Disorders of Language

An introduction to aphasia and its basic forms

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http://www.psyc.bbk.ac.uk/people/academic/thomas_m/msccogneuro/handout_page.htm

Introduction

- Structure of the course
- Historical background to aphasia
- Two modern approaches
- Basic forms of aphasia

Course

Disorders of Language, Spring 2009		
Lectures 11.30am to 1.00pm, Thursdays Room 534, Birkbeck College Main Building		
Wk1	Thursday 15th Jan	Introduction to aphasia and its basic forms
Wk2	Thursday 22nd Jan	Acquired Comprehension Deficits
Wk3	Thursday 29th Jan	Acquired Production Deficits
Wk4	Thursday 5th Feb	Dr. David Green: Aphasia in bilinguals
Wk5	Thursday 12th Feb	Prof. Sophie Scott: The neurobiology of speech perception
Wk6	Thursday 19th Feb	READING WEEK
Wk7	Thursday 26th Feb	Dr. Fiona Richardson: Neuroimaging and the architecture of the language system
Wk8	Thursday 5th March	Dr. Fiona Richardson: Connectionist models of language deficits
Wk9	Thursday 12th March	Dr. Jennifer Aydelott: Domain-general approaches to language disorders
Wk10	Thursday 19th March	Developmental disorders of the language system
Wk11	Thursday 26th March	The right hemisphere. Specialisation, plasticity, and recovery. Course Review.
Seminar 1	Date to be agreed (see note)	Category-specific deficits
Seminar 2	Date to be agreed (see note)	Specific Language Impairment

Reading List

Disorders of Language: Reading List

General sources

Hillis, A. E. (2002). *The handbook of adult language disorders*. Sussex, Hove: Psychology Press.

Keith, R. & Whitehurst, J. Q. (2003). *Fundamentals of human neuropsychology 5th Edition*. New York: W orth Publishers. [Chapter 10]

Demonet, J-F. Thierry, G., & Cardebat, D. (2005). Renewal of the neurophysiology of language. *Physiological Review, 85*, 49-95.

Bennett, M. R., & Hacker, P. M. S. (2008). *History of cognitive neuroscience*. Chichester, Sussex UK: Wiley-Blackwell. [Chapter 4]

Sources for specific topics

- **Broca's region**

Grodzinsky, Y. & Amunts, K. (2006). *Broca's region*. Oxford University Press.

Grodzinsky, Y., & Santi, A. (2008). The battle for Broca's region. *Trends in Cognitive Sciences, 12*(12), 474-480.

Schubotz, R. I., & Fiebach C. J. (2006). *Integrative models of Broca's area and the ventral premotor cortex*. Maxum.

- **Semantic retrieval:**

Price, C. J., & Friston, K. J. (2002). Degeneracy and cognitive anatomy. *Trends in Cognitive Sciences, 6*(10), 416-421.

- **Psycholinguistics and aphasia:**

Dick, F., Bates, E., Wulfeck, B., Aydelott Utman, J., Dronkers, N., & Gernsbacher, M. A. (2001). Language deficits, localization, and grammar: Evidence for a distributive model of language breakdown in aphasics and neurologically intact individuals. *Psychological Review, 108*(4), 759-788.

Dick, F., Wulfeck, B., Krupa-Kwiatkowski, & Bates (2004). The development of complex sentence interpretation in typically developing children compared with children with specific language impairments or early unilateral focal lesions. *Developmental Science, 7*(3), 360-377.

Seminar Readings

- **Seminar 1: Category-specific deficits**

Sartori, G., Job, R., & Zago, S. (2002). A case of domain-specific semantic deficits. In E. M. E. Forde & G. W. Humphreys (Eds.), *Category specificity in brain and mind* (p. 25-49). Hove, Sussex: Psychology Press.

Whatmough, C., & Chertkow, H. (2002). Category-specific recognition impairments in Alzheimer's disease. In E. M. E. Forde & G. W. Humphreys (Eds.), *Category specificity in brain and mind* (p. 181-210). Hove, Sussex: Psychology Press.

Gainotti, G. (2002). The relationships between anatomical and cognitive locus of lesion in category-specific disorders. In E. M. E. Forde & G. W. Humphreys (Eds.), *Category specificity in brain and mind* (p. 403-426). Hove, Sussex: Psychology Press.

