.

You write about the fear that many African Americans have of being "exposed" or having family or community "dirty laundry" aired. "Never let them see you sweat," as the expression goes.

Shame is such a big issue in our society in general. What many African Americans have internalized is a sense of shame about just not being "good enough." That's a horrible thing to be sentenced to for your life.

When a person walks around with that sense of shame and self-hatred, they are likely to function poorly in society, no matter who they are. Add the extra layer of racist socialization, of being devalued, and what it means to be just human in America, and all those things just makes the shame worse. We as African Americans don't get a pass on all the problems that humans have to deal with in life: finances, career choices, personal crises, relationships, and so forth. But when we add that to this intergenerational trauma in the context of a society that is in denial about its racism, people's lives can become overwhelmed, even frozen in place.

I'm saying let's just take a few of those burdens off of people's shoulders. Look at what we, as African Americans, have been able to do even with those burdens on our shoulders. Can you imagine what we could accomplish if some of those burdens were removed?

ABOUT THIS AUTHOR

Silja J.A. Talvi, a senior editor at *In These Times*, is an investigative journalist and essayist with credits in many dozens of newspapers and magazines nationwide, including *The Nation, Salon, Santa Fe Reporter, Utne*, and the *Christian Science Monitor*.

More information about Silja J.A. Talvi

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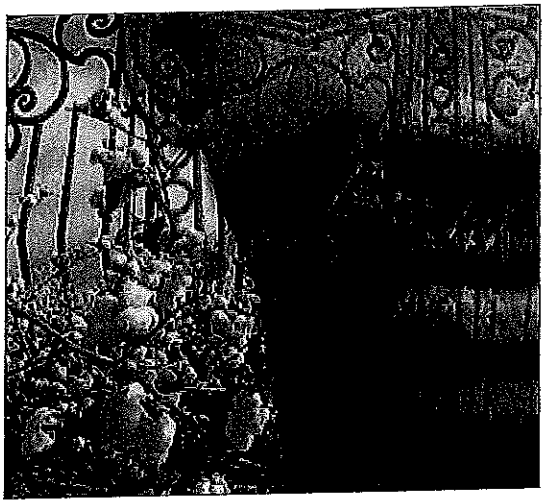

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Racism erodes our very humanity. No one can be truly liberated while living under the weight of oppression, argues Dr. Joy DeGruy Leary in her new book, *Post Traumatic Slave Syndrome: America's Legacy of Enduring Injury and Healing*.

Leary, who teaches social work at Portland State University, traces the way that both overt and subtle forms of racism have damaged the collective African-American psyche--harm manifested through poor mental and physical health, family and relationship dysfunction, and self-destructive impulses.

Leary adapts our understanding of Post Traumatic Stress Disorder to propose that African Americans today suffer from a particular kind of intergenerational trauma: Post Traumatic Slave Syndrome (PTSS).

The systematic dehumanization of African slaves was the initial trauma, explains Leary, and generations of their descendents have borne the scars. Since that time, Americans of all ethnic backgrounds have been inculcated and immersed in a fabricated (but effective) system of race "hierarchy," where light-skin privilege still dramatically affects the likelihood of succeeding in American society.

Leary suggests that African Americans (and other people of color) can ill afford to wait for the dominant culture to realize the qualitative benefits of undoing racism. The real recovery from the ongoing trauma of slavery and racism has to start from within, she says, beginning with a true acknowledgment of the resilience of African-American culture.

"The nature of this work," Leary writes in her prologue, "is such that each group first must see to their own healing, because no group can do another's work."

What kind of reaction have you received to your book? And has that reaction differed based on who is in the audience?

Overall, the response has been very positive, although I'm sure the naysayers are out there. The difference in reaction is noticeable when I deal with grassroots folks in the African-American community. With them, the response has been extremely emotional. It's as though I'm speaking people's personal stories, which seems to give them a feeling of hope.

Of course, I'm not the first person to initiate this kind of work into the intergenerational nature of trauma in the African-American community ... What I did differently is that I pulled from many different historical sources and scholarly disciplines. In essence, I created a "map" of knowledge so that people could see how African-American self-perception has been shaped.

Throughout your book, you emphasize that an acute, social denial of both historical and present-day racism has taken on pathological dimensions. You write that this country is "sick with the issue of race."

