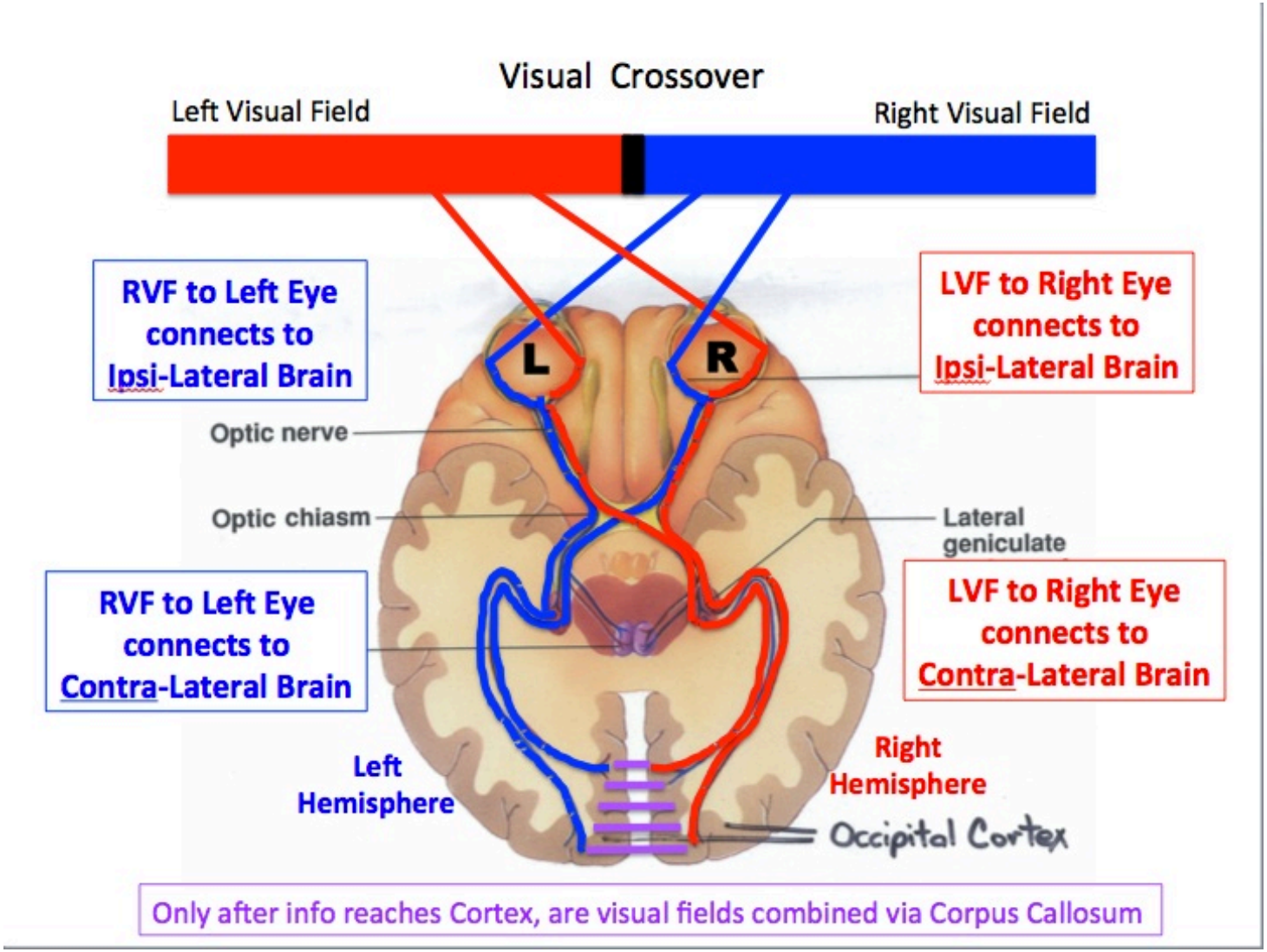
Lecture 12

Language & Lateralization

Cogs17 * UCSD

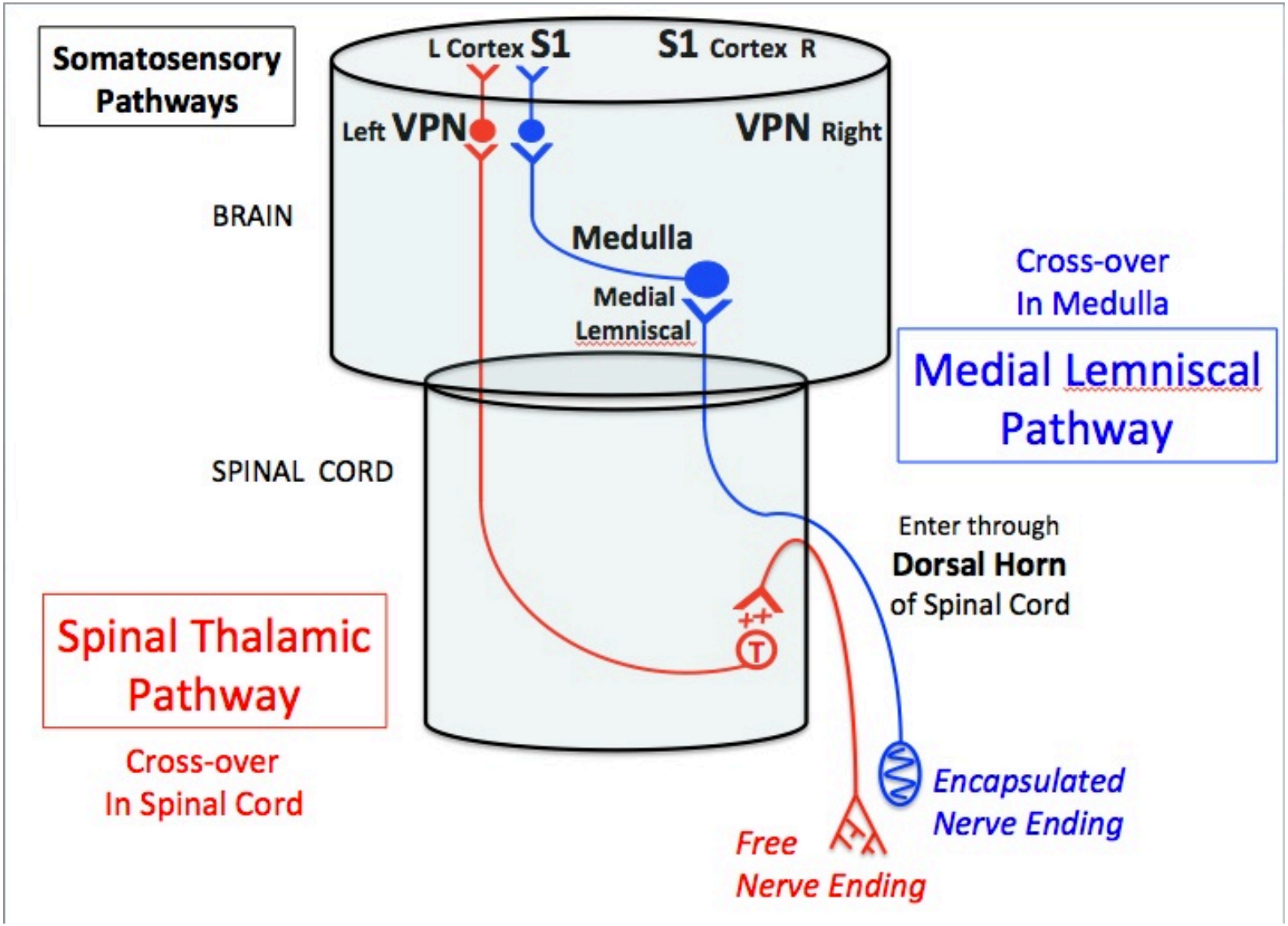
RECALL

Crossover in Visual System



RECALL

Crossover in Somatosensory System

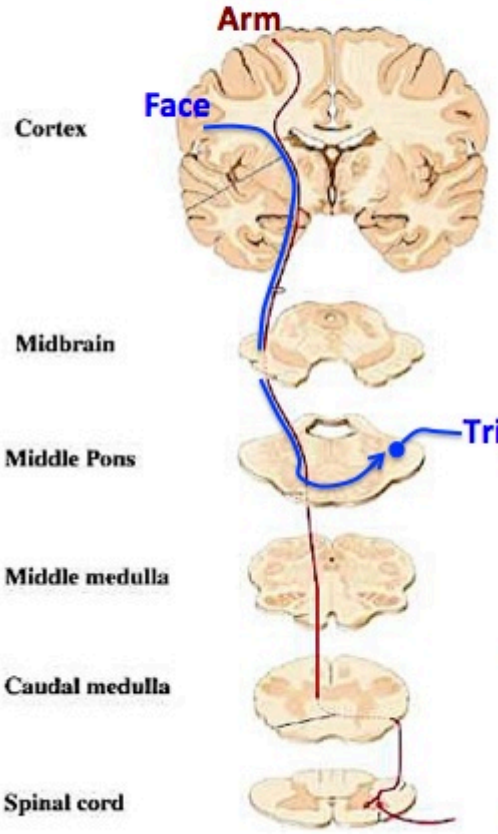


RECALL

Crossover in Motor System

Cortico-Spinal Tract

For control of voluntary motion, on contralateral side of body



Cortico-Spinal Pathway
from Motor Cortex

Corticobulbar Tract
for face movements

Crosses over in the **Pons**

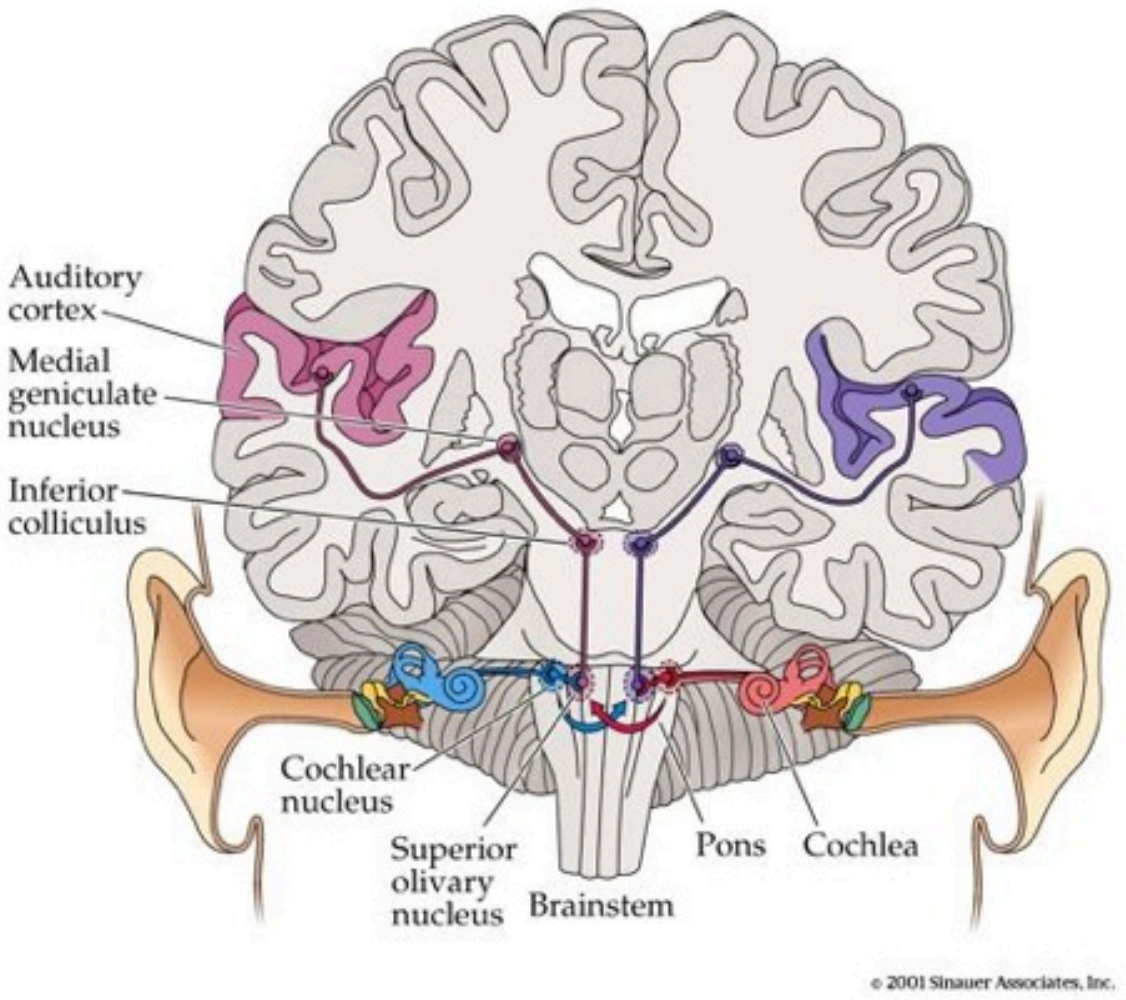
Trigeminal Nerve
to face

Most fibers cross to **Contralateral Spinal Cord** in Medulla

Activates motor neurons to contralateral skeletal muscles

RECALL

Bilateral Auditory Crossover



Lateralization

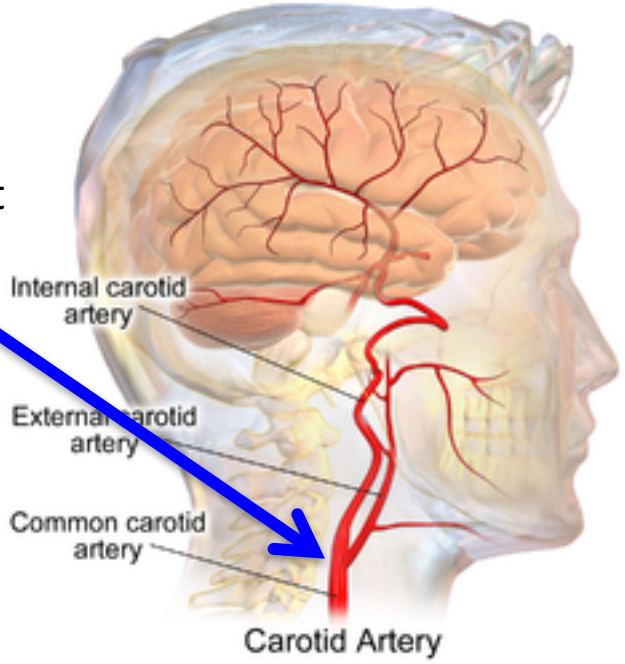
Dominance of (an area in) one hemisphere of cortex over the other
for a particular function

