Language production

Michael Thomas
Birkbeck College

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

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)
    - difficulty retrieving content words
    - cueing with initial phoneme helps
    - high freq word forms easier than low freq
    - picture sorting / matching intact

Word naming
- (3) neologistic jargonaphasia
  - Output mostly nouns and function words, plus nonwords
  - Frequency effect? (function words high freq)
  - 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 produced by Output lexicon

Talk/t/ Declar/d/ Spout/ed/

Declared => Dislap => dislap/t/ not dislap/d/

Subject RD: Ellis et al., (1983)
(4) Articulation disorders
- Problems of coordination and control of articulatory muscle groups
- Can occur if comprehension and productive knowledge of word forms (cf. rhyme judgement, # of syllables) both intact

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

Why three 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
  - Evidence in favour of lemmas – grammatical info available to speaker without phonological form, e.g. TOT 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 (Chiajani 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)

Word errors
- Deduce functional structure from the way that naming can go wrong in normal individuals
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 /rate to get up in the morning"
  - Phonological: "insect" for "index"
  - Neologisms: [given definition of platform for public speaking] "strow... strum... rostrum!"
  - Phoneme selection: "cuff of coffee" for "cup of coffee"

Two approaches

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

<table>
<thead>
<tr>
<th>Table 1: The implicit priming effect: priming the first syllable of bisyllabic words</th>
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<tr>
<td>Heterogeneity condition</td>
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<td>Interference condition</td>
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Computational models (1)

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

Computational models (1)

- Foygel and Dell (2000)
  - 6 dimensions ‘projected’ onto 2...

Computational models (1)

- Dell et al. model claimed to explain normal errors BUT ALSO aphasic errors if two parameters varied
  - Strength of connections
  - Rate at which unit activation decays
  - Making two assumptions:
    - Assumption of global damage
    - Interactivity of processing
  - Or so they thought...

What sort of errors can the model not possibly make, varying just its 2 parameters?
Computational models (1)

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 (2)

- WEAVER (Roelofs, 1997; Levelt)
- Attempts to explain priming / interference data
- Assumes no interactivity between lemmas and 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

- 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
Verbs imply roles and syntactic structures

Sentence production in aphasia
- Problems with this analysis
  - overlap of symptoms between Broca’s and Wernicke’s
  - differentiation with 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 direct mapping from elements of message to skeletal structural form (e.g. noun-verb-noun)
  - Model not currently detailed enough to go much further

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.)
- Even bound vs. free grammatical morphemes dissociate

Constructional deficits
- Absence of elaboration within phrases (adjectives, prepositional phrases)
  - Martin et al. (1998) => deficit in maintaining lexical/semantic information in memory when planning phrases
- Fragmented utterances, paucity of verbs
  - Saffran et al. (1980) => problem selecting verb lemma which would specify argument structure linking noun lemmas to syntactic functions
  - Few word-order problems in free speech of aphasics (they are found in elicitation)
    - lexical-semantic factors may affect word order more in aphasics => e.g. reliance on animacy to order nouns would not produce order violation
Constructional deficits

- When asked to describe a picture of a cow kicking a horse, but to start his sentence with "horse"

  The horse ... The horse kicks the cow. The horse kicks the cow. The horse is kicking. The horse is going to kick. Jesus! The horse kicks. The horse is kicking. How is the horse. The horse.

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" (cf. syntactic, lexical-semantic, phonological working memories)
- May have implications for matching functional structure to neural substrate and imaging data

Neural substrate

- Price (1998): review of imaging studies
  - Difficulty of appropriate subtractions + comparing imaging to lesion studies
  - Left hemisphere specialisation for word retrieval (semantics to phonology) = left posterior inferior temporal cortex + left frontal operculum
- Distinction between accessing phonological code and rapid syllabification important (Price, 1998)
  - Accessing code = Wernicke's area
  - Syllabification = posterior inferior frontal cortex