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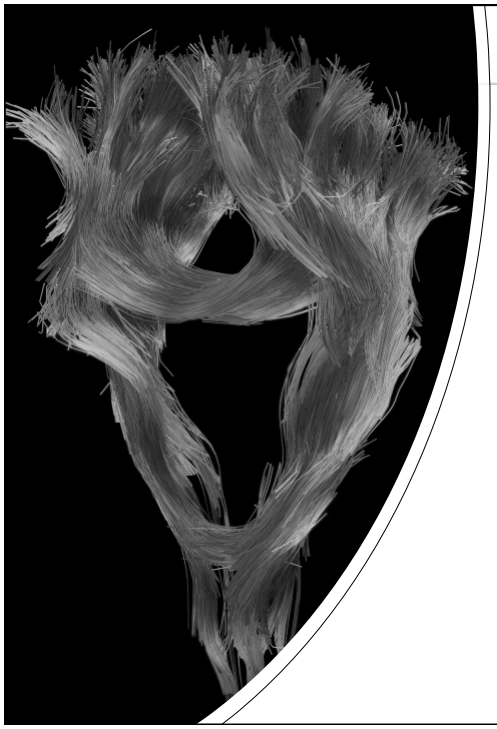


Cranial Dysfunction in Children

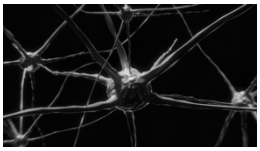
A focus on neurodevelopment and social engagement

CONTINUED

Learning Outcomes

- After this course, participants will be able to identify, name and explain the function of the cranial nerves.
- After this course, participants will be able to identify cranial nerve dysfunction, especially as it relates to the vagus nerve.
- After this course, participants will be able to list different treatment techniques that enhance cranial nerve function.

The Cranial Nerves



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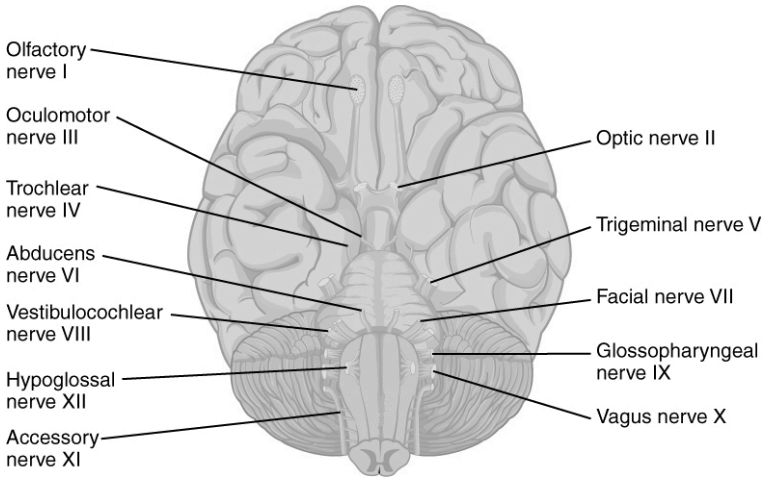
- Cranial nerves are composed of the neural processes associated with distinct brainstem nuclei and cortical structures.
- Typically, the more posterior and lateral nuclei tend to be sensory, and the more anterior of tend to be the motor.

Cranial Nerve - Function

- Cranial nerves I (olfactory), II (optic), and VIII (vestibulocochlear) are considered purely afferent.
- Cranial nerves III (oculomotor), IV (trochlear), VI (abducens), XI (spinal accessory), and XII (hypoglossal) are purely efferent.
- The remaining cranial nerves, V (trigeminal), VII (facial), IX (glossopharyngeal), and X (vagus), are functionally mixed (sensory and motor)



