The Vagal System
And its link to Auditory Processing

Equipping Minds Conference

Frankfort Kentucky April 2019

Rafaele Joudry MS (Psych)
Founder Sound Therapy International
Our Nervous System

Portable Affordable Easy
Fight or Flight

Pupils Dilate
Tunnel Vision
Constant Serveillance of Surroundings
Breathing Becomes Fast & Shallow
Heart Beat is Faster and Noticeable
Increase Sweating
Insomnia
ADD/ADHD type Symptoms

Mouth Gets Dry
Inhibition of Erections
Leg Muscles Become Tense and Strengthened
Neck, Shoulder and Arm Muscles Become Tense and Stronger

Portable Affordable Easy
Chronic stress
Retraining techniques

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Let's do an exercise

A time when you felt scared
A time when you shut down
A time when you were connected
Where is stress stored?

Triune Brain Model

- **Mammal Brain (Paleomammalian)**: Feelings and emotions
- **Reptilian Brain**: Instinct, dominance, survival
- **Human Brain (Neomammalian)**: Language, ideas, concepts, artistic visions

**Portable**  **Affordable**  **Easy**
Self regulation makes it easier for young people to move through challenges and choose how to respond to events in their lives.
Sound Therapy SYNERGY

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Listening to the brain

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Myelinated Vagus

Portable  Affordable  Easy
Polyvagal Theory and Sound Therapy SYNERGY

![Diagram of Parasympathetic and Sympathetic Nerves]

- **Portable**
- **Affordable**
- **Easy**
The Autonomic Nervous System has two branches

1 Sympathetic nervous system SNS
2 Parasympathetic nervous system PNS
The Autonomic Nervous System has two branches

1. Sympathetic nervous system SNS
2. Parasympathetic nervous system PNS

2a) Ventral Vagal Portion
2b) Dorsal Vagal Portion “Freeze”
Charles Darwin

“The heart, guts and brain communicate intimately via a nerve – the pneumogastric nerve (or vagus) – the critical nerve in the expression and management of emotions in both humans and animals. When the mind is strongly excited it instantly affects the state of the viscera.” Charles Darwin
## Less Evolved >>>>>>>>>>>>>>> Most Evolved

<table>
<thead>
<tr>
<th>PRIMITIVE (PNS)</th>
<th>REPTILIAN (SNS)</th>
<th>MAMMALIAN (PNS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeze/Digest Dorsal</td>
<td>Fight or Flight</td>
<td>Social Engagement</td>
</tr>
<tr>
<td>Hibernation</td>
<td>Activity</td>
<td>Connection</td>
</tr>
<tr>
<td>Shock</td>
<td>Exercise</td>
<td>Gradually slows heart rate</td>
</tr>
<tr>
<td>Disengagement</td>
<td>Adrenalin</td>
<td></td>
</tr>
<tr>
<td>Immobility</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primitive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood goes to the core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Oxygen, low metabolism</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Burnout

Portable  Affordable  Easy
Social Engagement

Portable  Affordable  Easy
Connection and Kindness

Portable  Affordable  Easy
Evolution of the Autonomic Nervous System

"The Ultimate Survival Machine"

Stage One: A primitive passive feeding and reproduction system creating a metabolic baseline of operation to manage oxygen and nutrient-rich blood.

Stage Two: A more sophisticated set of responses enabling mobility for feeding, defense and reproduction via limbs & muscles.

Stage Three: A sophisticated set of responses supporting massive cortical development (i.e., enabling maternal bonding (extended protection of vulnerable immature cortex processors) and social cooperation (language and social structures) via facial functions).

"Three neural circuits form a phylogenically ordered response hierarchy that regulates behavioral and physiological adaptation to safe, dangerous and life-threatening environments."

