Disorders of Language

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Language can appear to be affected by other things

Non-language problems

- Dysarthria / Anarthria
- Dysphonia
- Dyslexia / Alexia
- Dysgraphia / Agraphia
- Dyspraxia of speech
- Agnosia
Dysphasia / Aphasia

Specific loss of language

- Broca: cannot speak
- Wernicke: cannot understand
- Conduction: cannot repeat a sentence, despite good speech and understanding
- Transcortical Motor
- Transcortical Sensory: repetition intact, but cannot speak / understand
- Anomia
- Global: cannot find words
- Mixed
Paul Broca 1861
Expressive aphasia
- Sparse speech production
- Word-finding effortful and frustrating
- Good comprehension

Carl Wernicke 1874
Receptive aphasia
- Poor comprehension
- Unaware of language deficit (anosognosia)
- Production intact
Speech areas

Mouth Premotor Cortex and Auditory Association Cortex?
Different aphasias impair different levels of processing

**Mapping lesions to a model of language**

- Two approaches: hierarchical vs sequential
  - Abstract meaning vs low-level representations
  - Auditory → semantic → motor

Garrett 1984, Garret & Newmeyer 1988
## Common pathologies

Many problems can damage any given region

<table>
<thead>
<tr>
<th>Stroke (sudden onset deficit)</th>
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<tr>
<td>• Ischaemic (blocked artery)</td>
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<tr>
<td>• Haemorrhage (burst artery)</td>
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<tr>
<td>Brain tumour</td>
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<td>Trauma (head injury)</td>
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<tr>
<td>Surgery</td>
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<td>Atrophy (dementia)</td>
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- Deficits often change over time – spontaneous recovery
- Often muddied by compensatory strategies
Broca’s aphasia

Agrammatic / Expressive / Motor aphasia

- Telegraphic
- Few closed-class words
- Impaired comprehension esp. word order
- Circumlocutions
Wernicke’s Aphasia

*Fluent / Jargon / Receptive / Sensory aphasia*

- Impaired comprehension
- Neologisms
- Lack of meaning in speech
- Paraphasia
  - Phonemic: “racket” for “basket”, Verbal: “talking” for “hearing”
Wernicke’s Aphasia
Is Broca’s a deficit in syntax, sparing semantics?

- Can have selective word production deficits
  - Inability to read aloud, name pictures, repeat
  - Intact oral comprehension and reading

- Nonfluent *without* agrammatism:
  - Verb inflection
  - Determiners
  - Auxiliary verbs
  - Embedding (subordinate clauses)

- Agrammatics “sequence ideas as a series of simple structures”
  - The girl is taller than the boy ➔ “*girl tall, boy short*”

De Renzi and Di Pellegrino *Cortex* 1995
Saffran Berndt Schwartz *Brain and Lang* 1989
Gleason et al. *Brain & Lang* 1975
Saffran Berndt Schwartz *Brain and Lang* 1989
Comprehension deficits for syntax in Broca’s

- Caramazza & Zurif 1976
  - Sentence read aloud
  - Patient points to one of the pictures
  - Broca’s choose syntactic but not lexical foils

- Caplan et al 1985
  - Patients manipulate toy animals to depict the sentence
  - Brocas and conduction aphasics have selectively syntactic deficits; Wernicke are impaired even for simple sentences.

- Broca’s patients lack syntactic priming (Blumenstein et al. 1991).

**Stimulus sentences**

<table>
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<tr>
<th>Caplan Baker &amp; Dehaut <em>Cognition</em> 1985</th>
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</table>

**Sentences with one verb:**

- Two-place verb sentences:
  - Active (A): The elephant hit the monkey
  - Passive (P): The elephant was hit by the monkey
  - Cleft-subject (CS): It was the elephant that hit the monkey
  - Cleft-object (CO): It was the elephant that the monkey hit

- Three-place verb sentences:
  - Dative (D): The elephant gave the monkey to the rabbit
  - Dative passive (DP): The elephant was given to the monkey by the rabbit

**Sentences with two verbs:**

- Conjoined (C): The elephant hit the monkey and hugged the rabbit
- Subject-object relative (SO): The elephant that the monkey hit hugged the rabbit
- Object-subject relative (OS): The elephant hit the monkey that hugged the rabbit

"The ball kicked the girl"
Are comprehension failures due to word order or morphology?

Morphology seems to be most strongly affected

- Two types of syntactic cue for meaning: German: word order, Italian: morphology
- Morphological cues appear to be most affected - in both Broca and Wernicke

Comprehension deficits in Wernicke’s

*Information capacity vs. complexity*

- “Token test” for verbal comprehensison (De Renzi 1972)
  - “pick up the yellow rectangle”
  - “pick up the small yellow rectangle”
  - “take the yellow rectangle and the red circle”
  - “take the small yellow rectangle and the large red circle”
  - Touch the blue circle with the red rectangle.
  - Touch—with the blue circle—the red rectangle.
  - Touch the blue circle and the red rectangle.
  - Put the blue circle before the red rectangle.
  - If there is a black circle, pick up the red rectangle.
  - Pick up the rectangles, except the yellow one.
  - Put the blue circle between the yellow rectangle and the green rectangle.
  - Instead of the white rectangle, take the blue circle.
  - Before touching the blue circle, pick up the red rectangle.

- Wernicke’s cannot discriminate meaningful sounds, but fine with meaningless sounds

Faglioni, Spinnler & Vignolo, Cortex 1969
Is Wernicke’s acoustic or semantic?