Barsalou, L. W., Simmons, W. K, Barbey, A. K., & Wilson, C. D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Sciences, 7*(2), 84-91.

- **Seminar 2: Specific Language Impairment**

Joanisse, M. F. (2004) Specific Language Impairments in children: Phonology, semantics and the English past tense. *Current Directions in Psychological Science, 13*(4), 156-160.

Tomblin, B. (in press). Children with Specific Language Impairment. To appear in E. Bavin (Ed.), *The handbook of child language*. Cambridge University Press.

van der Lely, H. K. J. (2004). Evidence for and implications of a domain-specific grammatical deficit. In Lyle Jenkins (Ed.), *The genetics of language. Linguistic Variations series*, (pp115-145). Elsevier, Oxford.

Ullman, M. T., & Pierpont, E. I. (2005). Specific language impairment in not specific to language: The Procedural Deficit hypothesis. *Cortex, 41*, 399-433.

Groszer, M. et al. (2008). Impaired synaptic plasticity and motor learning in mice with a point mutation implicated in human speech deficits. *Current Biology, 18*, 354–362.

Aphasia

- Same incidence as MS or Parkinson's
- 200,000 in UK; 1M in US
- 90% caused by stroke, mostly in elderly
- Loss of (aspects of) language
- Can be accompanied by paralysis / weakness of right arm and leg

History

- Egyptians, Greeks, Romans
  - 2800 BC: loss of language + treatment in Egyptian papyrus
  - Hippocrates 400 BC: loss of speech 'aphonia'
  - Valerius Maximus, AD 30: selective problems with reading
- Confused with paralysis of tongue, deafness, mutism, stuttering
- Relation to brain?
  - heart seen as engine of thought (Aristotle)
  - mind seen as controlled by non-physical spirit (Descartes)

History

- 19th century
  - Gall = well-developed mental faculties correspond to large areas of cortex; language in frontal lobes
  - 1825 French physician Jean-Baptiste Bouillaud delivers scientific paper with same conclusion
  - 1830 Marc Dax, language in left hemisphere

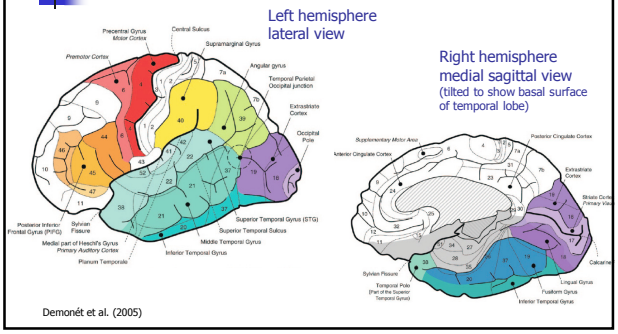
History

- 1861 Paul Broca
  - post-mortem reports of two patients with impaired language function
  - Tan (named after one of few utterances)
  - 1863, 8 more patients
  - All cases, damage = left anterior lesion
  - Additional patient, right anterior lesion + no language impairment

History

- Conclusion= impaired language production associated with left anterior damage to third frontal gyrus
- Suggestion of second type: posterior damage, impaired associations between language and thought
- Did not offer specific localisation

Relevant brain areas



Demonét et al. (2005)

History

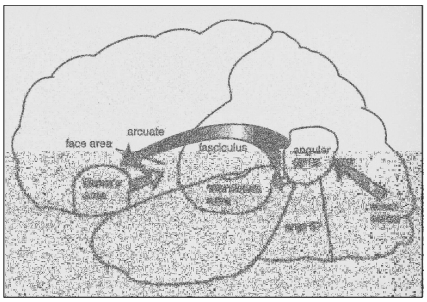
- 1884 Carl Wernicke
  - Aphasia + predominant difficulty with comprehension = lesions to left superior temporal lobe
  - Further type predicted, due to disconnection between anterior and posterior areas (conduction aphasia)
- 1885: Lichtheim proposes diagrammatic form of model

