VAGUS NERVE

101 STIMULATION EXERCISES THAT CHANGE LIFE

HOW TO NATURALLY ACTIVATE YOUR VAGUS NERVE FOR UNLOCKING CREATIVITY, PREVENTING HEART DISEASE, OVERCOMING DYSLEXIA, ANXIETY AND DEPRESSION

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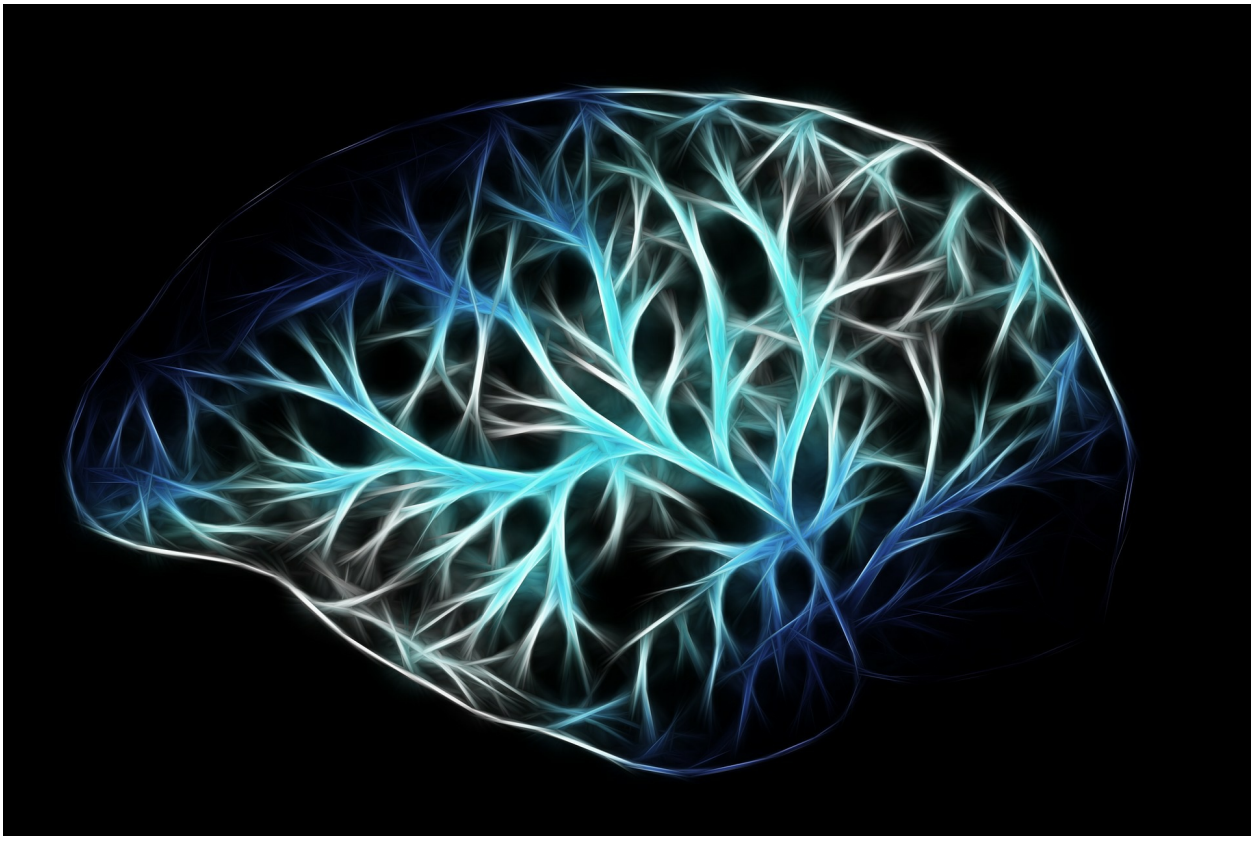

Your heart will beat 100,000 times today without your giving it a second thought. You will be taking 23,000 breaths. Three times a minute, your blood will flow through your body, and your liver must continuously cleanse and detoxify the blood. The ever-changing bacteria species in your gut will work symbiotically with your digestive tract to break down your food and consume the nutrients that each of your cells requires to survive. Did you ever wonder how this happens when there is no conscious control? How do all those processes work together?

The key to this is the autonomous nervous system. The device is a wonder of evolution. This is the portion of the nervous system that regulates unconsciously guided bodily functions.

Our bodies are built to live and function without having to think consciously. As humans evolved, we increasingly increased our capacity for critical thinking. It was only possible as the mechanisms needed for survival were

subconsciously or, ultimately, automatically controlled. The forebrains have evolved and let us think, ponder, and interact with the world. Meanwhile, our brainstem has kept us alive and healthy.

The brain-stem is the spinal cord's thickest and highest level. There are several information control centers within the brainstem, called nuclei, each with a different set of functions from which it manages and sends or receives signals.

These mechanisms alert us to both internal and environmental stressors and threats to our survival. If such stressors are triggered by an illness that develops in our bodies, anxious thoughts about tasks that need to be done, or the physical appearance of a tiger in front of us, this system's automatically controlled functions enable us to survive. These functions are regulated by a branch of the autonomic nervous system called the sympathetic branch (or, for convenience, sympathetic nervous system). It is understood that the sympathetic nervous system raises the heart rate, raises the pulse rate, reduces pulse volume, shunts blood flow to muscles in the arms and legs and away from the liver and digestive tract, and dilates our eye pupils. This method helps us to counter stressors or "take flight" and run away from the presenting stressors. It is called the "fight-or-flight" condition when the sympathetic nervous system is involved.

There is, by comparison, another branch of the autonomic nervous system that helps us to relax and recover from the day's rigor and tasks. It helps us to remain calm, lower our heart rate, lower our breath rate to take deeper, fuller breaths, and shunt blood flow away from the limbs and into the internal organs, which enables our bodies to heal, stay calm and even procreate. This branch of the autonomic nervous system is called the parasympathetic branch (the parasympathetic nervous system, to be exact). It is called the "rest-and-digest" condition when the parasympathetic nervous system is involved.

The vast majority of controls claimed by the parasympathetic nervous system pass through a particular nerve pair in the body-the vagus nerve, which is the subject of this book. It is the only nerve with its roots in the brainstem and passes through the entire body. The vagus nerve (actually the vagus nerves, because there are two paired structures, with one on either side of the body) controls movement of the heart, lungs, throat and airway muscles, liver, stomach, pancreas, gallbladder, spleen, kidneys, small intestine, and part of

the large intestine. How well the functions of the vagus nerve are a good determinant of health; vagus nerve dysfunction is strongly associated with illness.

Earlier, we assumed that nerves had a simple job: to relay signals rapidly from one place to another. We now find that the messages and signals transmitted by the vagus nerve is much broader and more significant than we knew initially; in addition, it is the direct connection between the brain and the gut microbiome. The vagus nerve is the most critical means of communication pathway regarding food, nutritional status, and the ever-changing population of bacteria, viruses, yeast, parasites, and worms living within our digestive tracts.

Harmony between the two branches of the autonomous nervous system is important in order to live life. Overactivation of one branch and disregarding the opposing branch may cause severe loss of function. Chronic disorder sends us later of instability and disease. The parasympathetic system loses the ability to function if the stress levels remain too high for too long. Blood flow and function are based on the sympathetic branch, meaning blood flow to the parasympathetic branch will be restricted, and thus function will be decreased. The reverse is also true, as parasympathetic system overactivation will hinder your ability to cope with possible stressors and build risks for your survival.

It is a very common problem today: that we are living under enormous stress levels and placing massive amounts of pressure on ourselves. The capacity of our bodies to differentiate between types of stressors has not yet developed, and mental and emotional stressors evoke the same reaction as the appearance of a lion, tiger, or bear –anything that threatens our existence. This means we will respond identically to the imminent physical danger, just like we'd respond to our high school teacher shouting "pop quiz," or our supervisor sternly exclaiming she wants to see you "immediately" in her office. Our bodies generate high levels of inflammation under consistent stress rates and are not given the opportunity to heal and relax, which is necessary to maintain optimal function. For this cause, we break down much faster and more frequently than we used to. We are developing autoimmune disorders such as rheumatoid arthritis, thyroiditis of Hashimoto, and higher levels of multiple sclerosis than our medical system can keep up with. We are

developing all cancers and heart disease and are dealing with alarmingly high levels of obesity and diabetes, and collectively, our metabolism has never been worse. Our bodies will fight back and perform the tasks that our cells performed, helping us to resolve many of those conditions, provided the right opportunity to heal. The problem is so many of us don't give this opportunity to our bodies.

We stress ourselves by consuming highly refined foods (which are brought to us by an agricultural system that is more concerned with high yields and convenience than nutritional value) while spending more time indoors, away from nature, and worrying about loved ones while failing to care about oneself. Meanwhile, we want our physicians and healthcare professionals to keep up with our life's demanding rate of transition.

There is a solution to these problems: take back your own health obligation.

Instead of depending on your physicians to monitor your wellbeing, take power back, and use them as a tool to test your own hypotheses. Do your own study, learn how to handle your own stressors, and discover what causes are bringing you into a stressed state. Your primary care doctors are a very valuable tool, but you're eventually setting yourself up for failure when you turn over responsibility to a program low of money and oversees hundreds and thousands of patients.

I will be inspiring you to take back control of your health in this book. I'll help you discover the root factors ignored by many negative health problems that your doctor does not yet know are the true reasons your health is so bad. Your doctor would probably not even know there are practical laboratory tests to help you discover those blind spots. I will give you practical daily, weekly, and monthly tools you can use to improve the function of your vagus nerve and parasympathetic nervous system so you can better recover from the stressors of each day.

HOW THIS BOOK IS ORGANIZED

This book is organized into three parts.

Part 1 will concentrate on medicine, primarily the anatomy, neuroanatomy, biochemistry, and vagus nerve basic functions and the processes it regulates. If you are more of an action-taker, you can skip through this segment. To get

a better understanding of this nerve and its behavior, this section is important to read about.

Part 2 will concentrate on feature improvement and optimization. I will discuss common techniques and procedures used by industry experts, colleagues, and my patients to improve this nerve's work to recover and resolve the root causes of their health conditions.

Part 3 will concentrate on vagus nerve dysfunction" its signs, symptoms, and root causes, and how to measure this nerve's activity with the tools you will use every day. It will be a valuable chapter for many people who suffer from different health issues and want to dig deeper to decide why the problems can arise first.

If you're prepared to take control back and put your safety in your own hands, then buckle up. Let's get at it, right!

CHAPTER 1

WHAT IS THE VAGUS NERVE?

If the human brain were so simple we could understand it, we would be so simple we couldnâ€™t.

—Emerson W. Pugh

This stumped anatomists. How can a single nerve that begins in the brainstem be so long and interact with so many organs? What consequences could probably this nerve have? What would happen if the nerve is damaged or cut, considering its large array of possible functions?

WHAT IS THE FUNCTION OF THE VAGUS NERVE?

The vagus nerve (VN) originates in the brainstem --essentially the brain trunk, which detects, processes, and regulates the vast majority of the body's automatic functions. Mostly, to make them happen, we do not have to actively think about certain roles. Those are called autonomic functions and are governed by the autonomic nervous system.

WHY DO WE CALL IT THE VAGUS NERVE?

Vagus is derived from a Latin word meaning " wandering, rambling, strolling," often and to a lesser degree, "uncertain or vague." On initial analysis, the anatomists and researchers needed a descriptive term meaning this. When they landed on the word vagus, they literally called this nerve "the wanderer." Some functions controlled by the autonomous nervous system included:

- Beating of the heart
- Blinking of eyelids
- Breath rate and depth
- Constriction and dilation of blood vessels

- Detoxification in the liver and kidneys
- Digestion in the digestive tract
- Opening and closing sweat glands
- Producing saliva and tears
- Pupil dilation and constriction in eyes
- Sexual arousal
- Urination

Neurons here receive input from other cells all over the body. Such nuclei have different functions and are distinguished by names derived from Latin. Nuclei are like a router being linked to a home internet network. Some information enters the router through your cable link or telephone line, the information is processed in the router, and other information is then sent out from the router to your device, television, and any other devices linked to your network.

There are two main neurons, and in one of two directions, they send information. The first is afferent neurons that collect information about what's happening inside and around the body. Afferent neurons take input toward the brain from the body, called afferent information. The second is called efferent neurons, which send information to different organs and structures in the body with regulatory or motor effects (called efferent information) so efferent information is transmitted from the brain to the body.

The vagus nerve is attached inside the brainstem to four separate nuclei. Eighty percent of the information that the VN transmits is afferent information, indicating that the most common way that information travels in the VN is from the body's organs to the brain. The remaining 20 percent of VN neurons provide an efferent signal, spreading from the brain to the body, contributing to different roles in each cell and organ. It's interesting to hear that most medical students are surprised by the fact that only 20 percent of the VN's work is efferent, as it has so many efferent effects on the organs –just imagine then the amount of information that this nerve relays back to the brain, more than four times

as much as the information it relays away from it.

Unlike the wires of your home network link, the neuron bundles inside your nerves transfer information along their length using electrical signals that contribute to the release of a chemical signal called a neurotransmitter after hitting the end of the nerve. These neurotransmitters bind to receptors on the receiving cells, resulting in the cells at the end of the connection having an impact. The main neurotransmitter used by the VN is called acetylcholine (in short, ACh), which has a strong anti-inflammatory effect in the body.

Managing the inflammatory system is one of the VN's most critical functions; it is the body's primary inflammatory control mechanism and has far-reaching effects on your personal health and illness. Many of my patients ' health problems are due to elevated rates of inflammation in many organs and systems, from the digestive tract to the liver and even the brain.

Inflammation is a major reaction inside the body to keep us healthy from bacterial and viral pathogens, physical damage, and other things that do not reach the body optimally. The results can be wide-ranging and contribute to several different health problems when inflammation rates are not held in control and become chronic. Several specific disorders linked to elevated rates of inflammation include:

- Arthritis
- Alzheimer’s disease
- Asthma
- Cancer
- Crohn’s disease
- Diabetes
- Heart and cardiovascular disease
- High blood pressure
- High cholesterol

- Postural orthostatic tachycardia syndrome (POTS)
- Ulcerative colitis
- As well as any condition that ends in the suffix “itis

Majority of the organs that are at risk in these conditions are connected by the Vagus nerve. Thus, it is impossible but mostly likely that the vagus nerve is functioning suboptimally and not having its anti-inflammatory consequence on these organs, leading to chronic inflammation and/or disease.

It is important to note that these conditions will not exist in isolation, and if there is one of these conditions, it is probable that there will be another. The same signals are transmitted to and from almost every internal organ through the vagus nerve, and if inflammation rates are not regulated in one organ, the same is likely to occur in other areas.

CHAPTER 2

WHERE IS THE VAGUS NERVE LOCATED?

The longest nerve in the body is the vagus nerve. Without being too technical, I would like to illustrate where the nerve begins and how it flows and enters the organs it innervates and sends information from and to. Let's follow through the body along its course.

BRAINSTEM CONNECTIONS

The neurons that make up the vagus nerve begin in the brainstem, originating from four nuclei. Such nuclei are formed by the dorsal motor nucleus, the solitary nucleus, the spinal trigeminal nucleus, and the uncertain nucleus. Growing of these nuclei regulates nerve fibers unique to their components.

Sensory neurons transports signals from the skin which the VN innervates to the spinal trigeminal nucleus. It involves a particular portion of the ear's skin, which is necessary when using acupuncture treatment to stimulate the vagus nerve and will be addressed in later chapters. Signals from the body's internal organs are carried through the vagus nerve to the solitary nucleus and passed up into the brain for further processing. Such signs include stomach, intestine, lungs, pulse, liver, gallbladder, pancreas, and spleen. We can also send direct signals through the vagus nerve to these organs using parasympathetic fibers which originate in the dorsal motor nucleus. Such signals help to relax and control the heart and lungs activity, and increase the gut and intestinal tract, liver, pancreas, gallbladder, and spleen action.

The nucleus ambiguus is the final nucleus which contributes fibers to the VN. This nucleus sends out motor functioning neurons, primarily working to regulate most muscles present in the throat and upper airways. These muscles are responsible for holding the airway open and transmitting sound through the vocal cords, thus generating your voice.

The right and left vagus are the only nerves in the body that have four different functions and four distinct nuclei contributing directly to component fibres. Most other body nerves bring basic sensory input to the muscles from the skin and motor signals. This simple distinction will make you aware of

the true importance of the vagus nerve and the broad scope of its operation.

Now, let's trace the nerve path down through the neck, thorax (chest area), and abdomen (belly area) from the brainstem.

INTO THE NECK

The fibers of the left and right vagus nerves reach into the cranial cavity (the inside of the skull) from the brainstem region known as the medulla oblongata and converge to form what we call the vagus nerve. Then the nerve passes into an opening called the jugular foramen from the skull. This opening is a large gap for movement between the neck and the skull between the nerve and other blood vessels. If the VN leaves the brain, it joins the upper neck region right behind the jaw, between the inner jugular vein and the carotid artery inside. Such blood vessels are the main blood lines to and from the brain and are very necessary to keep us alive.

Being so close to these different blood vessels is an indicator of how vital the vagus nerve is because physical trauma can cause irreparable trauma to any of these three structures. In the case of blood vessels, damage will lead directly to death, while nerve damage can result in a total loss of function in many of the body's organs.

There is a thickening of the nerve called the superior ganglion (or jugular ganglion) shortly after the vagus passes through the jugular foramen. A ganglion is a nerve thickening produced by a group of sensory neuron cell bodies very close to each other. In this ganglion, the cell bodies of the sensory nerves congregate and then develop into the thinner nerve segment, resulting in the vagus nerve's first branch.

The VN's first branch is referred to as the auricular branch. The auricular branch passes through an opening called the mastoid canaliculus back into the skull, and through another skull hole called the tympanomastoid fissure back into the head.

The nerve stretches to each ear's tissue. This branch senses pressure, temperature, and wetness on the ear skin; in particular, the outer canal, tragus, and auricle. This is the key focus for VN dysfunction activation therapy using auricular acupuncture (acupuncture points in the ear), which we will explore in later chapters.

As the nerve continues to move down (or inferiorly, using anatomical language) from the upper ganglion, the VN thickens again to form the lower ganglion, also known as the nodose ganglion. This ganglion houses the neuronal cell bodies involved in taking in input from the internal organs. The nerve then thins out again and enters a passageway formed by a thickening of the connective tissue called the carotid sheath immediately. As it passes through the heart, the vagus nerve, along with the internal carotid artery and the internal jugular vein, is given extra soft tissue protection.

The vagus nerve gives off their next branch inside the carotid sheath: the pharyngeal branch. The pharyngeal branch has vagus nerve neurons but also bears some contributing neurons (glossopharyngeal and peripheral nerves) from the ninth and eleventh cranial nerves. As these neurons merge, they move over to the body's midline before they enter the upper portion of the mouth, called the pharynx. The vagus nerve in the pharynx relays motor impulses to various muscles involved in the swallowing reflex, controls the opening and closing of the upper airway, and retains the gag reflex.