- Many Wernicke patients are no worse at discriminating phonemic sounds compared to Brocas -- so their deficit is not perceptual

Blumenstein Baker and Goodglass *Neuropsychologia* 1977
Wernicke’s aphasia

In some cases, it is auditory-specific

- Auditory comprehension deficit with preserved visual comprehension
- “Pure word deafness”

Kirshner Webb and Duncan JNNP 1981
Where is the processing problem?

A computational model of Wernicke’s

- Accepts auditory “bun” for picture of a bus
- But no problem for visual words
- Good auditory discrimination ("bun" from "bus")
- LDT errors: accepts “roove” sound but not written
- Dictation poor, reading good.

1) an impairment in selecting a single spoken word form from among competing word forms that are all partially activated by subword phonologic units during listening and
2) an impairment in selecting the subword phonologic units from among many subword units activated by the spoken word form during speech output.

Hillis, Boatman, Hart & Gordon Neurology 1999
Semantic deficits in Wernicke’s

Is it specific?

- Matching semantic pictures impaired in Wernicke’s

  ![Pyramids and palm trees test](image)

- But Broca’s patients equally bad.

  Koemeda-Lutz, Cohen and Meier Brain & Lang 1987

- Could Wernicke’s have intact “semantic store” but poor access?

  Thompson, Robson, Lambon Ralph and Jefferies Brain 2015
Is language necessary for thought?

*Seems to be dissociable*

- Aphasic patients have preserved semantic sorting
  - “sort the items freely”
  - Semantic vs shape vs color

Milton, Wertz, Katz Prutting 1981
Wernicke’s: Acoustic or semantic?

- Perhaps deficits in both acoustic and semantic processing contribute
- But could still be different subgroups.
Is Broca’s area syntactic, and Wernicke’s area semantic?

May not match functional imaging data

- fMRI meta-analysis – semantic and syntax activation might cluster, but not as expected from lesions

Vigneua et al. *Neuroimage* 2005
Semantic-syntactic distinction reversed for “rapid” processing

Lexical decision task with two semantic primes

<table>
<thead>
<tr>
<th>Concordant</th>
<th>Discordant</th>
<th>Neutral</th>
<th>Unrelated</th>
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<tbody>
<tr>
<td>tool pick shovel</td>
<td>choose pick shovel</td>
<td>ship pick shovel</td>
<td>choose ship shovel</td>
</tr>
<tr>
<td>phone ring bell</td>
<td>finger ring bell</td>
<td>color ring bell</td>
<td>finger color bell</td>
</tr>
<tr>
<td>fur hide skin</td>
<td>seek hide skin</td>
<td>shape hide skin</td>
<td>seek shape skin</td>
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- Broca’s lacked semantic priming, yet Wernicke’s intact
- But conflicting findings; may depend on exact timings
- Similar findings in crossmodal priming (auditory-to-visual, Zurif & Nicol 1989)

Milberg Blumenstein Dworetzky Brain & Lang 1987
Global aphasia

Stereotypic utterance

Poor comprehension
Primary progressive aphasia

A collection of dementia subtypes

- Progressive Nonfluent Aphasia (PNFA)
- Semantic Dementia
- Logopenic PPA (Variant of Alzheimer’s)
Semantic Dementia

*A loss of representation for “meanings”*

- Preserved Raven’s matrices, block design WAIS
- **Good repetition** for words and nonwords
- WM preserved
- Impaired categorical fluency
- Preserved lexical fluency
Semantic Dementia

Atrophy of the Left temporal pole

Mesulam et al (2009) Brain
Semantic Dementia

Type of frontotemporal dementia

- Progressive and very disabling
- Dysexecutive syndrome, short term memory, eventually global aphasia
- No treatment at present
Progressive Nonfluent Aphasia (PNFA)

- Broca-like syndrome, progresses over years
- Classed as a frontotemporal dementia
- Early mutism
- Signs include dysexecutive syndrome, disinhibition, amnesia
Apraxia of speech

*May not be a disorder of language.*

- Normal comprehension
- Worse with long sentences
- Errors in repetition
- Paraphasia (e.g. compluter)
- Aware of these, so compensate with shorter utterances
- Physical apraxia & poor handwriting

- Associated with Progressive Supranuclear Palsy (parkinsonism and eye movement problems)
Anomia

Logopenic variant of Alzheimer’s disease

Impaired
- Naming
- Repetition
- Fluency
- Verbal WM
Anomia

Graded naming test – Warrington & McKenna 1980

or Boston Naming Test (Goodglass, Kaplan Weintraub 1983)
Selective anomias

- Proper nouns (Luchelli and De Renzi Cortex 1992)
- Category specific (animals, tools)
- Modality-specific (visual, auditory → “disconnection”)
Pure agraphia

Apraxic agraphia / ‘the aphasia of hand’

- Can read and speak but not write
- Normal oral spelling
- Strokes involve Exner’s area
- Can be for numbers and letters
Alexia without agraphia

*Pure Alexia / Word Blindness*

- Cannot read even simple words. Letter-by-letter spelling
- May ‘trace’ letters with finger, to help reading.
- Can write complex sentences though!

- VWFA or disconnection?
Pure word deafness

*Auditory verbal agnosia*

- Reading preserved
- Preserved understanding of nonword meaningful sounds
- Sometimes occurs in Wernicke’s Aphasia