Psychology of Language

19 Acquired aphasia

Fall 2023
Tues/Thur 5:00-6:15pm

Emma Wing
Drop-in hours:
Wednesdays 3-4pm
& by appointment
Webex link

Road map

- Unit 3: Language, Brain, & Diversity
  - 18 Language & brain – Wrap-up
  - 19 Acquired aphasia

Tools to study language in the brain

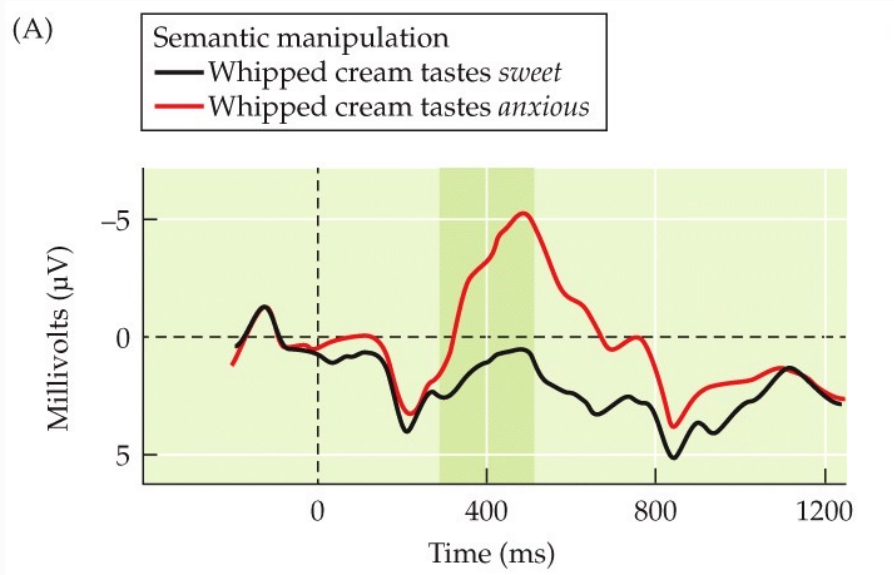
Electroencephalography (EEG)

Figure 3.23 A research participant with EEG electrodes placed over the scalp. (Photograph © Burger/Phanie/Science Source.)

Tools to study language in the brain

Electroencephalography (EEG)

- Major language-related "event related potentials" (ERPs) – negative is plotted UP
  - Two major ones:
    a) N400: typically related to a semantic anomaly
       1. John buttered his bread with socks.



What?	When?	Why?	Example(s)	Triggering stimulus[a]
Negative-going activity	Peaks at about 400 ms after stimulus onset	Occurs when the content of a word is unexpected	Reading words that are nonsensical in a sentence	*The winter was harsh this* ***allowance***. (Expected: *The winter was harsh this* ***year***.)
			Reading rare or unusual words in a sentence	*He painted the bike* ***vermillion***. (Expected: *He painted the bike* ***red***.)

Tools to study language in the brain

Electroencephalography (EEG)

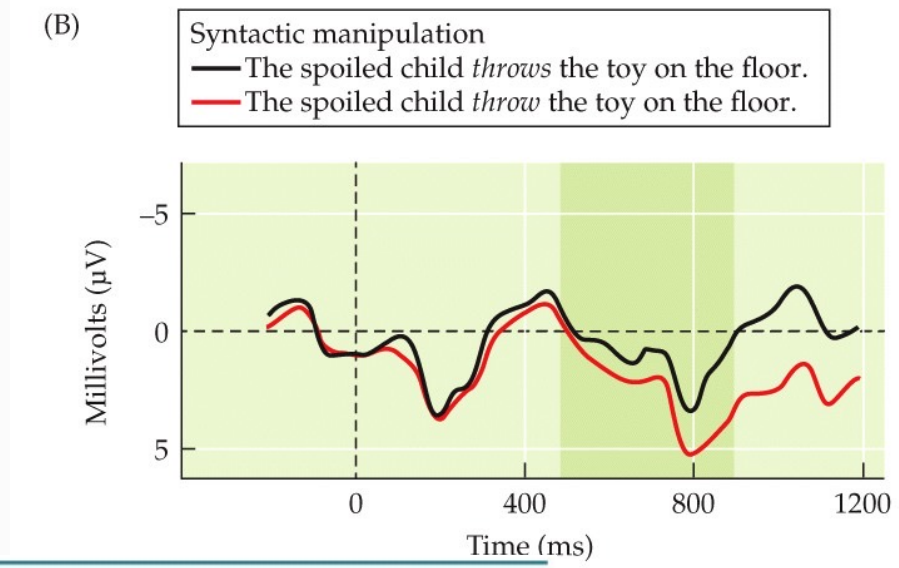
- Major language-related “event related potentials” (ERPs) – negative is plotted UP
  - Two major ones:
    a) N400: typically related to a semantic anomaly
       1. John buttered his bread with socks.

Involved in accessing a word’s contents from stored memory and integrating it with preceding information.

Tools to study language in the brain

Electroencephalography (EEG)

- Major language-related "event related potentials" (ERPs) – positive is plotted DOWN
  - Two major ones:
    b) P600: typically related to a syntactic violation
       1. The spoiled child throw the toys on the floor.



What?	When?	Why?	Example(s)	Triggering stimulus[a]
Positive-going activity	Peaks at about 600 ms after stimulus onset	Occurs in processing (and possibly trying to repair) an unexpected syntactic structure	Reading or hearing sentences with a syntactic violation	*The boats **is** at the dock.* (Expected: *The boats **are** at the dock.*)
			Reading sentences that contain an unusual or unexpected structure	*The broker persuaded **to sell** the stock was tall.* (Expected: *The broker persuaded **his client** to sell the stock.*)
			Reading sentences in which the participants involved in an event are in the wrong order	*The hearty meal was **devouring** the kids.* (Expected: *The kids were **devouring** the hearty meal.*)

Tools to study language in the brain

Electroencephalography (EEG)

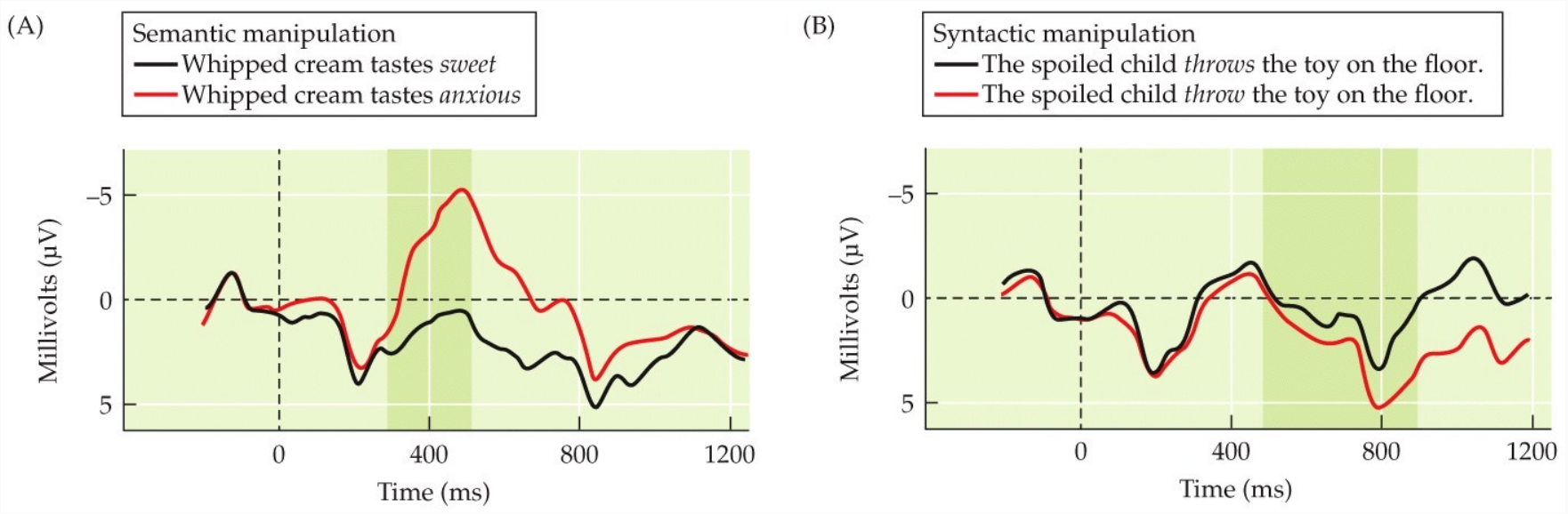
- Major language-related “event related potentials” (ERPs) – positive is plotted DOWN
  - Two major ones:
    b) P600: typically related to a syntactic violation
       1. The spoiled child throw the toys on the floor.

Found in the combination of syntactic units.

Are syntax and semantics two different processes?

