

Neurophysiologic Substrates of Hanna Somatics

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All embodiment practices require a thorough knowledge of human anatomy and muscle and joint physiology. Hanna Somatics is practiced with this knowledge base. The study of the body in movement (kinesiology) is ongoing throughout a practitioner's career. In addition, because of the unique principles by which Hanna Somatic Education is practiced, a committed understanding of the structures and functioning of the central and peripheral nervous system is necessary. In Hanna Somatics, it is the nervous system that is the specific target for change rather than a specific muscle or muscle group. We get at the muscles by way of the brain; and the point of entry into the brain is through the muscles.

The human soma might be said to be controlled from the top down. The brain, at the body's apex, receives information from our internal and external environment and responds to it. The brain sends its responses out to our various muscles, organs and glands, sometimes with our conscious awareness and sometimes—much of the time, in fact—without it. Many movements we make, many postures we assume, are controlled beneath the level of our conscious awareness; that is, without the direct involvement of our voluntary, neocortical centers. Our postures while sitting and standing as well as most of the regular, daily movements we make are largely automatic functions that do not require our deliberate, conscious attention or direction the way skilled movement requires. That is why we humans are so good at multi tasking. We can perform our various cognitive, linguistic or physical activities without being overly distracted by our internal milieu. But this also is why we may acquire and maintain musculoskeletal dysfunctions and perhaps develop chronic aches and pains.

The brain is a pattern generator (Kelso, 1995), and it is very adaptable. One of the brain's functions is to maintain homeostasis in our various body systems. If we hyperventilate, for example, the brain will send signals to the kidneys to excrete more bicarbonate to attempt to balance our blood pH (Chaitow & Bradley, 2002). Or if we were to start becoming dehydrated, the brain, via the hypothalamus and pituitary gland, will secrete anti-diuretic hormone and signal the kidneys to conserve water (Guyton & Hall, 2006; Batmanghelidj, 2003). Just as these internal homeostatic functions take place in our bodies without our conscious awareness, so do many of the neuromuscular processes involved in maintaining our posture and balance as we sit, stand and move. If our posture and movement patterns become imbalanced or distorted and we do not correct the problem, the brain will eventually adapt to the distortion and make it part of the automatic, unconscious pattern. The involuntary motor centers in the brain, via gamma motor neurons, send signals that keep postural muscles, in particular, contracted above their normal resting tonus. Chronically over tensed muscles lead to discomfort and eventual postural distortion.

It is easy for us to fall into patterns, as we all have daily schedules, routines, repetitive tasks. If something happens to us that alters the way we complete our daily tasks (e.g., accidentally turning an ankle, straining our back if picking up a heavy object incorrectly, undergoing an invasive medical procedure), our regular pattern gets disrupted. That is, we start using ourselves differently to “work around” whatever pain or discomfort we might be feeling. A new pattern develops. Most of the time this is temporary. As an injury heals we usually transition back to our pre-morbid pattern. But sometimes this does not happen, especially if the altered pattern goes on for some time. Moreover, some

of our daily, repetitive behavior in and of itself is what leads to the development of our various musculoskeletal complaints. The point is that things can happen that cause the brain to alter its output to the muscles. Muscles can only activate via the nervous system (Enoka, 2008). Likewise, they do not *deactivate* without a change in the neural output to them. Hanna Somatics is a method of changing the way the nervous system communicates with the muscles, allowing chronically overactive muscles to decrease their activity, relieving pain and restoring range of motion and function—not just of muscles, but also perhaps of the organs underneath and near the involved muscles. It is not uncommon, after all, for structural problems to affect the underlying viscera (Schamberger, 2002).

Sensory-motor amnesia is the term coined by Thomas Hanna (1988) to describe the maladaptive patterns that develop in our neuromuscular system that can lead to the unconscious maintenance of dysfunctional postures and movements that cause muscle and joint pain—pain that might be characterized as a “chronic tension myalgia” (Schamberger, 2002). Hanna understood that the central nervous system involves two-way traffic, and Hanna Somatic Education takes advantage of our two-way neural circuitry to bring unconscious neuromuscular patterns to the conscious level and regain control of hypercontracted muscles that the brain has “forgotten” about. Why the forgetting? Our pre-central gyrus (motor cortex) is usually not involved in our habitual postures and stereotypical movements. While the intention and initial plan to stand up, sit down, pick up an object, or adjust our posture may come from the voluntary portions of the brain (motor cortices in the frontal lobe), most of the motor commands that are sent to the muscles involved ultimately come from the subcortical, involuntary parts of the

brain that are not under our direct conscious control. We simply move without having to think about all the postural and muscular minutiae. In part, this is how we develop habits and achieve “muscle memory.” Most motor patterns are responsive to practice—learning to tie your shoes, for example. Once we thoroughly learn something, there is not often a need for our higher sensorimotor centers to be actively involved. This is true for both functional and dysfunctional patterns. When the neuromuscular pattern is dysfunctional and keeps muscles inappropriately contracted it is sensory-motor amnesia.

