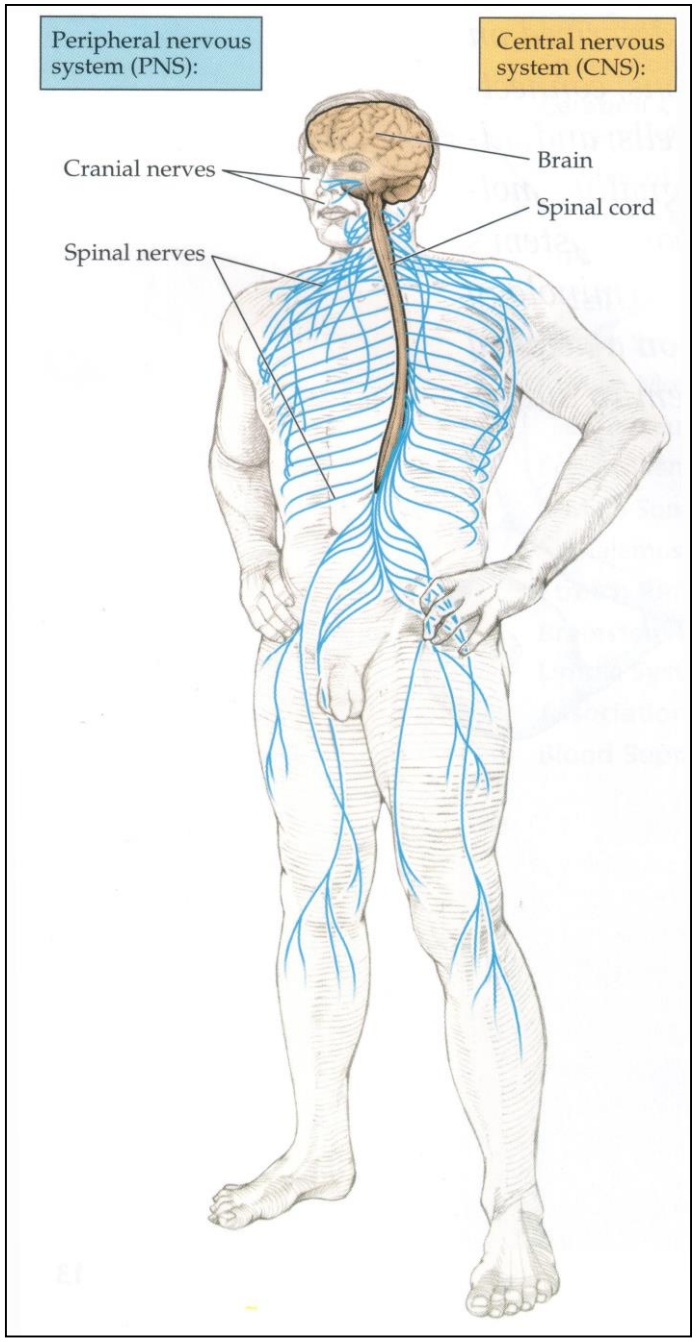
MassGeneral Hospital *for* Children℠

Pediatric Stroke Rehabilitation Workshop

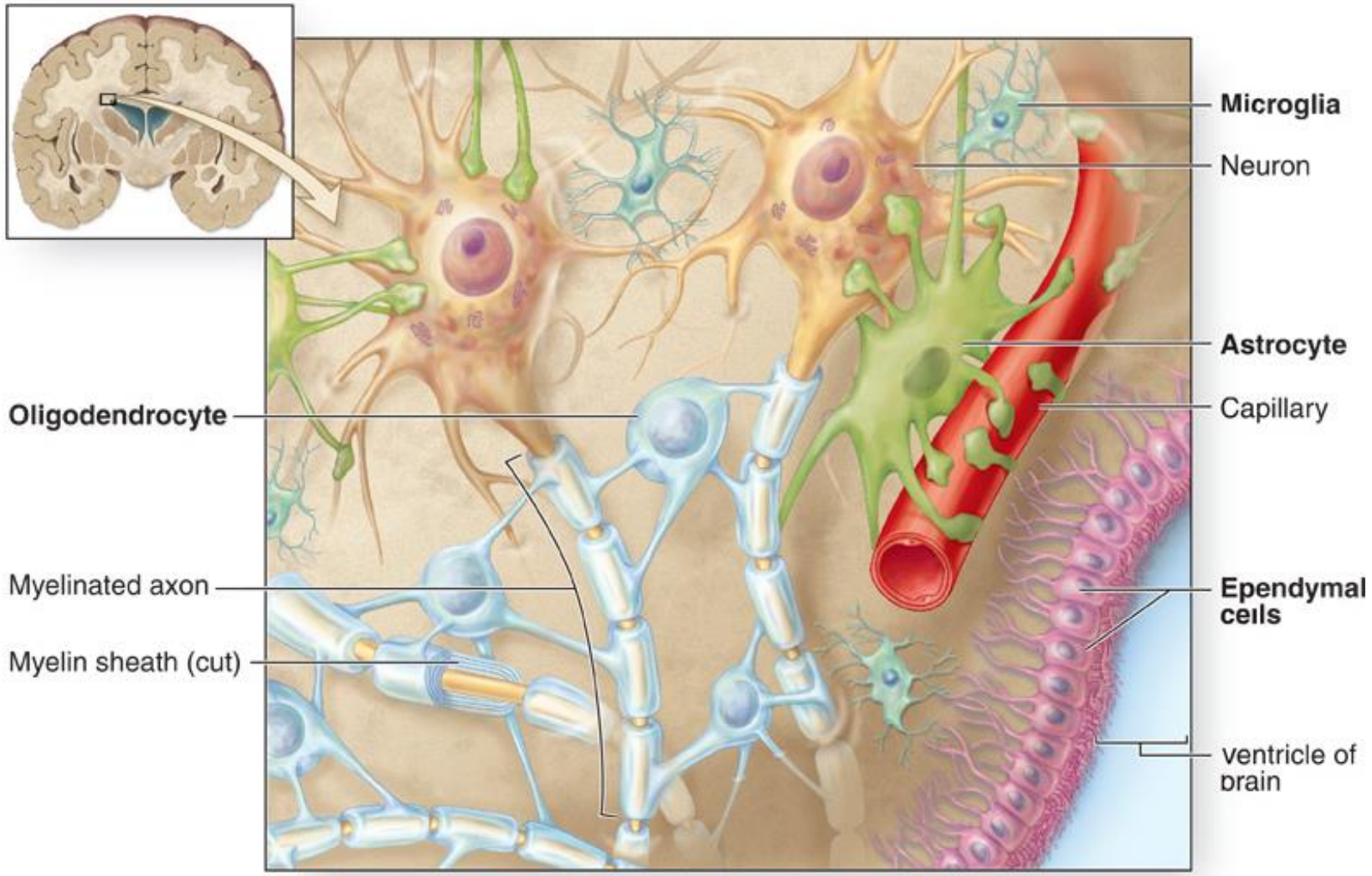
Language and Learning during Development

