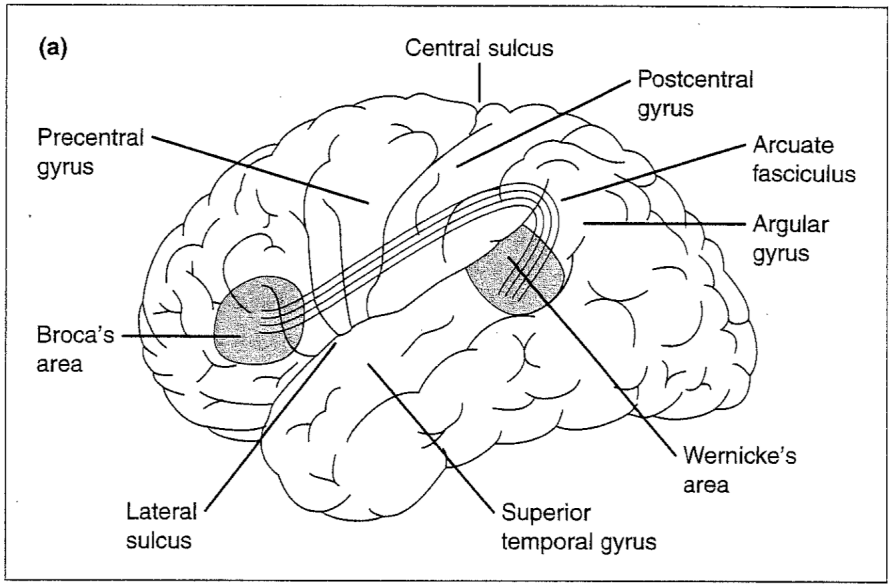
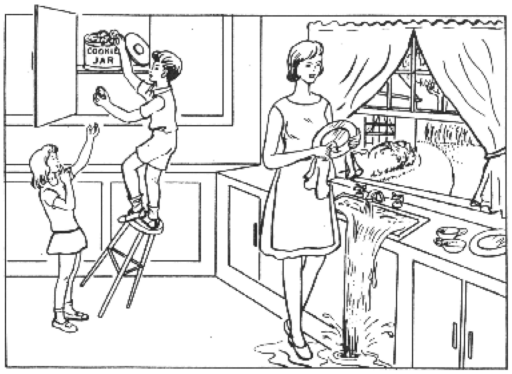
How Are Our Linguistic Abilities Realized in the Brain?

Language aphasia: an acquired disturbance or loss of language abilities due to brain injury, disease, or stroke.

- ~70% of individuals who suffer damage to the left hemisphere experience some form of aphasia, while only 1% of individuals who suffer damage to the right hemisphere experience aphasia



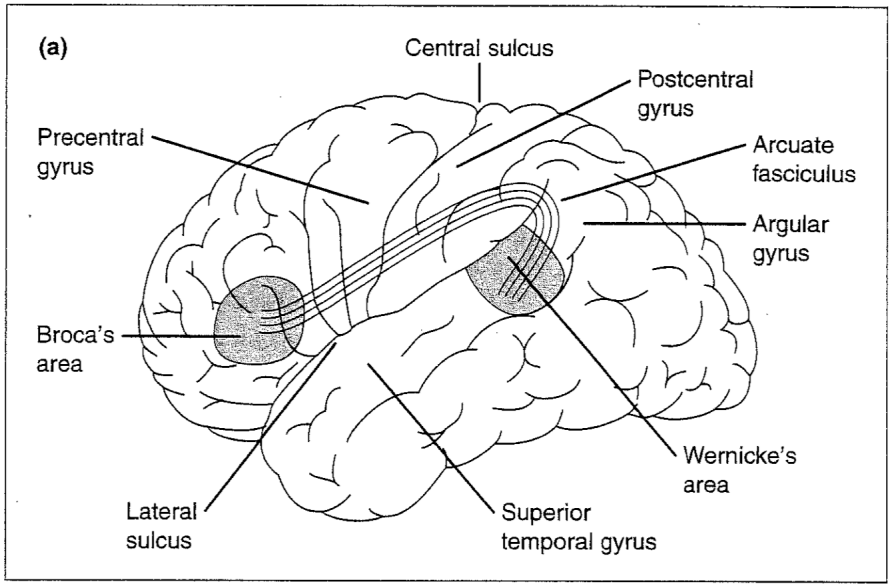
Broca's aphasia (also known as **expressive** or **motor aphasia**): due to damage in the lower posterior region of the left frontal lobe (**Broca's area**, first identified by the 19th-century French physician Paul Broca).



