Language Production

Speech Production

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General Points about Speech Production

- 15 speech sounds per second => 2 to 3 words (7)
- Automatic, we can’t tell how we do it; ‘impossible to think in the middle of a word, shall I say ‘t’ or ‘d’” (Levelt)
- Production side has gotten less attention in Psycholinguistics than the comprehension side.
- Evidence for speech production behaviour has until recently relied heavily on speech errors (laboratory induced or natural)
Processes in Speech Production

- Decide what to say
- Select appropriate words
- Organize words into grammatical form
- Turn sentences into speech
From Thought to Speech or Written Text

**SPEECH**

- Conceptualizing
- Formulating
- Articulating
- Self-monitoring

- Slips of the mind
- Slips of the tongue
- Corrector
Spoonerisms

• Speech error in which the initial letter or letters of two or more words are switched

• “The Lord is a shoving leopard to his flock.”
SLIPS OF THE TONGUE

- Spoonerisms: Exchange of phonemes (named after Reverend Dr. William Spooner, 1844-1930).

- You have hissed my mystery lectures =>
  You have missed my history lectures

- * In fact, you have tasted the whole worm =>
  In fact, you have wasted the whole term.

- 8 major types of slips of the tongue. These errors appear at all levels (phoneme, morpheme, word level).

- => Speech errors are not made at random
<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shift</td>
<td>That’s so she’ll be ready in case she decide to hits it (decides to hit it).</td>
</tr>
<tr>
<td>Exchange</td>
<td>Fancy getting your model renosed (getting your nose remodeled).</td>
</tr>
<tr>
<td>Anticipation</td>
<td>Bake my bike (take my bike).</td>
</tr>
<tr>
<td>Perseveration</td>
<td>He pulled a pantrum (tantrum).</td>
</tr>
<tr>
<td>Addition</td>
<td>I didn’t explain this clarefully enough (carefully enough).</td>
</tr>
<tr>
<td>Deletion</td>
<td>I’ll just get up and mutter intelligibly (unintelligibly).</td>
</tr>
<tr>
<td>Substitution</td>
<td>At low speeds it’s too light (heavy).</td>
</tr>
<tr>
<td>Blend</td>
<td>That child is looking to be spaddled (spanked/paddled).</td>
</tr>
</tbody>
</table>
Common Types of Speech Errors

- **Sound Exchanges**
  - Night life
  - Nife lite
  - Beast of burden
  - Burst of beaden
  - Coin toss
  - Toin coss

- **Anticipation Errors**
  - Take my bike
  - Bake my bike

- **Perseveration**
  - Beef noodle
  - Beef needle
Speech Errors & Constituents

• Sound exchange, sound anticipation, and sound perseveration errors tend to occur within a single constituent
  – Tend not to occur across constituents

• Unlikely Speech Errors
  The dancer took my bike.
  The bancer took my bike.
  At night, John lost his life.
  At nife, John lost his lite.
Stranded Morpheme/Morpheme Exchange Error

• I’m not in the read for mooding.
• She’s already trunked two packs.
• (I’m not in the mooding for read.)

Decide on Pattern to Generate
Noun for Verb + ing
Fill in Specific Words
Noun for Verb + ing

mood read
Common properties of speech errors

1. Exchange of phonemes in similar positions
   *a hissed mystery lectures (missed history lectures)
   *b burst of beaden (beast of burden)
   *c nife lîfe (night life)

2. On top of that, phonemic environment plays a role (see ex. c)

3. Moreover, exchange of consonants with consonants and vowels with vowels.

4. Novel forms are consistent with phonological rules of a language (blend of slick and slippery becomes slickery, not phonologically impermissible forms as slickperry or slipkery)

=> Simultaneous activation of language units, filled in the wrong slots
<table>
<thead>
<tr>
<th>Stage</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identification of meaning—a meaning to be conveyed is generated.</td>
</tr>
<tr>
<td>2</td>
<td>Selection of a syntactic structure—a syntactic outline of the sentence is constructed, with word slots specified.</td>
</tr>
<tr>
<td>3</td>
<td>Generation of intonation contour—the stress values of different word slots are assigned.</td>
</tr>
<tr>
<td>4</td>
<td>Insertion of content words—appropriate nouns, verbs, and adjectives are retrieved from the lexicon and placed into word slots.</td>
</tr>
<tr>
<td>5</td>
<td>Formation of affixes and function words—function words (articles, conjunctions, prepositions), prefixes, and suffixes are added.</td>
</tr>
<tr>
<td>6</td>
<td>Specification of phonetic segments—the sentence is expressed in terms of phonetic segments, according to phonological rules.</td>
</tr>
</tbody>
</table>

