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Steven Porges: American Psychologist, University of Illinois at Chicago, 1945 – Still actively engaged

In 1995, Steven Porges first proposed the Polyvagal Theory. Building upon Hess's idea of an integrated autonomic nervous system, Porges began investigating the neural circuitry that drives the alarm state response (fight, flight and less understood freeze) of the sympathetic nervous system. When Porges began his work, the prevailing view was that two primary control circuits managed the parasympathetic and sympathetic subsystems of the autonomic nervous system; specifically, the myelinated vagus nerve and the sympathetic-adrenal circuit, respectively. Porges's work revealed a significantly different perspective upon closer investigation of the vagus nerve.

The vagus nerve has long been associated with normalizing heart rate as part of the homeostatic function of the parasympathetic system, lowering the rate after stimulation (exercise or other alarm state response) or ongoing regulation in non-alarm states. A vagus anomaly uncovered by Porges motivated him to investigate the function of the vagus nerve through comparative, anatomical research. Through this work, Porges revealed that the vagus nerve controlling the autonomic nervous system actually had two active branches, a myelinated vagus branch responsible for the parasympathetic action of lowering heart rate, and an unmyelinated branch that engages a freeze response in reaction to life threatening circumstances. This was an interesting new finding, because the freeze response had previously been assumed to be part of the alarm state (fight/flight) function activated by the sympathetic nervous system. Porges further revealed that in addition to maintaining normative function in non-alarm states, the myelinated vagus nerve also engages and regulates muscles in the face and head, resulting in a "coupling between social engagement behaviors and bodily states." (Porges, 2008) This heart-face connection along with the life-threatening alarm state triggered by the unmyelinated vagus nerve proved to be important to Porges's full understanding of the human nervous system.

The Polyvagal theory incorporates Porges's new vagal nerve findings and outlines three distinct behavior strategies triggered by one of three neural circuits (myelinated vagus circuit/parasympathetic system, (sympathetic adrenal circuit/sympathetic system, and unmyelinated vagus) to ensure survival in a *safe* environment, a *dangerous* environment or a *life-threatening* environment; namely, social engagement, mobilization, and immobilization. **According to Porges:**

"The three circuits are organized and respond to challenges in a phylogenetically determined hierarchy consistent with the Jacksonian principle of dissolution. Jackson proposed that in the brain, higher (i.e., phylogenetically newer) neural circuits inhibit lower (i.e., phylogenetically older) neural circuits and 'when the higher are suddenly rendered functionless, the lower rise in activity.' Although Jackson proposed dissolution to explain changes in brain function due to damage and illness, the polyvagal theory proposes a similar phylogenetically ordered hierarchical model to describe the sequence of autonomic response strategies to challenge." (Porges, The Polyvagal Theory: New Insights into active reactions of the autonomic nervous system, Cleveland Clinic Journal of Medicine, Vol 75, p. S3 2008)

Porges further points out that the social behavior, social communication, and normative homeostasis actions engaged in a safe, non-alarm state by the parasympathetic subsystem are:

"Incompatible with the neuro-physiological states and behaviors promoted by the two neural circuits that support the dangerous fight and flight strategies and the life-threatening freeze strategies. Thus, via evolution, the human nervous system retained three neural circuits, which are in a phylogenetically organized hierarchy. In this hierarchy of adaptive responses, if the newest circuit fail to provide safety, the older circuits are recruited sequentially". (Porges, The Polyvagal Theory, Cleveland Clinic Journal of Medicine, Vol 75, 2008, pp. S3-S4)

Assuming normal function in an individual, if the surrounding environment does not present novel change, the phylogenetically newest myelinated vagal circuit of the autonomic nervous system will activate the *social communication engagement* strategy

of the parasympathetic nervous system and initiate a green light state in the body. In this state, heart rate will be slower, aspects of social awareness activated, normative homeostasis maintained, and the conditions necessary to promote growth and ensure long-term survival will be present. If however, novel change is detected in the environment, the phylogenetically older sympathetic adrenal circuit of the autonomic nervous system will activate the *mobilization strategy* of the sympathetic system, and engage a yellow alarm state in the body. While generally characterized as fight and flight, the body's mobilization strategy could be in reaction to either a positive or negative novel change. Again assuming normal function in an individual, the degree of the mobilization engagement will vary in relation to the magnitude of the novel change. In this state, normative homeostasis will be halted, heart rate will be faster, and the body will ready itself to take the necessary action to ensure its near-term survival. Finally, if an extreme novel change is detected, the phylogenetically oldest, non-myelinated vagal circuit will activate the immobilization strategy. In this state, heart rate will drop, and all action in the body will slow, reflected by a general behavioral shut down, all to ensure immediate survival. Again, Porges proposes that the red light state can result in reaction to both positive and negative circumstance sharing "mammals immobilize themselves for essential pro-social activities including conception, childbirth, nursing and the establishment of social bonds." (Porges, The Polyvagal Theory, Cleveland Clinic Journal of Medicine, Vol 75, 2008, pp. S3-S4)

The behavioral adaptation strategies outlined by Porges's Polyvagal theory help to explain how three subsystems of the autonomic nervous system impact general behavior. In light of the earlier findings of Cannon and Seyle, it is easy to understand how the near-term and immediate survival states engaged by the mobilization and immobilization strategies of the body, if allowed to persist, can lead to detrimental physiological and developmental challenges. Porges's Polyvagal theory has broadened Hess's interpretation of the integrative autonomic nervous system and Cannon's alarm state perspective by demonstrating the presence of a third subsystem in the autonomic nervous. The theory also broadens understanding regarding the role of the parasympathetic system in managing a heart-brain connection important to social communication, engagement, and growth. His theory builds logically upon the integrated nervous system and is consistent with the (Jacksonian) evolutionary development of the mammalian nervous system where newer structures were added to provide finer control over reactions to the external environment and where the newer evolutionary structures control philogenetically older structures. This model provides interesting new avenues for clinical techniques and provides a physiological explanation for the importance of the neurosensorimotor integration approach of the Masgutova Method.

Following is a brief summary of the Polyvagal Model and the three behavioral strategies:

Safe and Non-Threatening Environment » Social Communication & Engagement

- Phylogenetically youngest myelinated vagus nerve
- Engages parasympathetic long term survival subsystem
- Returns normative restorative action and fosters calm
- - Maintains ongoing homeostasis
- - Supports social communication and engagement activities
- - Promotes growth

Dangerous Environment » *Mobilization*

- Phylogenetically older sympathetic-adrenal circuits
- Engages sympathetic first line of defense subsystem
- Defensive fight and flight mechanisms necessary

Life-Threatening Environment » *Immobilization*

- Phylogenetically oldest unmyelinated vagus nerve
- Engages last line of defense subsystem
- - Feigns death
- - Behavioral shut-down or freeze