

Plan

- Speech Errors (Review)
- Issues in Lexicalization
- LRP in Language Production (Review)
- N200 (N2b)
- N200 in Language Production
- Semantic vs. Phonological Information
- Semantic vs. Syntactic Information
- Syntactic vs. Phonological Information
- Time Course of Word Production in Picture Naming

Eech Sperrors

- What can we learn from these things?
- Anticipation Errors
 - a reading list → a leading list
- Exchange Errors
 - fill the pool → fool the pill
- Phonological, lexical, syntactic
- Speech is planned in advance
 - Distance of exchange, anticipation errors suggestive of how far in advance we “plan”

Word Substitutions & Word Blends

- Semantic Substitutions
 - That's a horse of another color
→ ...a horse of another race
- Phonological Substitutions
 - White Anglo-Saxon Protestant
→ ...prostitute
- Semantic Blends
 - Edited/annotated → editated
- Phonological Blends
 - Gin and tonic → gin and topic
- Double Blends
 - Arrested and prosecuted → arrested and persecuted
- Lexicon is organized semantically AND phonologically
- Word selection must happen after the grammatical class of the target has been determined
 - Nouns substitute for nouns; verbs for verbs
 - Substitutions don't result in ungrammatical sentences



Word Stem & Affix Morphemes

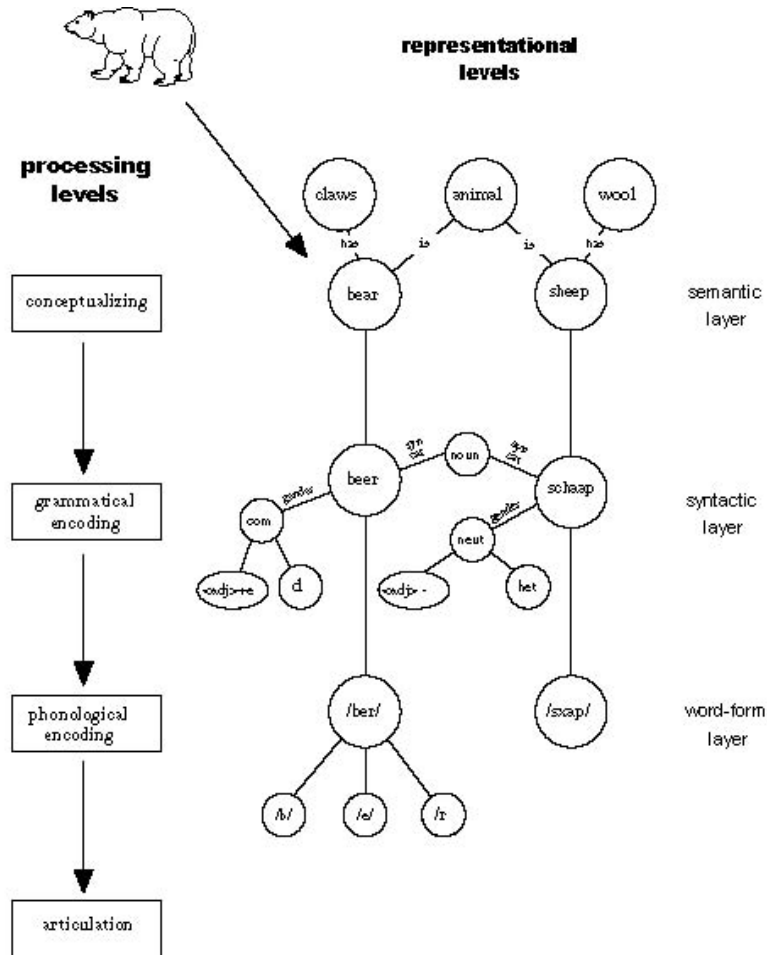
- A New Yorker → A New Yorkan
(American)
- Seem to occur prior to lexical insertion
- Morphological rules of word formation engaged during speech production



Stranding Errors

- Nouns & Verbs exchange, but inflectional and derivational morphemes rarely do
 - Rather, they are stranded
- I don't know that I'd know one if I heard it → I don't know that I'd hear one if I knew it
 - Heard and Know have exchanged
 - Present tense marker remains after "I'd"
 - Past tense marker remains on the word before "it"
- I hopeD he would like Chris → I likeD he would hope Chris
 - D is stranded when like/hope exchange
- Not: The boyS are goING → the boyING are goES
- Inflectional and derivational morphemes stored/processed differently than words and word stems (such that they don't exchange)

Levelt and Colleagues Model



- Image
- Lexical or Concept Level
 - Stored information about bears
 - Related concepts stored close
 - These can be co-activated by thought or image
- Lemma Level
 - Syntactic information
 - Competition among all activated items
- Lexeme Level
 - Match syntactic elements from lemma to sounds
 - Syllables, stress, rhythm, intonation
- Message goes to formulator for grammatical encoding
 - Lemmas: Semantic & Syntactic
- Phonological Encoding
 - Lexemes
- Articulator

Plan

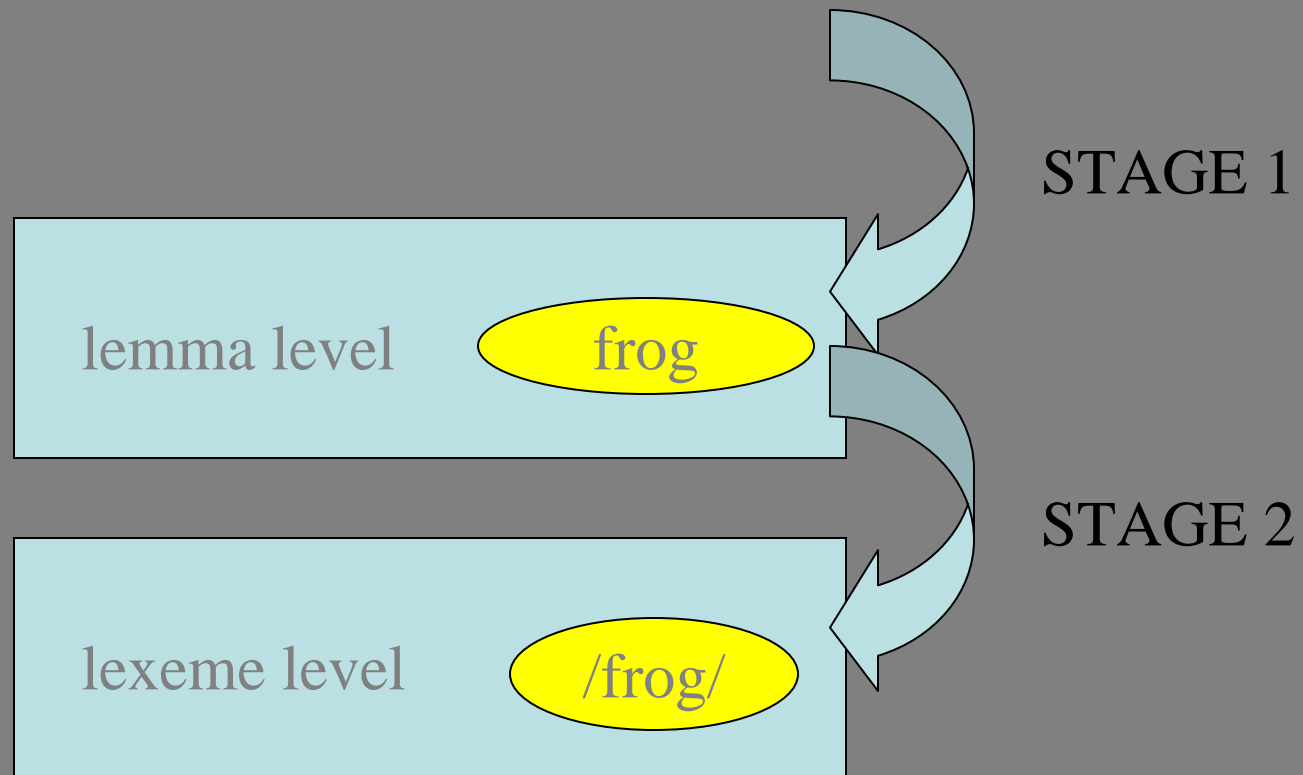
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Lexicalization: central issues