It gives rise to the third branch, known as the superior laryngeal nerve, while the vagus nerve descends the sides of the neck within the carotid sheath. This nerve branches off the VN very soon after the pharyngeal branch, and supplies motor signaling to the larynx muscles above the vocal cords, specifically the muscles that regulate your voice's pitch.

As the VN runs down through the carotid sheath, it gives rise to the branches of the cervical cardiac, which are two of the three branches that innervate the heart. Immediately after leaving the carotid sheath in the chest (thorax) region, the third branch, the thoracic, cardiac branch emerges. These branches intermingle with the nerves of the sympathetic nervous system and form the cardiac plexus (a plexus, pluralized as Plexi, is a series of intermingling nerve fibers of various branches and separate nerves of origin that migrate towards a particular location). We have two cardiac plexi: one that is called the superficial cardiac plexus in front of the aorta and one that is called the deep cardiac plexus behind the aorta's arc. (The aorta is the main blood vessel transporting blood from the heart to the rest of the body.) Some cardiac plexi fibers connect to the heart's Sinatrial (SA) node, while some stretch to the AV node. In the next chapter, we will address the role of those nerves on the heart. The most important thing to note right now is that these fibers regulate the electrical activity rate that pumps your heart.

INTO THORAX

After the nerve leaves the bottom of the sheath, it runs down into the thorax, between the first and second ribs, and before the wider blood vessels extending from the neck.

The left vagus nerve crosses the aorta's arch before (anterior to) and then sends off its fourth branch —the recurrent laryngeal nerve. The right vagus nerve takes a similar path on the opposite side of the body; however, it crosses in front of the right subclavian artery and then sends off its fourth branch, the recurrent laryngeal nerve on the right side.

Both recurrent nerves of the laryngeal follow a similar direction, but on opposite sides. These are the nerve's only branches that are turning and heading upward again towards the arm. Based on tensioning and loosening of the vocal cords, they bring motor signals from the brainstem to each of the larynx muscles below the vocal cords, which are essential for vocal sound production. We're going to talk more on how we can use such particular branches to help strengthen the vagus nerve if it functions suboptimally.

When the nerves enter the aorta level, each of the vagus nerves sends branches off to the next pair of organs, the lungs. The left vagus nerve sends a pulmonary branch to the anterior pulmonary plexus, and a pulmonary branch is sent to the posterior pulmonary plexus by the right vagus nerve. Both branches of the nerves combine with sympathetic neurons, reorganize, and then move to either side to innerve the lungs. Such branches go to the bronchi and wider branches of the lungs to open and close them on the basis of each condition according to the body's needs.

One organ in the thorax which is frequently extremely neglected or ignored that the vagus nerve innervates is the thymus. The thymus is an immune system's extremely critical organ. It is found in the chest's mediastinum, just before the heart but behind the sternum. A vagus branch makes its way to the nerve to send out signals to and from the thymus. The thymus is the primary source of training for and growth of our white blood cells early in our development. The reason this organ is so easily forgotten is that it shrinks over time and is replaced with fat tissue. This cycle begins during puberty, and can continue on into early adulthood for several years. I tend to think of thymus as a school for new immune cells, and as the school gets older and deteriorates, the consistency of the training that the white blood cells go

through declines.

INTO THE ABDOMEN

The organs of the abdomen are the final segment which the vagus nerve innervates. Such organs are vital for digestion, for regulating the immune system, and for ensuring that the blood that enters the rest of our cells does not contain toxins that can adversely affect cell health.

The vagus nerve's first abdominal branch goes out into the stomach. Once our body is in the rest-and-digest stage, the vagus nerve fibers activate the activity of the stomach muscles. They give signals to the parietal cells to produce and secrete hydrochloric acid (HCI), the chief cells to produce and secrete the pepsin and gastrin digestive enzymes, and the smooth stomach muscle cells to physically churn and transfer the food in our stomach into the next digestive tract, the small intestine.

If the vagus nerve is weakened and these essential signals are not transmitted to the stomach cells, it can lead to complications like hypochlorhydria, or low stomach acid, which is a major root cause of many health conditions. To activate the digestive enzymes and break down food, sufficiently low pH (high acid) is needed. The maximum stomach pH level will be about 3.0 in the stomach, while nothing above 5.0 would be high enough to activate pepsin and gastrin. Low stomach acid allows for a less optimal breakdown of food. Higher pH in the stomach will also make it possible for unwanted bacteria, viruses and parasites to penetrate the intestines and create havoc on the digestive tract.

The second vagus abdominal branch goes into the liver. Interestingly, these divisions are closely correlated with the feeling of hunger and the need for other forms of nutrients. Initially, the food we consume goes into the stomach to be broken down. It then goes into the small intestine, where much of our macronutrients (protein fats, carbohydrates, and amino acids) are absorbed into the bloodstream. These nutrients then flow into the liver for filtration, processing, and sending back to the brain through the portal vein.

Through the liver, the vagus relays information about blood sugar levels, fat consumption, and overall function of the liver to the brain. The vagus nerve may also transmit information about the amount of bile needed to assist in the digestion of fats. The liver has many functions that require vagus input,

including and certainly not limited to the production of bile and bile salts (the active component of bile), which are then sent to the gallbladder for storage; the balancing of blood sugar by producing glucose; the management of hunger and satiety by measuring fat intake; the filtration of blood in the portal vein that brings all nutrients; For our overall well-being, the liver is very necessary and the vagus innervation is strongly associated with maintaining this balance.

The gallbladder is closely linked to the liver. The gallbladder, which is necessary for our bodies to function optimally, is often ignored by the medical system,. Once the liver produces bile and bile salts, they are sent for storage into the gallbladder in preparation for the next meal. The gallbladder pumps bile into the duodenum (the first component of the small intestine) as the next meal happens to help get fats into the bloodstream. The gallbladder pump is regulated by the vagus nerve. The vagus branches out from the liver to send messages to the gallbladder, activating the smooth muscle cells in its walls to pump bile into the digestive tract. This occurs in response to a meal decided by the taste buds (sensory receptors on the tongue) containing fat, which should be digested until it enters the small intestines.

The next branch of the vagus is directed to the pancreas. Your pancreas is one of your body's most significant glands, with both an exocrine and endocrine component. The endocrine pancreas produces and secretes insulin and glucagon directly into the bloodstream for blood glucose (blood sugar) levels to regulate. The exocrine pancreas stimulates and secretes digestive enzymes directly into the small intestine through a channel. The three most notable digestive enzymes produced by the pancreas are protease, which breaks down proteins into their amino acid components; lipase, which breaks down fats into free fatty acids and cholesterol from their components, and amylase, which breaks down carbohydrates into simpler sugars.

Vagus innervation signals message back into the brainstem from the pancreas, relaying information about the state of exocrine and endocrine cells. It also relays information about food intake from the brainstem back to the liver, and the enzymes are necessary for development and release into the bloodstream and digestive tract. Vagus innervation is important to transmit this information, as a lack of signaling can hinder the release of digestive enzymes, decreasing the efficacy of the digestive process.

As the vagus nerve passes through the stomach, it forms the celiac plexus, a network formed between sympathetic lumbar nerves and vagus parasympathetic fibres. This network sends branches into the remaining abdominal organs.

The spleen is the first organ that is innervated after the celiac plexus. The spleen is located opposite the liver on the left side of the body, below the left lung. Its purpose is to track the bloodstream and activate or deactivate immune system cells based on what they are sensing. Both spleen and thymus control immune cell function early in our lives, but later in life after the thymus has vanished, this mechanism is regulated by spleen alone.

The spleen receives signals from the sympathetic branches to activate the inflammatory pathways that arise in response to or damage from physical and biochemical traumas. The parasympathetic branches send out signals to stop cycles of inflammation. The vagus nerve modulates a mechanism called the anti-inflammatory cholinergic pathway, which has important effects in the spleen. We will address certain common inflammation-related effects in later.

After the celiac plexus, the next branch of the vagus passes to the small intestine. Once the chemical and physical churning in the stomach has broken down food, it joins the small intestine. Here the pancreatic digestive enzymes and bile undergo more digestive processing. The small intestine has the task of breaking down and consuming much of our macronutrients. These include fats, carbohydrates, and proteins (which usually break down into their amino acid components). The bloodstream receives the macronutrients the small intestine's lining cells have recognized.

The bite of food we take (which at this point in the digestive process is called chyme) must be moved along the length of the small intestine winding and coursing. To this end, the vagus nerve activates the digestive tract's smooth muscle cells by signaling the extensive network of nerves lining the intestine, called the enteric nervous system.

Contrary to its name, the small intestine is actually very long, about 22 feet long, and considerably longer than the larger gut, the next component of the digestive tract.

We have an incredibly important interaction with the other cells existing within our digestive tracts. I am talking about the symbiotic relationship

between our human cells and the bacteria that live in our intestines: our microbiome. The overwhelming majority of our bacterial allies live in the thicker, shorter region of the digestive tract in our large intestine. While many essential vitamins, minerals, and biochemical precursors are produced for us by these bacteria, they can also generate many toxins and methane. We need a device that can hold these bacteria in our brain's power and transmit signals about the status of the digestive tract and microbiome work. Therefore, while the vagus nerve activates smooth muscle cells to push food along the rest of the digestive tract, the microbiome's main relay path is also to communicate to the brain. The vagus nerve inwards in the first half of the large intestine– the ascending and transverse parts.

The final organ that the vagus nerve innervates is actually two organs, with each one either side of the body: the kidneys. These organs have a variety of specific roles vital to our wellbeing. In the form of urine, the kidneys pump fluid out of the body, a mixture of uric acid and water, which is then sent down to the bladder. Blood pressure is one of the main determinants of this regulation and will be addressed further in the next chapter. The vagus nerve is a major controller of kidney activity, and hence has a significant role to play in controlling blood pressure.

The vagus nerve does not actually stop at the end of its course. Rather, it forms a final plexus from the lower end of the spinal cord with the parasympathetic nerves that are. Such parasympathetic fibers innerve the second half of the large intestine, which is called the descending and sigmoid colon, as well as the bladder and sex organs.

CHAPTER 3

THE FUNCTIONS OF THE VAGUS NERVE

An optimally working VN is utterly crucial when it comes to improving health and halting disease progression. There are many explanations for this, and in this chapter, we'll go over some of them.

One body that functions optimally is like a symphony orchestra. All the different instruments have unique parts to play in a symphony, so perfect harmony can only be accomplished if each instrument is guided toward doing its job. The orchestra's conductor needs to ensure that no instrument is off pitch or tempo because a single mistake could lead to disastrous performance. A conductor that does not keep its end up will also result in a broken performance.

The vagus nerve is the conductor of a symphony orchestra for the human body. This controls the activity of so many different organs and cells in our body, but only when it functions optimally can it do so. The body's multiple organs and cells must be capable of detecting and communicating correctly. Dysfunctional signaling can result in a loss of equilibrium in the body, and ultimately a disorder and disease state.

Let's break down all the various roles that the human body orchestra conductor performs-the vagus nerve.

SENSING SKIN OF THE EAR

As described in the previous chapter, the first branch of the vagus nerve is the auricular branch, which is directly involved in the sensation of the skin of the auricle, the tragus, and the ear's external auditory canal.

This branch's purpose is pure in sensation, enabling us to feel pressure, touch, temperature, and moisture on each ear's central portion. This is clinically significant and very critical, as this is one of the main areas where the VN can be stimulated using techniques such as acupuncture.

ALLOW YOUR FOOD TO BE SWALLOWED

The last thing you're worried about when you're consuming a meal is the process of swallowing every bite and pausing the breathing reflex so you don't scare. The vagus nerve copes with this essential function.

The second branch of the VN (the pharyngeal branch) regulates the activation of five pharynx muscles: the three constrictor muscles at the back of the throat and two other muscles that link the throat and the soft palate (the soft tissue at the back of the mouth's roof). These muscles are involved in the pharyngeal process of swallowing which involves pushing the chewed food towards the larynx and the esophagus while keeping it out of the trachea, thus keeping the airways clear of food. The active motor part of the gag reflex is also regulated by this VN branch.

This is clinically significant because poor vagus nerve function can lead to coughing and a shift in gag reflex function. This meditation can be used to help balance the VN with constructive exercises and stimulate the gag reflex.

MANAGING YOUR AIRWAY AND VOCAL CHORDS

Are you conscious of the effort needed to hold your upper airways open for every breath that you take? The muscles involved in that process are also involved in your voice development. If you have ever wondered what nerve is responsible for ensuring verbal contact with others around you is possible, that's the vagus!

Superior and frequent laryngeal nerves are the third and fourth branches of the VN. The muscles above the vocal cords are responsible for the dominant laryngeal branch while the recurrent laryngeal branch is responsible for the muscles below the cords.\

The superior branch of the laryngeal holds motor information to certain larynx muscles and regulates vocal pitch. Suboptimal feature of the superior branch of the laryngeal results in a pitch transition. A chronically hoarse voice or an easily fatigued, monotonous voice in this branch of the nerve is a sign of weak vagal tone (signaling capacity). Irritation of this nerve can also lead to extreme cough and the risk of aspiration (i.e., food or drink entering the trachea through impaired vocal cord function).

The recurrent laryngeal branch brings motor information to the muscles below the vocal cords, allowing the vocal cord structures to create sounds by

opening, closing, and tensioning. It also has a sensory component that relays information of these structures from the esophagus, trachea, and internal mucous membranes. Dysfunction of these nerves during physical exercise contributes to heaviness, speech loss, and difficulty breathing.

Those laryngeal muscles control the airway's opening, closing, and working. Hence, any breathing or speech problems may be due to reduced activity and tone of the vagus nerve. Airway respiration and muscle tone are of paramount importance for vagal control. Any persistent obstructions to a clear and well-functioning airway will impede the function and signaling input from these muscles, which will affect the vagus nerve function negatively.

BREATHING:

What about breathing? Well, the vagus also has a role to play in managing this vital function. The VN's pulmonary branch flows through the pulmonary plexus, binds to the sympathetic nervous system, and innervates both lungs' trachea and bronchi. The vagus portion is a sensory nerve that relays information about lung expansion levels to the brain, as well as the levels of oxygen and carbon dioxide.

Within the lungs, the activation of the vagus nerve reduces the respiration rate and deepens the breath. Breathing appears to be slower during the rest-and-digest process and comes from the diaphragm rather than the breathing accessory muscles, so the breath rate tends to be lower. A steady, deep breath rate will activate the vagus nerve and trigger the relaxation reflex when a person is transitioning from a combat-or-flight state into a rest-and-digest process.

Vagus tone is required in the pharynx, larynx, and trachea to open the airway. The pharynx and larynx muscles are innervated by the VN motor components. Such neurons ' suboptimal activity may contribute to obstruction of the airways, as occurs in chronic obstructive pulmonary disease (COPD) and obstructive sleep apnea. Both of these symptoms are a symptom of low vagal tone and an activation of the vagus nerve. I would also go so far as to suggest that narrowing of the airways could be a possible root cause of vagus nerve dysfunction-something that will be addressed in far more depth in later chapters.

CONTROLLING YOUR MANNER OF BREATHING

Your heart beats to bring blood filled with nutrients and oxygen into each of your cells and to take toxins to the organs that will dispose of them. The VN plays an important role in ensuring the heart rate stays within a healthy range when the body is not under stress. Without the VN, our heart would not be functioning close to its optimum pace.

The vagus nerve is attached directly to the sinoatrial node, which sends electrical signals to the two atria (the thinner chambers at the top of the core). It is also linked directly to the atrioventricular node which manages the ventricles ' pumping rate and contraction pressure (the two thicker, lower chambers of the heart).

The sympathetic nervous system stimulates the heart during fight-or-flight periods to increase the beating rate and the strength of the contractions in both ventricles. After the stressor exits, the rest-and-digest process takes over, and the body progresses into a period of vagal activation. At this time, the VN's parasympathetic fibers slow the heart rate and actively lower the pumping contractions pressure. These fibers function to lower heart rate, allowing the heart to relax and heal from stressful times and extreme activation.

Blood pressure is a determinant of the volume of fluid that is present in the bloodstream. The kidneys work to flush out the body's fluid and contaminants and are therefore, the main controller of blood pressure in the body. The vagus nerve relays information from and to the kidneys to help it control the flow of water and fluid from inside the kidney glomeruli, the kidney's essential filtration unit, thereby controlling the body's total blood pressure. When the body is under stress, via the vagus and sympathetic nerves, impulses from the blood vessels (in particular the carotid muscle) are transmitted up the brainstem and back down to the kidneys. The kidneys then narrow their blood vessels and raise blood pressure by raising the amount of water from the bloodstream that is drained out. When the body is comfortable, carotid body signals tell the kidneys to pump out more water and dilute the blood vessels to relieve blood pressure.

Hormones, interacting with the vagus and sympathetic nerves, are also closely linked to this cycle. The immediate control, therefore, comes from the nerves, and the hormones dictate the slow, incremental management.

High blood pressure is a very common condition, and to regulate these levels, drugs are also prescribed. High blood pressure may be a symptom of overactivation of the adrenal glands ' stress receptors, and the stress response mediated by the sympathetic nerves. It is also a very common symptom of defective vagus nerve and weak vagal sound.

CONTROLLING THE MANY FUNCTIONS OF THE LIVER

The vagus nerve relays a great deal of vital information from and to the liver, regulating its almost 500 functions. I'll cover just a couple of the roles that are more widely recognized in this section.

The liver regulates where blood flows inside the body. As the body moves into fight-or-flight mode during periods of stress, blood flow is forced towards the arms and legs to increase muscle activation and encourage us to fight off an attack or run away from it. Blood flow in the liver should decline, as digestion and blood filtration are not a priority for survival during this traumatic event. Once the body is relaxed and at rest-and-digest, the activation of the vagus nerve increases, and the blood flow to the liver increases. At these times, priority is given to feeding, blood filtration, and other cellular thriving functions.

The vagus nerve also regulates the liver cells that contain bile and bile salts, as well as moving bile into the gallbladder and small intestine. It has been shown that these cells, called cholangiocytes, are activated when the vagus nerve is activated and increases bile flow to the gallbladder for storage.

Bile performs various liver and body functions. In a two-step cycle, the liver detoxifies fat-soluble contaminants, producing a water-soluble waste product that requires releasing. Bile contains certain toxins that are made harmless and ready to be released from the body through our stool via the digestive tract. Stool is only one of three routes for removing the waste materials. Some waste management forms are as urine through the liver, or as sweat through the skin.

