Polyvagal Theory in a Challenging World: Harnessing the Healing Power of Signals of Safety

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Disclosures


• Receives royalties from Integrated Listening Systems/Unyte (iLS) for the Safe and Sound Protocol™ based on the Listening Project Protocol and the Rest and Restore Protocol™.

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Synopsis:
Claiming Our Evolutionary Heritage as a Connected Species

• PVT focuses on exploring relationships between ANS regulation and human health and experience.
  – ANS as an intervening variable
  – Signaling the ANS is an efficient and potent portal of intervention to heal mental and physical illness and injury
  – Signaling the ANS as an efficient and potent defense system
• Evolution provides an organizing principle that links
  – ANS as an enabler of social behavior
  – Sociality as an enabler of health

What if Descartes Were Polyvagal-Informed?

• Je pense, donc je suis (I think therefore I am).
• Je *me* sens, donc je suis (I feel myself, therefore I am).
Consequences of a Cartesian Perspective on Mental and Physical Health

- Institutions assume a cause-and-effect model of causation
  - Science
  - Medicine
  - Education
  - Religion
  - Politics
- Cause and effect modeling
  - Healing from outside in
  - If broken fix it via an external strategy
    - Surgery
    - Pharmaceutical
    - Rewards/punishments

Healing From the Inside Out:
An Alternative Perspective on Mental and Physical Health

- An alternative model causation departs from linear, direct cause-and-effect relationships to embrace more complex, dynamic interactions, and feedback loops among variables
- Simplify non-linear to ‘mediational’ models
- **Signaling the nervous system to support homeostatic functions of health, growth, restoration, and sociality (Polyvagal informed strategies).**
ANS as Intervening Variable

Physiological State
An Intervening Variable Capable of Biasing Responses

S → Yellow → R

Physiological State

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**Neurophysiological-Based Domains of Hypotheses**  
**ANS as Intervening Variable**

• PVT is focused on the measuring chronic autonomic state (“O”) as the individual’s vulnerability/accessibility at the time of challenge (S-O-R).
• Predictions of biobehavioral reactivity from chronic states (assessments)
• PVT leads to strategies of intervention targeted at changing ANS state (treatment) and optimizing outcomes.

**‘Stealth’ Neuromodulation**

• Homeostatic function is projected in the slow rhythmic neural signals regulating the ANS (e.g., HRV)
• The vagus is involved in the regulation of homeostatic rhythms expressed in visceral organs.
• Common disruptors of homeostatic rhythms
  – Stress, pathology, anxiety, threat, pathogen, predator, illness, pathophysiology, organ dysfunction, functional disorders
• Signaling the nervous system to optimize homeostatic functions (health, growth, and restoration).
Homeostasis
Dynamic Modulation and Not a Constant Setpoint

Visceral Organs
Vagus (sensory)
Receptor

Vagus (motor)
Control Center

Effector
Visceral Organs

Vagal Nerve Stimulator

Imbalance corrected
Imbalance

11

12
**Homeostasis**
Dynamic Modulation and Not a Constant Setpoint

- Signaling ANS State
- Vagus (sensory)
- Visceral Organs
- Receptor
- Control Center
- Effector
- Vagus (motor)
- Visceral Organs

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**PVT Principle #1**

- ANS as an intervening variable influencing and biasing behavioral, cognitive, and physiological reactivity to context (stimuli).
The ANS as an Intervening Variable

- An intervening variable, also known as **mediating** or **moderating** variable, is a variable that explains how an independent variable affects a dependent variable.
- A mediator explains the relationship between a predictor variable and an outcome variable.
- A moderating variable influences the strength and direction of that relationship.

ANS State is a Mediator Within PVT

Adversity History
(Childhood Trauma Questionnaire)

Autonomic Reactivity
(Body Perception Questionnaire)

Mental Health Outcomes
During Pandemic

The Body Perception Questionnaire:
Subjective Measurement of Autonomic Function
Body Perception Questionnaire (BPQ)
A Subjective Index of Autonomic Reactivity


Trauma History Predicts Reactions to COVID-19
Due to Adverse Event or Retuned Autonomic State?

- Is an adversity history, a pre-existing condition?