- ❖ Lexicalization: The process in speech production whereby we turn the thoughts that are underlying words into sounds.
- ❖ How do we select the words we select?
 - ❖ a: How many stages are there?
 - ❖ b: Are the stages discrete or cascading?
 - ❖ c: Is there feedback in lexicalization: interactive or not?

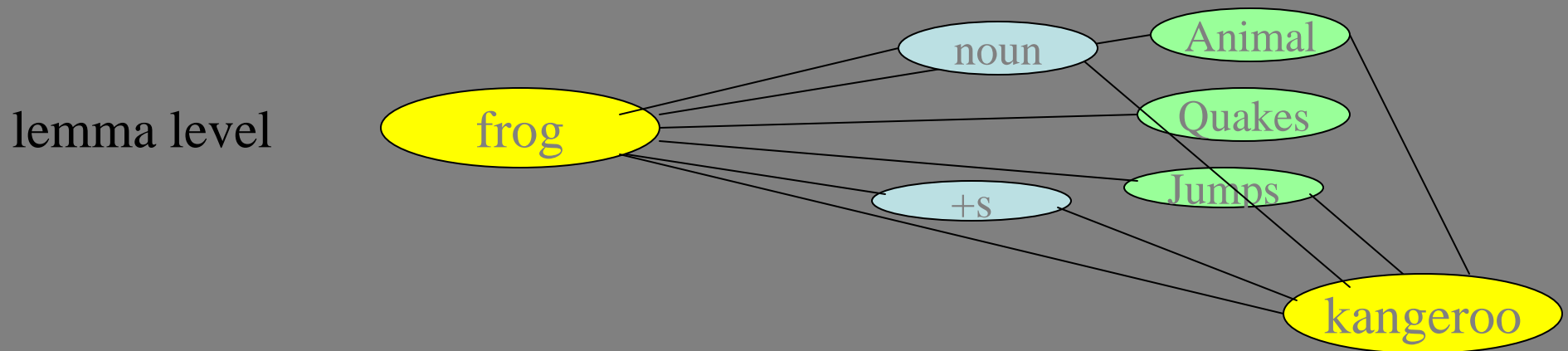
Lexicalization: central issues

a: How many stages are there? (Levelt, 2)