Patricia Musolino &Emma Hill

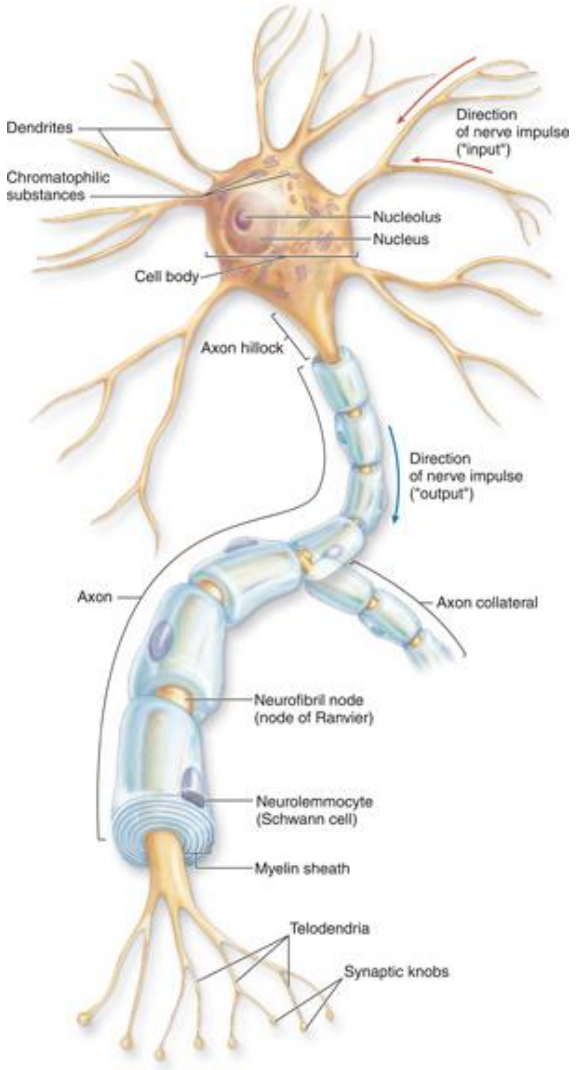


Brain, Spinal Cord and Nerves Anatomy

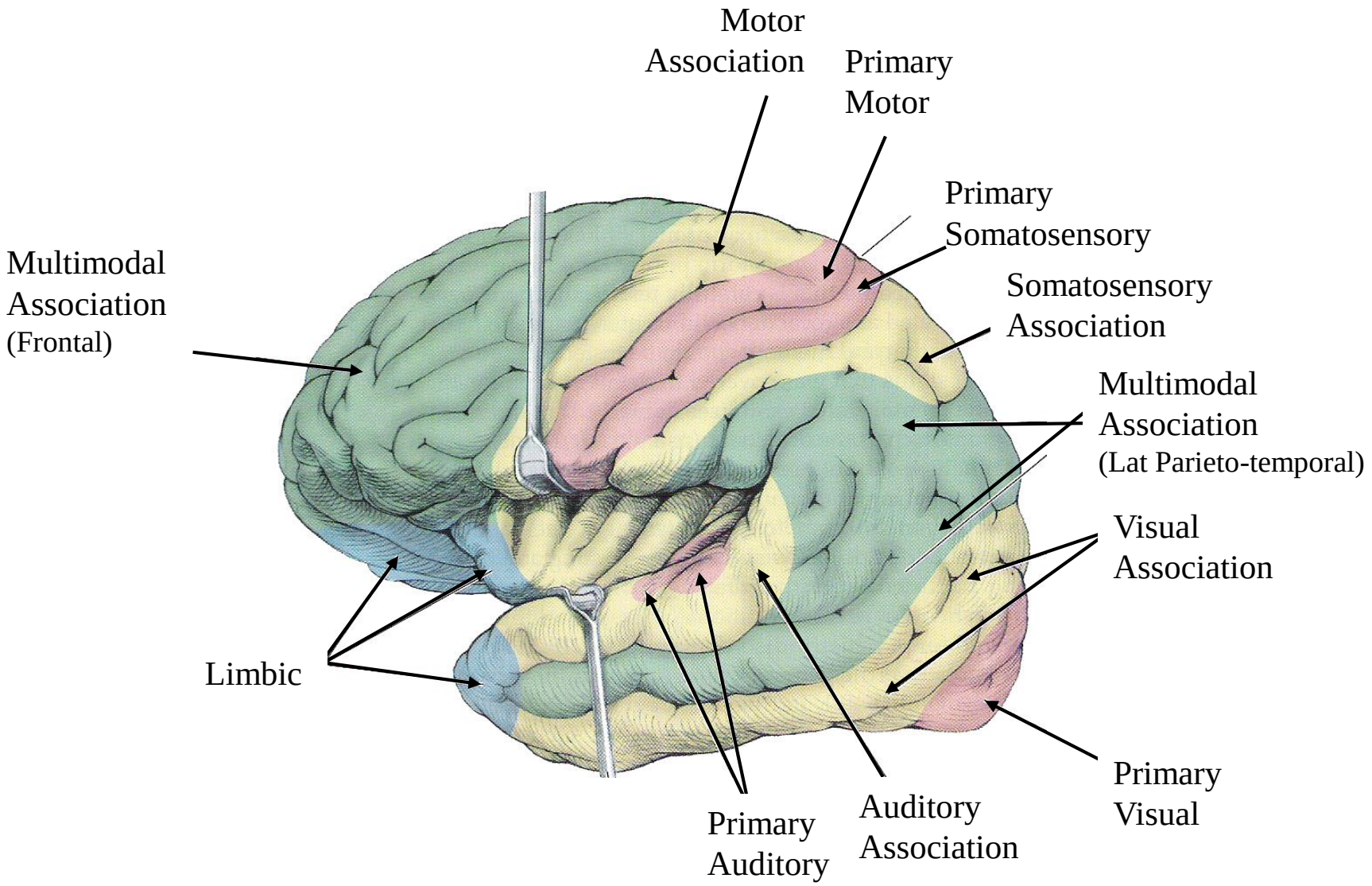
Cells of the Nervous System