The root of this denial for the dominant culture is fear, and fear mutates into all kinds of things: psychological projection, distorted and sensationalized representations in the media, and the manipulation of science to justify the legal rights and treatment of people. That's why it's become so hard to unravel.

Unfortunately, many European Americans have a very hard time even hearing a person of color express their experiences. The prevailing psychological mechanism is the idea, "I've not experienced it, so it cannot be happening for you."

Truly, how can anyone tell me what I have and have not experienced? This is a very paternalistic manifestation of white supremacy, the idea that African Americans and other people of color can be told, with great authority, what their ancestor's lives were like and even what their own, present-day lives are like. The result for those on the receiving end of this kind of distortion is an aspect of PTSS. People begin to doubt themselves, their experiences, and their worth in society because they have been so invalidated their whole lives, in so many ways.

Attempts to encourage European Americans to join in on a more honest, national dialogue about "race" and racism often results in defensive posturing and positioning. Common responses include "slavery happened a long time ago," or people saying that they're tired of being made to feel guilty about something they didn't do. How do we respond to this detachment from the crucial issues of the legacy of slavery?

It's irrelevant that you weren't alive during slavery days. I wasn't there either! But what we as a nation face today has been heavily impacted by our history, whether we're talking in the gulf between the haves and have-nots; education gaps between white and black children; or the racial disparities in our prisons.

I don't believe in making people feel "guilty." We have to recognize that remnants of racist oppression continue to impact people in this country.

Much of my work really is about black people looking at ourselves and understanding how our lives have been shaped by what we've been dealt. I don't want to wait for permission to examine this or to hear that looking back into our histories is somehow counterproductive.

An eye-opening experience for you was your first visit to New York's largest and most overpopulated jail facility, Rikers Island. What kinds of insights did you gain about PTSS from talking to imprisoned African-American young men about their lives?

It was remarkable to see their physical disposition. They walked into the room with their heads held low, shuffled in ... for lack of a better word, [they looked like] slaves. They had lost their way, and there was no light in their eyes whatsoever. Young people typically have a high level of energy. While there was a feeling of angry rebelliousness, the prevailing feeling of hopelessness was staggering.

It's also significant that it took about a half-hour for them to realize that I was talking to them, not at them. In that brief moment, I felt as though I gave them hope. Their body language had already changed by the time they were getting ready to leave. They had become students by the end of our time together.

These young people are being raised by these institutions, and then unleashed back into their communities to wreak havoc. Most of these young men grew up in poverty, and they have the experience of being black and poor in a materialistic society that says if you have nothing, you are nothing. In comparison, when I was in Africa I witnessed incredible poverty unlike anything I had ever seen before. I always talk about how tall and proud the people walked. Their greatest shame was their lack of education, not their lack of wealth. But in America, you are what you have, what you wear.

You write about the fear that many African Americans have of being "exposed" or having family or community "dirty laundry" aired. "Never let them see you sweat," as the expression goes.

Shame is such a big issue in our society in general. What many African Americans have internalized is a sense of shame about just not being "good enough." That's a horrible thing to be sentenced to for your life.

When a person walks around with that sense of shame and self-hatred, they are likely to function poorly in society, no matter who they are. Add the extra layer of racist socialization, of being devalued, and what it means to be just human in America, and all those things just makes the shame worse. We as African Americans don't get a pass on all the problems that humans have to deal with in life: finances, career choices, personal crises, relationships, and so forth. But when we add that to this intergenerational trauma in the context of a society that is in denial about its racism, people's lives can become overwhelmed, even frozen in place.

I'm saying let's just take a few of those burdens off of people's shoulders. Look at what we, as African Americans, have been able to do even with those burdens on our shoulders. Can you imagine what we could accomplish if some of those burdens were removed?

ABOUT THIS AUTHOR

Silja J.A. Talvi, a senior editor at *In These Times*, is an investigative journalist and essayist with credits in many dozens of newspapers and magazines nationwide, including *The Nation*, *Salon*, *Santa Fe Reporter*, *Utne*, and the *Christian Science Monitor*.

