

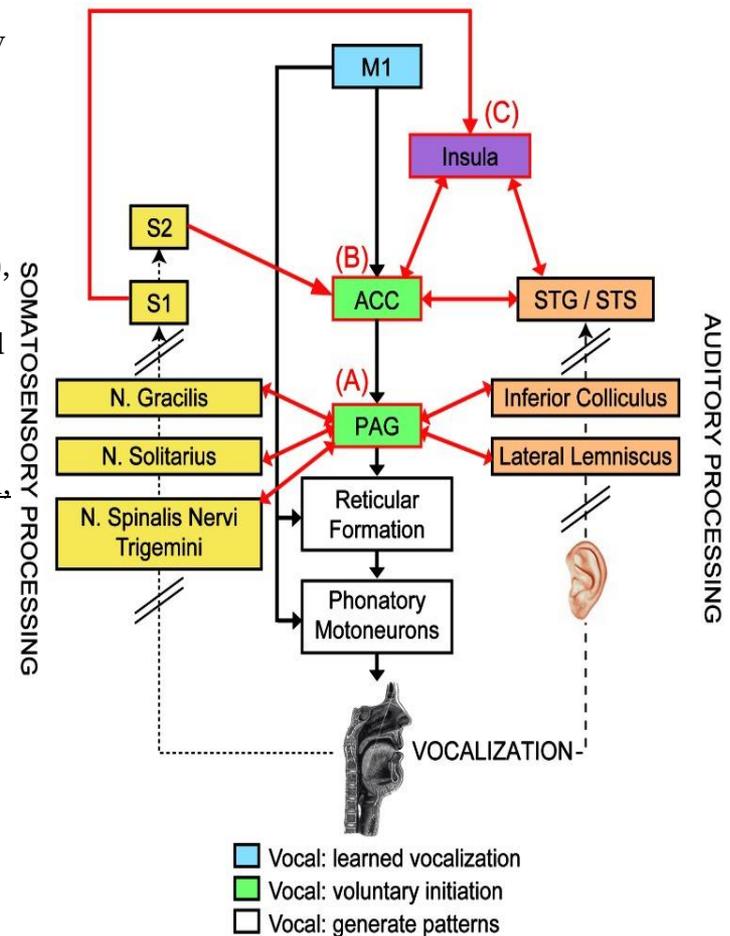
Round table: Neurogenic disorders, voice and swallowing

Moderated by Mette Pedersen

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Motor and sensory control systems of voice production

- The vocal motor control hierarchy starts with the generation of complete vocal patterns from the reticular formation and phonatory motor neurons (white boxes)
- the next highest level of control (green boxes) stems from the anterior cingulate cortex (ACC) and periaqueductal gray (PAG), which can initiate and emotionally motivate vocal responses.
- The highest level of vocal control comes from the primary motor cortex (M1, blue box; its modulatory brain regions are not depicted), which is responsible for producing learned vocalizations.
- Somatosensory feedback (arrow) from various receptors distributed throughout the vocal tract is processed in the ascending somatosensory pathway (yellow boxes, left; black slanted lines indicate that only selected regions of this pathway are shown) and transmitted to the primary and secondary somatosensory cortex (S1, S2).
- Auditory feedback (arrow) from the vocalization is processed by the ascending auditory pathway and auditory cortical regions (orange boxes, right).
- Potential neural regions that integrate sensory feedback processing with vocal motor control are indicated with red-outlined boxes, and their shared connections are represented by red arrows: (A) the PAG, (B) ACC, and (C) the insula (in purple, classified as a higher-order associative area).

