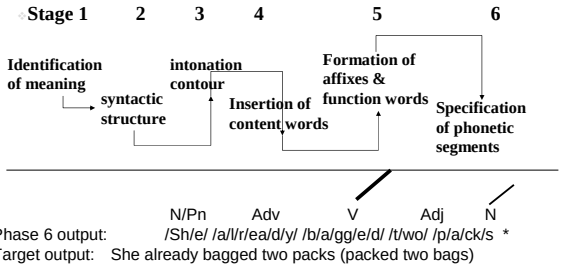
Serial models of linguistic planning

- **Fromkin's model of Speech Production**



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 accomodate 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 *maniac*s 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 fluently 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 stuffer ... I mean, tougher (stiffer).***
  - ***It's a parial ... 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

	Target		Outcome
Addition:	***impossible***	>	***implossible***
Deletion:	***processing***	>	***prossing***
Shift:	***It sure runs out fast.***	>	***It sure run outs fast.***
Strand: (+Exchange)	***Drink is the curse of the working class.***	>	***Work is the curse of the drinking class.***
Substitution:	***Liszt's Second Hungarian Rhapsody***	>	***Liszt's Second Hungarian restaurant***

Malapropism (= amusing whole-word substitution)
"I'm a person who recognizes the fallacy of humans." (W)

Most types of errors can occur on most linguistic units

Exchanges

Word	***a symbol system***	>	***a system symbol***
Morpheme	***Ford made a Freudian slip***	>	***Freud ... Fordian slip***
Cons. Cluster	***snow flurries***	>	***flow snurries***
Vowel	***beast of burden***	>	***burst of beaden***
Consonant	***bad kid***	>	***kad bid***
Phonetic Feature (very rare!)	***clear blue sky***	>	***glear plue sky***

- **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 all 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 wraith 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 longed-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 wraith 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

Target		Outcome
It sure runs out fast. *runz*	>	*It sure run outs fast.* *outs*
Even the best teams lost. *teamz*	>	*Even the best team losts.* *losts*
two sheets of paper *sheets*	>	*two papers of sheet* *paperz*
a language acquisition project	>	*an anguage lacquisition project*
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
    - Same syntactic category (both nouns or both adjectives or ...)
    - From the same clause
  - But dissimilar in other ways
    - From different phrases
    - They don't have to sound like each other to exchange
  - Typically other words between them
- **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

- So, word exchange errors happen at a stage that:
  - Knows about syntactic categories of words
  - Has ordered **sentence frame** with empty **slots** for words
    - Each slot tagged for a particular **syntactic category**
  - Frame is planned up to at least end of current clause
  - It doesn't know about the sounds of the words
  - **Positional Level**: The slots are for **lemmas**
- Word exchanges happen when lemmas are put in the wrong slots in sentence frame
  - But lemmas only "fit" into slots tagged with their syntactic category

- And 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

An Example with Multiple Errors

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

- 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 complex representation of words and relations.

↓

Position Level Representation

Word forms (lexemes) are retrieved (based on the selected lemmas) 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

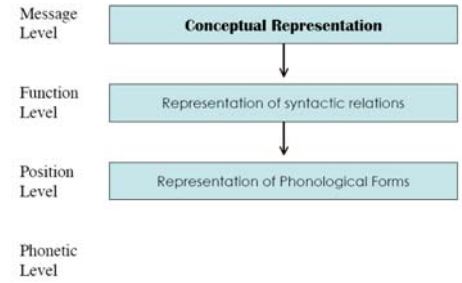
Processing Increments: the level-by-level theory

Message Level	**Conceptual Representation**
Function Level	
Position Level	
Phonetic Level	

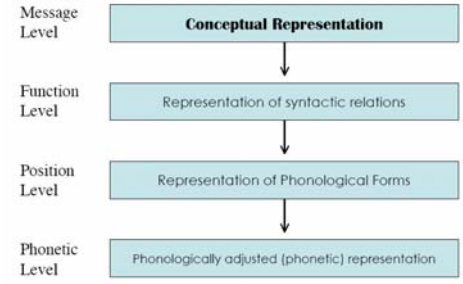
Processing Increments: the level-by-level theory

Message Level	**Conceptual Representation**
	↓
Function Level	Representation of syntactic relations
Position Level	
Phonetic Level	

Processing Increments: the level-by-level theory

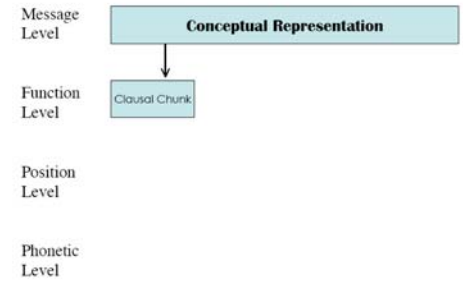


Processing Increments: the level-by-level theory

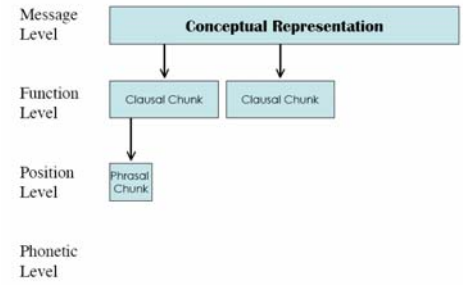


Cascade

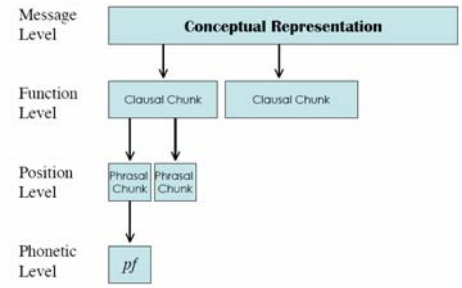
Processing Increments: The incremental theory



