Serial models of linguistic planning

Fromkin's model of Speech Production

<table>
<thead>
<tr>
<th>Stage</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<tbody>
<tr>
<td>Identification of meaning</td>
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<td>Syntactic structure</td>
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<td>Intonation control</td>
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<td>Insertion of content words</td>
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<td>Formation of affixes &amp; function words</td>
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<tr>
<td>Specification of phonetic segments</td>
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</table>

<table>
<thead>
<tr>
<th>N/Pn</th>
<th>Adv</th>
<th>V</th>
<th>Adj</th>
<th>N</th>
</tr>
</thead>
</table>

Phase 6 output: /Sh/e/ /a/l/r/ea/d/y/ /b/a/gg/e/d/ /N/o/ /p/a/ck/s  *
Target output: She already bagged two packs (packed two bags)

Evidence for the model

AD 1: Errors typically occur at one level

E.G.: Level 4 word stems exchange, but level 5 suffixes stay:

stem1+suffix1  stem2 suffix2
packed  bags => bagged packs  *

Or Level 4 word stems stay, but level 5 suffixes exchange:

stem1+suffix1  stem2 suffix2
Singer  sewing => sing ing sewer  *
(machine)

Evidence for the model

AD 2: Errors typically accommodate themselves to linguistic environment. In other words, errors made at stage X trigger adjustments at stage X+1 (but not X-1)

E.G.: phonological accommodation (Garrett,1980):

Stage 4 error: A weekend for maniacs ⇒ A maniac for weekends
Stage 5: morpheme stranded
Stage 6: phonological accommodation

In weekend’s final consonant is voiced /z/, in maniacs it is unvoiced /s/.

Language Production

• Very different kind of process than comprehension

• "Linearization" Problem
  – A thought, with many parts simultaneously present in mind
  – Must be converted into an ordered sequence of Articulatory Gestures
  – Words must be in right order in sentences
  – Sounds must be in right order in words
  – More necessary to get it right than in comprehension?
  • Syntax exists so we can say implausible things. (Garrett)

Evidence about Production

• Production is harder to study than comprehension
  – So, much less work has been done on production

• Much of what we know about production comes from Speech Errors
  – Slips of the Tongue, "Freudian" slips

• Errors are not random - they're systematic
  – Only some of all the possible kinds of errors actually happen
  – And some types of errors are much commoner than others
  – Error patterns provide clues about how the system works

Some Things Errors Tell Us

That toy sure makes a great cat mouse.
That toy sure makes a great cat mouse.
That mouse sure makes a great cat toy.

• We sometimes say a word too early (= Anticipation)
  – So, the word must be in mind & "ready" to say well ahead of its time
  – Planning: This is what allows us to speak fluidly much of the time

• How far ahead do we plan? Sometimes not far enough!
  – Your mouth catches up to the end of what you have planned
  – You pause or stumble if you start to say a word before it's "ready"
  – Pauses, filled pauses, & dysfluencies more likely before harder-to-retrieve words
  – Listeners know this & make predictions based on it
  – Occasionally start to say a word before fully deciding which word to say!

• The drug laws have gotten much stiffer ... I mean, tougher (stiffer).
  – It's a partial ... a parallel process (serial)
  – Blend
• What else does That toy sure makes a great cat mouse. show?
  – We sometimes say a word later than intended
  – Perseveration
  – Especially if:
  – The word that should go in that position is already “used up” & a word that was supposed to go earlier is still “available.”
  – Exchange

• Some more errors:
  – Work is the curse of the drinking class.
  – Freud made a Fordian slip.
  – Imagine getting your model renosed.
    • So, parts of words can slip. What kinds of parts?
    • Morphemes, usually

• And some more errors:
  – With this wing I thee red.
  – Children sure can wreck your knife light.
  – So, individual phonemes can slip

• Are all kinds of sounds equally likely to slip? No.
  – The single most common kind of slip:
    – Exchange of first consonant or consonant cluster of 2 words:
      • With this wing I thee red.
      • We’re supposed to get flow snurries today.
  – Spoonerism
    – You’ve tasted the whole worm.
    – May I sow you to a sheat?