Since the chronic muscle contractions of sensory-motor amnesia are maintained by subcortical, involuntary pathways (cerebellar and brainstem tracts), they are, by definition, unconscious processes. With repetition of the process, the perception of chronically contracted muscles can lose its significance for the sensory cortex in the parietal lobe (Brooks, 1986). Sensitivity to a repeated stimulus will decrease over time and can stop reaching the thalamus and cerebral cortex (Tortora & Grabowski, 1996). And the brain as a pattern generator tends to relegate motor programs to the simplest level (Brooks, 1986). It takes time for neuromuscular patterns to set; but once they are integrated and controlled by the involuntary (subcortical) system, the brain is usually happy to leave them there.

Sensory-motor amnesia is a functional problem that, as mentioned, develops as a result of either mishaps/injuries that reset the usual motor pattern or, perhaps more importantly, from chronic repetitive motion and/or less-than-healthy postures and movement patterns that can end up altering body morphology. How we use ourselves day in and day out makes a major contribution to the shape we take (Winters & Crago, 2000; Juhan, 1987). Ultimately, that shape, if distorted, can affect the accuracy of the sensory information the

brain receives because, for one, the position of the head often changes. This altered sensory input can be fraught with unfortunate possibilities for our daily well being.

We have many different types of sensory nerve fibers throughout our bodies (exteroceptors, interoceptors, proprioceptors). Each type of receptor transmits different sensory information. There are sensors for pain, heat and cold, touch, and motion among many others. These sensory receptors are constantly sending feedback to the central nervous system (afferent input) through tracts in the spinal cord and brain stem—spinothalamic, spinocerebellar, and spinal trigeminal tracts, as well as others. The central nervous system relies on this feedback in order to appropriately control posture and movement. With sensory-motor amnesia, the feedback gets distorted, which in turn alters the efferent output to the muscles. If the brain, particularly the cerebellum, ends up receiving misleading information, especially from the proprioceptors, muscle/body imbalances are the result (Rolak, 2005).

Thomas Hanna identified 3 principal somatic distortions that result from sensory-motor amnesia. Depending on the neural centers and muscles involved in these distortions, the body becomes either over-arched/extended (Green Light reflex), overly flexed forward (Red Light reflex), or laterally flexed (Trauma reflex). These imbalances often manifest their effects from the center of the body—our somatic center, which is roughly from the lower thoracic spine to the sacral area—but affect many peripheral muscles as well. The somatic center is the area of manifestation of the “reflexes” noted above because it is this area of the body that is least represented in the sensorimotor cortex. Neuroscientists have mapped the brain in terms of which areas of the cortex perceive sensory information and also generate motor impulses as well as identified just how much cortical space each area

of the body occupies. The most sensitive areas of the body and the areas that involve the most refined level of motor function require more space in the pre-central and post-central gyri than those areas that are less sensitive or less highly involved with fine motor control (Guyton & Hall, 2006; Tortora & Grabowski, 1996). So the cortical area that represents the thigh, for example, is much smaller than that for the hand. The cortical area that represents sensory and motor function for the somatic center is quite small. So it is less likely that we will perceive with high accuracy various torques and misalignments through the trunk, especially the longer they are present. These somatic distortions spread from the trunk down into the pelvis and legs and also upwards into the head and neck, which, among other things, can affect our equilibrium.

If a person becomes habituated to the Green Light, Red Light or Trauma reflex, even to a small extent, it can start having an effect on the ability to remain functionally upright and to stay well balanced during regular daily activities because of the way the body's sensory receptors communicate with the central nervous system. The body's balancing mechanism depends on feedback from the visual and vestibular centers located in the head (brainstem and inner ear), as well as from the proprioceptors of the muscles and joints, especially those located in and around the neck. If a somatic "reflex" is present and the body is maladaptively extended, tilted or flexed, this puts the head off center. If the head isn't on right the brain may not be able to appropriately interpret the altered input from the sensory receptors (Schamberger, 2002). The resulting change in efferent output to the muscles of the trunk, pelvis and legs via the various subcortical neural pathways can be problematic for maintaining consistent balance and alignment when standing. Walking also can become more effortful with any change in the orientation of

the head (Patla, 1997). Specifically, the lateral vestibulospinal and medial reticulospinal tracts are most likely involved with the Green Light reflex, with their influence on extensor motor neurons that control the tone of postural-extensor muscles (Crossman & Neary, 2010; Tortora & Grabowski, 1996; Brooks, 1986). Likewise, in a person habituated to the forward-flexed Red Light reflex, the muscular over-contraction may be mediated by the rubrospinal tract and the lateral reticulospinal tract, as this type of generalized bodily flexion is bulbar in origin (Enoka, 2008); that is, the cell bodies of these neural tracts are located in the brainstem. And the tectospinal tract, at least in part, may be an effector in the side-flexed and rotated Trauma reflex (in fact, in all somatic reflexes) with its origin in the subcortical visual centers and output to head and trunk muscles involved in orienting the head and body in space in response to visual stimuli (Brooks, 1996).