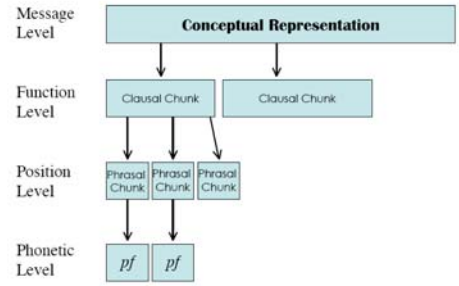
Processing Increments: The incremental theory



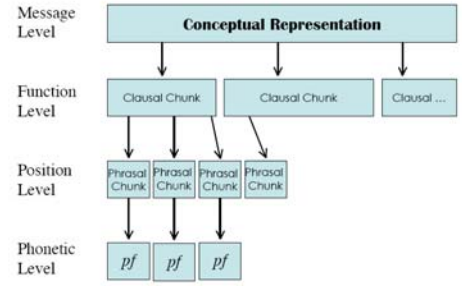
Processing Increments: The incremental theory



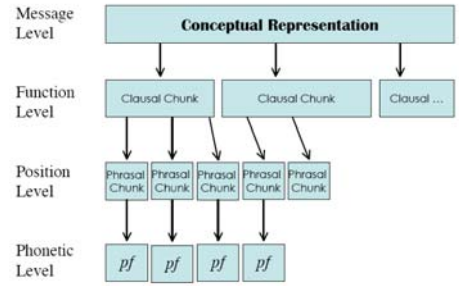
Processing Increments: The incremental theory



Processing Increments: The incremental theory



Processing Increments: The incremental theory



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

$\exists x \exists y \exists^{mult} z$ (*Past*[YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

↓

Function Level Representation

Mapping content onto form: Function Level Representation

$\exists x \exists y \exists z$ (*Past*[YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

↓

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

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

Mapping content onto form: The Garrett Model

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

- 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

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

- 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)

- Frame construction is done in **clausal chunks**
- Slots in the frame specify the category of Open Class elements (N,V,Adj)
- Function words & Inflections (Closed Class elements) are marked as features on the frame

Mapping content onto form: Lemma Selection

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], *fey*

Mapping content onto form: Lemma Selection

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], *fey*

BOOK, Noun, [—], *fax*

Mapping content onto form: Lemma Selection

$\exists x\, \exists y\, \exists z$ (*Past* [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], *fey*

BOOK, Noun, [—], *fax*

CLASS, Noun, [—], *fox*

Mapping content onto form: Lemma Selection

$\exists x\, \exists y\, \exists z$ ($\mathcal{P}_{past}$ [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], f_{GIRL}

BOOK, Noun, [—], f_{BOOK}

CLASS, Noun, [—], f_{CLASS}

CARRY, Verb, [— NP_i PP_k], <ag, th_j, go_k>, $f_{\alpha\beta}$

Mapping content onto form: Frame Construction

$\exists x\, \exists y\, \exists z$ ($\mathcal{P}_{past}$ [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

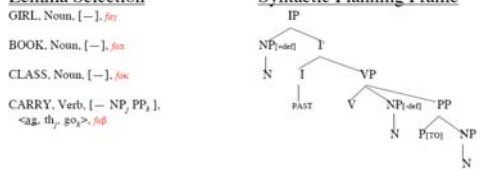
Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], f_{GIRL}

BOOK, Noun, [—], f_{BOOK}

CLASS, Noun, [—], f_{CLASS}

CARRY, Verb, [— NP_i PP_k], <ag, th_j, go_k>, $f_{\alpha\beta}$



Mapping content onto form: Linking Lemmas to "Slots"

$\exists x\, \exists y\, \exists z$ ($\mathcal{P}_{past}$ [YOUTH(x) & FEMALE(x) & HUMAN(x) & BOOK(y) & CLASS(z) & CARRY(agent: x; theme: y; goal: z) & POS(agent: x; theme: z)])

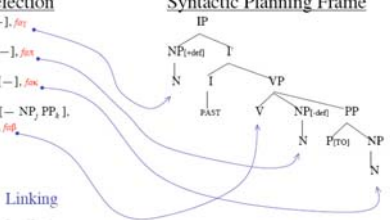
Lemma Selection — Syntactic Planning Frame

GIRL, Noun, [—], f_{GIRL}

BOOK, Noun, [—], f_{BOOK}

CLASS, Noun, [—], f_{CLASS}

CARRY, Verb, [— NP_i PP_k], <ag, th_j, go_k>, $f_{\alpha\beta}$

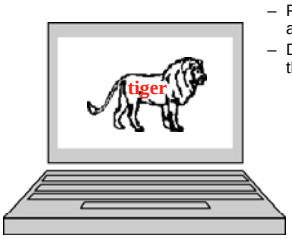


Linking

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?

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

Basic findings

- 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

- 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

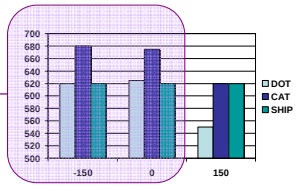
Schriefers, Meyer, and Levelt (1990)

- Auditory presentation of distractors
  - DOT phonologically related
  - CAT semantically related
  - SHIP unrelated word
- 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)

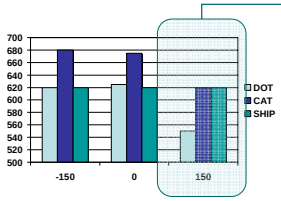
- Auditory presentation of distractors
  - DOT phonologically related
  - CAT semantically related
  - SHIP unrelated word

Early Only Semantic effects



Schriefers, Meyer, and Levelt (1990)

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



Late Only Phonological effects