Νευροφυσιολογία και Αισθήσεις

Διάλεξη 17

Η Γλώσσα

(Language)

Introduction

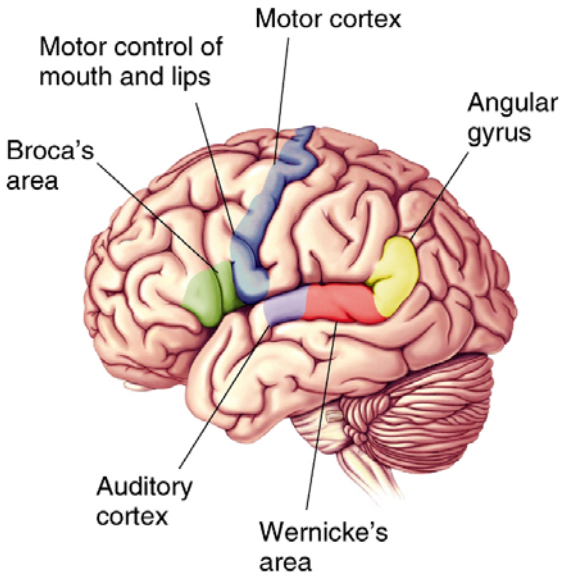
- **Language**
  - System by which sounds, symbols, and gestures used for communication
  - Process
    - Language comes into brain through visual and auditory systems
    - Motor system: Produces speech, writing
    - Processing between sensory and motor systems; Essence of language

Specialized Language Areas in the Brain

- **Aphasia**
  - Partial/complete loss of language abilities following brain damage
    - Greek/Roman Empires: Tongue control speech
    - Sixteenth century: Speech impairment, tongue not affected
- **Studying the relationship between language and the brain**
  - Correlate functional deficits with lesions

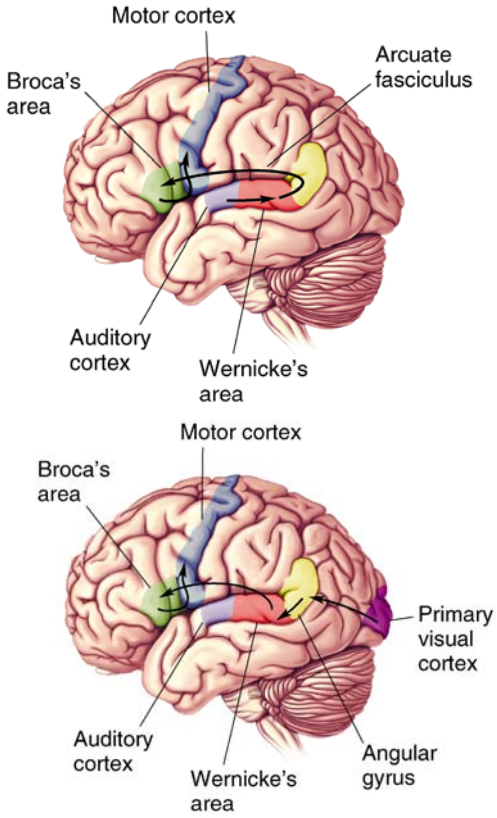
Specialized Language Areas in the Brain

- **Types of Aphasia**
  - Broca's Aphasia (motor, nonfluent aphasia)
    - Difficulty speaking, but understand spoken/heard language
    - Paraphasic errors
    - Pause to search for words, repeat "overlearned" things, difficulty repeating words
  - Wernicke's aphasia
    - Speech fluent, comprehension poor
    - Storing memories of sounds that make up words
    - Symptoms: Mixture of clarity and gibberish, undisturbed by sound of own or other's speech
    - Characteristics: Correct words in incorrect sequence, incorrect word similar to correct word



Specialized Language Areas in the Brain

- **Wernicke-Geschwind Model**
  - Broca's area
  - Wernicke's area
  - Arcuate Fasciculus
  - Angular gyrus
  - Problems with model
- **Conduction Aphasia**
  - Lesion of fibers composing arcuate fasciculus
  - Comparison with Broca's aphasia, Wernicke's aphasia:
    - Comprehension good, speech fluent
  - Difficulty repeating words
  - Symptoms:
    - Repetition substitutes/omits words
    - Paraphasic errors
    - Cannot repeat function, nonsense words, polysyllabic words