Electroencephalography (EEG)

- N400 isn't just nonsensical, but unpredictable
  - Example: He painted the bike *vermillion*.
- P600 isn't just a problem with syntactic structure
  - Example: structures that are less common (straining working memory)



Unit 3:
Language, Brain, & Diversity

Acquired aphasia

Learning objectives

- State what typically causes aphasia
- Describe the main symptoms of Broca's and Wernicke's aphasias
- Name the areas of the brain associated with Broca's and Wernicke's aphasia
- Learn the typical relationship between written and spoken language in aphasia
- Define anomia, phonological paraphasia, semantic paraphasia, and neologisms and give an example of each
- Learn the basics of the "House" model, how it accounts for Broca's and Wernicke's aphasia and the correct prediction it made about Conduction aphasia

Discuss

- Are the systems of language comprehension and language production separate? Support your answer to your group members!
- Why should we study acquired language disorders?
- What is aphasia?
- What causes aphasia?

What is aphasia?

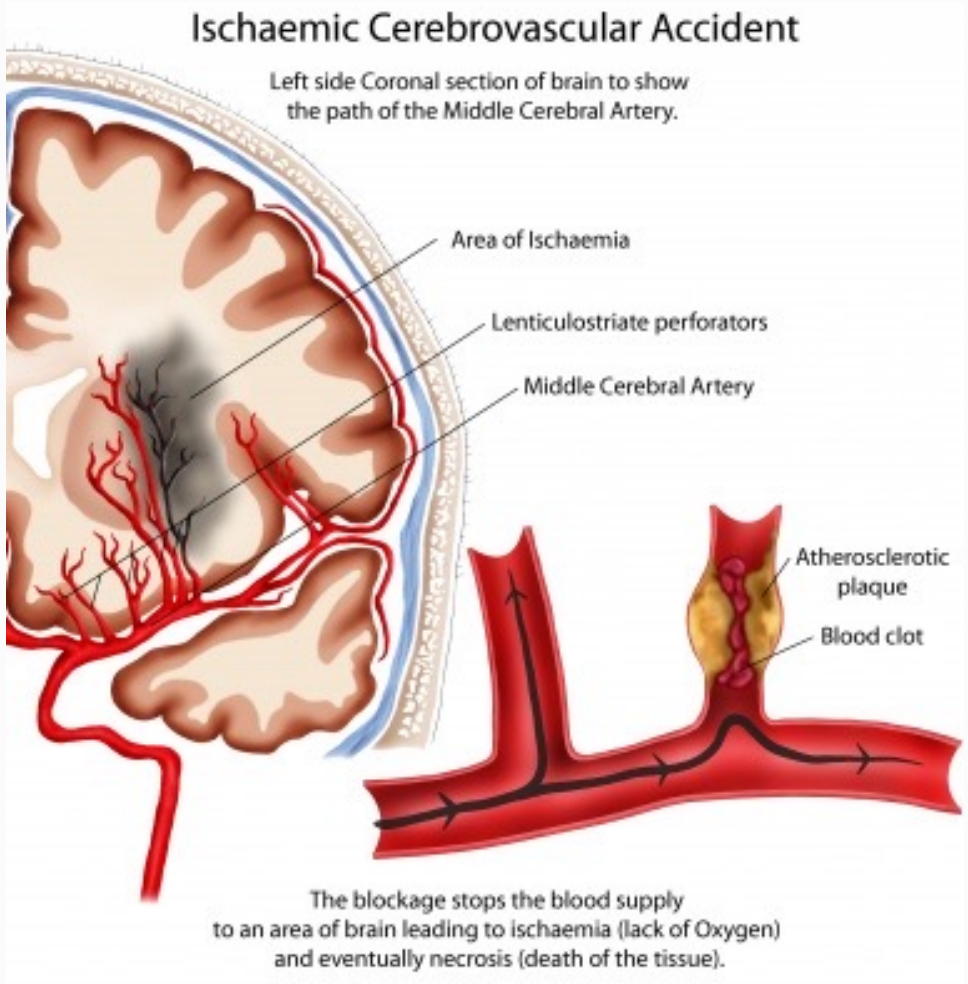
- Difficulty producing and/or understanding language due to brain damage
- Language is impaired disproportionately to other intellectual abilities
  - People with aphasia can have severe language deficits while other cognitive functions remain intact

Why study acquired aphasia?

- Learn about (cognitive or neural) architecture of language system via how it can break down
- Learn about structure-function relationships in the brain
- Learn how to improve therapies

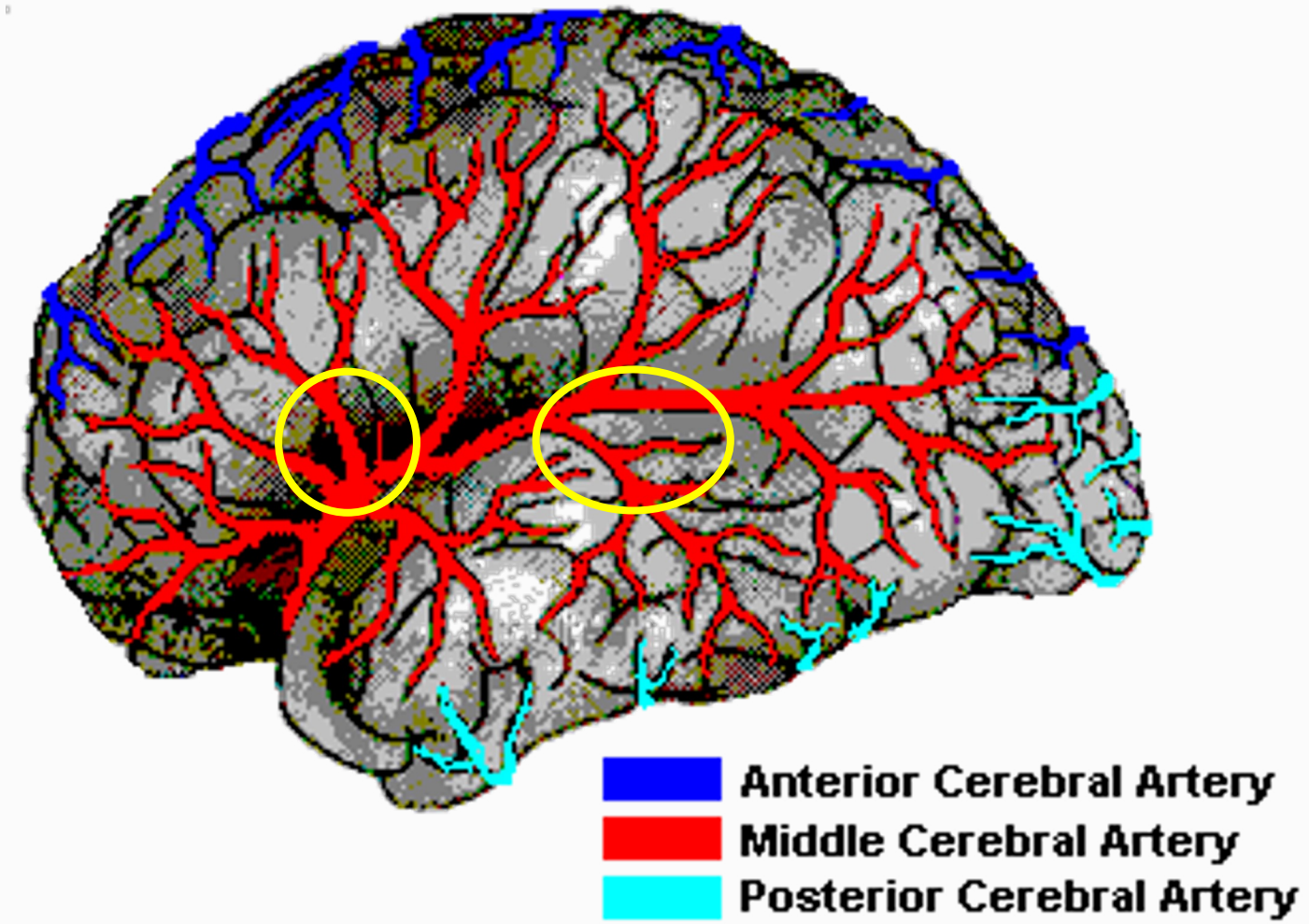
What causes aphasia?

