Neurophysiology of Hanna Somatics:
A novel way of thinking about movement and chronic pain
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It’s no secret that chronic pain is endemic in the United States. Traditional therapies often fail and we find ourselves resorting to surgeries and/or medications to solve our problems, which often they do not. However there is hope. There is a little known but powerful tool in understanding and helping sufferers fix their chronic pain. It is called Hanna Somatics, developed by Thomas Hanna, PhD.

Dr. Hanna long ago realized that most therapies only target the muscles, fascia, joints, or ligaments without incorporating their central controlling organ—our brains. Because all muscles in some way report and respond to the brain via nerves, ultimate control of movement is found in our brains. The brain can be thought of as having four areas:

1. The cerebral cortex- our most evolutionarily advanced area responsible for higher executive functioning and which contains, among other structures, the sensory and motor cortexes from which conscious sensation occurs and movement is initiated.

2. The limbic system- which contains parts of the brain that help with processing information, storing memory, and filtering sensations for threats.

3. The brain stem- the oldest part of our brain from an evolutionary standpoint which houses our more reflexive responses to events and stimuli. All tracts carrying information coming up from the body and going back down, travel through the brainstem.
4. The cerebellum—located behind the brainstem and below the cerebral cortex, this area is responsible for coordination and storing and retrieving habitual patterns of movement, such as sitting down or walking. It is also important in maintaining muscle tone and helps with postural control. This part of the brain is engaged during most of our activities during the day to help us perform these tasks without paying much attention to them.

Extending down from the brain is the spinal cord. The spinal cord has tracts, much like specialized highways running to and from the brain and body. These tracts are dedicated solely to carrying certain types of information.

For instance, the spinothalamic tract is an ascending highway from the body that carries pain, temperature, rough touch, and pressure sensations to the thalamus (the thalamus is part of the limbic system and is a relay station of sorts where information comes into the brain and is redirected to other areas pertinent to that type of information).

There are also the spinocerebellar tracts. These pathways carry information to the cerebellum from muscle spindles and other receptors which help us with posture, coordinating movements (such as pouring a cup of coffee), and muscle tone.

Both the brain and spinal cord comprise the central nervous system (CNS). Nerves traveling to and from our muscles and other structures in the body emerge from the spinal cord. The CNS then, via these nerves, communicates with these peripheral tissues.

Hanna Somatics is most concerned with how well the brain communicates with and controls muscles and movements. In order to help people eliminate pain-causing tension, we must apply specific knowledge of neurophysiology to release that tension.
Working from the muscle level, this knowledge begins with a motor unit which is a neuron and the corresponding muscle fibers it attaches to or innervates. Often there is more than one motor unit controlling a muscle. Within these muscle fibers are small structures called muscle spindles. Muscle spindles are sensitive to stretch and the change in velocity of lengthening muscles. For instance if a muscle is stretched too far or too fast, the spindle is stimulated and helps restore the muscle back to its previous resting length. Especially if the stretch occurs rapidly, the spindle stimulates Groups Ia and II afferent nerves which stimulates an alpha motor neuron in the spinal cord which, in turn, stimulates the contraction of the muscle fibers in which those muscle spindles are imbedded. This is referred to as a stretch reflex and occurs in muscles throughout the body. The stretch reflex can happen rapidly and does not involve the brain. Perhaps the most widely known stretch reflex is that involving the patellar tendon. When the knee is bent and the tendon is tapped with a small reflex hammer, the quadriceps tendon is rapidly stretched which reflexively contracts the quadriceps muscles, kicking the foot up into the air.

Another structure involved in controlling muscle tension is the Golgi tendon organ. These structures are primarily found in the junction between muscle and tendon and are sensitive to force delivered through a muscle. They act in a negative feedback manner whereby the muscle in which they are imbedded is relaxed due to the inhibition of the alpha motor neuron. When tension in a muscle exceeds a certain parameter, Golgi tendon organs stimulate Group Ib afferent neurons which synapse with an interneuron in the spinal cord. The interneuron then inhibits its associated alpha motor neuron and the corresponding muscle fibers then relax. This phenomena may play a role in
dispersing force throughout a muscle rather than allowing a few fibers to absorb most of the strain of lifting.