More information about Silja J.A. Talvi

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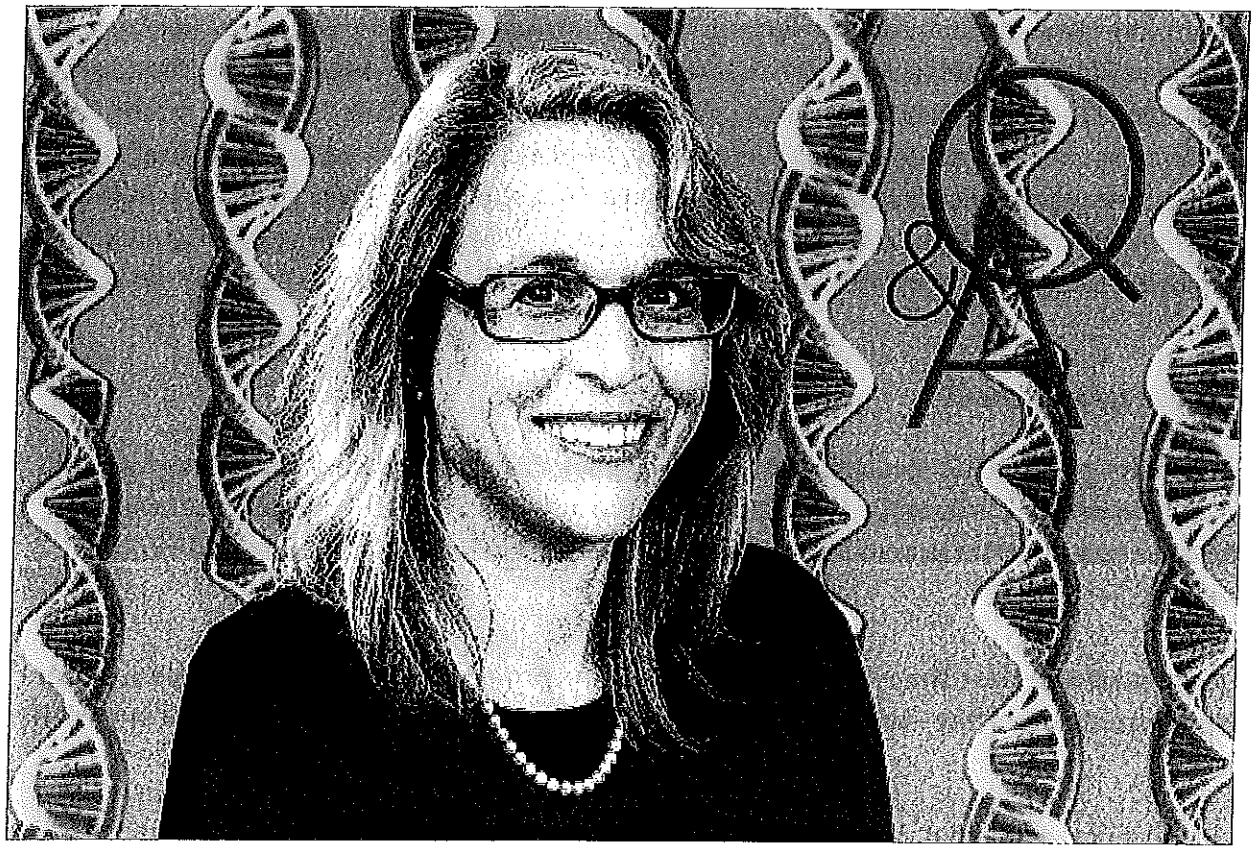
Do Jews Carry Trauma in Our Genes? A Conversation With Rachel Yehuda.

The innovative neuroscientist discusses how the Holocaust, famine, and other catastrophic experiences can affect our DNA

By David Samuels | December 11, 2014 12:00 AM



The James J. Peters Veterans Affairs Medical Center in the Bronx is one of those out-of-the-way places where America warehouses the casualties of its wars. It's a functional place, surrounded by a high fence, that looks like a cross between an urban community college and a low-security prison. Inside is a modern no-frills hospital that smells like a mix of heavy-duty disinfectant and vegetable soup. While it is not uncommon to see men of all ages in combat jackets or fatigues, no one is wearing a complete uniform. The handful of women I see in the hallways appear to be widows. No one who is doing exceptionally well in life shows up for treatment at a VA hospital in the Bronx. It is a closed universe, inhabited by people who have been permanently altered by the physical and psychological wounds of combat, perhaps the

most painful of which is that they are treated like lepers by a society that is made deeply uneasy by their sacrifice.