Lexicalization: central issues

Speech error evidence for the 2-stage model

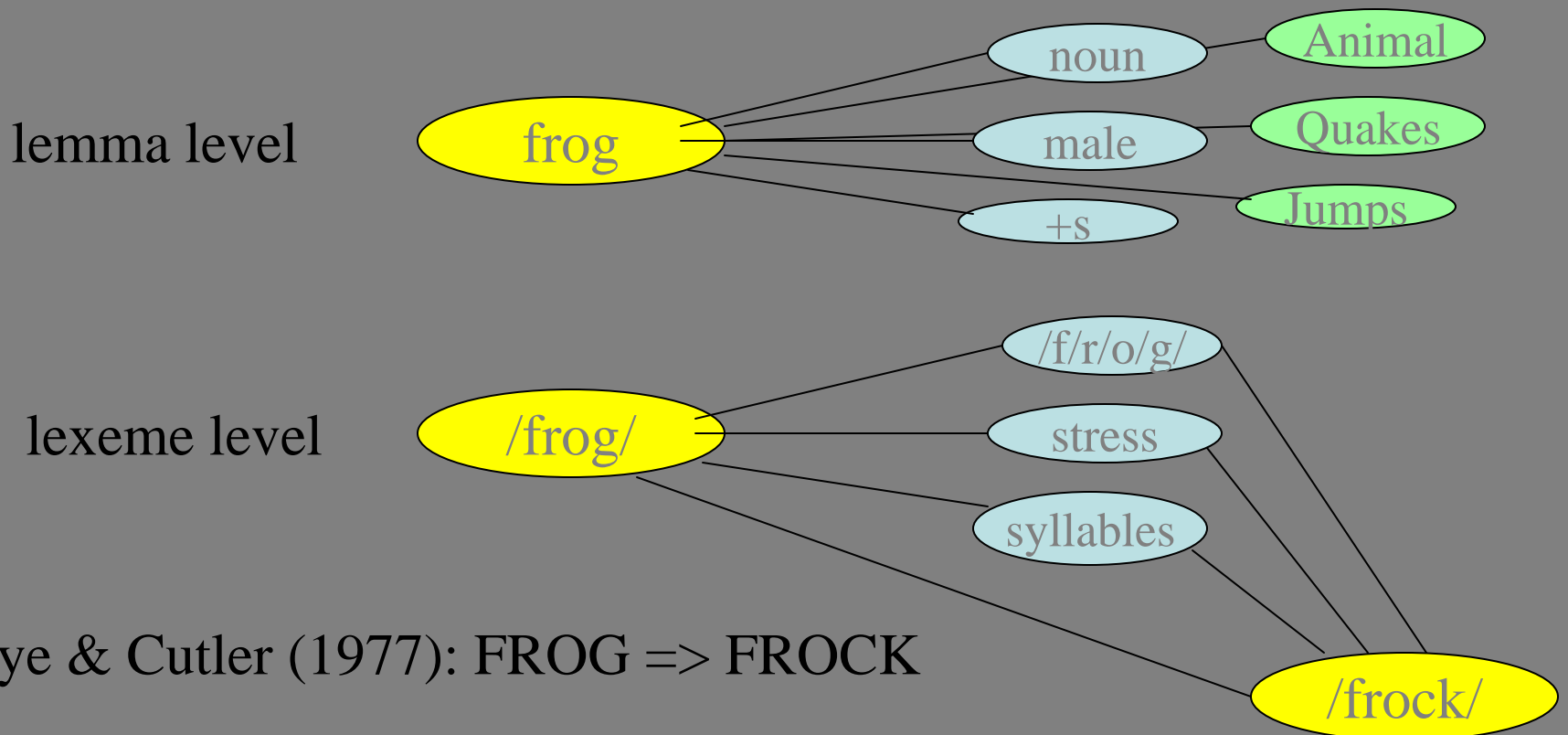


Faye & Cutler (1977): FROG => CANGEROO

LEXICAL SELECTION ERROR – SEMANTIC SUBSTITUTION

Lexicalization: central issues

Speech error evidence for the 2-stage model



Faye & Cutler (1977): FROG => FROCK

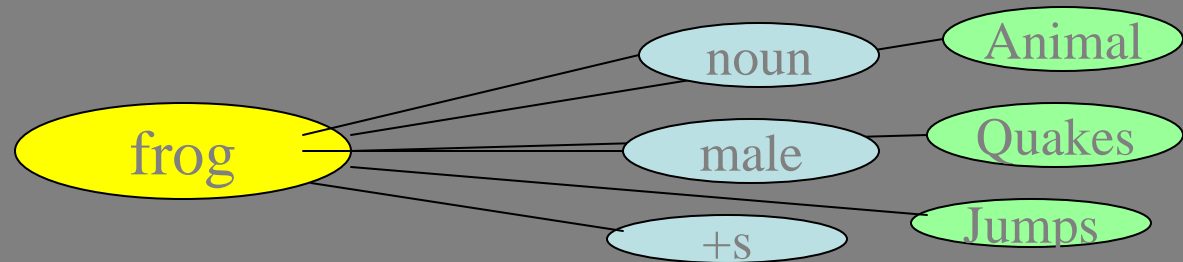
LEXEME/PHONOLOGICAL FORM SELECTION ERROR