History

- 1965: Geschwind extends theory to produce

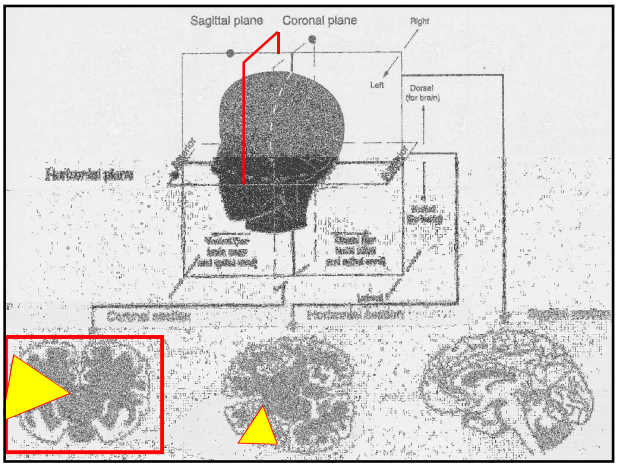
"Wernicke-Geschwind" model

The Wernicke-Geschwind model

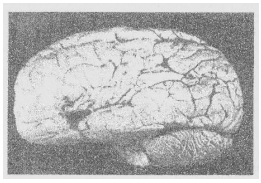


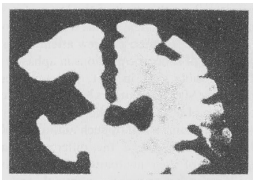
History

- 1885-1965: Why the 80-year delay?
- Early writings of Broca and Wernicke controversial
  - e.g. Pierre Marie (1906) proposed that:
    - All aphasia has some comprehension deficit
    - Broca's aphasics = interference with more posterior zone
    - Broca's area purely for motor aspects of speech
    - Critical lesions in Broca's aphasia are sub-cortical
  - And then Tan's brain turned up…



The brain of Paul Broca's patient, Tan





- Note the gross subcortical extent of the lesion in the coronal section – Tan case study supports Marie?

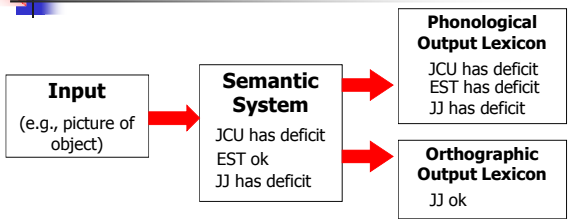
Why the 80-year delay? (cont.)

- 1860s John Hughlings Jackson - rejection of localisationist approach
- Head (1926) - more psychological description of aphasia, irrespective of neural correlates
- 1940s - Behaviourist approach rejects mentalistic analysis
  - External S-R schedules of reinforcement

Two modern approaches

- Cognitive neuropsychology
  - Single case studies looking for dissociations between psychological components of language system
  - Less concerned with relation to underlying substrate
- Syndrome approach
  - Group patients according to symptoms, look for common patterns of underlying damage
- Approaches interact; brain imaging brings them together
  - Functional module may be realised by distributed network of brain areas
  - Imaging may help us link network with module via regions of brain damage

Cognitive neuropsychology



Patient JCU: naming problem with semantic errors (Howard & Orchard-Lisle, 1984)

Patient EST: could give precise semantic info about objects unable to name (Kay & Ellis, 1987)

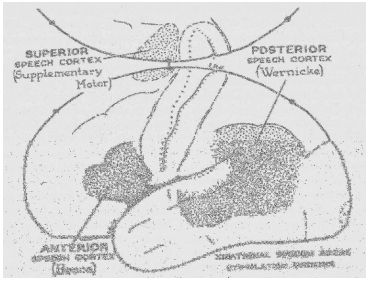
Patient JJ: naming problems, unable to give meanings, but could write word forms (Hillis & Caramazza, 1991)

Syndrome approach

- Let's identify the broad types of language breakdown
- First, what are the language 'areas' of the brain?
  - Try poking it

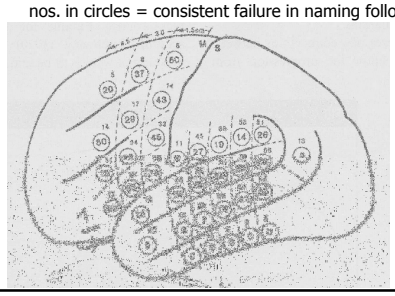
The language areas

- Electrical mapping: Penfield and Roberts (1959)



The language areas

- Electrical mapping: Ojemann et al. (1989)
  nos. in circles = consistent failure in naming following stimulation

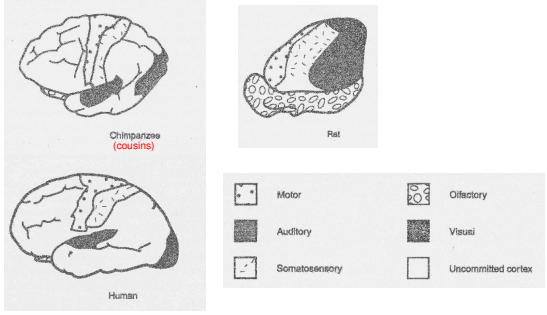


Bigger language areas?