Rachel Yehuda, the director of the Mental Health Patient Care Clinic at the Peters Medical Center, and a professor of psychiatry and neuroscience at the Icahn School of Medicine at Mount Sinai Hospital, is one of the world's leading experts in post-traumatic stress. In addition to tending to injured minds, Yehuda has used her brilliant mind and the intuitions drawn from decades of clinical work to become one of the pioneers of the emerging field of epigenetics, which seeks to identify the mechanisms by which traumatic stress may permanently alter the physiology of survivors in ways that are passed on to their descendants.

That epigenetics may have particular relevance for the self-understanding of the Jewish community is an idea that is hardly lost on Yehuda, whose parents are Israeli and who spent a decade working with Holocaust survivors and their children. In the hope of understanding her field better, I met Yehuda in her small, government-furnished office in the Bronx, where she spends most of her working hours. She is a lively, empathetic woman with a lightening-fast mind, whose ego seems grounded in the knowledge that she is using her enormous emotional and intellectual capacities to help others. When I mention that it is snowing heavily outside, she glances over at the window to make me feel comfortable, and then realizes that the shade is drawn.

What is epigenetics?

Epigenetics refers to the study of alterations on genes that change the way the genes function. An epigenetic mark is literally a change to the gene or to the DNA environment that will then affect the way the DNA is read into RNA, and subsequently how RNA is expressed into a protein.

Are you saying that the experiences of human populations—famines, wars, other experiences like that—are encoded into our genes? That we take our history with us?

I think you're saying that. You just asked me to tell you what epigenetics was. You didn't ask me about how you get an epigenetic change.

How do you get an epigenetic change?

Well, an epigenetic change occurs from the environment. So there's something in the external environment that affects the internal environment, and before you know it a gene is functioning in a different way. Epigenetics has been something that cancer researchers studied for a long time because it helped explain how a dramatic change could occur in the environment of a person to cause a tumor. But it's become interesting now in neuroscience and mental health because it helps answer questions that have not been answered either by classic genetics or by stress theory. And those questions involve, "How do you create an enduring transformative change that isn't genetically programmed?"

When it comes to trauma exposure, what people will say is that they're changed. You hear veterans saying, "I'm not the same person I was before the war. I left myself on the battlefield." A rape victim might say the same thing. People don't talk in terms of fight or flight language, which is: There's a stressor, a reaction, the body calms down, and homeostasis and recovery are achieved.

I was violently raped, or I was blown apart on a battlefield, but guess what? I'm totally fine now! I'm back!

Almost nobody says that after trauma. If they are resilient, and they don't feel broken anymore, they can acknowledge that. But it's still not "back." "Forward," maybe. Or, "different in a positive way." Or, "I've somehow taken this adversity and transformed myself into a better version of myself," which some people call "post-traumatic growth." But almost nobody says, "I'm back." Because trauma changes people permanently and in an enduring way. And so the language of epigenetics, the science of epigenetics, offers a very tangible way for understanding how environmental events can permanently change things. And it also offers a mechanism for potentially understanding how those changes can be transmitted to the next generation.

The idea that those permanent changes are encoded in us in a way that can be passed on to our children and affects their physiology is a startling idea. Can you explain in a little more detail the mechanism by which that happens? Our DNA literally becomes different, or it's read differently? How does that work?

Our DNA becomes different and is read differently. But the question is whether this is transmitted through meiosis or through, I guess, sex cells, or whether it is acquired based on a parental response to their environment. And there are epigenetic mechanisms that can be linked to both of those things.

Another type of a change can be based on changes in the in-utero environment that can become incorporated into the offspring based on what is happening to a mother during her pregnancy. And yet another mechanism involves completely post-natal changes. You didn't inherit the DNA change, but there was something so different about the way the parent is responding to having a new baby that the behavior between mother and child, or parent and child, is altered as a function of parental trauma.