  – Errors on vowels (burst of beaden) & final consonants (knife light) much rarer

Some More Types of Errors

<table>
<thead>
<tr>
<th>Target</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition:</td>
<td>impossible &gt; impossible</td>
</tr>
<tr>
<td>Deletion:</td>
<td>processing &gt; prossing</td>
</tr>
<tr>
<td>Shift:</td>
<td>It sure runs out fast. &gt; It sure runs outs fast.</td>
</tr>
<tr>
<td>Strand: (+Exchange)</td>
<td>Drink is the curse of the working class. &gt; Work is the curse of the drinking class.</td>
</tr>
<tr>
<td>Substitution:</td>
<td>Liszt's Second Hungarian Rhapsody &gt; Liszt's Second Hungarian restaurant</td>
</tr>
<tr>
<td>Malapropism (= amusing whole-word substitution)</td>
<td></td>
</tr>
</tbody>
</table>

"I'm a person who recognizes the fallacy of humans." (W)

Most types of errors can occur on most linguistic units

<table>
<thead>
<tr>
<th>Exchanges</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Word</td>
<td>a symbol system &gt; a system symbol</td>
</tr>
<tr>
<td>Morpheme</td>
<td>Ford made a Freudian slip &gt; Freud ... Fordian slip</td>
</tr>
<tr>
<td>Cons. Cluster</td>
<td>snow flurries &gt; flow snurries</td>
</tr>
<tr>
<td>Vowel</td>
<td>beast of burden &gt; burst of beaden</td>
</tr>
<tr>
<td>Consonant</td>
<td>bad kid &gt; kad bid</td>
</tr>
<tr>
<td>Phonetic</td>
<td>clear blue sky &gt; glear plue sky</td>
</tr>
<tr>
<td>Feature</td>
<td>buzz (and)</td>
</tr>
</tbody>
</table>

• But some units are much more "slippable"

• Out of all Errors:
  – 35% = single phonemes (usually consonants)
  – 33% = whole words
  – 17% = morphemes
  – 5% = consonant clusters

• And some types of errors don't happen on all kinds of units
  – Shifts & Strands happen only with Function Morphemes
  – But other errors are far more common on Content Morphemes

• These patterns provide clues about how production works

Tip of the Tongue (TOT) Phenomenon

William James (1893)

“Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein; but no mere gap. It is a gap that is intensely active. A sort of wrath of the name is in it, beckoning us in a given direction, making us at moments tingle with the sense of our closeness and then letting us sink back without the longing-for term. If wrong names are proposed to us, this singularly definite gap acts immediately as to negate them. They do not fit its mould. And the gap of one word does not feel like the gap of another, all empty of content as both might seem necessarily to be when described as gaps.”

• A navigational instrument containing a graduated 60-degree arc, used for measuring the altitudes of celestial bodies
  – sextant

• Lemma = the "sort of wrath of the name"
Evidence that sounds are not specified until the very end of production

In speech errors, Assimilation is correct for the Outcome, not for the Target.

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<td>It sure runs out fast.</td>
<td>It sure run outs fast.</td>
</tr>
<tr>
<td>Even the best teams lost.</td>
<td>Even the best team losts.</td>
</tr>
<tr>
<td>two sheets of paper</td>
<td>two papers of sheet</td>
</tr>
<tr>
<td>a language acquisition project</td>
<td>an language acquisition project</td>
</tr>
</tbody>
</table>

So, the experiments worked better than you wanted them to. Better ... wanted to them.

Producing Language

- Many partially overlapping processes (cascade)
  - Planning different properties of different parts of message at any given moment
  - For words coming up soon, planning sounds
  - But for parts coming up later, still figuring out “words” (i.e., lemmas) & sentence frame
  - Haven’t gotten to sounds of far-ahead “words” yet

- How far ahead do you plan at the different stages?
  - i.e., What are the sizes of the Planning Units?

Evidence from Speech Errors about Planning Units

- **Properties of Word Exchanges:**
  - The 2 words are usually similar in some ways
    - From the same class
    - From different phrases
      - They don’t have to sound like each other to exchange
    - Typically other words between them
  - The 2 words are usually similar in some ways
    - From the same position in their word (both word-initial or ...)
    - Typically from the same phrase
    - But dissimilar in other ways
      - Their words typically have different syntactic categories
      - Typically no other words between the 2 words involved

- **Properties of Sound Exchanges:**
  - The 2 sounds are usually similar in some ways
    - Same type of sound (both consonants or ...)
    - From the same position in their word (both word-initial or ...)
    - Typically from the same phrase
    - But dissimilar in other ways
      - Their words typically have different syntactic categories
      - Typically no other words between the 2 words involved

An Example with Multiple Errors

The squeaky wheel gets the grease.
> The squeaky guease gets the wheel.