In real life this plays out if, for instance, you are carrying a tray of food and someone puts a heavy pitcher of water on it. The heavy pitcher suddenly stretches the arm muscle, activating muscle spindles. The muscle spindles, through the pathway described above, causes the muscles in the arm to contract to maintain their predetermined degree of contraction. The tray then remains level and supported with the appropriate amount of muscle contraction and with limited strain to the muscles. Once this acceptable load is achieved, the muscle spindles and Golgi tendon organs by virtue of not being stimulated then inhibit and stimulate respectively their corresponding alpha motor neurons returning the muscles to their previous state of tone and readiness. Because we move with this tray, this load is continually changing and so requires constant monitoring by these structures.

Because chronic pain is often a function of increased muscle tension, and muscle spindles are important in maintaining length and tension in muscles, affecting muscle spindles are important in lessening chronic pain. The brain is integral to this process. So let’s look briefly at how the brain generates muscle tone or tension.

1. The autonomic nervous system, located in the brainstem, which activates the sympathetic nervous system (our fight or flight response) when we are faced with a threat or endure stress. This tension is created due to the release of the hormone adrenaline. While it may be easy to identify a true threat to our lives,
such as a charging bull heading our way, it is often difficult to identify those non-threatening stressors such as meeting a deadline, filling a quota, or constant presence of pain. Our sympathetic nervous system responds to these stressors, even though they may fall below our conscious awareness, by generating tension in our muscles.

2. The brainstem, which has significant influence on our bodies. It plays a role in certain reflexes, muscle tone, and voluntary movement. It is comprised of the pons, medulla, and midbrain. The brainstem houses reflex motor patterns such as the Startle, Landau, and Trauma (Withdrawal) Reflexes.

The Startle Reflex is triggered by sudden loud noises or some other noxious stimuli or stress. When startled or scared, the most common response is for the shoulders to lift and the body to fold or flex inward protecting the organs.

The second, Landau Reflex, emerges when we are aroused and are called to action. It first emerges after a few months of age to help us lift our head and arch the spine, in order to crawl forward. As we grow, this reflex is somewhat overridden by other activities our bodies engage in. However, when we need to respond urgently to a situation, the Landau Reflex triggers contraction along the spine and elsewhere to bring us to an erect posture.

The third pattern is the Trauma Reflex, which occurs when we injure one side of the body (such as spraining an ankle) and withdraw from or respond to that injury unilaterally. In this case our hip will flex to remove weight from that injured foot. Additionally the waist muscles of that side will lift the hip and pelvis to help unload that ankle. Because many of these muscles also connect to the rib
cage, it’s not uncommon to find one side of the rib cage resting lower than the other as a result of the waist muscles contraction.

These three reflex patterns of contraction are of particular interest to Hanna Somatics. By systematically releasing muscle tension in these key patterns, chronic pain is often eliminated or significantly reduced.

3. The motor cortex portion of our cerebral cortex consciously controls our muscles and movement patterns. Embedded in the motor cortex is a map of our body, called a homunculus (see Figure 1, below). The body is depicted on this map according to the importance of the structure in question. For instance, the hands, face, and feet are very important to us for manipulating objects, communication, and locomotion respectively. Our motor cortex map therefore has a larger percentage of space devoted to these three important functions.
4. The cerebellum receives information, including from muscle spindles and Golgi tendon organs, along the spinocerebellar tract. It communicates with a structure within the brain called the red nucleus. From the red nucleus, the rubrospinal tract emerges carrying information regarding muscle tone of flexor muscles. The red nucleus also receives information from the motor cortex to help coordinate this tone.
When considering these potential muscle tension generators it’s important to understand that three of the four tension generators (the autonomic nervous system, brainstem, and cerebellum) are generally outside of our conscious control. They handle automated responses to help us deal with threats or noxious stimuli. These responses have been built into our brains, over hundreds of thousands if not millions of years and are ancient in their origins. Their roots are in survival and are therefore primitive, powerful, and pervasive regarding their effects within the body.

The fourth means, via the motor cortex, exerts conscious control over our muscles. The cortex uses corticospinal tracts (other specialized highways), to communicate messages directly to muscles. These tracts extend from the motor and sensory cortices of our brain, down the spinal cord, where they synapse with an alpha motor neuron in the spinal cord which then stimulate or inhibit corresponding muscles. They can also inhibit efferent gamma motor neurons to the muscle spindles.

It is this fourth means whereby Hanna Somatics techniques can help people make great strides in relieving chronic pain. This is ultimately achieved by asking the client to slow down and sense movement more precisely. In other words, they must pay attention.