Neurons –Nerve Cells and their insolation (myelin)

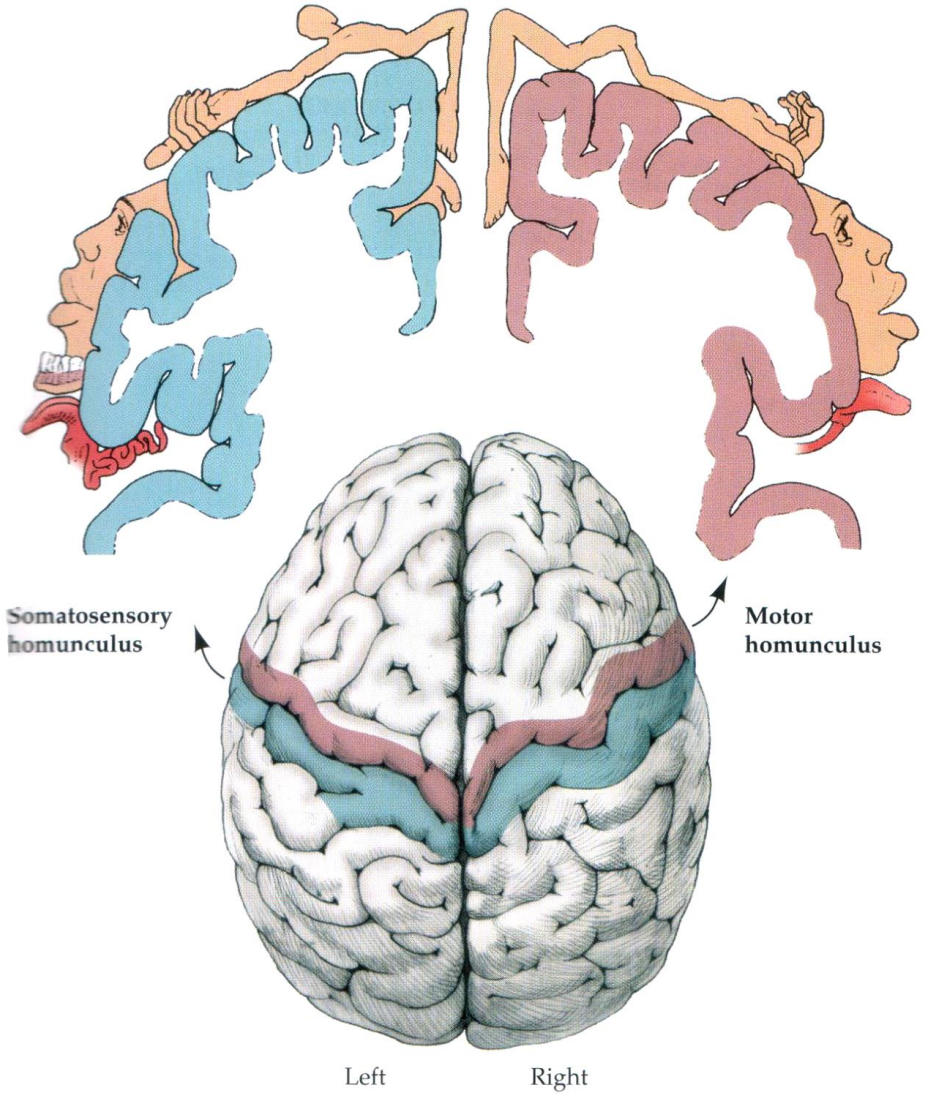


The brain has a map for each function



How does the brain know where the information is coming from and going to?

