Inaccessible or Unstable? Further Applications of the IA Model

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Types of Impairments in the IA Model

- Dell et al (2003); Foygel and Dell (2000): weakened S->L and/or L->P connections
- Result = reduced/slowed transmission of activation
  - Weakened S->L connections: lexical nodes under activated, so can’t access correct word
  - Weakened L->P connections: phonological nodes underactivated, so can’t access correct phonemes

- Martin, Dell, Safran & Schwartz (1994): Increased decay rate of nodes
- Consequently, representations are “accessed” but activation not stable over time
- Predicts different error patterns: stronger influence of feedback = more formal paraphasias

BUT an alternative type of impairment is possible....
“Decay” Impairments

- Martin et al (1994): Global increase in decay rate (all nodes affected)
- Produces Deep dysphasia:
  - Frequent formal paraphasias in naming and speech
  - Can’t do tasks requiring maintenance of activation:
    - word repetition (semantic and other errors)
    - nonword repetition
    - short-term memory
- This idea of “unstable” or “fast fading” info not new (e.g. Michel & Andreevsky, 1983)
- BUT, IA model provides a formal framework for describing this idea.

“Decay” Impairments

- Later work: group study varied global decay impairments and global connection strengths (Dell, Schwartz, Martin, Saffran & Gagnon, 1997).
- Variation in these two parameters explains some differences between individuals, but not as many as S-P model
Our Research

- Perhaps we need to consider both dimensions:
  - Not only *locus* of impairment (lexical or phonological)
  - But also *nature* of impairment (weak connections or decay)

- Two fluent aphasic individuals: MS and GE

- For both, phonemic paraphasias are main error type in naming
  - i.e. both have same *locus* of impairment

- BUT performance of the two differs qualitatively, suggesting *nature* of impairment is different.

Case Descriptions

**Patient MS**
- CVA; small lesion in left posterior parietal lobe; 12 months post stroke
- Speech is well-articulated, grammatical, but many phonological errors
- Comprehension impaired
- Can’t repeat words/sentences, zero performance on nonwords repetition
- BDAE: Borderline Wernicke’s/Conduction Aphasia

**Patient GE**
- CVA; moderately large lesion in left parietal lobe; 4 months post stroke
- Speech well-articulated, grammatical but hesitant; many phonological errors
- Comprehension preserved
- BDAE: Conduction Aphasia
### Performance in Naming and Repetition

<table>
<thead>
<tr>
<th>Response type</th>
<th>Naming</th>
<th>Repetition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MS</td>
<td>GE</td>
</tr>
<tr>
<td>Correct</td>
<td>47.3</td>
<td>21.7</td>
</tr>
<tr>
<td>Phonemic paraphasia</td>
<td>19.5</td>
<td>33.3</td>
</tr>
<tr>
<td>Formal paraphasia</td>
<td>13.6</td>
<td>7.2</td>
</tr>
<tr>
<td>Semantic paraphasia</td>
<td>4.7</td>
<td>5.6</td>
</tr>
<tr>
<td>Unrelated word</td>
<td>6.5</td>
<td>7.2</td>
</tr>
<tr>
<td>Neologism</td>
<td>4.1</td>
<td>12.2</td>
</tr>
<tr>
<td>Other</td>
<td>4.2</td>
<td>12.8</td>
</tr>
<tr>
<td><strong>Word Length Effects</strong></td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Word Frequency Effects</strong></td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

### Auditory Comprehension

**Patient MS:**
- Phoneme discrimination (e.g. cub - cut): 75%
- Auditory lexical decision: 79%; missed many real words
- Word-picture matching with semantic distractors (e.g. crab-octopus) 100%
- Word-pic matching with with phonological distractors (e.g. comb-cone) 58%

**Patient GE:**
- Phoneme discrimination (e.g. cub - cut): 85%
- Auditory lexical decision: 85%
- Word-picture matching with semantic distractors (e.g. crab-octopus) 94%
- Word-pic matching with with phonological distractors (e.g. comb-cone) 80%
Summary

- Both patients produce phonemic paraphasias as main error type
  - can’t correctly access phoneme nodes
- BUT

<table>
<thead>
<tr>
<th>PATIENT MS</th>
<th>PATIENT GE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many formal paraphasias</td>
<td>Few formal paraphasias</td>
</tr>
<tr>
<td>Repetition &lt;&lt; naming</td>
<td>Repetition &gt; naming</td>
</tr>
<tr>
<td>No length effects are weak</td>
<td>Strong length effects</td>
</tr>
<tr>
<td>Phonological input processing esp. poor</td>
<td>Phonol. input processing still weak, but better than MS</td>
</tr>
</tbody>
</table>

The Phonological “Decay” Hypothesis

These differences suggest:
- Problem at same locus, but nature is different

Our hypothesis:
- GE = weak L->P connections
- MS = fast decay in phonological nodes
Predicts

- MS’s will produce a high rate of formal paraphasias
- MS will perform poorly on tasks requiring maintenance of phonological information, such as word (and especially nonword) repetition
- If network is used in both production AND comprehension, then MS will also have comprehension difficulties (fast decay means fast “fading” of phonological input)

Conclusion

- One type of impairment - weak connections - not enough to capture actual differences between cases
- An ideal model of aphasic word production needs to consider both “accessibility” and “stability” of linguistic information
- IA model provides ideal framework for describing dynamic impairments such as this