Bile salts, the bile's powerful component, have another role to play. When bile is released into the small intestine, waste product and ball salts are released. The bile salts are needed to escort triglycerides (fat molecules) from the digestive tract, through the enterocytes (cells lining the small intestine),

and into the bloodstream. Fats can not be consumed without being accompanied by bile salts, which is a bad thing because fats and cholesterol have many important functions inside the body. That also results in fatty stools. The role of the vagus nerve in this process is to stimulate cholangiocytes and to open the flow of bile from the liver into the gallbladder and from the gallbladder into the small intestine, thus ensuring that the enterocytes can consume fat.

ACTIVATING GALL BLADDER EMPTYING

When the liver releases bile and the cholangiocytes transfer the bile into the gallbladder, it is stored and matures, like a fine wine, until it is essential. When eating a meal, the taste buds in the tongue and the rest of the mouth transmit messages to the brain, letting our body know about the macronutrients it tastes as part of every bite and the whole of the snack or meal. When the central nervous system suggests that fats are being ingested, then the vagus nerve will soon signal that bile will be required for the liver and gallbladder.

After receiving this signal, the gallbladder stimulates the smooth muscle cells in its lining and pumps the bile out into the small intestine through the bile duct to aid with the absorption of food. The gallbladder will stay complete without this vagus nerve signal, and will not pump out the requisite bile–a condition known as obstructive cholestasis.

The removal of the gallbladder, called cholecystectomy, is one of the most common procedures taking place in hospitals and clinics in North America. Obstructive surgery to remove a gallbladder, such as gallstones, is often the first choice available to patients who start experiencing pain associated with obstructive cholestasis. Unfortunately, most patients don't get the chance to assess the root cause of this disease.

Gallstones are a painful problem which can affect the gallbladder. After a long time of low vagus nerve activity, gallstones develop in the gallbladder which would prevent the gallbladder from properly pumping out bile and bile salts. If bile salts remain long in the gallbladder, they start crystallizing and forming stones. This appears to occur with a lack of activation of the vagus nerve and is an early sign of dysfunction of that nerve. In clinical settings, it has been shown that gallstones may be produced in early cases of this disease

when the vagus nerve starts to function at a higher level. Performing some of the vagus nerve relaxation exercises and treatments that we will explore in later chapters can be very helpful for those struggling with cholestasis and gallstone formation pain triggered by gallbladder.

MANAGING HUNGER AND SATIETY

Satiety is achieved as our brain receives vagus nerve signals. We need signals from the liver to be satiated, meaning we have enough fat, protein, and carbohydrates in the body. All carbohydrates and fats are metabolized in the liver.

The following regulation is regulated by the vagus nerve in terms of carbohydrate metabolism: As blood sugar levels slowly decrease, afferent vagal fibers in the liver increase activity and signal to the brain that more carbohydrates are needed by the liver cells. However, this pathway does not signal abrupt increases in blood sugar; these are detected directly inside the brain.

The small intestine releases a hormone called glucagon-like peptide 1 (GLP-1) as a response to increased levels of blood sugar which the body translates as satiety. Diminishing levels of GLP-1 stimulate the vagus nerve, which in effect manages a gradual reduction in blood sugar. Many pharmaceutical companies are now developing drugs that function along the GLP-1 pathway to help control hunger; however, stimulating the vagus nerve will handle this within your own body.

The vagus nerve provides yet another road to satiety feelings. After eating a meal, vagal afferent neurons transmit information to the brain about the amount of fats, particularly triglycerides and linoleic acid, that have made their way to the liver. This activates the role of the vagus nerve and sends a signal to the brain which creates a feeling of satiety and a desire to stop eating.

An underactive vagus nerve may not be able to send the signal efficiently, resulting in constant feelings of hunger, lack of satiety, and overeating at mealtime. During a meal, it should take less than 15 to 20 minutes to feel complete when the VN is functioning effectively. When you know someone who loses the feeling of satiety, and their appetite continues even after a big

meal, they probably suffer from VN dysfunction.

MANAGING SUGAR AND INSULIN LEVELS

Blood sugar and insulin levels and levels of type II diabetes are rising at exorbitant rates. Obesity and appropriately called diabesity–combined diabetes and obesity–are significant signs of a lifestyle that is unhealthy. Weight issues and concerns with blood sugar regulation are major indicators that something about the body is functioning suboptimally.

The bodies change their focus towards the sympathetic nervous system during periods of stress and release more of the adrenal stress hormones, specifically cortisol. Cortisol's primary effect is to raise blood sugar by inducing a mechanism called gluconeogenesis, which is when new glucose is produced from fat and protein processed in the hepatic system.

In short bursts, it is necessary to use the sympathetic nervous system to keep us alive and to allow us to survive. This fight-or-flight mechanism developed in response to external threats to our survival-think of our ancestors trying to run away from a sabre-toothed tiger. In this case, our bodies have to change to survival mode when the stressor hits us. We either have to combat the assault, or take the flight and run as quickly as possible.

Our skeletal muscles need significant energy-forming resources to promote the fight-or-flight response–ideally, the fastest-acting and most easily accessible way to form cellular energy, which would enable us to survive the threat. Our bodies can generate glucose rapidly, use gluconeogenesis for short-term fuel, and transfer it through the bloodstream. The sympathetic nervous system rapidly transfers blood flow to the arms and leg muscles to make us extra powerful and quick, thus moving it away from the digestive tract and kidneys. We will then easily use our muscles to fight the threat or to run away as fast as humanly as possible.

The problem with this method is that it is always more involved than is completely appropriate for longer periods. Under the constant stress that we face at work and at home, with our jobs, relationships, friends, and families, and because of biochemical stressors and stealth infections, our bodies continue to remain in the fight-or-flight state far longer than they should, so we don't move back to the rest-and-digest state in which the parasympathetic recovery system is predominantly involved. The failure to turn back allows

the liver to generate glucose continually, which in the longer term contributes to higher levels of blood sugar. The pancreas is triggered to produce insulin in response to the high blood sugar levels. Insulin is the messenger that signals to each of our cells that they take glucose from the blood and use it to produce energy.

HOW WE PROCESS INSULIN

I like to think of insulin like Girl Scouts dropping by, knocking at your door and giving you cookies every now and then. If every house on your block is a muscle cell, then insulin will come knocking each time blood sugar levels rise. The Girl Scouts will knock at your door once or twice a day, though not too loudly in an ideal situation. In this case, the insulin receptors on the muscle cell play a role in your entrance. Each time they knock at your door, you open it and happily accept the offered treat. You will initially be sensitive to the knock at the door much as our cells are preferably sensitive to insulin.

The Girl Scouts come and pound at your door with all their might when blood sugar levels rise and spike really high because they need you to take the cookies because soon as possible so they can move on to the next house and do the same. It occurs when the scouts have a wagon full of cookies and need to sell them before their next shipment arrives as soon as possible. I can imagine they'd be pushy and ask you to take several boxes, not your usual order. This would be okay once in a while, and by this, you wouldn't feel stressed or upset. However, if they came banging three, four, and even five times a day at your door, it would become a problem. When this banging on the door continued many times a day, you'd probably get irritated every day for a week. By the end, you'd even avoid answering the bell. You'd become immune to the Girl Scouts in the same way our cells are insulin resistant.

Once our cells are insulin resistant, they simply stop reacting to insulin at the threshold. They won't take in the treats insulin offers anymore. It results in higher levels of insulin and higher levels of blood sugar.

If this same problem starts with each house on your street, and then with each house in your neighborhood, the Girl Scouts will finally have no choice but to avoid coming to the neighbourhood. When their sales rates drop, the suppliers of cookies will stop sending them cookies and then send them to a storage facility. The storage facility is code, called adipocytes or adipose

tissue, for our fat storage cells. This tissue is found throughout the body, but the body put the majority of it most efficiently in the central region of the body: the belly. This helps the arms and legs to work during fight-or-flight periods when muscle strength is still required.

In this example, if the Girl Scouts stop coming to your neighborhood and knocking at your door, the insulin supply has effectively burned out and is no longer effective. This is type II diabetes that happens when the pancreas has burned out for such a long time after generating too much insulin. It couldn't control all the blood sugar spikes anymore, and thus stops functioning. Diabetic patients are also administered medications that either increase insulin sensitivity, or insulin itself is given to help regulate blood sugar. Chronic stress, chronic overeating, and a high-sugar diet are often at the root of this problem and are some of the most common causes for obesity, insulin resistance, and diabetes production.

So what does the vagus nerve have to do with all of this? Just as we discussed before, our bodies are under long-term and persistent stress, leading to inactivity and weakening of the vagus nerves. Our bodies should spend the vast majority of their time in the rest, digest, and regeneration phase that is activated by the vagus nerve, under optimum circumstances. When this system is working, it should help increase insulin sensitivity and enable gluconeogenesis to be reduced in the liver. The liver function should change from the bloodstream towards digestion and filtration of toxins. The VN will also send signals to the liver asking for the development of a signaling molecule called a hepatic insulin sensitizing product, which increases the responsiveness of insulin and the concentration of glucose in the cells.

The key thing to note is that to activate the rest-and-digest mechanism and increase our insulin sensitivity, lower blood sugar levels are required. When triggered, the vagus nerve is also actively involved in regulating blood sugar levels via the pancreas, which is a significant cause for insulin output and secretion.

The pancreatic islet cells generate and secrete insulin in response to elevated blood glucose levels. The insulin production increases as glucose increases. A spike in blood sugar levels will lead directly to a spike in insulin release, and frequent chronic spikes will result in insulin resistance and eventually, diabetes, as mentioned earlier. A hormone called cholecystokinin (CCK),

released after a meal in the gut, immediately activates the vagus nerve, which then signals insulin release to the islet cells as required.

To ensure adequate signaling from the gut to the brain and from the brain to the pancreas, the vagus mechanism must be optimized. Owing to chronic defective signaling, less than ideal function can inevitably lead to a disease state. To avoid insulin resistance and, ultimately blood sugar dysregulation and diabetes, we need to be able to activate the parasympathetic vagus system with regularity.

MANAGING THE RELEASE OF DIGESTIVE ENZYMES FROM THE PANCREAS

The pancreas is not only active in the regulation of blood sugar; it is also very important for the production and secretion of digestive enzymes in the small intestine in response to a meal.

As we feed, our small intestine taste buds and sensory cells transmit signals to the brain that decide the precise macronutrients present in the meal. Was it protein, fat and/or carbohydrate in the meal? How much of the digestive tract has reached each, and how fast? If the answers to these questions are decided, the vagus triggers the pancreas to release various digestive enzymes–proteases, lipases, and amylases–to assist in the breakdown of such macronutrients, enabling our cells to absorb such nutrients and ultimately use them properly.

The pancreas secretes proteases to help break down the bonds between the amino acids which make up the proteins in response to higher protein levels. The pancreas secretes lipases to help break down triglycerides into cholesterol and free fatty acids, in response to higher levels of fats. Eventually, amylase is secreted in response to higher levels of carbohydrates to help divide complex carbohydrates into simple sugars.

Without this process, the essential macronutrients needed for cellular function would not be absorbed by our bodies. Amino acids are mainly involved in making new proteins within our cells, including protein and peptide hormones, neurotransmitters, receptors, and other molecules for intracellular signaling. The free fatty acids and simple sugars are mainly used for the production of energy, while the cholesterol portion of the fats is used as a

precursor to steroid hormones such as estrogen, testosterone and cortisol. All these molecules are important for cellular function, so to ensure that these molecules make it into the body, an optimally functioning pancreas is needed.

MANAGING GUT MOTOR FUNCTION

The vagus plays an essential function in bringing food from the mouth to the other end of the digestive tract. We chew the food down in our mouth when we take a bite of food until it is physically able to be swallowed and transferred across the rest of the digestive tract.

It's the responsibility of the vagus nerve to move it to the next place as soon as the meal, or bolus, hits the back of the mouth–the pharynx. To do so, the digestive tract's sensors and muscles must work properly. When each bite hits the back of the throat, a stretch reflex in the smooth muscles is elicited, which alerts the brainstem through the vagus nerve, letting it know where the bolus is. In addition, the VN signals the smooth muscle cells to engage in motor activity and force down the food bolus. This method is referred to as peristalsis.

In fact, this relatively simple task is quite complex and important because the digestive tract is very long. To extract nutrients from our food and drive out any unwelcome tourists, we need movement along the digestive tract.

A badly toned VN can be a root cause of a bolus' damaged tract movement. Chronic constipation and diarrhea are definitely symptoms of low vagal tone and loss of muscle and nerve stimulation. Some of the main issues that cause the problem are that we don't chew our food well enough and that we eat in a rush and too quickly. That is what I call the drive-through effect, as we eat in a hurry and in a stress-filled environment. We are attempting to trigger a rest-and-digest cycle when in a state of fight-or-flight.

For now, it is important to understand that food can not travel along this path-from the pharynx to the esophagus, through the stomach, through all three sections of the small intestine, and against gravity in the ascending and transverse colon-without a properly working vagus nerve.

MANAGING THE OPERATION OF THE IMMUNE SYSTEM

Consider this question: Will you be driving a car with no brakes working? A

car has the important function of getting you safely from point A to point B and the important role of your immune system is to keep you protected from invading cells and proteins. And just like a car needs a network of checks and balances, including braking, so the body's immune cells need a specific set of checks and balances.

The immune system can run amok without its brakes and start attacking human cells, which can lead to autoimmunity, or even avoid attacking tumor cells which can lead to cancer. A car can be a very dangerous vehicle without brake. The immune system can also be very harmful, without a system to hold it in check. Enter, the nerve to the vagus.

A LOOK INTO THE IMMUNE SYSTEM

The body's protective system is immune system. It protects you from contaminants and harmful toxins that can contribute to adverse health conditions, and often do so. This system includes white blood cells which send out sensors to search for body invaders. We roam through the bloodstream in an optimally working scenario, identifying proteins and species that have invaded the body and transmitting signals to other immune cells whose role is to remove those invaders which should not be present.

In the immune system, there are several forms of white blood cells, often known as leukocytes, including monocytes, macrophages, neutrophils, mast cells, and dendritic cells, collectively known as phagocytes; as well as basophils, eosinophils, lymphocytes (T cells and B cells), and natural killer cells.

Phagocyte' means simply' cells that consume.' Once they detect dead or dying human cells, unwanted bacteria, and harmful proteins that should not be present, they activate and essentially start engulfing the unwanted cells or proteins, initiating a process called phagocytosis. We break down these invaders and produce waste in the digestive organs and liver, which is then washed out of the blood. Every phagocyte detects different invaders and has a different way of breaking them down, but both of these cells are important for an efficient and healthy immune system that works.

As well as phagocytosis, mast cells are also strongly involved in allergy and anaphylaxis, as they produce and release histamine-rich granules. For a

person living with chronic allergies and related reactions, these are likely to be hyperactive. Through ensuring that we recognize the effects of the disease, mast cells have shown to be highly involved in autoimmunity. Interestingly, they are one of the few immune cells in both the stomach and the brain. If mast cells become overactivated within the brain, the brain's nerves can become more responsive to pain, leading to inflammation of the brain. Likewise, when these cells are stimulated in the stomach, they make the gut's nerves more responsive to pain, contributing to inflammation of the stomach around the nerves, which can hinder the regular movement of the gut (peristalsis) motility. As we will discuss shortly, the vagus nerve is the main controller of gut motility, and hyperactivation of mast cells can be a cause for dysfunction of the vagus nerves.

Basophils are responsible for inflammatory reactions during an immune response, and are involved in conditions such as mast cells that cause allergic symptoms such as anaphylaxis, asthma, atopic dermatitis, and hay fever. Parasites and allergies can cause them. All of these can usually occur and reach the body through the digestive tract or broken skin.

Eosinophils are responsible for reacting to parasites and infections and for battling them. We are also considered, as basophiles, to be involved in allergies and asthma. Low-grade, chronic parasite, or bacterial infections may cause overstimulation of eosinophils, which have been shown to trigger asthmatic and allergic symptoms. Such diseases most often affect us and get through our bodies via the digestive tract.

The main cells involved in suppressing viruses and tumor development in the body are natural killer cells. They do not need sensors to recognize human cells as opposed to invading cells, thus the name of natural killers. The dysfunction of these cells may lead to tumor growth, and the body's ability to recognize and fight these cancerous growths can decrease.

The vast majority of leukocytes produce sensors which roam the body's internal environment to do their job. Such sensors are called immunoglobulins, or anticorps. These sensors come in five different forms– immunoglobulin A (IgA), IgE, IgG, IgM, and IgD. Each of these sensors has a different function and speed, at which the white blood cells are signaled to respond.

IgG is the most abundant sensor and is located on mature immune cell surfaces. Its function is to identify non-present cells and proteins, and to activate a pathway which leads to inflammation and immune activation.

IgA is the second most abundant sensor, and a particular subset of IgA (called secretory IgA) is dispatched to our body fluids such as breast milk, saliva, and digestive tract secretions. Secretory IgA is important for recognizing possible threats, like mouth, to the digestive tract. High levels of IgA indicate the existence of bacteria, viruses, parasites, and yeast while low levels of IgA suggest dysfunction of the immune system due to persistent activation by these same invaders. In my patients, I test secretory IgA levels to assess their current immune function and activation status. This is a very important and versatile instrument used in the practice of functional medicine.

They are much less popular in IgM, IgE, and IgD. They are located on the surface of mature immune cells, and have a feature similar to IgG.\

The mechanism is regulated through the vagus nerve to keep immune cells in place. A significant pathway called the cholinergic anti-inflammatory pathway is needed to set off a properly functioning vagus nerve. The pathway keeps the immune system in check when involved, and pumps the brakes when needed. Vagus innervation to the digestive organs, such as thymus, spleen, and intestines, is strongly involved in stimulating the pathway. It's important to understand how these essential organs function inside the immune system before you know about the pathway itself.

The main lymphatic organ is the thymus. It produces primarily T-cells, white blood cells which try and kill foreign invaders. To activate it, the vagus nerve sends a branch to the thymus, while it can be deactivated by sympathetic fibers that connect to this organ. The thymus, on average, is fully functioning until we reach puberty when it begins to shrink and decrease in both size and function. This mechanism is called thymus involution. Recent work has shown that our high-stress lifestyle and sympathetic branch hyperactivation will contribute to earlier thymus deactivation. This is thought to be a root cause of autoimmune disorders and an increased risk of bacteria, viruses, and other pathogens being infected.

The immune systems have been developing and evolving earlier in the lives

to build a mechanism that helps to protect us from invasion by bacteria, viruses, and other pathogens that should not enter our bodies. It is a complex device, one that takes years of training and practice to cope with the body's invaders. Overstimulation of the thymus may occur via parasympathetic fibers, leading to excessive organ development, but this is not very common. The much more common issue is that there is a higher degree of sympathetic activation, which ultimately unnecessarily deactivates the brain.

So long as you have a thymus that functions well, the body is covered as it grows. The thymus functions as a classroom, or immune cell training center, the body's police officers. It continues to churn out professionally trained, and highly educated police officers who defend our cells from threats as long as this training center is operational and fully funded. If the support for this school declines, fewer, less well-trained officers are released, and the standard of security withers, placing us at a much higher risk of invaders infection.