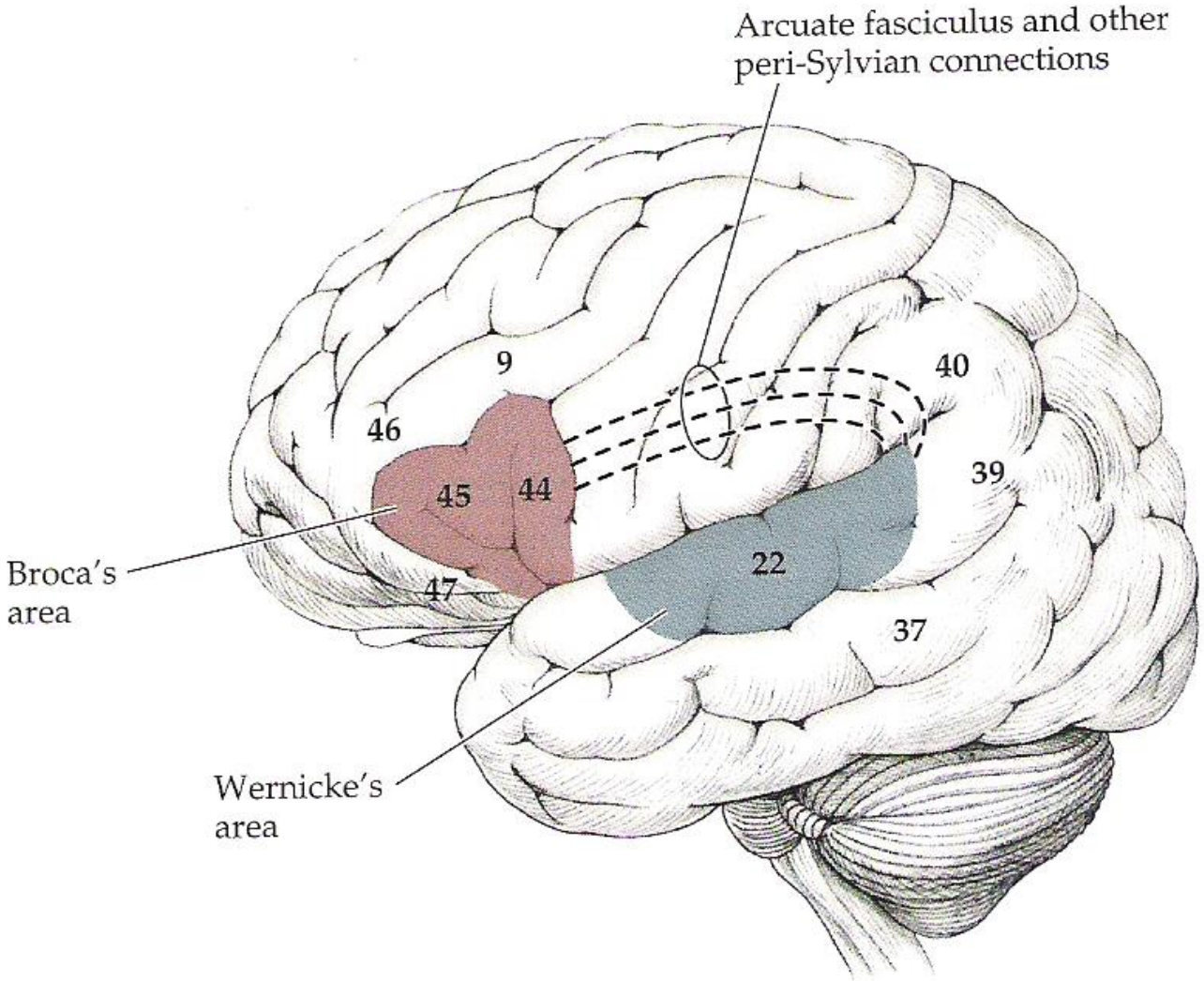
Sensation from face, tongue, vocal cords and diaphragm movements activated during phonation



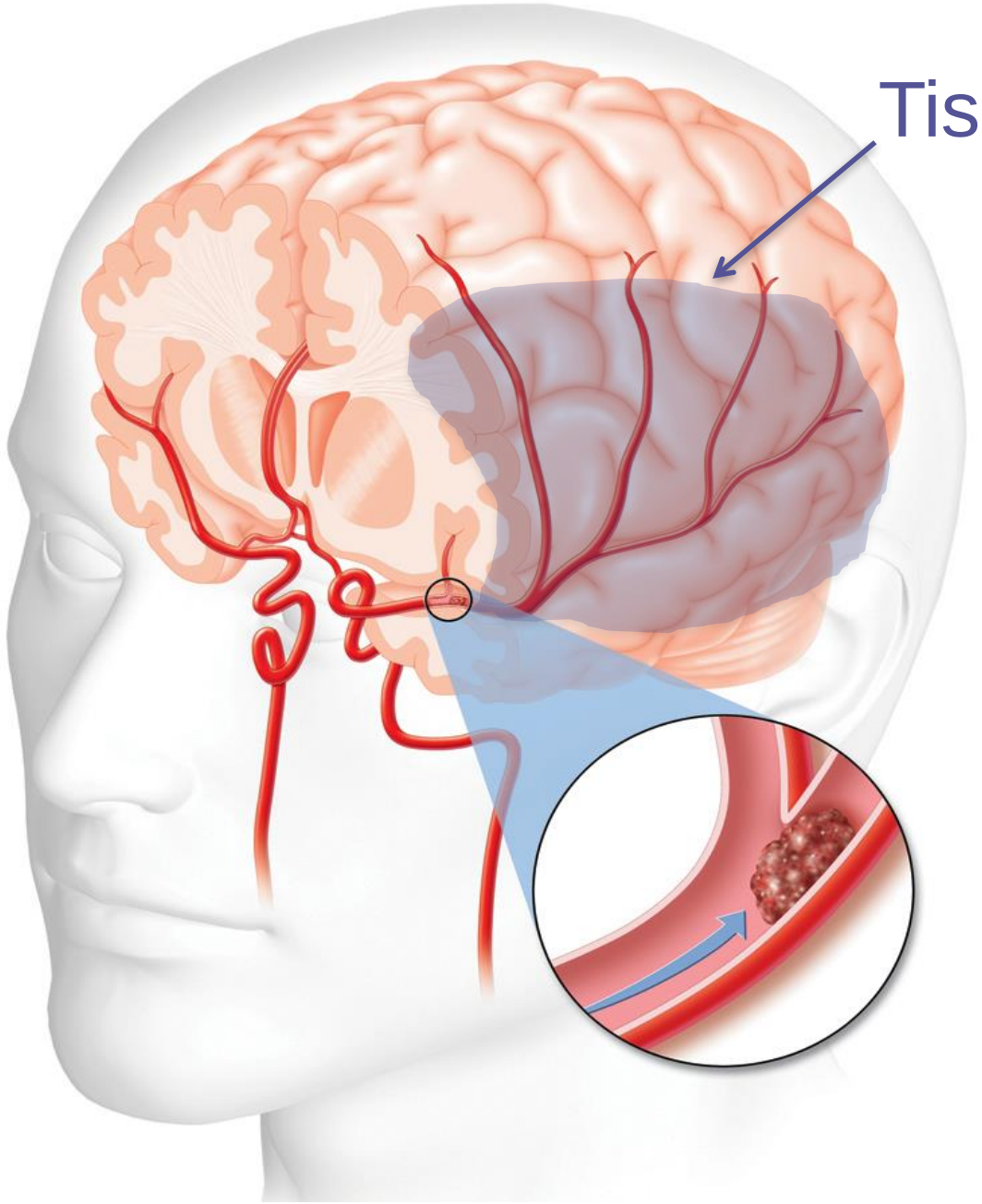
Muscles involved in face, tongue, vocal cords and diaphragm movements needed to phonate