- Most caused by stroke
  - Stroke occurs when blood flow to brain is interrupted, usually due to blocked artery (clot) or hemorrhage.
  - Blood supply blocked, usually by:
    - Plaques or fatty (cholesterol-containing) deposits in blood-vessel walls
    - Fatty deposit or clot that formed elsewhere (e.g., leg), becomes dislodged and travels to brain where narrow blood vessels cause it to become lodged



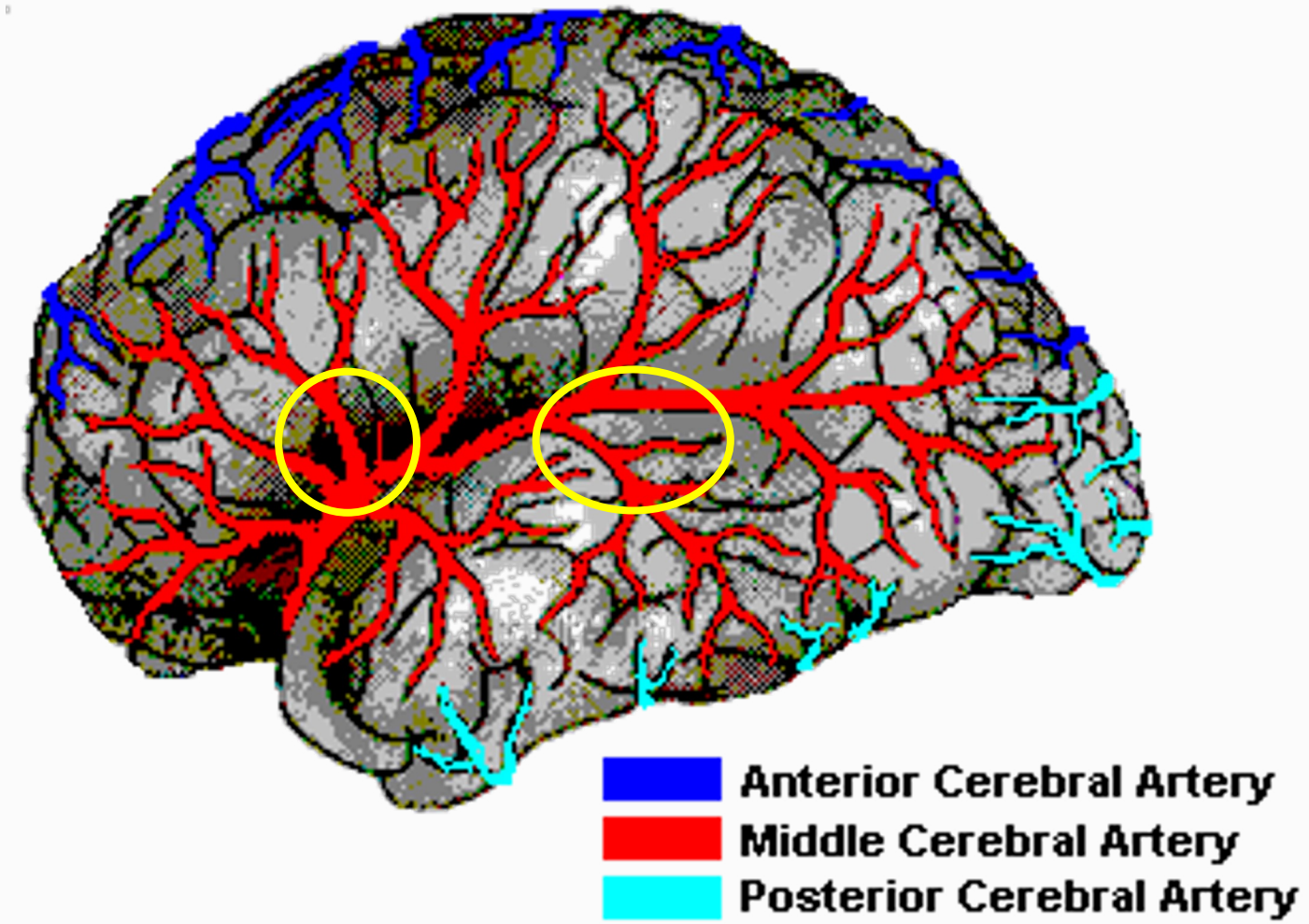
Why do strokes commonly cause aphasia?

- Clots often swept into middle cerebral artery, and get stuck in Synvian fissure (dark region)
  - This is an important part of the brain for language

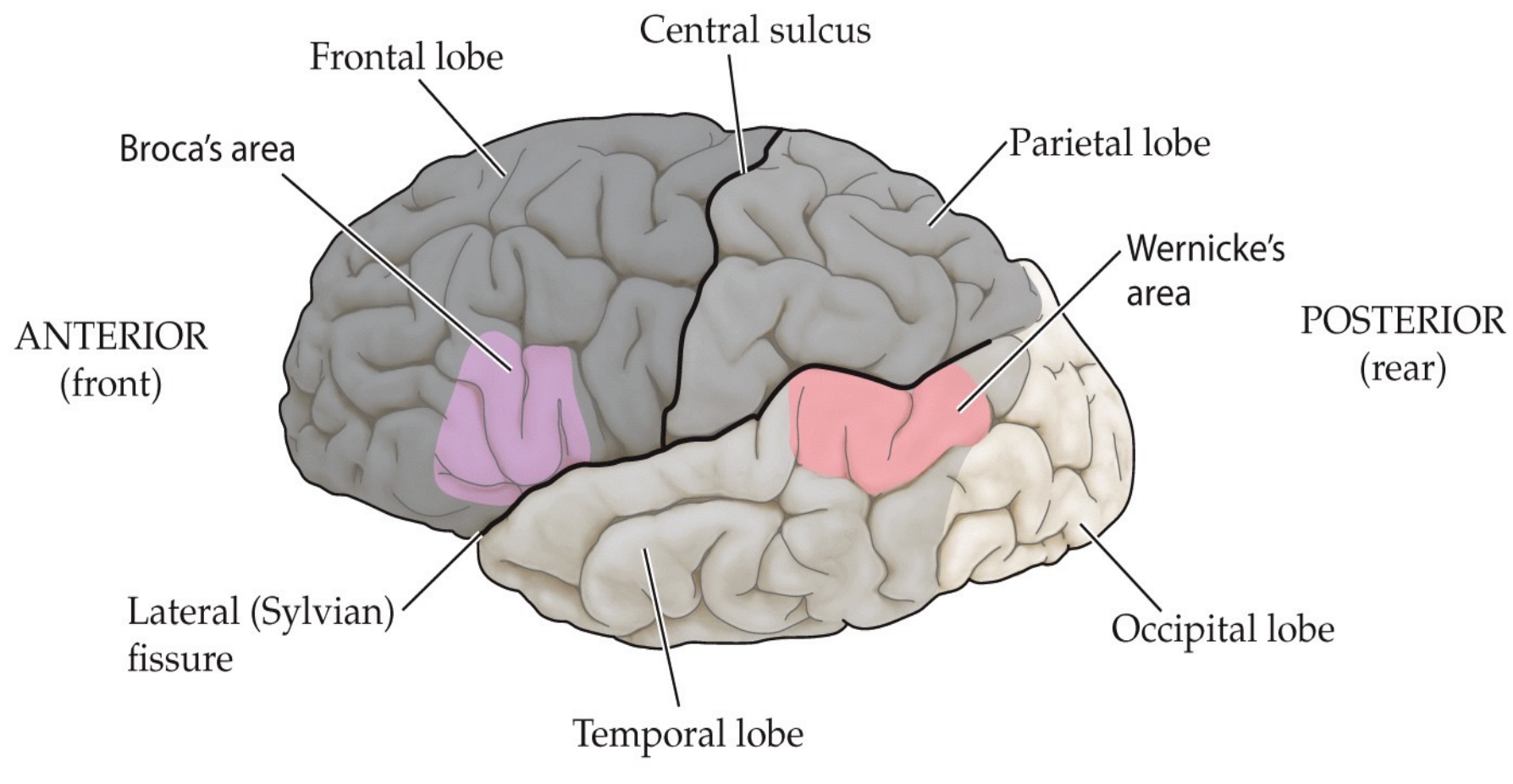


Why do strokes commonly cause aphasia?

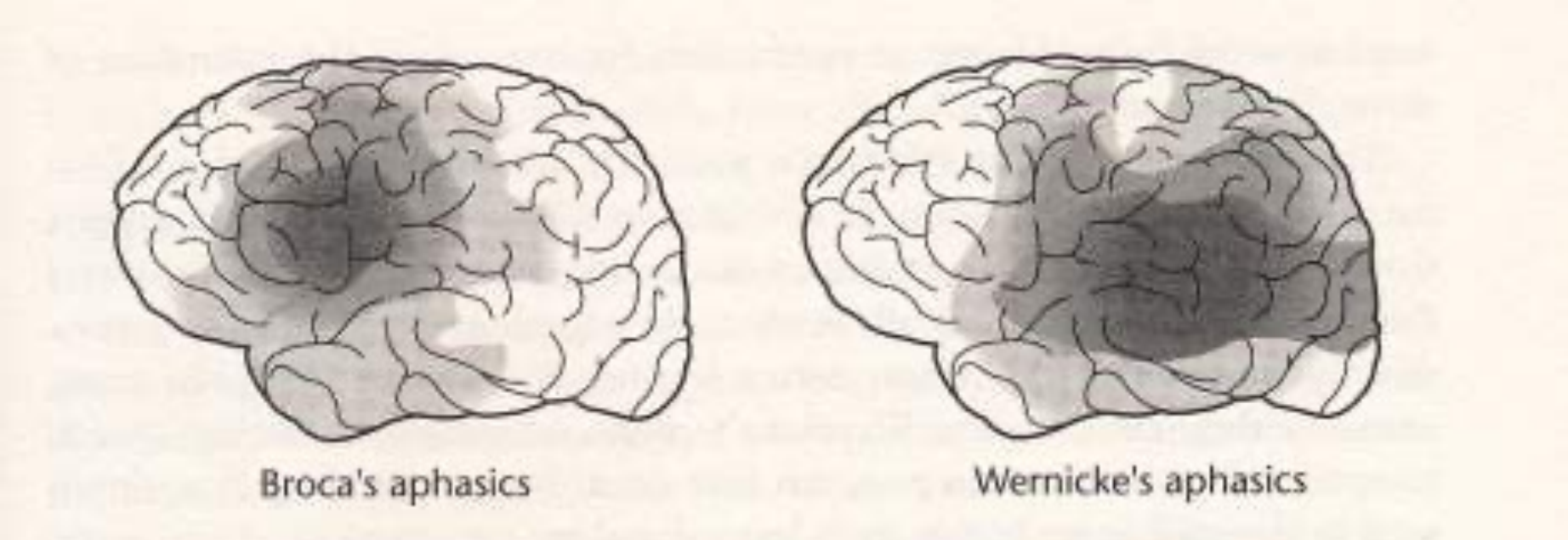
- Left circle: Broca's
- Right circle: Wernicke's



