



Vagus Nerve Hacks for Nutrition Professionals

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Institute of Functional Medicine Certified Practitioner

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Visceral/pelvic floor/craniosacral therapist

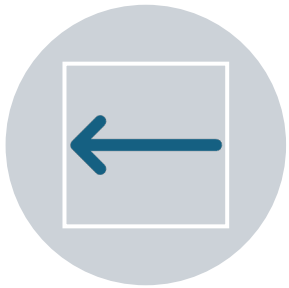
Medical Educator for Rupa Health

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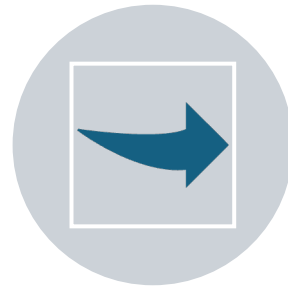
Certified Strength and Conditioning Specialist

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Objectives



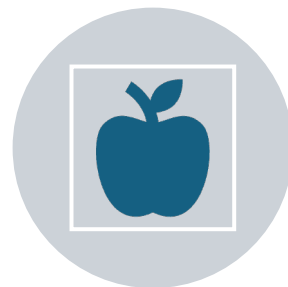
Vagus nerve anatomy
and physiology



Vagus nerve hacks



Gut-brain connection



Nutritional and lifestyle
strategies



Meet
Michelle

Have you ever had a gut feeling or butterflies in your stomach?





Vagus...

The superhighway of your body,
transporting vital information
between your brain and the rest of
your internal organs



Vagus Nerve¹

- 10th pair of cranial nerves
- 80% of our parasympathetic system
- Longest cranial nerve
- “wandering” in Latin
- Craniosacral
- Homeostasis

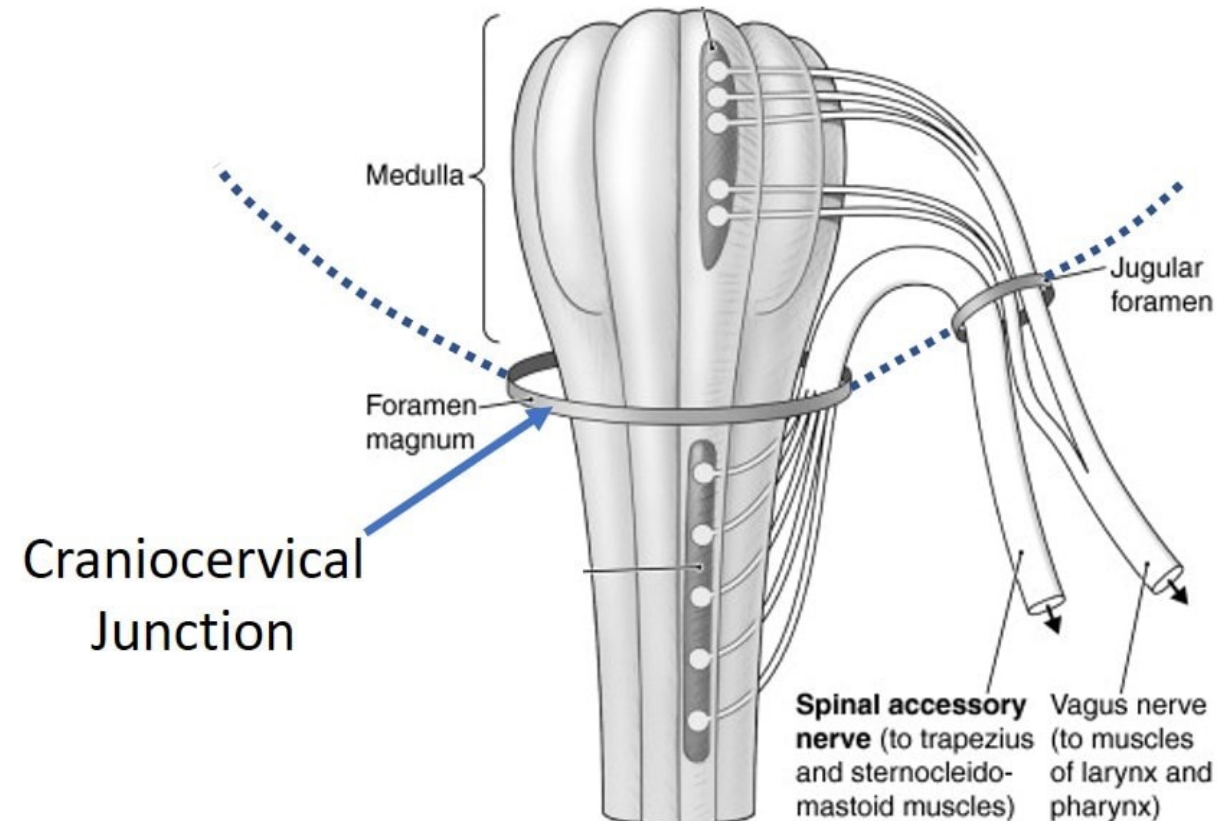
¹ Fleming MA 2nd, Ehsan L, Moore SR, Levin DE. The Enteric Nervous System and Its Emerging Role as a Therapeutic Target. *Gastroenterol Res Pract.* 2020 Sep 8;2020:8024171. doi: 10.1155/2020/8024171. PMID: 32963521; PMCID: PMC7495222.



Vagus Anatomy²

✓ The vagus nerve exits anteriorly from the medulla oblongata, leaving the skull through the middle compartment of the jugular foramen.

✓ In the neck, the vagus nerve provides required innervation to most of the muscles of the pharynx and larynx, which are responsible **for swallowing and vocalization.**



² Breit S, Kupferberg A, Rogler G, Hasler G. Vagus Nerve as Modulator of the Brain-Gut Axis in Psychiatric and Inflammatory Disorders. Front Psychiatry. 2018 Mar 13;9:44. doi: 10.3389/fpsy.2018.00044. PMID: 29593576; PMCID: PMC5859128.

Vagus Anatomy

- ✓ The left vagus nerve travels anterior to the aortic arch, behind the primary left bronchus and into the esophagus. The right vagus nerve travels behind the esophagus and primary right bronchus.
- ✓ The SA node is predominantly innervated by efferent branches of the right vagus nerves. It provides the main parasympathetic supply to the heart and **stimulates a reduction in the heart rate.**
- ✓ Both left and right vagus nerves subsequently enter the abdomen through the esophageal hiatus of the diaphragm and **regulates the contraction of smooth muscles and glandular secretion.**



Vagus Anatomy

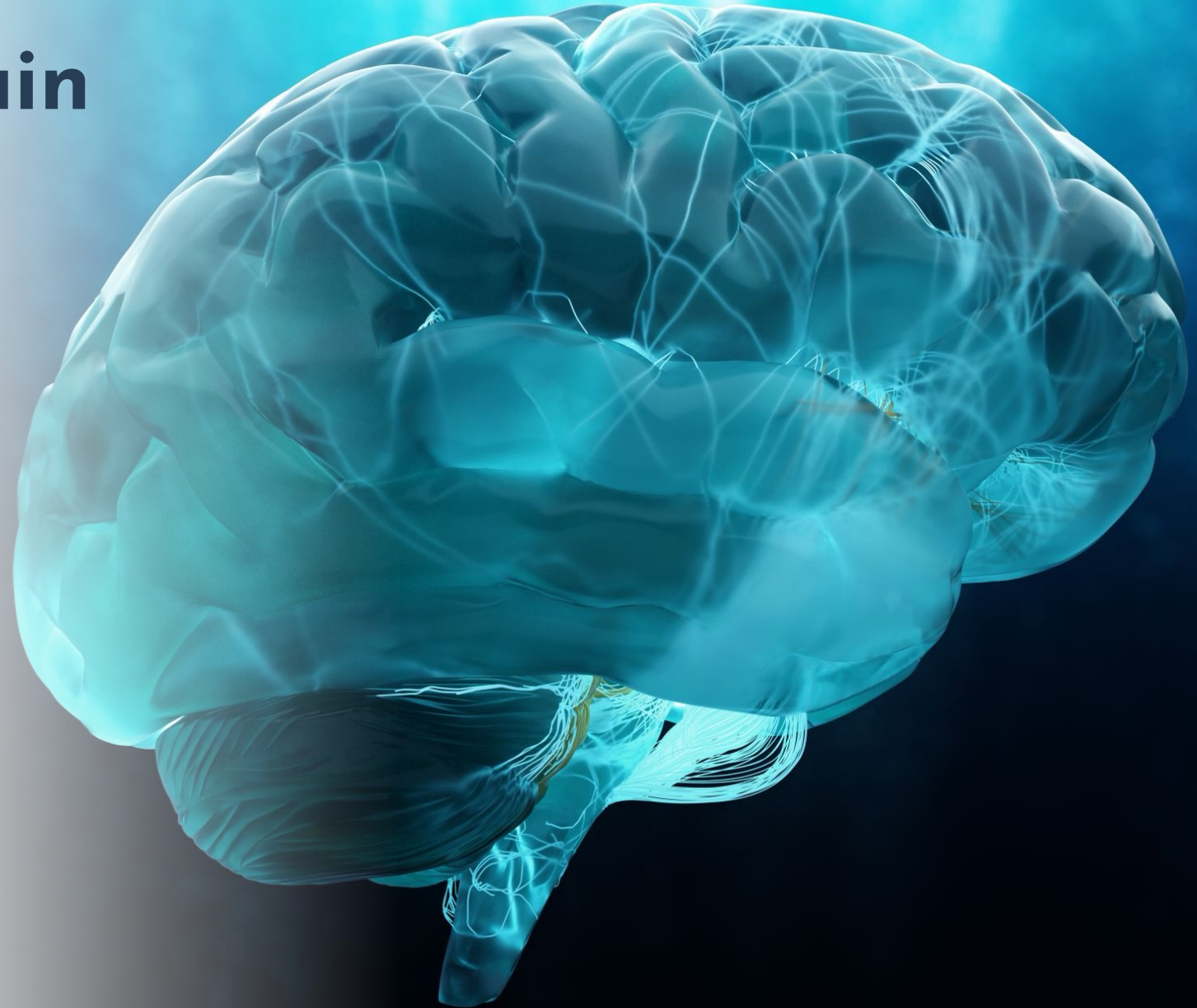
- ✓ The celiac branch (right vagus) supplies the intestine from proximal duodenum to the distal part of the descending colon.
- ✓ The abdominal vagal **afferents**, include mucosal mechanoreceptors, chemoreceptors, and tension receptors in the esophagus, stomach, and proximal small intestine, and sensory endings in the liver and pancreas.
- ✓ The sensory afferent cell bodies are located in nodose ganglia and send information to the nucleus tractus solitarii (NTS).