Lateralization

The WADA Test

Inject Sodium Amytal into either the left or the right Carotid Artery

This will anesthetize only the one hemisphere



Give the subject tasks to do, see which hemisphere has more of an impact on performance

e.g. Right Hemisphere: Visio-spatial tasks, Socio-emotional processes

e.g. Left Hemisphere: Speech, Fine motor control

- 90% of humans are right handed (left hemisphere dominant for handedness)

Lateralization

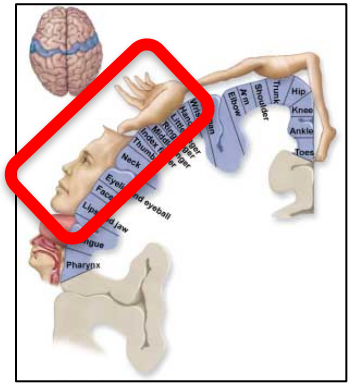
Interference

If similar parts of brain are critical in two tasks,
those tasks will tend to interfere with one another

Listening to music
does <u>not</u> interfere with
reading

But listening to the lyrics
<u>does</u> interfere with
reading

Try tapping a rhythm with your right hand
and talking at the same time!



RECALL

Hand & Face
adjacent in
dominant left
hemisphere

Lateralization

Why be lateralized??

One cause of **stuttering**
(seen mainly in left-handers)
may be
hemispheric competition
for control of speech

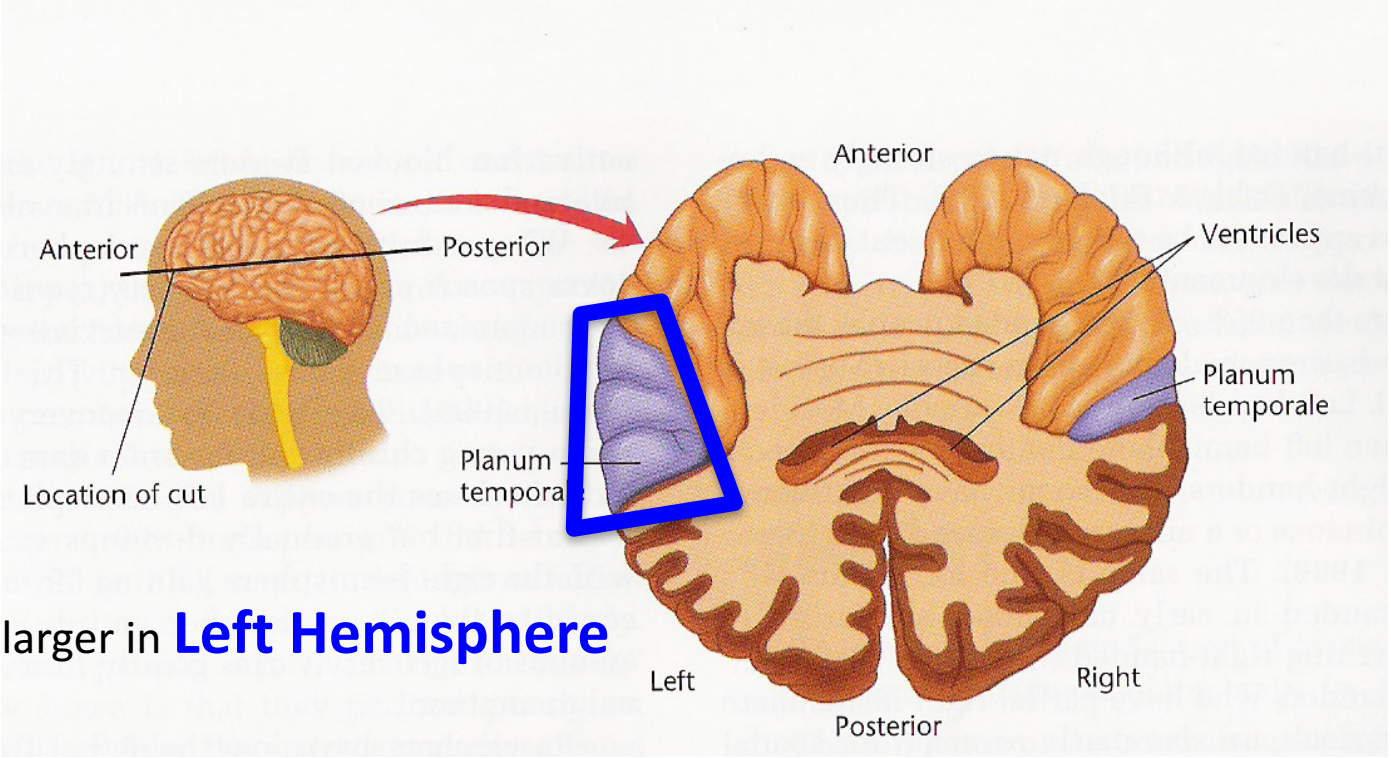
Lateralization of function may be a way to
avoid such competition

But note – most often, BOTH hemispheres contribute
to processing info & producing behavior

Lateralization

Sometimes based on structural differences across hemispheres

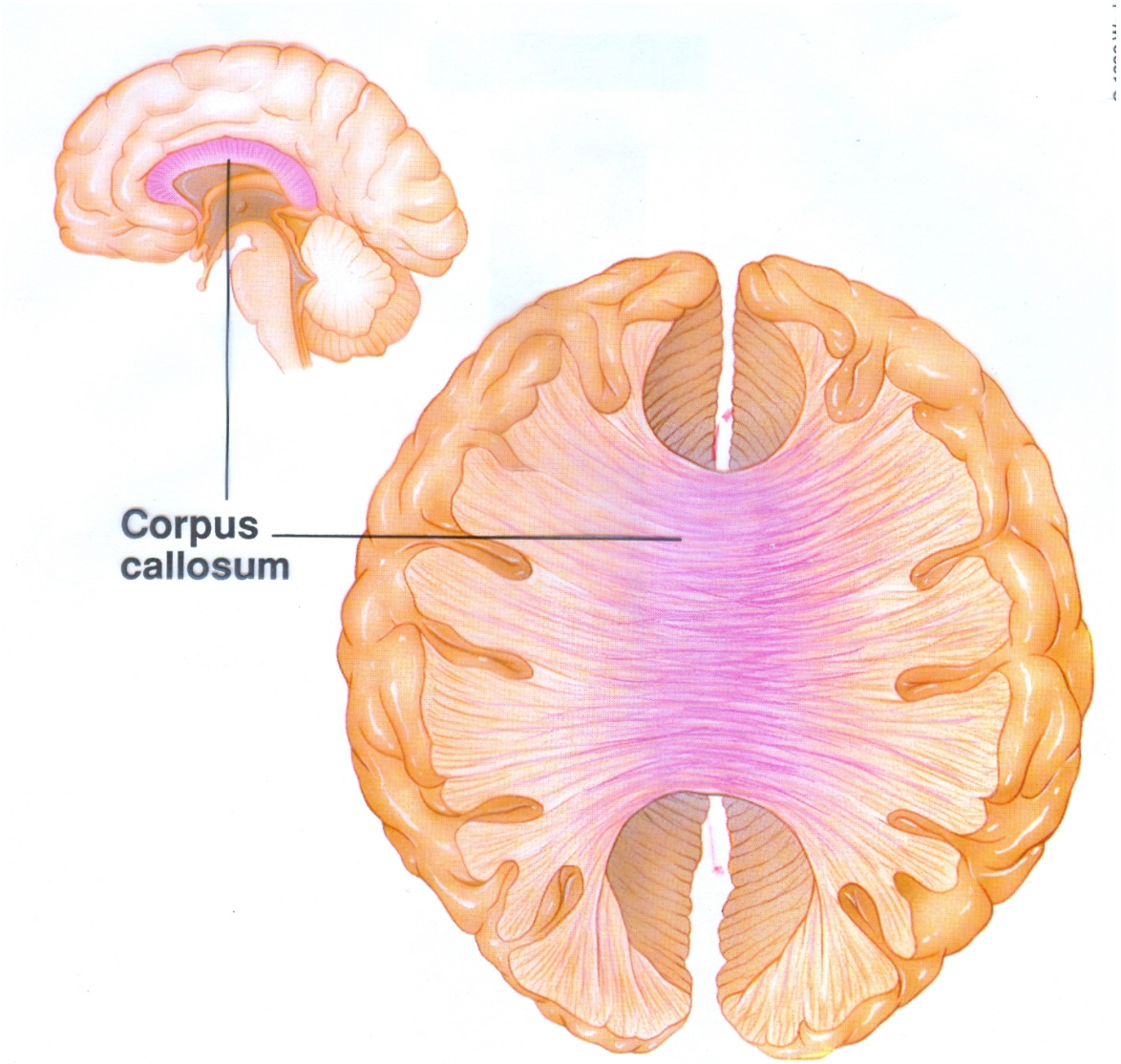
Planum Temporale



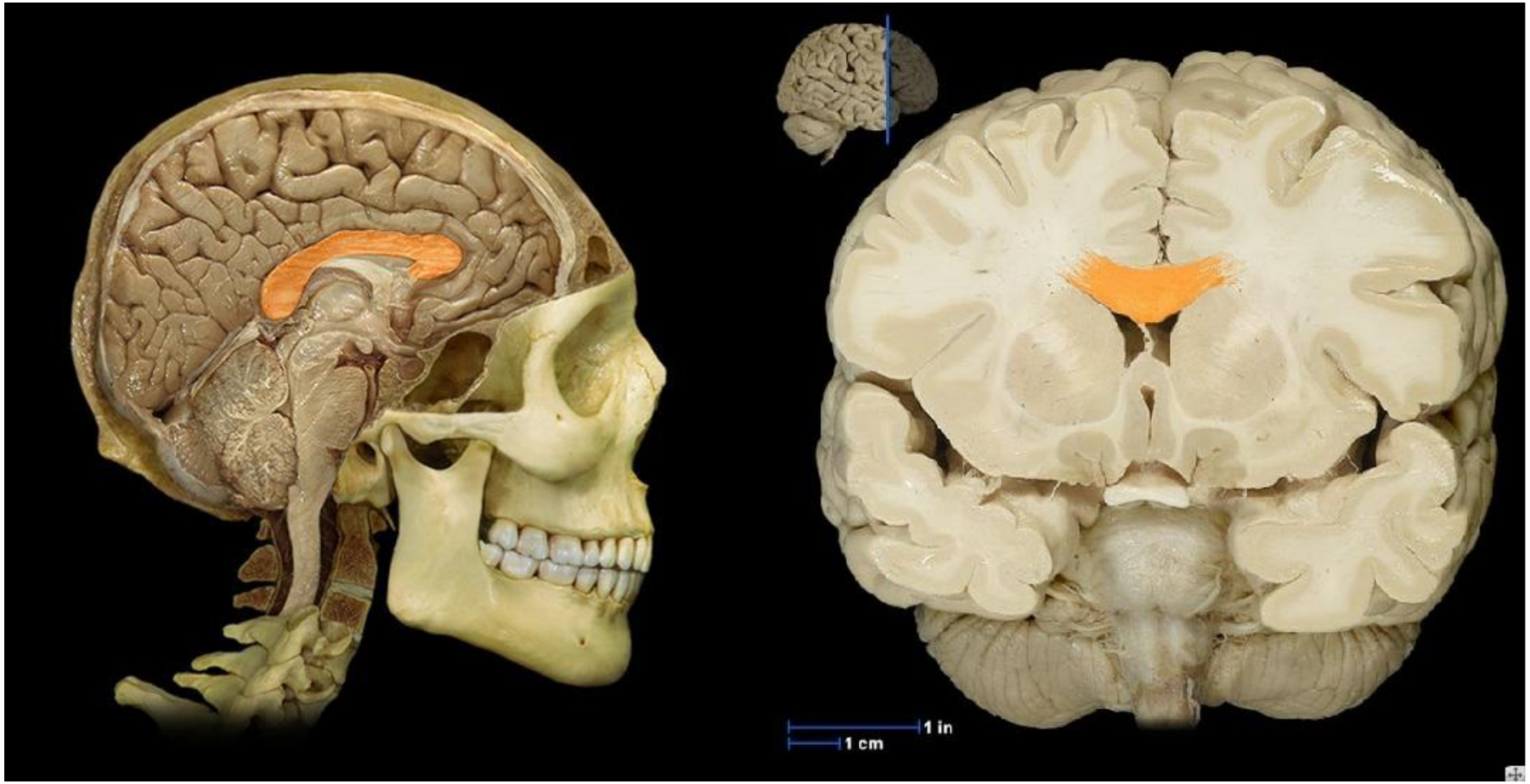
Significantly larger in **Left Hemisphere**