FORM_BASED SUBSTITUTION

Lexicalization: central issues

Temporal evidence for the 2-stage model
stage 1: => lemma

lemma level

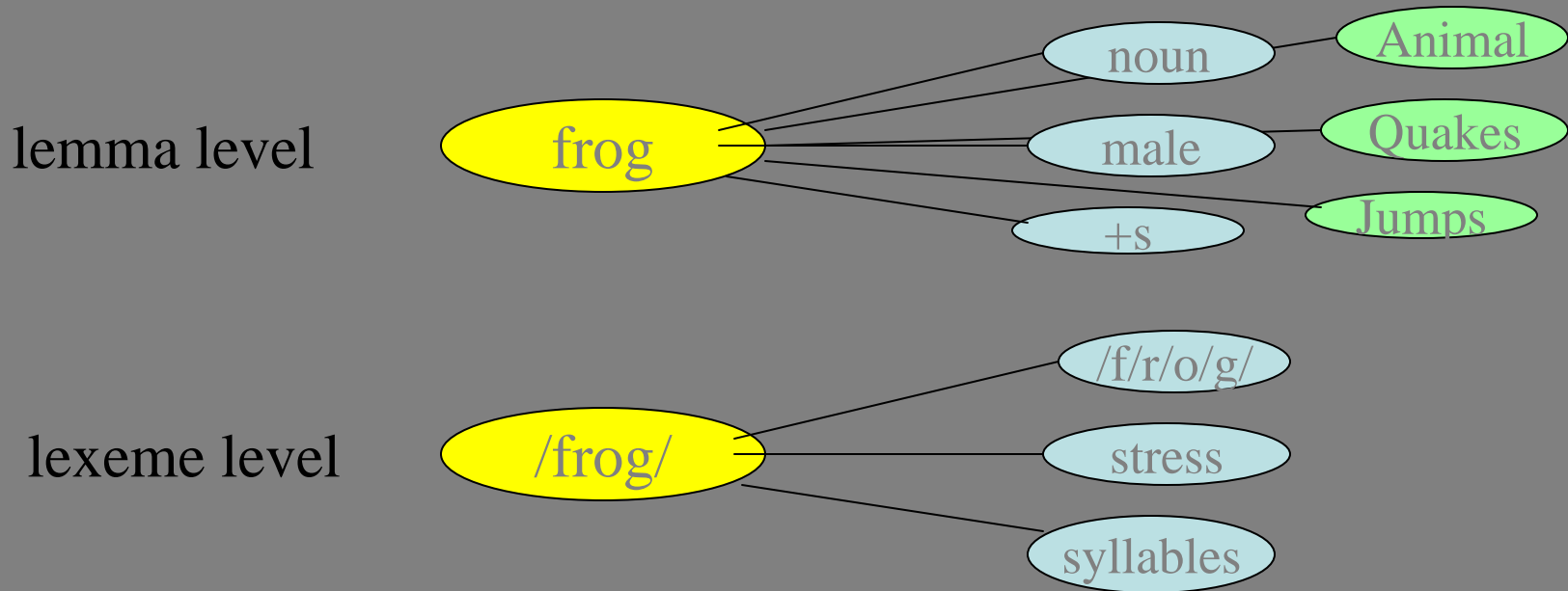


Levelt et al. (1991): EARLY PRIMING: CANGEROO => FROG



Lexicalization: central issues

Temporal evidence for the 2-stage model
stage 2: lemma => lexeme

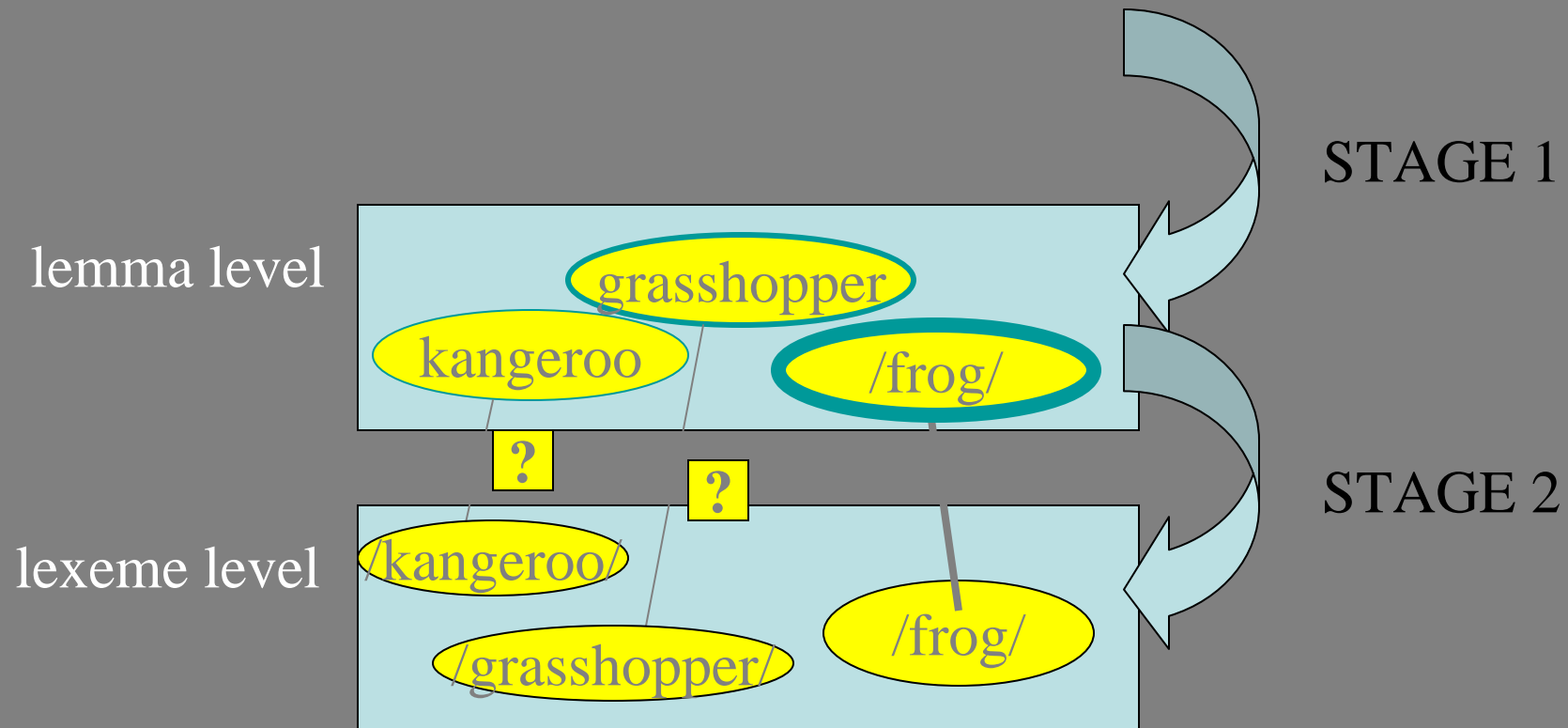


Levelt et al. (1991): LATE PRIMING: FROCK => FROG



Lexicalization: central issues

b: Are the stages discrete or cascading?

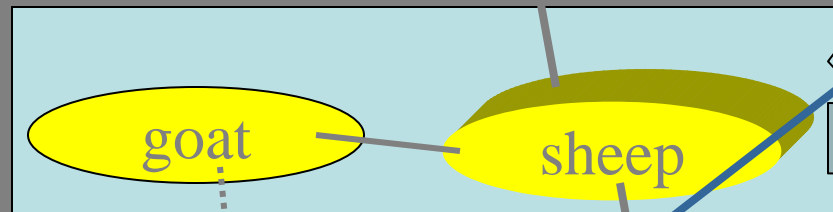


Lexicalization: central issues

b: Discrete vs. cascading put to the test: the mediated priming paradigm ?