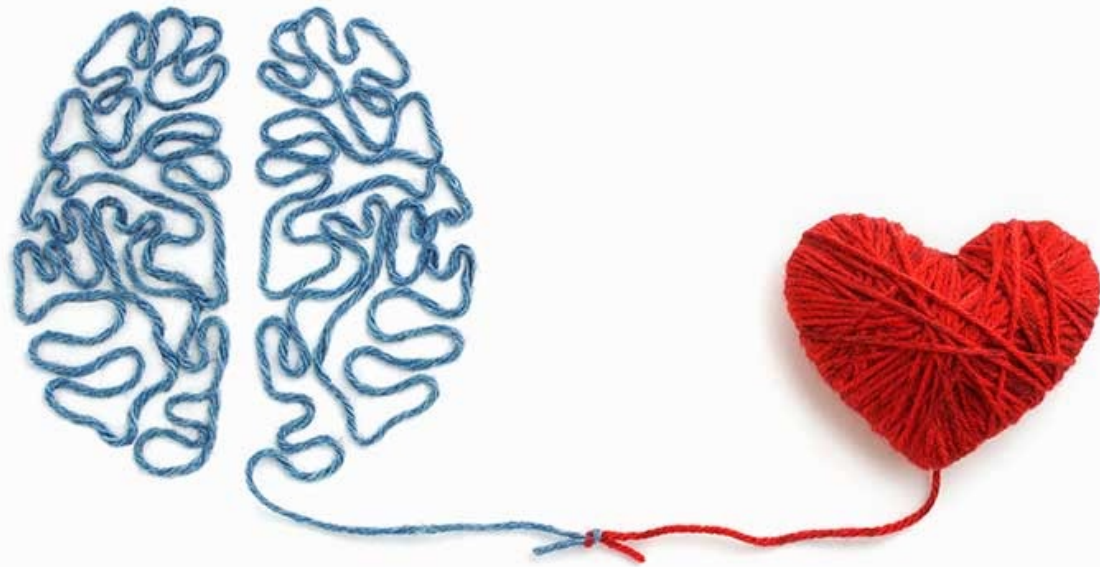


Gut Brain

Axis

- Bidirectional communication which occurs through multiple pathways that include **hormonal, neural, metabolic, and immune mediators.**
- **Maintains normal gut function and appropriate behavior.**





Heart ← → **Brain**
Connection



Heart-brain
synchronization
**(PAYING
ATTENTION IS
THE KEY PART!)**

Heart-brain

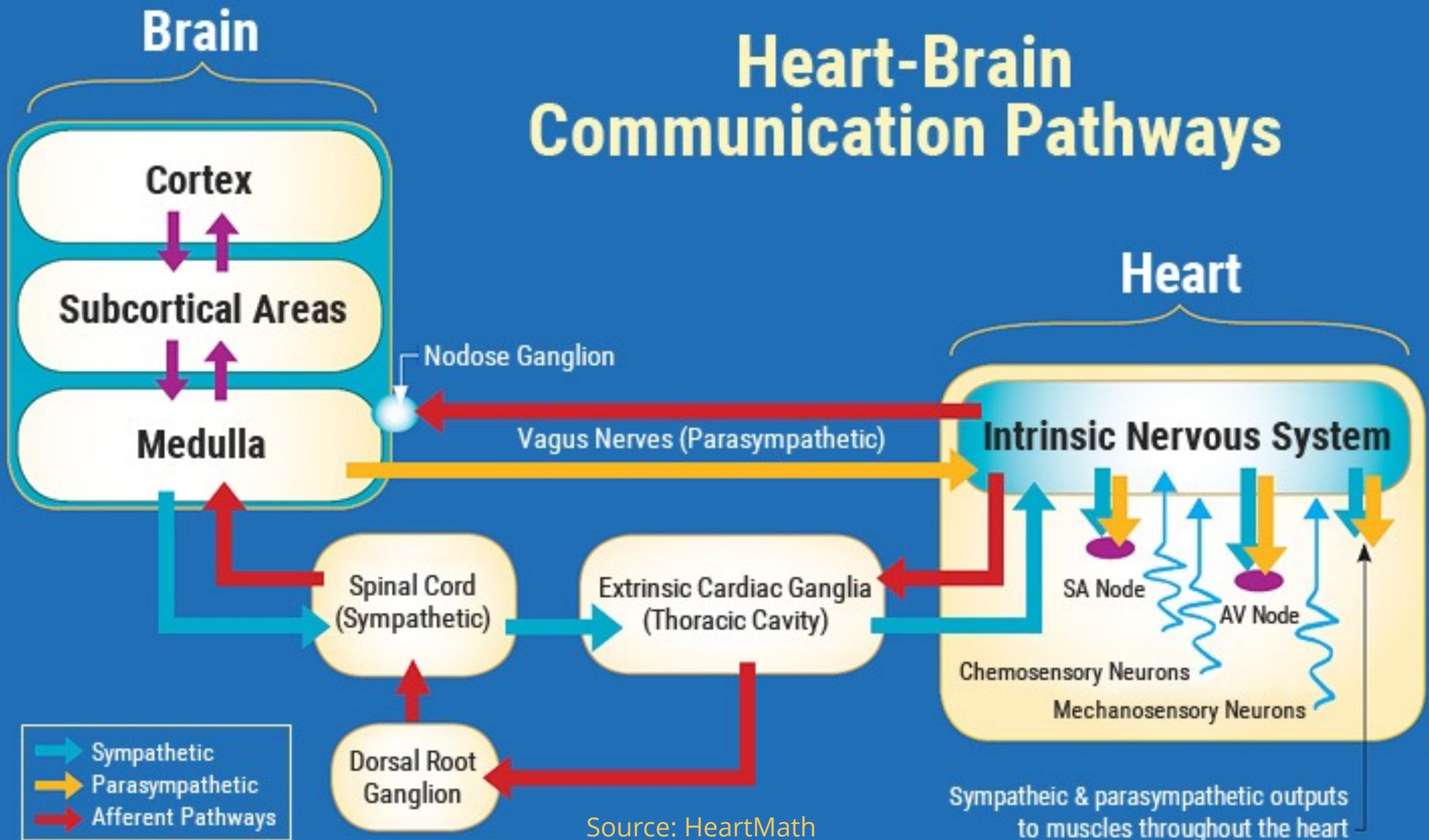
Heart has its own complex nervous system

Heart sends **far more information** to the brain than the brain sends to the heart

Heart signals especially affect the brain centers involved in decision making, creativity, and emotional experience

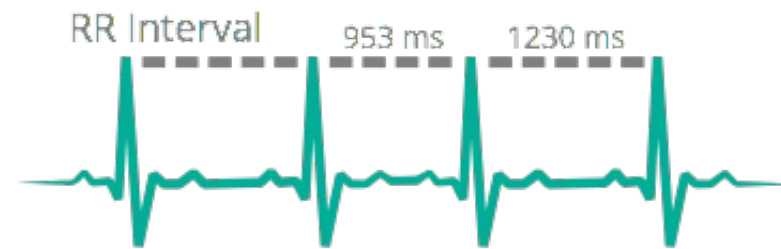
Anything we can do to affect heart rhythm can affect physiology and psychology

Heart-Brain Communication Pathways



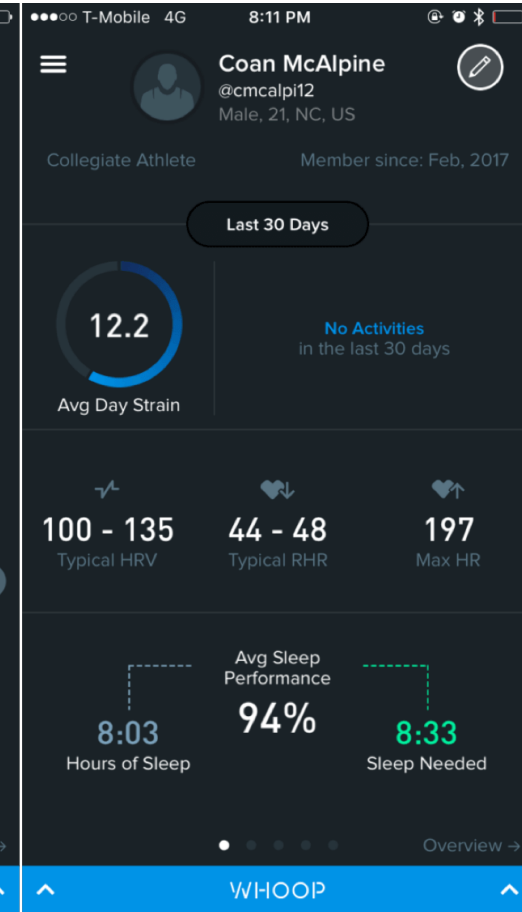
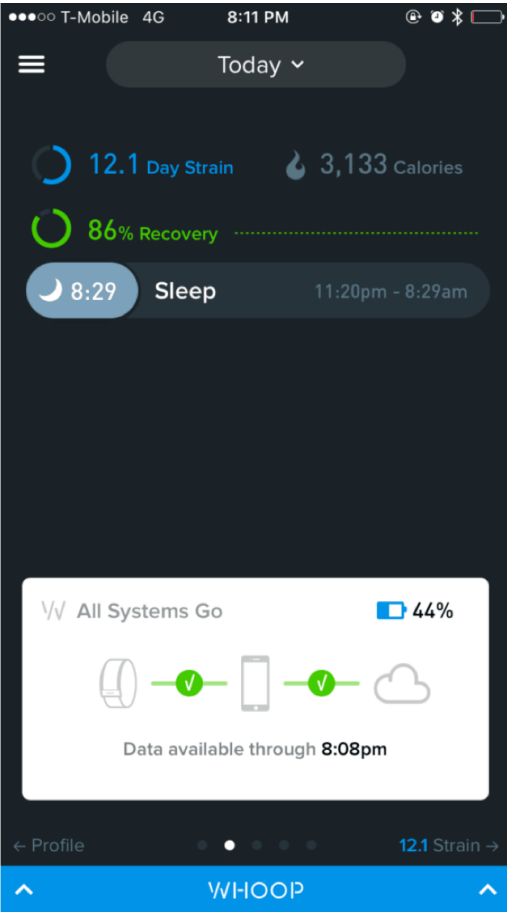
Heart Rate Variability (HRV)

- ✓ Measure of the variation in time between each heartbeat.
- ✓ Controlled by the autonomic nervous system (ANS)—parasympathetic
- Works regardless of our desire and regulates, among other things, our heart rate, blood pressure, breathing, and digestion.
- ✓ Marker of how we regulate emotions



RR Intervals (also called Interbeat Intervals - IBIs)

HRV



4 Primary Gut-Brain Pathways³

Bidirectional communication between the gut and brain can be mediated by several **top-down** and **bottom up, direct** and **indirect** pathways.