Origins - Nuclei

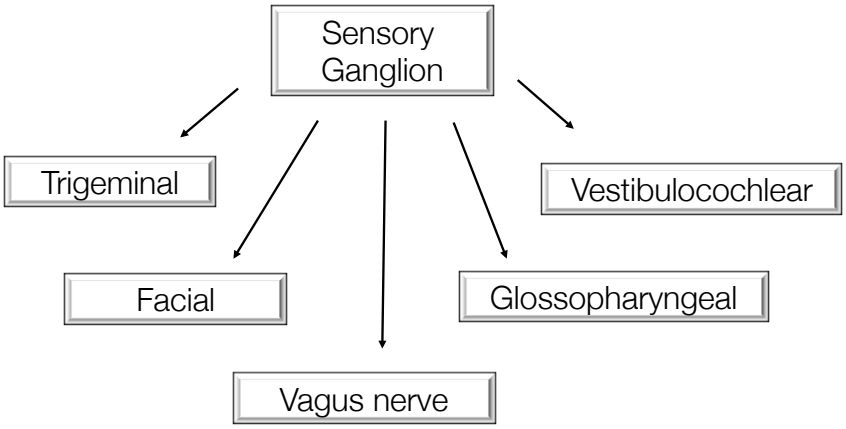
- Brainstem
  - Oculomotor nerve (III)
  - Trochlear nerve (IV)
- Pons
  - Trigeminal nerve (V)
  - Abducens nerve (VI)
  - Facial nerve (VII)
  - Vestibulocochlear nerve (VIII)
- Medulla
  - Glossopharyngeal nerve (IX)
  - Vagus nerve (X)
  - Accessory nerve (XI)
  - Hypoglossal nerve (XII)

Ganglion

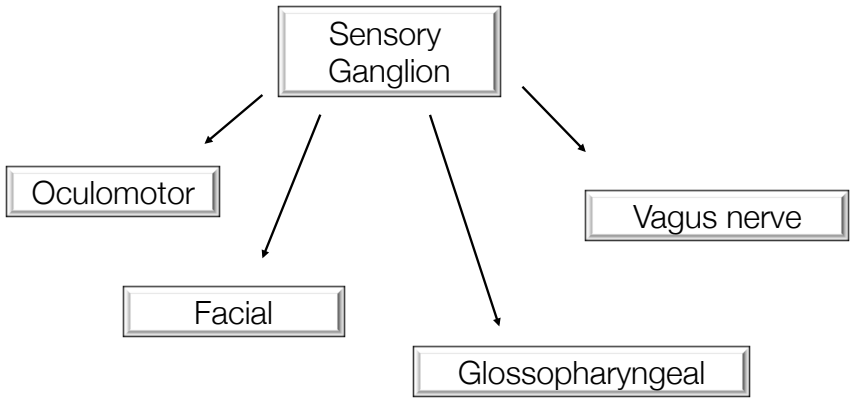
Some of the cranial nerves have sensory or parasympathetic ganglia (Cell Bodies – outside the brain).[1]

Typically, the more posterior and lateral nuclei tend to be sensory, and the more anterior of tend to be the motor.[2]

Sensory Ganglion[3]



Parasympathetic Ganglion



Olfactory (I)

- Shortest cranial nerve
- Most primitive responses
- Does not go to the brainstem
- Ethmoid bone (cribriform plate)
- Nonconscious role in activating the limbic system[4]

Optic (II)

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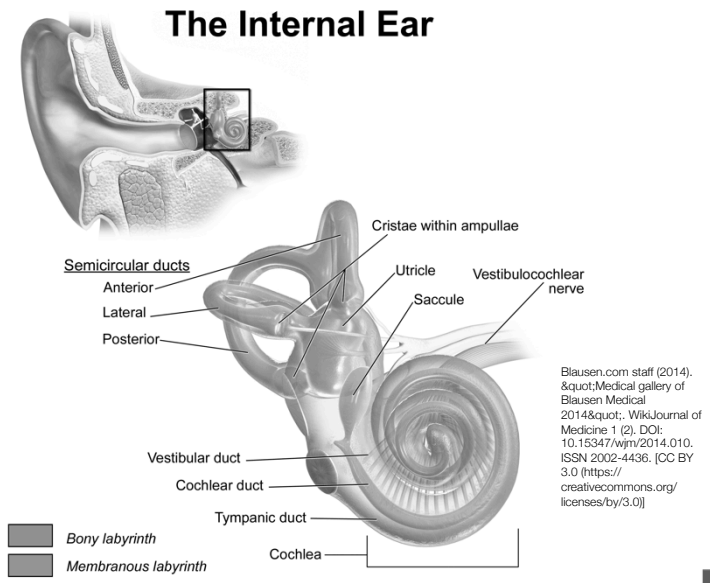
- Processing visual information
- Important for reflex integration of the VOR – movement and balance correction
- Neuroception
- Strong connection with memory centers
- Effect in Reticular Activating System (RAS)

