PHYSIOLOGY OF SPEECH

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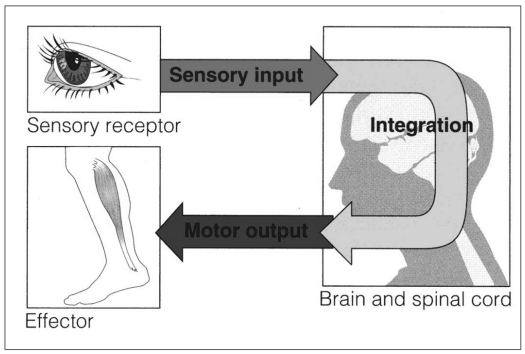
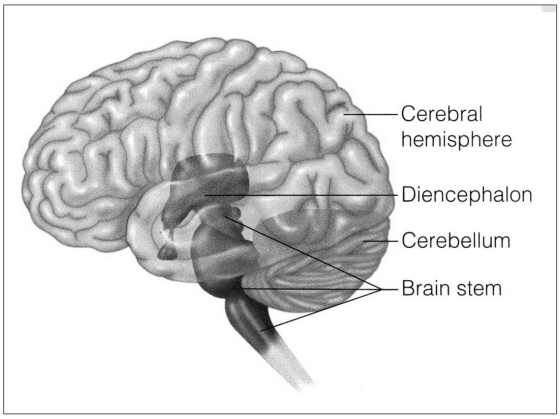
FUNCTIONS OF NERVOUS SYSTEM

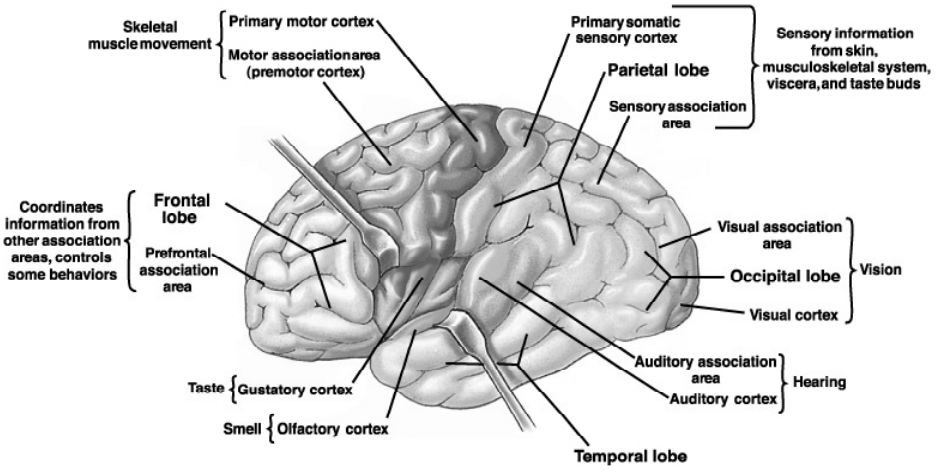
- **collection of sensory input**
- **integration**
- **motor output**