Includes **Wernicke's Area**, for speech comprehension

Corpus Callosum



Corpus Callosum



Shown in **orange**

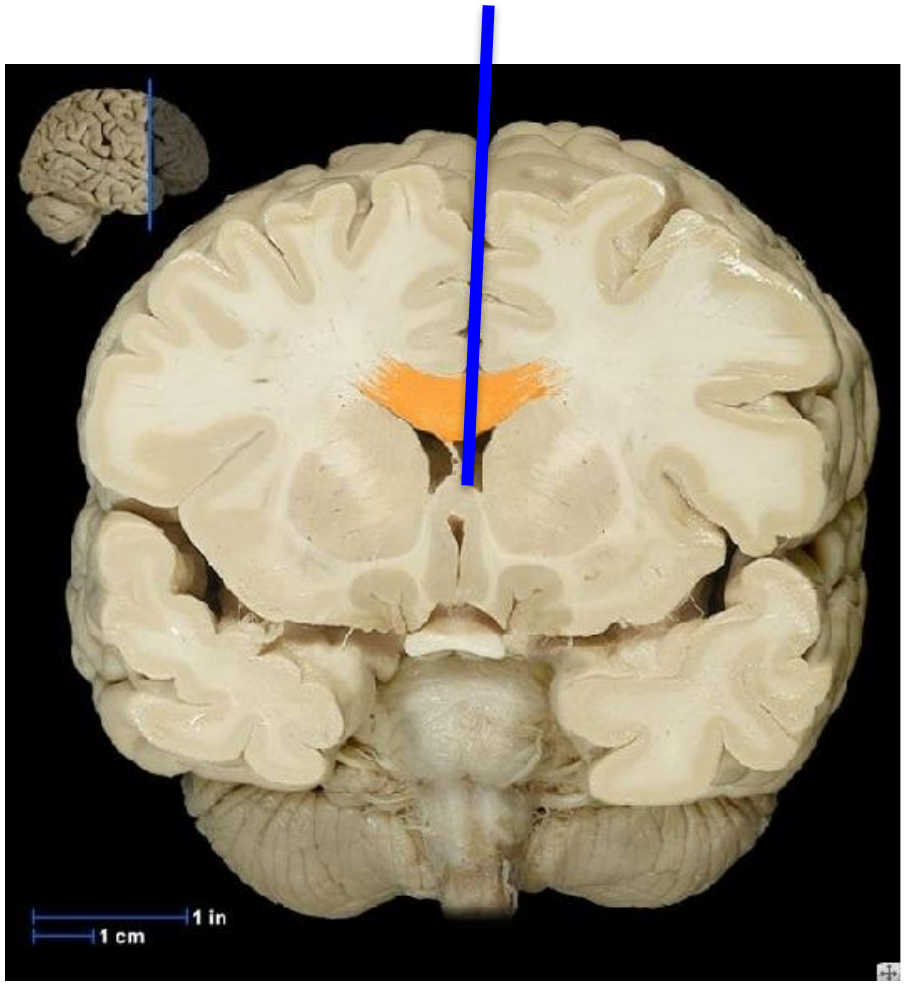
Corpus Callosum

"Split-Brain" Surgery

Sometimes performed as a treatment for **Epilepsy**

Epilepsy is runaway activation that spreads, from a source node, throughout cortex
>> debilitating Seizures

Severing the Corpus Callosum will reduce the spread of activation,
lessening severity of seizures



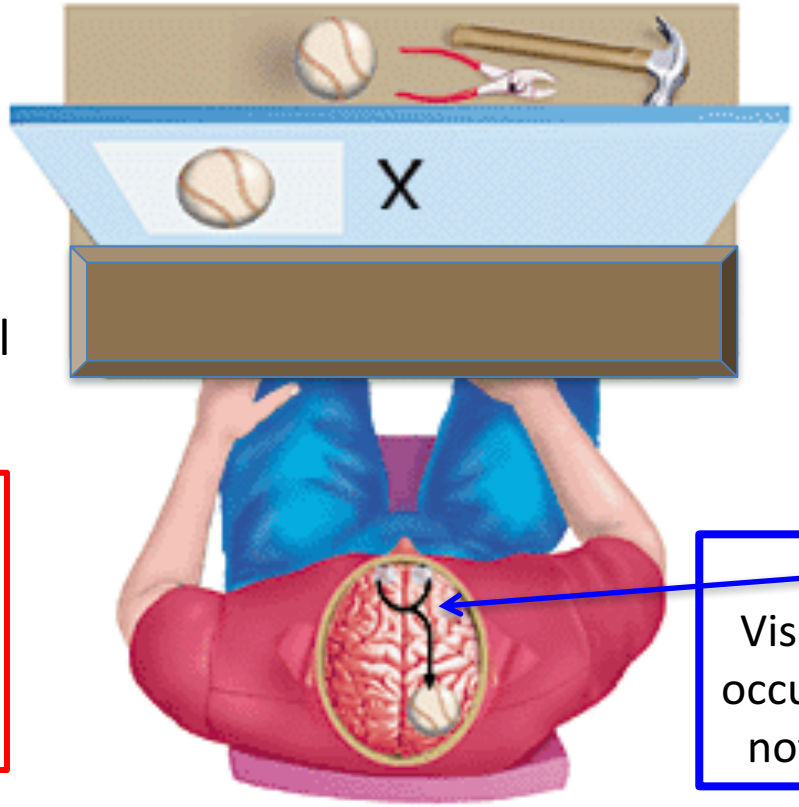
NOTE: Such surgery generally requires local anesthetic to scalp, but patient can be awake & responsive

Split-Brain Research

Recovered patient looks at X. Visual image presented in one visual field.
Patient must handle unseen objects to find match.

Left Visual Field sends info to **Right Hemisphere**

If reach with **Right Hand**, cannot identify matching object by feel



BUT, if reach with **Left Hand**, can identify matching object by feel

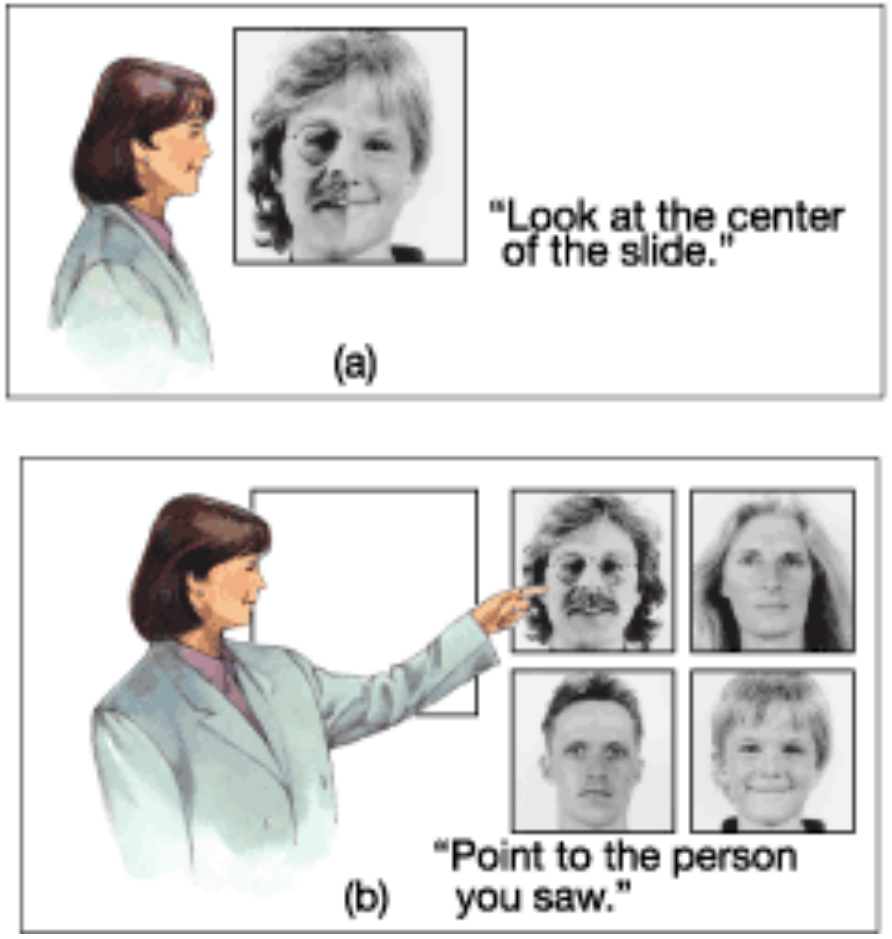
Note:
Can "cheat" by talking to self!
(Since acoustic system crosses over in Medulla)

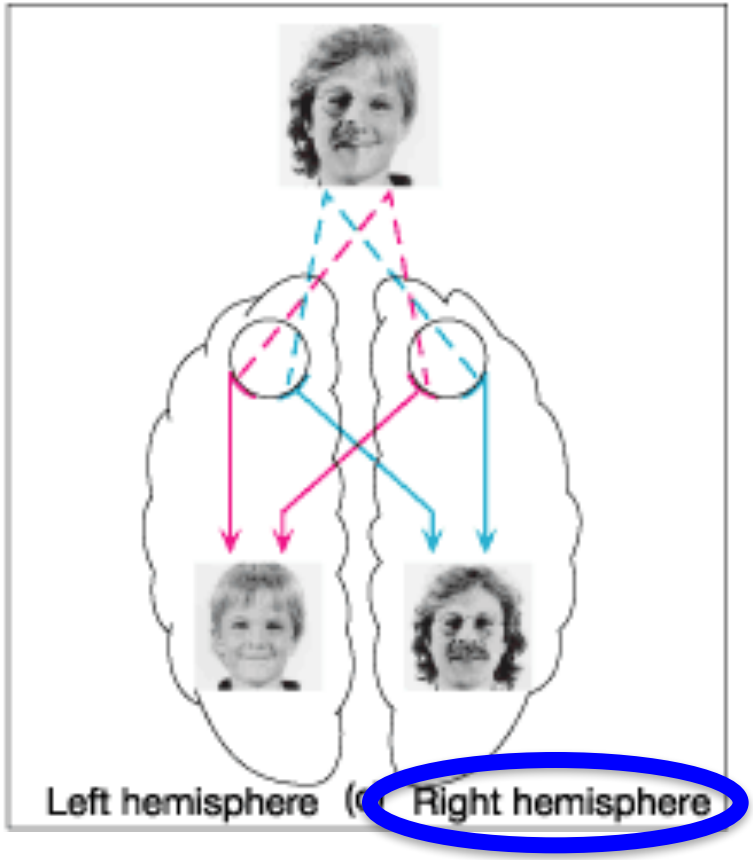
Note:
Visual Field crossover occurs at Optic Chiasm, not Corpus Callosum

Since **Left Hand** is represented in **Right Hemisphere,**
and **Right Hand** is represented in **Left Hemisphere**