Adverse Events and Autonomic Reactivity (United States)


Outcome Mediation Model (adjusted for age and sex)

Probabilities of Covid-19 Infection


Sexual Function in Adults With a Childhood Trauma: Mediating Effects of Self-Reported Autonomic Reactivity

Impact on Male Sexual Function


Childhood Trauma

Self-reported autonomic reactivity partially mediated the effect of childhood trauma on purpose in life:

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Does practicing body psychotherapy moderate the influence the impact of childhood adversity on autonomic regulation.

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Association of childhood maltreatment with adult body awareness and autonomic reactivity: The moderating effect of practicing body psychotherapy.

- Study aimed to explore the effects of practicing body psychotherapy (BPT) on the link between early maltreatment and autonomic reactivity in adulthood. An online study included 570 body psychotherapists and 592 participants from the U.S. general population.

**Adverse Events and Autonomic Reactivity**

(United States)


**Childhood Trauma and Autonomic Reactivity**

The Moderating Effect of Practicing Body Psychotherapy

Association of Childhood Maltreatment With Adult Body Awareness and Autonomic Reactivity: The Moderating Effect of Practicing Body Psychotherapy

- Compared to the general population, BPT practitioners reported higher levels of childhood maltreatment, but fewer autonomic symptoms in adulthood, and a weaker association between childhood maltreatment experiences and present-day autonomic symptoms.

The Autonomic Nervous System: A Paired Antagonism Perspective

Vagus (Parasympathetic Nervous System)

Sympathetic Nervous System

The Autonomic Nervous System: Need to Update Perspective

Ventral Supra-diaphragmatic (myelinated) vagus

Dorsal Sub-diaphragmatic (unmyelinated) vagus
Evolutionary Journey to Sociality

Polyvagal Theory

- Derived from phylogenetic and developmental investigations of the ANS, identify a sequence during which the brainstem structures regulating the ANS emerge during vertebrate phylogeny and are paralleled in mammalian ontogeny.
- Provides a theoretical basis for a neuroscience of safety and explains how safety promotes spontaneous social engagement behaviors and health, growth, and restoration.
- Explains how autonomic state is optimized during safe social interactions and disrupted during states of defense.

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Hierarchical Model of Autonomic State
Newer Circuits Inhibit Older Circuits

Myelinated (supra-diaphragmatic) Vagus
Social Engagement System

↓

Sympathetic Nervous System
Fight/Flight

↓

Unmyelinated (sub-diaphragmatic) Vagus
Immobilized with Fear

PVT Principle #2

- Three neural circuits form a phylogenetically ordered response hierarchy that regulate autonomic state adaptation to safe, dangerous, and life-threatening environments.
Dissolution (Evolution in Reverse)
Predictable Changes in ANS State (Testing PVT Hypotheses)

The higher nervous arrangements inhibit (or control) the lower, and thus, when the higher are suddenly rendered functionless, the lower rise in activity.

John Hughlings Jackson (1884)

Trauma and Stress Trigger Dissolution:
Evolution/Development in Reverse

Myelinated (supra-diaphragmatic) Vagus
Social Engagement System

↓

Sympathetic Nervous System
Fight/Flight

↓

Unmyelinated (sub-diaphragmatic) Vagus
Immobilized with Fear

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Social Engagement
Calming

Mobilization with Fear
Metabolically Costly
Apnea and Bradycardia

Immobilization with Fear
Death Feigning
Trauma/Threat Triggers Dissolution: Evolution in Reverse

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
<th>VVC</th>
<th>SNS</th>
<th>DVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Communication</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limbs</td>
<td>Mobilization</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Viscera</td>
<td>Immobilization</td>
<td></td>
<td></td>
<td>+</td>
</tr>
</tbody>
</table>

PVT Principle #3

- In response to a challenge, the ANS shifts to states regulated by circuits that evolved earlier consistent with the Jacksonian principle of dissolution, a guiding principle in neurology.
Phylogenetic Emergence of an Integrated Social Engagement System

Evolutionary Journey to Sociality
Ventral Migration of Cardioinhibitory Structures
Brainstem Origin of the Vagus Ventral Migration

Ventral Vagus

Dorsal Vagus

Pyramid
Medial lemniscus
Inferior olivary nucleus
Sensory nucleus of CN V
 Inferior cerebellar peduncle
 Cochlear nuclei
Vestibular nuclei
Hypoglossal nucleus

Vagus nerve
Nucleus ambiguus
Spiral nucleus of CN V
Nucleus solitarius
Dorsal motor vagal nucleus