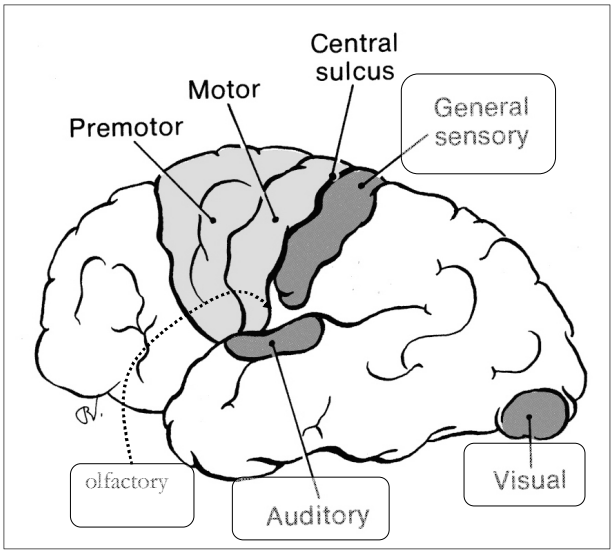
REGIONS OF THE BRAIN



- **cerebral hemispheres**
- **diencephalon**
- **cerebellum**
- **brain stem**



MAIN SENSORY AREAS OF THE CORTEX

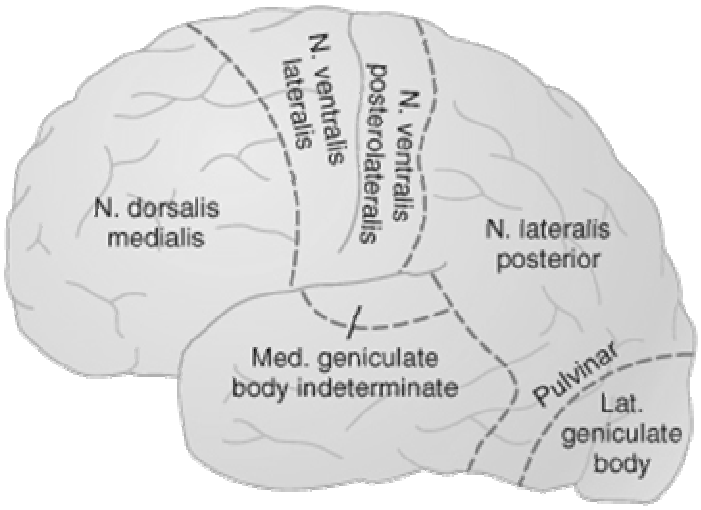


- **the somatic sensory area is located in the <u>parietal lobe</u> posterior to the central sulcus**
- **visual sensations are received in the visual area in the posterior lobe**
- **auditory sensations are received in the temporal lobe close to the lateral sulcus**
- **olfactory sensations are received deep inside the temporal lobe**

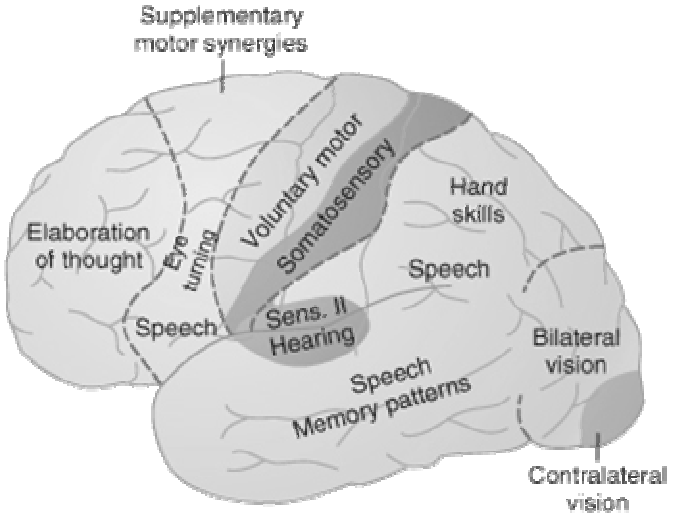
Function of the Brain in Communication- Language Input and Language Output

- **Sensory Aspects of Communication.**
- **Motor Aspects of Communication.**
- **Articulation.**

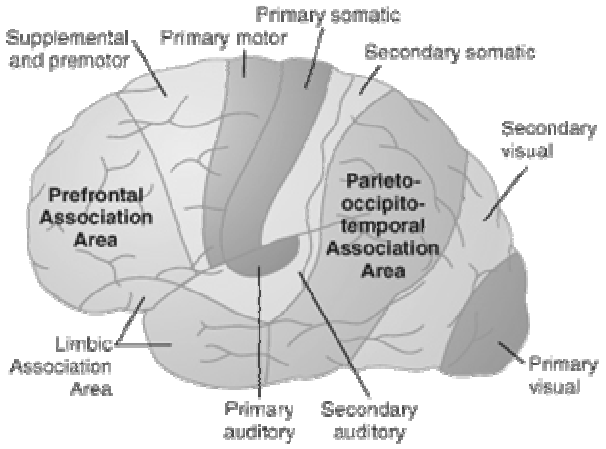
Thalamus and Cerebral Cortex



BRAIN AREAS AND SPEECH



PRIMARY, SECONDARY AND ASSOCIATION AREAS



PRIMARY MOTOR AREAS

The primary motor areas have direct connections with specific muscles for causing discrete muscle movements. The primary sensory areas detect specific sensations-visual, auditory, or somatic-transmitted directly to the brain from peripheral sensory organs.

SECONDARY MOTOR AREAS

- **The secondary areas make sense out of the signals in the primary areas. For instance, the supplementary and premotor areas function along with the primary motor cortex and basal ganglia to provide "patterns" of motor activity.**
- **On the sensory side, the secondary sensory areas, located within a few centimeters of the primary areas, begin to analyze the meanings of the specific sensory signals**
- **(1) interpretation of the shape or texture of an object in one's hand; (2) interpretation of color, light intensity, directions of lines and angles, and other aspects of vision; and (3) interpretations of the meanings of sound tones and sequence of tones in the auditory signals.**

ASSOCIATION AREAS

These areas receive and analyze signals simultaneously from multiple regions of both the motor and sensory cortices as well as from subcortical structures.

The most important association areas are

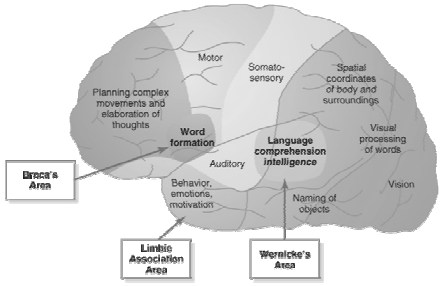
(1) the parieto-occipitotemporal association area

(2) the prefrontal association area, and

(3) the limbic association area.