-Porges 8/05
<table>
<thead>
<tr>
<th>PNS Social Engagement System</th>
<th>SNS Sympathetic Nervous System</th>
<th>PNS Parasympathetic Nervous System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tend and befriend</strong></td>
<td>Intense rapid response</td>
<td>Rest and digest</td>
</tr>
<tr>
<td><strong>Engage</strong></td>
<td>Fight or Flight</td>
<td>Freeze</td>
</tr>
<tr>
<td><strong>Prosociality and compassion</strong></td>
<td>Defensive protective reactions</td>
<td>Calm and meditative states</td>
</tr>
</tbody>
</table>
Vagal nerve

- Right vagus nerve (CN X)
- Superior laryngeal nerve
- Sinus nerve
- Laryngeal nerve
  - Internal
  - External
- Superior cardiac nerve
- Right recurrent laryngeal nerve
- Inferior cardiac branches
- Pulmonary plexus
- Esophageal plexus
- Posterior gastric nerve
- Celiac ganglion and plexus
- Superior mesenteric ganglion
- Pyloric branch
- Renal plexus
- Hepatic flexure
- Pharyngeal branch
- Left vagus nerve (CN X)
- Left recurrent laryngeal nerve
- Cardiac plexus
- Branches of cardiac plexus
- Anterior gastric nerve
- Gastric branches
- Splenic branches
- Pancreatic branches
- Left colic flexure
- Branches to the small and large intestine as far as the left colic flexure

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Trigeminal nerve
Facial nerve
Glosso-pharyngeal nerve

Superior and inferior ganglia
To parotid gland
To palatine tonsil
To pharynx
Glosso-pharyngeal nerve
To stylo-pharyngeus muscle
To carotid body and carotid sinus
To tongue for taste and general sensation

Portable
Affordable
Easy
Dr Tomatis

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Middle Ear Muscles

Hammer Muscle

Stirrup Muscle

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Listen to Your Heart: A Preliminary Investigation on the Impact of Sound Therapy on Heart Rate Variability

Lucy Warhurst and Andrew Kemp
University of Sydney

Background
- Depression and anxiety adversely impact on heart rate variability (HRV), which may have future physical health implications (i.e., heart disease and obesity).
- Sound Therapy is claimed to be effective in reducing stress and anxiety in the ‘benefit self’.
- Evidence for the efficacy of Sound Therapy in healthy study participants is lacking.
- Principles derived from the parasympathetic nervous system (PNS) provide a potential mechanism for the impact of Sound Therapy.
- This study aimed to investigate the acute and longitudinal effects of Sound Therapy on HRV and selected behavioral measures of psychological wellbeing.

Hypotheses
- Sound Therapy may increase HRV relative to neutral state.
- Impact of Sound Therapy on HRV will be greater than classical music control.

Method
- Developed and randomized controlled, blind experimental design.
- Sound Therapy device contained classical music (i.e., Mozart sonatas) which had been filtered to contain lower energy at high frequencies relative to the frequencies and diminished energy at low frequencies. Classical music contained the same music, labeled.
- Participants
  - 15 healthy adults participated in Experiment One.
  - The pre- and postmeasurements were completed 3 months apart with participants listening to Sound Therapy devices for 10 minutes.
  - The DASS-21 and VLSQ-QOL were completed pre and post assessment.
  - 16 healthy adults participated in Experiment Two.
  - The pre- and postmeasurements were completed 3 months apart with participants listening to Sound Therapy devices for 10 minutes.
  - The DASS-21 and VLSQ-QOL were completed pre and post assessment.

Experiment One: Main Findings
- Sound Therapy increased HRV relative to rest and control, and
- HRV did not increase under exposure to classical music, control, or baseline.

- Participants who were acutely exposed to Sound Therapy showed improvements in well-being as measured by self-reported measures of psychological symptoms, and psychological wellbeing remained stable.
- Taken together, the increase in HRV induced by Sound Therapy and the null effect of classical music on HRV support the notion that exposure to balanced tones of sound with minimal intensity and sound frequencies less than 2,000 Hz may also affect HRV. The long-term effects of Sound Therapy on HRV and psychological wellbeing remain unclear.
- Sound Therapy-induced changes in HRV give insight into the link between the PNS, cranial nerves, and the heart.