- **Properties of sound exchanges happen at a stage that:**
  - Knows about speech sounds
  - Has ordered word frames with empty slots for sounds
  - Each slot is tagged for a particular kind of sound
    - e.g., initial consonant, vowel, coda consonant
  - Frames are planned only up to end of current phrase
  - It doesn’t know about syntactic categories of words
    - Sound Level: The slots are for phonemes
  - Sound exchanges happen when phonemes put in wrong phoneme slots in word frames
    - But phonemes only “fit” into slots tagged with their phoneme-type
  - Notice, there’s a sound exchange between 2 words that should have been far apart
    - Sound exchanges are supposed to happen only between words that are closer together
    - So, the word exchange must have happened first, in order for the 2 words involved in the sound exchange to be in position to be able to exchange their sounds
  - Example provides evidence supporting the idea that “words” are ordered before their sounds are filled in
"Standard" Model of Language Production (Garrett)

Series of cascaded stages

1. Message Level: Formulate a message to convey
2. Functional Level: Retrieve "words" (lemmas) to perform functions in message (agent, instrument, action, ...)
3. Positional Level: Build sentence frame that specifies where to put "words", given their functions
4. Sound Level: Retrieve sounds of words & turn whole thing into a plan for articulation

Producing Language

- Cycle through series of stages over & over
  - Many partially overlapping processes (cascaded)
  - Planning different properties of different parts of message at any given moment
    - For words coming up soon, planning sounds
    - But for parts coming up later, still figuring out "words" (lemmas) & sentence frame
    - Haven't gotten to sounds of far-ahead "words" yet

Mapping content onto form: The Garrett Model

- Message Level Representation
- Function Level Representation
  - Words (lemmas) are selected on the basis of how well their meaning encodes elements of Message Level content. Structures are built on the basis of message content AND the grammatical needs of the words chosen to encode that content, and the words and structures are merged into a complete representation of words and relations.
- Position Level Representation
  - Word forms (lemmas) are retrieved based on the selected lemma and are combined with closed class morphemes that are spelled out by rule. Ordering of spell out forms.
- Phonetic Representation
  - Phonological operations then apply to Position level representations to make them conform to the phonotactics of the language.

Processing Increments: Understanding the computational flow

- Message Level
  - Function Level
    - Position Level
      - Phonetic Level

Processing Increments: the level-by-level theory

- Message Level
  - Function Level
  - Position Level
  - Phonetic Level
  - Conceptual Representation
  - Representation of syntactic relations

- Message Level
  - Function Level
  - Position Level
  - Phonetic Level
  - Conceptual Representation

- Message Level
  - Function Level
  - Position Level
  - Phonetic Level
  - Conceptual Representation
Cascade
Processing Increments: The incremental theory

Message Level

Function Level

Position Level

Phonetic Level

Conceptual Representation

Processing Increments: The incremental theory

Message Level

Function Level

Position Level

Phonetic Level

Conceptual Representation

Mapping content onto form: The Garrett Model

Message Level Representation

Function Level Representation

Words (lemmas) are selected on the basis of how well their meaning encodes elements of Message Level content.

Structures are built on the basis of message content AND the grammatical needs of the words chosen to encode that content;

and the words and structures are merged into a complex representation of words and relations.

Mapping content onto form: Conceptual Representations

Function Level Representation

Words (lemmas) are selected on the basis of how well their meaning encodes elements of Message Level content.

Structures are built on the basis of message content AND the grammatical needs of the words chosen to encode that content;

and the words and structures are merged into a complex representation of words and relations.
Mapping content onto form: Lemma Selection

- Selection is based on meaning match
- Lemma selection gets you access to grammatical properties of words
- Also gets you access to an address of the word’s form (but NOT the form itself)

Mapping content onto form: The Garrett Model

- Selection is based on meaning match
- Lemma selection gets you access to grammatical properties of words
- Also gets you access to an address of the word’s form (but NOT the form itself)
There seem to be distinct stages in linguistic planning, each of which can be subject to error. Different models propose different stages, or slightly different assumptions about what is activated first. Garrett: semantic content of words specified and assigned to syntactic roles (e.g., subject: mother concept; verb: wipe concept; object: plate concept) ⇒ Ordering of words/syntactic frame.

At least it seems clear that one needs to have some kind of plan about the syntactic frame, lexical items to be retrieved, and the phonological output, before one starts to speak. Is everything (the whole linguistic plan) ready before we start articulating?

**Experimental tests**
- Picture-word interference task
  - Participants name basic objects as quickly as possible
  - Distractor words are embedded in the object
  - Participants are instructed to ignore these words

**Basic findings**
- Semantically related words can interfere with naming
  - E.g., the word TIGER in a picture of a LION
• However, form-related words can speed up processing
  – e.g., the word liar in a picture of a LION

• Experiments manipulate timing:
  • picture and word can be presented simultaneously
  • or one can slightly precede the other
• We draw inferences about time-course of processing

Schriefers, Meyer, and Levelt (1990)

• Experiments manipulate timing:
  • SOA (Stimulus onset asynchrony) manipulation
    – -150 ms (word … 150 ms … picture)
    – 0 ms (i.e., synchronous presentation)
    – +150 ms (picture … 150ms … word)

Schriefers, Meyer, and Levelt (1990)

• Auditory presentation of distractors
  – DOT phonologically related
  – CAT semantically related
  – SHIP unrelated word

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Early
Only
Semantic
effects

Late
Only
Phonological
effects