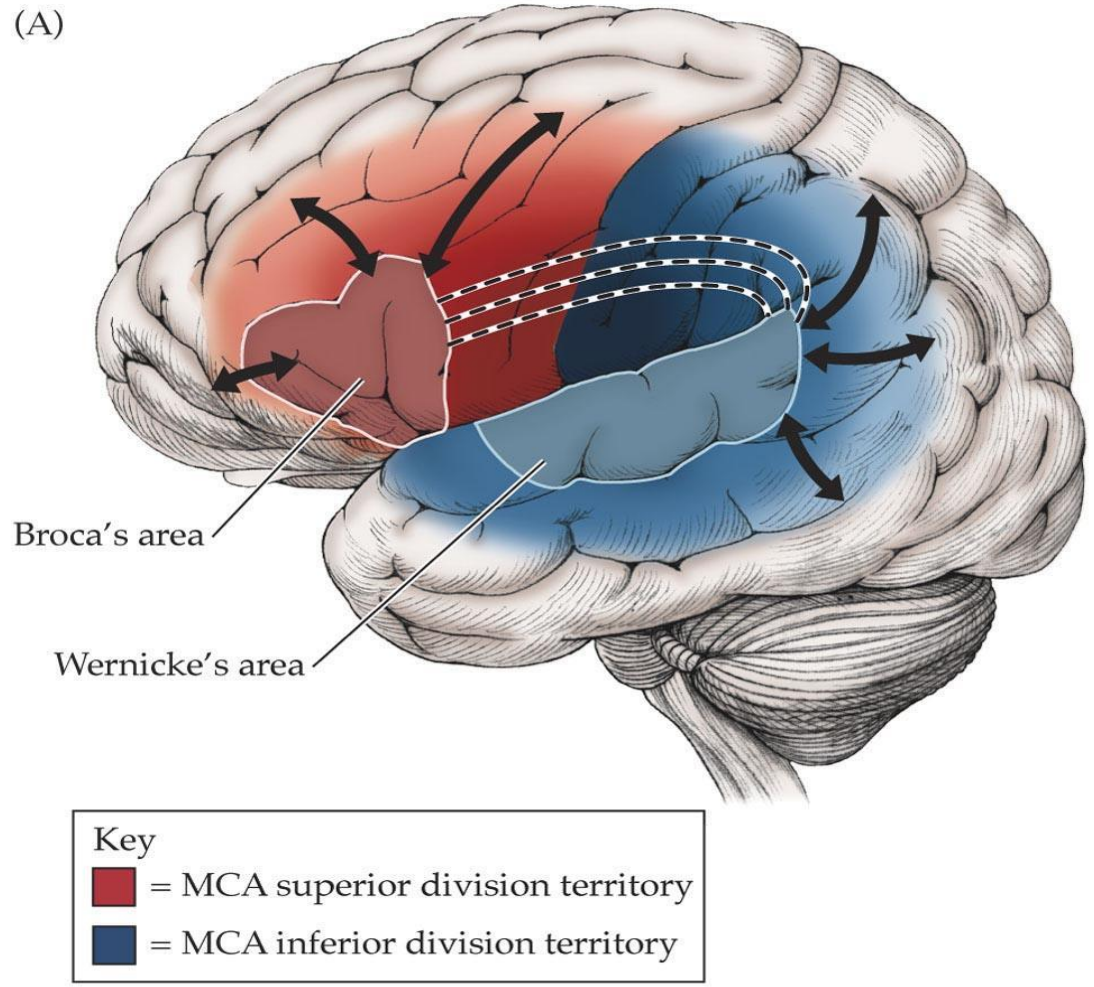
Language Mapping in the Brain

- Receptive Language
  - one area to decode sound into words (Wernicke: 22),
  - few to give meaning and integrate with other information (visual, sensory, etc) (37, 39),
- Connection between receptive and expressive language areas (circled)
- Expressive Language
  - few areas planning what to say (46,47)
  - one area controlling muscles involved in breathing, phonation and speech produciton (Broca: 44-45)

