Language production

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Outline
- Word naming
  - Structure from dissociations: “lexemes”?
  - Two approaches
  - Two models
  - Computational simulations
- Sentence production
  - Normal model
  - Sentence production in aphasia

Sources of evidence
- This is going to be a story based on:
  - Dissociations in aphasia
  - Psycholinguistic experiments in normals
  - Errors of production

Word naming
- Components of word naming system derived from aphasic dissociations
  - (1) Anomia due to semantic impairments
    - category-specific or category-general
    - correlation of comprehension and production deficits suggests single semantic system
  - (2) Anomia without semantic impairment
    - (e.g., patient EST – Kay & Ellis, 1987)
    - difficulty retrieving content words
    - cueing with initial phoneme helps
    - high freq word forms easier than low freq
    - picture sorting / matching intact

Non-linguistic assessment of semantics

EST: Speech output

EST, Cookie jar picture:

content word-finding difficulties, with okay grammar + plus awareness of errors

Rule of frequency?
Marshall (1987): you can replicate anomic-like speech using just 100 most common English words

It had to go over these. Did a, ... as like that. It must be every time in this, but it’s not. He said, well, where is... or so... it was before he had his... mice are not like that. They must also be ball from the... a man has flame, many of these, but a new one should be next door of... Did you have one when you were sick there? You said that you had never been there that you were... and it was small, but if all three years. Even then it’s not the first one that I could have taken through...
Word naming

(3) Neologistic jargonaphasia
- Output mostly nouns and function words, plus nonwords
- Frequency effect? (function words are high frequency)

Subject RD: Ellis et al., (1963)

Word naming

(3) Neologistic jargonaphasia (cont.)
- Just more serious version of output lexicon damage than in (2)?
- But lack of awareness + poor comprehension = added comprehension deficit / pure word deafness?
- Inflections present but produced to be consistent with neologised word => separate inflection system acts on ROOT

<table>
<thead>
<tr>
<th>Talk/t</th>
<th>Declar/d</th>
<th>Spout/ed</th>
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<tr>
<td></td>
<td>Declared =&gt; Dislap = &gt;dislap/(\not) dislap/0</td>
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Word naming

(4) Articulation disorders
- Problems of coordination and control of articulatory muscle groups
- Can occur if comprehension and productive knowledge of word forms both intact (e.g., rhyme judgement, # of syllables)

Word naming

Conclusion: (minimally) separate semantic system, output lexicon, and speech articulation

Word naming

Why have I shown three possible models?
- Distinction between concepts (pre-linguistic) and semantics (meanings related to individual words)?
- Postulation of lemma? = (modality-neutral) identity of word including grammatical info prior to accessing phonological form
Word naming

- Evidence in favour of lemmas
  - grammatical info available to speaker without phonological form, e.g. TDT gender in French
- Evidence against lemma
  - modality-specific output deficits inc. semantic errors (e.g., naming but not writing) – implies direct connection from semantics to modality of output (Chialant et al., 2002)

Two approaches

- Two historical approaches to theories of word production
  1. Explain pattern of errors
  2. Explain time taken to produce word names (e.g., from pictures)

Relation of normal errors to aphasia

- It has been argued aphasic errors are exaggerated versions of normal speech errors
- Normal speech errors:
  - Semantic: “I really like to – hate to get up in the morning”
  - Phonological: “insect” for “index”
  - Neologisms: (given definition of platform for public speaking) “straw... strum... rostrum!”
  - Phoneme selection: “cuff of coffee” for “cup of coffee”

Semantic errors in normals

- An actual transcript of a call a woman made to a travel agent:
  WOMAN: I want to go from Chicago to Hippopotamus.
  TRAVEL AGENT: Err... are you sure that's the name of the town?
  WOMAN: Yes, What flight do you have?
  TRAVEL AGENT: We don't have anything flying to Hippopotamus.
  WOMAN: Oh, don't be silly. Check your map.
  TRAVEL AGENT (after some time): You don't mean Buffalo, do you?
  WOMAN: That's it. I knew it was a big animal.
Two approaches

**Chronometric**
- Deduce real-time patterns from interference patterns or priming effects

Can you prime:
- First phoneme? Yes.
- Later phonemes? No.
- Stress pattern? No.

*Computational models (1)*

**Dell et al. (1997)**
- Explains mixed errors (+ others)
- Assumes INTERACTIVITY!
- RAT instead of CAT

**Dell et al. model claimed to explain normal errors BUT ALSO aphasic errors, if ONLY two parameters were varied**
- Strength of connections
- Rate at which unit activation decays

They made two assumptions:
- Assumption of global damage
- Interactivity of processing

But it didn’t end happily…

*Computational models (1)*

**Foygel and Dell (2000)**
- Correct + error types
  - 6 dimensions ‘projected’ onto 2…

Correct
- Semantic
- Phonological
- Nonword
- Mixed
- Unrelated

What sort of errors can the model not possibly make, varying just its 2 parameters?