- ① Nervous system *including the ENS and the VN*
- ② Neuroendocrine and HPA axis
- ③ Immune system
- ④ Microbiota-derived neuroactive compounds

³ Gwak MG, Chang SY. Gut-Brain Connection: Microbiome, Gut Barrier, and Environmental Sensors. Immune Netw. 2021 Jun 16;21(3):e20. doi: 10.4110/in.2021.21.e20. PMID: 34277110; PMCID: PMC8263213.

1 Neural Connection



Enteric Nervous System



Vagus nerve!



Interoception



80% of information from the vagus nerve goes TO the brain

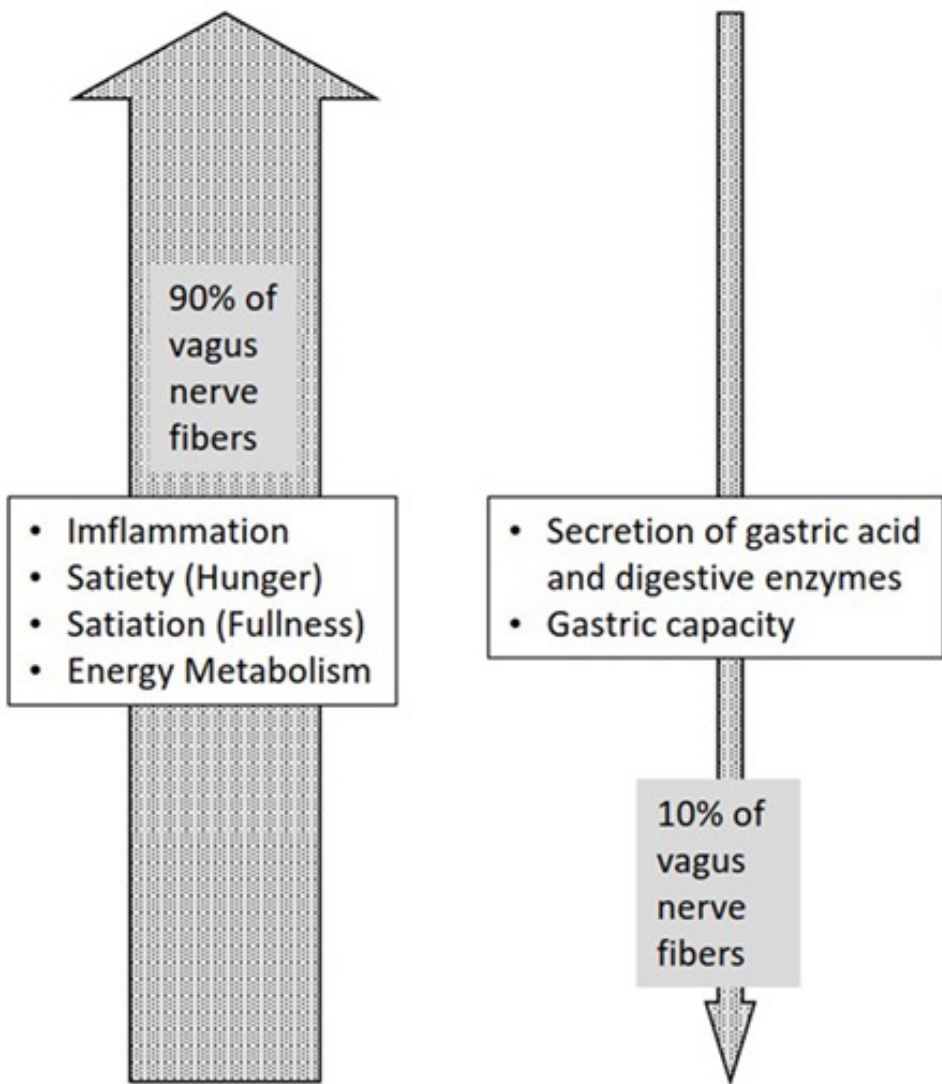


Has an abundance of sensory fibers, and is able to convey rich information on organ function throughout the body to the brain