Specialized Language Areas in the Brain

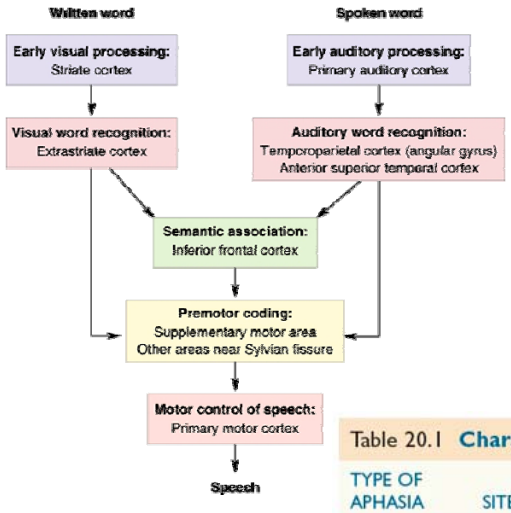


Table 20.1 **Characteristics of Types of Aphasia**

TYPE OF APHASIA	SITE OF BRAIN DAMAGE	COMPREHENSION	SPEECH	IMPAIRED REPETITION	PARAPHASIC ERRORS
Broca's	Motor association cortex of frontal lobe	Good	Nonfluent, agrammatical	Yes	Yes
Wernicke's	Posterior temporal lobe	Poor	Fluent, grammatical, meaningless	Yes	Yes
Conduction	Arcuate fasciculus	Good	Fluent, grammatical	Yes	Yes
Global	Portions of temporal and frontal lobes	Poor	Very little	Yes	—
Transcortical motor area	Frontal lobe anterior to Broca's	Good	Nonfluent, agrammatical	No	Yes
Transcortical sensory	Cortex near junction of temporal, parietal, and occipital lobes	Poor	Fluent, grammatical, meaningless	No	Yes
Anomic	Inferior temporal lobe	Good	Fluent, grammatical	No	

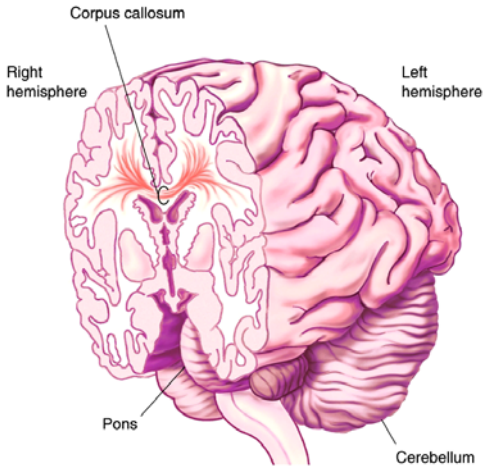
Biomedical Imaging and Applied Optics Laboratory

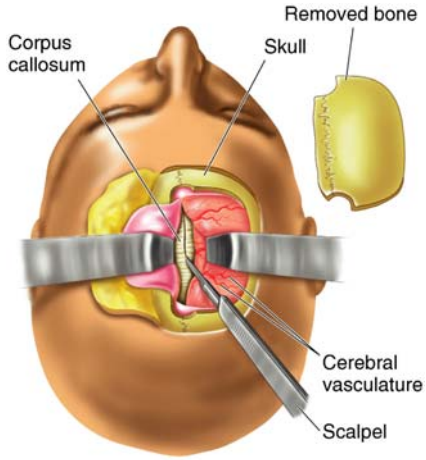
Specialized Language Areas in the Brain

- **Aphasia in Bilinguals and the Deaf**
  - Aphasia in bilinguals
    - Language affected depends on: Order, fluency, use of language
  - Sign language aphasias analogous to speech aphasias → but can be produced by lesions in slightly different locations
  - Verbal and sign language recovered together in one case→ indicating overlapping regions used for both
  - Evidence suggests some universality to language processing in the brain

Asymmetrical Language Processing

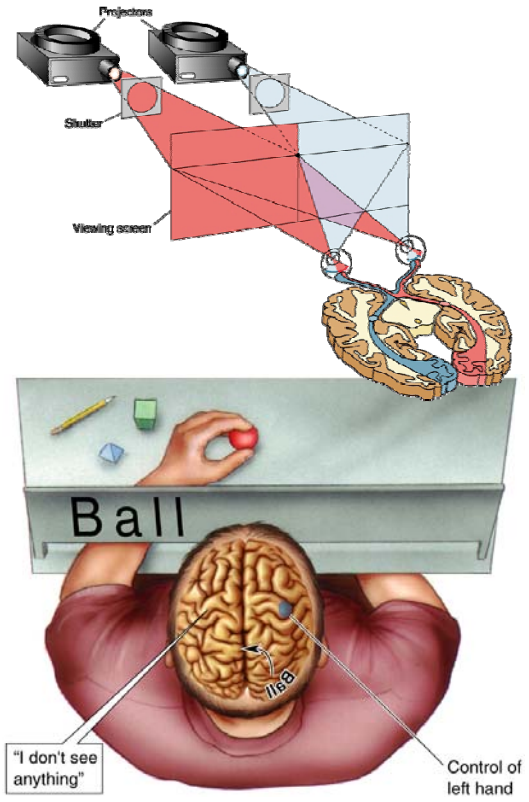
- **Split-Brain Studies**
  - Split-brain procedure in animals
    - Sever axons making up the corpus callosum
    - No major deficits
    - With proper experiments, animals behaved as if they had 2 brains