The first demonstration of this was by a scientist named Michael Meaney in McGill, and he did studies in rodents, where he removed the mother for a few minutes, and put the mother back in the cage. And the mother would begin to behave differently toward the rat pups. And he could see by having—simply on the basis of differences in the licking and grooming behavior of the mother, he could induce a change in the rat pup that was permanent and dictated the way that rat offspring would respond to stress forever, and through the different generations. He began by looking at one region in one gene in the hippocampus. And that was the glucocorticoid receptor gene, the gene that is responsible for the activity of the cortisol receptor. Then the work obviously expanded to other genes, other regions.

What we decided to do was look at that same gene in blood in connection with Holocaust offspring. That's how our work began. We found changes in the same gene. There are also other studies that have to do with responses to famine in the second and third generation.

Can you talk a little bit about the famine studies?

One of the first observations was that in women who had been exposed to starvation, they tended to have babies that were born with altered enzyme activity and were at subsequent risk for hypertension and metabolic syndrome, simply as a consequence of maternal starvation during the pregnancy. Now, the enzyme that was altered is also an enzyme that is related to glucocorticoid function. It's a very interesting enzyme. It's an enzyme that converts active cortisol to inactive cortisol. And cortisol is a glucocorticoid. So, we were very interested in that because we wondered how much of our effects in offspring in general had to do with maternal starvation. And we did a study where we looked at Holocaust survivors, and we found that within the Holocaust survivors themselves, there were alterations in this enzyme. So, we then looked at the children of Holocaust survivors and found alterations in the enzyme in the opposite direction in the children, but particularly this was based on the maternal age during the Holocaust. So, mothers who were younger during the Holocaust transmitted a different enzyme change to their offspring, compared to mothers who were adults during the Holocaust.

What this suggests is that there's some kind of different change that may be occurring as a result of the age of exposure, or pre-puberty or development that then gets transmitted differently in the case of that system. We know that the age of exposure is important. We know that the environment in which someone is pregnant is extremely important. We know that by studying women who were in the World Trade Center on 9/11 and were pregnant, and following them for several months, and their offspring.

What were the effects you observed in the children of World Trade Center survivors?

Women who were in the second or third trimester gave birth to babies that had low cortisol if that mother had PTSD. And if the mothers had PTSD, but they were in their first trimester, we didn't see the low cortisol effect. So, from this we learned that there must be some kind of an in-utero influence that interacts with the biology of PTSD, and a different result occurs. We also learned that mothers who were pregnant and in the World Trade Center towers on 9/11 gave birth to babies that were smaller for their gestational age. So, there are all sorts of effects in utero that can have big effects on offspring. So, we now have a language, we now have a methodology, and we can begin the task of unpacking this.

I know the offhand reaction of someone like my father, for example, or other post-Soviet people is, "Well, wasn't that Joseph Stalin's great contribution to science, Lamarckian adaptation?"

In my circles, Lamarckian genetics wasn't such an accepted thing, even though there is evidence of it everywhere. Lamarck didn't talk about epigenetics; he observed a phenomenon that was true, but he didn't have a mechanism to explain why it occurred, the way Mendelian genetics could explain things. Scientists like to know how things happen. Now, with epigenetics there is a real possibility of understanding really more enduring changes and how changes that occur at the molecular level can really have high yield. The question becomes: How enduring are these changes? What other kinds of influences can change them yet again?

Think about the difference between writing something in pencil and writing something in pen. If I write something in pencil, it's there, but I can erase it pretty easily if I want to, if it gets wet or something like that. The way that I think about this—for right or wrong—is that a person can acquire a new set of tools for an unforeseen circumstance, and then to the extent that their environment is similar, they use the tools, and they need the tools, and they pass the tools on. And to the extent that there is a complete mismatch between the tools that they've been given in their environment, maybe they don't.

So, for example, if a mother was in Auschwitz and was starving and transmitted the biology to the offspring—it's a biology that allows your liver to hang on to free cortisol and not have it converted to inactive cortisol, so that you can effectively get by with less fuel—that would be a fantastic thing for an offspring to have under periods of starvation. But if the offspring lives in a country where a breakfast bagel can feed a family of two for a day, there is a mismatch between that biology and what has been given.