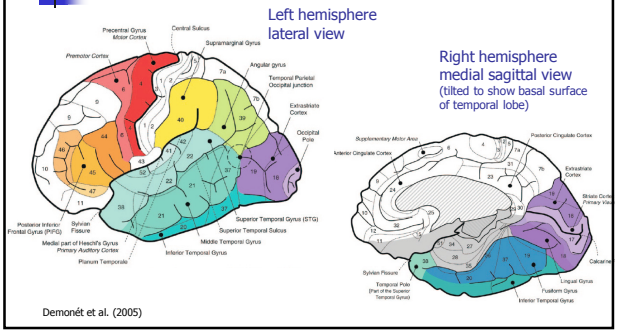
or

Individual variability?

Cross-species comparison

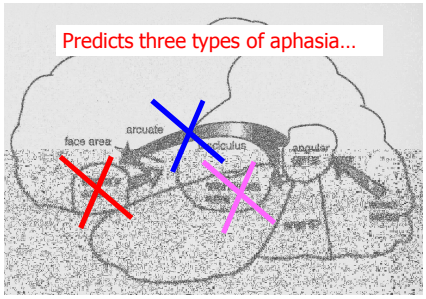


Relevant brain areas



Demonét et al. (2005)

Types of Aphasia: The Wernicke-Geschwind model



Basic forms of aphasia

- Broca's aphasia
  - Agrammatism
- Wernicke's aphasia
  - Jargon aphasia
- Conduction aphasia
- Word deafness
- Global aphasia
- The Transcortical aphasias
  - Transcortical motor aphasia
  - Transcortical sensory aphasia
- Subcortical aphasia
- Right hemisphere damage

The Perisylvian aphasias

Extrasylvian aphasias

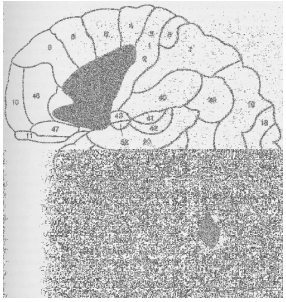
Broca's aphasic

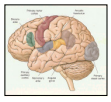
Broca's aphasic

- Cinderella's story (from Saffran, Berndt, and Schwartz, 1989)

"a mother/… three kids/ … bad mother/one kid beautiful/… rich/Italian/ … mother/ … stepmother/ … talk about Cinderella/Cinderella/clean my house/ … you Cinderella/close the door/ … Cinderella like jail/ … mother … three kids/ … I love mother/ … Cinderella walk ball/ … people ball/ … rich people/ … man and Cinderella dance dance dance party/ … one/ … dance dance dance/ … dance every time/ … ball beautiful people/ … people watched Cinderella/ … Cinderella … beautiful clothes … and garments/ … twelve o'clock night/ Cinderella/ oh no/ oh no/ I'm sorry/ I'm sorry people/ I love you baby/ … walk walk/ tumble/ … one shoe bye-bye/ … Cinderella … pumpkin cab/ … oh shoe/ oh please/ oh well/ walk pumpkin car/."

Broca's aphasia





Broca's aphasia

- Symptoms:
  - Difficulties in production (lack of function words and inflections), some problems in comprehension of syntax (e.g., reversible sentences)
  - Non-fluent / Agrammatism
  - Repetition difficulties
- Type of damage:
  - In excess of Broca's area. Arterial system means motor areas typically also damaged
- Problems with simple model:
  - 1. Lesion location – need to damage more than original Broca's area; Broca's alone = articulation difficulties
  - 2. Term too broad, individual variability of agrammatism: small vs. large Broca's patients; function word/inflection deficit dissociate from word order deficit; (syntactic) comprehension deficits

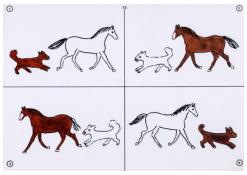
Patient with small Broca's aphasia

- Initial speech assessment (Andrewes, 2001, p.309)

HH: Sometimes I say "yes" … [halts in mid sentence] when I mean "no". I realise immediately afterwards that I have said the wrong thing and … correct myself.
DA: Does this happen often?
HH: … [Appears to be thinking about what to say and lunges forward as if forcing out the word] "No" (we both saw the humour in the situation, but he refrains from elaborating).
DA: How does this affect your everyday life?
HH: It's a problem when … converse with the mates.