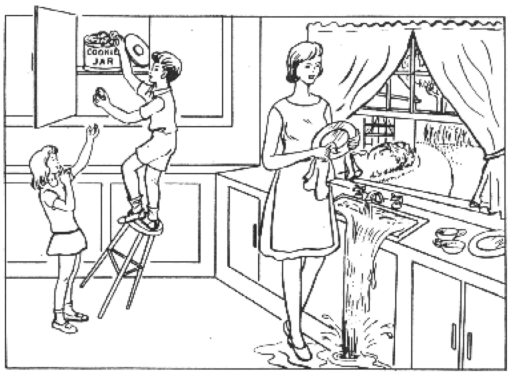
B.L.: Wife is dry dishes. Water down! Oh boy! Okay…Cookie is down…fall, and girl, okay, girl…boy…um…
Examiner: What is the boy doing?
B.L.: Cookie is…um…catch
Examiner: Who is getting the cookies?
B.L.: Girl, girl
Examiner: Who is about to fall down?
B.L.: Boy…fall down!

What sorts of disturbances affect the language abilities of Broca's aphasics?

- slow, laborious speech: great effort required to articulate complete words
- absence of function words and endings ("telegraphic speech")
- comprehension usually appears intact (but also suffers problems; see pg. 4)
- acute awareness of their own mistakes (respond well to treatment)



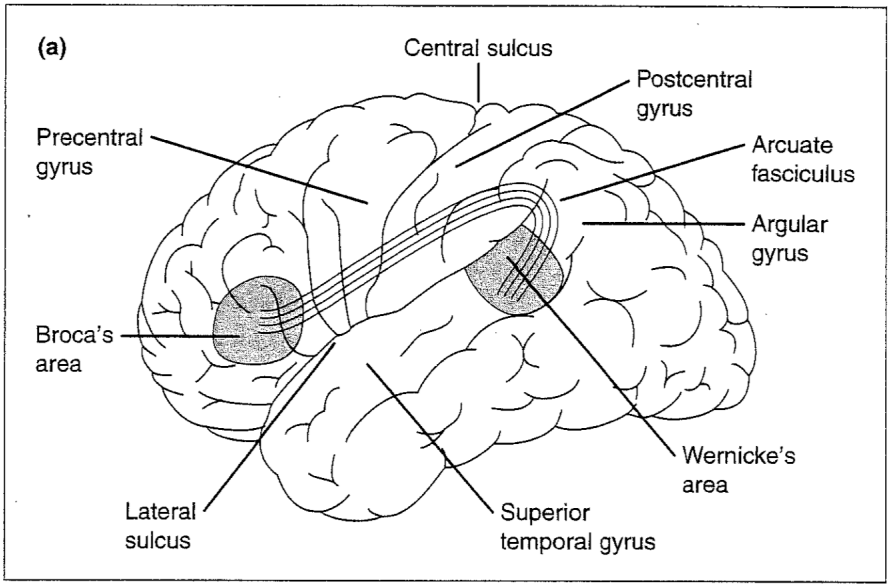
Wernicke's aphasia (also known as **receptive** or **sensory aphasia**): due to damage in the left temporal lobe (**Wernicke's area**, first identified by the 19th-century German neurologist Karl Wernicke).



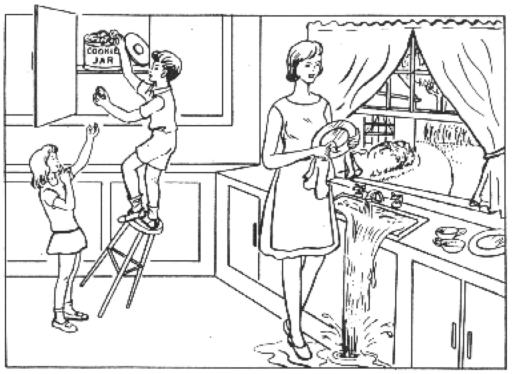
Patient: Well this is … mother is away here working her work out of here to get her better, but when she's looking, the two boys looking in the other part. One their small tile into here time here. She's working another time because she's getting to. So two boys work together and one is sneakin' around here, making his work and his further funnas his time he had.

How does the speech of Wernicke's aphasics differ from that of Broca's aphasics? What sorts of disturbances are seen in their language abilities?

- speech is rapid, fluent, and generally grammatical
- speech is incoherent: short, meaningful sequences strung together in a meaningless, repetitive way
- difficulty finding words: substitutions, circumlocutions, or "coinages"
- extremely poor comprehension: don't follow instructions/answer ?'s well
- typically unaware of their own mistakes (rarely respond to treatment)



Anomic aphasia: due to damage to the angular gyrus (a particularly prominent convolution in the parietal lobe).