Split-Brain Research

Some recovered patients show Visual Dominance for one Visual Field



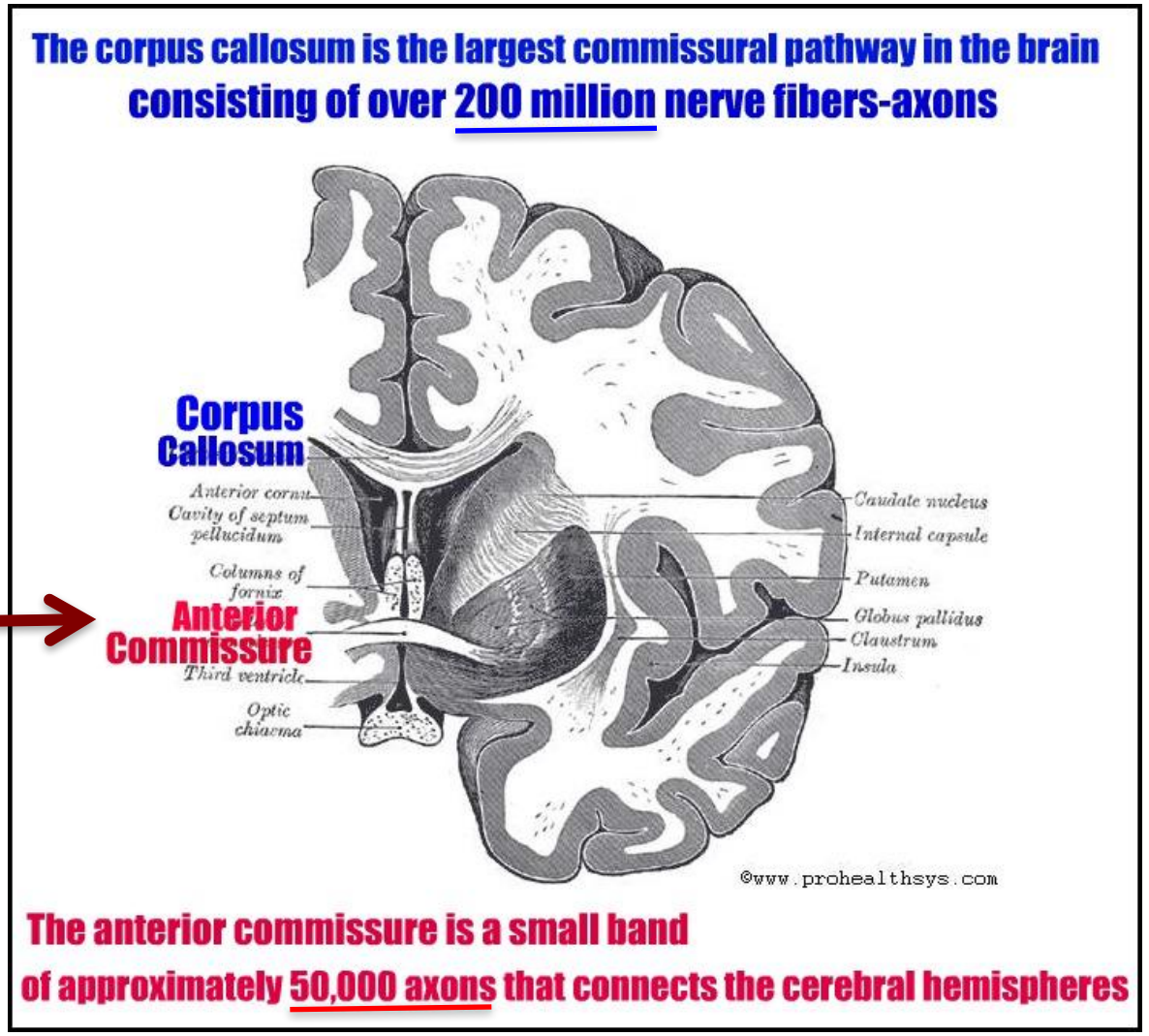


Dominant Hemisphere

Split-Brain Research

Alternative pathways for communication between the hemispheres

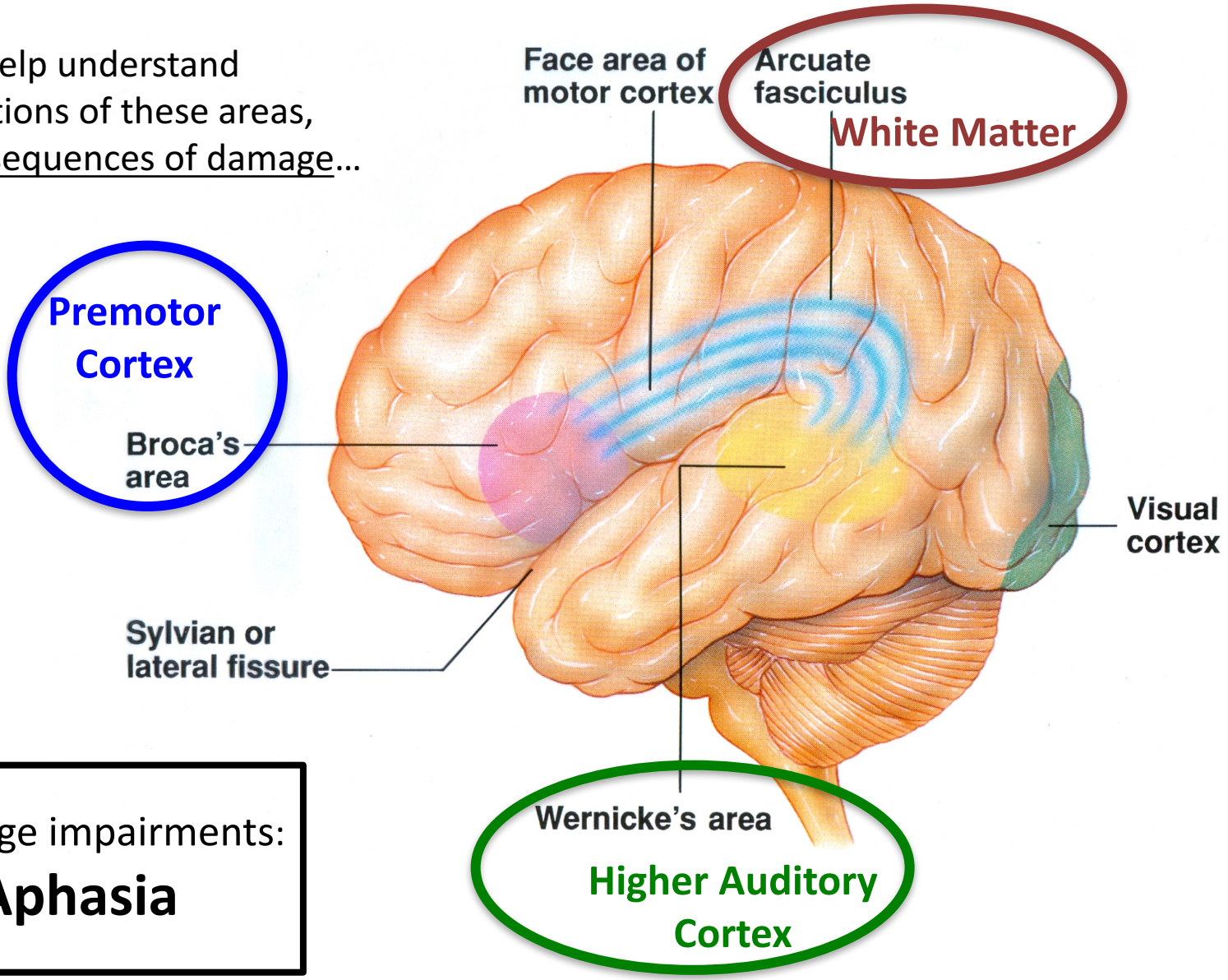
The Anterior Commissure



Also
Hippocampal Commissure,
Posterior Commissure

Language Areas

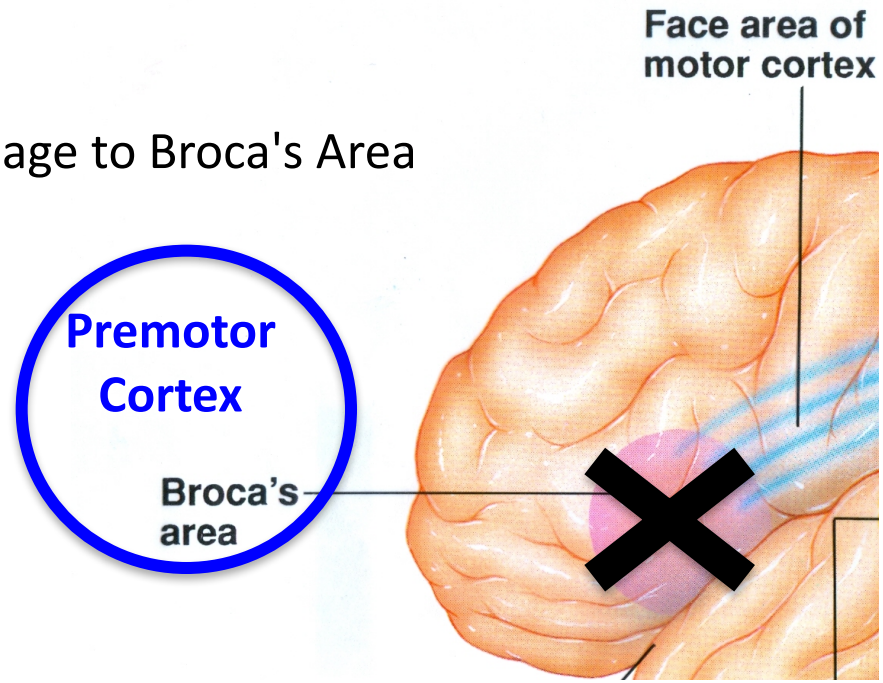
To help understand
the functions of these areas,
look at consequences of damage…



Language impairments:
Aphasia

Broca's Aphasia

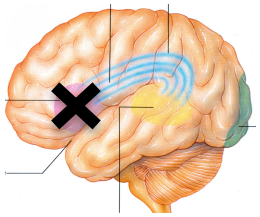
Damage to Broca's Area



Production Aphasia

("Nonfluent Aphasia", "Broca's Aphasia")

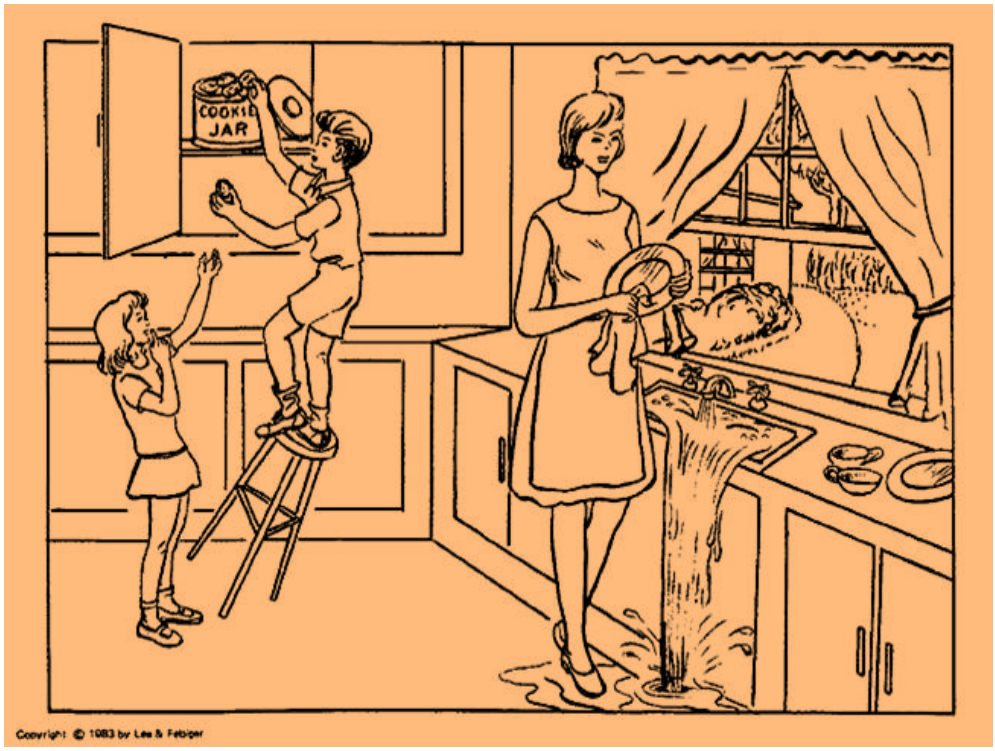
- Articulation difficulties
- Anomia for Closed Class terms
- Agrammatism



Broca's Aphasia

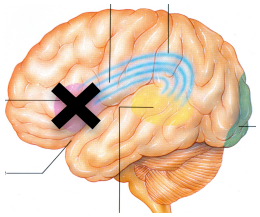
Articulation Difficulties

Speech is slow, halting, laborious, loss of prosody, words often mispronounced



Patient's Description:

"kid . . . kk . . . can . . . candy . . . cookie . . . candy . . . Well I don't know but it's writ . . . easy does it . . . slam . . . early . . . fall . . . men . . . many no . . . girl. Dishes . . . soap . . . soap . . . water . . . water . . . Falling pah that's all . . . dish . . . that's all.



Broca's Aphasia

Anomia, esp for **Closed Class** Terms

"**Closed Class**" = Fixed set of terms in a given language that serve syntactical functions

e.g. Prepositions (of, by, for)
Articles (the, a)
Conjunctions (and, but)
Tense & # markers (-ed, es)

Can repeat "Cows eat Grass"
(all Open Class terms)

Cannot repeat "No ifs, ands, or buts"
(all Closed Class terms)

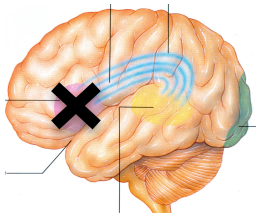
Can read "Two bee oar knot two bee"
(all Open Class terms)

Cannot read "To be or not to be"
(all Closed Class terms)

Plus, speech tends to lack these terms:

Say: "I . . . go . . . store"

Not: "I will go to the store"



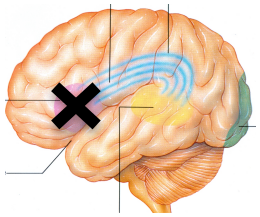
Broca's Aphasia

Agrammatism

Difficulty producing, understanding grammatical forms

e.g. **Word Order**

Cannot select which of these images represents
"Boy chase Man" ?