Ventral
Dorsal

50
The Face-Heart Connection:

- At birth mammals have bidirectional neural communication between the face and the heart (suck-swallow-breathe-vocalize), which forms the core of a Social Engagement System.
- Metabolic demands, perceived danger, life threat, and illness retract the Social Engagement System resulting in a face that is not “social” and a physiological state (removal of the vagal brake on the heart) that promotes defensive behaviors.
- The face reflects Polyvagal state.
- Cues of safety work through the ‘face-heart’ connection.
- **Sociality as a ‘neuromodulator.’**
Easiest Mammals Could Nurse


Reciprocal Face-to-Face Interactions Regulate State
Dissolution of the Social Engagement System
Core Deficits

- Lack of prosody
- Poor eye contact and difficulties in social communication
- Blunted facial expressivity
- Difficulties in behavioral state regulation (hypervigilant, anxious, distractible, impulsive, tantrums, hypoarousal)
- Compromised vagal regulation (e.g., state regulation, digestion)
- Difficulties in listening, following verbal commands, speech-language delays
- **Sound sensitivities**
- Oral motor defensiveness (e.g., ingestive behaviors)

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PVT Principle #4

- Ventral migration of cardioinhibitory neurons leads to an integrated brainstem circuit (ventral vagal complex) that enable the coordination of suck-swallow-breath-vocalize, a circuit that forms the neurophysiological substrate for an integrated social engagement system,
Neuroception
Triggers of Defense or Portal of Intervention

Neuroception
A Portal to Reclaim Our Evolutionary Heritage?

- Signals of threat triggers dissolution
- Signals of safety fosters homeostatic processes of health, growth, restoration, and sociality
- Portal to reverse threat induced dissolution
- Neuroception of threat shared with virtually all living organisms (even plants)
- The healing properties of sociality (neuroception of safety) is a product of mammalian modifications to the ANS.

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Neuroception
Our Personal TSA Agent

Neuroception

Environment

Behavior

Safe $\rightarrow$ Social Engagement

Danger $\rightarrow$ Fight/Flight

Life Threat $\rightarrow$ Shutdown

Physiological State

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Neuroception

Environment

Safe  →  Behavior

Physiological State

Social Engagement

Play

Intimacy

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Social Engagement

Calming
Mobilization Without Fear (Play)
A Successful Product of Ventral Migration
Polyvagal Theory
Links Sociality to Homeostatic Functions

Feature Detectors
The Role of Face-to-Face Interactions

• How do we “feel” when there is a violation of the face-to-face interactions?
• Does a violation displace spontaneous social engagement behaviors with defensive reactions?
Violation of Face-to-Face Interactions
An Experimental Manipulation

The Face-to Face Still Face Procedure (Tronick, Als, Adamson, Wise, & Brazelton, 1978)

3 Phases:
• 2 minutes Social Play
• 2 minutes Still Face
• 2 minutes Reunion Play

Reciprocal Interaction (Play)
Still Face (1)

Still Face (2)
<table>
<thead>
<tr>
<th>Page</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>Still Face (3)</td>
</tr>
<tr>
<td>72</td>
<td>Violation Repaired</td>
</tr>
</tbody>
</table>
Impact of Maternal Vocalizations on Infant Distress


PVT Principle #5

- Neuroception: Reflexive detection of risk and safety triggers adaptive autonomic state to optimize survival.
Transforming Ideas Into Practice

Neuroception of Safety
The Safe and Sound Protocol
Neuroception

Environment
Safe

Behavior
Social Engagement
Play
Intimacy

Physiological State

Homeostasis: As a Feedback System
Dynamic Modulation and Not a Constant Setpoint

Control Center
Vagus (sensory)
Visceral Organs
Receptor

Vagus (motor)
Effector
Visceral Organs

Imbalance corrected
Imbalance
Homeostasis
Recruiting ‘Central Regulator’ to support healing

- Healing is dependent ‘homeostatic processes’
  – Homeostasis is adaptively not an option during acute threat.
  – To optimize responses to threat homeostatic functions are depressed to optimize the metabolic resources to defend.
  – Whether threat is a pathogen, a physical or mental injury, or an anticipation of an injury.
The Engineering of the Safe and Sound Protocol: Proposed Mechanisms

- Listening is dependent on and influences autonomic state.
- Listening provides opportunities to exercise neural circuits that support mental and physical health.
- Music evolved to support our biology of connectedness and our capacity to co-regulate.
- Polyvagal informed music functionally amplifies the cues of safety (frequencies of social communication) being broadcast to the nervous system and functions as an acoustic vagal nerve stimulator.
- The acoustic cues of safety down regulate the metabolic costly mechanisms of defense and optimize homeostatic processes that support mental and physical health.
- The technology embedded in the listening protocol has the potential to ‘calm’ nonhuman mammals.