‘Tidy’ map of Broca’s and Wernicke’s areas



A more realistic view across patients



Lesion overlay of 65 aphasic individuals (Kertesz, 1977)

Patients with Broca's and Wernicke's aphasia

Broca's

- http://www.youtube.com/watch?v=f2IiMEbMnPM
- https://www.youtube.com/watch?v=JWC-cVQmEmY

Wernicke's

- http://youtu.be/aVhYN7NTIKU
- https://www.youtube.com/watch?v=3oef68YabD0

Fill out the chart based on your observations

Use this information to fill in the chart:

- AKA non-fluent aphasia
- AKA fluent aphasia
- can remember object names well/with difficulty
- repetition is good/poor
- comprehension is good/poor
- production is ungrammatical
- production is grammatical
- uses non-words that only they understand
- uses real words

* some answers are the same in both columns!
If you're not sure, take a guess

	Broca's	Wernicke's
What else might it	be called?	
Object names?		
Repetition?		
Comprehension?		
Production?		

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Broca's	Wernicke's

* some answers are the same in both columns!
If you're not sure, take a guess

Fill out the chart based on your observations

- **Phonological paraphasia**: phonological error when producing word (e.g., dish or lish for fish)
- **Semantic paraphasia**: semantic error when producing word (e.g., cat for dog)
- **Neologism**: non-word (e.g., ferbus lalo!)
- **Jargonistic**: makes sense to them, no one else (e.g., strings of neologisms)

Broca's	Wernicke's
Alternative names: Non-fluent or anterior aphasia	Alternative names: Fluent or posterior aphasia
Anomia = difficulty remembering object names	Anomia = difficulty remembering object names
Poor repetition	Poor repetition
Relatively good comprehension	Relatively poor comprehension
Agrammatic production and comprehension; uses real words	Grammatical production and comprehension; uses non-words; Jargonistic = paraphasic, neologistic, production (*jabberwocky-esque)*

Jabberwocky by Lewis Carroll

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
And the mome raths outgrabe.

"Beware the Jabberwock, my son!
The jaws that bite, the claws that catch!
Beware the Jubjub bird, and shun
The frumious Bandersnatch!"

He took his vorpal sword in hand;
Long time the manxome foe he sought—
So rested he by the Tumtum tree
And stood awhile in thought.

And, as in uffish thought he stood,
The Jabberwock, with eyes of flame,
Came whiffling through the tulgey wood,
And burbled as it came!

One, two! One, two! And through and through
The vorpal blade went snicker-snack!
He left it dead, and with its head
He went galumphing back.

"And hast thou slain the Jabberwock?
Come to my arms, my beamish boy!
O frabjous day! Callooh! Callay!"
He chortled in his joy.

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe:
All mimsy were the borogoves,
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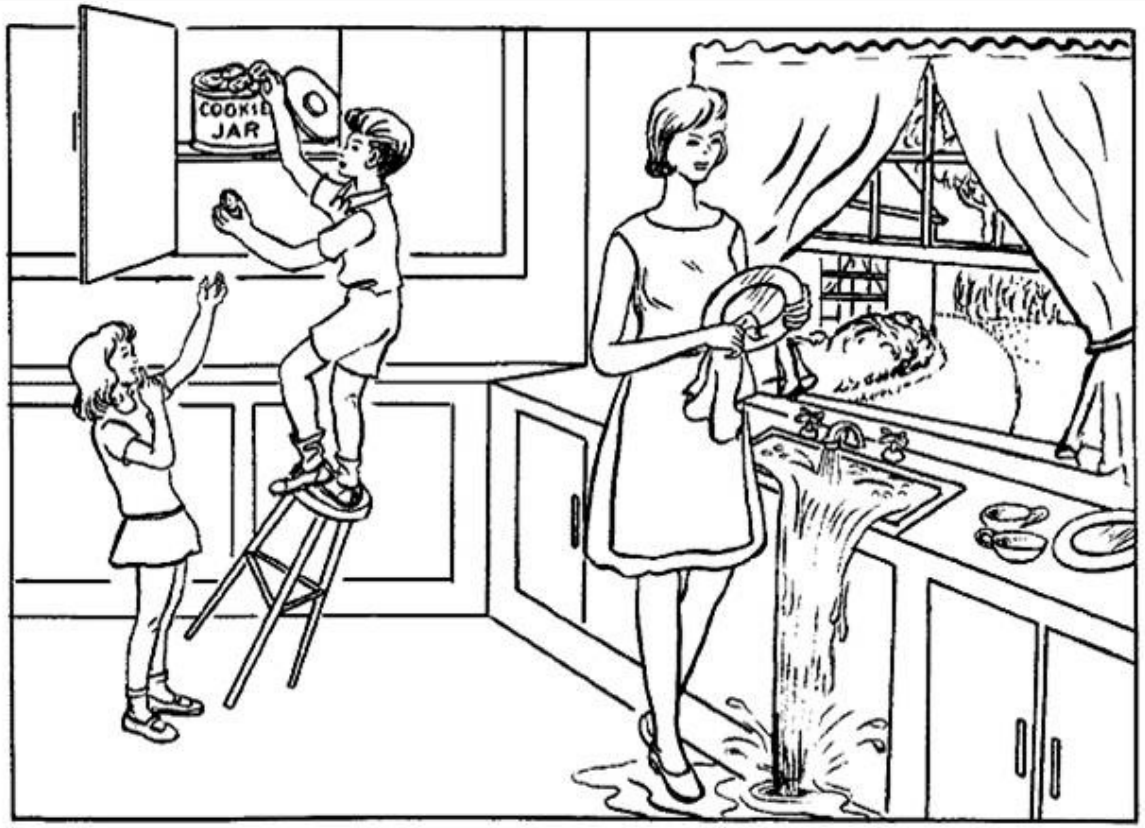
Speech: Cookie Theft picture description



Patient: Wife is dry dishes. Water down! Oh boy! Okay Awright. Okay ...Cookie is down...fall, and girl, okay, girl...boy...um...

Examiner: What is the boy doing?

Patient : Cookie is...um...catch

Examiner: Who is getting the cookies?

Patient : Girl, girl

Examiner: Who is about to fall down?

Patient : Boy...fall down!

Patient : Well this is … mother is away here working her work out o' here to get her better, but when she's looking, the two boys looking in the other part.

Examiner: What is the boy doing?

Patient : One their small tile into here time here. She's working another time because she's getting to.

Examiner: Who is getting the cookies?

Patient : So two boys work together and one is sneakin' around here, making his work an' his further funnas his time he had.

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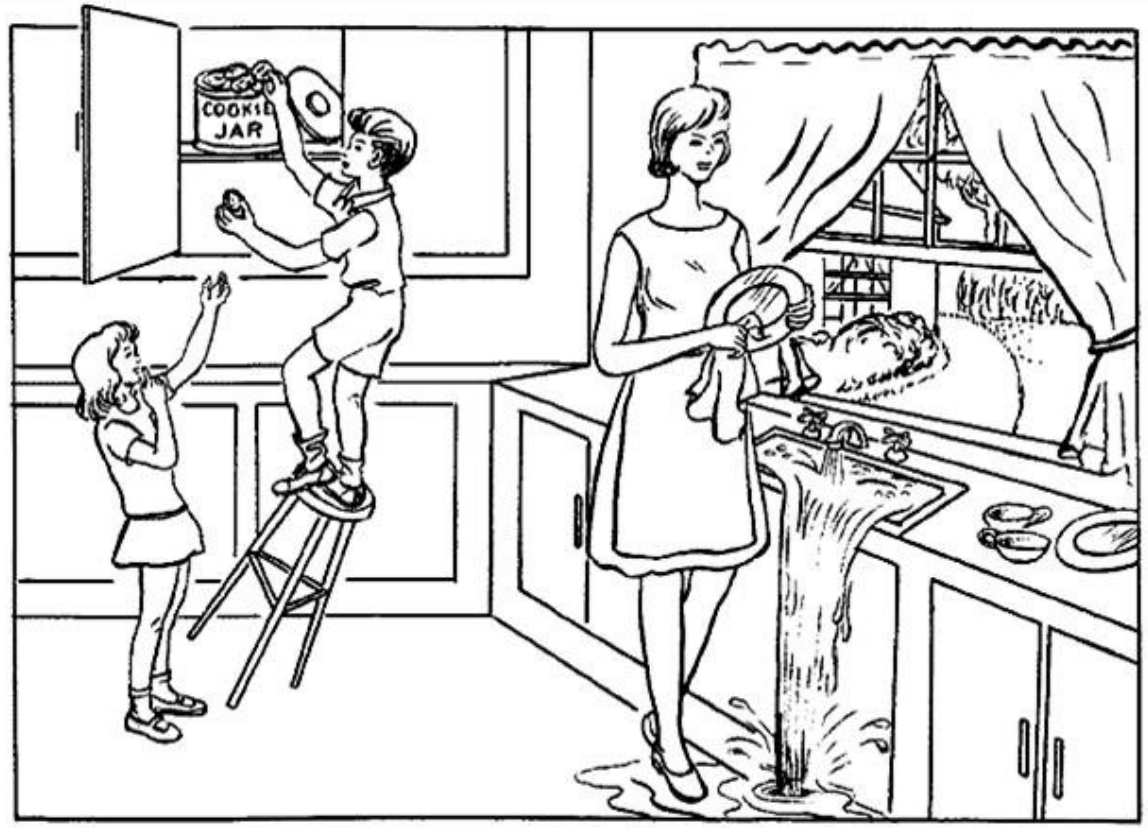