(Subtler) comprehension deficits

- Problems with syntactic aspects of comprehension
  - "Point to the picture that goes with *The brown dog is chased by the white horse*"



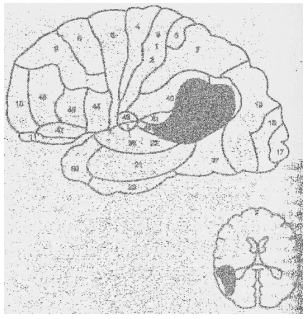
Wernicke's aphasic

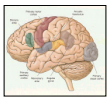
Wernicke's aphasic

SP: Could you tell me where you are?
Frank: … Yes, er, I just don't feel too good.
SP: Are you in hospital at the present time?
Frank: … That is really one thing, really I feel bad you know. Mm … I'm not really feeling too good.
SP: What's wrong with you, Frank?
Frank: Well I don't know, to be honest you just er, there will be a few days I feel shy. Saturday was bad, I get bad, Sunday and today.
SP: Where do you live?
Frank: … I don't know, to be honest, we've got a lot of things my dad.
SP: Do you live in East Keilor?
Frank: … Sorry? Yeh well fair outside things, you can't do warn. I can talk but I can't show up myself. I can't put the voice. It would be one thing if I could talk. But I can't talk so people can see it.
SP: Are you married, Frank?
Frank: … I was news to due to be.

(Note: Production data but comprehension deficit)

Wernicke's aphasia





Wernicke's aphasia

- Symptoms:
  - Comprehension difficulties
  - Fluent (sometimes excessive), word finding difficulties, paraphasias, excess of grammatical words but paucity of meaning; some syntactic difficulties
  - Severe: 'jargon' aphasia: neologisms (new words) + lack of awareness
  - Repetition difficulties
- Type of damage:
  - In excess of original Wernicke's area. Posterior superior temporal gyrus still appears crucial
- Problems with simple model:
  - Patients appear to be aware of meaning they are trying to produce: Not semantic deficit but communication with phonological output system?
  - Lack of awareness of jargon implies 'unconscious' route to production

Patient with Wernicke's (jargon) aphasia

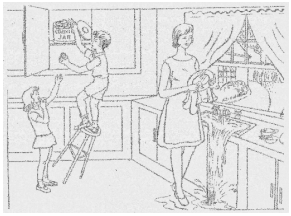
Interviewer: Can you tell me your address, Tom?
Tom: Four and pleasant, Plain Sodars. [There is no such district]
Interviewer: How long have you lived there?
Tom: I think that was only five, no eight prentices. Small plut be in there.
Interviewer: How old are you?
Tom: 80, 85 no 83 cheldren. [His age is 83 years old]
Interviewer: What month is it?
Tom: Today? Well that would be ten. If I say, it used to be called Naym Prentice.
Interviewer: If I said it was May, what would you say?
Tom: That's correct, Naym Prentice.
Interviewer: Could you count up to ten?
Tom: A, B, C, D, E, F, M, P, M.
Interviewer: No, say after me: 1, 2.

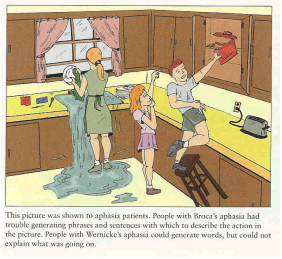
[Tom then proceeds to count fluently with only a few errors]

Comparison

- Broca's vs. Wernicke's aphasics

Cookie theft (from Boston aphasia exam)





This picture was shown to aphasia patients. People with Broca's aphasia had trouble generating phrases and sentences with which to describe the action in the picture. People with Wernicke's aphasia could generate words, but could not explain what was going on.

Wernicke's vs. Broca's aphasia

- Description of cookie theft story
  - Wernicke's patient (Goodglass, 1983)

"Well this … mother is away here working her work out o'here to get her better, but when she's looking, the two boys looking in the other part. One their small tile into her time here. She's working another time because she is getting, too."

