

LECTURE 7: LANGUAGE AND THE BRAIN

- Lateralization and hemispheric specialization¹

LEFT BRAIN

Analytic processing (language, etc.)
Temporal relations
Speech sounds
Mathematics
Intellectual

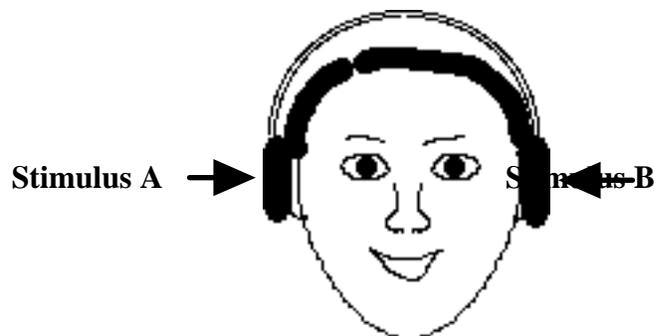
RIGHT BRAIN

Holistic processing (face recognition, etc.)
Spatial relations
Nonspeech sounds
Music
Emotional

- Language is located in the left hemisphere of the brain

Evidence from ...

- Study of the brain itself (PET scans, EEG, anaesthetizing one hemisphere using the Wada test, etc.): PET scans in the film on “Brain and Language” shows that “hot” areas of the brain used during language processing are on the left side
- Experimental studies
 - “Shadowing” and tapping (Pinker 307)
 - Dichotic listening (cf. Pinker 307)



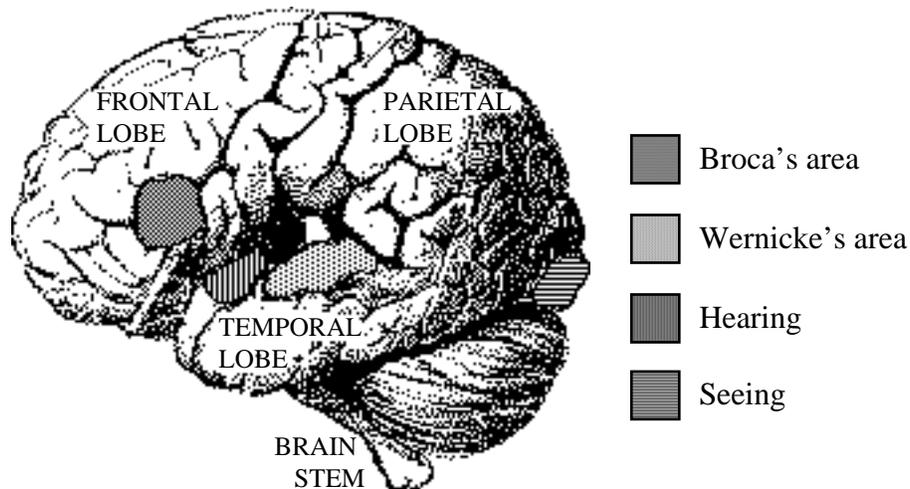
Stimulus A and **Stimulus B** are played simultaneously. They will be processed most rapidly by the side of the brain opposite the ear into which they are played. The subject will claim to have heard the one processed first. If both are *non-linguistic* sounds, he will say he heard the one played into the left ear, but if both are *linguistic*, he will say he heard the one played into the right ear.

- Damage to the left hemisphere → association of
 - Language impairment, i.e. *aphasia*

¹Table adapted from Jeannine Heny, “Brain and language,” in V.P. Clark et al., *Language: Introductory Readings* (Fifth Edition), p. 210, New York: St. Martin’s Press, 1994.

- *Right side* perceptual and motor problems (the *left* brain controls *right* side motion and perception such as hearing and vision; the *right* brain controls *left* side)
- Aphasia
 - Linguistic deficits resulting from trauma to the brain; provides a way to associate certain language functions with certain areas of the brain

LEFT HEMISPHERE OF THE BRAIN



• Types of aphasia

- Broca's aphasia (first documented by Paul Broca, 1861): faltering, agrammatical, usually sensible and relevant, e.g. ²

Q: What kind of work have you been doing?

A: Me ... build—ing ... chairs, no, no, cab—in—nets.”

Q: How would you go about building a cabinet?

A: One, saw ... then, cutting wood ... working ...
... ... Jesus Christ, oh boy!

- Wernicke's aphasia (first documented by Karl Wernicke, 1873): fluent, usually grammatically structured, nonsensical and often irrelevant to the situation, e.g.

Q: What kind of work have you been doing?

A: We, the kids, all of us, and I, we were working for a long time in theyou know ... it's the kind of space, I mean place rear to the spedwan

²The Broca's and Wernicke's examples are from Howard Gardner, "The loss of language," in V.P. Clark et al., *Language: Introductory Readings* (Fifth Edition), pp. 227-228, New York: St. Martin's Press, 1994. Others are transcribed from a tape recording provided by Kathy Jackson.

Q: Excuse me, I wanted to know what type of work you have been doing.

A: If you had said that, we had said tha, poomer, near the fortunate, forpunate, tamppoo, all around the fourth of martz. Oh, I get all confused.

Severe Wernicke's aphasia may become *jargon* aphasia, which "sounds" like fluent speech but includes much nonsense vocalization mixed with language, e.g.

Interviewer: What kind of work do you do?

Mr. S: What does it take to teck in my hergins? I guess, uh, ... I've tried to ... fix ... some cafrend from my ... from meggers ... hmm ... I don't go in a severy pazing in the corper bazing because I'm ormer sevin kazming or usually in pazer in paguer in pazning. Hmm. I don't cash in a ... hmm ... I don't cash in a bearing cazhner from the pegger.

- **Anomia:** cannot find words for specific things (*a-nomia* "not-naming"), fluent, comprehension usually good and speech relevant to the situation, though there tends to be overuse of pronouns and "filler" words (words like 'well', 'just', cliched phrases), e.g. the example from Pinker 318-319

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 ... (see Pinker for continuation)

- Contributions of aphasia studies
 - Localization of brain functions, esp. association of language with left hemisphere
 - Evidence for the modularity of language, e.g. the separation of syntax, morphology (and other grammatical marking), lexicon (words and word meanings), and phonology
 - Separation of language from other symbolic systems, e.g. some aphasics can do math or read music
 - Separation of language and thought, e.g. some aphasics can solve puzzles, paint, or compose music
- Puzzles and paradoxes raised by study of language and the brain, including aphasia study
 - Adaptability of the brain: surgical or traumatic loss of large parts of the brain in very young children often results in minimal or no impairment in language and other cognitive functions
 - Experimental study (dichotic listening, etc.): the same subject shows different results at different times, and reactions can be changed by *priming*, e.g. subjects asked to memorize a list of words (a "left hemisphere task") may then perform a spatial task (an expected "right hemisphere task") with activated left hemisphere
 - Differential effects of brain trauma in different individuals:

Linguistics I, Willson

Multilinguals: aphasia does not affect the various languages equally; moreover, “aphasia is about five times more likely to result from right-hemisphere damage in a polyglot speaker than in a monolingual.” (Heny, p. 217—see footnote 1 of this lecture)

Handedness: “Aphasia tends to be less severe and to last a shorter time for left-handers ... Moreover, left-handed speakers are eight times more likely than right-handers to suffer from aphasia after damage to the right hemisphere only.” (Heny, p. 220)

Sex: “Women are less likely than men to become aphasic from unilateral damage to the left hemisphere.” (Heny, p. 221)