Vestibulocochlear nerve (VIII)

- Auditory sense and the vestibular sense of orientation of the head
- Special sensory afferents (SSA) from the inner ear to the cochlear nuclei and the vestibular nuclei in the caudal medulla oblongata
- Fetus can hear at 20 weeks gestation



Nervus Terminalis CN: Zero

- Comprised of an independent central plexus of small unmyelinated nerves
- Possibly special visceral afferent [SVA] fibers
- Very close proximity to the olfactory tract
- It appears to have a rich bundle of well vascularized fibers ascending from the nasal submucosa and projecting to important limbic structures.
- Pheromones processed unconsciously by regulating autonomic responses

Oculomotor III

- Purely Motor nerve
- Movement of the eye
- Reference, eye contact and convergence
- Reference – social performance

Trochlear IV and Abducens VI

Trochlear

- Longest intracranial length
- Exits the rear of the brainstem
- Innervates the superior oblique muscle of the eye

Abducens

- Innervates the lateral rectus muscle
- Lateral and medial movement of the eye

Spinal Accessory Nerve XI

- Motor innervation of the trapezius and sternocleidomastoid muscles by way of the spinal nucleus of accessory nerve[2]
- Critical for head positioning and alignment
- Involved in the ATNR and STNR
- Important proximal stabilizer of the shoulder (scapula)
- Involved with torticollis

Hypoglossal XII

- All tongue muscles
- Limited by tongue tie or physical restriction
- Gag responsivity
- Nasal airflow / congestion
- Important for latch and SUCK of the infant
- Important for development of effective speech

Trigeminal V

- General somatic sensory innervation (GSA) of the face
  - V1 – Ophthalmic - eye
  - V2 – Maxillary: Face – cheek bones
  - V3 – Mandibular: Mastication - closing
- Sucking and jaw mobility
- Tactile, proprioceptive and sensation of the face, mouth, nose, sinus, dura, scalp, upper eyelids, and scalp.

Facial Nerve VII

- Has motor and autonomic fibers with minor somatosensory components[2]
- Special visceral efferent (SVE) motor innervation is to the muscles of facial expression
- Taste fibers from the anterior two-thirds of the tongue
- Innervation: orbicularis oris – Facial expression of emotion (Crow's feet)
- Stapedius muscle – inner gear
- Parasympathetic salivation

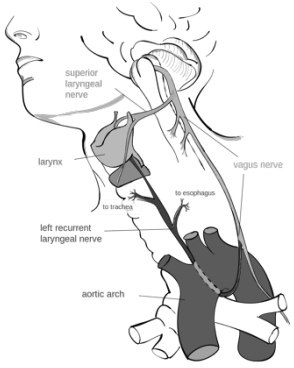
Glossopharyngeal IX

- Inferior salivary nucleus
- Pharyngeal constrictor muscles by the nucleus ambiguous
- Posterior one third of the tongue

"Finally" Vagus X

- 80% Afferent
- 15% Efferent
- 5% Motor – involuntary control

- Ventral Vagus – Myelinated (Nucleus Ambiguus)
  - Supports Health, growth and wellness
  - Visceral organs above the diaphragm
  - Path to the social system (Porges)
- Dorsal Vagus – Unmyelinated (Dorsal Nucleus)
  - Supports fight or flight and biobehavioral shutdown
  - Terminates in the visceral organs below the diaphragm