Serial models of linguistic planning

Fromkin’s model of Speech Production

Stage 1

- Identification of meaning
- Syntactic structure

Stage 2

- Intonation contour
- Insertion of content words

Stage 3

- Formation of affixes & function words

Stage 4

- Specification of phonetic segments

Stage 5

Stage 6

1. Sentence level: syntactic planning

2. Word level: lexicalization

She already bagged two packs (packed two bags)
Serial models of linguistic planning

- Fromkin’s model of Speech Production

- Stage 1

Identification of meaning

Target output: She already bagged two packs (packed two bags)
Serial models of linguistic planning

- Fromkin’s model of Speech Production

- Stage 1

Identification of meaning

- syntactic structure

Phase 2 output:

N/Pn  Adv  V  Adj  N

_1_  _2_  _3_  _4_  _5_

Target output:

She already bagged two packs (packed two bags)
Serial models of linguistic planning

- Fromkin’s model of Speech Production

- Stage 1  2  3

Identification of meaning

syntactic structure

intonation contour

Phase 3 output: N/Pn  Adv  V  Adj  N

1  2  3  4  5

Target output: bags

She already bagged two packs (packed two
Serial models of linguistic planning

- Fromkin’s model of Speech Production

Stage 1  2  3  4

Identification of meaning  intonation contour  Insertion of content words

syntactic structure

Error at this stage

Phase 4 output: She already bag___  two pack__
Target output: packed two bags

She already bagged two packs
Serial models of linguistic planning

- Fromkin’s model of Speech Production

- Stage 1 2 3 4 5

Identification of meaning → syntactic structure → intonation contour → Insertion of content words → Formation of affixes & function words

Phase 5 output: She already bagged two packs
Target output: (packed two bags)

N/Pn Adv V Adj N

*Target output: She already bagged two packs
Serial models of linguistic planning

- Fromkin’s model of Speech Production

Stage 1 2 3 4 5 6

Identification of meaning → syntactic structure → intonation contour → Insertion of content words → Formation of affixes & function words → Specification of phonetic segments

N/Pn Adv V Adj

Phase 6 output: /Sh/e/ /a/l/r/ea/d/y/ /b/a/gg/e/d/ /t/wo/ /p/a/ck/s

Target output: She already bagged two packs (packed two...
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 => singing 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 **weekends** final consonant is voiced /z/, in **maniacs** it is unvoiced /s/.
So

- 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?
No

Speech production is at least in part an incremental process

Planning of complex sentences

Meyer (1996): the arrow is next to the bag

- When you hear bow (sem.rel.1), uttering ‘the arrow is next to the bag’ is delayed
- When you hear suitcase (sem.rel.2), uttering ‘the arrow is next to the bag’ is delayed
- When you hear sparrow (phon.rel.1), uttering ‘the arrow is next to the bag’ is delayed
- When you hear bad (phon.rel.2), uttering ‘the arrow is next to the bag’ is not delayed

=> When starting to speak, not everything is ready, independent modules, can work at the same time!

- Planning: X (fully) X+1 (partly)
- Articulating: X
Constituent Structure in Generation

• Speakers generate language in phrases or constituents of phrases (clauses, NPs, VPs)

• Hesitations & Pauses
  – Mean pause length @ clause boundary = 1 s
  – Mean Pause length w/in clause = .75 s (Boomer)
  – “Um,” “Ah” vs. Silence (Maclay & Osgood)
Constituent Structure in Generation

- When speakers repeat or correct themselves, they tend to repeat or correct a whole constituent.

<table>
<thead>
<tr>
<th>VP</th>
<th>NP</th>
<th>NP</th>
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Turn on the heater/ the heater switch.

Not:

<table>
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<th>VP</th>
<th>NP</th>
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Turn on the stove/ the heater switch.