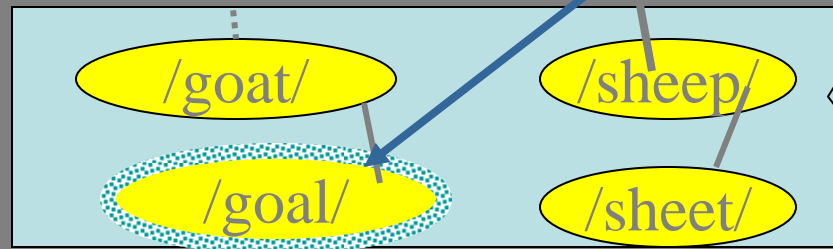


lemma level



STAGE 1

lexeme level

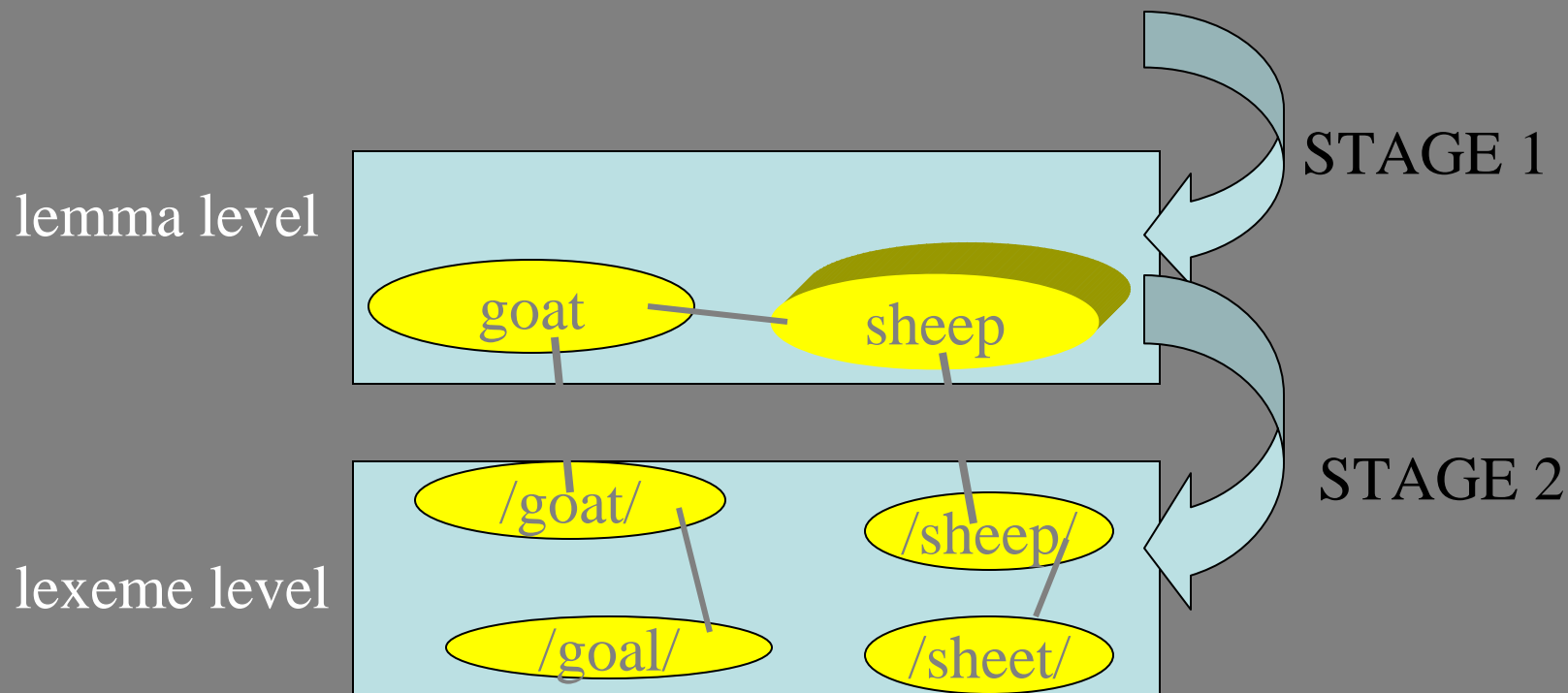


STAGE 2

Does sheep prime goal?

Lexicalization: central issues

a: Discrete vs. cascading put to the test: the mediated priming paradigm



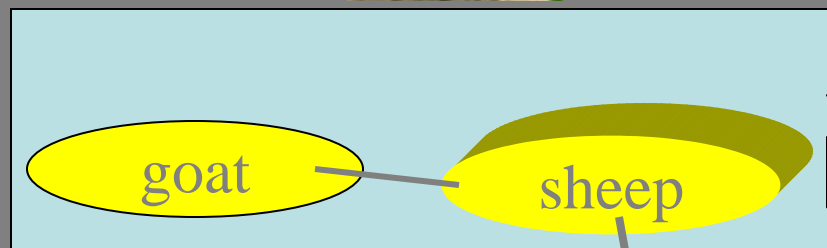
Does sheep prime goal? Cascaders would say yes