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BROCA'S

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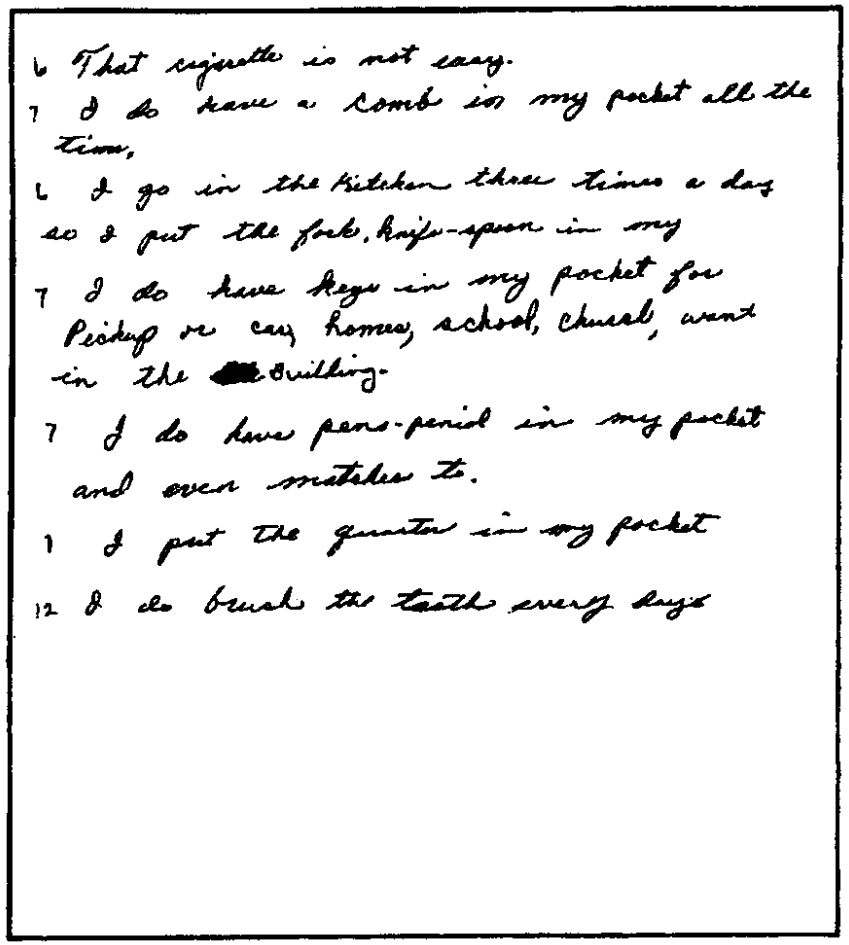
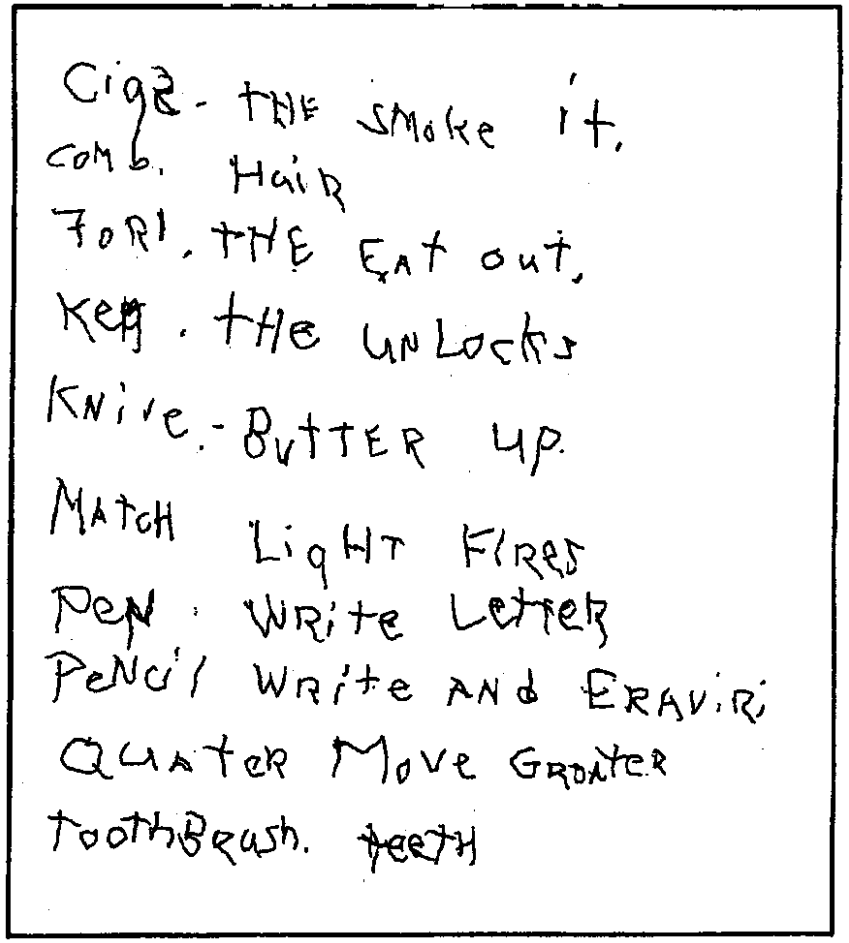
WERNICKE'S

Writing



6 That cigarette is not easy.
7 I do have a comb in my pocket all the time,
6 I go in the kitchen three times a day so I put the fork, knife-spoon in my
7 I do have keys in my pocket for Pickup or car, homes, school, church, went in the [redacted] building.
7 I do have pens-penid in my pocket and even matches to.
1 I put the quarter in my pocket
12 I do brush the teeth every days