This illustrates why we are at a higher risk of infectious disease when we grow older and also why we are at a higher risk of autoimmune disorders following extremely stressful events in life. Our immune cells are not sufficiently suited to separating invading cells from our own cells in an autoimmune disease. When we age, we are subjected to stressful life circumstances, thus growing levels of autoimmune disorders including, but definitely not limited to, Hashimoto thyroiditis, rheumatoid arthritis, multiple sclerosis, Crohn's disease, ulcerative colitis, and many more.

The spleen is the next target for immune system cells. Speak of the spleen as the White and Red blood cell buffer. It ensures there are only eligible, professionally trained immune cells in the body's bloodstream and other tissues. It will remove and filter out any cells which reach the end of their optimum operating period. The spleen acts as a test and balance for bloodstream immune cells. It ensures that the immune system defends against pathogens while operating optimally while not behaving aggressively against our own cells. The vagus nerve relays back and forth information from the central nervous system to let our bodies know which cells are drained out of the blood.

As with the thymus and so many other organs, the vagus' parasympathetic activity is necessary to keep the spleen active, while the sympathetic activity

may decrease or shut down splenic activity temporarily. Chronic stress or activation of the sympathetic branches would inevitably contribute to consistently decreased levels of spleen activity, and low white and red blood cell filtration in turn. This leads to an increased risk of autoimmune disease, because the less-qualified wandering "police officer" is not held in check and can not differentiate between invaders and our own cellular proteins.

The immune cells nearest to the region determine the danger and release proteins called cytokines to attract additional cells that will assist in the immune response when a damaging event happens in the body or when invaders are identified. Such cytokines are identified by afferent fibers of the vagus nerve, which send signals back to the brain to warn it of the type of inflammation that is developing. Recent work has also shown that cytokines may be identified by the vagus nerve.

The intestine is the most common place where pathogens will reach the body, and as such, the vast majority of our immune cells are found in the gut lining. Throughout the digestive tract, they are kept in small pockets which we affectionately refer to as gut-associated lymphoid tissue (GALT). In the gut, the vagus nerve functions are very extensive and essential in order to ensure optimal health. It helps to regulate immune and inflammatory responses, allow us to build memories and relay information between the bacteria in the gut and the brain. The next three parts address those positions.

MANAGING INFLAMMATION IN THE GUT

Continuing the discussion of the effect of the vagus nerve on immune responses in the intestine, we will address what is perhaps the most important function of the vagus' anti-inflammatory cholinergic pathway. Using the neurotransmitter acetylcholine (ACh), the vagus nerve sends signals throughout the body to the cells of the immune system, but particularly strong signals in the gut. These signals are meant to soothe immune function and reduce inflammation.

Afferent vagus activity in the thymus and spleen has been shown to increase in response to stressors like lipopolysaccharide (LPS), a toxin that is created and released by one of two forms of bacteria, and invaders such as bacteria, viruses and parasites in our gut. Around the same time, the nervous system's sympathetic branch, the fight-or-flight response, makes sure immune cells are ready to attack the invaders. Once immune cells first sense the presence of

these unwanted stressors in the intestine, they send a signal to the GALT, triggering a stress response and sympathetic nerves. The sympathetic nerves then signal norepinephrine (NE), also known as adrenaline, to the neurotransmitter. NE stimulates the cells of the immune system that are highly susceptible to threats and stressors. This system is very useful, but brakes are required for optimal operation as with all important systems.

Parasympathetic activity is carried out through the vagus nerve in the vast majority of the heart. The role is to regulate inflammation and immune response. To combat the pro-inflammatory reaction of sympathetic nerves and norepinephrine, the vagus nerve and its branches send out ACh in the gut and other areas of the body. The ideal balance between sympathetic NE secretion and parasympathetic ACh secretion occurs while functioning optimally. This keeps our health in check by triggering an immune response when needed and turning it off if it is not needed. Control of a feature comes from turning it off.

During response to higher levels of stress and immune function, ACh is released from the vagus nerve. The release is massively and efficiently intensified by the enteric nervous system, a group of nerve cells in the gut which is so huge, it is also known as the second brain. Others claim that the enteric nervous system in our head is more important than the brain, as the relationship between this system and our microbiome determines much of our safety.

A significant receptor located on the surface of most white blood cells - thealpha-7 nicotinic acetylcholine receptor –promotes the immune cell effect of ACh. This receptor works to lower activation and slows down the immune response when it is not needed. The parasympathetic and sympathetic stimulation of inflammatory response in the gut is essential in balancing.

RELAYING KNOWLEDGE FROM THE MICROBIOME

Microbiome work has been the biggest contribution to our wellbeing in the course of centuries. Every day we are learning new exciting stuff about the bacteria population in our gut and its effect on our wellbeing and biochemistry. For the vast majority of our nutritional intake, neurotransmitters, our mood, and even how our brains function, this population is responsible.

Our digestive tract comprises almost 100 trillion bacterial cells, much more than the number of human cells in our body. Such bacteria have a particular breakdown of the population that can affect nearly every part of our health and wellbeing. Signal transmission from the gut to the brain happens most rapidly through the vagus nerve and is augmented by the bloodstream and hormonal systems.

For all the other organs and processes regulated by the vagus, the intestines and bacterial changes are more likely to be felt. Unlike our heart, liver, or spleen, we can "tune in" to our gut and what is happening in there. A desire is the commonest example of this. As stated in a great book called *The Psychobiotic Revolution*, written by Scott Anderson, John Cryan, and Ted Dinan, Your cravings are most times just committee memos sent up from your gut microbes. They consist of a full list of the carbs, sugars, and fats they are in search of.
The book proceeds to address the example of Bifidobacterium (a.k.a. Bifido), a genus of bacteria found in our gut in high proportion: certain microbes, especially our friendly Bifido species, produce butyrate that feeds and heals your gut lining. Butyrate can make its way to the brain, where it can promote good mood, humidify inflammation, or stimulate the development of a hormone for brain growth. Both these improvements will enhance your mood and even help you think better. "The genus Lactobacillus (a.k.a. Lacto) is another form of bacteria that is discussed in this book. Anderson, Cryan, and Dinan elaborate: In experiments with IBS sufferers, it has been found that certain species of Lacto directly stimulate the opioid and cannabinoid receptors in the brain, functioning more like a morphine shot. Unlike the addiction to the high of a runner, this form of reaction will induce cravings for whatever food your Lacto microbes prefer. You may think your cravings are all in your head, but chances are they start with your gut bacteria.

When we understand that cravings and signals about the foods that our bacteria want are actually transmitted via the vagus nerve and into our bloodstream, it is possible to take back control of our decisions and make dietary improvements that can have a beneficial impact on our microbiota and overall health.

ALLOWING US TO BUILD MEMORIES

Recent work has shown that both the growth and maturation of the enteric nervous system and the central nervous system involve the involvement of gut bacteria. As described above, the vagus nerve is strongly involved in relaying microbiome information from the intestinal bacteria to the brain. This coordination chain may be responsible for initiating the development of a protein called neurotrophic factor (BDNF) derived from the brain. BDNF activation contributes to increased neuronal integration, and most importantly, to memory production in the brain.

This means it can be difficult to develop new memories and establish new neuronal connections without gut bacteria and a healthy working vagus nerve. To an even greater degree, this ensures that if you have an optimally working vagus nerve, you are likely to be able to create broader memories and connections with the world around you and others who matter to you.

We are creating barriers during our fetal development to shield us from external threats. One such barrier is the gut-blood barrier which protects us from bacteria (both good and bad) that may want to invade. It is made from the same cells that build our barrier to the blood-brain. It means that any inflammation that happens in the intestine and breaks down the gut barrier also has the potential to break down the blood-brain barrier.

Have you ever stepped into a house, and forgot why you were going into that house? Have you ever wanted to say a very easy thing but couldn't find the right words to say? Such problems are generally referred to as "brain fog" and are caused by inflammation levels in the brain that are higher than normal. Brain fog happens when the blood-brain barrier has partially broken down, and inflammatory impulses are allowed to penetrate the brain tissue, reducing neuron activity.

Brain fog suggests the presence of inflammation in the brain caused by a less-than-optimal blood-brain barrier, and thus poorly working gut lining or leaky intestine.

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Vagus is obviously much more essential than basic biochemical and physiological functions. How does it manage to do all at once?

CHAPTER 4

HOW THE VAGUS NERVE MANAGES IT ALL

Neurons act to relay messages to other body cells. Such signals may be for muscle control, proprioception (stimulus reception), active brain thought, and, of course, unconscious processes that take place in the autonomic nervous system. To have the signal of a neuron reaching the expected cells, three things have to happen:

1. The neuron needs to transmit an electrically charged signal all along its length.
2. The neuron requires a protein called a neurotransmitter to be released into the space between itself and the cell it wants to influence.
3. The neurotransmitter must fit on the surface of the next cell into a protein receptor and induce action inside it.

Most neuron impulses need to function optimally in the case of the vagus nerve so that it can perform all of its tasks.

SENDING THE SIGNAL THROUGH NEURONS

As you read in Chapter 1, about 80 percent of the signals transmitted along the vagus come from the organs to the brain–an positive message. You learned that these signals relay information about the current state of operation, when something goes wrong and what immediate attention is required. The vagus, which is the longest nerve in the body, communicates information from the liver on detoxification, bile production, and blood sugar balance; from the digestive tract on the digestive cycle, food movement, and microbiome; and most importantly, from the cells and organs of the immune system on their working condition. This also relays knowledge about their levels of operation from the heart and lungs, and any impairments that arise.

The signals are distributed by very long neuron cell axons and dendrites, the long arms and legs. It's really necessary that the signals will strongly transmit from one end of the neuron to another. As I’m sure you can understand, these impulses have to travel distances to the brain like the intestines and kidneys.

The vagus neurons need an insulation level to efficiently transmit these signals. If an electrical cord carries a signal through a metal wire, the cord requires insulation in the form of a material wrapped around it that does not conduct electricity, such as plastic or rubber. It means the electrical charge within the cord remains. However, if a wire is frayed, it does not transmit the signal strongly, and can dissipate and weaken until it enters the brain.

Our cells store fat to insulate the nerves and ensure that the signals pass from one end to the other rapidly and effectively. Most of our body's nerves are covered by Schwann cells, and the vagus nerve is no exception to this. Schwann cells build an isolating shield around neurons, called a myelin sheath, which protects signals and effectively ensures nerve function. Any damage to these Schwann cells may, in fact, result in isolation "fraying" and inadequate signaling along the nerve. We are starting to develop this myelin sheath though at 24 weeks of development we are still in the womb of our mum. The myelin continues to grow up to around 40 weeks when we are at full term. This myelination rate remains about the same until we hit teenage age when it begins to decline. The Schwann cells and myelin sheath ensure signals make it from one end to the other of the vagus.

RELEASING THE CHEMICAL MESSENGER

When an electrical signal reaches the end of a neuron at the terminal axon region, the signal generates a charge that causes the release of a neurotransmitter from the cell. There are several different neurotransmitters in the body, including NE and ACh, some of which I stated earlier. The vagus nerve uses ACh as its neurotransmitter, almost exclusively.

ACh needs to be formed from two distinct structures: acetyl coenzyme A (acetyl-CoA) and choline. The glucose and free fatty acids are broken down into acetyl-CoA via different metabolic processes. Such metabolic reactions require optimum functioning of different micronutrients. Our cells need adequate amounts of carnitine and vitamin B2 to metabolize free fatty acids, while our cells need high amounts of vitamin B1, vitamin B3, chromium, lipoic acid, and coenzyme Q10 to metabolize glucose. Unfortunately, as shown by research, these nutrients are usually missing in our bodies. The practical laboratory testing of urinary organic acid will help ensure that this cycle occurs efficiently and that nutrients are available to fulfill those obligations.

On the other hand, choline is an organic compound that originates from certain amino acids. This is considered an important food for humans, which means that it can not be produced in our body–it must be included in the diet. The highest-quantity foods containing this compound are egg yolks, soy, and beef, chicken, and turkey livers. Sometimes, it is a part of soy lecithin that is used as an additive in many food products.

In the neurons, acetyl-CoA and choline cross to form acetylcholine. ACh is released from the neuron axons of the vagus so that it can affect the various cells and organs regulated by this nerve. This process ensures that the second nerve function requirement is met by releasing a neurotransmitter into the space near the target cell to be carried out. Getting good sources of acetyl-CoA and choline is very important for our wellbeing

RECEIVING THE SIGNAL IN THE NEXT CELL

When a nerve releases a neurotransmitter, the effect on the next cell is not immediate. Actually, there is a very small space or gap between the end of the neuron axon and the cell which receives the signals, called a synapse. The neurotransmitter is released into the synapse, and must be present in adequate amounts to find its way to the next cell's receptor proteins.

In the case of the vagus nerve, ACh is released into the synapse and binds on the surface of several different cell types to receptor proteins. The receptor protein used by these cells to receive ACh signals from the vagus is either the fast-acting nicotinic acetylcholine (nAChR) receptors or the slower muscarinic acetylcholine (mAChR) receptors. To receive the signals from the vagus, each receptor cell must have its own unique type of AChR and induce a response within the individual type of cell. Most tissues and non-neuron cells express the nicotinic receptor, while the muscarinic variants appear to be expressed by other neurons in the central nervous system.

Some circumstances can cause the output of receptors on receptor cells to decrease or even rise. One of the most important is the presence of LPS, which is sent in by opportunistic intestinal bacteria and causes the bowel cells to break down. The gene that holds the blueprint for this protein in the presence of LPS possesses the ability to become substantially more or less active. This can explain why some people are extremely prone to changes in the inflammatory gut, and others are less susceptible. Regardless of the

degree of sensitivity, LPS is a catalyst for changes to this gene and causes problems with concentrations of the receptor protein.

PART 2

ACTIVATING YOUR VAGUS NERVE

CHAPTER 5

MEASURING VAGUS NERVE FUNCTION

Anything that can be measured can be changed.

We have a saying in functional medicine that we keep tight and pledge to work with: We don’t guess –we test. Determining the activity of the vagus nerve is no exception here. Although we can base many of our suggestions on the symptoms a patient has, there is no substitute for an objective test that tells us the best steps to take for each particular patient.

In this chapter, I will address the four methods we use to assess the functioning of the vagus nerve and determine if the VN functions optimally or needs training. Such techniques are the calculation of variation of heart rate, breathing rate, breath rhythm, and transit time in the bowel. The most important thing to keep in mind is that nobody should alter something that can be calculated. When you check the vagus nerve output, and it isn't ideal at the moment, you'll be able to trigger it and improve its work when you make the effort to do so individually.

HEART RATE VARIABILITY

Heart rate variability (HRV) is the gold standard for assessing the activity of the vagus nerve. No single test is known to represent the activity levels of the vagus nerve and vagal tone in a stronger and more precise way. It is measured most accurately in a laboratory setting using very costly and advanced equipment, but we can calculate it at home with a fair amount of precision with appropriate investment.

Note the vagus nerve has the purpose of calming down and controlling the heart rate to a relaxed pace of rest. There are four chambers in the heart: the

left and right atria, from which the blood reaches the heart, and the left and right ventricles, which pump the blood through the blood vessels so that it can circulate the rest of the body around it.

A pounding heart's "lub-dup", in fact, reflects the two phases of the heartbeat. The heart's first pump–the "lub part" reflects the operation of the left and right atria's muscle walls, pumping blood into the ventricles. This process reflects the thicker ventricular walls pumping blood into the aorta and pulmonary artery, delivering oxygenated blood to the body's cells, and deoxygenated blood to the lungs. After the "lub-dup," there is also a brief period of time called an "interbeat interval" during which there is no anticipated electrical activity in the heart.

Heart rate variation is the calculation of time between consecutive heart pumps in milliseconds, the time from the end of a "lub-dup" to the beginning of the next "lub-dup." Whether and how much time between pumps varies is a significant predictor of both autonomic and cardiovascular safety. The more active the vagus nerve will be, the lower the heart rate will be within an ideal zone and the more variable the time between your heart pumps will be.

Unless the heart had no innervating parasympathetic or sympathetic nerves, it should pump at around 100 beats per minute (bpm). Sympathetic innervation will increase heart rate to around 120 bpm. A heart rate of about 120 bpm is very high and means that around two heartbeats occur each second. This means that between each pump of your heart, there'll be around 400 to 450 milliseconds of time. This should be called low HRV, as the time between pumps remains fairly constant –the difference between beats is at most 38 milliseconds.

In comparison, parasympathetic innervation tends to lower heart rate and improve variability in heart rate. HRV can be calculated to assess how well a person really is and how well their vagus nerve is working when the heart rate drops down to its usual resting state. The optimum heart rate is between 50 and 70 bpm, and the HRV will differ considerably between pumps. This can be considered an example of high variability in heart rate, as there are 130 milliseconds of variation between beats. The higher the amplitude of your heart rate, the more likely you will have a higher fitness level, cardiovascular health, and vagal tone. High HRV is one of the best longevity predictors, as well.

As technology is evolving and becoming accessible to the general public, instruments are emerging that allow us to take control of our health and calculate these health predictors on our own. I only use two devices and urge my patients to use them as well.

The first tool I use is HeartMath's Inside Balance app. For those interested in learning about their heart rate variability and overall health, it is a perfect simple resource while still continuing to take measures to boost their HRV. The Inner Balance method helps you to change the heart rhythm and to transmit positive health and longevity messages to the brain through the vagus nerve. The aim of HeartMath and the Inner Balance method is to reach a state called coherence and to consistently increase your HRV. Our HRV is strong when we are in a state of stability, and our bodies function in an ideal condition.

The best thing about this device is being able to use it on your mobile. This will connect to Apple or Android and provide you with details on your current level of operation and consistency. This can teach us to reach the state of coherence, which in high-stress circumstances, is incredibly useful, particularly for those who appear to be in a sympathetic state.

There are all sorts of new and emerging wearable devices, many of which are intended to track how the body functions. In determining how to monitor your results, the most important thing to consider is whether you may be exposed to electromagnetic radiation or other suboptimal energy fields, and to what degree. More and more studies show that exposure to different forms of radiation impacts one's wellbeing less than expected. Many of my colleagues and I use the Oura Ring since it restricts sensitivity to harmful electromagnetic frequencies (EMF) when used in aircraft mode. I can share the data with my computer until I remove it from my body.

Using a technique called photoplethysmography, Oura Ring records intermission intervals. The best thing about the Oura Ring is that you can wear it all the time, and when you add a monitoring device, it gives you real-time data for your entire day. The Oura Ring can monitor your current condition, your recovery from endurance or training activities, your readiness to perform a new workout, decreases in activity that could signify an oncoming infection or cold (even before you get symptoms), sleep quality, how your body handles stress, and even if you are dehydrated (which may

lead to a drop in HRV).

