Aphasia after stroke: Using clinical neuroimaging to predict speech-language deficits and recovery patterns

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Main aims of The Aphasia and Language Imaging Lab

1. Where is language function located in the brain?
2. What happens to the language network after stroke?
3. What are different neural patterns of recovery?
4. Can behavioral outcomes be predicted?
The recovery project

Investigate potential recovery patterns within the first year of stroke

Assess speech and language across first year
  ◦ within 5 days, 1 month post, 3 months post, 12 months post

Use fMRI to better understand what areas of the brain are being used for language after stroke ... any reorganization?
Today’s outline

**Structure**
- Location in the brain

**Function**
- Role of area
- What happens when disrupted?

**Clinical practice**
- Using structure and function to help assess, treat and educate
Important anatomical landmarks

- Central Sulcus
- Parietal Lobe
- Occipital Lobe
- Sylvian Fissure
- Temporal Lobe
- Frontal Lobe
The language network
The posterior temporal area: Structure
The posterior temporal area: Function

The posterior temporal area is responsible for:

• The mapping of sounds onto meaning
• The mapping of meaning onto sounds

When the posterior temporal area is disrupted:

• Comprehension deficits
• Phonemic paraphasias
• Semantic paraphasias
• Empty speech
The posterior temporal area: Function

Lesion overlay of 12 subjects with comprehension deficits (Kertesz et al., 1977, Arch Neurol)
Sentence comprehension

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Picture naming

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Using sentence comprehension to parse apart comprehension deficits

Are you sitting?
Am I a man?

Do you brush your teeth with a comb?
Do you open your door with a key?

Are doctors treated by patients?
Are cats chased by mice?

If I was at the park when you arrived, did I get there first?
If I tell you I used to smoke, do you think I smoke now?
The inferior parietal area: Structure
The inferior parietal area: Function

The inferior parietal area is responsible for:

• Selecting and sequencing sounds for words

When the inferior parietal area is disrupted:

• Phonemic paraphasias
• Comprehension likely to be intact
  • Multiple attempts at correcting phonemic paraphasias
  • Halting nature from self monitoring
• Number deficit
• Verbal working memory deficits
Spontaneous speech

Audio removed
Naming

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The inferior frontal area: Structure
The inferior frontal area: Function

The inferior frontal area is responsible for:

- Verbal expression
- Creating syntactic structure
- Speech motor programming

When the inferior frontal area is disrupted:

- Limited output
- Agrammatism
- Apraxia of speech
- Verbal working memory deficits
- Comprehension likely intact
- Hemiparesis often co-occurs
Spontaneous speech

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"No"

"Ma"

"Dad"
Broca’s area lesion and Broca’s aphasia

Spontaneous speech and picture naming 3 months later...

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The occipitotemporal area: Structure
The occipitotemporal area is responsible for:

- The mapping of a purely visual stimulus to a lexical entry
  - Perceiving letters
  - Mapping graphemes to phonemes

When the occipitotemporal area is disrupted:

- Reading deficits
  - Can break down at different stages
  - Reading comprehension impacted as a result
- Word finding deficits
  - *Tends to be temporary*
- Visual deficits often co-occur
Reading

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tin
dough
proposition

The baby cries in the night.
Spontaneous speech

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Total left hemisphere damage

Damage to all left hemisphere language areas

Expect global deficits

Outcome?

Lesion overlay of 12 subjects with deficits across domains (Kertesz et al., 1977, Arch Neurol)
Spontaneous speech

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Repetition

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Patients can make progress after a year

26 participants with aphasia
All at least 6 months post stroke (mean 5.5 years post)
Tested twice; at least 1 year apart (WAB-R)

Holland et al., 2017, Aphasiology
Take home messages

Anatomy can inform and impact clinical practice
Outcomes are variable
Recovery can continue past a year
Research is ongoing...
Thank you!

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