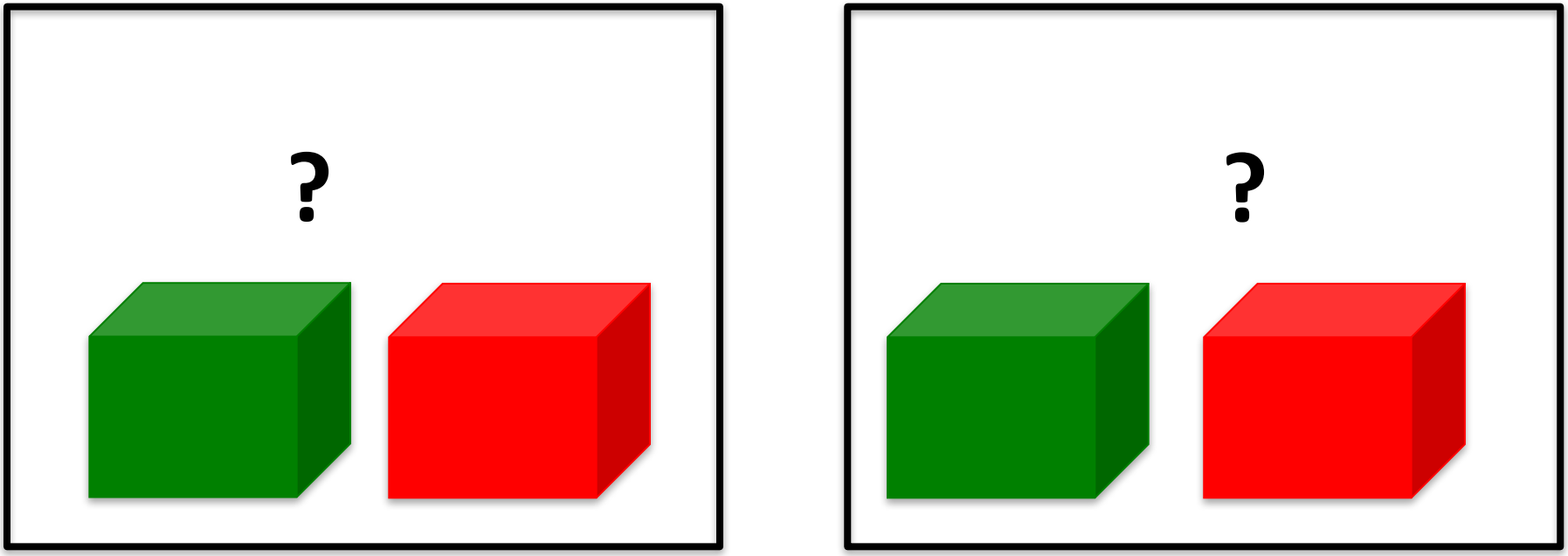


Broca's Aphasia

Agrammatism

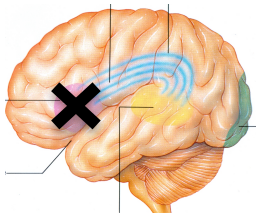
Difficulty producing, understanding grammatical forms

e.g. **Word Order**



Cannot follow the instructions

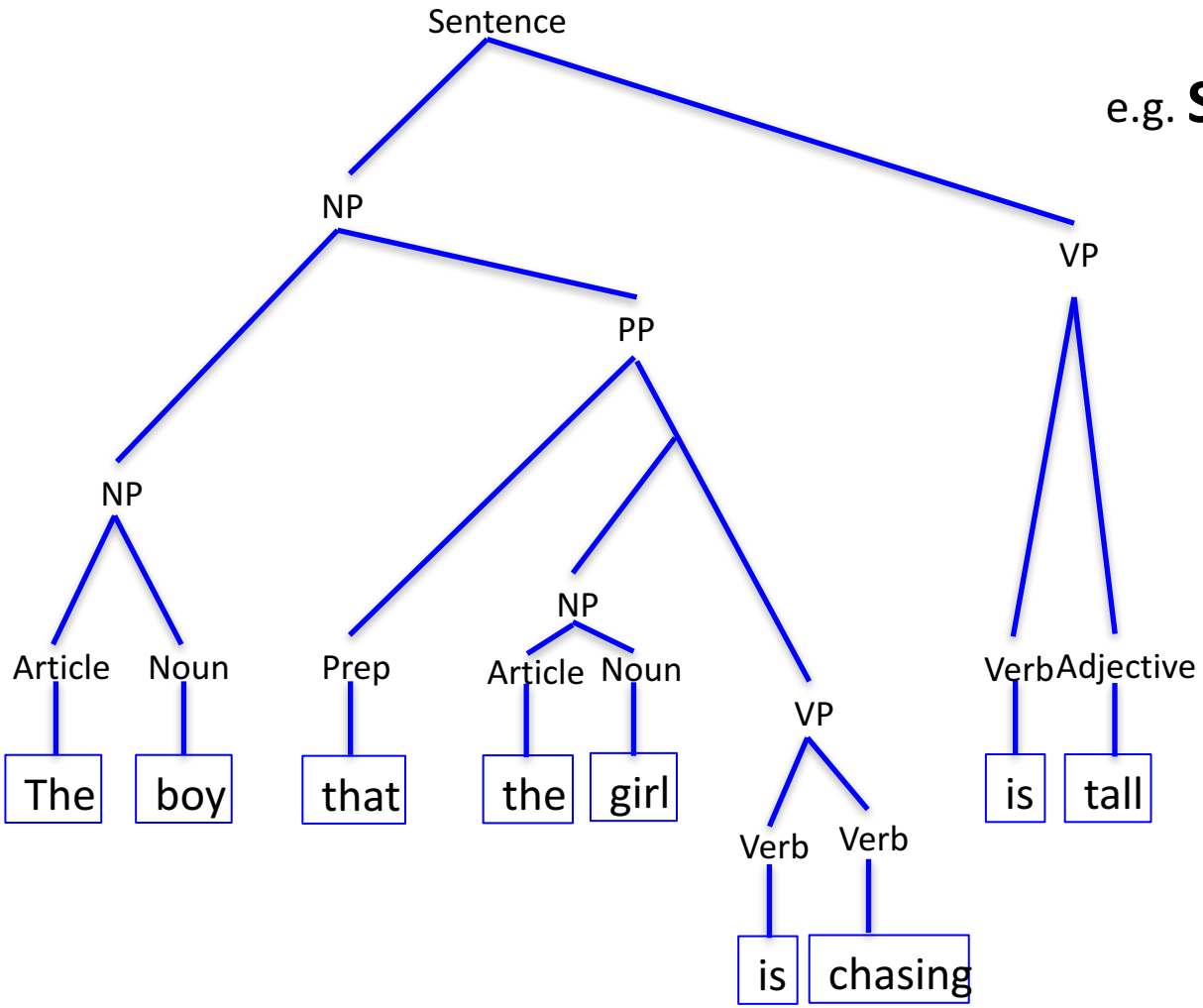
"Put Red on Green"



Broca's Aphasia

Agrammatism

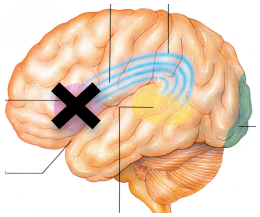
Difficulty producing, understanding grammatical forms



e.g. **Syntactical Embedding**

Given a sentence like "The boy that the girl is chasing is tall" . . .

. . . cannot determine "Who is tall?"



Broca's Aphasia

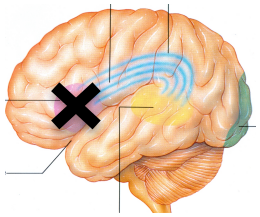
BUT, patients with Broca's CAN generally **understand speech**

e.g. Given command like
"Go and knock on the door". . .

. . . they can comply
(even if what they understand is
"Go -- knock -- door")

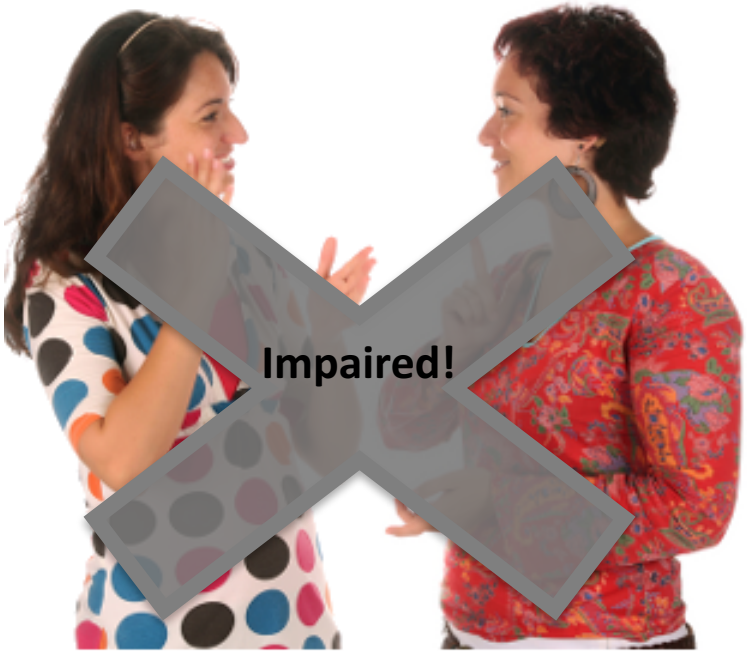
BUT, given question like
"What did you do before you came to the hospital?"
while they *seem* to understand,
cannot generate a reply.

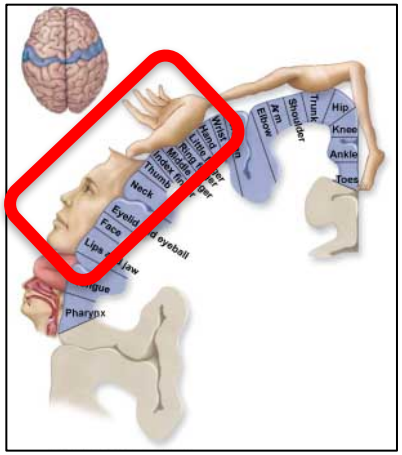
Broca's patients tend to be highly frustrated, depressed.



Broca's Aphasia

NOTE:
Broca's patients
who understood sign,
can have <u>deficits</u> in ability to
produce or understand
Sign Language . . .





. . . Depending on location and extent
of damage
(since again, recall, <u>Mouth & Hand</u> areas
are <u>adjacent in Premotor Cortex</u>)

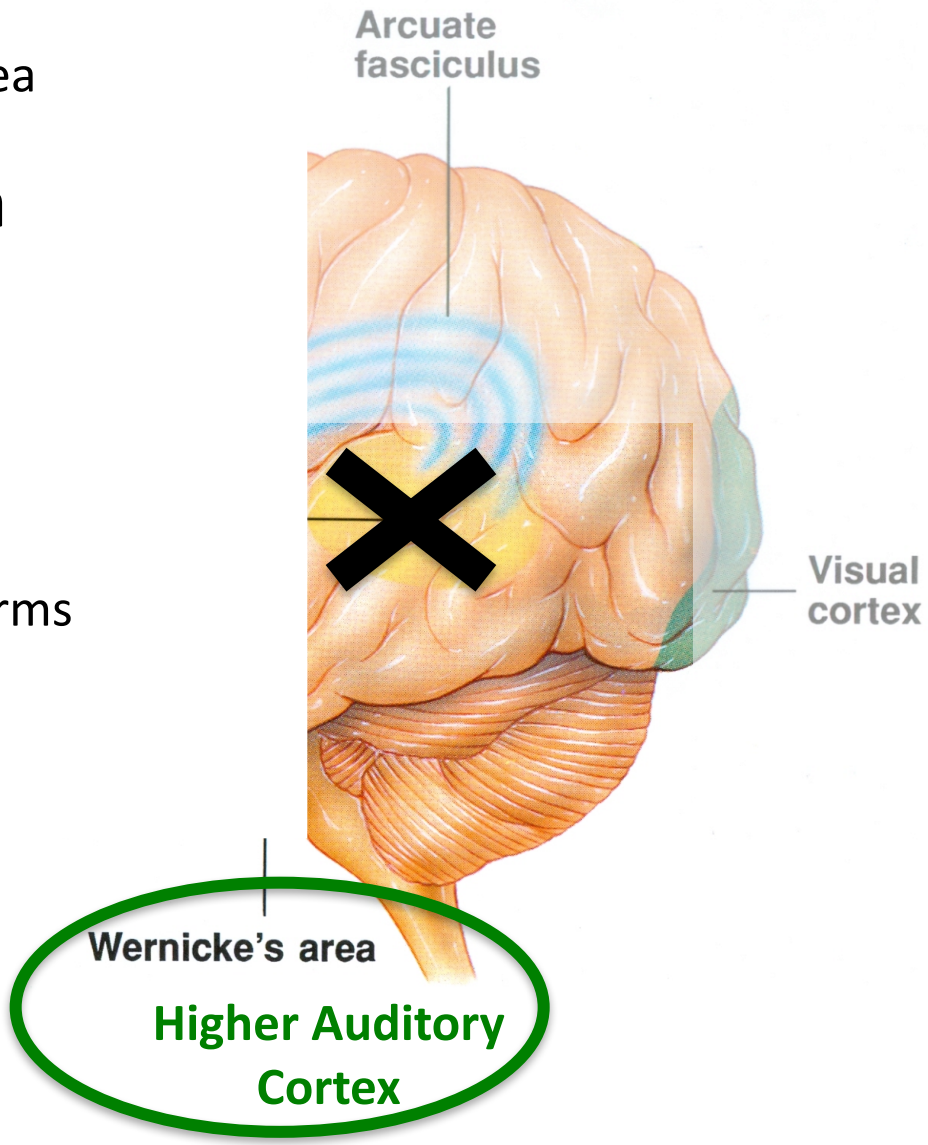
Wernicke's Aphasia

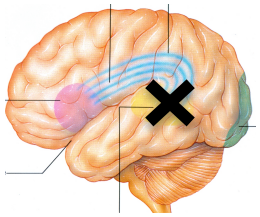
Damage to Wernicke's Area

Receptive Aphasia

("Fluent Aphasia",
"Wernicke's Aphasia")

- Fluent Articulation
- Anomia for content terms
- Nonsensical Speech
- Incomprehension





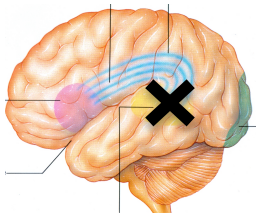
Wernicke's Aphasia

Fluent Articulation but **Nonsensical Speech**

- ***Examiner:*** What kind of work did you do before you came into the hospital?

- ***Patient:*** Never, now mista oyge I wanna tell you this happened when happened when he rent. His-his kell come down here and is-he got ren something. It happened. In thesse ropiers were with him for hi-is friend-like was. And it just happened so I don't know, he did not bring around anything. And he did not pay it. And he roden all o these arranjen from the pedis on from iss pescid. In these floors now and so. He hadn't had em round here

Sounds (roughly) like English, but is mostly nonsensical



Wenicke's Aphasia

Anomia

For "Content" terms (nouns, verbs, adjectives, etc.)

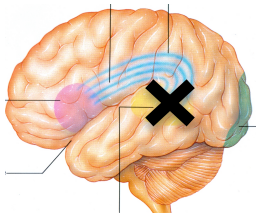
What is this?

What color is this?

<u>Cannot name</u> familiar objects, action, features

What is this person doing?

?