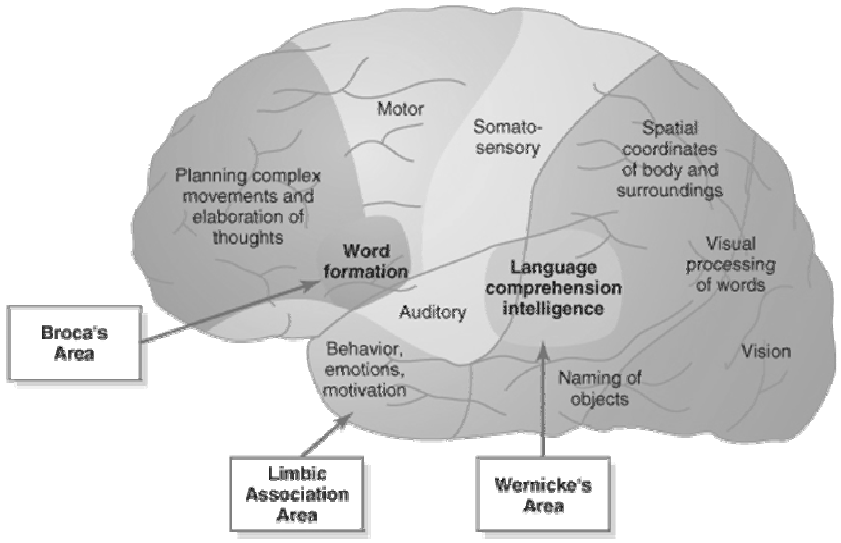
PARIETO-OCCIPITOTEMPORAL ASSOCIATION AREAS

- 1. Analysis of the Spatial Coordinates of the Body.
- 2. Area for Language Comprehension.
- 3. Area for Initial Processing of Visual Language (Reading).
- 4. Area for Naming Objects.



PARIETO-OCCIPITOTEMPORAL ASSOCIATION AREAS

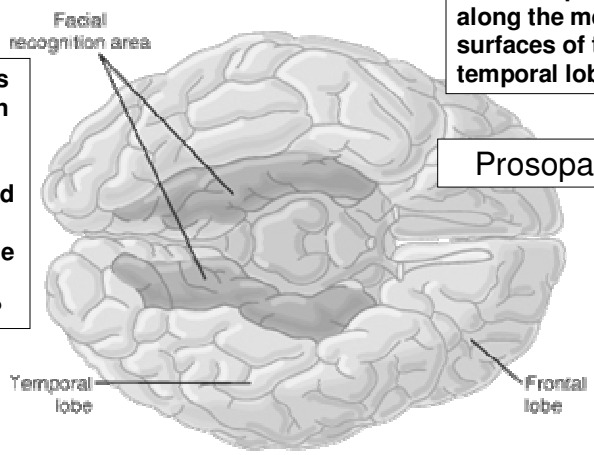
AREA	SITE	FUNCTION
Analysis of the Spatial Coordinates of the Body.	beginning in the posterior parietal cortex and extending into the superior occipital cortex	computes the coordinates of the visual, auditory, and body surroundings.
Area for Language Comprehension	Wernicke's area, lies behind the primary auditory cortex in the posterior part of the superior gyrus of the temporal lobe.	higher intellectual function
Area for Initial Processing of Visual Language (Reading).	angular gyrus area	make meaning out of the visually perceived words (Dyslexia or Word Blindess)
Area for Naming Objects.	In the most lateral portions of the anterior occipital lobe and posterior temporal lobe	naming objects.



Broca's Area. A special region in the frontal cortex, called *Broca's area, provides the neural circuitry for word formation.* This area, is located partly in the posterior lateral prefrontal cortex and partly in the premotor area. It is here that plans and motor patterns for expressing individual words or even short phrases are initiated and executed. This area also works in close association with Wernicke's language comprehension center in the temporal association cortex,

FASCIAL RECOGNITION AREAS

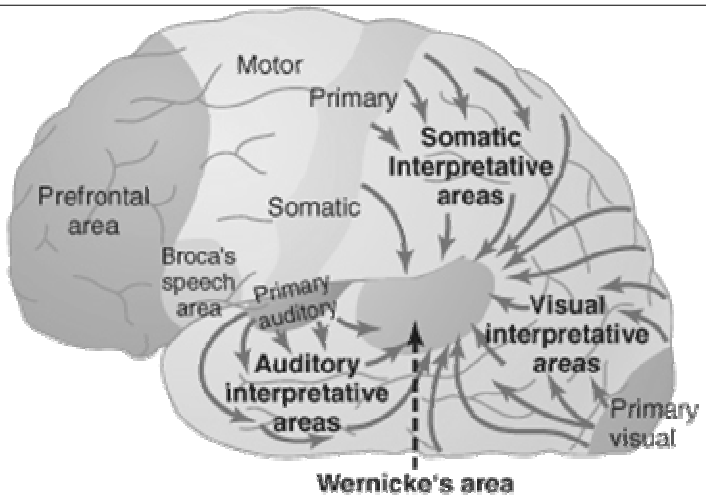
medial undersides of both occipital lobes and along the medioventral surfaces of the temporal lobes



One wonders why so much of the cerebral cortex should be reserved for the simple task of face recognition?