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Listening as Therapy

Combined Data for Trials I and II

Listening as Therapy


SSP Improves Sensory Processing

SSP Improves Sensory Processing Maltreated Children

Heilman et al. (unpublished)

SSP Significantly Reduces Anxiety, Depression, and Autonomic Reactivity in Clients with Voice or Speech Problems

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>SE</th>
<th>Min</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>HADS Anxiety</td>
<td>10.12</td>
<td>4.38</td>
<td>.762</td>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>7.21</td>
<td>2.74</td>
<td>.476</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Significance</td>
<td>F(1, 32) = 17.228, p&lt;.001, obs power = .980</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>HADS Depression</td>
<td>6.55</td>
<td>5.30</td>
<td>.922</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>4.33</td>
<td>3.38</td>
<td>.588</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>Significance</td>
<td>F(1, 32) = 9.336, p=.005, obs power = .842</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPQ Supra-diaphragmatic Reactivity T Score</td>
<td>56.00</td>
<td>7.45</td>
<td>1.316</td>
<td>36.8</td>
<td>70.50</td>
</tr>
<tr>
<td>Pre</td>
<td>53.90</td>
<td>7.08</td>
<td>1.251</td>
<td>36.8</td>
<td>69.59</td>
</tr>
<tr>
<td>Significance</td>
<td>F(1, 31) = 7.704, p=.009, obs power = .767</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPQ Sub-diaphragmatic Reactivity T Score</td>
<td>51.47</td>
<td>9.67</td>
<td>1.709</td>
<td>36.5</td>
<td>75.01</td>
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<tr>
<td>Pre</td>
<td>47.95</td>
<td>9.46</td>
<td>1.673</td>
<td>36.5</td>
<td>68.02</td>
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<tr>
<td>Significance</td>
<td>F(1, 31) = 6.599, p=.015, obs power = .701</td>
<td></td>
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</tr>
</tbody>
</table>

Hospital Anxiety and Depression Scale (HADS) (n=33)
Body Perception Questionnaire Short Form (BPQ-SF) (n=32)

Diagnosis
A ten-year-old girl (MT) in Year 5 of primary school referred to the Mind-Body Program by a pediatrician for treatment of functional somatic symptoms—unsteady gait, blurry vision, periods of confusion or appearing dazed, and persisting headache—that had been triggered in the context of a viral illness.

Key Components of the Inpatient Mind-Body Program (FND)
- Physical therapy (daily)
- Psychological therapy (daily, including art therapy sessions)
- Pharmacotherapy —sleep, pain, manage comorbid anxiety and depression
- Family work (weekly, with additional meetings if needed)
- Hospital school (daily)
Table 1
Pre- and Posttreatment Measures on the Depression, Anxiety, and Stress Scales (DASS) and on the Body Perception Questionnaire (BPO)\(^a\)

