Connecting sound to meaning

/kæt/
Questions

- Where are lexical representations stored in the brain?
- How many lexicons?
Lexical access

Stimulus: TURN
Lexical access is affected by...

- Frequency
- Context, i.e., what was accessed before.
  - **Identity priming**
    - DOG - DOG
  - **Phonological priming**
    - FAME - LAME
  - **Semantic priming**
    - DOCTOR - NURSE
Sound-meaning interface in the Hickok & Poeppel (TiCS, 2004) model

Main argument: Transcortical sensory aphasia
Wernicke’s aphasia

- Lesion site:
  - Wernicke’s area

- Characteristics
  - Auditory comprehension: impaired
  - Reading: (often) impaired
  - Repetition: poor
  - Naming: often impaired
  - Writing: (often) impaired
Anomia

- Lesion site:
  - Much variance. Left anterior temporal in the Ashcroft case study.

- Characteristics
  - Auditory comprehension: intact
  - Repetition: intact
  - Naming: impaired
Conduction aphasia

- Lesion site:
  - Arcuate fasciculus.

- Characteristics
  - Auditory comprehension: intact
  - Repetition: impaired
  - Naming: impaired
  - Reading: typically good (but trouble reading aloud)
Transcortical sensory aphasia

- Lesion site:
  - Left inferior and/or middle temporal gyrus.

- Characteristics
  - Auditory comprehension: impaired
  - Repetition: intact
  - Naming: intact
  - Reading: intact
Inducing TSA with electrical interference (Boatman et al. 2000)

- Stroke lesions typically involve multiple areas
- Focal, transient, lesions can be via induced electrical interference:
  - A low-level (10–15 mA) electrical current is generated for 5–10 s at a time, between pairs of electrodes located on the lateral surface of the cortex.
  - The current disrupts processing associated with the underlying brain tissue, causing a “functional” lesion.
- Downsides:
  - Invasive
  - Subject population limited to patients undergoing electrocortical mapping.
Inducing TSA with electrical interference
(Boatman et al. 2000, Transcortical sensory aphasia: revisited and revised, Brain)

All electrode locations
Inducing TSA with electrical interference
(Boatman et al. 2000, Transcortical sensory aphasia: revisited and revised, *Brain*)

Location of electrode sites where TSA was induced.

Intact: Repetition, syllable discrimination, speech. Naming is impaired in 19/29 sites.
Inducing TSA with electrical interference
(Boatman et al. 2000, Transcortical sensory aphasia: revisited and revised, *Brain*)

Location of electrode sites where TSA was induced.

Intact: Repetition, syllable discrimination, speech, naming and word reading.
Inducing TSA with electrical interference
(Boatman et al. 2000, Transcortical sensory aphasia: revisited and revised, Brain)

Location of electrode sites where Wernicke’s aphasia was induced.

Impaired auditory comprehension, repetition and naming. Fluent speech.
Where are sound and meaning representations primed?

- Semantic priming is consistently found in
  - The superior temporal gyrus in fMRI (although not exclusively)
  - In the N400 response (which localizes in the superior temporal gyrus) in ERPs

- Phonological priming is consistently found in
  - No robust generalization from fMRI.
  - In the N400 response (which localizes in the superior temporal gyrus) in ERPs
Left frontotemporal contributions to lexical semantic processing

Retrieval of abstract semantics

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Left frontotemporal contributions to lexical semantic processing

STIMULI:
- Sound: humming, buzzing, howl
- Visual: purple, yellow, orange
- Hand action: wipe, dusting, hold
- Abstract: conceit, arrogance, pride

Table 2
Behavioural data

<table>
<thead>
<tr>
<th>Reaction times</th>
<th>Difficult</th>
<th>Easy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 P</td>
<td>2 P</td>
</tr>
<tr>
<td>Sound</td>
<td>1886 (288)</td>
<td>1801 (278)</td>
</tr>
<tr>
<td>Visual</td>
<td>1943 (272)</td>
<td>1729 (344)</td>
</tr>
<tr>
<td>Hand action</td>
<td>1880 (295)</td>
<td>1710 (289)</td>
</tr>
<tr>
<td>Abstract</td>
<td>1835 (304)</td>
<td>1745 (294)</td>
</tr>
</tbody>
</table>

Values are across-volunteer means (SD).
Left frontotemporal contributions to lexical semantic processing
Right hemisphere contributions to lexical semantic processing
Divided visual field technique

- One of the hemispheres is given “priority” in processing by presenting the stimulus in the left of right hemifield for .

http://faculty.washington.edu/chudler/vispath.html
Burgess & Simpson 1988

- Visual-visual semantic priming with homograph primes. Combined hemifield & SOA (stimulus onset asynchrony) manipulation.

<table>
<thead>
<tr>
<th>Relatedness</th>
<th>Prime</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subordinate</td>
<td>Unrelated, Neutral, Related</td>
<td>Riddle, Bank</td>
</tr>
<tr>
<td>Dominant</td>
<td>Unrelated, Neutral, Related</td>
<td>Riddle, Bank</td>
</tr>
<tr>
<td>Nonword</td>
<td>Word, Neutral</td>
<td>Bear</td>
</tr>
</tbody>
</table>
Burgess & Simpson 1988

- Semantic priming can be found in the right hemisphere (sorta) in the absence of priming in the left hemisphere.
What’s the state of the mental lexicon after the presentation of an ambiguous prime?

- Assume this resting state (BANK₁ = financial institution, BANK₂ = edge of river)
What’s the state of the mental lexicon after the presentation of an ambiguous prime?

35 ms after onset of \textit{bank}  

750 ms after onset of \textit{bank}
35 ms after onset of *bank*

- Priming both for *MONEY* and *RIVER*.

750 ms after onset of *bank*
35 ms after onset of *bank*

- Priming for MONEY. No priming for RIVER.

750 ms after onset of *bank*

- Why? LP: Because the LH doesn’t get direct visual input, this is in fact a longer “SOA” condition and the suppression of BANK\(_2\) has already started.
35 ms after onset of *bank*

- Priming for MONEY. No priming for RIVER.
- Makes sense, river-related meaning of BANK has already been suppressed.

750 ms after onset of *bank*
- Priming for MONEY. But also priming for RIVER.
- Why?
35 ms after onset of bank

- Priming for MONEY only.
- RH representations stay active even when representations in the LH are suppressed.

750 ms after onset of bank

- Priming for MONEY. Priming for RIVER.
Coarse coding hypothesis (Beeman 1998)

- Semantic processing processing the RH is more coarse than in the LH.
  - More meaning active. More distant meanings.
    - Supports comprehension of figurative language.