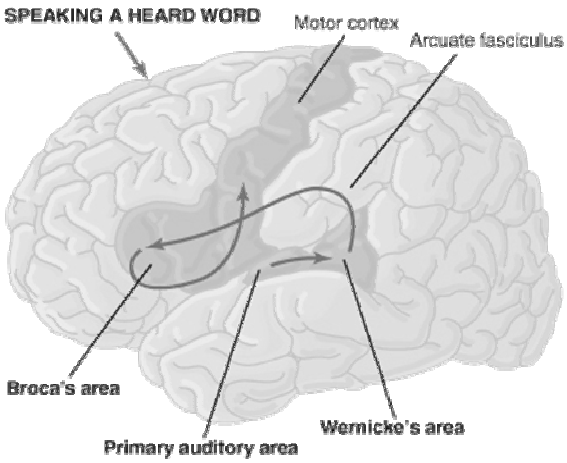
Prosopagnosia

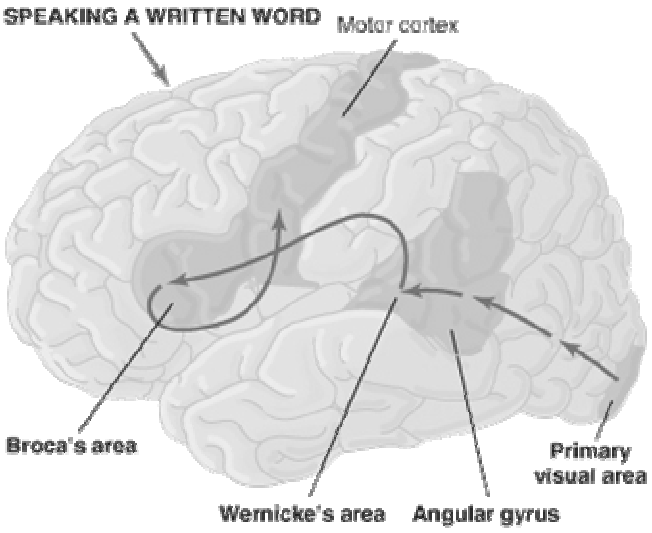
Comprehensive Interpretative Function of the Posterior Superior Temporal Lobe-"Wernicke's Area" (a General Interpretative Area) GNOSTIC AREA, the KNOWING AREA, the TERTIARY ASSOCIATION AREA,

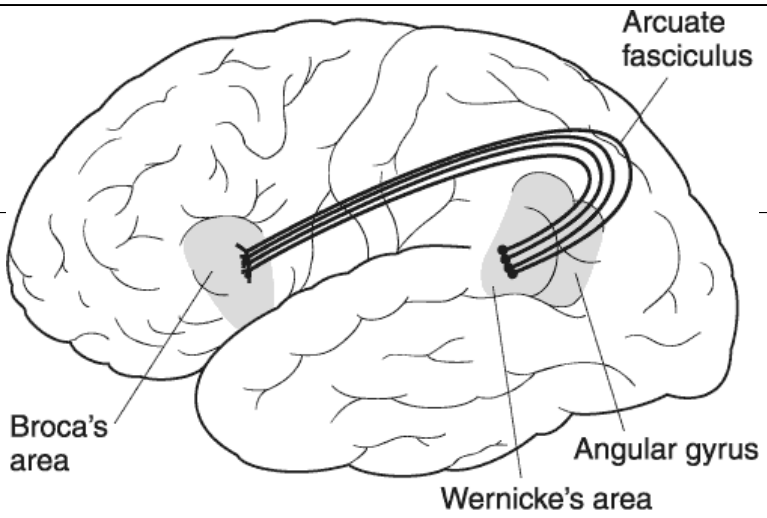


After severe damage in Wernicke's area, a person might hear perfectly well and even recognize different words but still be unable to arrange these words into a coherent thought.

AREA	LESION FAETURES
Auditory association areas	Word deafness
Visual association areas	Word blindness called dyslexia
Wernicke's Aphasia Global Aphasia	Unable to interpret the thought
Broca's Area Causes	Motor Aphasia


SPEAKING A HEARD WORD
Motor cortex
Arcuate fasciculus
Broca's area
Primary auditory area
Wernicke's area


SPEAKING A WRITTEN WORD
Motor cortex
Broca's area
Wernicke's area
Angular gyrus
Primary visual area



ARTICULATION

- **Means the muscular movements of the mouth, tongue, larynx, vocal cords**
- **Responsible for the intonations, timing, and rapid changes in intensities of the sequential sounds.**
- **The facial and laryngeal regions of the motor cortex activate these muscles, and the cerebellum, basal ganglia, and sensory cortex all help to control the sequences and intensities of muscle contractions**