RESTING HEART RATE AND HEART RATE RECOVERY

Resting heart rate is a simple indicator that shows you how well your body functions. (If you want to buy one, visit OURAring.com and use the exclusive "vagus" code to get a discount on your purchase.) If we assume that the normal resting heart rate is usually between 60 and 100 bpm, but without any autonomic stimulation, the heart rate will be around 100 bpm, it is reasonable to extrapolate that the lower the heart rate within the ideal range, the greater the parasympathetic signaling to the heart.

The normal heart rate will be in the range of 50 to 70 bpm in a healthy person. Many athletes tend to find their heart rate at the lower end, 50 to 60 bpm, whereas less active but still stable individuals appear to be 60 to 70 bpm in heart rate. New evidence indicates that a heart rate that sits above 76 bpm is associated with increased risk of heart attack. In addition, there is a link between the risk of dying from any cause and a rise in heart rate in both men and women. Essentially the higher the risk of dying from any cause, particularly one that is cardiovascular, as the resting heart rate increases.

It is necessary to calculate how quickly the heart rate gets back to its resting rate after exercise. High-intensity exercise and training are known to reduce the resting heart rate over time, and regular training is correlated with quicker recovery times. When after an exercise session it takes you a long time to recover, this is a sign of poor cardiovascular health and poor vagal tone; note, vagus signaling is required to slow heart rate and keep heart rate resting. Optimal recovery from exercise requires a reduction of 12 bpm per minute, while unhealthy individuals take longer and appear to be less than 12 bpm downwards.

To calculate the improvement in heart rate, monitor the heart rate a few times when you are comfortable. You can use a smartphone or wearable devices to locate and record the number with reasonable accuracy. Then, follow your daily workout or training routine and check the heart rate immediately at the conclusion of the session, using the same procedure as before. Between 2 minutes, 4 minutes, and 6 minutes, check again. Your heart rate will drop by more than 24 bpm after 2 minutes, by more than 48 bpm after 4 minutes, and should be very close to your original resting heart rate after 6 minutes. That depends, of course, on how intensive the preparation was, and whether it was

aerobic (e.g., running) or anaerobic (e.g., weight lifting).

When you regularly monitor your heart rate and HRV, you'll note a rise in HRV following exercise; the vagus nerve is extremely involved during rehabilitation as it works to rebuild tissues. When exercises and tones muscles, heart, and spinal nerves in aerobic and anaerobic activity, then rehabilitation is the training session for the vagus nerve. The more you practice, the faster you heal, and the more quickly the vagus nerve can fire when you exercise next time. That is why recovery levels are improving for those who regularly exercise: the VN is practicing with greater strength and tone to do their job.

PARADOXICAL BREATHING PATTERN CHECK

Using the diaphragm to continue breathing? Has your breathing habits been abnormal and your vagus nervous system function less than optimally? It is a very easy exercise and a tool for teaching yourself to breathe through your diaphragm.

Sit in a chair straight up, or lay down on the floor on your back. Place the middle of your chest with your right hand and put your left hand in the middle of your abdomen. Now give in a deep breath. When your right-hand works faster than your left hand, then you breathe poorly. Our bellies should rise and fall more during the inhalation process than our chest does, and if we are breathing correctly, our left hand will rise and fall more than our right hand.

Many people would notice that their chest moves faster than their stomach. It is a sign of paradoxical breathing and shows that someone actually doesn't use their diaphragm to breathe entirely, deeply, and properly. If you are paradoxically breathing, don't worry because once again you can train yourself to become an effective breather. It'll only take some work and a routine practice to relearn habits you had when you were a kid a long time ago.

SESAME SEED BOWEL TRANSIT TIME TEST

How well is the food moving through your digestive tract? Does that travel at an optimum, safe pace? To receive the essential nutrients that come from our food, we need to process and break down our food on a clear schedule for our

bodies. The sesame seed bowel transit time test will give us some knowledge about how our digestive tract functions, and whether we need to make any health adjustments. All you need is a tablespoon of golden or yellow sesame seeds, a cup of tea, a watch or clock, and a notepad and a pen.

We know our gut lacks the enzymes for digesting and breaking down sesame seeds (similar to corn), which is what makes them so good for this study. We all learn that the vagus nerve is the peristalsis driving force and keeps the digestive tract going at an optimum rate. Any variations in this rate can indicate a loss of control of VN or any other digestive dysfunctions.

Here's how to get the test completed. Second, apply a cup of water to the sesame seeds and whisk it around. First, drink the cup of water in it with sesame seeds, and make careful not to chew the seeds. Look at the time, and mark it on your notepad or computer. Then wait until the next time for a bowel movement, when you need to go to the toilet. Every time you go to the bathroom and have a bowel movement, take a peek at your stools to see if you see any sesame seed. Label the times and continue to search until you no longer see any seed. The best time to see the seeds start emerging is around 12 hours after ingestion, and the latest is about 20 hours after ingestion. Seeing seeds after 16 hours of ingestion suggests optimum digestive sequence and function.

When your body moves the seeds out too fast, your digestive tract does not work hard enough, and the VN probably will not fir optimally. When the body is very slow to extract the seeds, the operation of the vagus will definitely be reduced. Monitoring the gut microbiome is strongly recommended in any case, because it may uncover the cause of slow bowel transit time and potentially weak vagus nerve signaling. Now that we understand some basic ways to assess VN activity and evaluate how well our parasympathetic nervous system is functioning, we can get into the exercises and activities that enhance the function of this nerve and help regulate our bodies ' cardiovascular, respiratory, immune, digestive, and detoxifying systems.

CHAPTER 6

EXERCISES TO ACTIVATE THE VAGUS NERVE

I'll delve into each of the successful exercises and activities in this chapter that you can perform to activate your vagus nerve without purchasing costly equipment. Much literature on this subject shows that frequently conducted active exercises are as effective as (if not even more effective than) purchasing tools to activate the VN.

It is all noticed that the activities and exercises addressed in this chapter are successful in increasing vagal tone. It is important to note that the vagus nerve is not simply a parasympathetic signaling nerve: The VN has four different components, each of which can be stimulated to allow the other three components to be optimally signaled and triggered. Such components are:

1. skin sensation from the central region of the ear;

2. motor innervation of the pharynx and larynx;

3. parasympathetic innervation of the heart, lungs, and other organs; and

4. afferent vagus neurons that send signals back to the brain through visceral fibers. Keep these four components in mind as we go through these exercise options.

BREATHING EXERCISES

The first and most important way of getting a good effect on your vagus nerve is to learn how to breathe properly. Simply put, quick, rapid breathing of the chest is a sign of stress that activates the sympathetic branch while slow, deep breathing of the belly is a sign of rest that activates the vagus nerve.

Breath is our one window into the autonomics.

--Dr. Jared Seigler

The vast majority of us didn't learn to breathe properly. In reality, we taught ourselves subconsciously to forget the proper mechanics of breathing. Right breathing habits are closely correlated with autonomic regulation of the nervous system, and irregular breathing habits notify the body that it is under stress. This point is compounded even further when you know that the average human takes about 23,040 breaths every day.

If we want to know the easiest, most secure, and most effective way of breathing, then we need to look to the leaders and examples who live among us. Find some of the best artists of our day, vocal and instrumental. If you've ever been to a concert or opera, you've probably found that excellent singers and instrumentalists can perform a whole set of songs without much of a break. In songs performed by greats like Frank Sinatra, Aretha Franklin, and Celine Dion, the singers never sound like they're out of breath or unable to hold a note because they've been practicing their breathing patterns. Opera singers are some of the most effective breathers on the planet; they have learned to regulate their diaphragm function while keeping their vocal muscles vibrating.

High-performing professional athletes are also another category to remember. These are the best of the best, the ones that are not cracking under pressure. Stars like Michael Jordan, Tom Brady, Cristiano Ronaldo, Tiger Woods, Wayne Gretzky, Nolan Ryan, Ken Griffey Jr., and Babe Ruth all had one thing in common, they all managed to monitor their stress rates by ensuring that their breath patterns stayed perfect while working. To perform at these high levels, these performers conditioned themselves by using a steady, relaxed, and relaxing breathing technique to stay calm under high stress circumstances. You will also learn how to establish an effective breathing pattern that will signal to your body that you are not under stress, thereby allowing for effective signaling via the vagus nerve and parasympathetic nervous system.

Multiple research studies have shown that slow aerobic exercises are highly successful in improving variability in heart rate. One study found that slowing the breath rate for five minutes to six full breaths per minute was successful at instantly increasing HRV. The effect on HRV is much more successful if this is individualized. Determining the optimum slow breath rate and feeling good for you personally will have the greatest positive impact on

your HRV rates.

Here are quick measures to bring this exercise into practice:

1. Stand up straight, without making your back rest on something.

2. Exhale and expel all the air from the lungs entirely.

3. Place your right hand on your stomach, and place your left hand on your back, just above your back.

4. For five to seven seconds, take a deep breath through your nose, allowing only your belly to rise (feeling only your left hand rising).

5. Hold your breath for two to three second.

6. Exhale for six to eight seconds through your mouth, causing your belly to fall (simply feeling your left hand falling).

7. Keep your breath for two or three seconds, without any air coming into your lungs.

8. Repeat steps 4 to 7 or as many times as you feel confident.

Take five minutes a day to practice your own deep belly breathing and your body will be grateful. Perform this practice multiple times a day for better results, particularly during stressful periods. Even one minute of concentrating on steady, deep breathing can have major positive effects on your mood, levels of stress, and overall health. Try to concentrate your attention on breathing through your nose instead of your mouth to make this exercise even more successful when you do it.

If you've already learned to do this basic deep breathing exercise and are up for something a little more demanding and advanced, I suggest that you try the breathing exercise at Wim Hof. According to Google, Wim Hof is a Dutch "daredevil," but in studying his process, I now see him as a visionary. He is also known as the "Ice Man" because his preparation and technique require the use of breathing exercises and cold exposure as well as the practice dedication. Please check out his website www.wimhofmethod.com to learn more about the method and to take his free online mini-course.

BREATHING HABITS DURING SLEEP

Now that when you're awake, we've explored the value of optimal breathing patterns. It's time to ask: How about when you're asleep? The average person needs about seven and eight hours of restful nightly sleep, during which they take about 7,200 breaths. This is significant, as we take almost one-third of our breaths when we're not awake. If we are awake and in control of our acts, we can teach ourselves to breathe optimally, but what about when we're asleep?

Research has shown that when we are sleeping, we continue to fall back on bad breathing patterns. This is critical because airway obstructions can have a detrimental impact on our health and body function when we are not fully aware. Obstructive sleep apnea is a growing concern and needs to be tackled if we want our health to improve. Personally, I've been diagnosed with sleep apnea, and I know that many of you are still having symptoms, although you may not understand that they are. Only after I married was I made aware of the issue. My wife pointed out to me that for any excuse I would stop breathing in the middle of the night, and I was snoring very heavily too. This has affected my sleep negatively, and as you might imagine, it has sent a signal of stress to my body, as it has literally shocked my body many times during the night. It also showed that there was no proper functioning of my vagus nerve. After I lost most of my excess body fat, the symptoms changed, but they still persisted from time to time, particularly when I was incredibly exhausted before falling asleep. It was a challenge before I learned a fantastic tool from my colleague and mentor Mike Mutzel and Dr. Mark Burhenne, DDS, who was a guest on Mike's High-Intensity Health podcast. This method is called mouth taping and I use it all the time now.

Unlike me, Mike had a moderate case of sleep apnea to contend with. Dr. Burhenne talked on the podcast about this wonderful device and all the benefits it has. When we stop breathing through our nose, we start breathing through our mouth straight away. Over time, the lack of circulation via the nasal passage has a detrimental impact on the nasal microbiome and the nasal passage lining the cells. This results in inflammation of these nasal passages, post-nasal drip, and increased responses to histamine, such as seasonal allergies.

Face taping includes covering your lips with a sheet of tape around your face when you're sleeping. This effectively causes the airflow to pass through your nose while you sleep. No single tool has been more effective in enhancing

my breathing habits, allowing me to get a better, more restful sleep and lower my allergies.

It's much more difficult to use the diaphragm to breathe when we breathe through our ears, but when we breathe through our nose, it's absolutely second nature and normal. Studies with HRV have shown that when we breathe through our noses than pathologically through our ears, we boost vagus nerve function. During the day and mouth taping at night, constructive breathing techniques are an effective mix of methods that can be used to enhance their breathing habits both day and night.

GETTING GOOD SLEEP

We all know how important it is to have a good evening of rest. Here, I'll give you some tips to use as part of a bedtime routine to improve the likelihood of a safe, restful sleep night. A restful night of sleep has been shown to enhance autonomic equilibrium through studies of heart rate variability.

ELIMINATE BLUE LIGHT EXPOSURE IN THE EVENINGS

During the day, light wavelengths shift, and our bodies have adjusted to their signals. When the morning sun rises, in the red/yellow wavelengths, light is very dry. Around midday, the sun becomes much brighter and bluer. Yet again, in the evenings, the light turns into a red/yellow shade as the sun is setting. These are the cues our body uses to tell us the current time of day, and which hormones and cues to secrete at different times.

Our devices all emit a blue wavelength of light, including the laptop, Monitor, computer, and tablet. If we glance at our screens right before bed every evening, we give a warning to our bodies that the time really is noon. This will slow down the production of melatonin, which is an essential hormone required to help us relax and fall asleep. Some apps now come with blue-light filter,, but most do not.

You can:

• Trigger Night Shift on your Apple devices

• Download the Twilight app on Android devices

• Download flux or iris on your computer (Mac or Windows)

• Use blue-blocking sunglasses when you watch TV For blue-blocking glasses, I suggest using TrueDark Twilight sunglasses…

I recommend reading a physical book or spending device-free time with loved ones or friends instead of looking at your phone at night because social interaction is another great way to enhance vagus nerve function.

SWITCH OFF ELECTRONICS AT NIGHT

One of the best things I've done for my wellbeing was to cancel my subscription to cable TV. It forced me, at night, to stop watching TV. Since then, I have taken steps to minimize computer usage in the evenings and nights and, having done so, get considerably better sleep.

Loading your devices like a mobile phone or a laptop in a separate room, shutting off Wi-Fi routers with an automated timer, and even placing your devices in flight mode are perfect ways to avoid using them at night.

DON'T EAT OR DRINK TOO LATE

Bathroom breaks typically break up peaceful sleep. Whether you eat or drink later in the evening, then you're getting your body ready to use the toilet at night. Instead, make efforts to have dinner two hours early before you sleep, and your last glass of water at least one hour before bedtime. The next day your waistline and energy levels will be grateful!

LOVE YOUR ROOM

Dorming in a tidy, organized room is important to improve the quality of your sleep and your health. You can't help but go to sleep while your bedroom is a mess, worrying about the cleaning and organizing that needs to be done. This emotional energy gets into your subconscious and makes your sleep disturbed, which is essentially additional stress to your body and a simple way to turn off the night-time parasympathetic recovery mechanism.

Get a feng shui evaluation performed on your space to ensure that it is structured in an energy-positive manner that will help you feel better and make you develop. Make sure you regularly clean and organize your room, as this will have a direct impact on your mood and energy levels. To know more about how a clean room changes the energy in your body, I suggest reading Marie Kondo's *The Life-Changing Magic of Tidying Up*

SLEEPING ON YOUR SIDE

A 2008 study published in Circulation Journal by Yang et al. compared the HRV levels of different sleep positions. The research was performed to determine the optimal place for coronary artery disease patients relative to those without any blockages in their coronary arteries. The researchers found lying on your back was the worst position for HRV rates, both for patients in testing and control while lying on either side showed substantial improvement in HRV. Most interestingly, it has been found that sleeping on the right side is the best for vagal modulation, particularly within the control group.

What this basically means is that sleeping on your back, or lying on your back for a longer period of time, would have negative effects on vagus nervous function, whereas lying on either side (right side preferred) would actually allow you to increase vagus nerve tone. This is because your airway is more likely to close while you are lying on your back because your tongue will slip backward due to the gravity pull. That's not just as convenient when you're lying on your side. Note, an open airway is completely vital to breathing efficiency, both in terms of breath rate and breath depth.

I suggest placing a pillow between your knees when you sleep, to make it easier to sleep on your side. It will force you to sit on your side while you're sleeping, and won't let you sleep on your back.

COLD EXPOSURE

Did you ever leap into a lake or pool, only to find that the water is frigid and freezes you to your core? Your teeth start chattering, and your body starts shivering uncontrollably. The wind, too, is totally out of balance. You take very shallow breaths, so the diaphragm can't relax sufficiently to calm down and breathe deeply.

As you can imagine, this scenario is perfect to trigger your sympathetic nervous system and the response to fight or flight. In the short term, your body is fighting to survive, and that has an immediate effect on how your body responds. Your breath is quick and heavy, your heart rate rises, and during this time, your body does not wish to digest optimally. All short-term effort is intended for survival.

What you would be shocked to hear is that this, in fact, has the incredible long-term effect of stimulating the parasympathetic nervous system. Continuous acute cold or cryotherapy treatment helps you to control your intake, which has an overall beneficial effect on the activation of the vagus and major anti-inflammatory effects in the body.

Periodic exposure to cold is one of the strongest and simplest ways to restore a damaged vagus nerve and repair it. The best way to incorporate this into your life is to introduce cold exposure to your showers. One great advice I give to all of my patients is to take a regular shower, then turn the temperature down to the coldest possible at the end of the shower, and let it hit you on the head and back of your neck for the last minute of your shower. This will be surprising to your body first, which will change the way you breathe. During this time, your goal is to work to regulate your breath and take as many deep belly breaths as possible. If you can train your body to breathe through the cold, the vagus nerve can become very powerful, and the body will have a parasympathetic nervous system and vagus nerve functioning optimally. As this minute gets easier, you can add one or two minutes of cold exposure every week before you spend your whole shower in ice-cold water, and there's a big smile on your face!

Cryotherapy is an advanced and validated technique which is used by the parasympathetic nervous system to help alleviate inflammation and enable healing. During each game or event, the vast majority of the professional athletes, as well as celebrities like Tony Robbins, use cryotherapy. Mr. Robbins swears for his own health and considers it to have great healing effects.

For its incredible healing benefits, even Wim Hof, the founder of the Wim Hof process, uses cold exposure in this process. He is known as the Iceman, as he frequently participates with his clients in ice baths and teaches about the benefits of cold exposure. If you feel that cold showers have become repetitive and too quick, consider going out in just a pair of shorts and boots for a hike on a mountainside. A search for Wim on a Google picture would show him doing just that.

HUMMING OR CHANTING

Relaxing and using the voluntary muscles that signal is another way to

activate the vagus nerve. Through stimulating these muscles, you activate the centers of the brainstem that transmit signals through the vagus-not just the centers of muscle regulation, but also all the others around it.

You can activate the laryngeal muscles by humming and chanting, which gets signals directly from the VN's superior and recurrent laryngeal branches. They allow tightening and loosening of our vocal cords based on muscle tension, thereby giving us a pitch level in our voices. When we practice deep humming in our throat, we activate and vibrate these muscles and stimulate the vagus to send out these signals.