Lexicalization: central issues

a: Discrete vs. cascading put to the test: the mediated priming paradigm

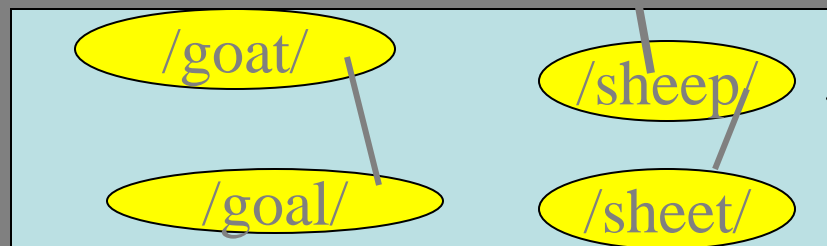


lemma level



STAGE 1

lexeme level

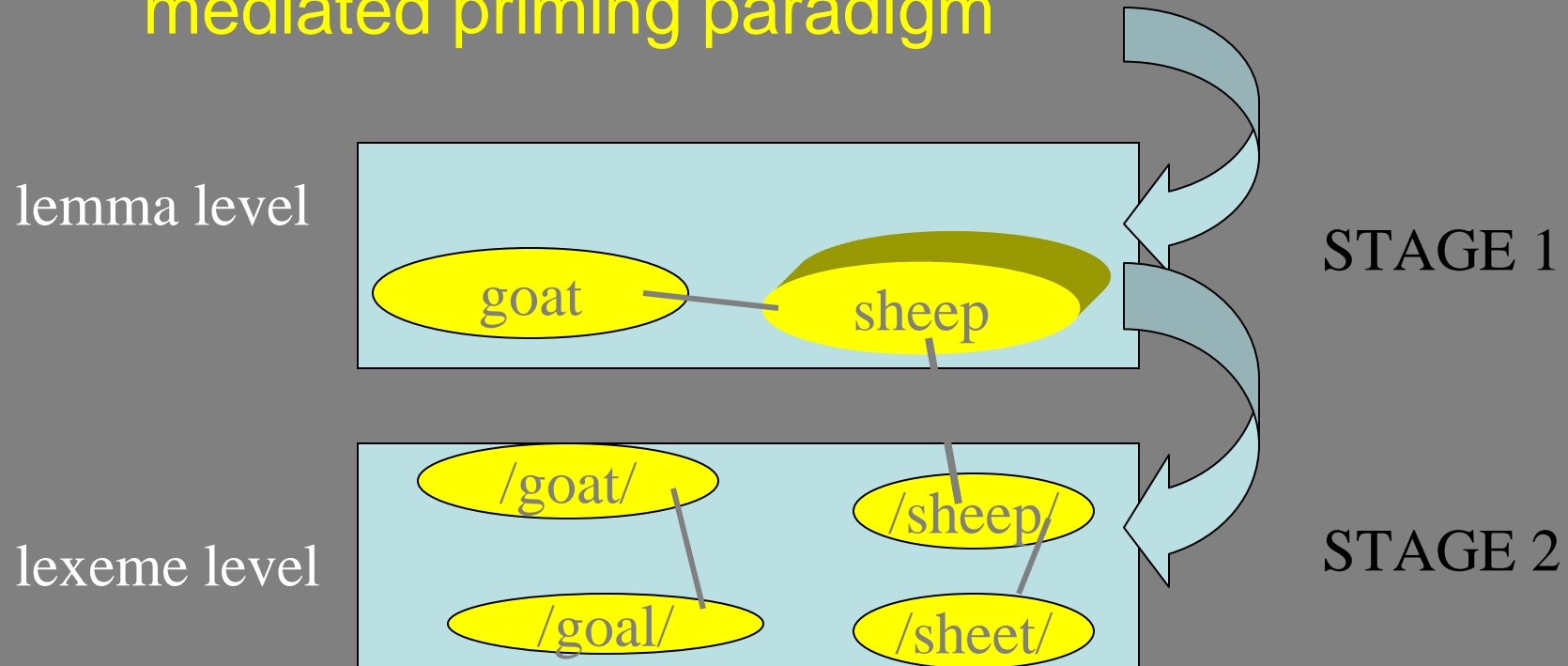


STAGE 2

Does sheep prime goal? Discreters would say no

Lexicalization: central issues

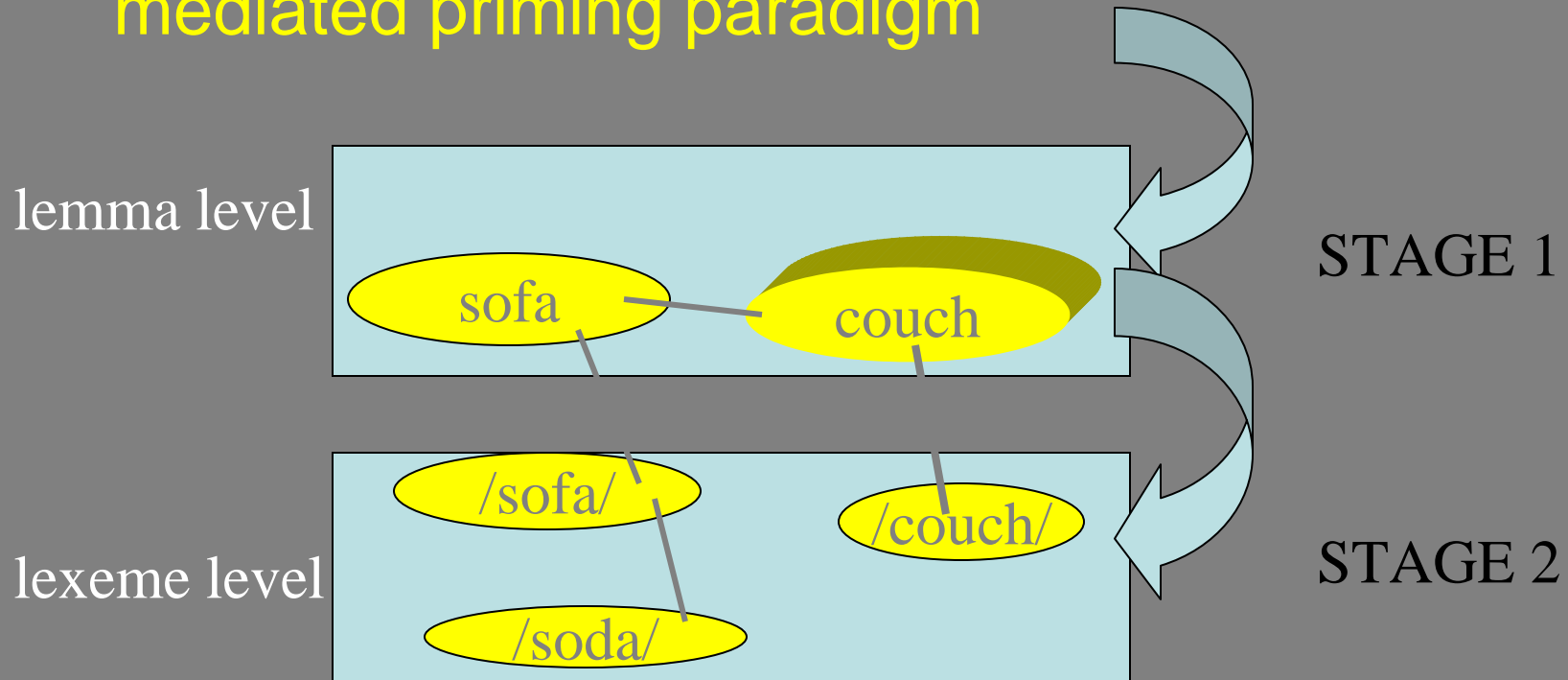
a: Discrete vs. cascading put to the test: the mediated priming paradigm



Levelt (1991): mediated priming doesn't work

Lexicalization: central issues

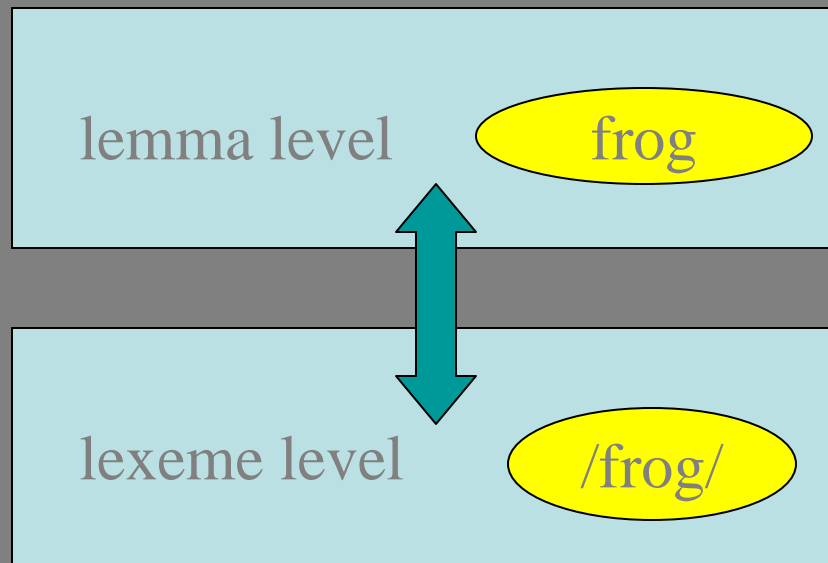
a: Discrete vs. cascading put to the test: the mediated priming paradigm



Peterson & Savoy (1998): Yes it does: couch primes soda via sofa
sheep – goat: categorical associates
sofa – couch: near synonyms

Lexicalization: central issues

c: Are the stages interactive? (Levelt, no; Dell, Laine, yes)



The lexical bias phenomenon

ball doze

bash door

bean deck

bell dark

darn bore

RESPOND

big dutch

bang doll

bill deal

bark dog

dart board

RESPOND

Semantic: barn door darn bore

phonological



error % 30%

10%

- Increase speech rate and phenomenon disappears interactive models can explain this by posing that the activation feed-back mechanism takes time.
- Also blend errors, being more common than one-level errors, speak for interactivity. Cat-Rat more common than Cat-Dog
- Levelt: errors don't tell the real thing, real-time picture naming more accurate in catching the normal lexicalization process

Lexicalization: in sum

❖ Lexicalization: The process in speech production whereby we turn the thoughts that are underlying words into sounds.

❖ a: How many stages are there? 2

❖ b: Are the stages discrete or cascading? ??

❖ c: Is there feedback in lexicalization: interactive? ??