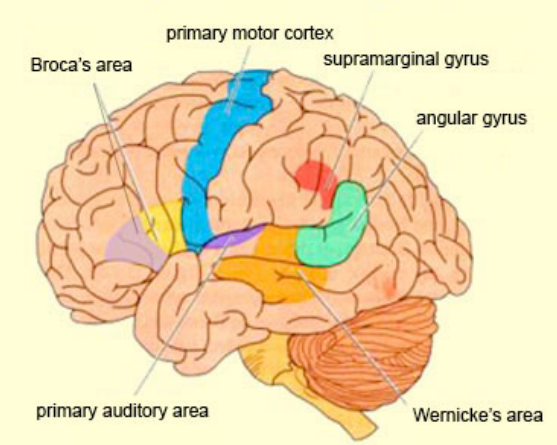
H.W.: First of all this is falling down, just about, and is gonna fall down and they're both getting something to eat...but the trouble is this is gonna let go and they're both gonna fall down...but already then...I can't see well enough but I believe that either she or will have some food that's not good for you and she's to get some for her too...and that you get it and you shouldn't get it there because they shouldn't go up there and get it unless you tell them that they could have it. and so this is falling down and for sure there's one they're going to have for food and, and didn't come out right, the uh, the stuff that's uh, good for, it's not good for you but it, but you love it, um mum mum (smacks lips)...and that so they've...see that, I can't see whether it's in there or not.

Anomic aphasics have difficulty finding words, both during the normal flow of speech and during explicit naming tasks:

- speech is rapid, fluent, and generally grammatical
- speech is filled with circumlocutions, pronouns, and generic nouns like *food* and *stuff*
- comprehension is usually unimpaired

What functions do Broca's area and Wernicke's area perform?

The classical picture (originally proposed by Wernicke): Broca's area stores **the motor instructions for how to articulate words** (necessary for speech production), while Wernicke's area store **our sensory memories of how words sound** (necessary for identifying words during speech comprehension).



- Broca's area is adjacent to the portion of the primary motor cortex which controls movement of the jaws, lip, and tongue during speech
- Wernicke's area is adjacent to the primary auditory cortex, which is responsible for processing incoming sounds (including speech)

Inadequacies of the classical picture:

(A) Wernicke's aphasics also show disturbances in their speech production: meaningless, repetitive dialogue, difficulty in finding words.

(B) Why does Broca's aphasia specifically target function words and endings?

(C) Broca's aphasics also show disturbances in their speech comprehension.

(1) The boy pushed the girl. (active)
AGENT TARGET

(2) The girl **was** pushed **by** the boy. (passive)
TARGET AGENT

- active vs. passive sentences: different word order, but same meaning

(3) It was the boy that pushed the girl.
AGENT TARGET

(4) It was the girl that the boy pushed.
TARGET AGENT

- *It*-cleft sentences: different word order, but same meaning

- Broca's aphasics reliably understand (1) and (3), but not (2) and (4): in latter, equally likely to identify the girl as the AGENT (pusher) and the boy as the TARGET (pushed)
- Broca's aphasics seems to depend on shortcuts like "the AGENT of an event comes before its TARGET in a sentence", instead of actual syntactic parsing

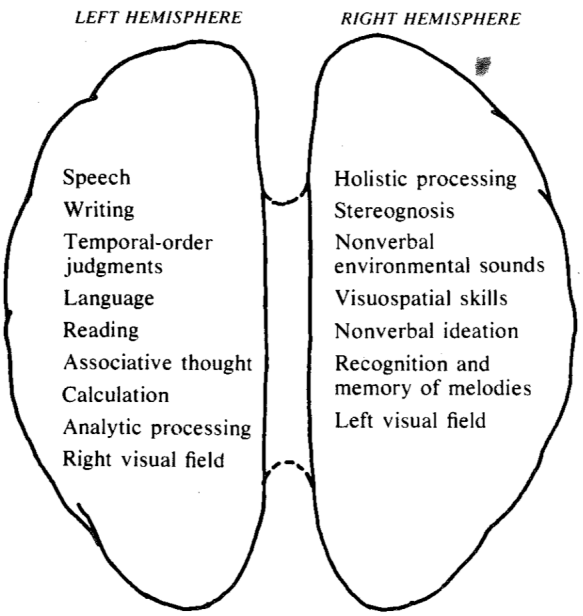
The revised picture (still under development): Broca's area is involved in **syntactic processing** (both during speech production and speech comprehension), while Wernicke's area is involved in **the processing of individual words** (both during speech comprehension and speech production).

Aphasia in American Sign Language (ASL)

Similarities and differences between spoken and signed languages:

- spoken and signed languages follow the same organizing principles: discrete units (words, endings) are heirarchically organized into constituents in order to form sentences
- but spoken language relies on the vocal and auditory channels for communication, whereas signed languages rely on the spatio-gestural and visual channels for communication

- damage to Broca's area leads to the same kinds of disturbances for ASL signers: signing is difficult and slow, and lacks function signs and "endings"
- damage to Wernicke's area also leads to the same kinds of disturbances for ASL signers: signing is fluent but meaningless, great difficulty in comprehending the signing of others
- damage to the right hemisphere leads to difficulty with nonlinguistic spatial tasks (comprehending spatial relationships amongst physical objects), but linguistic spatial tasks (signing) are unimpaired



Conclusion: Broca's area and Wernicke's area are not specifically tied to either auditory recognition of incoming speech sounds or articulatory control of the vocal organs. Rather, they are tied to abstract linguistic knowledge about words, and their heirarchical organization into structure.