Language

Lateralization

- Left hemisphere dominance in speech production in 95% of right handed people, and 70% of left handed people
- Left → time, sequence of events
- Right → analysis of simultaneous streams of information. Emotion expression and recognition (face and voice). Involved in global perceptions (maps)
- Language is crucial because we are language adamant
- Neurosurgeons try to make sure they go nowhere near the language barriers.
- Language is processed in left hemisphere
- Make sure language is not split

Language

- Recall the split-brain patients: using words and picture tests
- Do animals have language? May be… to some extent
- Is sign language lateralized? Yes
  - Signing deficits: Left Hemisphere
- Speech production vs. speech comprehension
  - Made by different brain areas.

Language: speech production

Perception memories } → verbal thoughts → brucas area (inferior frontal lobe)

- Broca Aphasia: deficit in verbal expression of thought (slow speech) but comprehension is (mostly) intact
- Broca’s Aphasia: deficient in function/relation words but normal in content words
- Function words (grammar related): a, some, about, around, below, verbs
- Content words (object related): chair, cookie, plate

Language production:

- Broca’s aphasia: people are aware of their deficits (hear themselves)
  - Theory: Broca’s area controls ‘motor programs’ for word production, control of tongue, throat muscles, jaw, lips..
- Other areas involved: insular cortex and Basal ganglia
- Broca’s Aphasia 3 independent components from mild to more severe
  - Articulation deficits: Left Insular Cortex
  - Anomia: deficit in finding words
  - Agrammatism: Deficit in the production/comprehension of word order (subject/complement), in ‘symmetric’ cases

Speech Comprehension:

- Wernicke's Area:
  - Wernicke's aphasia
    1. Deficit in recognizing words (including their own)
    2. Deficit in comprehending the meaning of words
    3. Deficit it in converting thoughts into words
- Normal at producing speech-like sounds
- Normal at functioning words. Produce nonsensical content words
- Wernicke’s Aphasia: Not aware of their deficit. Normal at facial expressions/tone recognition. Normal prosody
- Theory: deficits in the memory of the sounds that make up words (pattern matching)

Speech comprehension

- Wernicke’s Aphasia: 3 components

1. **Deficit in recognition of spoken words. Pure word deafness. Cannot recognize spoken words (as if foreign languages)**
   a. Due to a disconnection: auditory cortex → not wernicke’s area
   b. Or damages to wernicke’s area
- Can read lips, read words, produce speech, recognize meaningful sounds
- Does comprehension involves “internal rehearsal”
- Motor neurons (tongue comprehension) activated when hearing speech: minor neurons
- Experiment: Subjects hear, think about, or say words that would involved tongue/lips muscles (e.g ‘p’) and not (‘t’) → same brain areas in all conditions
  - Theory: motor neurons feedback to brain, help with the ‘recognition’ of words. ‘Mumbling’ = lack of inhibitory feedback control.
  - Experiment: subjects with ear plugs → auditory cortex activated when words are spoken aloud, but not whispered.
2. **Deficit in comprehensions of word meaning**
   - Transcortical sensory aphasia: can repeat words (perception intact) but cannot understand/produce meaningful speech. Damage to the posterior language area (=Angular Gyrus)

3. **Deficit in converting thoughts into words**
   a. Attributing meaning to a word involves meaning

   **Indirect Pathway**

   Wernicke

   ↓

   Posterior Language area (meaning) ↔ memories

   ↓

   Broca

   ↓

   Example: metaphors, humor, or ‘moral of a story’. Need more than just comprehensions, also need memories and meanings

   **Conduction Aphasia:**

   - Conduction Aphasia (Arcuate Fasciculus): meaningful speech, good comprehension, repetition is normal except for non-sense/meaningless words or sentences

   **From Wernicke to Broca**

   **Summary: Two Pathways**

   - Direct pathway: speech sounds, no meaning necessary. Foreign Language
   - Indirect Pathway: meaning information. No sounds necessary. Need to access memory

   **A few other Aphasias:**

   **Anomic Aphasia:**

   - Fluent and have well formed speech. Good Comprehension
   - Difficulty in finding words: Use circumlocutions
     - Problems finding verbs/actions (motor cortex)
     - Problem in finding nouns (association cortex)
Aphasia in Deaf people

- Sign language is a language!
- Mirror neurons in Broca's areas respond to perception of hand gestures. Speech production is influenced by perception of visual/hand information. ‘Speaking with your hands’?

Aphasia → may also result in deficit in the perception/production of hand gesture (left hemisphere)

Other aspects of speech

Prosody

- Use of intonation to convey information
  - Grammatical information (‘?’)
  - Emotional information
- Affected in Broca’s aphasia, but not Wernicke’s asphaia
- Right hemisphere specialization

Stuttering

- 1% of the population. 3x more men than women
- Deficit in planning/intuition of speech
- Theory: faulty auditory feedback from subjects' own speech (too fast?)
- Delayed auditory feedback decrease stuttering

Reading

Disorder of Reading (pure) Alexia

- Inability to read (but not write) words. Can recognize spelled words said aloud
- Perceptual disorder. Damage to the Corpus Callosum
- Patients with damage to the left hemisphere
- Alexia is independent from visual agnosia → Reading words and perceiving objects use different brain regions

The Normal reading Processes

Reading can be achieved in two ways: whole word and Phonetic

- Whole-word recognition
- Letter recognition, phonetic reading (sounds of letters)
Surface Dyslexia

- Deficit in whole word recognition. Deficit in reading ‘exceptions’ to pronunciation rules
- Left Lateral temporal lobe damage

Phonological Dyslexia

- Definition in reading unfamiliar words, or non-words
- Damage to left frontal lobe