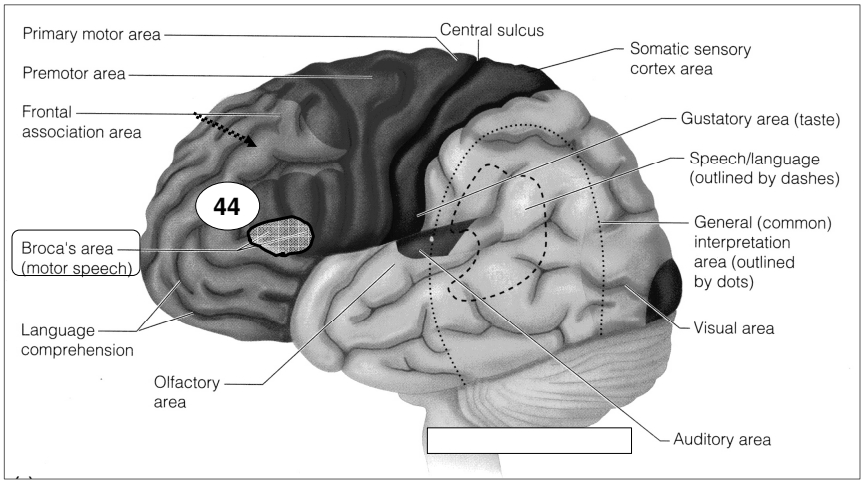
Brain Areas Concerned with Language

- **Wernick's Area**
- **Broca'a Area**
- **Speech articulation Area in Insula**
- **Motor Cortex**
- **Angular Gyrus**
- **Aud Assoc Areas**