You may be aware of the sacred Hindu syllable "om" that is used when recited loudly to create a deep vibration in the throat. The "om" vibration, which is said to vibrate at the God's resonance point, has a deep spiritual connection in Hindu practice. Simple terms such as Amin, Ameen, and Amen are used in many cultures, but they all seem to mean the word of god.

Vibrating at this frequency in the vagus nerve by chanting the word effectively activates the throat and vocal cord laryngeal muscles, facilitating activation of the VN motor fibers. When performed long enough and with adequate energy, it can be an effective method of activating the other nerve signaling components. It helps us to regulate our breath, slow our thoughts, and concentrate ourselves to the point of intense deep relaxation, which has been shown to enhance the body's rate of digestion, which inflammation. This can be a perfect way to calm down, sync with the world, and stimulate vagus nerve development in the digestive tract and other visceral organs like humming or chanting the word "Om" before a meal. Practicing "om" on certain occasions, like after a traumatic event, is a helpful resource after this stressful event in reducing levels of stress and sympathetic activation.

There are other words to hum or chant that will effectively activate these muscles and enhance the signaling of the vagus nerve, but "om" is one that I have found to be particularly successful as the activation of the muscles of the throat is clearly noticeable during the practice.

ACTIVATING GAG REFLEX

Activation of the gag reflex is another way of relaxing the muscles innervated by the VN in the same lines as humming and chanting. Also known as the pharyngeal reflex, this reflex is necessary to protect us from choking, which

requires a process of nerve activation to function optimally.

When an entity we do not know reaches our mouth and hits our soft palate (the fuzzy part at the back of the mouth's roof), a very strong sensory signal is transmitted through the ninth cranial nerve, up to the brainstem and to the motor portion of three different cranial nerves. The first of these nerves is the vagus' pharyngeal branch, which immediately contracts the three pharyngeal muscles at the back of the throat to stop the object from going deeper into the body and becoming trapped in the airway. Often, the cranial nerve five and the cranial nerve twelve are activated, allowing the mouth to relax and the tongue to move the object outwards.

Activating the gag reflex voluntarily will send an immediate signal to the vagus and other nerves to keep them signaling in a quick and optimal manner. The best time to do so is twice a day when the teeth are being cleaned. The toothbrush should be used to touch the sensitive palate to activate the reflex. It is a nice, easy choice known to have a direct impact on VN signaling. Because we have a collection of cranial nerves on each side of our body, it's important to stimulate the soft palate on both sides to get the full benefit of this exercise.

GARGLING

During my childhood, my father always urged me to gargle with salt water after brushing my teeth in the morning and evening, just as he has done for his whole life every day. He used to tell me it's good for my wellbeing–but I'd laugh it off and make the advice plain. Curiously, he was on to something. He's a very good septuagenarian; I should have known;

Gargling is the act of holding a drink of water in the back of your throat and aggressively spinning it around. This involves activation of the three pharyngeal muscles at the back of the throat, and as such, it is another way of stimulating the vagus nerve by activating the muscle. Practicing this twice a day after brushing your teeth is a perfect way to quickly leverage this device, as my father will constantly remind me.

Gargling with extra vigor, to the point that the eyes start to form tears, is ideal for better performance. It actively sends signals from its brainstem nuclei when your vagus is firing, which causes some neighboring nuclei as they become stronger. In this case, the superior salivary nucleus is stimulated,

which triggers the glands around your eyes to produce tear-bearing fluid. If you gargle hard enough to make yourself cry, you do so properly and have a great impact on your vagus nervous system.

Adding any salt to the water you use to gargle, such as Himalayan pink salt, is a great choice too. Gargling salt water has been shown to have antibacterial effects and may help the mouth and upper respiratory tract remove any unwanted bacteria. The use of essential oils, including oregano oil, is another great choice in your water, with very similar results.

YOGA AND PILATES

Yoga and Pilates are not only about exercising the body but about relaxing the mind and controlling the heart. Both approaches achieve maximum voluntary regulation of the body while through external stressors and teaching you how to regulate the body.

Most yoga sessions are booked with a slow breathing exercise to the deep abdomen. The aim is to teach you to maintain your breath pattern while keeping your body in various positions. Every of these positions requires a particular form of physical stressor at the body. We've learned to use heat and humidity, which are even more engaging, to raise the degree of tension within this exercise. Two examples of this are moksha and bikram yoga.

When we can learn to sustain a long, deep breath in the abdomen during periods of stress, our bodies can function at far higher levels. If we train ourselves by holding our breath to handle voluntary stressors, then we can be taught to maintain calm and handle other stressors with considerable ease.

Pilates was built around learning to breathe properly. We have addressed this necessity in the book a lot earlier but it is absolutely important for our wellbeing. Unless we paradoxically relax during times of low stress, our bodies won't be able to cope with periods of high stress.

When practiced with a focus on the body, both yoga and Pilates are great tools to refine breathing habits, enhance inflammatory responses, and activate the VN for optimal function.

MINDFULNESS PRACTICE

Should you take a moment to sit still, close your eyes, and concentrate your attention before starting a task? Are you making sure you put 100 percent of yourself into the job at hand? Do you take a moment while you're relaxing to be thankful for your surroundings?

Exactly this is mindfulness: taking the time and making an effort to pay attention to what you are doing and what is going on around you. Many of us are running from task to task, or putting out fire after fire without paying attention to what is happening around us. We are so wrapped up in our own minds that it is put on the backburner to pay attention to one particular task and give it our full attention; it feels like a waste of time and energy to do so.

Most health-care practitioners are guilty of this, including myself. We travel from patient to patient or appointment to appointment, ignoring or not paying our full attention to the fact that everyone trusts us with their health and life-related decisions. Becoming a functional medicine doctor has helped me to have a positive and deep effect on the lives of my patients and as such, I am much more mindful of the importance I can provide to each of my patients. Once I bring in my next patient, I take a few minutes to study my notes, remove any distractions from my area and clear up activities that include other matters. Once I do so, I take a moment to note that every patient trusts me to help them attain their health and life goals.

Practice mindfulness involves executing each task to your full potential, with 100 percent of your attention focused on that task. It means taking in your surroundings, being mindful of and thankful for all that has taken you through that exact moment.

The capacity to exercise sensitivity can not occur while we are stressed out, inflamed, and in pain. Our sympathetic nervous system has a tendency to catch our attention and keep us from concentrating on what we do. If you're consciously practicing mindfulness during the day, you're concentrating on your breath and how every task at hand can be done. This changes the balance to the parasympathetic nervous system and helps the VN to do its function.

Approaching a task deliberately means doing one thing with complete focus at a time and completing it before moving on to the next task. Eating conscientiously helps you to feel satiated and not overeat. Paying attention to

relaxation helps you to feel refreshed and rejuvenated faster than you can expect. Both of these require an active and activated vagus nerve because we must be able to rely on it so that our bodies can relax, digest, and heal. Multi-tasking is the exact opposite of being conscious.

Getting mindful of what I'm doing, eating, and thinking as each job approach was the most positive improvement I've made in my life, and it's by far the number one factor that my health outlook has become more positive. For me and many others around me, it has been a huge needle-mover, and I'm sure it will create significant positive changes in your life too.

THERAPY

Therapy is similar to a mindfulness exercise. It's the art of taking care of your breath and telling your heart not to follow every thought that comes into your mind. Our brains are built to create complex, creative linkages between our thoughts and actions. Meditation helps us to listen to our hearts and focus on our breath, to learn to become listeners of our thoughts and not victims of their fluidity.

Instead of discussing the various forms of meditation, I would like to explore its benefits. Studies of variation in heart rate have shown that meditation has major beneficial effects on the activity of the vagus nerve, and when we meditate, our focus turns towards our breath. There are several different forms of meditation, but breath-focused ones are usually best for HRV rates improvement. These include meditation on the air, meditation on loving-kindness, vipassana, and meditation on mindfulness.

One interesting tidbit of knowledge I found through my research is that HRV showed only progress in patients who did not self-identify as perfectionists. Research by Azam et al. found in the International Journal of Psychophysiology that control patients were much more likely to have positive HRV-level improvements compared to those who self-identified as perfectionists. Essentially, "perfectionist" has become so focused on meditating properly or appropriately that they have been able to relax and benefit from the practice itself. One of the most popular comments I hear about meditation when I ask my patients is that they are "not able to do it right." This perfectionist mentality is precisely what keeps them from understanding the benefits. It is easier to benefit from the practice while doing meditation without any assumptions or preconceived ideas about "the

best way" to do it.

To beginners, I suggest using audio-guided meditations found on YouTube or by using a phone app. I recommend the 21-day meditative journey by Headspace, Oprah Winfrey and Deepak Chopra, Relax, and Insight Timer. For those who want input on the practice of meditation, HeartMath's Inner Equilibrium is a fantastic resource to help you decide whether you have reached a state of congruence calculated by a change in heart rate. Another resource for those interested in having clear knowledge is Muse, the headband for meditation, which tracks brainwave activity and gives you audio feedback in real-time. These are add-on devices and should not be used at all, but they can be a good investment for those who usually aim for excellence.

LAUGHTER AND SOCIAL CONNECTEDNESS

Would you do it more often if you knew that more laughter would benefit your health? The last time you've had a good bonding session with friends, remember. Did you feel good for the next few hours? Have you slept the night better? Have you been waking the next morning to feel great?

Repeated ongoing work shows laughter and laughter yoga to be very successful in enhancing variation in mood and heart rate. As we laugh with vigor and laughter, we continue to use our diaphragms and, in effect, practice our ability to regulate our pulse rate and ensure that our breathing patterns can be controlled. This is a vagus nerve exercise.

Having a daily occurrence of enthusiastic laughter is a fantastic and very pleasant way to boost the vagus nerve work. I'm going to watch funny videos or comedy shows as much as I can to feel socially connected and appreciate the health benefits of laughter. Taking laughing yoga classes in your neighborhood, frequently meeting with friends to share fun stories, and putting on a comedy film are all great choices for more laughter. Social interaction is directly associated with this because when we are in the company of others, particularly friends and family, we are more likely to laugh out loud. Social interaction is one of health's biggest determinants, and could be even more important than the food you consume.

People would like to be around others. When we feel alone and isolated from others, we will have a negative effect on our mood and health. We continue

to enjoy others ' company, and prefer to have face-to-face interactions with real people. We appear to laugh more when we're around others, smile more and feel more confident.

When we spend time with people we connect and share the ideals with, we feel even better. Recently, I was able to take my family to a Living Proof Team Retreat in Minnesota that was a wonderful experience. The stunning natural environment and surroundings were combined with spending time with team members sharing the same ideals I do. At Point Retreats, we were taken care of by the team, another amazing group of people who supports getting people back to healthy and happier lives. We were both really content and comfortable at the end of the journey, regardless of the travel tension.

If you feel lonely, down, or just disconnected, you'll find a way to spend time with others and communicate with people with common values. If physical exercise is a major benefit, enter a gym or take part in a yoga class with colleagues. If contact is a significant value to you, join a community of toastmasters, and practice your public speaking skills with friendly, like-minded people. When you enjoy quality time with others, then go to a movie or a nice meal to have a great time and converse. On earth, there are 7 billion people and countless events and interactions that allow you to communicate with those people.\

It's believed we laugh less as we age, but the healthiest people I know make more of a point of laughing. And social engagement is a common trend in the blue zones, the areas around the world with the highest survival rates (with many people living past 100 while still being physically active.

So get out and enjoy social activities with those around you, meet new people, share fun stories, and laugh as loudly and as much as possible.

LISTENING TO MUSIC

After listening to some wonderful music and singing along, don't you feel very good? This is because the body really feels comfortable throughout and after this period, and is able to conduct recovery processes. It's the same reason why we enjoy belting our favorite songs into the lyrics while sitting in our cars or stuck in traffic.

A 2010 research by Chuang et al. found that cancer patients who took part in

a 2-hour music therapy session that included singing, listening, studying, and performing music reported substantial improvements in measures of heart rate variability, and therefore in vagus nerve and parasympathetic nerve activities. In 2014 another study by Lin et al. used HRV to show that the music of Mozart would enhance the function of the parasympathetic nerve. Most of this study was conducted with children who were diagnosed with epilepsy, a severe seizure condition. Listening to the music of Mozart, particularly the "K.448" sonata for two pianos by Mozart, showed a decrease in recurrence of seizures and changes in the brain.

Next time you sit in traffic and feel anxious that you are late for a meeting or a job, put on some good music and let your body shift and sing along with it. You will naturally feel more confident and less anxious, and at the same time you will always be getting to your meeting. Play Mozart in the background if you are at home and sound out of it, and remember how you sound afterwards.

Art has the power of healing. It has the power to take people for a few hours off of themselves.

WISE DIETARY CHOICES

As the study gradually becomes clearer, we are finding that there are foods that can have a detrimental effect on our cellular and digestive health and which have a greater likelihood of growing rates of inflammation. Many of these options are heavily processed products; products tainted with antibiotics, hormones, herbicides, and pesticides; and genetically modified foods. Avoiding these foods is important in reducing the possibility of damage to each of our cells ' gut lining, liver detoxification system, and wellbeing.

I promote organic, locally grown fruits and vegetables when selecting balanced and smart foods; lean, free-range chickens and eggs; lean, grass-fed, and finished beef; non-GMO grains such as rice and quinoa; and organic nuts and seeds. For a majority of people, the best way to start is a fresh, clean, and lean diet made from healthy fats and minimally processed food. I recommend reading Food: What the Heck Would I Eat To learn more about dietary options? Via Dr Mark Hyman. Follow his four-week plan, and re-introduce one meal at a time. Note, the diet needs to be adapted to your needs and

desires. Vegan, autoimmune paleo, paleo, and ketogenic diets are all beneficial, but you should have a diet that fits your needs. Note green, clean, and lean while shopping at the grocery store or farmer's market, my personal three rules are mine.

Foods that contain nutrients helpful to the development of ACh are important when looking specifically to increase vagus nerve function. Acetylcholine is the main neurotransmitter used by VN, and low levels may lead to nerve function and signaling in the suboptimal vagus. Nutrients needed to allow the development of ACh are high in choline, such as egg yolks; high-quality cooked organ meats such as beef, chicken, and turkey livers; and soy lecithin, a common food additive.

Another effective tool for improving vagus nerve activity is to give it a break–literally, let the vagus nerve take a while off. Intermittent fasting and time-limited feeding are important methods for increasing flexibility in the heart rate. I personally use this method to regulate blood sugar, increase energy levels, and reduce stress on my body. Intermittent fasting has been shown to increase HRV, which is a sign of maximizing vagus nerve function and increasing health in the long term.

Limit food consumption to a six-to eight-hour period when you're awake to do intermittent fasting or time-restricted feeding. For example, you can restrict calorie intake at breakfast time, thus reducing the amount of sugar contained in the blood early in the day, and have your first lunch meal. Personally, I eat two meals a day, between noon and 8:00 pm, while taking an amino acid powder a morning to ensure my cells have the resources they need to function optimally. Join my online Energy Boost Challenge at www.energyboostchallenge.com to learn more about this activity and try it out yourself for a 2-week span.

DAILY MOVEMENT AND EXERCISE

Our bodies are designed to move. Muscles are some of the body's most essential and neglected muscles, and muscle cells are the best to help us regulate the levels of our blood sugar and body fat–if we use them. The problem is that most of us are sitting and avoiding movement every day for a very long time, and then sitting in the car, sitting on the sofa, continuing this constant lack of movement.

Practicing some degree of movement, ideally one that helps raise the heart rate for a short period of time by increasing body stress levels, helps to boost parasympathetic nerve function. There are occasions that both the sympathetic and parasympathetic processes should be triggered, and one of those conditions is rehabilitation following exercise. Upon healing, we optimize our breathing pattern, which enhances feedback to the airway's muscles to improve patentability, trains the heart to become stronger, and pumps out more blood with each pump, and helps us to change back to a normal parasympathetic state.

Moving your muscles and forcing the body to do activities that stress you out on a regular basis will teach the body how to heal quicker from the stress while also helping you regulate energy levels and sources of macronutrient fuel. Using the muscles to make stuff happen on your body, preferably outdoors.

SUNLIGHT EXPOSURE

Day-long exposure to sunlight is directly linked to your health. Our bodies are genetically designed to function according to the amount and form of sunlight that falls through our eyes and skin. This has a strong impact on the way we function at a cellular level. When we spend a whole day indoors with minimal access to true sunlight under artificial lighting, we are depriving our cells of optimal signaling and work.

During daytime, exposure is specifically correlated with increased levels of HRV. Throughout sunrise and sunset, our eyes and skin tend to absorb signals from red, infrared, and yellow wavelengths, while at mid-day, they tend blue, green, violet, and ultraviolet light. Sun exposure will do so naturally, but at least not yet will our offices, vehicles, and homes. Around the time of this writing, several businesses are improving the Circadian lighting technology.

Since sunlight is directly linked to HRV rates, it is highly recommended that you get outside and get direct sunlight every day on your skin. An even better choice is to do so at many different times of the day. Within 30 minutes of dawn, two or three times during the day and within 30 minutes of sunset, the best opportunities to get outside are. Even still, spend the entire day outside whenever possible. When the body feels the sunrise and is pre-conditioned to the UV light that we feel during the day, you are much less likely to burn the

skin during the day.

SUPPLEMENTATION

Due to the lack of nutrient density in our diets and the reduction of our microbiome diversity in our ecosystems, supplementation is a good way to ensure that our cells get the right micronutrients and signals that will enable them to function optimally. Contrary to previous belief, supplements aren't a waste of time, as long as the right person takes them for the right cause. We can decide the best supplements for each person to achieve their optimal cellular function using functional laboratory testing. However, there are certain essential nutrients and supplements for the signaling that can benefit us all. Remember that this is for general guidance. You should talk to your primary health care provider before beginning or stopping any prescription or approved drugs or supplements.

PROBIOTICS

Antibiotic use, C-sections, and low nutrient content diets have led us to reduced bacterial diversity and low levels of healthy bacteria in our intestines. Testing to confirm which bacterial species are present is the best option, but most of us would need to use probiotics to help our gut and skin microbiome. Probiotics are naturally occurring bacteria. We will help increase the bacterial diversity and establish healthy bacterial colonies when ingested. They are distinct from prebiotics, which is typically extracted from fiber and serve as the bacteria's food for us to produce vitamins and minerals.

I prefer spore-based, naturally developed bacterial species such as Bacillus, which are naturally developed in soil when selecting a probiotic. Such probiotics fill in the voids left when other bacteria die. Probiotics that need to be cooled tend to have a very low absorption rate (5 to 10 per cent) relative to spore-based probiotics and those that need not be cooled. The question I wonder about probiotics that need to be refrigerated is that if the bacteria can't withstand room temperature, how can they get past the stomach acid and survive in our higher body temperature?