Epigenetics provides a mechanism for short-term adaptations. And the word "adaptations," it has positive connotations. Adaptation is good. Gene mutations take generations. We can't wait for evolution. You gotta act quickly. So, the idea of being able to, at critical periods, transmit something based on unforeseen circumstances is a very good idea. And then the question is: What will your environment be like, and how will you cope with the fact that you have a set of tools from someone traumatized, but you're not—or don't need to be?

Except you probably *were* traumatized by growing up with parents who were changed by their own traumatic experiences.

So, that's where this field gets a little mushy-squishy, because it's not strictly about changes on genes anymore. You're dealing with a very complex set of issues that are based on: what was the child-rearing like; and what were the circumstances like; and what were the overriding factors? All of these things combine together to determine whether or not what you've inherited—either genetically or epigenetically—becomes useful to you as a person. If the environment can transform you in one way, it can transform you in another way too. If we make little changes in very important circuits, this can have a very big impact on health and well-being.

There's a quote in Ezekiel, "The fathers ate sour grapes, and the children's teeth were set on edge." So, the Jewish culture and religion has understood that children bear the burden of their parents' legacy. Fair or unfair, it's a fact. It's a cultural fact. It's a biological fact. Everyone is born with a unique set of genes. The task is to refine from these traits the best self that we can

have and not get distracted by the traits that are weaker; build up the traits that are stronger. We all have the same job to do.

A century ago, there was a spate of movements that aimed to produce a new man: the new socialist man, the new communist man, the new Zionist Jew. All of these movements in some way posited that you needed to modify the environment in order to bring out a different set of traits, and then that would in turn produce a new and better kind of human being. Obviously those were crude ideas, but you're suggesting they weren't entirely crazy.

It's not a crazy idea. When you look at the Haredi community, which I understand because a lot of it is familiar but so much more is unfamiliar, that seems to have to do with being in a very enclosed environment, where the environment itself can help solidify the differences and create a new reality for generations and generations and generations to come. Now, is that epigenetics; I don't know. Somebody in the future may study that and know. But I think the part that epigenetics adds to that concept is that it is actually possible to change your DNA based on your environment. That's a powerful concept.

The Jews of Europe, at least, were a people who went through repeated selection events of mass trauma, hunger, persecution, and slaughter. So, you would probably be looking at some pretty major epigenetic effects in that population as a whole, a bunch of enzymes and markers that would have been turned on or off.

But to me the Jewish people seem also very diverse. Even if you take the smaller subset of Jews called "children of Holocaust survivors," or even children of Holocaust survivors from a particular concentration camp or region in Europe, they're not all the same. Though the event and trauma exposure may be a strong contributor to something, there's still this other biology that is about individual response that is either a sum total of highly unique events, or is the thing that keeps us from being solely responsive to events. I suppose you can, from a cultural perspective, decide that Jews are more alike than other non-Jews, or you can look within Jewish people and say, "Hey, there's quite a bit of variance here," which is what I tend to do. I focus on the variance.

My friend Edward Luttwak compares Israeli society to a soup that his housekeeper makes. He says that the soup has to be left to cook over a low to medium flame all day long, and then it tastes amazing. But if the heat is too low, it tastes terrible. And if you turn the heat up too high, it also tastes terrible. His point being that this particular society functions better with what we would regard as an intolerable level of stress, because that's what these people are optimized to deal with. If you take that away, they actually become less productive, less creative.

From my perspective, I'm more interested whether or not the low flame is going to have the same effect on the carrots and the peas. That is what I'm interested in. Or whether the low

flame will have different effects on two individual carrots. So, the idea of a flame being too high or not being there at all, that's nice in terms of understanding what it takes to catalyze any biologic change—that's correct, you have to have something, but not too much. Too much is death. Too little is not enough environment for anything to occur. But the question is where we want to put our focus in terms of understanding how different things work. We can focus on the unit of analysis that's generalizable to every ingredient, or we can ask, "What are the differences?"

For decades, the field of stress research did the first thing: What is the effect of a stressor? What I'm interested in is how people fundamentally transform themselves, because this is not such an easy thing to do. We are to some extent prisoners of our biology and our environments. We can theoretically choose our environments; in practice, our choices are more limited based on our genetics, and a lot of factors that are superimposed on our presumed free will. But I'm always going to be interested in the differences.