❖ As often, central issues under hot debate

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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

design

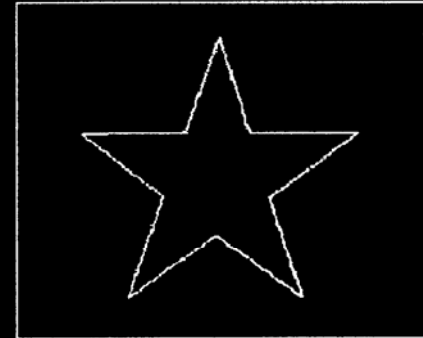
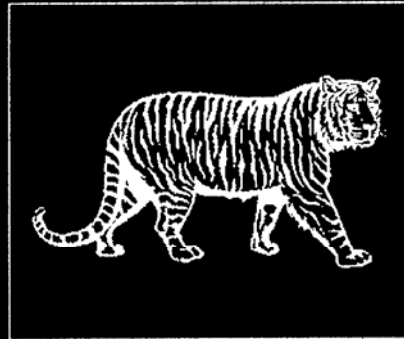
SEMANTICS

left hand
animal

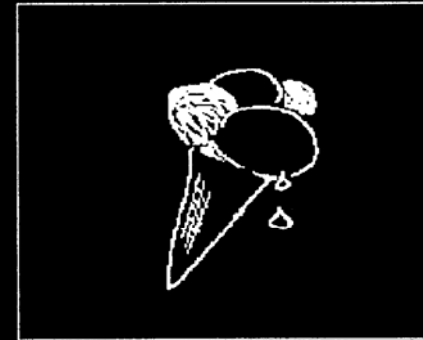
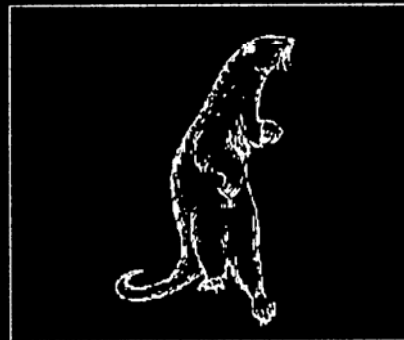
right hand
object

PHONOLOGY

go
word initial
consonant



no go
word initial
vowel



LRP: two major conditions

hand = semantics

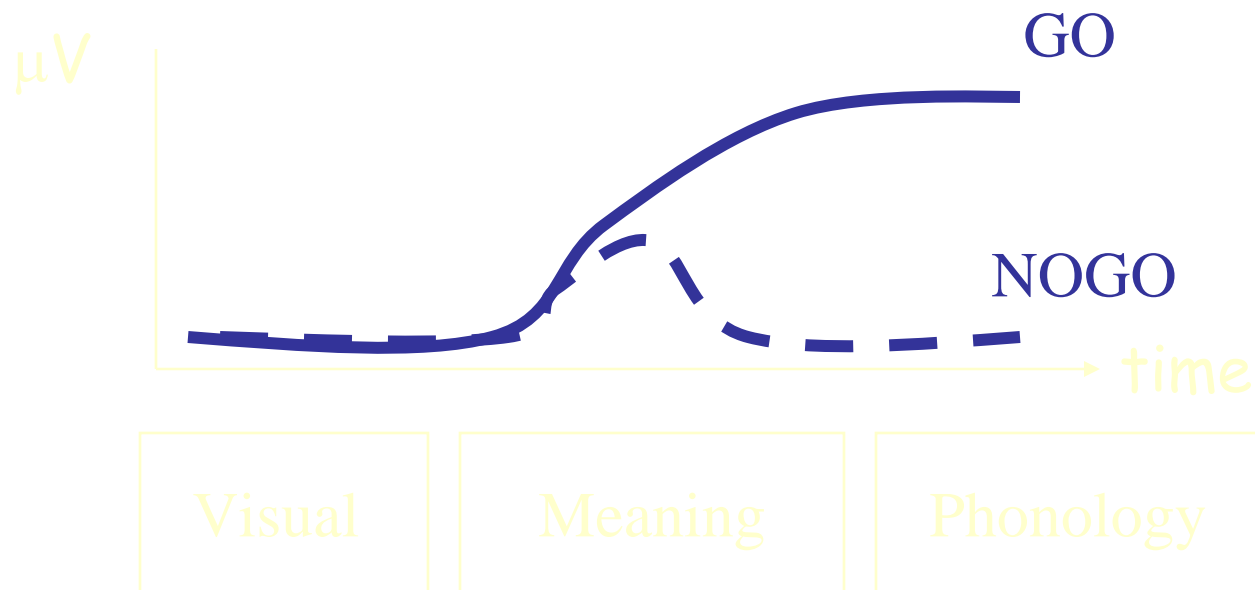
- left/right hand response preparation on **semantics**
- go/nogo decision contingent on **phonology**

hand = phonology

- left/right hand response preparation on **phonology**
- go/nogo decision contingent on **semantics**