While the aforementioned neural tracts are involved in the somatic reflexes and postural distortions, it is probably the cerebellum that plays the larger role in how these patterns are unconsciously maintained over time. Like the higher sensorimotor cortex, the cerebellum also is a pattern generator. With its projections to and from many cortical, subcortical and brainstem nuclei as well as the spinal cord, the cerebellum is fundamental in controlling posture and coordinating movement. The spinal cord transmits proprioceptive signals into the cerebellum which then exerts control over the muscles that automatically keep us upright against gravity (McCaffrey, 2010; Rolak, 2005; Tortora & Grabowski, 1996). Of course, if the spinocerebellar input is distorted, so too will be the output. In short, sensory-motor amnesia begets sensory-motor amnesia. The cerebellum also has an important function in the motor learning process, and it can adapt its function,

for better or worse, with experience (Rolak, 2005). Once the brain has “learned” to keep certain muscles in some level of constant contraction, it can continue to do so indefinitely.

The effects of sensory-motor amnesia can often be seen in a gait disturbance and a decreased ability to freely and comfortably use the limbs. Movement requires adequate underlying postural coordination (Winters & Crago, 2000; Patla, 1997). The human soma will not move with freedom and ease if the somatic center is bound by chronically tense, over-contracted muscles. This certainly has implications for participation in recreational activities and sports, but also for normal activities of daily living. In essence, sensory-motor amnesia and its resultant bodily distortions create conditions for a “general deterioration” (Maisel, 1978) and have an impact on all movement, even the movement of the breath.

What affects the somatic center and leads to deformation of the spine will eventually involve the breathing mechanism, both directly and indirectly. If we are to breathe fully and completely, the diaphragm needs to be able to move through its range of motion, as does the lower rib cage. Any collapse of the body forward (Red Light reflex), compression of the spine backward and downward (Green Light reflex), or contraction of the trunk laterally (Trauma reflex) will impede normal diaphragmatic and costal movement and not permit a healthful breathing pattern. Kyphosis and a restrictive lung disease can be the extreme result from the Red Light reflex, for example. Degenerative disc disease and shallow breathing (possibly secondary to pain) can be the long term consequence of the Green Light reflex. Moreover, the distal effects of the somatic “reflexes” also can impair breathing by possible compression of the phrenic nerve as it

exits the cervical spine and makes its way to the diaphragm (Bolton, et al., 2004). In fact, many neck, shoulder and upper extremity pains and paresthesias may be the result of nerve entrapment from hypertonic muscles that are chronically over-contracted (Birdstone, 2010). This also may be true for some lower extremity pains that are often labeled as sciatica. In fact, any over-contracted muscle will eventually cause pain due to lactic acid buildup that activates local nociceptors (Hanna, 1991). Moreover, other focal issues/complications result from hypercontracted muscles: impaired circulation to the muscles and nerves, reducing their needed blood and oxygen nourishment and ability to clear out waste products (Schamberger, 2002; Juhan, 1987). All this leads to further contraction, discomfort and decreased function. The way out of this neuromuscular predicament is a re-education of the sensory-motor system, starting with the sensory cortex.

Most human movement is based on sensations the brain receives, largely reliant on our motor memory from having performed the movement before. And we adjust the movement as needed based on the sensory feedback we receive as we do it, via spinocerebellar and spinothalamic feedback loops. It has been suggested that the parietal lobe, where our sensory cortex lives, may actually be more in charge of our motor activities than the frontal lobe/motor cortex (Guyton & Hall, 2006). The motor system responds to sensory information, both at the cortical and subcortical level. This is the “foot in the door” for the neuromuscular re-programming of Hanna Somatic Education. The brain can learn to relax and lengthen muscles by re-learning to sense them; and that sensory awareness is a result of movement. Pandiculation is one of the important facilitative techniques of Hanna Somatics to increase and enhance the brain’s ability to

sense and control muscle contraction through coactivation of alpha and gamma motor neurons. The gamma motor system that has been operating to keep postural muscles overly contracted operates below the conscious level (Cottingham, 1987). By co-activating gamma with alpha motor neurons—those involved in voluntary, programmed movement—we begin to “re-educate” and reset the unconscious gamma system. Essentially, brainstem-level patterns are taken over by the primary sensorimotor cortex with efferent output through the most direct pathway to the muscles (corticospinal tract). The alpha-gamma coactivation achieved through slow, deliberate contraction and release allows the muscles to find a new resting length and tone, and the brain has a new sensory experience as well as a new level of control of once hypertonic muscles.

Sensory-motor reawakening is the essence of Hanna Somatics. It is a method of education rather than therapy, although it definitely has a therapeutic benefit. Therapy, however, is often a third-person activity—one person doing something to another through various modalities. Hanna Somatics is a facilitated *first-person* approach. A person learns to re-connect with his or her own internal awareness and to rely on his or her individual sensory-motor feedback mechanisms to effect change. Hanna Somatics relies on more brain than muscle. Change is created in one-to-one sessions and supported with movements that complement the change and maintain the benefits of a re-educated sensorimotor system. This re-education opens the human soma to new possibilities for personal growth... a growth unhindered by chronic tension, distortion and pain.

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