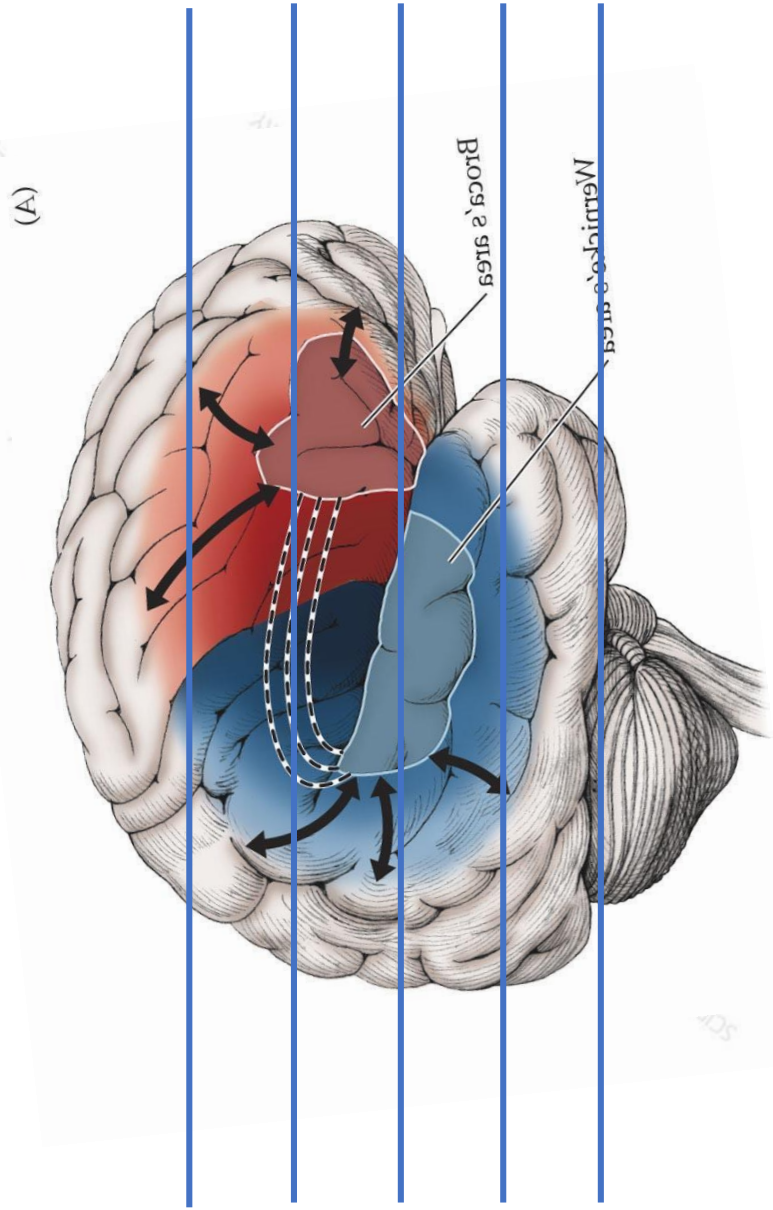


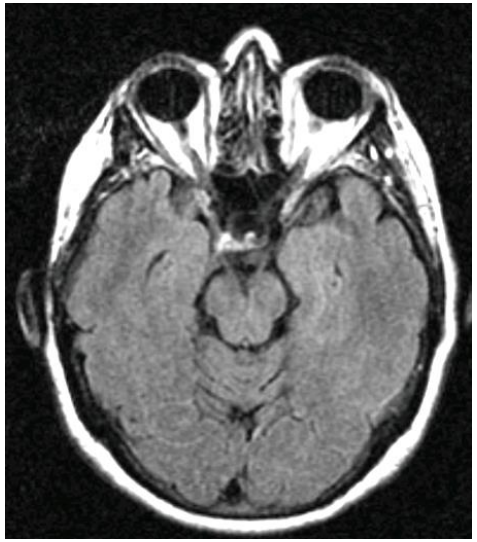
Tissue injured

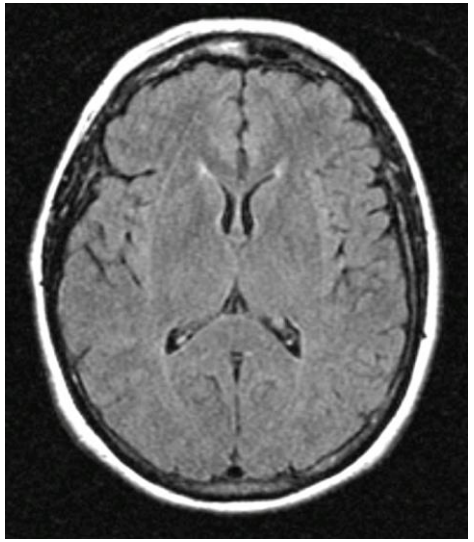


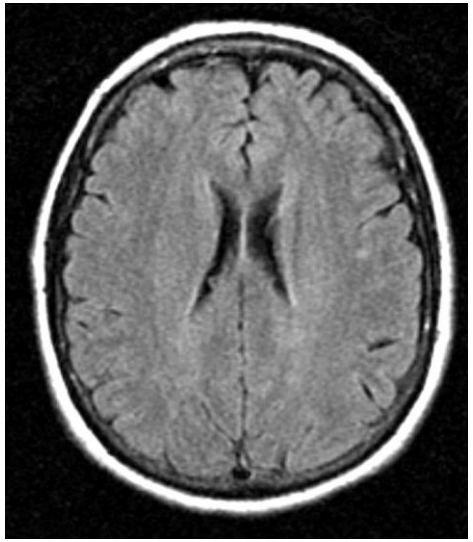


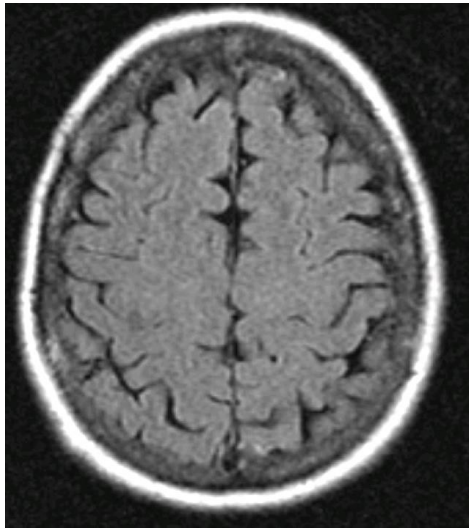
Brain Imaging



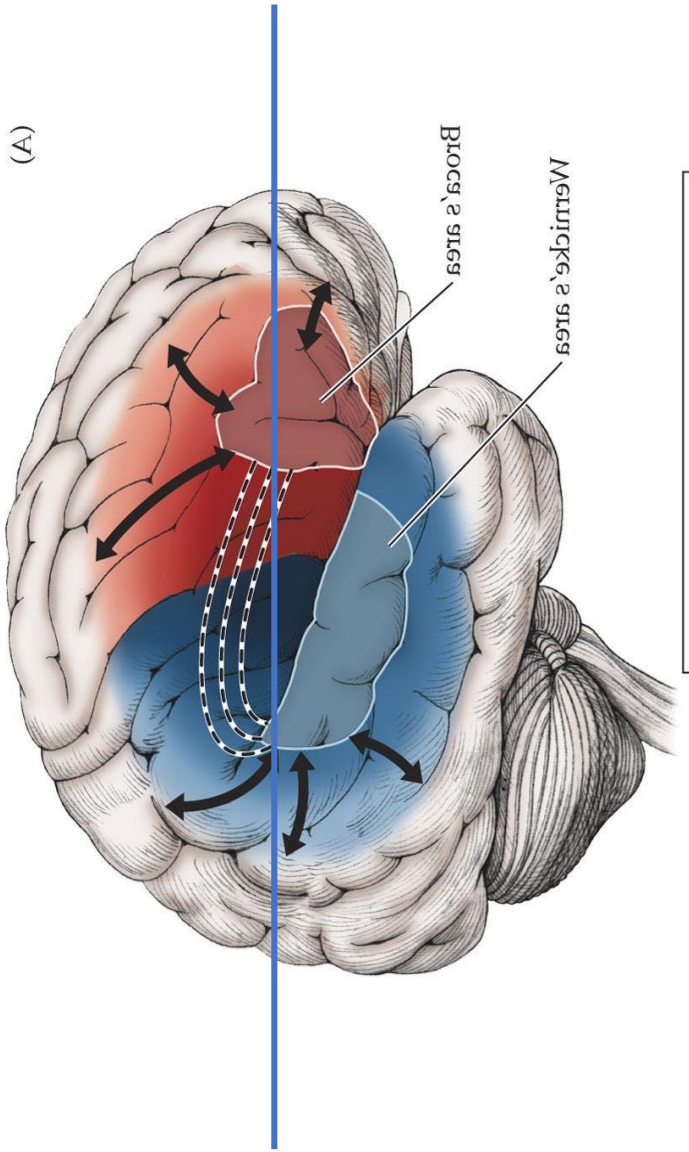


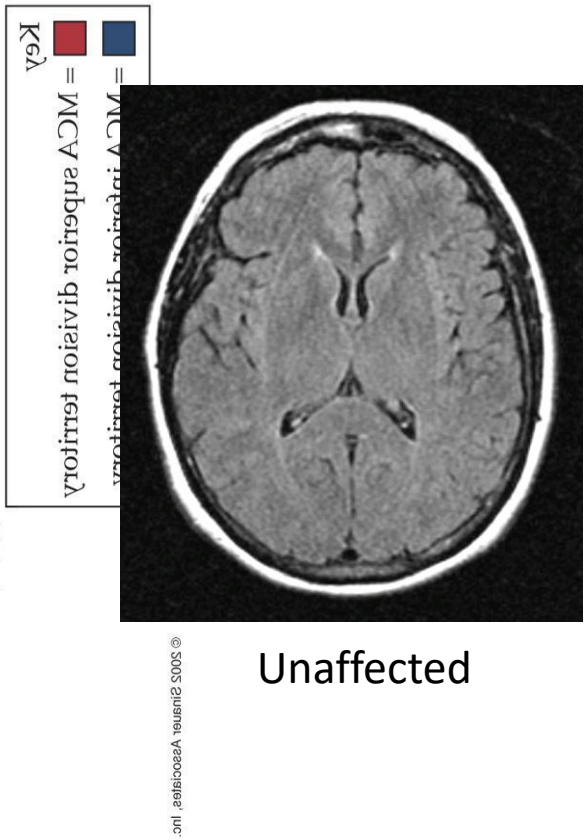




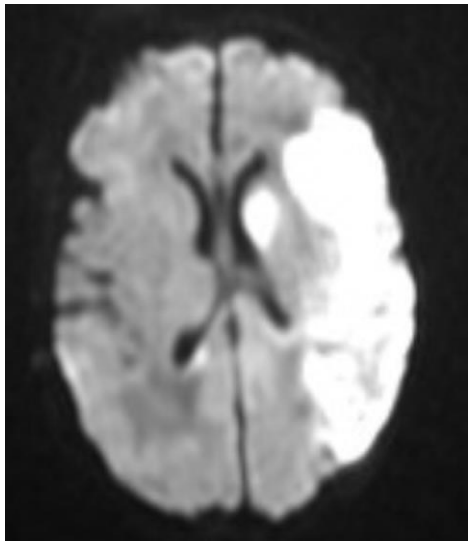


Brain Imaging- Acute and Chronic

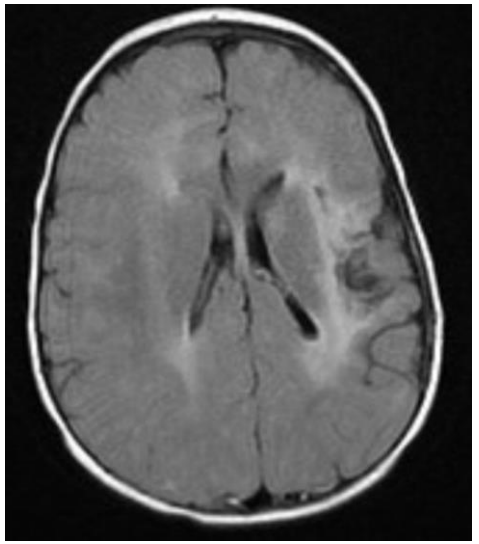




Unaffected

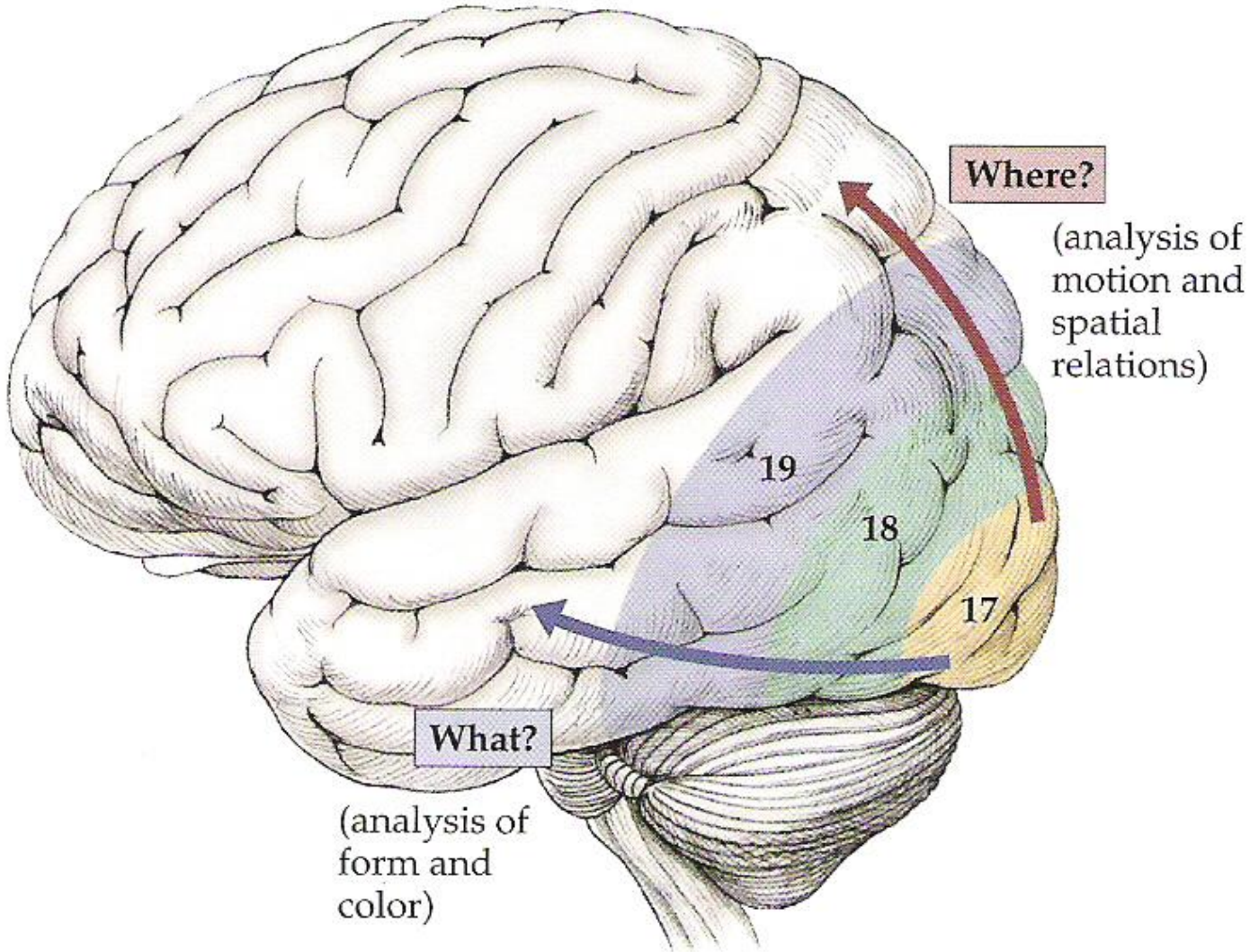


Left MCA Stroke



Sequla-Scar

Naming and Spatial Orientation



Instinctual communication

Expressive	Receptive	Speech Sounds
Vocalizing to express pleasure/discomfort - Hunger cry - Cooing in response to caregiver	Awareness of speaker/voices Recognizes familiar vs unfamiliar; friendly vs. unfriendly voices	Cooing - open vowels Sound play – “raspberries”, lip trills

Purposeful Communication

Expressive	Receptive	Speech Sounds
Vocalizing to express feelings Social communication - Back-and-forth cooing/babbling and laughing	Responds to sounds/voices Attends to speakers Recognizes highly familiar words/routines	Babbling - Reduplicated (repeats same syllable - babababa) - Variegated (different syllables - badabada)

True Language

Expressive	Receptive	Speech Sounds