For most patients on a maintenance protocol, MegaSporeBiotic is my preferred probiotic alternative. It has a very high rate of absorption, it does not need to be refrigerated, and it contains Bacillus species that can help fill

the voids left by several different forms of lacking bacterial organisms, not just Lactobacillus and Bifidobacteria, which are the key organisms protected by most probiotics.

OMEGA-3 FATTY ACIDS

Our Regular American diet and diets with low nutrient density do not contain high-quality omega-3 fatty acids. Sometimes referred to as fish oils, they are most often obtained from fish, but may also come from certain plant sources, which are the preferred vegan source.

The problem with most ingestible omega-3 oils is that they are produced chemically from natural sources, and this manufacturing reduces the potency of these sources. The natural form includes triglycerides, while ethyl esters are found in the refined form. Ethyl esters tend to taste and smell much more catchy than triglycerides.

I strongly recommend opting for the triglyceride form when selecting a high-quality source of omega-3 fatty acids because it is safe and contains a high amount of EPA and DHA, both of which are essential for brain function and anti-inflammatory effects in the body. EPA and DHA enhance the function of the nerves, including VN function, as they are essential for nerve myelination and have anti-inflammatory effects. Also recently, supplementation of omega-3 fatty acids has been shown to increase variability in the heart rate in obese children. I personally use the Ortho Molecular Products and Health Interface capsules, both for my patients and my colleagues.

5-HTP FOR SEROTONIN

This section addresses problems related to low mood and depression. Unfortunately, depression and mental health problems are very prevalent in North America today, and research has shown that antidepressant medications can potentially cause more of a problem. A long-term research conducted in 2014 by Regan et al. found that there was a decreased HRV in patients with depression, and that these rates are potentially increased by anti-depressant drugs that aim to boost serotonin levels.

The serotonin receptor is called 5-HTP. It can be used as an important supplement allowing the body to build up its own serotonin. Many depression cases are due to serotonin deficiency, and organic acid functional testing,

which I use for virtually every patient entering my office, will actually tell our patients whether they have too much serotonin and use it very easily, or whether they are running low in their output.

One thing to note is that the vast majority of serotonin development is driven by the intestinal microbiome. A healthy microbiome generates a decent amount of serotonin, which makes a positive attitude whereas an unbalanced microbiome does the reverse, contributing to an increased risk of mental health issues.

COFFEE ENEMAS

The enemas can be highly effective in more serious cases of bowel motility problems, particularly when people are chronically constipated and unable to clear their bowels for quite some time. A good coffee enema is a nice and easy choice with an exceptionally high degree of efficacy. In the book *Why Isn't My Brain Working?* Dr. Datis Kharrazian explains how the caffeine present in coffee highly activates the nicotinic ACh receptors, which are the same receptors that the vagus influences by releasing acetylcholine. Caffeine activates these receptors in the stomach, triggering an involuntary impulse during a bowel movement to empty the intestines.

To use this method effectively to re-train the vagus nerve, you need to inhibit this impulse for as long as possible. Through resisting the desire to go, you potentially cause an axis to fire in your brain (the frontopontine vagal enteric axis), effectively causing the vagus and brain to become highly active and to learn to reactivate these gut motility nerves. When you do so consistently over time, a coffee enema will retrain the vagus nerve and be able to expel stools without the need for external help.

When you have trouble with chronic constipation and inadequate liver detoxification, then this cycle is an excellent method to help you clear the bowels and more efficiently get the toxins out of your body. You'll actually be training the VN to learn how to fire and influence the nerves that regulate gut motility by doing so correctly and resisting the urge to void for as long as possible.

CHAPTER 7

PASSIVE METHODS TO ACTIVATE THE VAGUS NERVE

Among all the aggressive activities you can do on your own, there are passive therapies that can have significant effects on vagus nerve activation. Several of these include using other devices or visiting a health care facility while some can be performed in your own home comfort. Until starting some kind of treatment, remember to explore these choices with your primary health care provider.

AURICULAR ACUPUNCTURE

Acupuncture is an important method of treatment for many disorders, and with my patients, as a hands-on chiropractor, I have seen the amazing effects firsthand using it. If you note, one of the four types of signals mediated by vagus is sensation to different parts of the outer ear, or auricle: the entire concha, the helix crus, and the tragus. As such, stimulation of these specific regions can have effects that can activate the vagus nerve function. The vagus nerve receives solely sensory input from the central and anterior portions of the ear via its auricular branch. We will increase the flow of information in the auricular branch of VN by using acupuncture, and thus increase the activation of VN.

A substantial and increasing body of research indicates that in many patients with depression, anxiety, epilepsy, LPS-induced inflammation, tinnitus, and highly active pain receptors, acupuncture and transcutaneous vagus nerve stimulation via the auricular branch of the VN yield beneficial results. The best thing about this method of treatment is that it is effective without invasive action.

There is also a growing development within the health care community focused on vagus nerve activation by electrical stimulation. This is achieved by implanting an electrical stimulator on the vagus nerve itself, surgically. Acupuncture is considerably safer than this invasive procedure and just as effective. In addition, the exact same neural pathways include auricular acupuncture and implanted vagus nerve stimulation devices. I will actually

prefer acupuncture at any moment, provided the opportunity.

MASSAGE THERAPY AND REFLEXOLOGY

Massage therapy is an ideal resource for us to relax. I actually move slowly right after a successful massage, breathe deeply, and see the world in a more optimistic light. If the doctor hits some very tender spots, the majority of people feel comfortable and refreshed after a massage. This experience may be the epitome of parasympathetic activation and sympathetic disabling.

Not unexpectedly, several different massage techniques have been linked to increased rates of HRV or enhanced vagal tone like Chinese head massage; traditional Thai massage of the shoulder, neck, and head; conventional back massage; and even self-massage.

I always recommend attempting reflexology for several of my patients who have difficulty getting comfortable. I had been open to the possibilities since my mom began to practice reflexology, and was the first to volunteer as a patient as she was studying. I would fall asleep each time she was operating on my feet, even as a teenager. For this reason, I wasn't shocked when I found a research paper showing patients treated with foot reflexology reported significantly improved rates of HRV and lower levels of blood pressure 30 and 60 minutes after treatment.

Passive treatments such as massage therapy and reflexology may have tremendous beneficial effects on our health if they help us relax and improve the activity of the vagus nerve. This is yet another perfect excuse to have massages scheduled daily!

VISCERAL MANIPULATION

Visceral manipulation (VM) is a technique which is less common but which is very successful when done correctly. Usually performed by osteopaths, chiropractors, naturopaths, and other health care practitioners, VM is the gentle physical stimulation of the abdomen's organs, thereby increasing the supply of blood to areas that do not function best. When learnt right, patients will use this feedback device on their own.

As we know, all abdominal organs including the liver, gallbladder, pancreas, kidneys, spleen, uterus, small intestine, and ascending and transverse portions of the large intestine are innervated by the vagus nerve. For the VN to

influence these organs and communicate organ activity to the brain, optimum functioning of the organs is essential. Within these organs, physical constraints can build up and can only be altered by physical coercion and mobilization. Improving the blood flow to these organs can have major beneficial organ health outcomes and allow the VN to send out optimal function-related signals.

Gently applied hands-on therapy is used by visceral manipulation practitioners to identify places of altered or reduced movement within the viscera and remove constraints within these visceral organs. The procedure requires a gentle squeezing, relaxation, or soft tissue elongation. Finding a licensed visceral manipulation therapist in your area might be a good idea, especially for those with detoxification dysfunction or liver, gallbladder, or kidney pain.

CHIROPRACTIC TREATMENT

Mechanical pain in the neck and back is common everywhere. In the last 20 years, they have become even more common as our occupations and professions have become much more sedentary, and the majority of them allow us to sit for hours on end in front of a screen. As a chiropractor, as a result of sitting in this position for several hours each day, I treated thousands of patients struggling with pain in their neck and back.

The muscles surrounding them can become very rigid and weak when joints are not worked across their full range for a long period of time. The effect is that the joints will become slightly misaligned, leading to discomfort. Mechanical joint pain caused by lack of movement is more common than pain induced by joint overuse. In my research, I found it totally true that if you don't use it, you lose it–a joint feature, that is. A 2015 study in the Journal of Chiropractic Medicine showed that a chiropractor's stimulation of the spinal cord in patients with neck pain resulted in substantial positive improvements in blood pressure and heart rate variability, dramatically enhancing VN performance. Research published in the Journal of Psychological and Physiological Therapeutics in 2009 yielded similar promising results for lower back pain patients. Both of these researchers found that pain relief allowed patients to breathe more slowly and enhance their vagus nerve function, and that chiropractic manipulation had a beneficial effect on the mechanical function of patients. Especially when one

is in pain, chiropractic treatment can be a very successful therapy tool and can greatly support the VN and parasympathetic operation.

ELECTRICAL STIMULATION

Scientists have performed experiments over the last hundred or so years to learn about the effects of the vagus nerve. One technique involved stimulating the VN on laboratory animals with the help of electrical stimulators. In addition to learning about the value of the VN itself, researchers gradually found that they were able to improve its functions by electrically stimulating the vagus nerve.

Experiments were performed in the 1980s and early 1990s to demonstrate that vagus stimulation in the neck was effective in reducing seizure activity in dogs. This work resulted in dedicated clinical trials which developed devices for vagus nerve stimulation (VNS) that could be implanted into the neck. The FDA approved these devices for the treatment of epilepsy in 1997, and for the treatment of severe, treatment-resistant depression in 2005. Regarding numerous medical problems, including insomnia, bipolar disorder, treatment-resistant anxiety disorders, Alzheimer's disease, and obesity, researchers and companies have been developing and enhancing tools to electrically stimulate the VN since. The most commonly used clinically electrical VNS system today is the Cyberonics NCP System, which is inserted during an outpatient procedure on the left vagus nerve. This unit is used for treating patients with extreme depression and/or epilepsy resistant to the medication.

Right-side VNS is useful in animal models of epilepsy and seizures, but strong effects on depressive symptoms are not established. Preliminary clinical trials are promising and have shown positive results, and several companies have already begun to develop vagus nerve stimulation devices that can be used for specific conditions. BioControl Medical's CardioFit device uses right-side VNS to trigger efferent fibers and aid in heart failure care, whereas BioControl Medical's FitNeSS device is programmed to enable afferent fibers, thus helping to reduce the side effects of electrical vagal stimulation.

Typical surgical risks associated with this operation include infection, discomfort, scarring, swallowing problems, and paralysis of the vocal cord. Side effects of implanted electrical stimulators include speech changes,

heaviness, sore throat, cough, headache, chest pain, breathing difficulties (especially during exercise), trouble swallowing, abdominal pain, nausea, skin tingling, insomnia, and bradycardia (heart rate slowing). Though many of these may be temporary, they may be serious and may last forever.

There are other electrical stimulation devices which do not need to be implanted, but they have inconsistent results and are only licensed at this stage for some conditions. Cerbomed's NEMOS system is a transcutaneous VNS unit, applied to the vagus-innervated part of the body. Currently, it has been approved for epilepsy and depression treatment in Europe. In Europe, gammaCore system from the US-based company electroCore has been given approval for acute treatment of headaches in clusters, migraines, and overuse of headaches by medicine. The gammaCore is a compact handheld device with two flat contact surfaces for stimulation that are spread over the vagus nerve to the neckside. Larger trials for treating other disorders are ongoing.

As exciting as electrical vagus nerve stimulation is, I would consider using routine exercises and developing beneficial behaviors before seeking out external devices such as electrical stimulators. When you can have a positive effect on your vagus nerve function using the previously mentioned activities, I believe the symptoms will improve significantly with no unnecessary complications and costs.

PART 3

CHAPTER 8

WHAT COULD GO WRONG

Having gone through all the numerous and significantly important tasks performed by the vagus nerve, it is easy to see that if the VN function is not optimal, your health may suffer.

Imagine the charging wire to your mobile phone for a moment. If the wire has one of three separate issues, your mobile phone would not receive ample power from the outlet you've plugged into it. Such three problems encompass:

1. The plug is not working properly in the wall socket,

2. Wire not successfully connected to your mobile phone's charging port, and

3. The wire itself is bent, frayed or twisted.

Each of these three problems will result in your mobile phone being charged slower than average, and a large degree of irritation.

The vagus nerve has similar damage points; however, defective signaling results in the nerve have far more damaging and far-reaching consequences, which can result in the need for modern medicine to be diagnosed and treated. Hold in mind as we go through Part 3 that in a vast majority of cases, the vagus nerve tone can be strengthened and fixated. There is hope if you or a loved one suffer the consequences of relaying dysfunctional knowledge.

Throughout the following chapters, we'll go through the most common pathways leading to vagus nerve dysfunction and explore how such dysfunctions may manifest as symptoms.

There are various issues that could go wrong in the vagus, but we'll concentrate on: irregular breathing, heart rate dysfunction, chronic stress, and lack of social contact.

DYSFUNCTIONAL BREATHING

Dysfunctional breathing is the main and most common cause of dysfunctional signaling in the vagus nerve.

Immediately after we leave the womb of our mother, it's our duty to take our first breath of air. Although our hearts are already beating in the womb, and thanks to our mothers' help, our digestive tracts are still functioning. Breathing is the first job we get when we are born, and it's the only thing our small, brand-new bodies have to do to survive outside the warm, cozy world we grew up in and built for about 40 weeks.

The doctor or midwife will help us with this initiative by clearing our airways, allowing our diaphragm muscle to move freely into the lungs, and to contract and relax. They assist this function by removing fluid which can obstruct the pathway. This fluid normally reaches the airways and lungs very late in our fetal development as we take some practical breaths. The diaphragm must learn to contract and relax, as it is the required controlling mechanism for breathing.

The vagus nerve affects the diaphragm without impact. It is operated by the phrenic nerve that originates in the neck (from cervical spine level 3) and runs adjacent to the vagus into the thorax and through the lungs and heart before entering the most critical muscle for breathing function.

When our airways have been cleared, the first breathtaking activity begins. Our diaphragm contracts and creates a vacuum effect in our thorax, causing our lungs to expand and take in the oxygen-containing external air, among other gases. The vagus nerve signals our lungs extending to the brainstem, and we know that our mother no longer offers physical support for the oxygen we need. The job has been ours for the rest of our lives now. Then our diaphragm relaxes and forces the air out of the lungs and through the trachea, then out of our mouth and nose. The breathing cycle has started.

As a baby, we know the automatic and right way to breathe. Take a moment to watch how they breathe every time you're around a happy child or toddler. What you'll find is that their diaphragm will contract in order for them to take a breath in, and in doing so, they must actually expand their belly in the process. Diaphragmatic breathing is the mechanism whereby this main muscle is used for breathing rather than peripheral muscles.

Take a moment, place one hand on your belly and one hand on your shoulder, close your eyes, and breathe deeply.

I'm serious; check to see if you breathe correctly, right now!

Did your belly expand when you took this deep breath, or did you lift your shoulders to match your lung expansion?

When we grow and evolve through adolescence and enter our teen years, with the utmost respect and desire for emulation, we watch those around us. We want to look like those around us and behave like them; we prefer to imitate the mannerisms of those we look up to. Such people are always in the media and are introduced to us in a shallow way. Crazed culture in the North American social media, how you look is perceived to be one of the most significant aspects about who you are. It is an inconvenient fact, but a significant observation that has come across many others and I. In our childhood and teenage lives, we are told that thinner is healthier and that our belly size represents who we are.

If we start to understand these feelings and equate them to how we look and sound as adults, we are actually modifying our breathing habits. Our abdomen's constant expansion and contraction are not considered desirable, so we learn to breathe in another way. We start breathing using our accessory muscles–the backup muscles that are more critical and efficient in stressful situations. Using the muscles of the spine, shoulders and upper, middle, and lower back, as well as the anterior chest muscles, we begin to regulate the thorax expansion and the vacuum development.

Here's an interesting thought to ponder: Do you really train the muscle to do the job while you are exercising a different form of muscle in your body? If I want to be able to lift weight using the brachii biceps muscle in my arms and do bicep curls with weights over and over again, am I training the bicep muscles, or am I training the nerve to transmit signals to the bicep?

Through work, we now recognize that repeated movements and muscle exercise actually have more effect on the signaling nerves than on the muscle itself. The nerves regulate the signaling to the muscle, and as we practice, we actually train the nerve to send out signals to the muscle faster and more effectively than before. The muscle expands as blood flow to the region often increases as the usage of the muscle increases. This blood contains oxygen

and macronutrients such as amino acids and it helps eliminate any waste products.

Where you send flow is where you send function.

--Sachin Patel

The key thing to take away from this is that we can train nerves to signal and develop their function more effectively. In the same way, if we do not train a specific type of muscle or nerve, the nerve's function becomes unstable and sluggish. This less effective nerve signaling is the first stage of a complex combination of nerve and muscle dysfunction and nerve dysfunction.

As for breathing, for years, we have been teaching ourselves excessively to breathe inappropriately and inefficiently for the shallow reasons that have been subconsciously rooted in most of us from the beginning of our lives. This has contributed to several nervous problems. The phrenic nerve was not learned to breathe properly, because we usually do not use our diaphragms to breathe through our bellies. In the same way, as we are not completely expanding and causing successful vacuum results, the lungs are not adequately expanding and the signals of the vagus nerve as such. Signalisation of the vagus nerve is less effective as our breathing is less effective.

Breathing is the first act of life, and the last. Our very life depends on it. Since we cannot live without breathing it is tragically deplorable to contemplate the millions and millions who have never mastered the art of correct breathing.

--Joseph Pilates

Breathing right is one of the easiest and safest things to do for your wellbeing. So many different methods, practices, and trainings are at the core of proper breathing techniques. In the next segment, we will address several of these, which will concentrate on improving each of those dysfunctions.

The failure to regulate stress rates is another symptom of incorrect breathing patterns. Those with mental and physical stressors that feel chronically stressed also have very bad breathing patterns. Pause and take a moment to consider your breathing, the next time, you get riled up or find yourself in an disagreement or heated conversation. We typically take short and shallow breaths in these situations which trigger our response to fight or flight.

Pausing and taking deep breaths allows us to become more rational and calm, which very easily allows us to get a good outcome. Those with poor vagal tone appear not to be able to regulate their rage, and they are always quick to lash out and lift their voice, altering their breathing habits against such shallower and faster breaths.

DYSFUNCTIONAL AIRWAYS

Can you remember the last time you've had a stuffy nose? Remember trying to breathe in through your nose and feel terrible? Your strength was weak at the same time, and you probably had a bit of a sore throat or didn't feel great on the whole. If your airways are not clear, then deep and complete breathing can be very difficult. For anyone living with a deviated septum, chronic adenoid inflammation, and post-nasal drip, this can be a constant problem. Both of these problems will lead to the airways failing to operate optimally.

The problem of defective breathing associates defective airways. I am speaking explicitly of the nasal passage, the pharynx, the larynx, and the trachea when I speak about airways–all of which are known as the upper respiratory tract. There are a few different insults and problems that can have a negative effect on our airways, and in this segment, I will address could. The first is attitude which is unstable.