  - Broca's patient (Helm-Estabrooks et al., 1981)

"Well … see … girl eating no … cookie … no … ah … school no … stool … ah … tip over … … and ah … cookie jar … ah … kid … no … see … water all over … spilled over … yuck … Mother … daydreaming."

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- Subcortical aphasia
- Right hemisphere damage

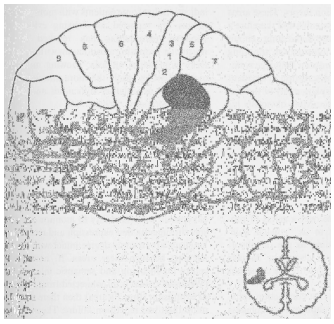
The Perisylvian aphasias

Extrasylvian aphasias

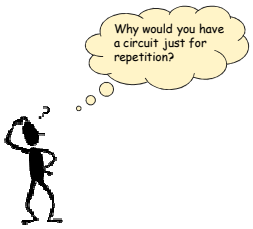
Conduction aphasia

- Symptoms:
  - Comprehension and production relatively intact
  - Repetition is predominant impairment
- Type of damage:
  - Supramarginal gyrus and insula (close to arcuate fasciculus)
- Problems with simple model:
  - W-G model suggests disconnection but why is expression okay? Shouldn't concepts be disconnected from syntax and articulation, impairing production?
  - Possibly problem with working or short-term memory

Conduction aphasia



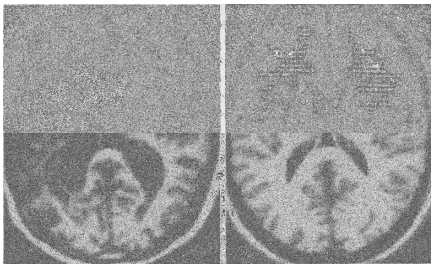
Conduction aphasia



Other perisylvian aphasias

- Global aphasia
  - Complete loss of language
  - If recovery, comprehension before production, to state like Broca's
- Type of damage:
  - Damage of all language areas
- Pure word deafness
  - Patients unable to hear phonological form of words
  - Production may be faultless
- Type of damage:
  - Bilateral lesions to posterior temporal plane (Heschl's gyrus)

Global aphasia



Basic forms of aphasia

- Broca's aphasia
  - Agrammatism
- [illegible]'s aphasia
- Conduction
- Word deafness
- Global aphasia
- The Transcortical aphasias
  - Transcortical motor aphasia
  - Transcortical sensory aphasia
- Subcortical aphasia
- Right hemisphere damage

Repetition is poor

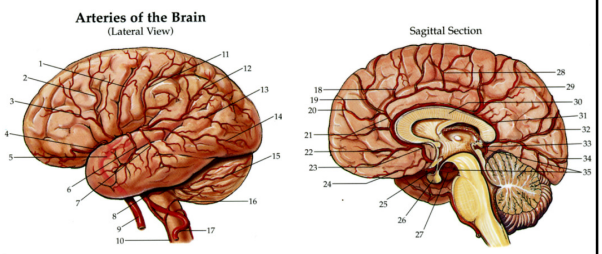
The Perisylvian aphasias

Extrasylvian aphasias

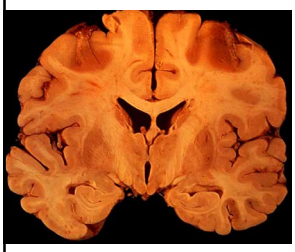
Transcortical aphasias

- Known since Wernicke's time that aspects of Broca's and Wernicke's aphasia could appear in patients who had a preserved ability to repeat back.
- Due to damage outside perisylvian area – watershed infarction
- Position of damage (anterior / posterior) determines type of deficit
  - Transcortical motor aphasia (Broca-like)
  - Transcortical sensory aphasia (Wernicke-like)
  - (or both)