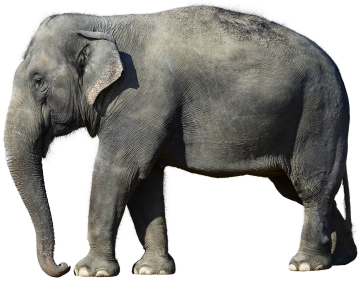
Wenicke's Aphasia

Anomia

For "Content" terms (nouns, verbs, adjectives, etc.)

Depending on extent & location of damage,
can get specific deficits

e.g. May be able to name animate
but not inanimate objects

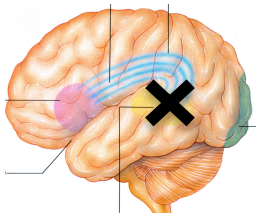


"Elephant!"

"???"

e.g. May be unable
to name
parts of the body

Suggests such categories of words may be spatially sorted in brain…



Wenicke's Aphasia

Incomprehension

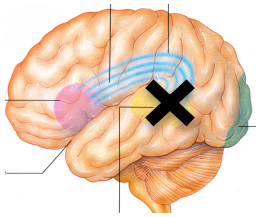
Many cannot understand speech

e.g. Given command like
"Go and knock on the the door". . .

. . . May produce fluent-sounding response,
but do not comply

Some patients can read, write words and
even read lips, but cannot understand spoken
= **Pure Word Deafness**

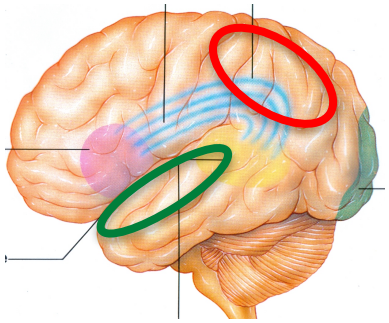
Wernicke's patients suffer somewhat less than Broca's from depression,
though tend to become withdrawn, detached



Wernicke's Aphasia

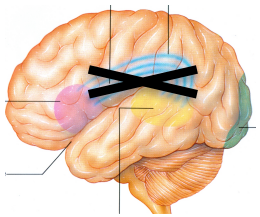
Not impaired!

NOTE:
Wernicke's patients
who understood sign,
tend to **not** lose ability to
understand or produce
Sign Language . . .



. . . since Dorsal Temporal area is an
Auditory Area

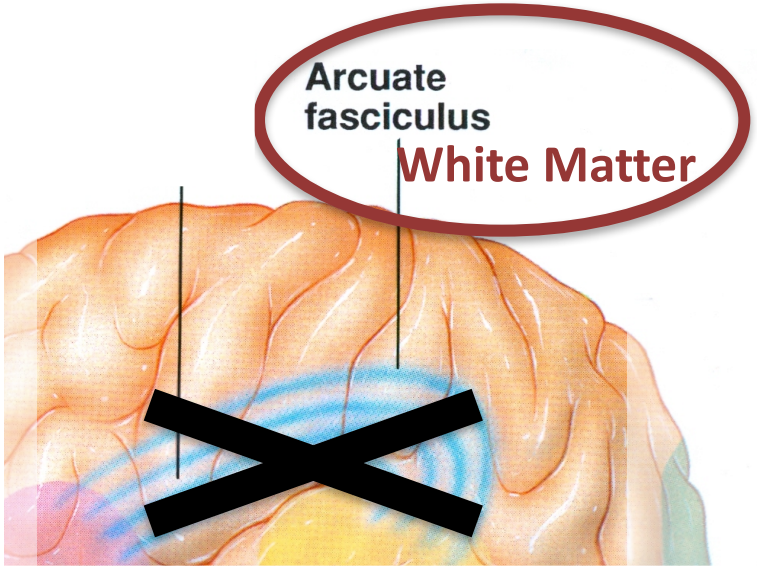
Instead, **STS** and **Parietal Lobe** damage
implicated in deficits of Sign Language comprehension



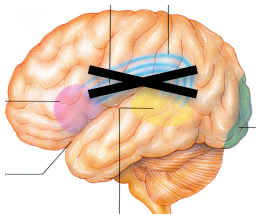
Conduction Aphasia

Arcuate Fasiculus

Damage to white matter connections between Broca's & Wernicke's

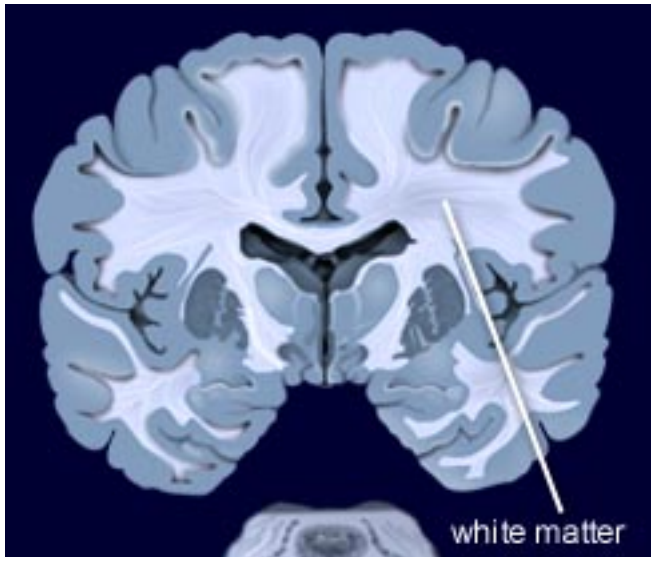


- Difficulty repeating what heard
- May show Phonemic Paraphasia
- Can impair Conversational exchange

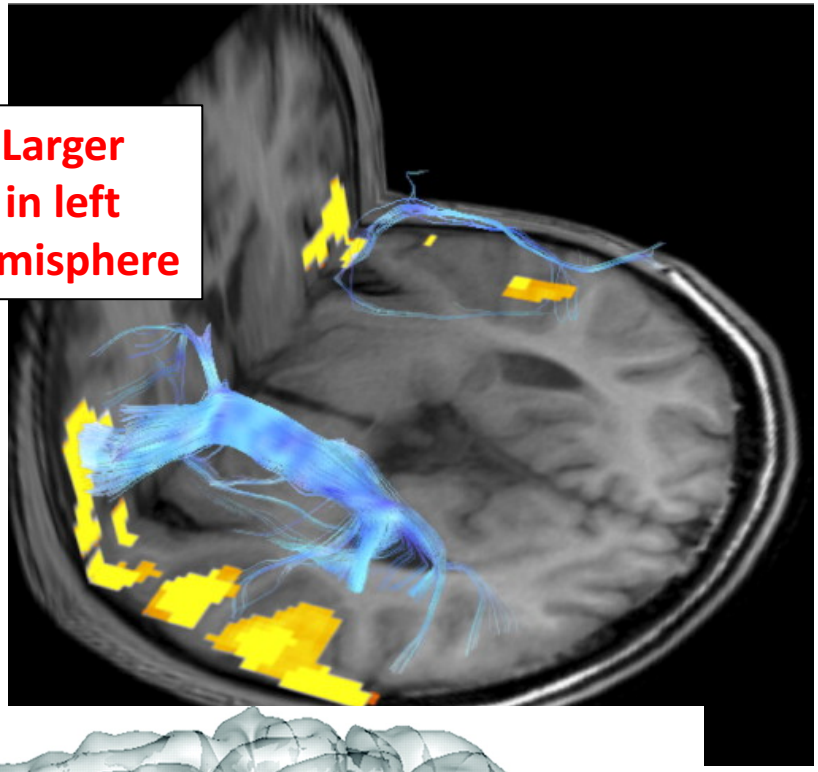


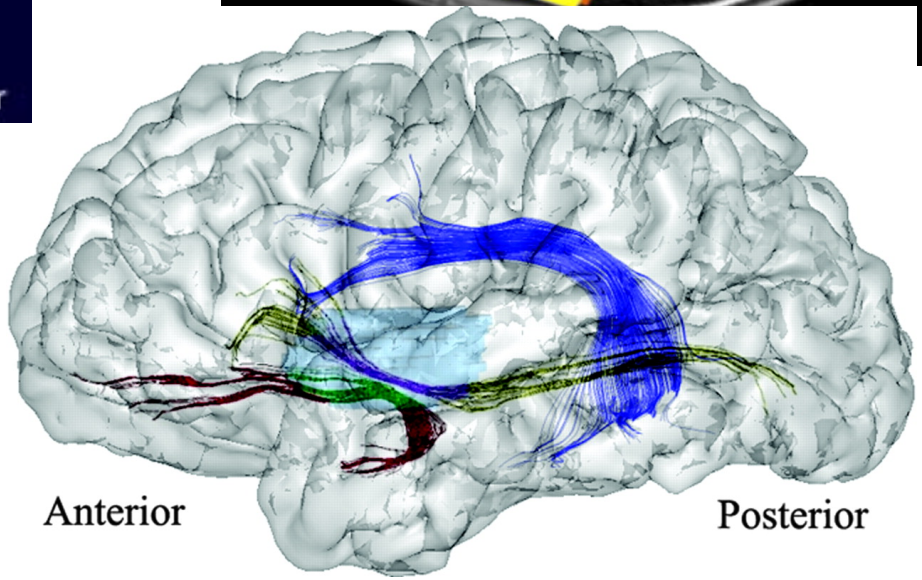
Conduction Aphasia

Arcuate Fasiculus

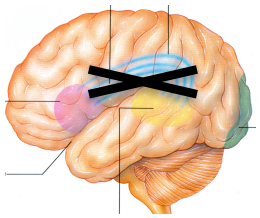


Larger in left hemisphere



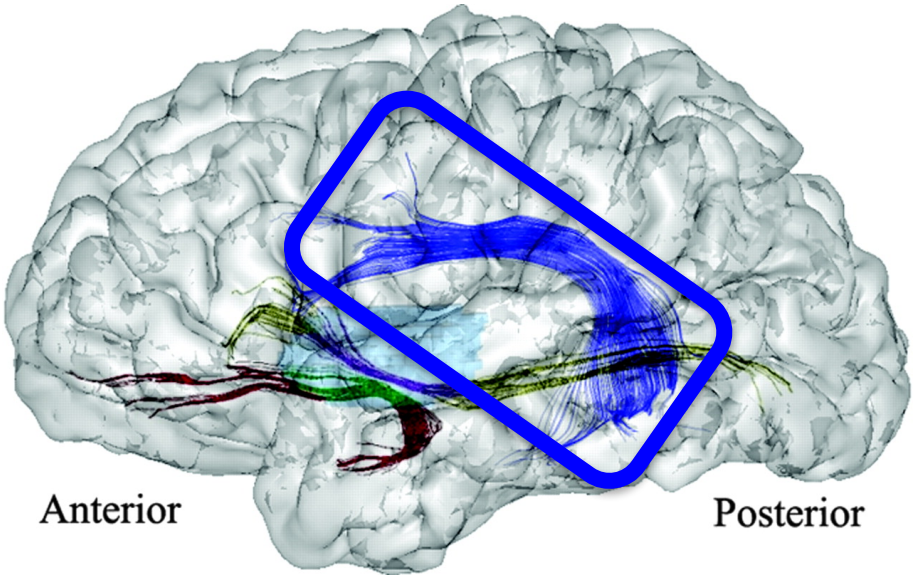


NOTE:
Multiple paths of connection



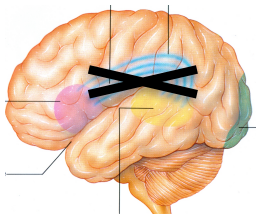
Conduction Aphasia

Impaired in
Repeating
heard words

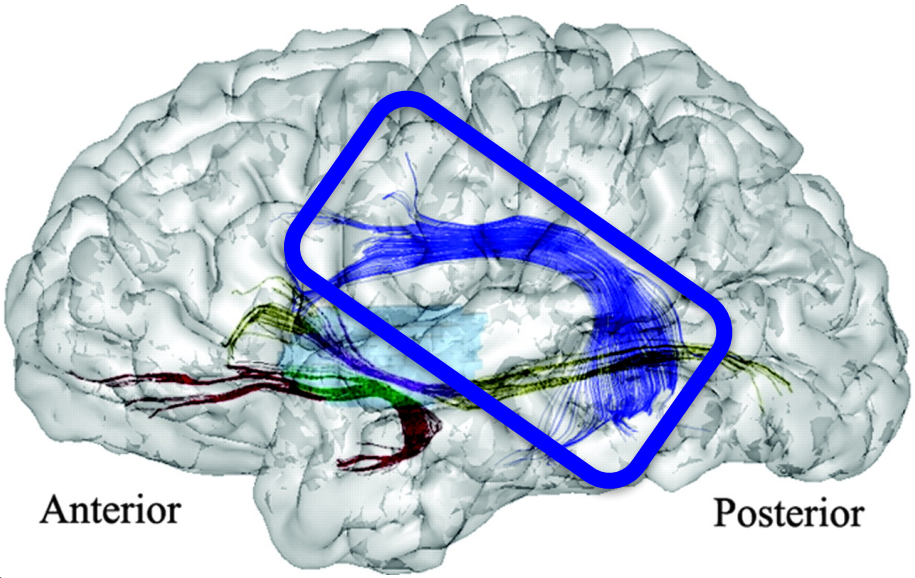


Aspect of a particular form of
Working Memory
called the
"Phonological Loop"

e.g. When you are told a phone number
and rehearse it until you store it.