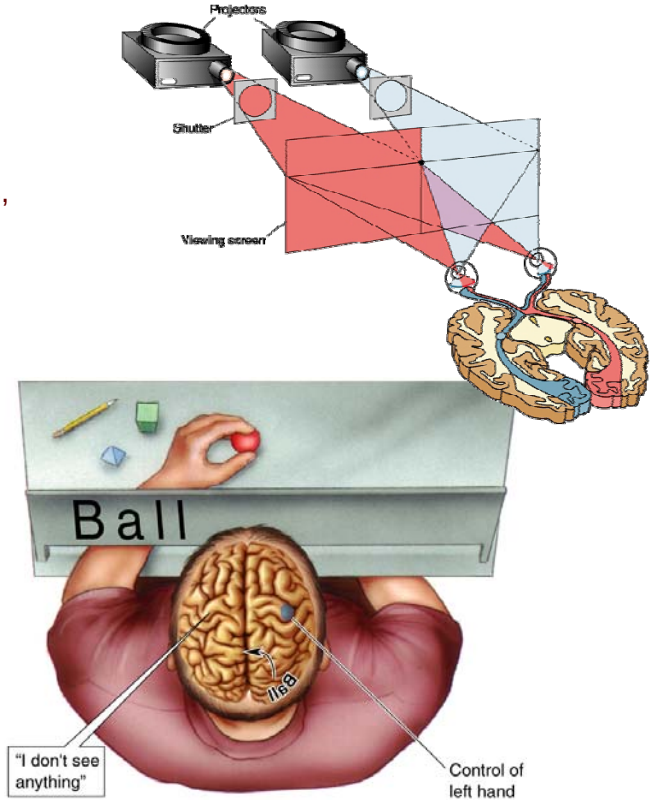
Asymmetrical Language Processing

- **Language Processing in Split-Brain Humans**
  - Stimuli to one hemisphere
  - Observation: Two hemispheres initiated conflicting behaviors
- **Left Hemisphere Language Dominance**
  - Right visual field → repeated easily
  - Left visual field → difficulty verbalizing
  - Image only in left visual field or object in left hand → unable to describe
  - Split-brain
    - Unable to describe anything to left of visual fixation point



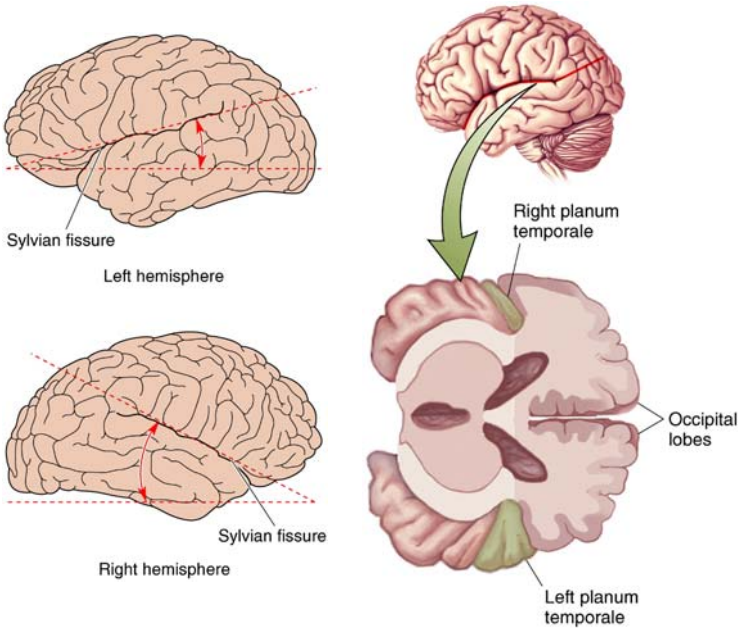
Asymmetrical Language Processing

- **Language Functions of the Right Hemisphere**
  - Functions of right hemisphere
    - Read and understand numbers, letters, and short words (nonverbal response)
  - Right hemisphere able to write, cannot speak
  - Right hemisphere
    - Drawing, puzzles, sound nuances
  - Left hemisphere
    - Language



