MENTAL HEALTH

Vision and Breathing May Be the Secrets to Surviving 2020

Stanford neurobiologist Andrew Huberman discusses the two things we can always control, even during a high-stress election and scary COVID pandemic

By Jessica Wapner on November 16, 2020

Credit: Bonnie Tarpey *Getty Images*

We are living through an inarguably challenging time. Earlier this year the U.S. faced its highest daily COVID-19 case counts yet. Uncertainty and division continue to dog the aftermath of the presidential election. We are a nation and a world under stress.

But Andrew Huberman, a neuroscientist at Stanford University who studies the visual system, sees matters a bit differently. Stress, he says, is not just about the content of what we are reading or the images we are seeing. It is about how our eyes and breathing change in response to the world, as well as the cascades of events that follow. Both these bodily processes also offer us easy and accessible releases from stress.

Huberman's assertions are based on both established and emerging science. He has spent the past 20 years unraveling the inner workings of the visual system. In 2018, for example, his laboratory reported its discovery of brain pathways connected with fear and paralysis that respond specifically to visual threats. And a small but growing body of research makes the case that altering our breathing can alter our brain. In 2017 Mark Krasnow of Stanford, Jack Feldman of the University of California, Los Angeles, and their colleagues identified a tight link between neurons responsible for controlling breathing and the region of the brain responsible for arousal and panic.

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This growing understanding of how vision and breathing directly affect the brain—rather than the more nebulous categories of the mind and feelings—can come in handy as we continue to face mounting challenges around the globe, across the U.S. and in our own lives. *Scientific American* spoke with Huberman about how it all works.

[*An edited transcript of the interview follows*.]

What is stress?

Stress is one position along the continuum of what we call autonomic arousal. At one end of this continuum would be somebody in a coma. At the very other end of that continuum is a full-blown panic attack: heart racing, pupils dilating, hyperventilating. In between we have lower levels of stress [and the states of being] alert and focused, sleepy and asleep. Stress is generally a high level of autonomic arousal. It was designed to be a generic response to mobilize the body.

Sometimes that's well matched to the demands of life. If you need to run and catch your train, you want all the things that go along with stress to go pursue that train. But if the stress response is spontaneous or excessive, it can start to feel pathological.

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What is stress's relationship to vision?

When you see something exciting or stressful—a news headline, a fraudulent credit-card charge—heart rate increases; breathing increases. One of the most powerful changes is with vision. The pupils dilate, and there's a change in the position of the lens in the eye. Your visual system goes into the equivalent of portrait mode on a smartphone. Your field of vision narrows. You see one thing in sharper relief, and everything else becomes blurry. Your eyeballs rotate just slightly toward your nose, which sets your depth of field and focus on a single location. This is a primitive and ancient mechanism by which stress controls the visual field.

How does this visual mode affect the body?

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This focal vision activates the sympathetic nervous system. All the neurons from your neck to the top of your pelvis get activated at once and deploy a bunch of transmitters and chemicals that make you feel agitated and want to move.

Why is the visual field so connected to this brain state?

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Something that most people don't appreciate is that the eyes are actually two pieces of brain. They are not connected to the brain; they are brain. During development, the eyes are part of the embryonic forebrain. Your eyes get extruded from the skull during the first trimester, and then they reconnect to the rest of the brain. So they're part of the central nervous system.

Having the eyes outside the skull orients the organism to the time of day. But it also means that you've got two pieces of brain that can register events in the environment at a distance in order to adjust the overall state of alertness in the rest of the brain and body. It would be terrible if we had to wait until things were in contact with us before we could prepare to react to them.

Is there a visual mode associated with calmness that can change our stress levels?

Yes: panoramic vision, or optic flow. When [you] look at a horizon or at a broad vista, you don't look at one thing for very long. If you keep your head still, you can dilate your gaze so you can see far into the periphery—above, below and to the sides of you. That mode of vision releases a mechanism in the brain stem involved in vigilance and arousal.

We can actually turn off the stress response by changing the way that we are viewing our environment, regardless of what's in that environment.

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You are also researching breathing as a way to regulate autonomic arousal.

Yes. Vision and breathing are, without question, the fastest and most obvious ways to control autonomic arousal. The way we breathe impacts our states of stress very strongly.

Data show that during sleep and claustrophobic states, people and animals generate what are called physiological sighs—double inhalations followed by exhalations. Children also do this when they are sobbing. A physiological sigh, two or three times, is the fastest way that we are aware of to bring the level of autonomic arousal back down to baseline.

Why does this breathing pattern work to reduce stress?

Our lungs consist of tons of tiny little sacs of air—millions of sacs of air. As we get stressed, these little sacs collapse. They deflate like a balloon. Physiological sighs cause the sacs to reinflate. Carbon dioxide is the trigger for breathing: We don't breathe because we need oxygen. We breathe because carbon dioxide levels get too high. Physiological sighs offload the maximum amount of carbon dioxide.

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How are you studying the link between breathing and stress?

David Spiegel, associate chair of psychiatry at Stanford, and I are leading a study of breathing in which 125 participants have been wearing wrist monitors that measure breathing, sleep duration, heart rate variability and heart rate. The participants are divided into four groups of different breathing modalities: meditation for five minutes a day; repeated physiological sighs; box breathing (equal durations of "inhale, hold, exhale, hold," repeated for five minutes); and deliberate hyperventilation repeated a few times. We want to see which patterns of breathing most rapidly reduce the stress response. We're analyzing the data now.

How are breathing and the brain connected?

The relationship is anchored through the diaphragm, the only organ in the body that is skeletal muscle designed for voluntary movement. You can immediately take control of the diaphragm. So breathing represents a bridge between the conscious and unconscious control of the body.

When you inhale, the diaphragm moves down, and the heart gets a little bigger because it has more space. Blood flows a little more slowly through the heart under that condition. So the heart then signals to the brain, and the brain says, "Oh, we'd better speed up the heart." So if you want to increase your heart rate, you inhale more than you exhale. The opposite is also true. Every time you exhale, you're slowing down the heart rate.

So with vision and breathing, you are looking at physiological processes that are automatic but that we can also control.

Yes. If I make you stressed, you'll perspire. But you wouldn't say, "I'm going to make myself sweat, and therefore I'll be stressed." You can't control your heart rate directly. You can't control your adrenals with your mind. But you can control your diaphragm, which means you control your breathing, which means you control your heart rate, which means you control your alertness. You can control your vision, which thereby controls your level of alertness, your level of stress and your level of calmness.

Vision and breathing are essential as levers or entry points to autonomic arousal because they are available for conscious control at any point.

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