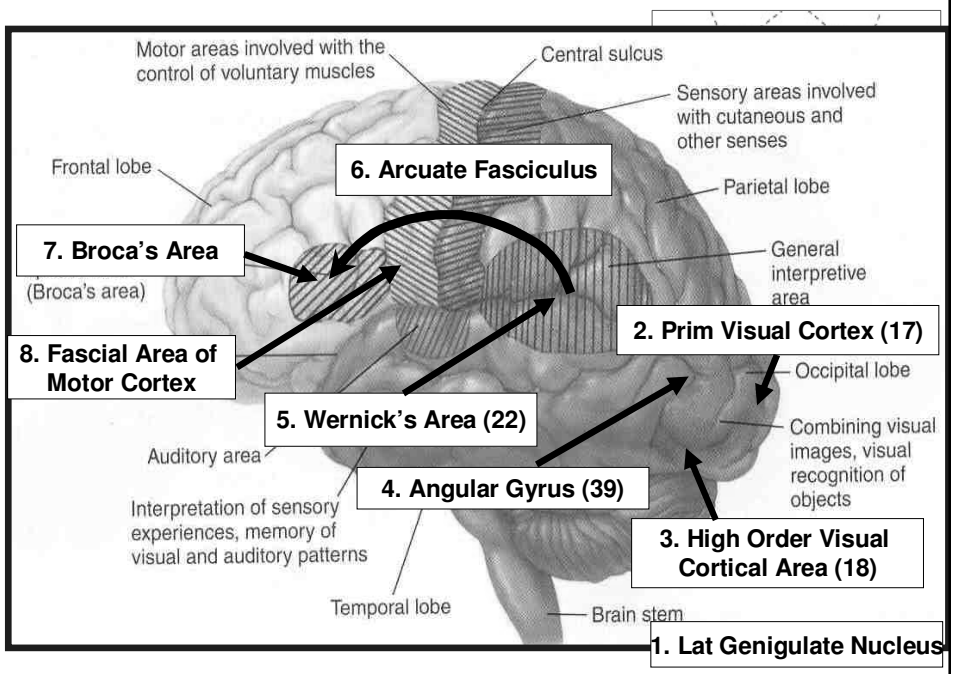
BROCA'S AREA

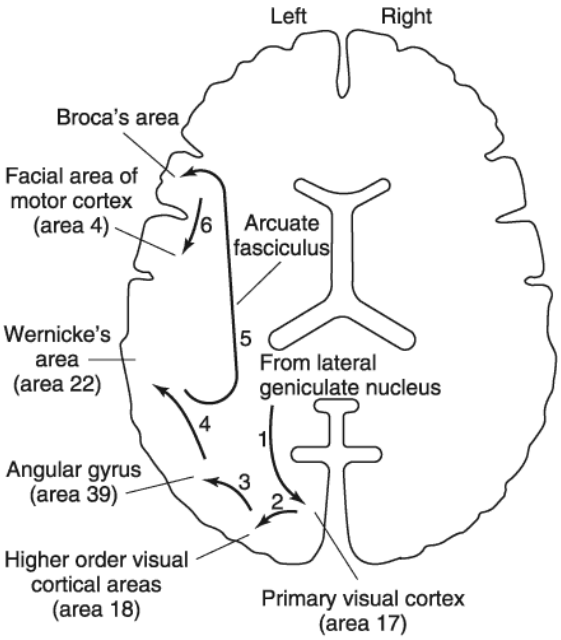
LOCATED AT THE BASE OF THE PRECENTRAL GYRUS, IN THE LEFT HEMISPHERE

DAMAGE TO THIS AREA CAUSES INABILITY TO SAY WORDS PROPERLY

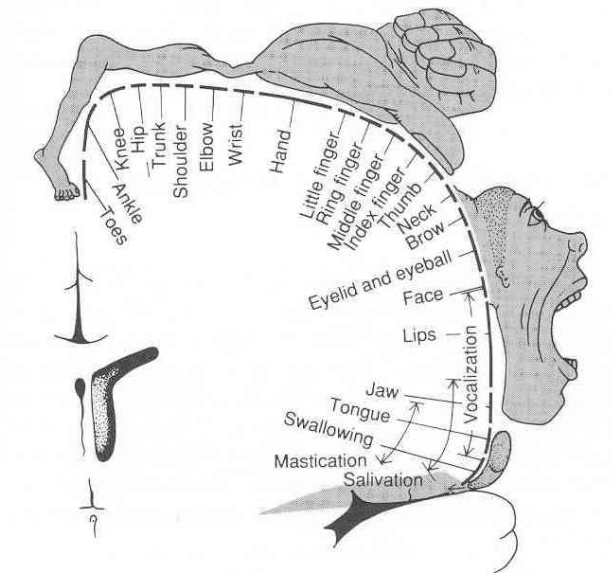


SEQUENCE OF EVENTS IN SPEECH PRODUCTION

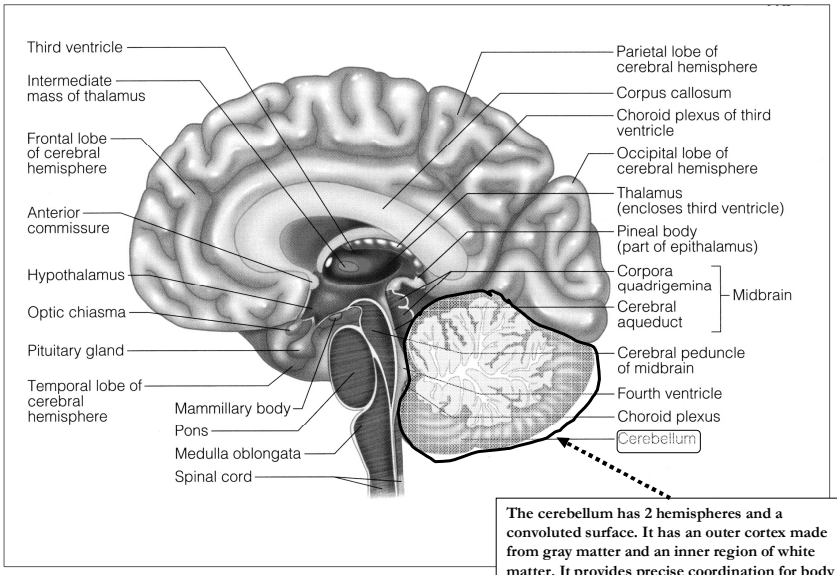




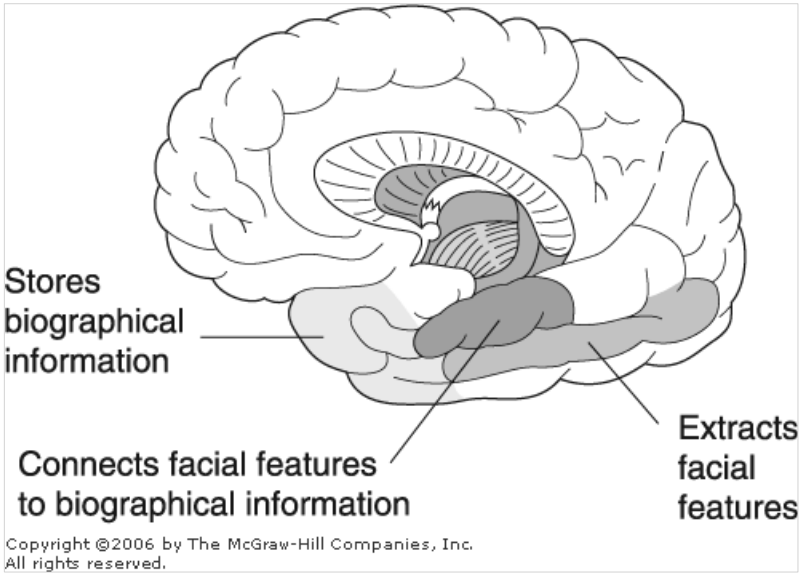
Motor Homonculus



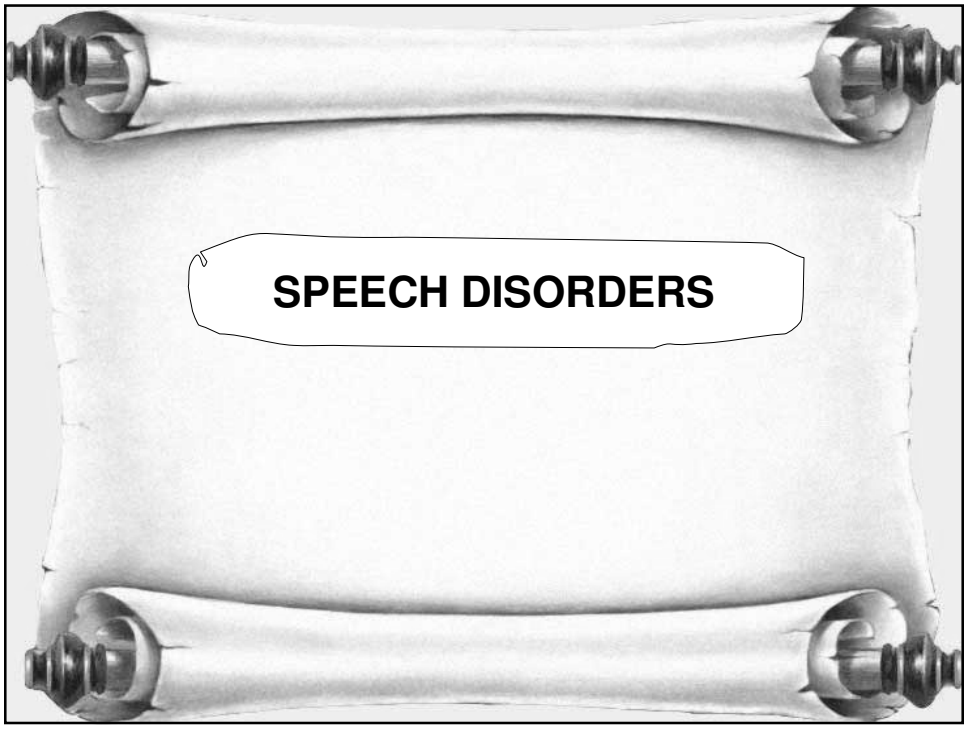
CEREBELLUM



The cerebellum has 2 hemispheres and a convoluted surface. It has an outer cortex made from gray matter and an inner region of white matter. It provides precise coordination for body movements and helps maintain equilibrium.



Areas in the right cerebral hemisphere, in right-handed individuals, that are concerned with recognition of faces



Huntington's Disease

- Hereditory , autosomal dominant
- Rare onset at 30-40s as early as 20s
- Disease of caudate & putamen.
- Jerky movement of hands toward end of reaching an object
- Slurred speech and incomprehensive
- Progressive Dementia