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Turn on the stove/on the heater switch.
Tongue Twisters

- Have speakers attempt to read the following 3 times rapidly and repeat 3 times from memory.
  - Describe 3 errors that were made
  - Discuss whether they fit with what’s been said about the nature of speech errors
- How polite is the fame of the fib to police.
- Your lapel has the fame and the fib of Lapointe.
- This locale has a yen for a yacht by LaCoste.
- You collect if you yawn, but not yet, said Colleen.
- The rebuff was too wan since it’s web to rebuild.
- If the ribbon is wan it’s too wet for a rebate.
- The balloon had no gun and could get the ballet.
- From the belly a gun will not get me a ballot.
- When the lubber is gone we can get him a lapel.
- You defy me the tin and I talk to defend.
A psycho-linguistic view of language

Intention to say or understand something

  Meaning
  Syntax
  Sound
  Articulation
Speaking

- a picture naming -> speech planning ->
Speaking

- a picture -> speech planning -> a response

DOCTOR
Speaking

• a picture  ->  speech planning  ->  a response
Manipulate meaning access

Picture-Word Interference Paradigm
- naming Doctor, hearing Nurse 880 ms
- naming Doctor, hearing Sun 830 ms

slow down 50 ms

semantic interference effect
Manipulate syntactic access

Picture-Word Interference Paradigm

- is Doctor a “de” or “het” word, seeing “het” 680 ms
- is Doctor a “de” or “het” word, seeing “de” 620 ms

slow down 60 ms

syntactic incongruency effect
Manipulate phonological access

Picture-Word Interference Paradigm

- naming Doctor, hearing Doll   800 ms
- naming Doctor, hearing Sun    830 ms

speed up                     30 ms

*phonological facilitation effect*
Time course

Visual → Meaning → Phonology

Levél et al., 1991
Time course

Levelt et al., 1991
Time course

Levelt et al., 1991
Time course

Levelt et al., 1991
Time course

Phonology → Meaning → Phonology

Visual

word

Phonology → Meaning → Phonology

word

Phonology → Meaning

SOA

Levelt et al., 1991
Time course

SOA

Effect size

Word first
Picture second

Semantics

Phonology

Word second
Picture first

Schriefers et al., 1990
Dry cognitive theory

Test the model in reaction time experiments

Problem:
reaction times only show the end of the process
Other methods?

Look into the process during its run

• Event related potentials
Today’s ERP components

- LRP (lateralized readiness potential)
- (N200)
LRP

- derivative from the Bereitschaftspotential
- button press tasks
- ramp-shape activation above the motor cortex
- planning of movement (before actual movement)
- in go and nogo responses
- maximum contra lateral to movement
- maximum at electrode sites C3’ and C4’
Isolating LRP

- Obtain lateralized activity
  - Subtract potentials from left motor cortex from right (C3 & C4)
  - Separate difference waves for left hand trials and right hand trials
- Cancel out lateralized potentials not directly related to response prep
  - Subtract left hand difference waves from right hand difference waves
- LRP reflects lateralization occurring as a result of motor preparation
LRP & Partial Information Transfer

• Can response preparation begin based on partial information?
• Two-choice go-nogo paradigm
• One choice indicates response hand
  – Letter shape
• One choice indicates whether to give response or withhold it
  – Letter size
Miller & Hackley (1992)

- Shape information available early (hand)
- Size information available late (go/nogo)
- LRP Present on no-go trials! Why?
- Partial stimulation activates response even before go/nogo decision is made
LRP

- Real time measure of response preparation
- Response selection can begin even before complete stimulus information available
- LRP provides index of time when different aspects of stimulus available for response selection
LRP in language production

• preparation to respond
• indicates when specific information becomes available
• dual choice go/nogo paradigm (Van Turennout et al., 1997, 1998)

• two decisions
• one is based on semantics
• one is based on phonology
LRP

SEMANTICS

left hand
animal

right hand
object

go
word initial consonant

no go
word initial vowel
LRP: two major conditions

hand = semantics
• left/right hand response preparation on semantics
• go/nogo decision contingent on phonology

hand = phonology
• left/right hand response preparation on phonology
• go/nogo decision contingent on semantics
LRP Hypothesis

- hand = semantics
- if semantics precedes phonology LRP even on nogo trials
LRP Hypothesis

- hand = phonology
- if semantics precedes phonology LRP only on go trials
hand=semantics
go/nogo=phonology

hand=phonology
go/nogo=semantics

RT=1097

RT=1053
LRP Conclusions

• nogo LRP in hand = semantics
• no nogo LRP in hand = phonology
• data fit hypothesis
• semantic encoding precedes phonological encoding