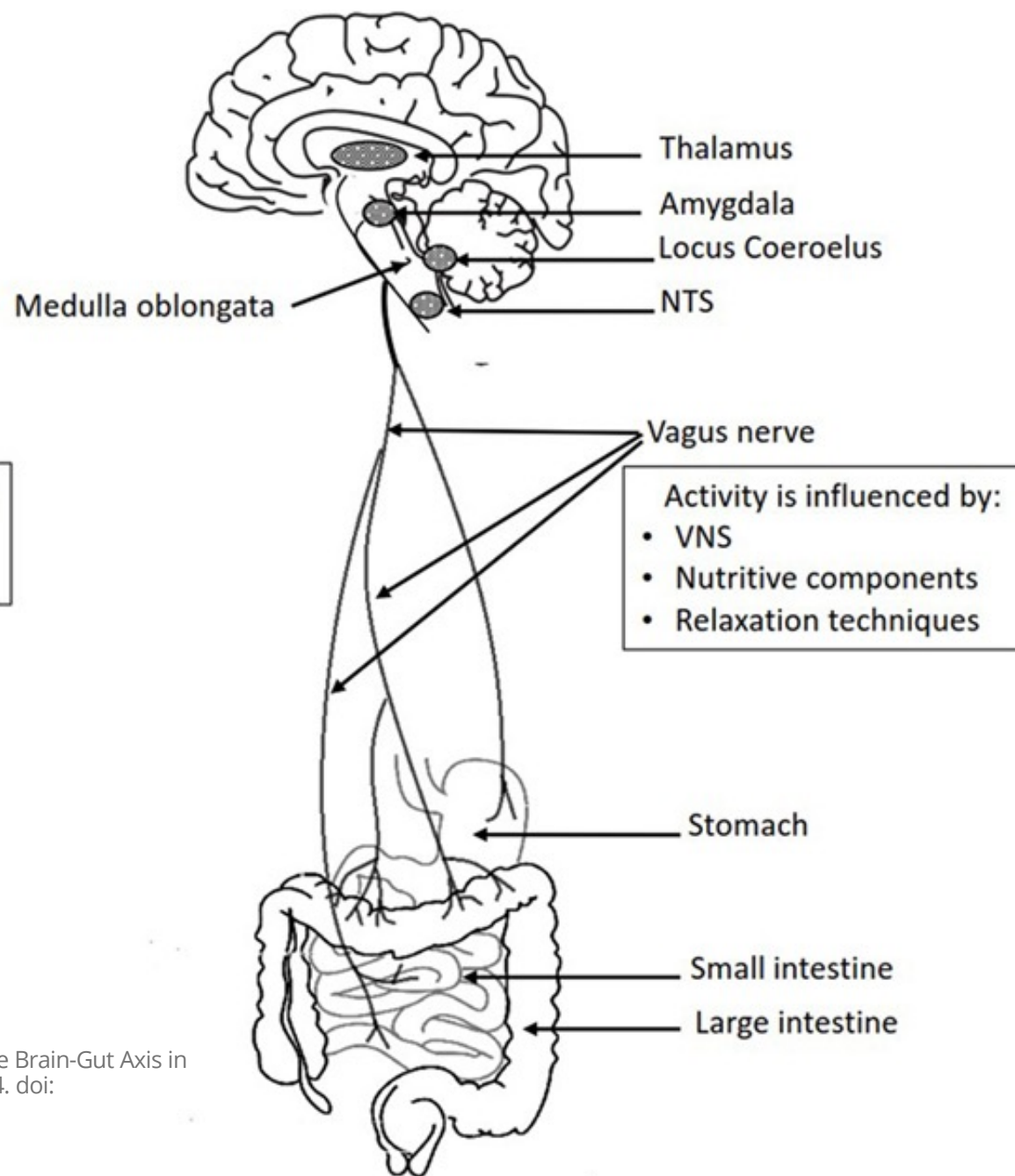


Vagal activity is sensitive to nutrition, exercise, and stress

Afferent and efferent connections



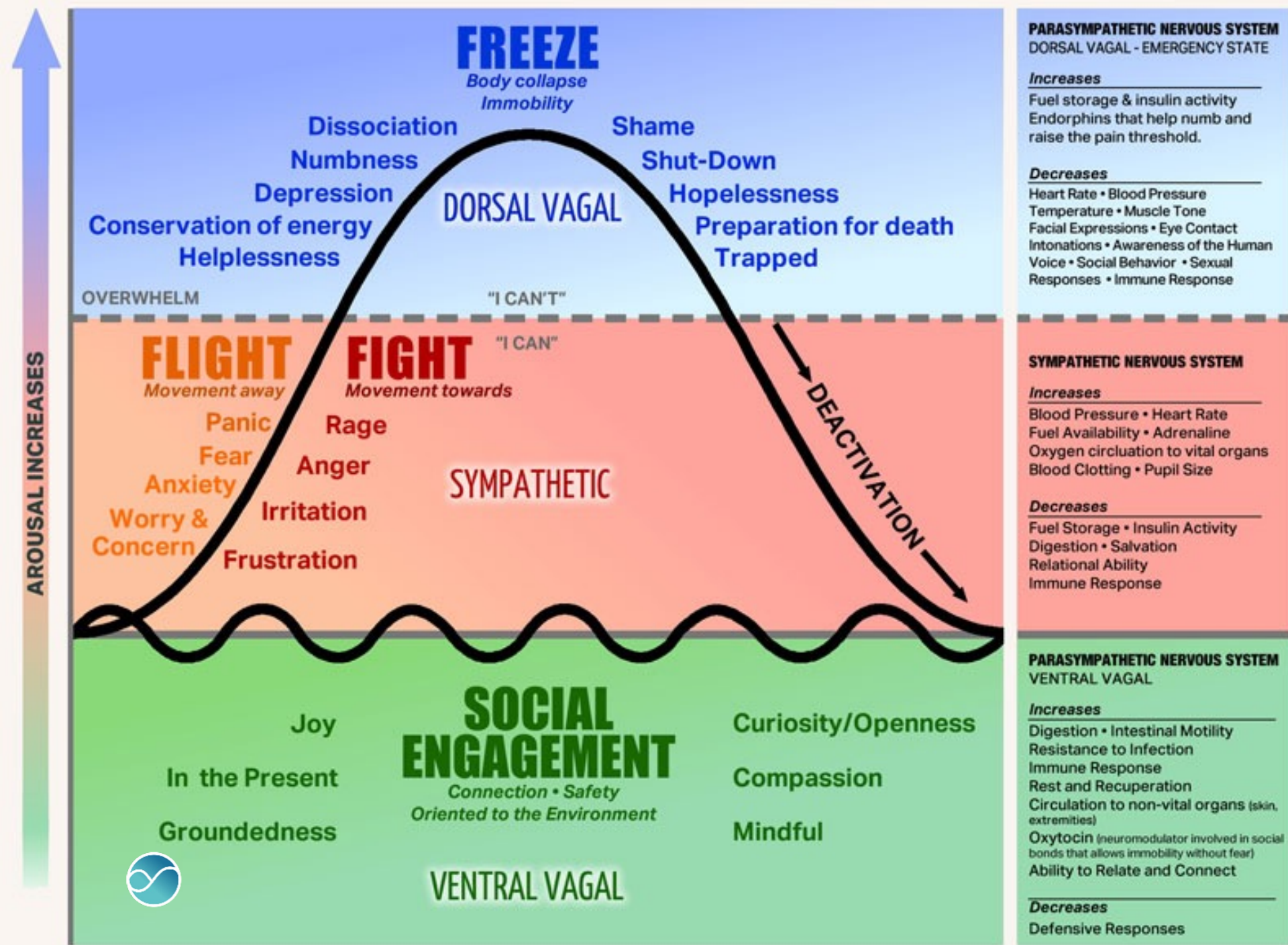
Anatomy



Disorders

- Psychiatric disorders
- Major depression
 - PTSD

- Inflammatory GI Disorders
- Ulcerative Colitis
 - Crohn's Disease



Polyvagal Chart⁵

Dr. Stephen Porges

⁵ Porges, Stephen, "The Pocket Guide to the Polyvagal Theory," (New York: W. W. Norton & Company, Inc., 2017), 15.

Adapted from: Ruby Jo Walker



Vagus Nerve Hacks⁶

to increase the nervous system's capacity for change and healing

- LOIS-swallowing
- Salamander—airway
- Breathing before eating
- Salivate
- Gastroesophageal Release (nickel- T10-11)

⁶ Rosenberg, S. (2017). Accessing the healing power of the vagus nerve: Self-Help exercises for anxiety, depression, trauma, and autism. North Atlantic Books.



2

Neuroendocrine

Top-down: Cortisol > Gut Microbiota composition

Bottom-Up: Gut epithelium > hormone secreting cells

- **K cell:** Regulate insulin via GIP (gastric inhibitory peptide), which also promotes triglyceride storage; duodenum.
- **L cell:** secrete GLP-1 and PYY, inhibits GI motility and increases satiety; ileum and large intestine.
- **I cell:** secrete cholecystokinin (CCK); modulate bile secretion, exocrine pancreas secretion, and satiety; duodenum
- **G cell:** Release gastrin and stimulate gastric acid secretion.

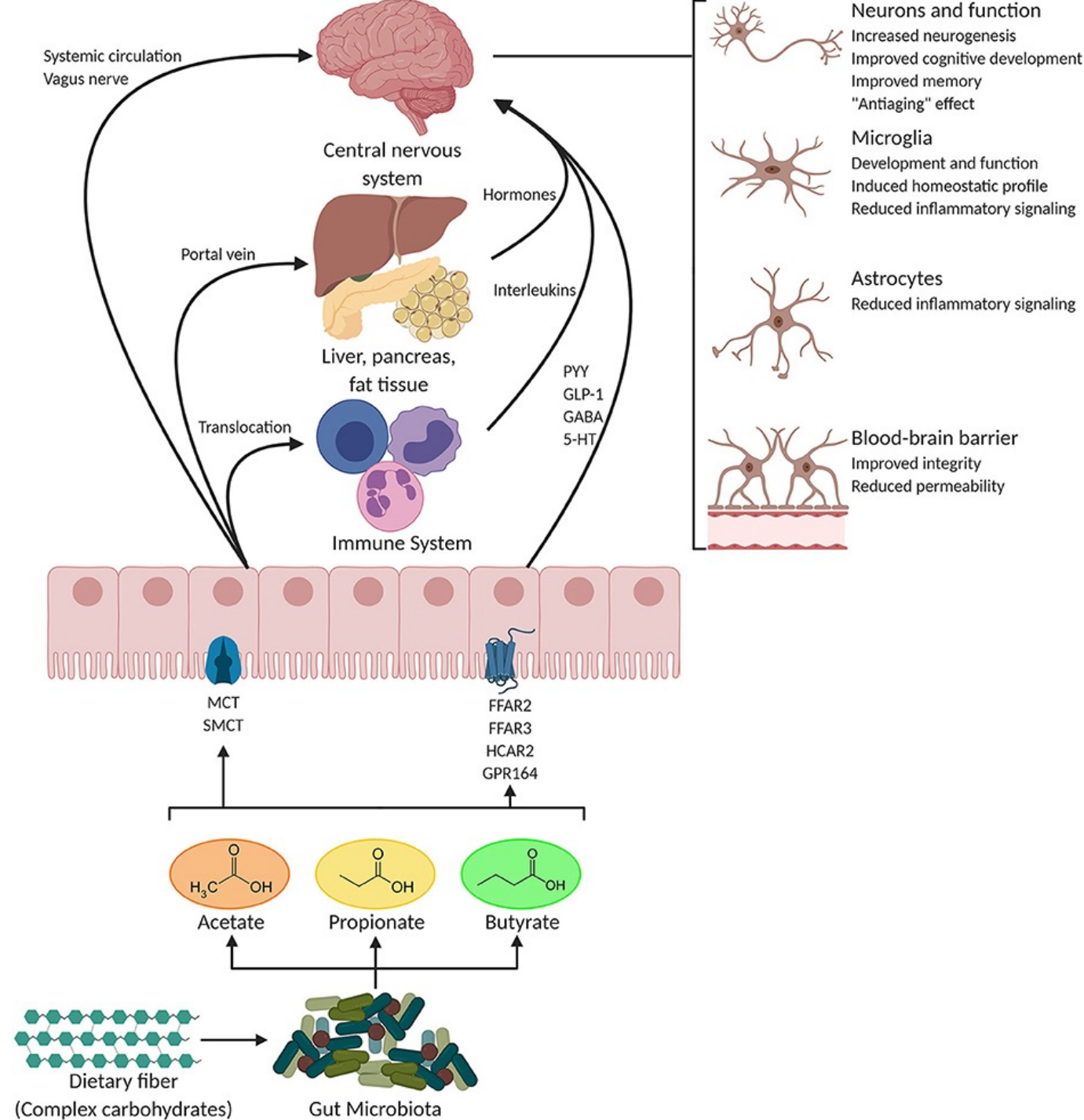
Neuroendocrine: SCFA⁷

SCFA interaction with their receptors on enteroendocrine cells promotes **indirect signaling** to the brain via the **systemic circulation or vagal pathways** by inducing the secretion of gut hormones such as:

- glucagon-like peptide 1 (GLP1)
- peptide YY (PYY)
- γ -aminobutyric acid (GABA)
- serotonin (5-HT)

⁷ Silva YP, Bernardi A, Frozza RL. The Role of Short-Chain Fatty Acids From Gut Microbiota in Gut-Brain Communication. Front Endocrinol (Lausanne). 2020 Jan 31;11:25. doi: 10.3389/fendo.2020.00025. PMID: 32082260; PMCID: PMC7005631.

Potential pathways through which SCFAs influence gut-brain communication⁸



⁸ Silva YP, Bernardi A, Frozza RL. The Role of Short-Chain Fatty Acids From Gut Microbiota in Gut-Brain Communication. *Front Endocrinol (Lausanne)*. 2020 Jan 31;11:25. doi: 10.3389/fendo.2020.00025. PMID: 32082260; PMCID: PMC7005631.

3

Top-Down-Immune

- Influences the composition of the microbiota in the gut.
- HPA axis: cortisol directly affects immune cells (including the secretion of cytokines) both locally in the gut and systemically.
- Cortisol affects gut permeability, barrier function, and composition of the gut microbiota
- IL-1 and IL-6 in hypothalamus > release of cortisol



What does **STRESS** do to our gut?