- Damage to neurones (GABA) in the indirect pathway from striatum to GP*e*

Parkinson's Disease

- Described by James Parkinson
- Degeneration of dopaminergic nigrostriatal neurons (60-80 %).
- Phenthiazines(tranquilizers drugs) .
- Methyl-Phenyl-Tetrahydro-Pyridine (MPTP). The oxidant MPP+ is toxic to SN.
- Four cardinal symptoms
  - Tremor
  - Rigidity
  - Akinesia & Bradykinesia
  - Postural Changes
  - Speech Changes (Monotonus & Slurred)

PARKINSON'S DISEASE

- RESTING TREMORS
- RIGIDITY LEAD PIPE & COG WHEEL
- MONOTONUS | SLURRED | ANARTHRIA
- ABSENCE OF ASSOCIATED UNCONCIOUS MOVEMENTS(SWINGING OF ARMS DURING WALKING .
- FACIAL EXPRESSION IS MASKED
- SIMIAN POSTURE
- SWEATING

APHASIA

CATEGORICAL HEMISPHERE

APHASIA IS LOSS OF OR DEFECTIVE LANGUAGE FROM DAMAGE TO THE SPEECH CENTRES WITHIN THE LEFT HEMISPHERE.

DYSARTHRIA

DYSARTHRIA SIMPLY MEANS DISORDERED ARTICULATION - SLURRED SPEECH. LANGUAGE IS INTACT, CF. APHASIA.

APHASIA

APHASIA IS LOSS OF OR DEFECTIVE LANGUAGE FROM DAMAGE TO THE SPEECH CENTRES WITHIN THE LEFT HEMISPHERE.