Conduction Aphasia



Phonemic Paraphasia

Substitute wrong phoneme
for part of word

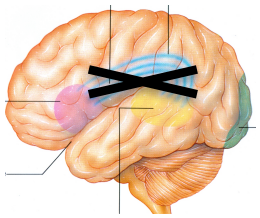
e.g. Instead of "happy" say "hippy"

Both are words, although
only one may be appropriate

e.g. Instead of "party" say "partoo"

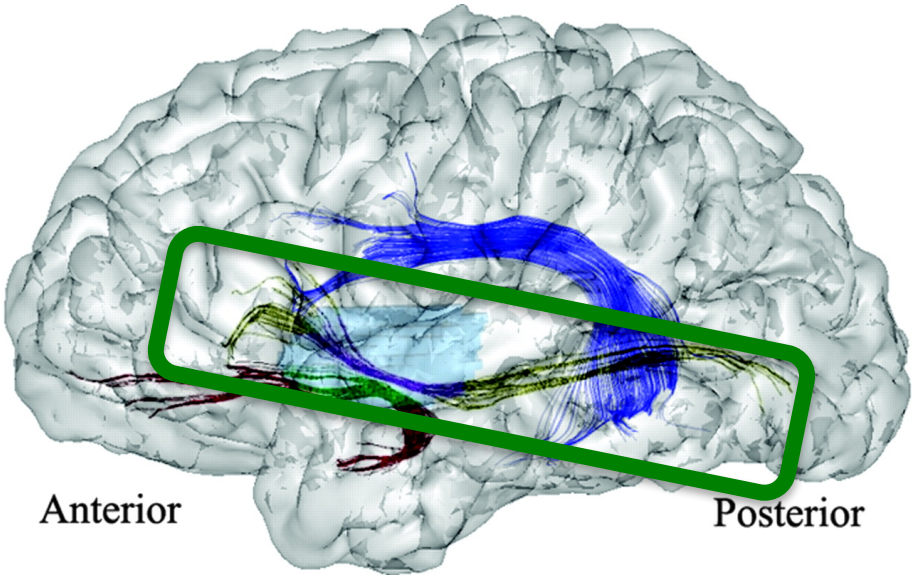
???

Substitution = nonsense

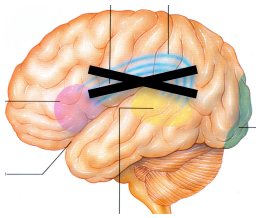


Conduction Aphasia

Impaired in
<u>giving meaningful,
relevant response</u>



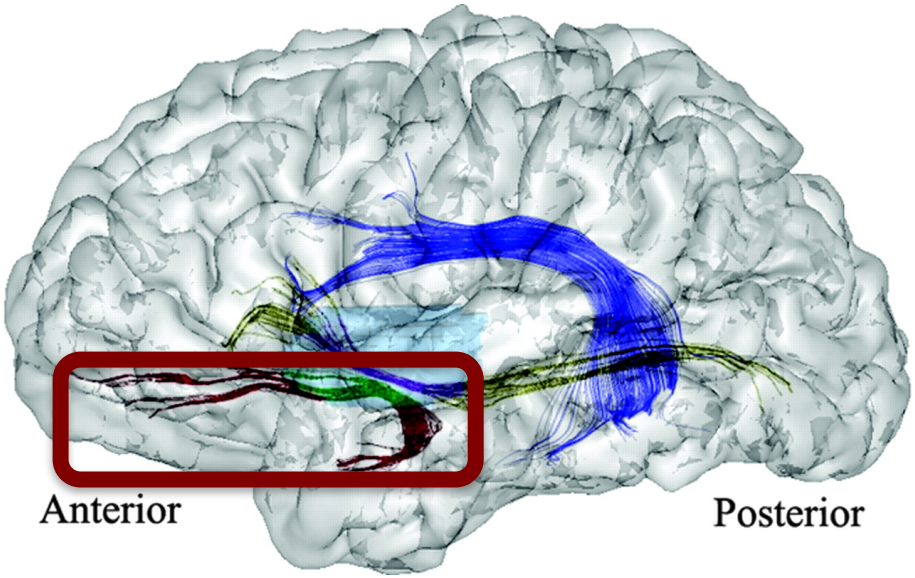
So, while may be able to generate
and understand sentences,
can have difficulty carrying on a
coherent conversation

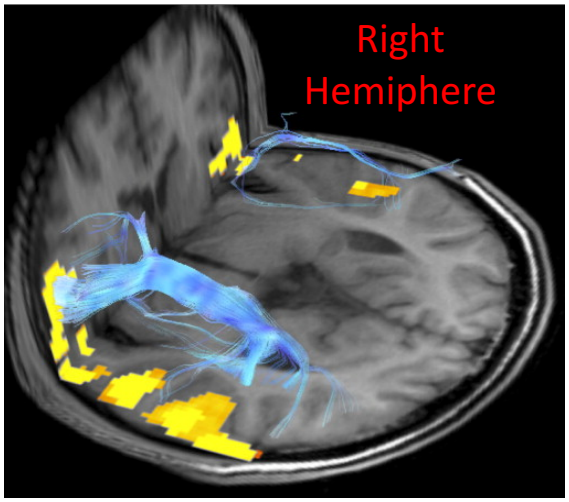


Conduction Aphasia

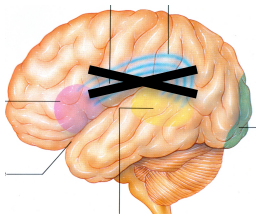
Impaired in
Lip Reading,
reading Facial Expressions

Involves connections with
STS - Superior Temporal Sulcus
(Biological Motion)





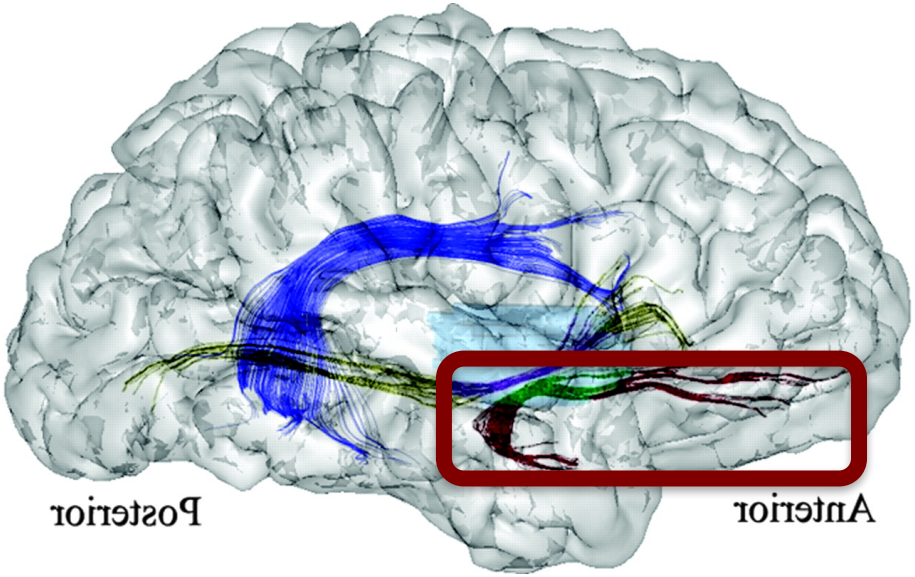
These connections / functions
actually dominant in
Right Hemisphere

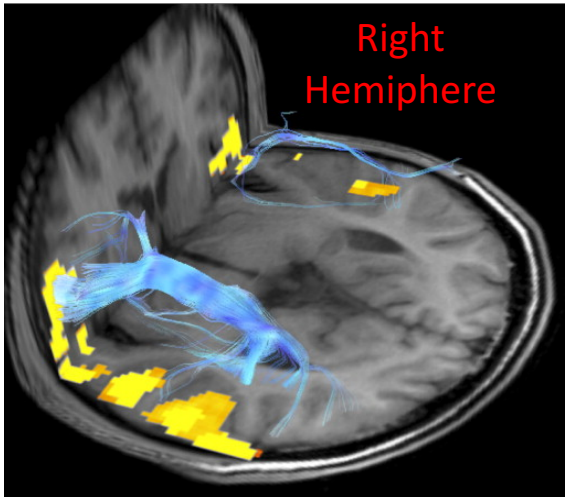


Conduction Aphasia

Impaired in
Lip Reading,
reading Facial Expressions

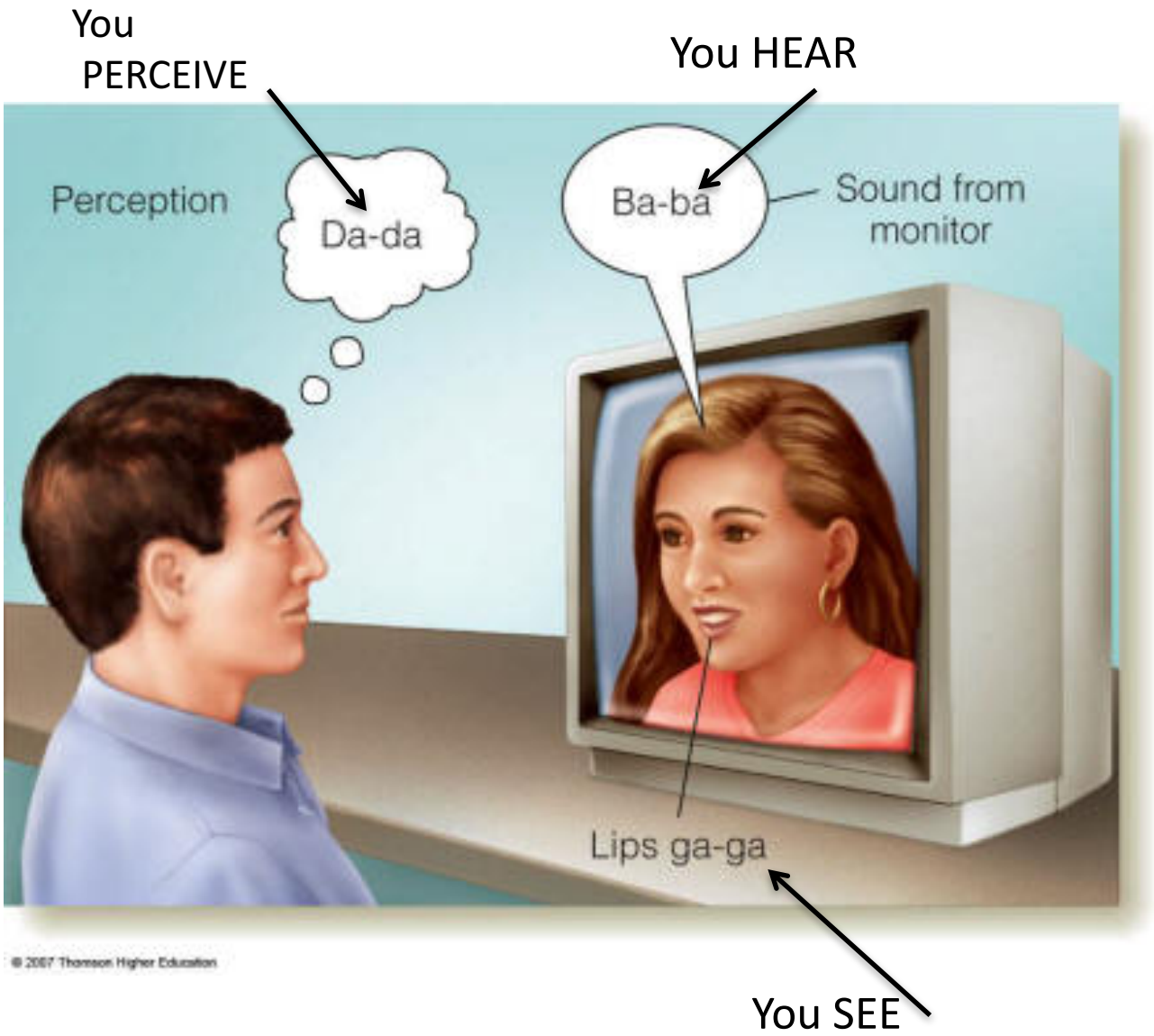
Involves connections with
STS - Superior Temporal Sulcus
(Biological Motion)

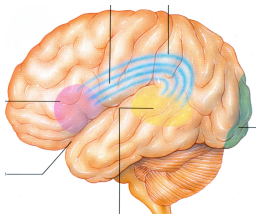




These connections / functions
actually dominant in
Right Hemisphere

Mc Gurk Effect - The Multi-Modality of Speech

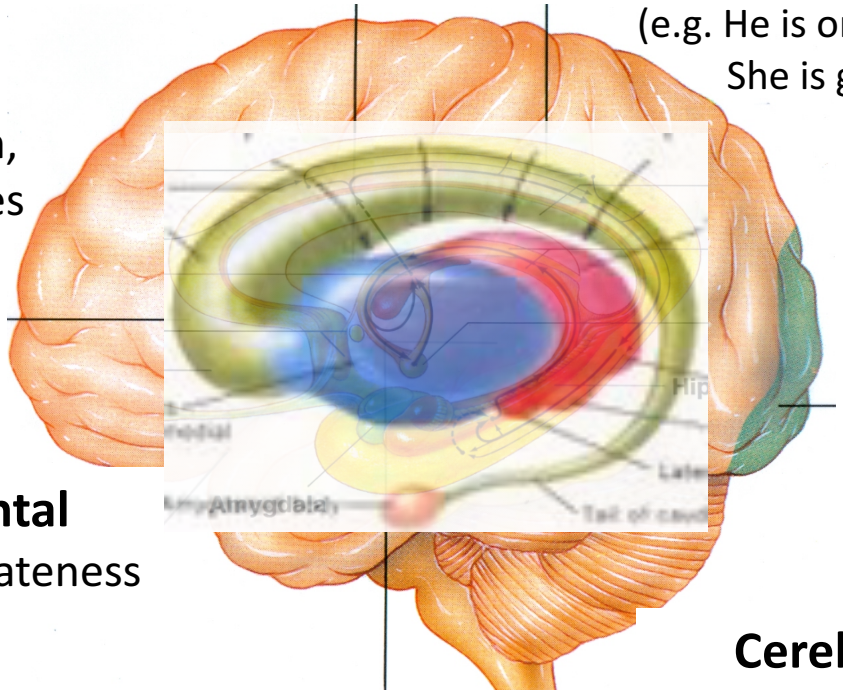




MANY areas involved in Language

Parietal Lobe
Spatial relationships,
Spatial metaphors
(e.g. He is on the right path
She is going crazy)