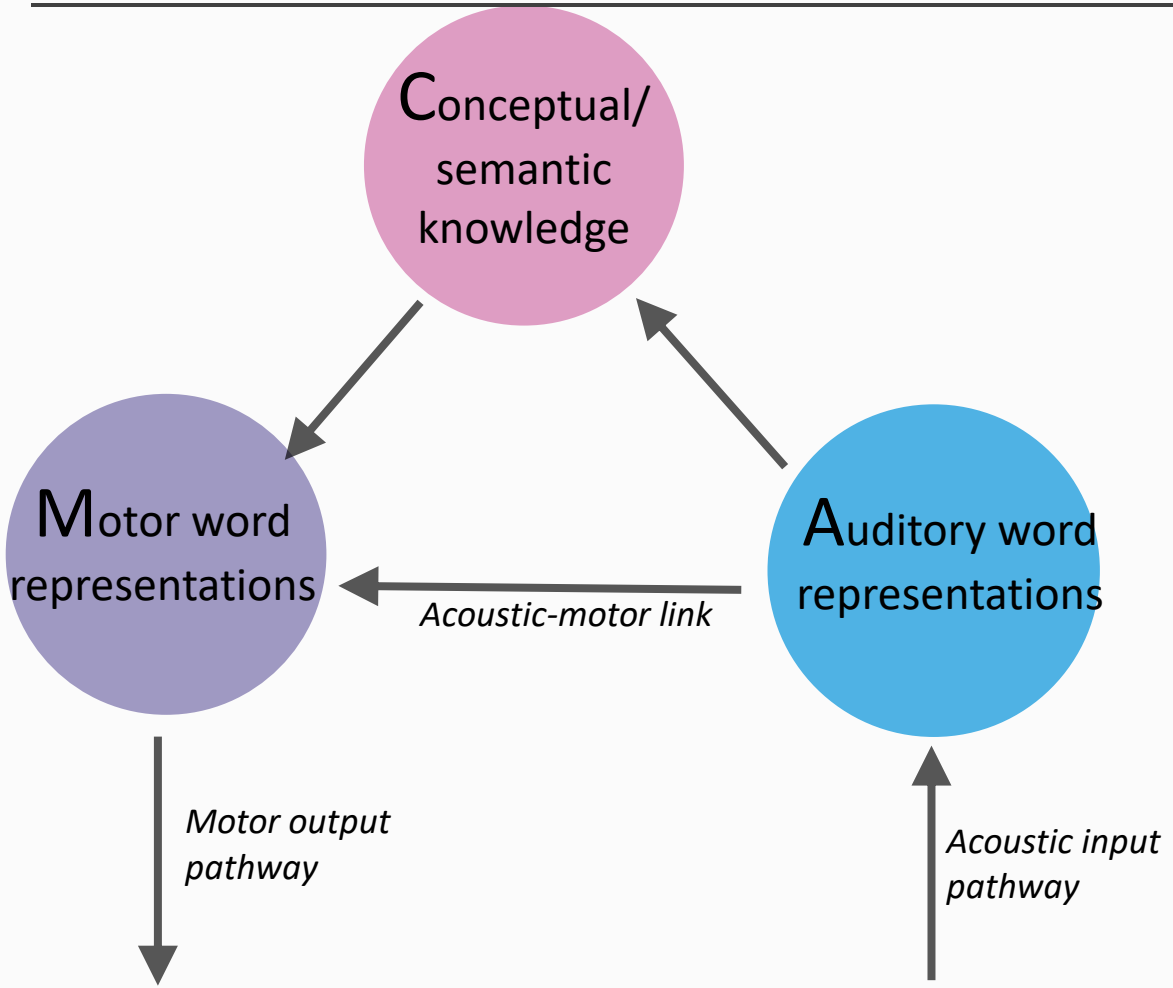
WERNICKE'S



CIGR - THE SMOKE IT.
COMB. HAIR
FORI. THE EAT OUT.
KEY. THE UNLOCKS
KNIVE. - BUTTER UP.
MATCH LIGHT FIRES
PEN. WRITE LETTER
PENCIL WRITE AND ERAVIR
QUATER MOVE GROATER
TOOTHBRUSH. TEETH

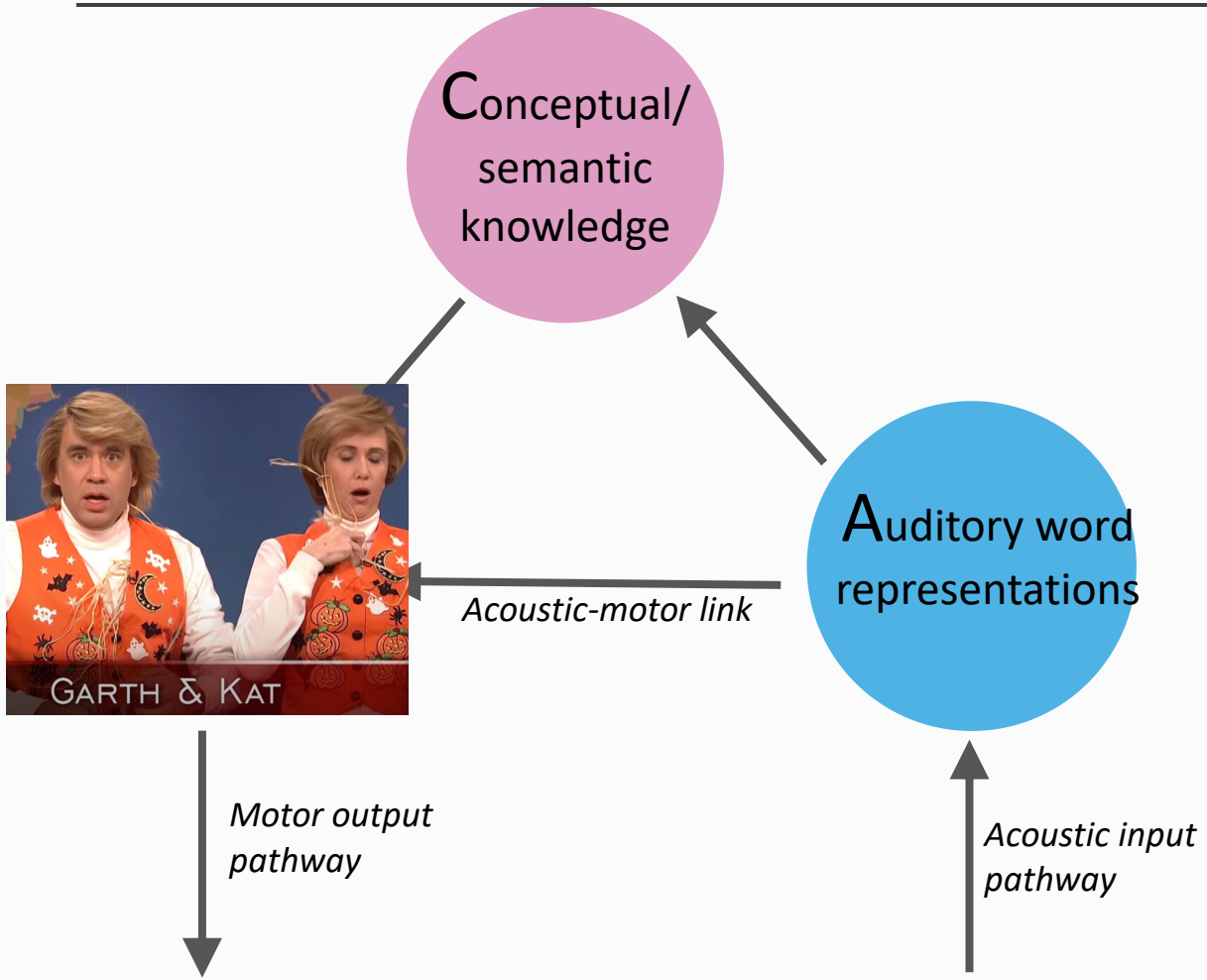
BROCA'S

Wernicke-Lichtheim "house" model (1885)



Broca's	Wernicke's
Non-fluent production	Fluent Production (but often seems inappropriate/nonsensical)
Relatively good comprehension	Relatively poor comprehension
Poor repetition	Poor repetition

Wernicke-Lichtheim "house" model (1885)



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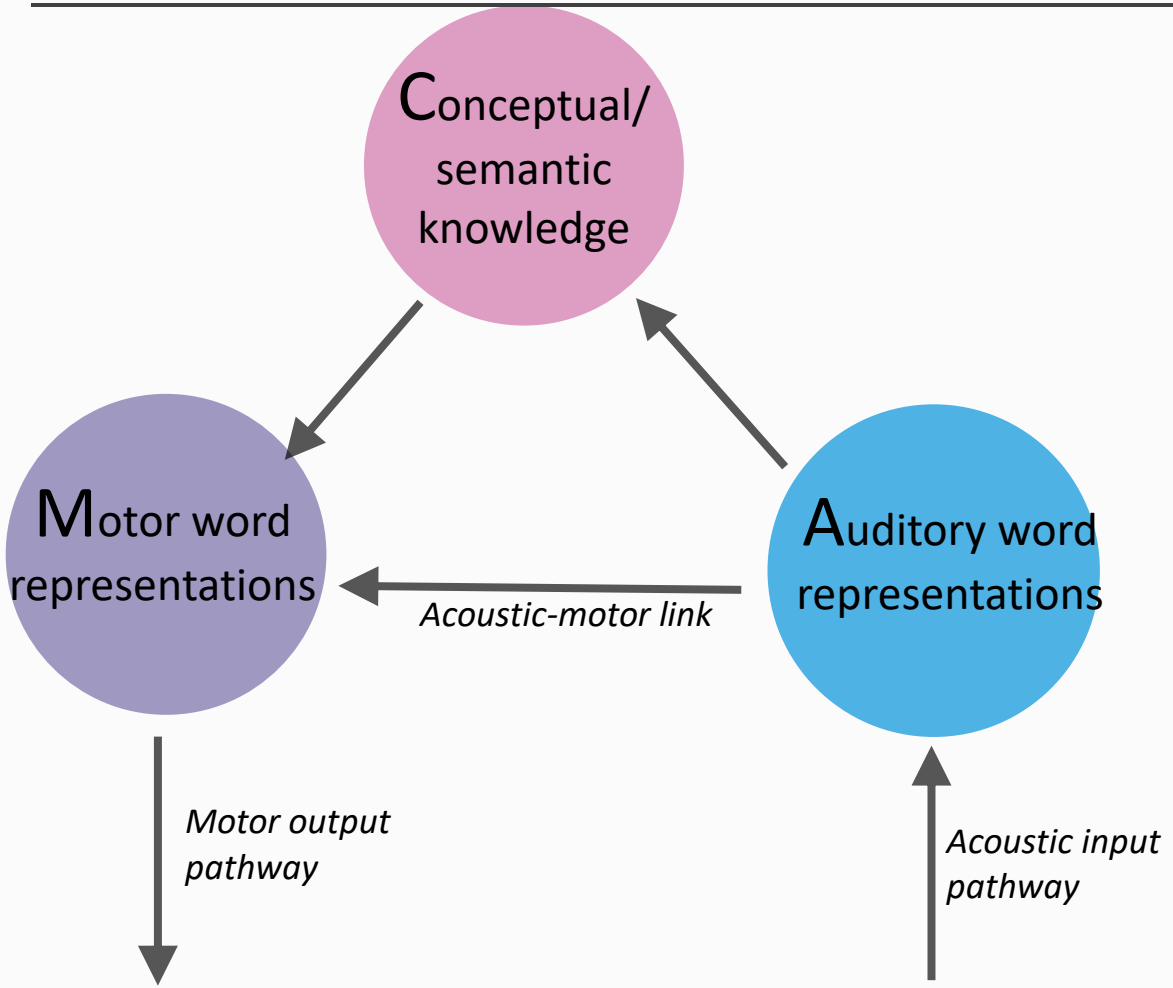