Limitations
- Although the current study found acute effects of Sound Therapy on HRV, the manner in which these effects were produced is not fully understood in detail and is a possible explanation.
- Although the current study measured several aspects of the mechanism, further study is required to establish which aspects are the most relevant.
- Experiment Two lacked control and rates of attention were high, potentially explaining the null effect of Sound Therapy in the long-term.

Conclusions
- This research was funded by Sound Therapy International and a Tech Vision from the Australian Government. Funders had no involvement in the study analysis or interpretation of data.

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References
- Building confidence in the use of Sound Therapy to reduce anxiety.

Acknowledgments
- This research was funded by Sound Therapy International and a Tech Vision from the Australian Government. Funders had no involvement in the study analysis or interpretation of data.

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Heart Rate Variability

**Figure 1.** This model combines aspects of polyvagal (Porges, 2003) and neurovisceral integration (Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Thayer & Lane, 2000) theories to provide a potential explanation for an existing feedback system between environment, special visceral efferent pathways, the middle ear muscles, the heart and higher brain structures.

**Figure 2.** Model showing possible pathway between sound therapy and HRV. This model is a variation on the environment-brain-viscera feedback system underlying the social engagement system, as described by Porges (2003).
Main Findings

Experiment One: Main Findings

- Sound Therapy increased HRV relative to resting-state baseline, and Control.
- HRV did not increase under exposure to classical music control, relative to baseline.

\[ p = .015, \eta^2 = .329 \]

\[ p = .006, d = 0.652 \]

\[ p = .042, d = 0.942 \]

\[ p = .034, d = 0.985 \]
Vagal Hierarchy

Sound Therapy has proven to be an effective tool for helping to improve self-regulation and thus make social engagement more possible.
Tomatis based Sound Therapy: A Research Review of studies on auditory processing

• So many countries
• Subjective observation is as significant as statistics
• African children felt safer after being in fear.
• Posture
• Leadership
• Attitudes to learning
• Responsibility
• Self-esteem
• Hypothesis stimulates myelination
• Tomatis said high freqs most important
Music is a powerful healer
100 studies on Tomatis therapy

This review covered the studies done to date in a wide variety of fields totalling over 100 studies reviewed, in 21 countries.

Singing, musicality, auditory processing, learning difficulties, dyslexia, ADHD, Autism spectrum disorder, stroke, communication, reading, academic performance, speech problems including dyspraxia and stuttering, voice, focus and concentration, spatial perception, severe developmental disability, epilepsy, brain damage, foreign language learning, depression and anxiety and pregnancy.
Sounds impact wellbeing

Holism
The whole is greater than the sum of its parts.

The whole contains properties that cannot be discovered through the analysis of parts.

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Objective measures

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Neurodevelopmental scientists

Jean Ayres

Michael Merzenich

Stephen Porges

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Why Music?

1. Music impacts the whole brain and whole body.

2. Music changes mechanical energy into electrochemical energy in the central nervous system.

3. Music releases endorphins and other neurotransmitters affecting behavior, physiology and emotion.
Tomatis’s theories and discoveries
### Review of 100 Studies

<table>
<thead>
<tr>
<th>Condition</th>
<th># of studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample size</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>ADHD</td>
</tr>
<tr>
<td>43</td>
<td>Anxiety</td>
</tr>
<tr>
<td>503</td>
<td>Auditory Processing</td>
</tr>
<tr>
<td>255</td>
<td>Autism</td>
</tr>
<tr>
<td>264</td>
<td>Brain damage, stroke &amp; developmental delay</td>
</tr>
<tr>
<td>15</td>
<td>Dyslexia</td>
</tr>
<tr>
<td>922</td>
<td>Foreign Language Learning</td>
</tr>
<tr>
<td>1984</td>
<td>Learning Difficulties</td>
</tr>
<tr>
<td>119</td>
<td>Mental Focus</td>
</tr>
<tr>
<td>223</td>
<td>Pregnancy</td>
</tr>
<tr>
<td>455</td>
<td>Speech and stuttering</td>
</tr>
<tr>
<td>1</td>
<td>Tinnitus</td>
</tr>
<tr>
<td>105</td>
<td>Voice</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4925</strong></td>
</tr>
<tr>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