Having grown up in a community that had plenty of Holocaust survivors, I don't think that there was a single one of those families that hadn't been given a spin by their trauma. On the other hand, the spins were different. Some of them were exceedingly amoral people. Some of them were exceedingly moral and charitable people. Some of those people were severely disturbed and psychotic people, while some of them were very gentle and kind people. You saw every kind of effect. The only thing I'd say about the effects is that they tended to be relatively extreme compared to the effects of growing up in a normal American suburb, I guess.

That's the point. In other words, what's new here is that we're trying to understand whether the different responses were there before, or whether trauma made them that way. We're trying to understand whether resilient people are born or made, whether in order to be resilient you actually have to have the trauma exposure, or whether you would have expressed the trait of resilience even in the absence of an environmental change.

The resilience was switched on by the traumatic event.

Yes. And that is very new. In the past, the idea would have been, "Well, that's the kind of person they were." Their pre-trauma traits would determine their post-traumatic responses. People who are generous before are generous before are generous after, people who are religious before are religious after. But that's just like saying that trauma is not that relevant. And I don't believe that. I think the trauma is highly relevant. But then the question is: If the trauma is highly relevant, how do I produce such different post-traumatic responses?

It's a very big question. If we respond to traumatic experiences based on who we are before the trauma, then we can have a lot of success in building resilience before anything bad ever happens. Then we should presumably be able to develop a formula and test it biologically. That really gives people an enhanced skill set to be able to respond in a completely optimized way to adversity. If what you're like before a trauma has a lot less to do with your response to an event, then that's something that we want to know also.

So, if I ask a very simple question like, "If you're a child of Holocaust survivors, are you more likely to respond differently to a car accident," that's very concrete. We did this study, and we published it, and the answer is: Yup, you're three times more likely to respond to a traumatic circumstance by getting Post Traumatic Stress Disorder if your parent had Post Traumatic Stress Disorder. So, then you have a place to begin to wonder, "Why is that so?" Is it because the Post Traumatic Stress disorder in the parent is there because of a gene that was there before the trauma? Is it there because of an interaction with the gene and the environment? Is it completely a de novo response to an environmental stressor? Does it have something to do with what happened after the trauma? Is it some interaction of all of this? And in the offspring, are you carrying the gene? Are you carrying an epigenetic change? Are you carrying the legacy of a behavioral response in the parent that then makes you more at risk? If you're 4 years old and your mother freezes when she sees a policeman, and you notice it cause you're holding her hand and she's not safe—to most people a policeman is a safety signal, but not to your mother—what is the impact of that on you?

Culture is the ever-evolving product of an ever-evolving group of people. So, if you have a large number of people whose parents or grandparents have been traumatized, and you can show that the effects—whether transmitted by maternal behavior, by epigenetic effects—then, in turn, the weight of having a very large number of people having very different kinds of responses to a policeman or whatever, are going to shape the literature, and art, and codes of behavior within that group, and provide a vehicle for the transmission of trauma responses to people who did not have parents who physically went through those particular events. So, culture can also be the bearer of trauma.

I think that's an excellent point. I think you're also explaining why someone like me, whose parents are Israeli and have really very little connection to the Holocaust, feels that the Holocaust was my trauma too. But I think it's very important to make sure that people understand that not all effects of trauma are negative. What you have represented among children of Holocaust survivors is a preponderance of people that are in therapeutic professions: doctors, nurses, social workers, psychologists. You have an extraordinarily large number of people that go into tikkun olam, fixing what's broken. I think that that's also a response to a cultural trauma. You can get stuck in the legacy of victimization, or you can say, "No, no, no, no, no. I'm going to be part of the solution." I don't know why in the Jewish culture, you have an overwhelming response of, "I'm going to make sure this doesn't happen again."

When I was running the Holocaust offspring clinic in the '90s during Darfur and all of these other events, I was so struck with the passion of Holocaust offspring to want to go, to do, to make sure the Holocaust never happens again. They have heightened radar for genocide. To me, it really felt like a post-traumatic response, but in a positive way. But it equally could have been, "What can we do? They're always going to kill us. They're always going to kill everybody." There could have also been a highly disempowered response. Maybe because, as they would say, they're children of the *survivors*.