First words/signs and gestures - Mama/dada - Waving - Reach to be picked up - Points to show Vocalizing with intent frequently	Follows some simple commands Understands words for some objects Understands some simple questions	Jargon – babbling with sentence-like intonation Imitates sounds and words

Expanding vocabulary

Expressive	Receptive	Speech Sounds
Pairs gesture and vocalization/words	Follows directions/routines consistently	Uses sounds like /p b w h t d n/
Vocabulary growth - Words for most familiar objects, people, routines	Understands many words Enjoys songs and books	Makes many sound errors Sometimes understood by familiar listeners
Emerging two-word phrases		

Language explosion

Expressive	Receptive	Speech Sounds
Rapid vocabulary expansion - Uses new words frequently Uses 2+ word phrases frequently	Follows longer, more-complex directions Responds to simple YES/NO and WH- questions Understands basic concepts (big vs. little; hot vs. cold, in vs. out)	By 2 years, 50% intelligible to familiar listener Still lots of sound errors

Emerging linguistic skills

Expressive	Receptive	Speech Sounds
Expanding grammaticality - Starts using early pronouns, prepositions, verb forms, etc. Answers simple questions Talks about personal experiences	Answers questions about personal experiences Answers questions about books while they are being read	By 3 years 75% to familiar listener

Starts telling simple stories

Able to retell favorite books/shows/movies

Asks questions

Topics expand beyond “here and now”

Adult-like language

Expressive	Receptive	Speech Sounds
Longer, more complex sentences More complex stories Academic concepts - letters, numbers, shapes	Understands and responds to “how” and “why” questions Recalls information from past experiences, previously seen books/movies	By 4 years, 100% intelligible to all listeners A few errors (/r/ /th/ /l/)

Higher level language

Expressive	Receptive	Speech Sounds
Complex conversations - True narratives - Predicting - Inferencing	Follows longer, more-complex directions with concepts like “first, next, before, after”	By 5, adult-like speech quality

Communication is much more than just words

Following their own developmental sequence








Multimodal-Integrative Experiences

- The developing brain is only able to learn by experiencing the body, the environment and the people around it
- Only by experiencing variation, trial and error the brain learns
- The developmental sequence is in place to assure no skipping important milestones that need to be in place before more complex learning can occur
- Healing from brain injury requires recreating these sequences
- By supporting this process we can make the highest impact in life potential and quality of every experience