Studies done in a total of 23 countries
Auditory processing

- receptive language - listening,
- auditory memory,
- processing of meaning, cognitive perception,
- and expressive language, the ability to form thoughts into words to share and express ourselves.
Sound Energy

sound transmits energy via cortical brain recharge.
The Tomatis Method was shown to compare well with other interventions for the promotion of self-regulation. Qualitative observations showed improved listening in social and academic contexts, attention and awareness, self-control and interpersonal regulation.
Fig. 2. Averaged results of pre- and post-training verification test for the MT, AT, and control subjects from both age groups.
Young 2013

Fall to Spring Growth Rate (Math)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Nat'l Trend</th>
<th>Wings</th>
<th>Non-Wings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 2</td>
<td>12</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>Grade 3</td>
<td>11</td>
<td>15.5</td>
<td>18.5</td>
</tr>
<tr>
<td>Grade 4</td>
<td>8</td>
<td>9</td>
<td>10.5</td>
</tr>
<tr>
<td>Grade 5</td>
<td>8</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>

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Qualitative survey results

<table>
<thead>
<tr>
<th>Skills surveyed</th>
<th>Percentage of teachers who noticed improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership skills</td>
<td>63.7%</td>
</tr>
<tr>
<td>Taking responsibility</td>
<td>58.8%</td>
</tr>
<tr>
<td>Academic performance</td>
<td>40.9%</td>
</tr>
<tr>
<td>Self esteem</td>
<td>65.9%</td>
</tr>
<tr>
<td>Overall behaviour</td>
<td>50%</td>
</tr>
<tr>
<td>Posture</td>
<td>52.3%</td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>54.6%</td>
</tr>
<tr>
<td>Communication skills</td>
<td>72.7%</td>
</tr>
<tr>
<td>Confidence level</td>
<td>63.7%</td>
</tr>
</tbody>
</table>
Du Toit 2011

Figure 1. Pre-, In-Program and Post-Test Mean Scores on the Profile of Mood States for the Experimental Group (n=9)

- Portable
- Affordable
- Easy
Tinkl and Koller 2011

Picture 5 – Illustration of the relation of chances of KG and VG concerning the possibility of solving an item in the 3DW

<table>
<thead>
<tr>
<th>t1</th>
<th>t2</th>
<th>t3</th>
</tr>
</thead>
<tbody>
<tr>
<td>KG</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VG</td>
<td>1</td>
<td>1,99</td>
</tr>
</tbody>
</table>
Callahan 2009

Average Student Percentile Rank on the Vineland II Adaptive Behavior Scales

- Communication
- Daily Living Skills
- Socialization
- Motor Skills
- Adaptive Behavior Composite

Comparison between pre-test and post-test.
80% of the test group exhibited left ear dominance, as opposed to 10% in the control group.
Tomatis postulated that left sided hearing laterality could lead to speech and language difficulties, due to the primary language centres being situated in the left hemisphere, which is more directly accessed via the right ear. They concluded that right sided deafness is characterised by more serious linguistic difficulties, dyslexia, poor spelling and a lower standard of academic achievement. Left sided deafness was associated with emotional problems, nervousness and lower performance in humanities subjects.
Gillis and Sidlauskas 1977

Right ear lateralisation with and without increased high frequency filtering was tested. The main result observed was that increasing right ear emphasis increased reading speed.

The results support the premise that children with dyslexia do not normally make use of the “right ear advantage” as normal children do.
Sound Therapy SYNERGY
SYNERGY Consultant Essentials Pack

The pack includes
Training
Books
DVDs
Follow up program
Brochures
Everything you need to get started

Portable
Affordable
Easy
SYNERGY Family Program

Portable  Affordable  Easy
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Thank you and questions