By consciously slowing down, the motor cortex using the corticospinal tract, inhibits both the muscle and the muscle spindle. This is referred to as reducing the alpha-gamma co-activation levels of those muscles. This inhibition occurs while the muscle is moving through a slow eccentric contraction while lengthening. Even though it is contracting, the motor unit and muscle spindle must be inhibited to a degree to allow lengthening to occur. This is important because inhibiting the contraction of the muscle as well as the muscle spindle essentially allows the client to “reset” the resting length and muscle tone
of the target muscle. Afterwards then, the muscle is not stimulated to contract when lengthened, as would be the case if the muscle spindle was not reset.

This is the primary difference between lengthening muscles using Hanna Somatics techniques and stretching muscles. Stretching muscles does not reset the muscle spindle and actually may invoke a stretch reflex whereby the muscle will involuntarily re-contract. Gently contracting and slowly lengthening muscles to reset the muscle spindles offers a longer term solution to the problem of chronically contracted muscles creating pain.

Looking more deeply into this phenomena, it’s important to understand that the process of lengthening muscles while inhibiting muscle spindle activity involves the client remaining aware of what they are doing. In other words, the client must sense the movement. Consciously sensing movement involves the sensory cortex portion of the cerebral cortex and again uses the corticospinal tracts. The sensory cortex has a sensory map (where the face, hands, and feet take up more space than the rest of the body) very similar to the motor cortex homunculus and for the same reasons (See Figure 1 above).

The client’s awareness and control of this process ensures the cerebral cortex is being accessed thereby affecting the alpha and gamma motor neurons controlling muscle tension. During this process the client is, in effect, learning to move differently and in such a way as to elicit a decrease in muscle tone rather than reflexive contraction of the muscles. Improved musculoskeletal function is therefore achieved.

Earlier I mentioned three reflexes whose roots are found in the brainstem: Startle Reflex, Landau Reflex, and Trauma Reflex. Each of these reflexes contributes to a
unique global pattern of muscle contraction. When a pattern of contraction is used or
activated again and again, a (typically unconscious) habit is created. Once habits are
established with poor movement patterns and excessive contraction of muscles, the
musculoskeletal system begins a slow degradation of function. Pain soon follows. This
unconscious or reflexive contraction of muscles creating patterns of movement
dysfunction is something Dr. Hanna termed Sensory Motor Amnesia (SMA).
All three reflex patterns (Startle, Landau, and Trauma) can be found to some extent in
any individual. These patterns are attributed to SMA, meaning the brain and body (or
soma) have forgotten how to move out of them and are heavily influenced by their
existence. The consequence of the existence of SMA is that muscles do not lengthen
smoothly and instead exhibit a type of ratcheting pattern. This ratcheting is actually
unconscious muscular contraction of muscles together with an inability to inhibit those
contractions efficiently and smoothly. SMA may be triggered by motor vehicle accidents
or other physical trauma such as falls, surgery, or emotional or psychological trauma or
stress. SMA could also result from repetitive or poor movement habits.
Central to all three reflex patterns are the muscles involved in the pelvis and lumbar
spine. This area is the center of gravity and movement for our bodies and is the site of
most fundamental changes in the musculoskeletal system in response to stress or
trauma. When unconscious contractions occur in this “somatic center” the brain and
body begin to compensate in a kind of ripple effect by contracting other muscles
throughout the kinetic chain.
Reducing SMA creates a profound change in the foundation of movement within the
body. Fluid, supple movement replaces unconscious dysfunctional patterns. Hanna
Somatics techniques can be used with any area of the body as well. They are equally effective in helping release chronic foot pain as in reducing wrist, neck, or back pain or tension.

Hanna Somatics Educators are trained to understand both the anatomy and neurophysiology of SMA patterns as well as how to help the client change them. Hanna Somatics techniques are gentle and relaxing for the client and often have a secondary benefit of activating the parasympathetic nervous system (PNS). This is desirable because the SNS contributes to muscle tension and so reduction of the SNS output will also help to reduce systemic chronic tension. Like the SNS, PNS activation affects many of the bodies systems and so has other far-reaching desirable effects for our brains and bodies.

In summary, Hanna Somatics techniques employ neurophysiology to specifically target chronically contracted or tense muscles. They do this by understanding patterns of contractions and resetting the muscle and their associated muscle spindle responses. By intentionally incorporating a client’s attention and control, the client uses his or her own nervous system to correct contraction patterns thereby ensuring a longer lasting effect. In doing so, movement re-education occurs and the client not only reduces his or her pain and improves musculoskeletal motor control but is also left with a deeper understanding of their body and brain and how to better control both.