- ✓ Stress and depression can reshape the gut bacteria's composition through stress hormones, inflammation, and autonomic alterations.
 - ✓ Decreases beneficial bacteria and increases bad bacteria
 - ✓ The gut bacteria release metabolites, toxins, and neurohormones that can alter eating behavior and mood.
- ✓ Maldigestion
- ✓ Alters intestinal mucosa permeability

Bottom-Up Immune



Gut microbiota >
microglia (innate
immune system in the
brain)



Intestinal cytokines >
Brain via systemic
immune system

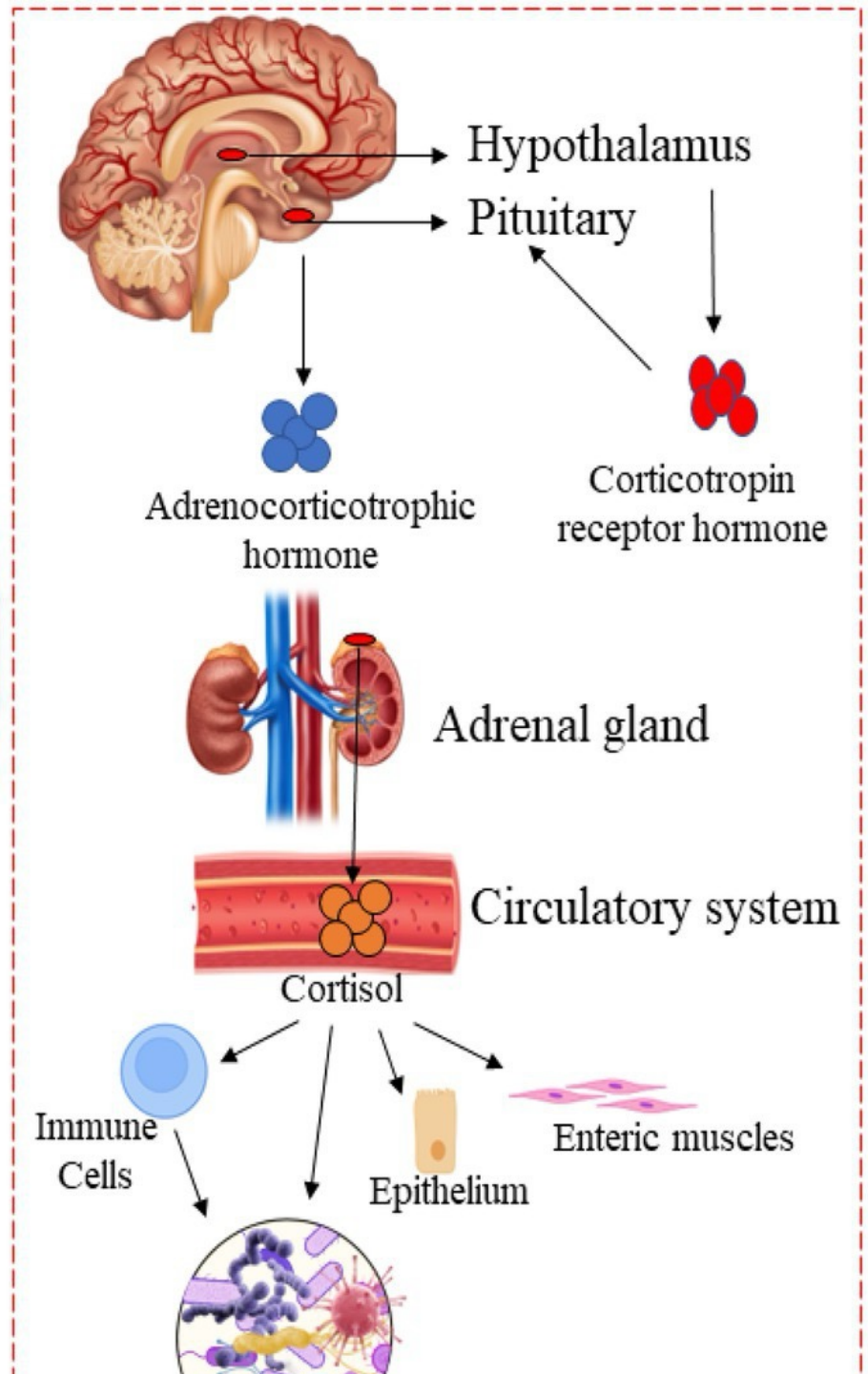
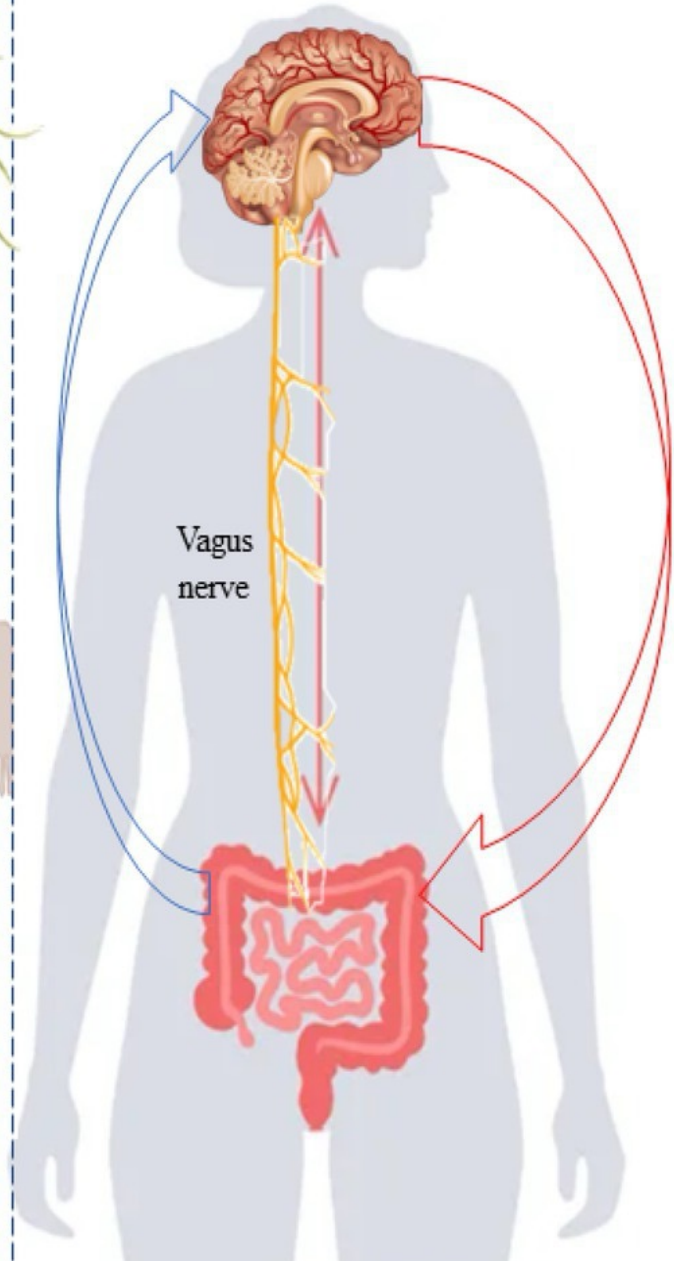
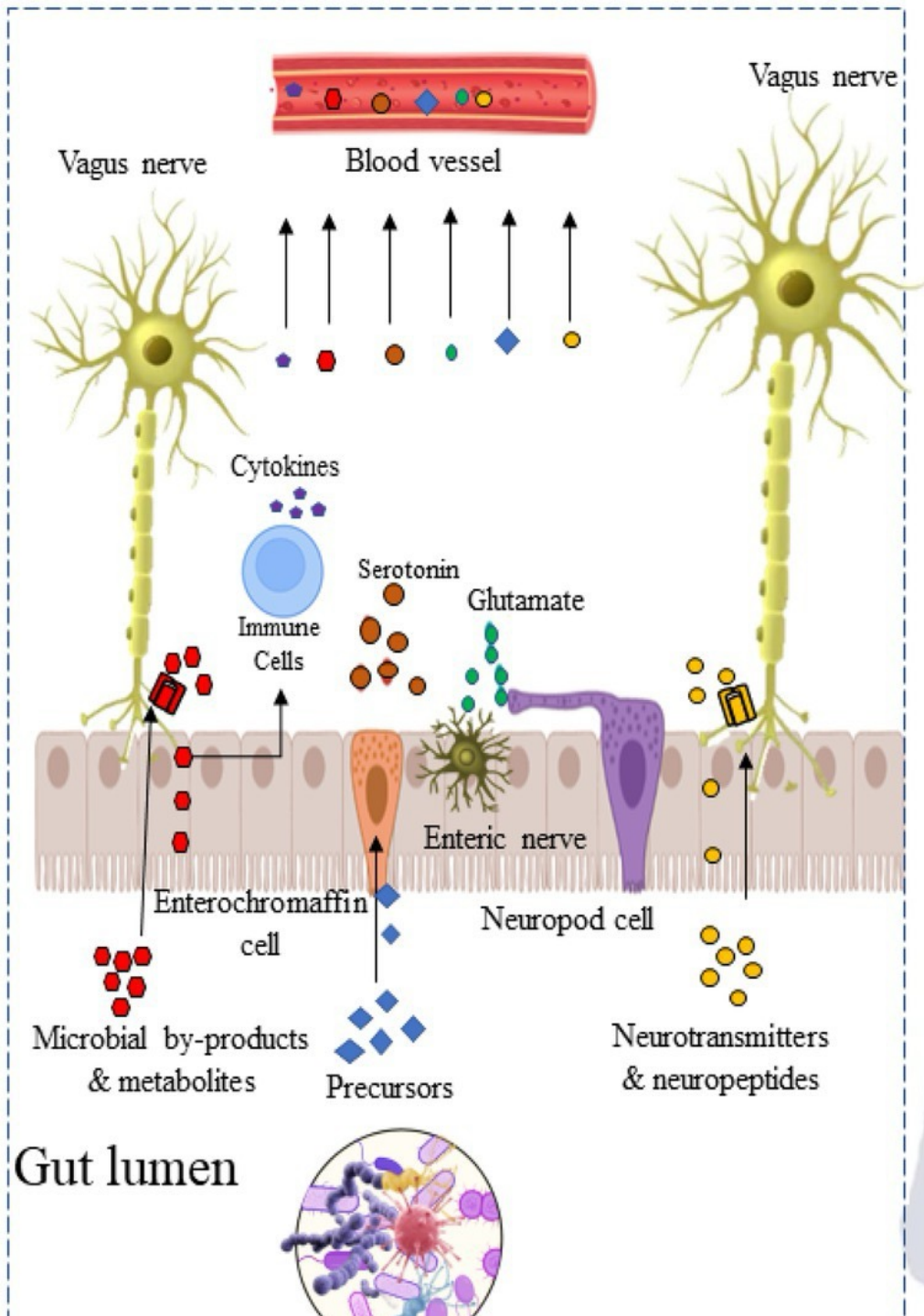