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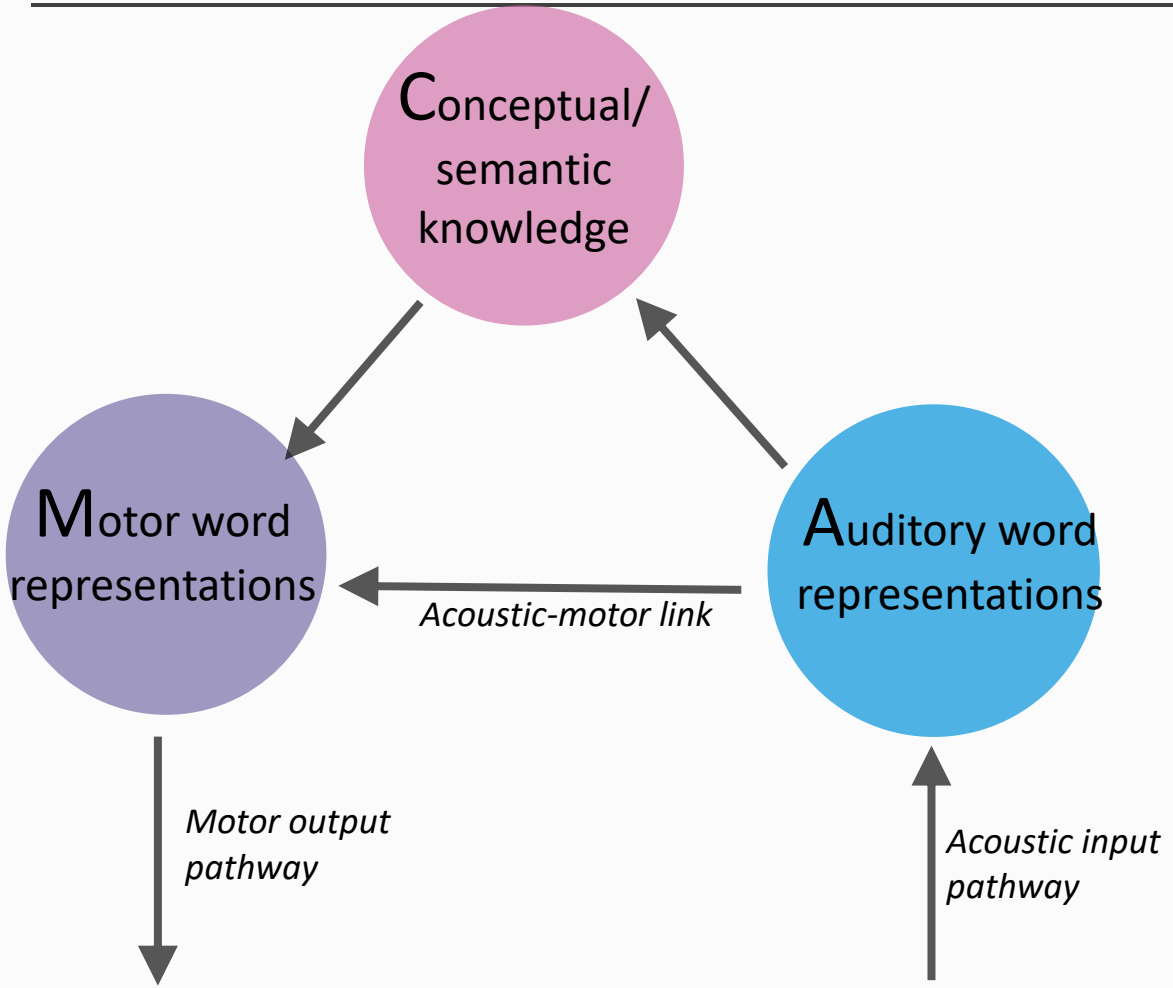
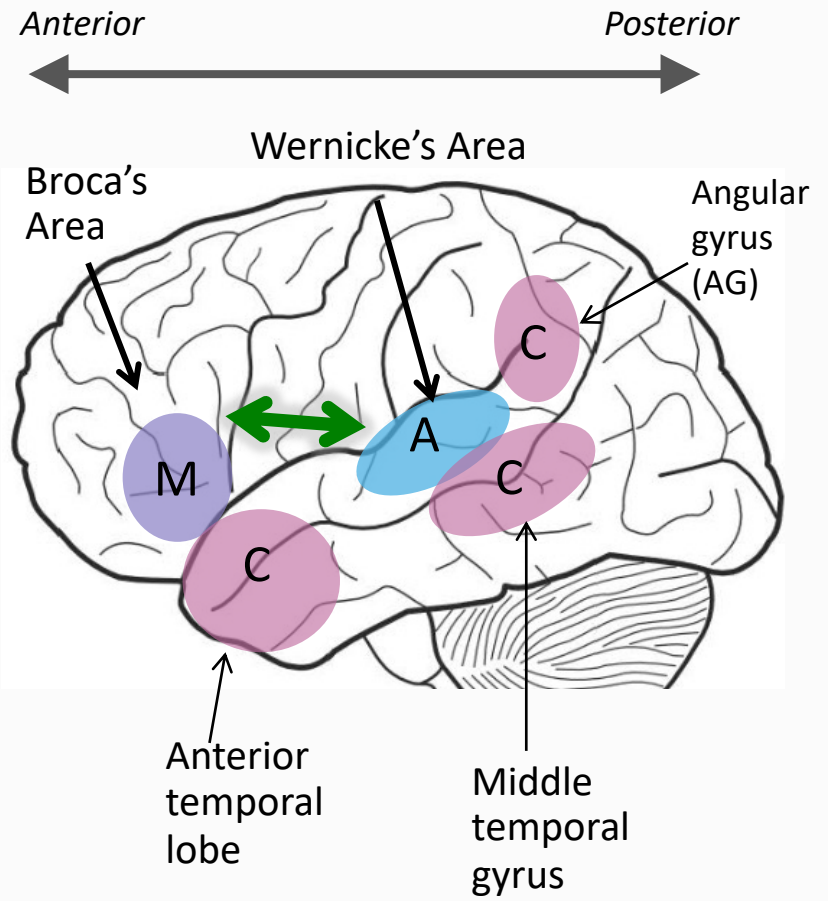
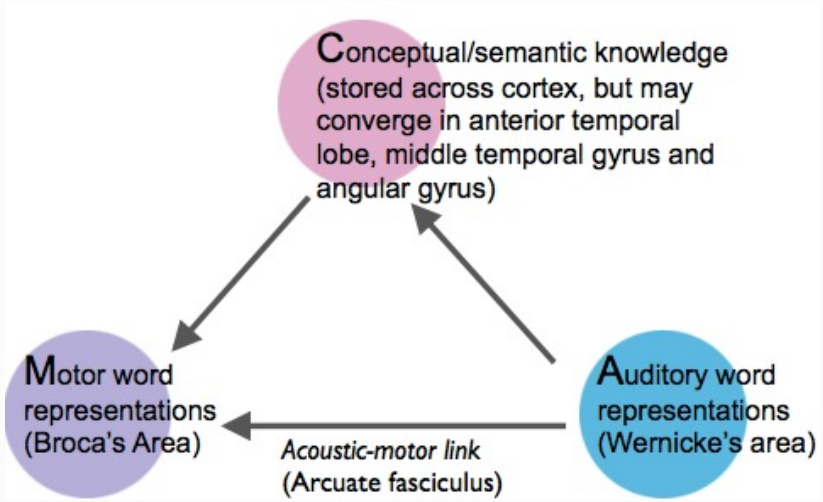
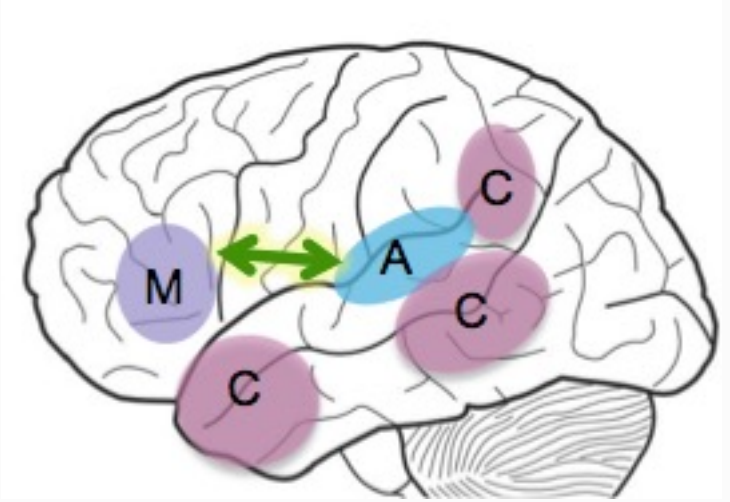