<table>
<thead>
<tr>
<th>Measure and domain</th>
<th>Pretreatment with Safe and Sound Protocol Baseline</th>
<th>Posttreatment with Safe and Sound Protocol (one month after completion of protocol)</th>
<th>Healthy control comparison (n = 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression, Anxiety, and Stress Scales</td>
<td>16</td>
<td>2</td>
<td>Mean = 6.25 (range, 0–12)</td>
</tr>
<tr>
<td>Anxiety scale</td>
<td>21</td>
<td>1</td>
<td>Mean = 1.38 (range, 0–12)</td>
</tr>
<tr>
<td>Stress scale</td>
<td>17</td>
<td>8</td>
<td>Mean = 2.84 (range, 0–7)</td>
</tr>
<tr>
<td>Total DASS score(^b)</td>
<td>56 (clinical range)</td>
<td>11 (normative range)</td>
<td>Mean = 5.63 (range, 0–37)</td>
</tr>
<tr>
<td>Body Perception Questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Awareness (percentile)</td>
<td>91.0% (clinical range)</td>
<td>21.3% (normative range)</td>
<td></td>
</tr>
<tr>
<td>Body Awareness (T-score)</td>
<td>63.4 (clinical range)</td>
<td>42 (normative range)</td>
<td></td>
</tr>
<tr>
<td>Supradiaphragmatic reactivity (percentile)</td>
<td>98.0% (clinical range)</td>
<td>26.3% (normative range)</td>
<td></td>
</tr>
<tr>
<td>Supradiaphragmatic reactivity (T-score)</td>
<td>70.6 (clinical range)</td>
<td>43.7 (normative range)</td>
<td></td>
</tr>
<tr>
<td>Subdiaphragmatic gut reactivity (percentile)</td>
<td>98.9% (clinical range)</td>
<td>9.0% (normative range)</td>
<td></td>
</tr>
<tr>
<td>Subdiaphragmatic gut reactivity (T-score)</td>
<td>72.8 (clinical range)</td>
<td>36.6 (normative range)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) The Body Perception Questionnaire is a measure of autonomic activation.

\(^b\) For comparison, DASS scores for 151 healthy children who had taken part in a research program for NDD are reported for the DASS.11 (as reported in Hilton et al. [2021]).

Open Access: https://journals.lww.com/hrpjournal/Fulltext/9900/Neuromodulation_Using_Computer_Altered_Music_to.5.aspx

85.6% improved, 61% moved from clinical to non-clinical level
Fewer Symptoms of Depression

81% improved, 54% moved from clinical to non-clinical level

91% improved, 63% moved from clinical to non-clinical level

Fewer Trauma-related Symptoms.
Fewer Pediatric Psychosocial Trauma Symptoms.

83% improved, 47% moved from impaired to not impaired
PVT Principles

1. ANS as an intervening variable influencing and biasing behavioral, cognitive, and physiological reactivity to context (stimuli).
2. Three neural circuits form a phylogenetically ordered response hierarchy that regulate autonomic state adaptation to safe, dangerous, and life-threatening environments.
3. In response to a challenge, the ANS shifts to states regulated by circuits that evolved earlier consistent with the Jacksonian principle of dissolution, a guiding principle in neurology.
4. Ventral migration of cardioinhibitory neurons leads to an integrated brainstem circuit (ventral vagal complex) that enable the coordination of suck-swallow-breath-vocalize, a circuit that forms the neurophysiological substrate for an integrated social engagement system.

Polvagal Theory
A New Paradigm with an Optimistic Perspective

- Assumes autonomic state influences behavior, reactions to the environment, self-regulation, and sociality (co-regulation)
  - Does not assume that atypical reactivity, asociality, or hypersensitivity are permanent or the product of a rewiring of the nervous system (neuroplasticity)
  - Assumes a more parsimonious mechanism that these features are ‘naturally’ occurring adaptive reactions primarily determined by biobehavioral (physiological, emotional, behavioral) state.
  - An optimistic strategy to increase flexibility, resilience, and sociality by ‘retuning’ the autonomic nervous system.
Clinical Impact of Polyvagal Theory
Emphasis on Response and Not Events

- The theory transforms the client’s narrative from a documentary (emphasizing events and objects) to a pragmatic quest for safety with an implicit bodily drive to survive (emphasizing feelings).
- Polyvagal Theory contrasts with Adverse Childhood Experiences (ACEs) inventories by emphasizing response (feelings) and not events.

Polyvagal Theory
Linking Sociality to Homeostatic Functions

- Evolutionary journey of sociality through co-regulation
  - Sociality triggers a ‘neural’ mechanism to turn off threat reactions (fight/flight and ‘death feigning’) and simultaneously optimize homeostatic functions (e.g., oxygenation, digestion, and sociality).
- Linking sociality and homeostatic functions.
  - Elevates the role of sociality as both a homeostatic process and a ‘neuromodulator’ supporting homeostatic processes.
- Reframes psychological experiential constructs of threat, stress, and anxiety as objectively disrupting homeostasis
- Places ‘feeling safe’ at the foundation of human experiences (e.g., relationships, society, self-actualization, and even spirituality).
Traumatic Stress Research Consortium
Studying the impact of traumatic stress on health, relationships, & sexuality
To become an affiliate: trauma@Indiana.edu

Additional Information

- stephenporges.com