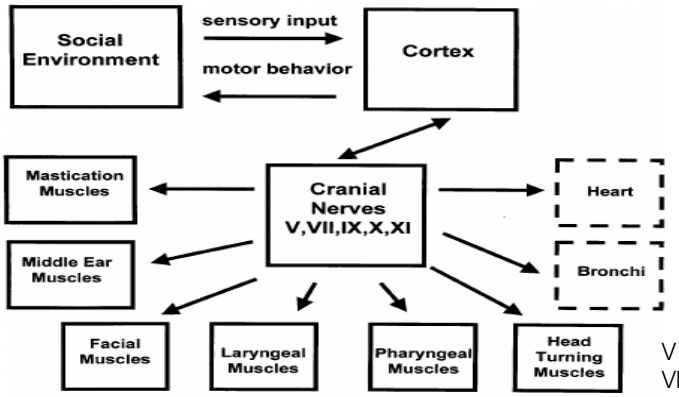
Vagus complex:

- Controls the Autonomic processes of the body
  - Social Engagement
  - Fight or flight
  - Immobilization / Freeze
- Vagal brake – effect on the heart
- Afferent Dorsal

Cranial Nerve Dysfunction

- Characterized by dysfunction / dysregulation or lack of efficient processing of the cranial nerves
- Typically present early in life
- Strong link to primitive reflexes and movement
- Asymmetry
  - Appearance
    - Facial
    - Postural
  - Function
    - Difficulty with suck/swallow and breath
    - Feeding difficulties
    - Challenges with posture
    - Lack of fluid movement
    - Inappropriate ANS response to environment

Social Engagement and Emotion



Porges 2001[5]

V - Trigeminal
VII – Facial
IX – Glossopharyngeal
X – Vagus
XI - Spinal Accessory Nerve

Face – Heart Connection

At birth for mammals the bidirectional neural communication between face and heart forms the core of social engagement

Metabolic demands, perceived danger, life threat and illness retract social engagement. Removing the Vagal Brake on the Heart and promoting defensive behaviors:

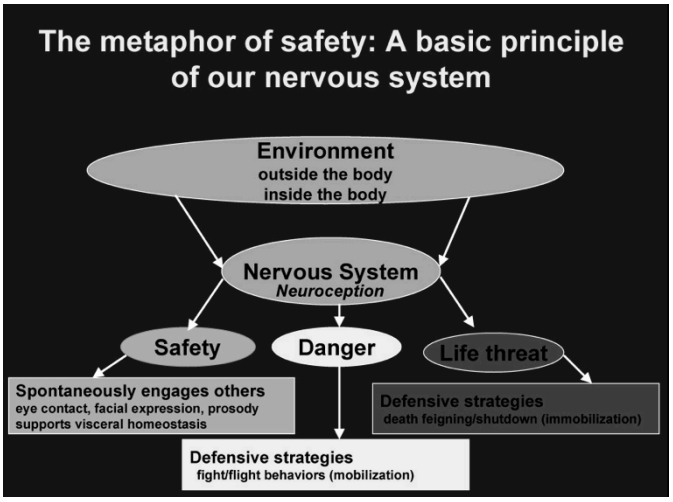
Baseline heart rate 90 – 100 bmp with no vagus…

The **FACE / VOICE** reflect polyvagal state

Polyvagal Theory

- Evolution provides an organizing principle to understand neural regulation of the human autonomic nervous system.
- Three neural circuits form a phylogenetically-ordered response hierarchy that regulate behavioral and physiological adaptation to safe, dangerous, and life threatening environments.
- New adaptive responses inhibit more primitive responses, but when they are unsuccessful, more primitive responses are activated.
- "Neuroception" of danger or safety or life threat trigger these adaptive neural circuits.
- New models relating neural regulation to health, learning, and social behavior may be reversed- engineered into treatments.