Because model is interactive, it struggles to account for patients showing semantic only or phonological only errors…
Computational models (1)
- Attempt to rescue model by rejecting globality assumption (allow selective connection damage S=>L or L=>P)

Computational models
- Note: implemented models produce progress because:
  - They force detailed specification of theory
  - The result is testable against quantitative data

Computational models (2)
- WEAVER (Roelofs, 1997; Levelt)
- Attempts to explain priming / interference data
- Assumes no interactivity between lemmas and word form (phonology)
- Has to explain mixed errors via a checking mechanism

Computational models (2)
- 2-step discrete model
  - Aims to explain inflectional processes and stress patterns
  - Also addresses syllabification, waits for word selection to be complete
  - Stored syllable vocabulary drives articulation

Word naming: conclusions
- Consensus on separation of semantic system and phonological forms
- Debate concerning necessity of modality-neutral lemmas and how syntactic info is encoded
- Debate concerning need for interactivity
- Debate concerning relation of normal to aphasic errors
- Computational models from different traditions

Sentence production
- What’s involved?
Four levels

1. **Message level**: generating what is to be said (requires perspective taking)
2. **Functional level**: selecting major lexical concepts for conveying the intended message and assigning grammatical roles or syntactic functions
3. **Positional level**: assembling phonologically realised words and morphemes into sentence frame
4. **Sound level**: programming articulatory processes

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**Sentence production**

- Distinguishes functional level representation and positional level representation
- Precise nature of roles to be filled at functional level not yet clear (probably depends on info carried by verb, what additional roles it requires)
- Model is sequential (top to bottom): same debate as in naming - whether interactivity is required

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**Interpreting breakdown**

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**Verbs imply roles and syntactic structures**

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**Damage here for Broca’s?**

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**Damage here for Wernike’s?**

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Sentence production in aphasia

- Problems with this analysis
  - overlap of symptoms between Broca’s and Wernicke’s
  - differentiation within each syndrome

Interpreting agrammatism

- Saffran, Schwartz and Marin (1980)
  - Agrammatic speech generated without benefit of logical relations among lexical elements (functional level)
  - Speech produced is simplified: direct mapping from elements of message to skeletal structural form
    - (e.g., noun-verb-noun)
  - Model not currently detailed enough to go much further

Constructional deficits

  - Patient asked to describe a picture of a cow kicking a horse, but to start his sentence with horse!
    - [hint: use the passive!]
  - The horse ... The horse kicks the cow. The horse kicks the cow. The horse is kicking. The horse is going to kick. Jeeze! The horse kicks. The horse is kicking. How is the horse. The horse.

Interpreting agrammatism

- Dissociation between morphological aspects and structural aspects of agrammatism needs to be explained
  - One proposal: articulation impairment affects grammatical morphemes only when functional structures also disordered (Saffran et al.)
  - But even bound vs. free grammatical morphemes dissociate

Varieties of constructional deficit

- Second form of simplification: absence of elaboration within phrases (adjectives, prepositional phrases)
  - Martin et al. (1998) => deficit in maintaining lexical/semantic information in memory when planning phrases
  - Saffran et al. (1980) => problem selecting verb lemma which would specify argument structure linking noun lemmas to syntactic functions
- But few word-order problems in free speech of aphasics (they are found in elicitation) [English]
  - lexical-semantic factors may affect word order more in aphasics => e.g. reliance on animacy to order nouns would not produce order violation

Sentence Production: Conclusions

- Sentence production model requires more detailed specification to interpret aphasic data
  - Discrete levels of planning for sentence production may have very specific cognitive support systems, rather than general "computational resource"
    - Separate syntactic, lexical-semantic, phonological working memories
  - May have implications for matching functional structure to neural substrate and imaging data
**Brain activations**

Production vs. Comprehension

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**Wise et al. (2001): PET**

- Hearing words
- Semantically cued word retrieval
- Articulation without perception
- Hearing and remembering / retrieving

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**Language sub-networks**

(Price, Thomas, Richardson, in progress)

- Within-subject design
- Four experiments tapping different language tasks
- Does a different combination of sub-networks become activated for each task?
- Tasks:
  1. Auditory sentences > reversed speech
  2. Silent speech > mouth movements
  3. Visual sentences > meaningless symbols
  4. Hand movement to object > unrelated hand movement to object

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**The mini-experiments**

- **RIGHT hem**
  - Auditory words
  - Visual words
  - Speech production
  - Action retrieval

- **LEFT hem**
  - Reversed words
  - Reversed words
  - Mouth movements
  - Hand movements

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**Vocabulary**

Kircher et al. (2000)

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**Brain vs. psycholinguistic model**

(Indefrey & Levelt, 2004)

(Levell et al., 1999)