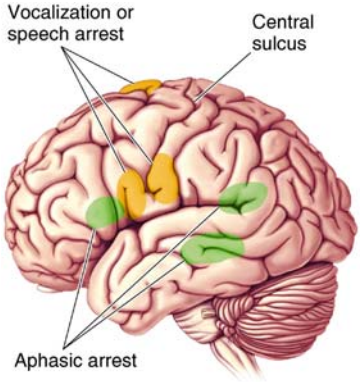
Asymmetrical Language Processing

- **Anatomical Asymmetry and Language**
  - Left lateral (Sylvian) fissure longer and less steep than right
  - Left planum temporal larger than right in 65% cases
  - Functional human asymmetry
    - More than 90% humans right-handed
    - Animals: Equal numbers of right-handers and left-handers



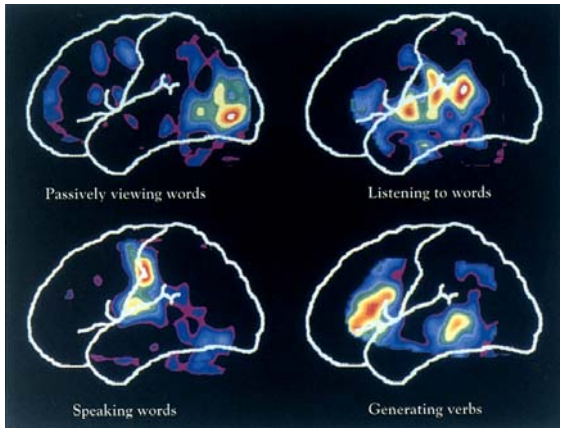
Language Studies

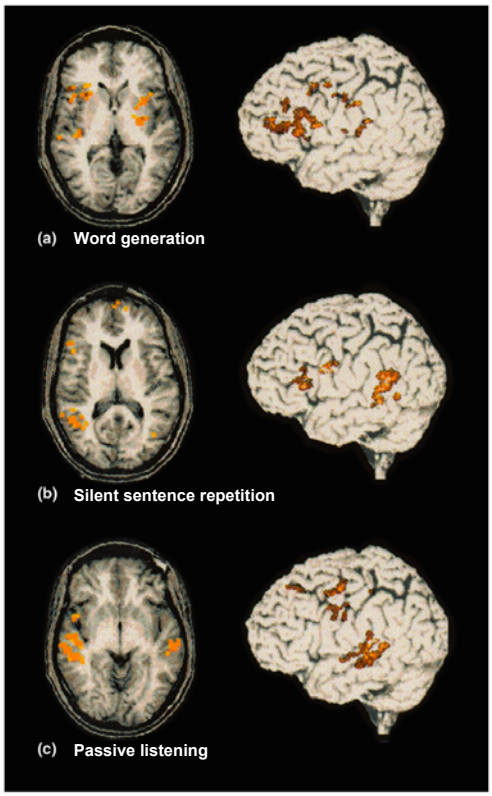
- **The Effects of Brain Stimulation on Language**
  - Three main effects
    - Vocalizations
    - Speech arrest
    - Speech difficulties similar to aphasia
  - Motor cortex
    - Immediate speech arrest
  - Broca's area
    - Speech stopped after strong stimulation, speech hesitation from weak stimulation
  - Posterior parietal lobe near Sylvian fissure and temporal lobe
    - Word confusion and speech arrest
  - Small parts of cortex
    - Naming, reading, repeating facial movements
  - Significant variability between patients



Language Studies

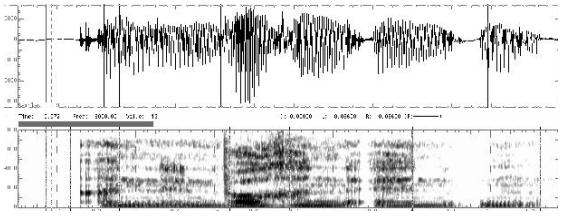
- **Imaging of Language Processing in the Human Brain**
  - fMRI
    - Record during 3 different language tasks
    - Activated brain areas consistent with temporal and parietal language areas
    - More activity than expected in nondominant hemisphere
  - PET





Language Studies

- **Language Acquisition**
  - Where does a word start or end?
  - Mechanism in infants
    - Statistical learning
    - Syllable emphasis
    - Motherese → Adults talk to infants; Speech slower, exaggerated, vowel sounds clearly articulated
  - Complexity: Foreign language
  - Brain response to spoken words of 3 month infant → similar to adults



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THERE, DON ATE A KETTLE OF TEN CHIPS

Conclusions

- Multiple brain areas critical for language
- Language skills: Naming, articulation, grammar usage, comprehension
- Further brain imaging studies will reveal more about language systems organization

Επόμενη Διάλεξη …

Διάλεξη 18

Οι Συναισθηματικοί Μηχανισμοί στον Εγκέφαλο

(Brain Mechanisms of Emotion)