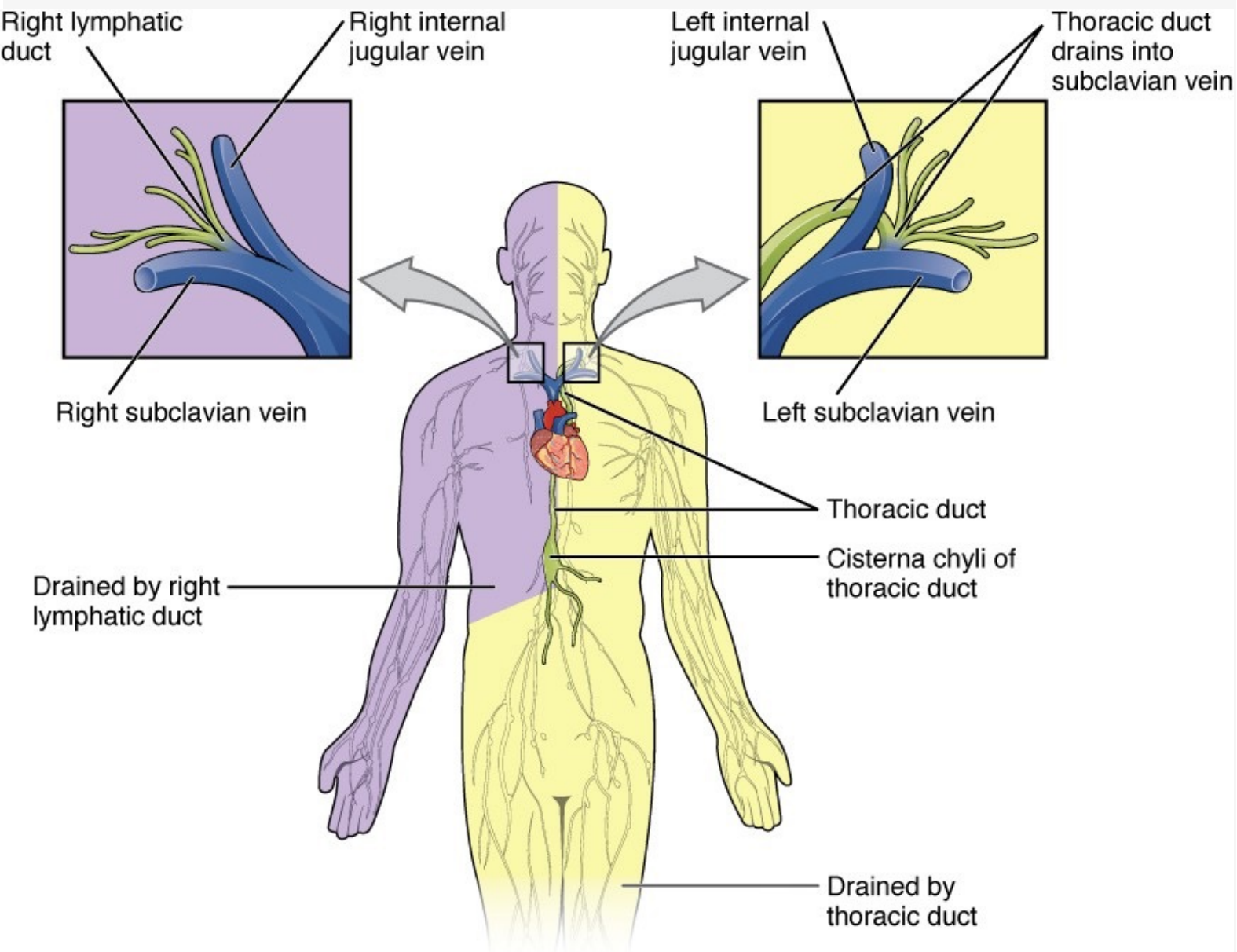
LPS/Cytokines > Barrier
function > BBB > brain
peripheral vascularity

Bottom-Up Immune

- ✓ 70-80% of our immune system!
- ✓ GALT (gut-associated lymphoid tissue) –adaptive immune-responses to gut-derived antigens
- ✓ Largest immune organ
 - Peyer's patches (PP)
 - Cecal patches
 - Colonic patches
 - Isolated lymphoid follicles
 - Cryptopatches
 - Mesenteric lymph nodes (MLN)
 - Solitary lymphoid nodes







- ✓ One of the most powerful and neglected systems of the body
- ✓ Lymphatic system consists of lymph, lymph vessels, lymph nodes, and lymph tissue
- ✓ Works with the circulatory system
- ✓ Removes waste and excess fluid from the tissues
- ✓ The lymphatic system handles 125 ml/hr (2500-2800 ml of lymph/day) ~1/2 of this is from the liver and small intestine alone

Two things that move lymph:



Diaphragmatic breathing



Movement

Intestinal motility
Skeletal muscle contraction
Respiratory motions

**Vagus Nerve Hack:
Neck Release
Abdominal Massage**

4

Microbiota-derived neuromodulators

- Produces 3/4 of the neurotransmitters (chemical messengers)
- 90% of our serotonin
- Up to 50% of our dopamine
- GABA (gamma amino butyric acid)

Therefore, gut issues, infections, inflammatory diets, can influence our mood and behavior.

Microbiota-derived neuromodulators: Indirect pathways⁹

- ✓ Dopamine can be synthesized from *Lactobacillus*, *Serratia*, *Bacillus*, *Morganella* and *Klebsiella*.
- ✓ Serotonin can be synthesized from *Streptococcus spp.*, *Enterococcus spp.*, *Escherichia spp.*, *Lactobacillus plantarum*, *Klebsiella pneumonia*, and *Morganella morganii*
- ✓ GABA can be synthesized from *Lactobacillus* and *Bifidobacterium*

⁹ Strandwitz P. Neurotransmitter modulation by the gut microbiota. Brain Res. 2018 Aug 15;1693(Pt B):128-133. doi: 10.1016/j.brainres.2018.03.015. PMID: 29903615; PMCID: PMC6005194.

HELICOBACTER PYLORI

H. PYLORI & VIRULENCE FACTORS

	Result	Reference
<i>Helicobacter pylori</i>	2.10e3 High ↑	< 1.00e3
Virulence Factor, babA	Negative	Negative
Virulence Factor, cagA	Negative	Negative
Virulence Factor, dupA	Negative	Negative
Virulence Factor, iceA	Negative	Negative
Virulence Factor, oipA	Negative	Negative
Virulence Factor, vacA	Negative	Negative
Virulence Factor, virB	Negative	Negative
Virulence Factor, virD	Negative	Negative

COMMENSAL/KEYSTONE BACTERIA

COMMENSAL BACTERIA	Result	Reference
<i>Bacteroides fragilis</i>	4.76e10	1.6e9 - 2.5e11
<i>Bifidobacterium</i> spp.	3.23e10	> 6.7e7
<i>Enterococcus</i> spp.	9.83e3 L	1.9e5 - 2.0e8
<i>Escherichia</i> spp.	1.59e5 L	3.7e6 - 3.8e9
<i>Lactobacillus</i> spp.	1.45e6	8.6e5 - 6.2e8
<i>Enterobacter</i> spp.	1.49e6	1.0e6 - 5.0e7
<i>Akkermansia muciniphila</i>	6.93e5	1.0e1 - 8.2e6
<i>Faecalibacterium prausnitzii</i>	2.58e6	1.0e3 - 5.0e8
<i>Roseburia</i> spp.	6.87e9	5.0e7 - 2.0e10
BACTERIAL PHYLA		
<i>Bacteroidetes</i>	7.14e11 L	8.6e11 - 3.3e12
<i>Firmicutes</i>	2.74e10 L	5.7e10 - 3.0e11
<i>Firmicutes:Bacteroidetes Ratio</i>	0.04	< 1.0