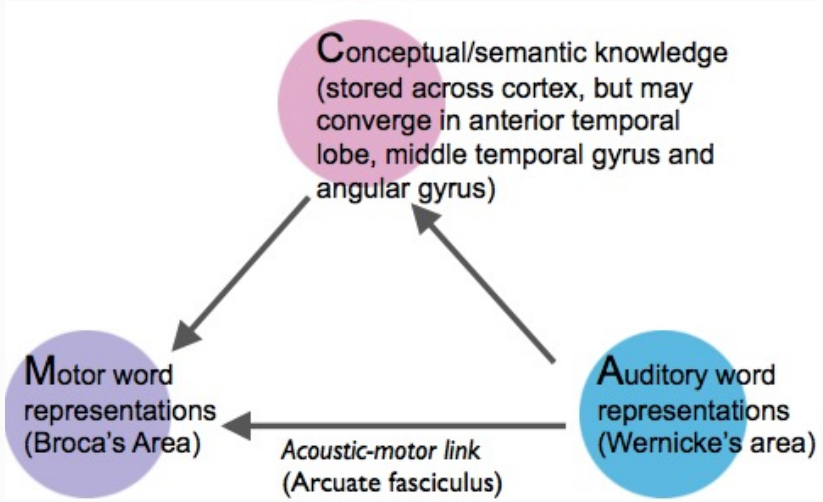


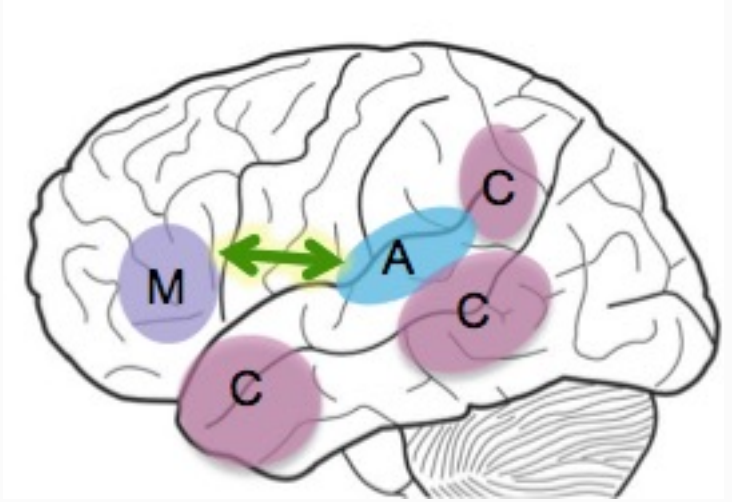




How Broca's, Wernicke's & Conduction aphasia are explained in "house model":

Syndrome	Typical symptoms	"House" model damage	Anatomical damage (typical)
Broca's Aphasia			Inferior frontal gyrus (IFG) 
Wernicke's Aphasia			Posterior half of superior temporal gyrus (STG), 

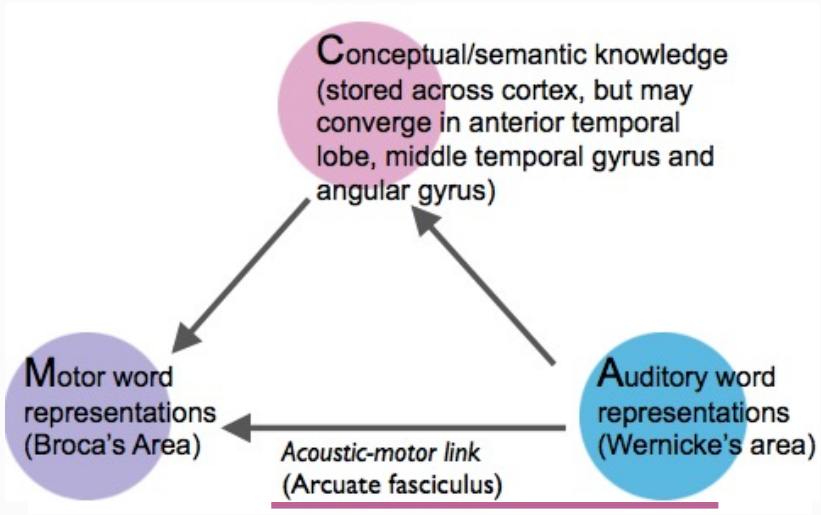


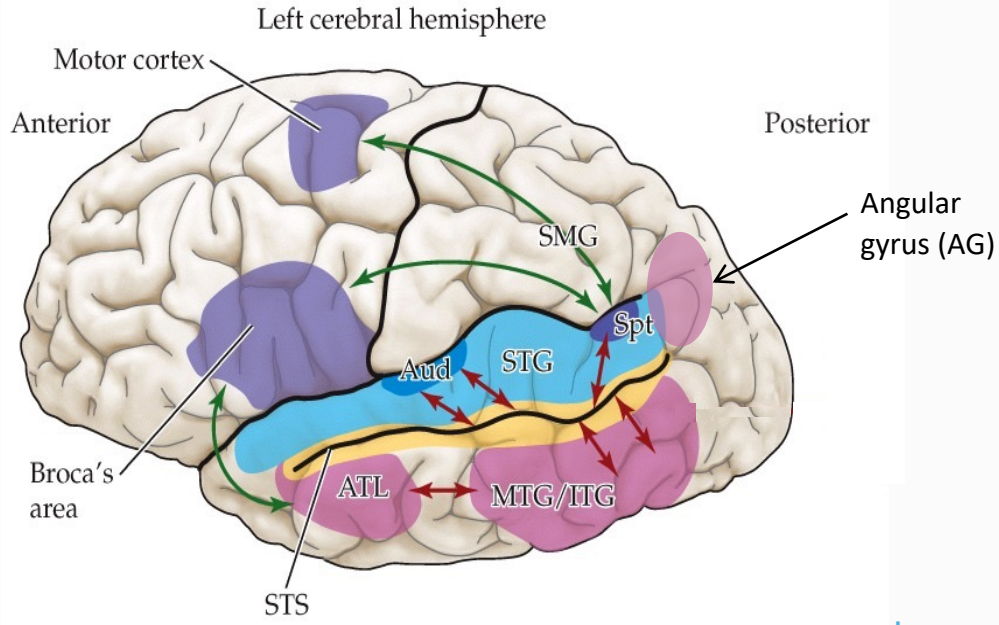


How Broca's, Wernicke's & Conduction aphasia are explained in "house model":

Syndrome	Typical symptoms	"House" model damage	Anatomical damage (typical)
Broca's Aphasia	- Disturbances in spontaneous speech (slow, effortful, agrammatic) - Poor repetition - Preserved auditory comprehension	Lesion to motor word representations (M)	Inferior frontal gyrus (IFG) 
Wernicke's Aphasia	- Comprehension deficit - Fluent but inappropriate production - Poor repetition	Lesion to auditory word representations (A)	Posterior half of superior temporal gyrus (STG), 
Conduction Aphasia	- Preserved comprehension - Relatively fluent production - Severe repetition impairment	Damaged connection between auditory word representations and motor word representations (A->M)	Lesion in arcuate fasciculus and/or cortico-cortico connections between W's and B's areas 

Connection to the dual-stream model





- **Dorsal stream** (green arrows): Supports speech production by translating sounds/phonological representations (blue) into motor sequences for speech (purple)
- **Ventral stream** (red arrows): Supports speech comprehension by mapping sounds/phonological representations (blue) onto to meaning (pink)
  - Meaning is widely distributed across cortex, but this model focuses on anterior temporal lobe (ATL) & middle temporal gyrus (MTG) – two areas where different aspects of meaning are processed.
    - Angular gyrus (AG) is another important area for meaning

Review

1. What typically causes aphasia?
2. Broca's and Wernicke's aphasia have different language symptoms
   - Name a language symptom for each
3. Different areas of the brain
   - Broca's associated with (anterior? posterior?) areas
   - Wernicke's associated with (anterior? posterior?) areas
4. In aphasia, are written and spoken language generally impaired similarly?
5. Give a definition and an example if you can:
   - Anomia; Phonological paraphasia; Semantic paraphasia; Neologisms
6. In the "House" model:
   - Broca's aphasia = problem with _____
   - Wernicke's aphasia = problem with _____
   - Conduction aphasia = problem with _____

Review answers

1. Stroke typically causes aphasia
2. Broca's and Wernicke's aphasia have different language symptoms
3. Different areas of the brain
   - Broca's associated with anterior (inferior frontal gyrus) areas
   - Wernicke's associated with posterior (posterior superior temporal lobe/greater Wernicke's metro area) areas
4. In aphasia, written and spoken language are generally impaired similarly
5. Definitions and examples
   - Anomia: word finding difficulty; Phonological paraphasia: cottle for bottle; Semantic paraphasia: chair for table; Neologisms: meerpis
6. In "House" model:
   - Broca's aphasia = problem with motor representations of words
   - Wernicke's aphasia = problem with auditory word representations
   - Conduction aphasia = problem with connection between auditory word representations and motor word representations