We exist in the era of smartphones and laptops. We sit at our desks and gaze hours on end at our computer screens, then take breaks from our machines to look down on our smartphones. We all, including myself, are guilty of this. We spend hours in a weak mechanical pose, contributing to back and neck pain and then keeping our cellphones under our nose. For the most part, we all know that postural issues lead to the spine's neck, back, and shoulder pain and mechanical weakness, but it is easy to forget the difficulties it creates with the airways and the ability to breathe properly.

Here's another check that you can do right now. I want to see you sitting in a slouched spot. You did so, did you? Well, fine.

Now, by stretching your chest, I want you to try and take a deep breath in, respite with your diaphragm.

Was it simple or difficult? Most people find it harder to take a deep breath in a slouched posture, and probably even painful. The explanation for this is that

when we slouch, the middle portion of the spine (the thoracic spine) lies in a flexed forward position. To optimally expand and contract, the diaphragm requires a less flexed thoracic spine position and an extended lumbar spine position. In a slouched pose, breathing using the accessory muscles is usually much easier and less painful.

Another problem when we look down on our desktop screens (and even farther down on our cellphones) is that for longer periods of time our necks appear to be bent in a flexed posture. It in turn causes us to close our airways, so that the pharynx and larynx muscles can not stay strong and allow the airway to remain as open as possible.

At another point, this portion of the airway is also particularly vulnerable to weak muscles: during the night, when we're asleep. Snoring and sleeping apnea are significant health issues that are much more common than most people would imagine. I was one of the millions of people suffering from sleep apnea during my days as an overweight youth and in my 20s. And my illness went undiagnosed, like so many other sufferers.

During sleep, sleep apnea is most frequently caused by some sort of obstruction to the upper respiratory tract. Vagus nerve dysfunction has been the most common cause of this problem I've encountered in my work. Weakness in the pharynx's sound and intensity causes the tongue to fall into the back of the mouth. This phenomenon appears to affect people who breathe mainly through their ears, rather than their nose. I was one of those people, and I tried to change the habit and educated myself.

We are supposed to breathe through our nose; mouth is just a backup plan. Our noses, after all, have hairs to clean the air, and our mouths have teeth to chew the food. Speak to every dentist and they will inform you that patients who breathe from their mouths certainly have a far greater oral health problem than nose breathers. Breathing by the mouth dries the saliva out and can be considered dangerous. A dry mouth causes bacteria in our saliva to develop uncontrolled by antibodies, leading to bad breath (halitosis), tooth decay, and cavities. This problem is also often caused by persistent obstruction to the nasal passage. A lack of ventilation through the nasal passage contributes to recurrent sinus and postnasal drip infections.

It is possible to teach yourself to breathe through your nose and will be

addressed in greater detail in the next section. Training the pharynx and larynx muscles is also necessary to improve muscle tone and vagal tone.

MONOTONE VOICE

I recently came to my office a patient suffering from a lot of emotional stress. She had suffered a rough breakup and had some problems with her parents at home. She had been struggling with an irritable bowel syndrome diagnosis and had been given several medications to help relieve these symptoms, but with only few progress to emerge from them. One of the signs I found during our initial evaluation was that she was not completely capable of through and diminishing her voice's pitch and sound. Her voice was completely monotonous.

Monotony is a sign of poor control over the laryngeal muscles which manages the vocal cord tension levels. When someone has a monotonous voice, it's a sign that signals don't move through the vagus ' motor part efficiently, so the muscles don't get enough signaling to contract, lengthen, relax or stretch the vocal cords. This contributes to very minor shifts in cord stress, and hence inability to regulate pitch or voice tone.

I immediately prescribed some unique vagus nerve toning exercises for this patient, and she was able to make major changes in her health and the sound of her voice within just two months. She had more control over her speech and had increased rates of contact with her mother. If you listen carefully to yourself or others around you, these little signals can be picked up which will guide you in the right direction.

DYSFUNCTIONAL HEART RATE

It is claimed that the normal heart rate resting in humans is between 60 and 100 beats per minute. The calmer and more composed you are, the lower your heart rate will be, and the more nervous you are, the faster your heart will beat. Electric impulses from the vagus nerve and sympathetic nerves determine a heart rate increase. The lower the heart rate, the stronger the nerve in your vagus. Ironically, there are findings that show that one's lifespan is inversely associated with resting heart rate, and the longer you live, the lower your heart rate. From this, we can extrapolate that better tone and function of the vagus nerve is correlated with lower heart rate and thus a

longer natural life expectancy.

If a vehicle spins out of control on an icy lane, the driver instantly feels anxious and enters the state of fight or flight. The sympathetic nerves automatically fire and the vagus is shut down. The signals from the sympathetic nerves speed up the heart rate by signaling that the arms and leg muscles need even more oxygenated blood to power the steering wheel and move the car's brakes.

When the car has arrived at a safe stop, the sympathetic nerves gradually stop firing and the vagus will turn on back. Vagus has the effect of slowing the heart rate using soothing, rhythmic electrical signaling.

One sign of a defective vagus nerve is the failure to normalize the heart rate rapidly after a traumatic event of this kind. The amount of time a person spends after a traumatic event with a high heart rate and slow respiration is a clear sign of vagus nerve activity. Someone who can relax their nerves easily and slow their heart rate has a very good vagus nerve, while anyone who takes longer to get back to their resting rate is possibly suffering from dysfunctional nerve tone of the vagus. How well do you work under the pressure of this kind of high-stress situation? Can you remain very calm and reasonable when faced with a situation like this?

The opposite of this problem can also occur as "an uncontrolled, overactive vagus." Vasovagal syncope is a big concern due to underactive sympathetic nerves and a hyperactive nerve of the vagus. Syncope is the psychological term for fainting. The sympathetic nervous system tends to increase blood pressure and heart rate while the parasympathetic nerves work on the heart to regulate heart rate and lower blood pressure. If the sympathetic nerves are weak and the vagus nerves are overactive, the result is a sudden, life-threatening loss of consciousness.

This disorder can manifest in otherwise healthy individuals and have immediate devastating effects. While there is no evidence of long-term consequences within the autonomic nervous system, vasovagal syncope is a symptom of inadequate coordination. It is a common problem without a specific single trigger. There are also several different factors, and the pathways between younger and older people are somewhat different.

The most popular hypothesis is that a physical head tilt motion causes the

difference of sympathetic to parasympathetic behavior, such as sitting or standing up quickly after lying down. This postural adjustment results in an adjustment in the position of blood pooling, from inside the chest to inside the abdomen, and in effect, the heart muscle fails to control its pumping activities. A significant increase in blood pressure occurs with the increase in the amount of blood being pumped out of the heart. The autonomic nerves function to maintain stable blood pressure, but if they are unable to do so, unexpectedly the blood pressure drops, which happens immediately before the episode. If the body gets a moment to control the blood pressure, the patient may regain consciousness and feel exhausted or nauseated because of the changes that have occurred.

Although this hypothesis points to a physical cause for the fainting episode to occur, it does not explain why the autonomous system can not control the heart and blood vessels to ensure a stable posture transition. This is a kind of dysautonomy, or the decreased capacity to control autonomous activity. The mechanisms contributing to dysautonomy may be hereditary, such as with Charcot-Marie-Tooth disease and Ehlers-Danlos syndrome, or they may manifest externally, such as pregnancy, physical trauma, chiari malformations, or surgery; Nonetheless, the most common causes contribute to the conditions of immune and metabolic health. If the nervous system cells lack the required nutrients for healthy metabolic responses or are coping with elevated toxicity rates in the body, the nerves are not able to function quickly enough. Perhaps more of a concern are autoimmune diseases affecting the nerves themselves, as well as the VN-innervated organs and the emotion. Such disorders include Parkinson's disease, sarcoidosis, Crohn's disease, ulcerative colitis, Sjogren's syndrome, amyloidosis, and even chronic polyneuropathy with inflammatory demyelination.

When someone is struggling with a condition like vasovagal syncope and has fairly common spells of fainting, it is also a symptom of an immune or metabolic disorder that may not yet be identified. Functional laboratory research and functional neurology provide insight into the possible root causes of this problem, which is often a symptom of malfunctioning nerves within the autonomic nervous system and vagus hyperactivation. Changes in heart rate, blood pressure, and cardiac production which can not be fully controlled, are indicators that vagus and the autonomous nervous system are not functioning optimally.

CHRONIC STRESS

Just imagine you're working out and lifting weights in the gym. You carry a long barbell, which you raise from the shoulder to overhead positions repeatedly. Every side of the bar has some weight but it's quite manageable. Because you know this is a healthy burden on your body, you feel comfortable when you are doing so. You are preparing your nerves and muscles to lift this weight over your head and with each lift you achieve successfully, you experience a greater sense of accomplishment.

Just imagine someone walking along and adding an additional 20 pounds to each side of the counter. The weight still lies beyond what you can lift, but it is beginning to get pretty heavy. Then someone else comes along and puts 10 more pounds to either side of the counter. You start struggling to raise the bar overhead. We add 10 pounds more, and another 10 pounds more. You are struggling seriously to lift the weight, and at this stage, even just keeping it up is very difficult. You're sweating, nervous, and worrying about losing the bar and potentially hurting yourself. Somebody actually steps in and supports you by taking off the remaining 20 pounds on either leg. The weight has once again become manageable. When your stress levels rise, the ability to manage stressors increases, but if it is not held in check, the load may become too heavy.

The weight on the bar is the stressors in your life in this analogy. In order to learn, we all need to feel some healthy tension. Yeah, I said good stress, also called ustress. These are obstacles that make us develop and experience the best of ourselves. Some common forms of eustress include gym workouts; traveling to see a new part of the world; raising a baby and helping her develop into a healthy, happy adult; and a new romantic relationship, along with the beautiful stressors that come with this. Those are all constructive stressors which our bodies can raise from shoulder to overhead positions fairly quickly and repetitively.

Nonetheless, external stressors sometimes come along and add extra weight to our plate. They may be emotional stressors, generally referred to as "distress." Some common forms of distress include financial stress, poor interpersonal communication, health problems, and a loved one's death. Such stressors can be viewed as negative and cause us to feel weighted down by the weight we lift overhead. It may be appropriate to seek external support,

and in many cases recommended, to help take some of this weight off the table.

The distinction between positive and negative stressors is not that one builds you up naturally, and another knocks you down. The distinction, then, comes from your understanding of the tension and the impact it has on you. This may be a little abstract, but keep in mind because it is a very significant factor in your wellbeing. When you think a stressor is positive, it will have a positive effect, and if you think a stressor is negative it will have that effect on you.

Parking your car far away from a store or mall's entrance has exactly that impact. If you think it's bad and you're burdened with the long walk ahead of you, the view is bad, and it will affect your mood as such. On the other hand, if you believe the long walk is an opportunity for you to take a few more steps in your day and enjoy some exercise, it will have a positive impact on your mood and health. If you are interested in reading more deeply about this, I highly recommend a book called The Biology of Belief by Dr. Bruce Lipton.

Remember that in our lives, we aren't really conscious of all the stressors. On the counter, we may be suffering from excess weight and not even know it's there. The weight we bear somehow seems heavier than it does seem. The stressors put on your bar are often invisible in the case of your wellbeing, thereby burdening you with the weight you do not know. Some of these are the product of behaviors we have, and may not know. I consider these "lifestyle habits" and the good news is that you can change them once you become aware of them. If you don't know about them, though, they can bring extra stress to your body. Those stressors will be addressed in more detail shortly.

Our bodies manage all forms of stress, exactly the same way, whether good or bad. We are going from a relaxed state of rest and digest to a state of fight or flight in which we can either stand up and fight or run away from the stressor. The body should respond in the same way to negative financial stress and positive exercise stress in the gym, experiencing the very same cycle as our evolutionary ancestors who had to deal with the stress of fleeing from a pack of sabre-toothed tigers and starting fires.

In the fight-or-flight condition, we start sweating, trembling, and pushing blood flow away from the rest-and-digest organs into the arms and leg muscles. The vagus nerve signals for blood flow in the rest-and-digest state to increase towards the digestive organs and the parts of the brain which make you feel rested.

There are not binary states. Fight-or-flight versus rest-and-digest isn't aswitch you can flip to turn on or off like a lamp. But it is a continuum.

To order for our bodies to work optimally, we will be the vast majority of the time on the parasympathetic side of this spectrum. Or put it another way, the weight we bear on the barbell will be really convenient. We should be able to bear it comfortably and operate well from inside. We will activate our vagus nerve about 80 per cent of the time and stay in a fairly parasympathetic state.

However, it is crucial that we can rapidly and easily transition toward the sympathetic state to handle stressors that can occur at any time. Thanks to the neurotransmitter adrenaline and hormone cortisol, we seem to be able to do this very quickly.

When an acute stressor happens, we make the leap to a high-grade sympathetic state. Imagine what your physical reaction will be when you get into a car accident, or when someone is jumping out of a door to scare you. You get scared straight away and get into a defensive mode. Your heart starts pounding, your eyelids close, but then you open your eyes wide to see everything that's going on around you. You start taking fast, rapid breaths, and you can start sweating immediately.

You can visualize how you feel when you're on holiday, lying on the sand, listening to the ocean waves crashing nearby, to imagine the parasympathetic state. Your body is comfortable, feeling like it can adequately eat, sleep well, and recover from any stressors that might occur. It shouldn't shock you at all that when you're on holiday, you feel so much happier and healthier.

Health concerns continue to arise when we are having difficulty going back from sympathetic to parasympathetic mind. If the weight we are lifting is very heavy and we have difficulty handling it, so it is hard for us to go back to the simpler, easier state of rest and digest.

This scenario includes the stressors constant pressure and the assumption that

the stressors are negative. If we remain in this condition, we begin to shut off operation of the vagus nerve; we avoid training it. Alternatively, we increase the function of our sympathetic nerves continuously, with constant exposure to low-grade stressors in a long-term way. When this persists for a long time, we can gradually decrease nerve tone of the vagus and move towards dysfunction of the vagus nerves.

Which are these low-grade, persistent stressors I'm worried about? Those are the everyday life stressors–waiting in traffic on the way to work, going in to work every day at a job you do not enjoy, thinking about the dinner you and your family are going to have every night when you haven't prepared ahead of time, etc. There are so many slight little stressors that add two, three, and even five pounds to the bar you're carrying, and while each stressor's weight is nominal and not very heavy, the total of all those small weights is much heavier than we know. Such stressors create an imbalance in the role of our hypothalamic-pituitary-adrenal (HPA) axis, which can hinder our ability to control the energy and stress rates all day long.

It is not stress that kills us, it is our reaction to it.

--Hans Selye

If your body is filled with chronic low-grade stress most of the time, then you won't be able to activate the requisite vagus nerve processes. Over time, this low-grade sympathetic disorder may result in reduced parasympathetic activity, resulting in increased inflammation, reduced immune cell activity, impaired digestive function, less successful detoxification, and many other health-causing issues. That is precisely why most people with health problems continue to struggle with numerous health issues over their whole lives. These are disorders that affect several organs, and each of our cells ' health.

One of the most significant factors in your wellbeing is your capacity to return you from a supportive state to a parasympathetic state. Patients who tend to get better quicker and achieve good results are the ones who learn to build healthy lifestyle patterns so they can change their condition from sympathetic back to parasympathetic quicker, more effectively, and more readily. In order to be able to make improvements in stress levels, we must first be able to recognize all the stressors our bodies might be experiencing,

in particular the invisible stressors that exist in our blind spots. Part 3 of the book addresses techniques my patients use to recognize their stressors and make meaningful changes.

It is not the load that breaks you down, itâ€™s the way you carry it.

--Lou Holtz

INABILITY TO HANDLE STRESSFUL SITUATIONS

We explored many of the typical symptoms of vagus nerve dysfunction in an interview with a friend and colleague of mine, Dr. Jared Seigler. Dr. Seigler talked of patients who came in to see him for an examination, and these people are struggling with high vagus nerve activity and complete sympathy burnout. These people also have significant difficulties in managing stressful situations. They're having problems with huge crowds, noisy noises, small spaces. This is an autonomic disorder, triggered by the inability of the vestibular canals to inhibit their emotional response.

If your sympathetic neurons are poor, then it will be very tough to maintain an emotional balance, particularly in these situations. Such patients often struggle with issues with their equilibrium, as the vestibular system is connected to autonomous function and emotion control; they may also have greater amounts of tears from the lacrimal glands and saliva production from the salivary glands in the mouth.

Those are symptoms of imbalanced autonomic activity, biased towards sympathetic vulnerability and parasympathetic dominance. Such signs can be recreated in patients performing simple vestibular measures such as head tilt exercises or turning around in a chair. Such movements can bring about major heart rate and breath rate changes and contribute to digestive slowing.

As we have discussed earlier, brain power is dependent on nerve power. In order to assess how powerful the vagus nerve really is, we have to check it against a reference to find the best way to ensure that this device really works.

LACK OF SOCIAL CONTACT

We need to have people around. Human contact face to face is of utmost importance to our wellbeing. If youâ€TMve ever spent a couple of days at

home, alone, I’m sure you started to feel a little down and moody. Okay, this isn’t just some sort of off - the-cuff feeling you have. It turns out that when you're in a social environment and communicate with people face to face, the vagus nerve actually gets triggered.

My mentor, Sachin Patel, pointed out to me that the punishment for doing something wrong in jail is to be put in solitary confinement essentially by yourself in a small cage without contact for hours and even days. They would prefer to be surrounded by other convicted criminals, like killers, rather than being locked in a cell.

A 2009 research in Health Psychology by Schwerdtfeger et al. found that heart rate variability "a perfect way of assessing vagal tone” decreases in people with less social contact and depressed mood. Depression symptoms are found to be related to a lack of vagal speech. If patients with these same symptoms were placed in social settings, their mood, variation in heart rate and autonomic heart function would increase.

A research in Biological Psychology, by Kok et al., just a year later, confirmed this observation. At the beginning of the program, adults recruited from a university had their vagal tone tested, and again nine weeks later. It is expected that individuals with higher vagal tone scores had higher increases in communicating feelings and positive emotions. More specifically, at the end of the test, these individuals also saw an improvement in vagal speech.

Depression is specifically associated with weak vagal tone.

Such findings show that our feelings of joy and positivity are directly linked to activation of the vagus nerve and vagal tonus. In reality, those with higher vagal nerve activity feel more positive and have more positive social interaction. Depression and poor mood are associated directly with lower vagus nerve activity rates.

This means the more optimistic, in-person social experiences you have, the better you prepare your vagus nerve for optimum functioning. Persons living in isolated environments with little social contact are unable to train their vagus nerves to their fullest capacity and are more likely to suffer from disorders of health triggered by rates of inflammation which the VN can not regulate. Positive emotions construct physical health while negative emotions cause physical dysfunction and illness.