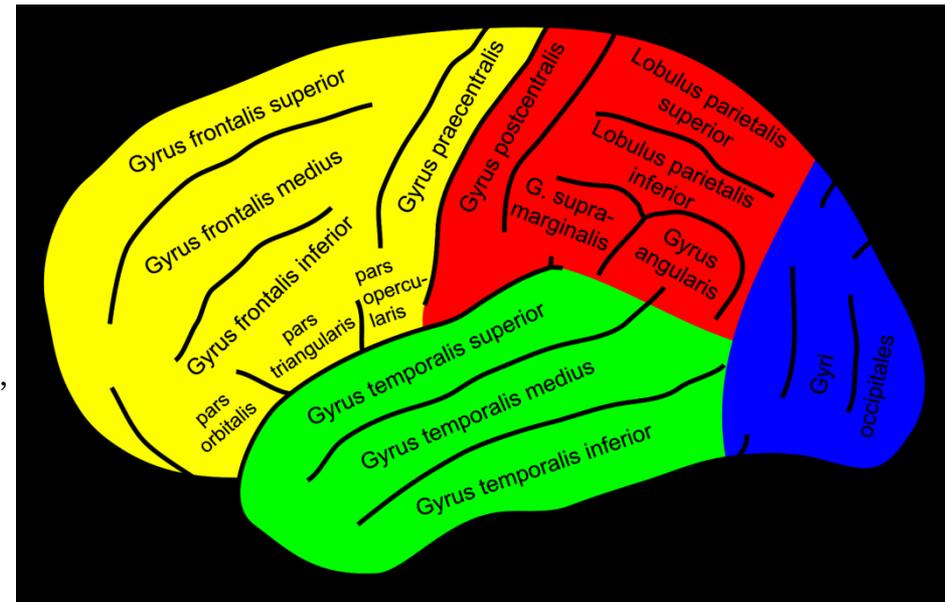


Superior temporal and middle temporal gyri activation during voice function

- The middle temporal gyrus and inferior temporal gyrus serve language and semantic memory processing
- Middle temporal gyrus and inferior temporal gyrus gray matter volumes were measured in 28 healthy male subjects by using high-spatial-resolution MRI.

Superior temporal gyrus:

- The superior temporal gyrus contains the primary auditory cortex, which is responsible for processing sounds. Specific sound frequencies map precisely onto the primary auditory cortex.
- This auditory (or tonotopic) map is similar to the homunculus map of the primary motor cortex.
- Specialized for processing combinations of frequencies.
- Specialized for processing changes in amplitude or frequency.
- Essential structure involved in auditory processing as well as in the function of language in individuals.
- Is an important structure in the pathway consisting of the amygdala and prefrontal cortex, which are all involved in social cognition processes.



Music rehabilitation systems

- **Rhythmic auditory stimulation (RAS)**
 - The key element of RAS is the phenomenon of auditory entrainment, that is, the body's ability to synchronize its movements rhythmically. External auditory activity is mediated by internal unconscious perceptual shaping at the subcortical level, and can arouse and raise the excitability of spinal motor neurons mediated by auditory-motor circuitry at the reticulospinal level.
 - Kwak, E. (2007). Effect of Rhythmic auditory stimulation on gait performance in children with spastic cerebral palsy. *J. of Music Therapy*. 198-216. (Gait means walking patterns).
 - Stahl, B., Kotz, S.A., Henseler, I., Turner, R., Geyer, S. (2011). Rhythm in disguise: why singing may not hold the key to recovery from aphasia. *Brain*; 134, 3083-3093. (Disguise means hidden).
- **Patterned sensory enhancement (PSE)**
 - Regulates functional movement by translating the temporal, spatial and force-dynamic components of movement kinematics into sound patterns, similar to sonification patterns in high performance athletic training, and then plays them back to provide feedback and feedforward regulation for enhanced motor control.
 - Studies based on PSE for home-bound stroke patients by measuring the level of upper extremity function, depression, and interpersonal relationship prove that the PSE upper extremity exercise program for home-bound stroke patients was an effective strategy for enhancing upper extremity function, decreasing the depression level, and improving interpersonal relationships.
 - Hong, M. (2011). The development and effect of an upper extremity exercise program based on patterned sensory enhancement for home-bound stroke patients. *Journal of Korean academy of community health nursing*; vol.22:192-203.
- **Melodic intonation therapy (MIT) and neurological music therapy (NMT)**
 - Is a therapeutic process used by music therapists and speech pathologists to help patients with communication disorders caused by brain damage. This method uses a style of singing called melodic intonation to stimulate activity in the right hemisphere of the brain in order to assist in speech production.
 - Carroll, D. (1996). A study of the effectiveness of an adaptation of melodic intonation therapy in increasing the communicative speech of young children with down syndrome. A thesis, McGill University, Montreal, Canada.
 - Thaut, M. H., Hoemberg, V. Eds. (2014). *Oxford Handbook of Neurologic Music Therapy*. Oxford University Press, Oxford, UK.

Deglutition Disorders

- Difficulty in SWALLOWING which may result from neuromuscular disorder or mechanical obstruction.
- Dysphagia is classified into two distinct types:
 - oropharyngeal dysphagia due to malfunction of the PHARYNX and UPPER ESOPHAGEAL SPHINCTER;
 - and
 - esophageal dysphagia due to malfunction of the ESOPHAGUS

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- Testing
- aspiration and swallowing

- Treatment plan
- is only focusing on compensating the lost function