INTESTINAL HEALTH MARKERS

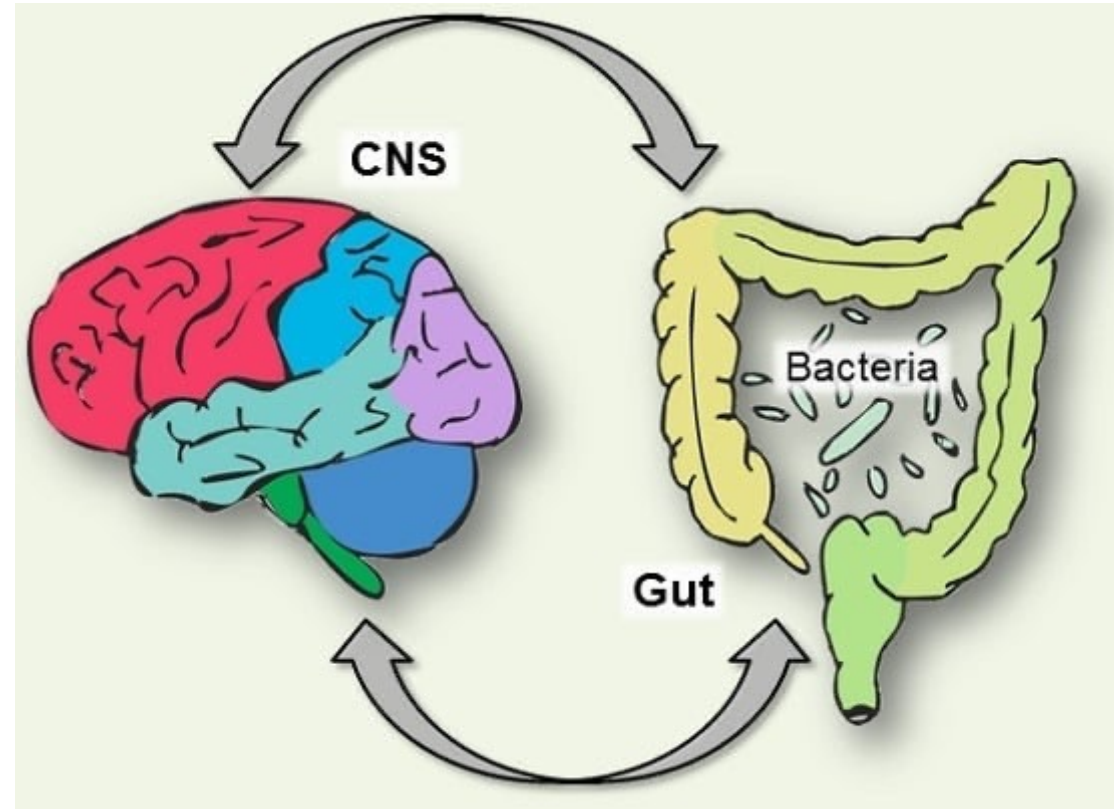
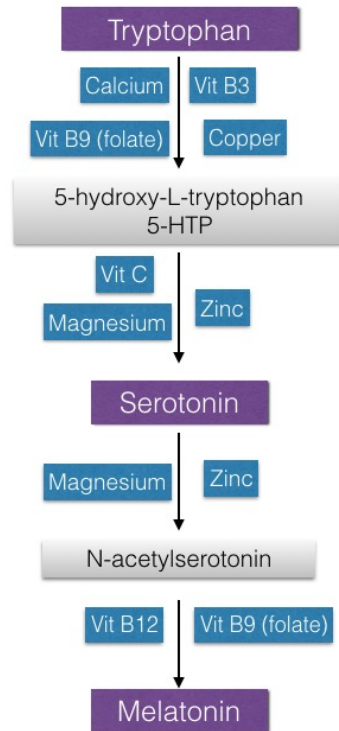
DIGESTION	Result	Reference
Steatocrit	6	< 15 %
Elastase-1	>750	> 200 ug/g
GI MARKERS		
β-Glucuronidase	3165 H	< 2486 U/mL
Occult Blood - FIT	<dl	< 10 ug/g
IMMUNE RESPONSE		
Secretory IgA	1138	510 - 2010 ug/g
Anti-gliadin IgA	181 H	< 175 U/L
Eosinophil Activation Protein (EDN, EPX)	0.09	< 2.34 ug/g
INFLAMMATION		
Calprotectin	3	< 173 ug/g
ADD-ON TESTS		
Zonulin	79.9	< 175 ng/g

OPPORTUNISTIC/OVERGROWTH MICROBES

DYSBIOTIC & OVERGROWTH BACTERIA	Result	Reference
<i>Bacillus</i> spp.	4.04e5	< 1.76e6
<i>Enterococcus faecalis</i>	<dl	< 1.00e4
<i>Enterococcus faecium</i>	5.02e2	< 1.00e4
<i>Morganella</i> spp.	<dl	< 1.00e3
<i>Pseudomonas</i> spp.	<dl	< 1.00e4
<i>Pseudomonas aeruginosa</i>	<dl	< 5.00e2
<i>Staphylococcus</i> spp.	<dl	< 1.00e4
<i>Staphylococcus aureus</i>	2.24e3 High ↑	< 5.00e2
<i>Streptococcus</i> spp.	7.76e3 High ↑	< 1.00e3
COMMENSAL OVERGROWTH MICROBES		
<i>Desulfovibrio</i> spp.	3.28e6	< 7.98e8
<i>Methanobacteriaceae</i> (family)	1.95e8	< 3.38e8
INFLAMMATORY & AUTOIMMUNE-RELATED BACTERIA		
<i>Citrobacter</i> spp.	<dl	< 5.00e6
<i>Citrobacter freundii</i>	<dl	< 5.00e5
<i>Klebsiella</i> spp.	<dl	< 5.00e3
<i>Klebsiella pneumoniae</i>	<dl	< 5.00e4
<i>M. avium</i> subsp. <i>paratuberculosis</i>	<dl	< 5.00e3
<i>Proteus</i> spp.	<dl	< 5.00e4
<i>Proteus mirabilis</i>	<dl	< 1.00e3