Damage depends on position of blockage

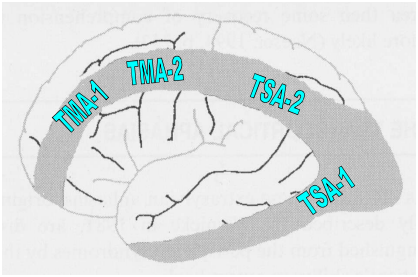


Watershed infarction

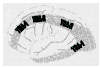


- Brain, Vol. 111, No. 3, 631-641, 1988 BOGOUSSLAVSKY, REGLI & ASSAL (1988)
- Four of 1 200 consecutive patients with their first stroke showed acute transcortical mixed aphasia (TMA) characterized by nonfluent speech with impaired naming, semantic paraphasias, echolalia, impaired comprehension, good repetition, reading, and writing on dictation. All 4 had left internal carotid artery (ICA) occlusion with ipsilateral anterior pial territory infarction (precentral-central sulcus artery territory) and watershed infarction between the middle and posterior cerebral artery territories, which spared and 'isolated' the perisylvian speech areas. Although rare, acute TMA is highly suggestive of infarction due to ICA occlusion, in that it is probably related to simultaneous embolism (anterior pial infarction) and haemodynamic insufficiency (posterior watershed infarction).

Transcortical aphasias



Transcortical aphasias

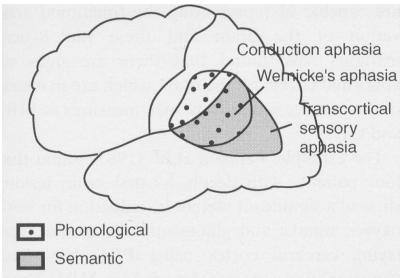


- Transcortical Motor Aphasia
  - Type 1
    - Dysexecutive production problems (echolalia, perseveration)
    - Prefrontal lesion superior to Broca's area
  - Type 2
    - Motor initiation symptoms
    - Reduced motivation and drive, lower limb paralysis
    - Lesions in anterior cingulate and left supplementary motor area

Transcortical aphasias

- Transcortical Sensory Aphasia
  - Type 1
    - Comprehension problems, extreme difficulty naming objects / pictures, semantic paraphasias, visual object agnosia
    - Damage inferior and posterior to Wernicke's area (non-overlapping)
  - Type 2
    - Word finding difficulties, few content words, difficulty with complex relational sentences – "semantic" aphasia
    - Superior angular gyrus and posterior parietal damage

TSA vs. Conduction vs. Wernicke's aphasia



Subcortical aphasia

- Can aphasia be due to sub-cortical damage (e.g., to thalamus)?
- Do sub-cortical structures play a processing role or just connectivity?
- Nadeau and Crosson (1997): subcortical damage associated with
  - Anomia in spontaneous language
  - Poor verbal fluency
  - Problems in confrontation naming
- Ullman & Pierpont (2005)
  - Grammar uses 'procedural' memory system – a network including basal ganglia / cortico-thalamic loops

Subcortical aphasia

- But
  - could be remote effects on distant cortical areas
  - or metabolic effects on adjacent cortical areas
- thalamus may play role in boosting focus or selectivity of function
- may be part of sub-cortical circuit for complex motor articulation

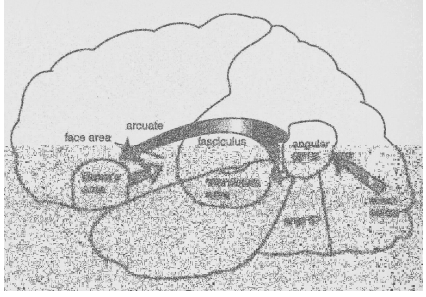
Right hemisphere

- Damage to RH associated with deficits in prosody (production and comprehension)
- Hemisphere has limited speech expression
  - Swearing, emotionally charged words, singing, stereotyped phrases
- RH comprehends overall context or theme
- RH damage associated with
  - Deficits in thematic inferences
  - Deficits in non-literal language processing
  - Reduced sense of humour

Conclusion

- What does the set of aphasias tell us about how language works?

The Wernicke-Geschwind model



Modifications to Wernicke-Geschwind model

- 1. Broca's area itself associated with articulation deficits. Agrammatism requires larger area of damage
- 2. Broca's aphasics also have comprehension deficits for information related to syntax
- 3. Conduction aphasia not disconnection but impairment in phonological working memory
- 4. Jargon aphasia implies dissociable conscious and unconscious routes from posterior areas to production areas
- 5. Subcortical structures implicated in connectivity between regions
- 6. Right hemisphere plays a role in prosody and thematic processing

Modified model (Andrewes, 2001)