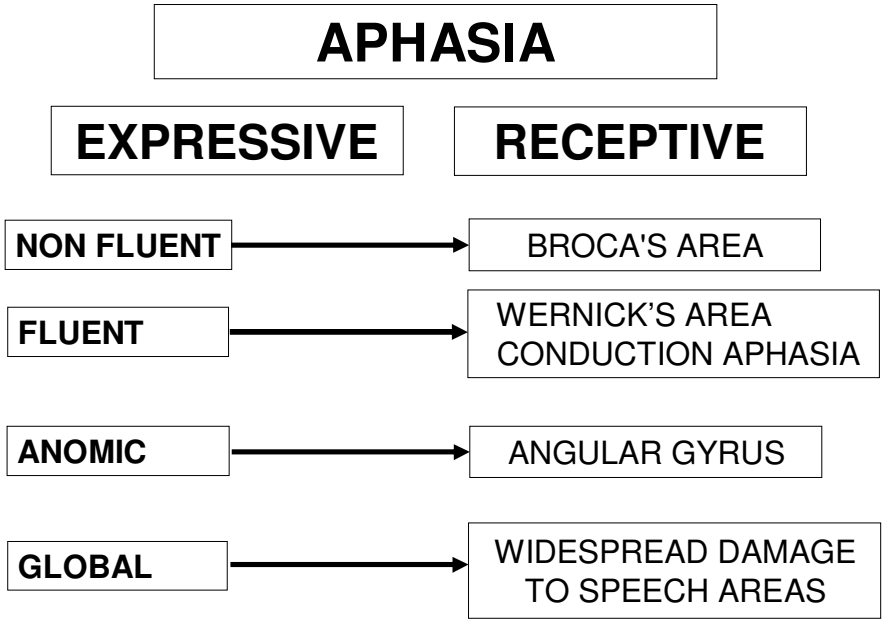
REMEMBER THAT

IN APHASIA THERE IS NO DAMAGE TO VISION, HEARING OR MOTOR PARALYSIS. THE DAMAGE IS IN SPEECH CENTERS IN CATEGORICAL HEMISPHERES

APHASIAS

ARE ABNORMALITIES OF LANGUAGE FUNCTIONS THAT ARE NOT DUE TO DEFECTS OF VISION OR HEARING OR TO MOTOR PARALYSIS.

THEY ARE CAUSED BY LESIONS IN THE CATEGORICAL HEMISPHERE



BROCA'S APHASIA
(EXPRESSIVE APHASIA, ANTERIOR APHASIA)

Damage in the left frontal lobe causes reduced speech fluency with comprehension preserved. The patient makes great efforts to initiate language, which becomes reduced to a few disjointed words. There is failure to construct sentences.

Patients who recover from this form of aphasia say they knew what they wanted to say, but 'could not get the words out'.

WERNICKE'S APHASIA
(RECEPTIVE APHASIA, POSTERIOR APHASIA)

Left temporo-parietal damage leaves language that is fluent but the words themselves are incorrect. This varies from insertion of a few incorrect or nonexistent words into fluent speech to a profuse outpouring of jargon (that is, rubbish with wholly nonexistent words). Severe jargon aphasia may be bizarre - and confused with psychotic behaviour.

Patients who have recovered from Wernicke's aphasia say that when aphasic they found speech, both their own and others', like a wholly unintelligible foreign language. They could neither stop themselves, nor understand themselves and others.

GLOBAL APHASIA

(CENTRAL APHASIA)

This means the combination of the expressive problems of Broca's aphasia and the loss of comprehension of Wernicke's. The patient can neither speak nor understand language. It is due to widespread damage to speech areas and is the commonest aphasia after a severe left hemisphere infarct. Writing and reading are also affected.

DYSARTHRIA

DISORDERED ARTICULATION

Slurred speech.
Language is intact, cf. aphasia.
Paralysis, slowing or incoordination of muscles of articulation or local discomfort causes various different patterns of dysarthria.

Examples
•'gravelly' speech of upper motor neurone lesions of lower cranial nerves,
• jerky, ataxic speech of cerebellar lesions (Scannimg Speech),
•the monotone of Parkinson's disease (Slurred),
•speech in myasthenia that fatigues and dies away.
Many aphasic patients are also somewhat dysarthric.

Table 16–3. Aphasias. Lesions in Various Areas When Shown a Picture of a Chair.

Type of Aphasia and Site of Lesion	Features	Characteristic Naming Errors
Nonfluent (Broca's area)	slow, and words are hard to come	"Tssair"
Fluent (Wernicke's area)	fails to comprehend the meaning of spoken or written words	"Stool" or "choss" (neologism)
Fluent (areas 40, 41, and 42; conduction aphasia)	speak well good auditory comprehension cannot put parts of words together	"Flair . . . no, swair . . . tair."
Anomic (angular gyrus)	auditory ok Prob in written w or pictures, visual is not processed	"I know what it is . . . I have a lot of them."

THE NON-DOMINANT HEMISPHERE

REPRESENTATIONAL HEMISPHERE

- Understanding and interpreting music,
- Nonverbal visual experiences (especially visual patterns),
- Spatial relations between the person and their surroundings,
- The significance of "body language"
- Intonations of people's voices, and probably
- Many somatic experiences related to use of the limbs and hands eg;

  dressing or constructional apraxia

STUTTERING التأتأة

- **Have right cerebral dominance and widespread overactivity in the cerebral cortex and cerebellum. This includes increased activity of the supplementary motor area.**
- **Stimulation produce laughter, with the duration and intensity of the laughter proportionate to the intensity of the stimulus.**

ACALCULIA

In the inferior portion of the left frontal lobe is an area concerned with number facts and exact calculations.

Frontal lobe lesions can cause, a selective impairment of mathematical ability

Terms to Remember

- **Dysarthria**
- **Broca's aphasia**
- **Wernicke's aphasia**
- **conduction aphasia**
- **Anomic aphasia**
- **global aphasia**
- **Dyslexia**
- **Acalculia**
- **Prosopagnosia**
- **Achromatopsia**
- **Stuttering**