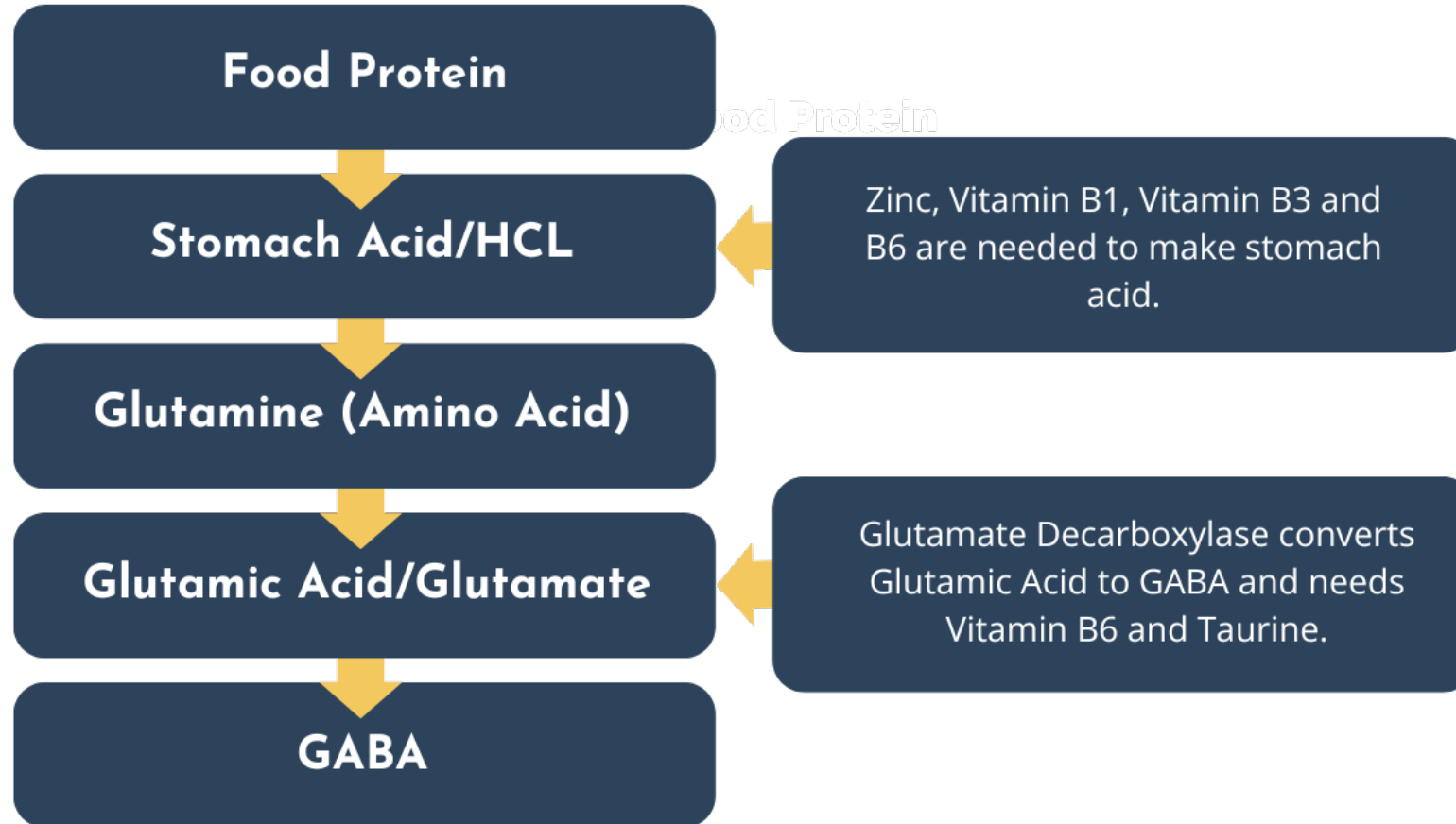
Serotonin¹⁰

Serotonin metabolic pathway

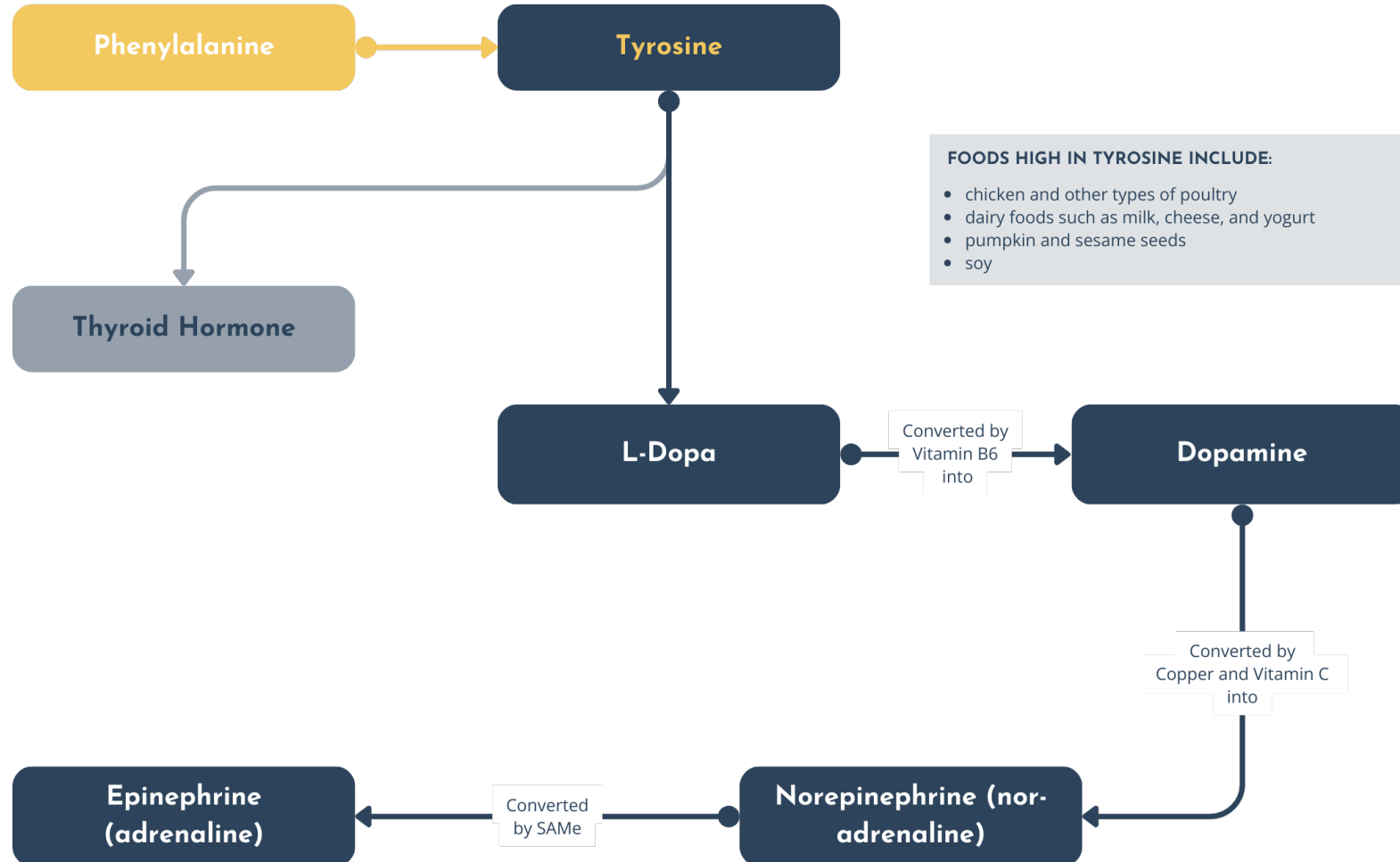


¹⁰ Jenkins TA, Nguyen JCD, Polglaze KE, Bertrand PP. Influence of Tryptophan and Serotonin on Mood and Cognition with a Possible Role of the Gut-Brain Axis. *Nutrients*. 2016; 8(1):56. <https://doi.org/10.3390/nu8010056>

GABA Pathway



Dopamine Pathway



Case Study

Ben, a 53-year-old male, husband, dad of three boys, and successful entrepreneur, has been experiencing several distressing symptoms over the past six months. After having COVID-19, he reported persistent throat clearing and excessive mucus production. Additionally, Ben has been dealing with heart rate spikes with standing, fainting episodes, facial swelling, lightheadedness, blood pressure dysregulation, flushing, palpitations, and occasional bouts of nausea. These symptoms have significantly impacted his daily life, prompting him to seek medical attention.

Case Study: Patient's Starting Values

Lab	Optimal Reference	Patient Values
H Pylori	<1.00e3	2.10e3 H
Enterococcus spp.	1.9e5-2.0e8	9.83e3 L
Escherichia spp.	3.7e6-3.8e9	1.59e5 L
Lactobacillus spp.	8.6e5-6.2e8	1.45e6 L
Enterobacter spp.	1.06e6-5.0e7	1.49e5 L
Bacteroidetes	8.6e11-3.3e12	7.14e11 L
Firmicutes	5.7e10-3.0e11	2.74e10 L
Staphylococcus aureus	<5.00e2	2.43e3 H
Streptococcus spp.	<7.76e3	7.76e3 H
B-Glucuronidase	<2486 U/mL	3165 H
Ant-Gliadin IgA	<175 U/L	181 H

Case Study: Patient's Starting Values

Lab	Optimal Reference Range	Patient's Starting Values
Tryptase	<10.9 ug/L	15.7 ug/L H
Magnesium	1.8-2.2 mg/dL	1.8 mg/dL L
Vitamin D	30-100 ng/mL	27 ng/mL
TSH	0.45-5.33 uIU/mL	3.76 uIU/mL
Free Thyroxine	0.61-1.30 ng/dL	.85 ng/dL
Parathyroid Hormone	14-72 pg/mL	33.4 pg/mL
Complete Metabolic Profile		WNL
Heme Profile and Elect Diff		WNL
Basic Metabolic Panel		WNL
IgE allergy panel		(+) dog and cat dander

Diagnosis

- Dysautonomia
- Mast Cell Activation
- Postural Orthostatic Hypotension
- Paroxysmal Tachycardia

Treatment

- **Vagus Nerve Exercises:** These exercises, including the salamander, Valsalva maneuver, and humming
- **Daily Lymph Drainage**
- **Xlear and Mutes**
- **Diet**
 - **Modified Elimination Diet/Low histamine**
 - **2 g Salt/day:** Ben required additional salt intake to help increase blood volume and improve orthostatic tolerance.
- **Supplements:**
 - DAO (Diamine Oxidase) Supplementation
 - 1st Phorm Microfactor, 1st Phorm Magnesium, Vitamin D3 with K2 5000 IU
 - Ashwagandha, Stinging nettle, Quercetin
 - Phase 1 Gut Healing: Biocidin, Pylori Plex (Mastic Gum), SBI Protect:
 - Phase 2 Gut Healing: Betaine HCL with Pepsin (Hydrochloric Acid), Candibactin AR and BR

3-month follow-up

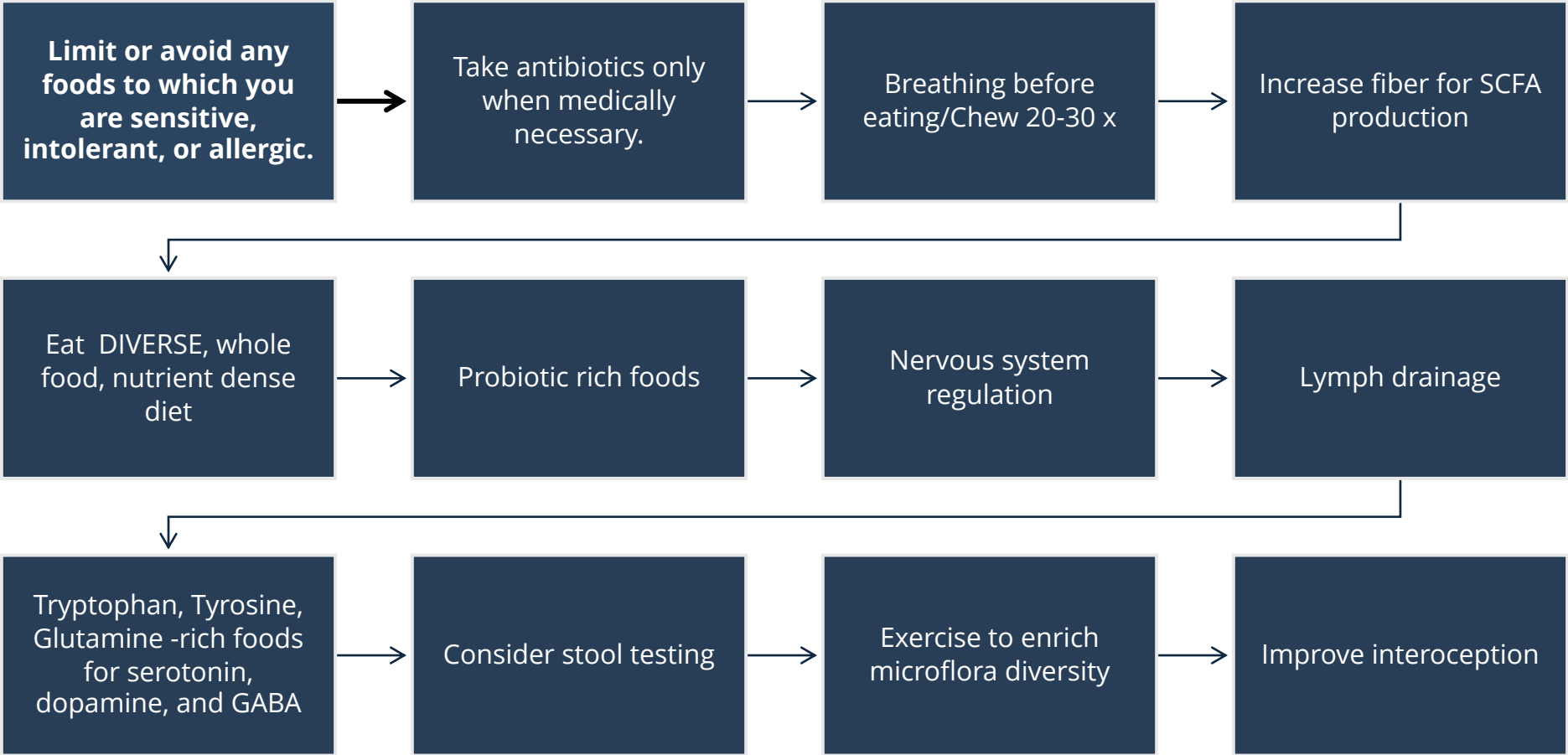
Lab	Optimal Reference	Patient's Starting Value	Patient's Follow-Up Value
H Pylori	<1.00e3	2.10e3 H	Negative *

Lab	Optimal Reference Range	Patient's Starting Values	Patient's Follow-Up Values
Tryptase	<10.9 ug/L	15.7 ug/L H	11.9ug/L
Magnesium	1.8-2.2 mg/dL	1.8 mg/dL L	2.2 mg/dL
Vitamin D	30-100 ng/mL	27 ng/mL	53 ng/mL
TSH	0.45-5.33 uIU/mL	3.76 uIU/mL	3.02 uIU/mL
Free Thyroxine	0.61-1.30 ng/dL	.85 ng/dL	.90 ng/dL

Patient Outcome

- He no longer experiences high heart rate episodes, thanks to improved cardiac function and autonomic nervous system regulation.
- Engages in regular strength training in a supportive group environment has not only enhanced his physical strength but also provided social support.
- His H. Pylori has resolved, stress is effectively managed, and a well-balanced diet has stabilized his energy levels.
- He utilizes the vagus nerve exercises as part of his normal routine.
- Ben now enjoys a fulfilling family life, fully present and engaged with his loved ones.

Nutritional and Lifestyle Strategies to Optimize Your Vagus Nerve



Questions?



Get In Touch:

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References

- ¹ Fleming MA 2nd, Ehsan L, Moore SR, Levin DE. The Enteric Nervous System and Its Emerging Role as a Therapeutic Target. *Gastroenterol Res Pract*. 2020 Sep 8;2020:8024171. doi: 10.1155/2020/8024171. PMID: 32963521; PMCID: PMC7495222.
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