Neuroception



Lack of Social Engagement

Observable deficits:

- Lack of prosody
- Poor eye contact (reference in social communication)
- Blunted face (Especially eye – no beam or gleam)
- Difficulties with behavioral stat regulation (Hypervigilant, anxious, distractible, impulsive, tantrums and hyper-arousal)
- Compromised vagal regulation (e.g. State regulation, digestion)
- Difficulties in listening, following verbal directions and speech delays
- Sound sensitivity
- Oral motor defensiveness (digestion)

Treatment for Cranial Dysfunction

- Emphasis on Subcortical Processing
  - Bottom up approach
- Manage arousal and autonomic system
  - Safe Space
  - Coregulation / Connection
- Work on Integrating Reflexes
- Sensory Integration
  - Registration
  - Discrimination
  - Processing
- Establish functional movement patterns
- INCORPORATE PARENTS / CAREGIVERS

Managing Cranial Dysfunction

- Social Engagement and Self Regulation
  - Safe and Sound Protocol
  - Dr. Stephen Porges
    - https://www.stephenporges.com/
    - https://integratedlistening.com/ssp-safe-sound-protocol-clinical-resources/
- Reinforce Autonomic Regulation
  - Co-regulation
  - Music based support (Integrated Listening / The Listening Program / Tomatis / Therapeutic Listening)
    - Multi-sensory engagement of cranial nerves

Managing Cranial Dysfunction

- Reflex Integration
  - Maxine Haller
    - https://www.cardinalcapers.com/
- Tongue . Lip Tie, movement and social engagement
  - Michelle Emanuel, OTR/L, CST, CIMI, NBCR, RYT200
    - https://www.tummytimemethod.com/professional-training.html
- Sensory Integration
  - A. Jean Ayres, PhD, OTR
  - Lucy Miller, PhD
    - Sensory Over Responding
    - Sensory Under Responding
    - Sensory Discrimination
    - Arousal

Managing Cranial Dysfunction

- Feeding
  - SOS Feeding Star Institute
    - Dr. Kay Toomey
    - https://sosapproach-conferences.com/professionals/sos-certification-program/
  - TR-eat® Feeding Therapy
    - Elizabeth Clawson, PhD
    - http://www.pediatricfeedinginstitute.com/about/the-tr-eat-model/
  - Vital Stim
    - Ciao Seminars
    - https://www.ciaoseminars.com/home/courses/?CFID=9592838&ctid=2&nonid=0&evd=1&CFTOKEN=76304610&oid=129

Managing Cranial Dysfunction

- Interoception
  - Activities to build awareness of internal state
  - Kelly Mahler, OTR/L
  - https://www.kelly-mahler.com/what-is-interoception/
- Co-Regulation
  - Floortime® Therapy
  - Parents or Primary caregivers education
  - Engaging the Face – Heart Connection
  - Using movement and reinforcement of connection

Managing Cranial Dysfunction

- Movement
  - Torticollis and Plagiocephaly
  - Michelle Emanuel, OTR/L, CST, CIMI, NBCR, RYT200
    - https://www.tummytimemethod.com/professional-training.html
- Functional Emphasis
  - Do OT
  - FUN

References:

1. Vilensky, Joel; Robertson, Wendy; Suarez-Quian, Carlos (2015). The Clinical Anatomy of the Cranial Nerves: The Nerves of "On Olympus Towering Top". Ames, Iowa: Wiley-Blackwell. ISBN 978-1-118-49201-7.
2. Sonne J, Lopez-Ojeda W. Neuroanatomy, Cranial Nerve. [Updated 2019 Apr 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019
3. Kandel, Eric R. (2013). Principles of neural science(5 ed.). Appleton and Lange: McGraw Hill. pp. 1019–1036. ISBN 978-0-07-139011-8.
4. Mutic S, Brünner YF, Rodriguez-Raecke R, Wiesmann M, Freiherr J. Chemosensory danger detection in the human brain: Body odor communicating aggression modulates limbic system activation. Neuropsychologia. 2017 May;99:187-198. [PubMed: 28254652]
5. Porges, S.W. (2001). The polyvagal theory: phylogenetic substrates of a social nervous system. International journal of psychophysiology : official journal of the International Organization of Psychophysiology, 42 2, 123-46 .

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Questions?

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