Limbic System
Mediate emotion,
Activate memories

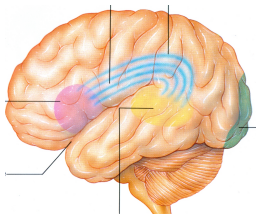


Occipital Lobe
Visual Imagery

Obito-Frontal
Social appropriateness

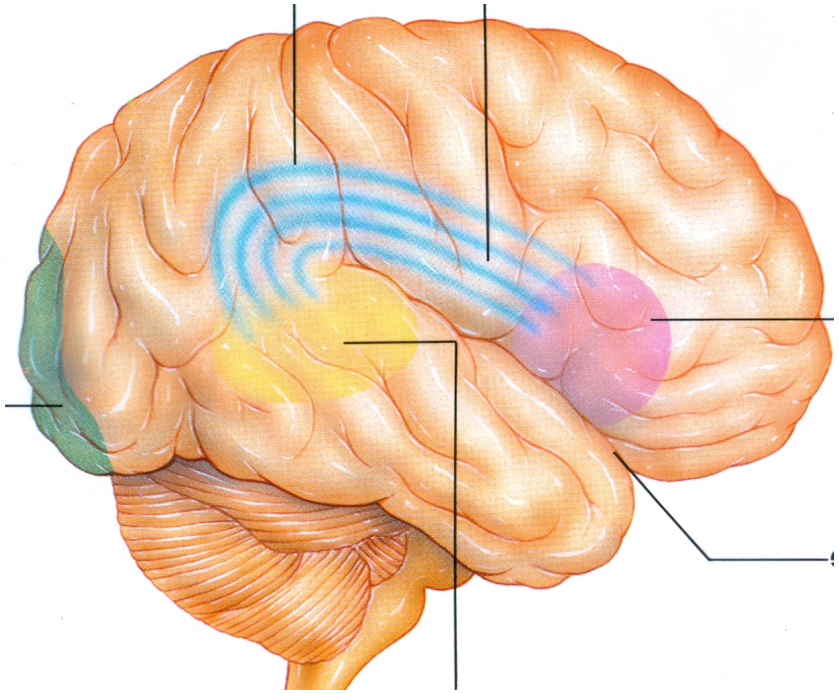
Cerebellum
Articulation
as a motor sequence

Basal Ganglia
Pragmatic goals,
Turn-taking



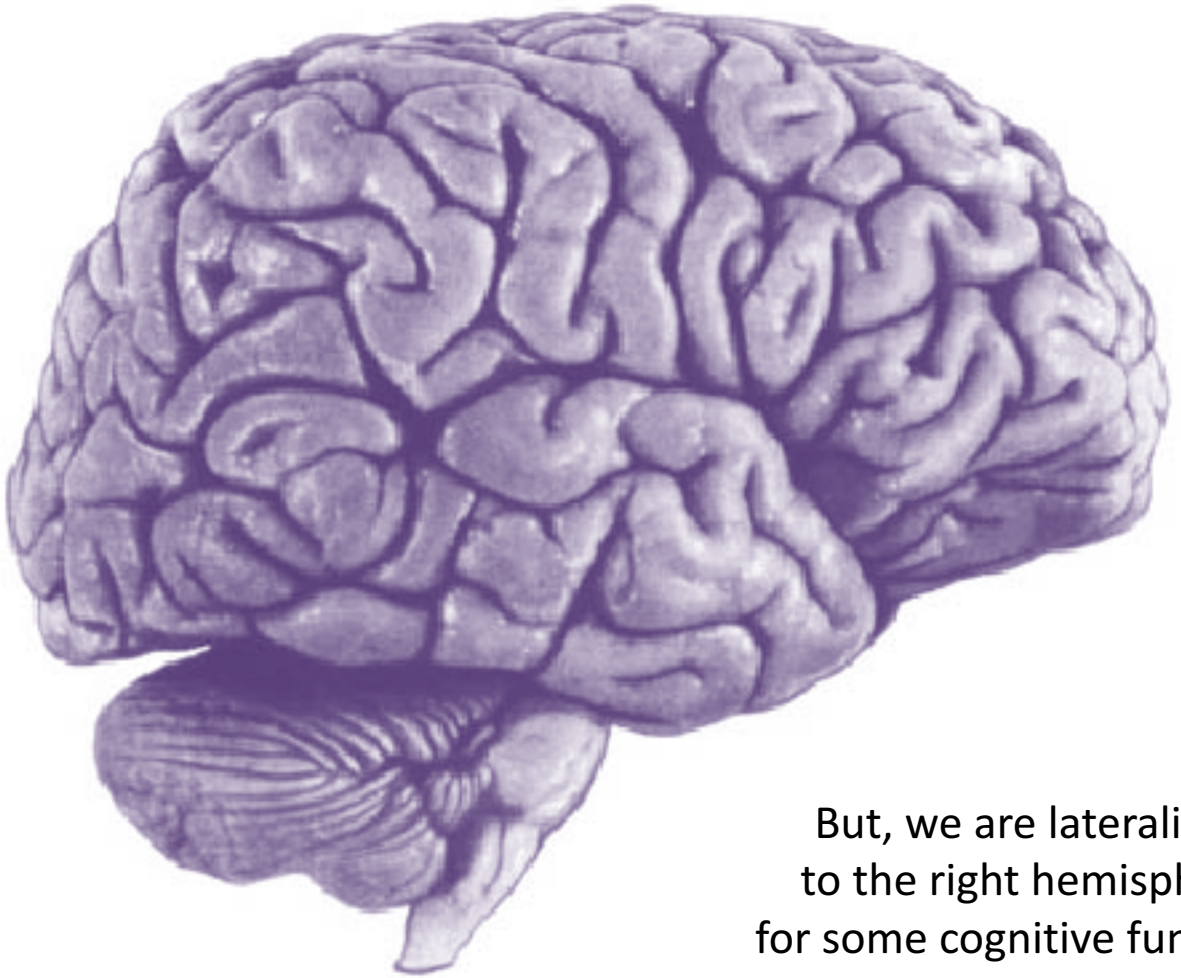
MANY areas involved in Language

PLUS the
Right
Hemisphere!



The Right Hemisphere

Not as well-studied or understood as the left



But, we are lateralized
to the right hemisphere
for some cognitive functions

Right Hemisphere Specializations

Global Processes

Magnocellular (Low-spatial frequency) paths dominant over
Parvocellular (High-spatial frequency) paths
in Right **Occipital Lobe**

"Big picture" over details

Organizing narrative

Get the "gist"

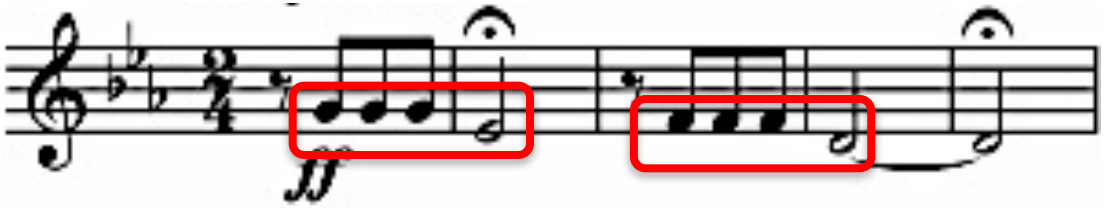
So, also involved in
getting a joke

Right Hemisphere Specializations

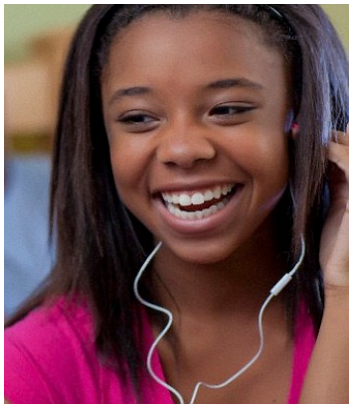
Global Processes

Also involved in processing

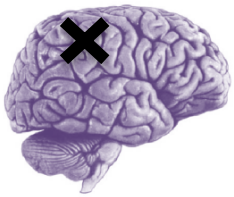
<u>Musical Patterns</u>



Also for <u>emotional</u> interpretation of music



Although music is COMPLEX,
<u>involves MANY brain areas!</u>



Right Hemisphere Specializations

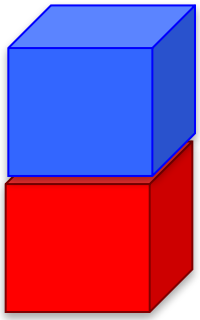
Spatial Abilites

Damage esp to

Right Parietal Lobe

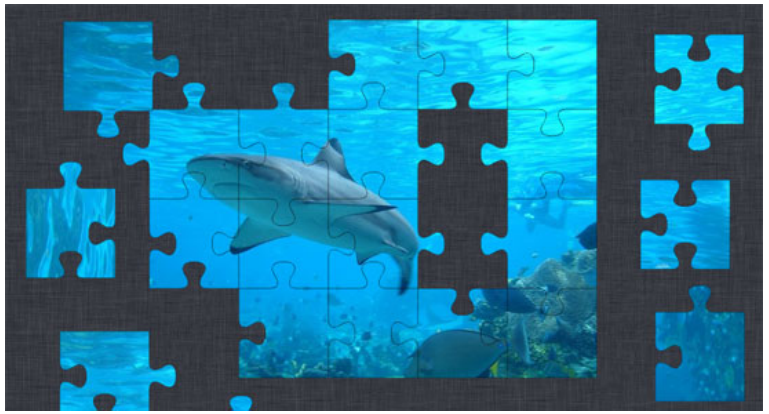
can lead to deficits in. . .

Spatial relations



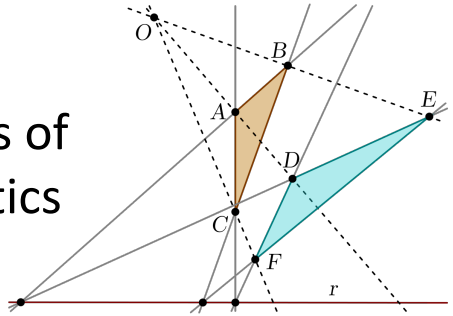
Which is above?

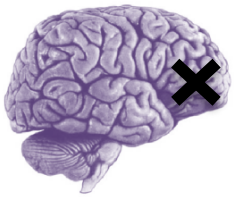
Map reading



Solving puzzles

Some types of mathematics





Right Hemisphere Specializations

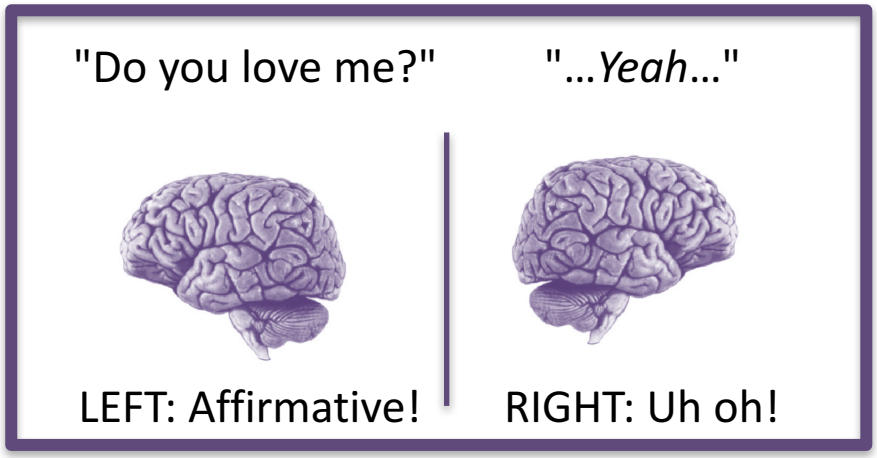
Socio-Emotional Processes

Damage esp to

Right Frontal Lobe

can lead to <u>deficits</u> in. . .

. . . Nonlingusitic aspects of language interpretation



. . . Emotional expression, interpretation

. . .Recognizing sarcasm, irony

So, its important to recognize...

BOTH hemispheres contribute to all of the above!

Differences in dominance, timing, how coordinated, etc...

Best of luck on all your FINALS!

Take care & be well !

One final announcement. . .

Final exams for this class have been <u>canceled</u>!

But, for those of you who were counting on showing

IMPROVEMENT

on those exams, we have good news...

Your final score in Cogs 17 has been computed...

- Based on ~5000 grades, past 5 yrs of Cogs 17
- For those who received an NP (<65%), C (<80%), B (<90%), A (<100%), or A+ (>100%)
- We calculated mean # of improvement points from Midterm 1 to Final
- Only for those who showed improvement
- Mean improvement was approximately
  - **NP 12%, C 8%, B 4%, A 2%, A+ 0%**
- So, your final score = Your Midterm 1 grade+ the appropriate above %
- If you marked "Agree" on the waiver, your final score will be posted on class website tonight; else email me for your score.
- Above does NOT include Extra Credit, the deadline for which is now **Midnight, Tuesday, March 17**