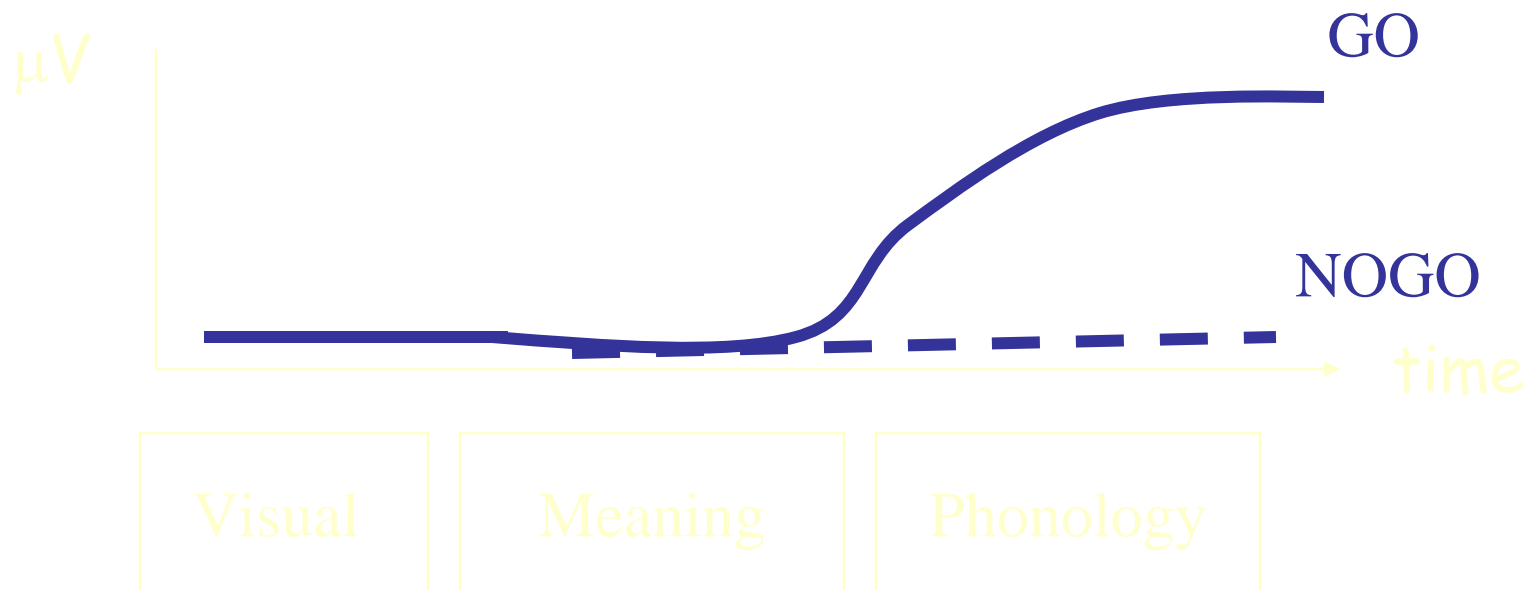
LRP Hypothesis

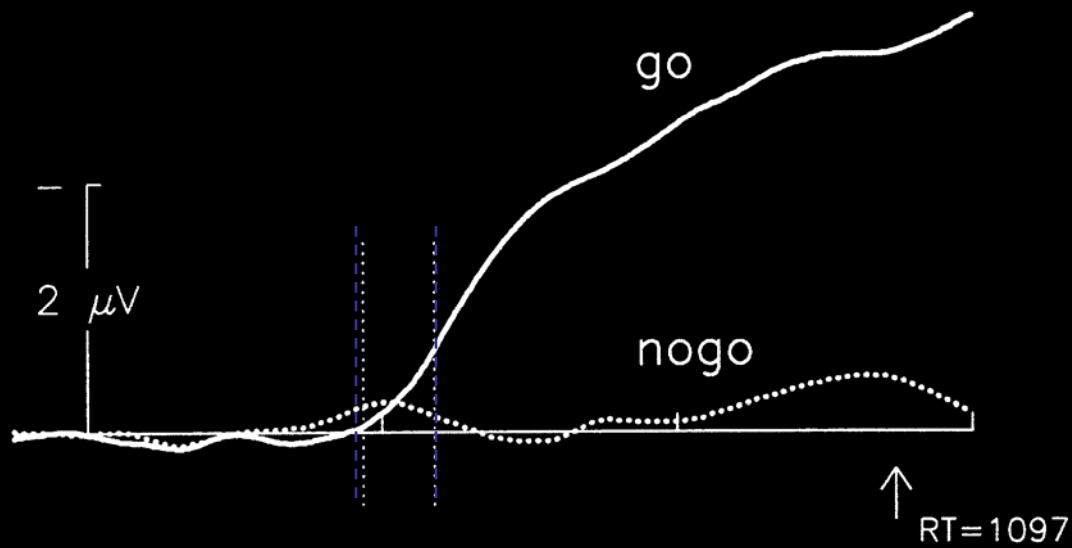
- hand = semantics
- if semantics precedes phonology LRP even on nogo trials



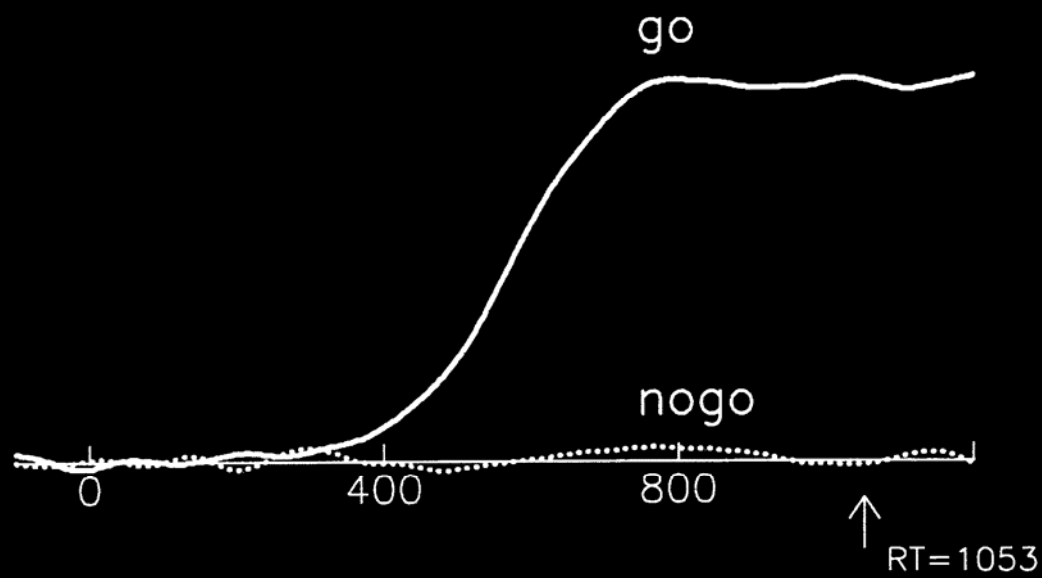
LRP Hypothesis

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





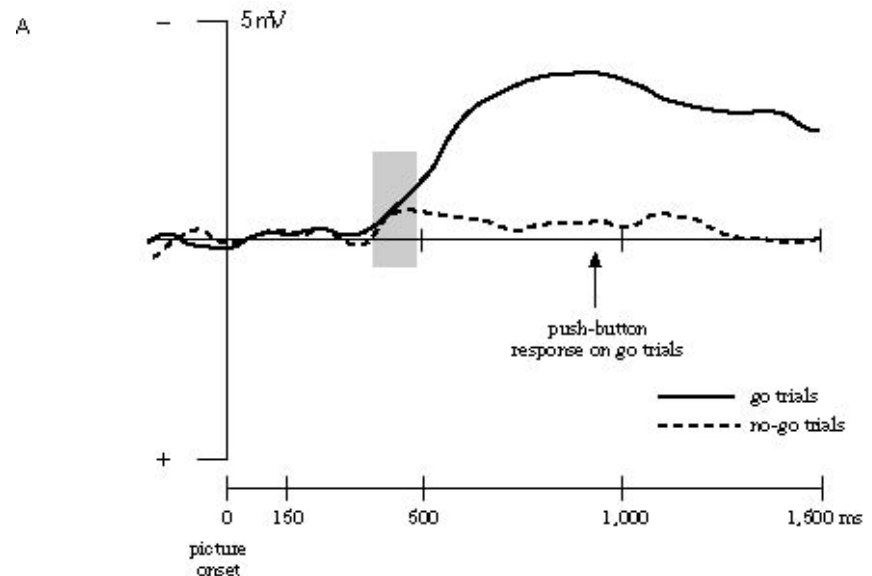
hand=semantics
go/nogo=phonology



hand=phonology
go/nogo=semantics

Time Course of Phonological Encoding

- When go-nogo decision based on *first* phoneme of word, nogo LRP lasted 40 ms
- When go-nogo decision based on *final* phoneme of word, nogo LRP lasted 120 ms (right)
- Phonological encoding proceeds left-to-right



Plan

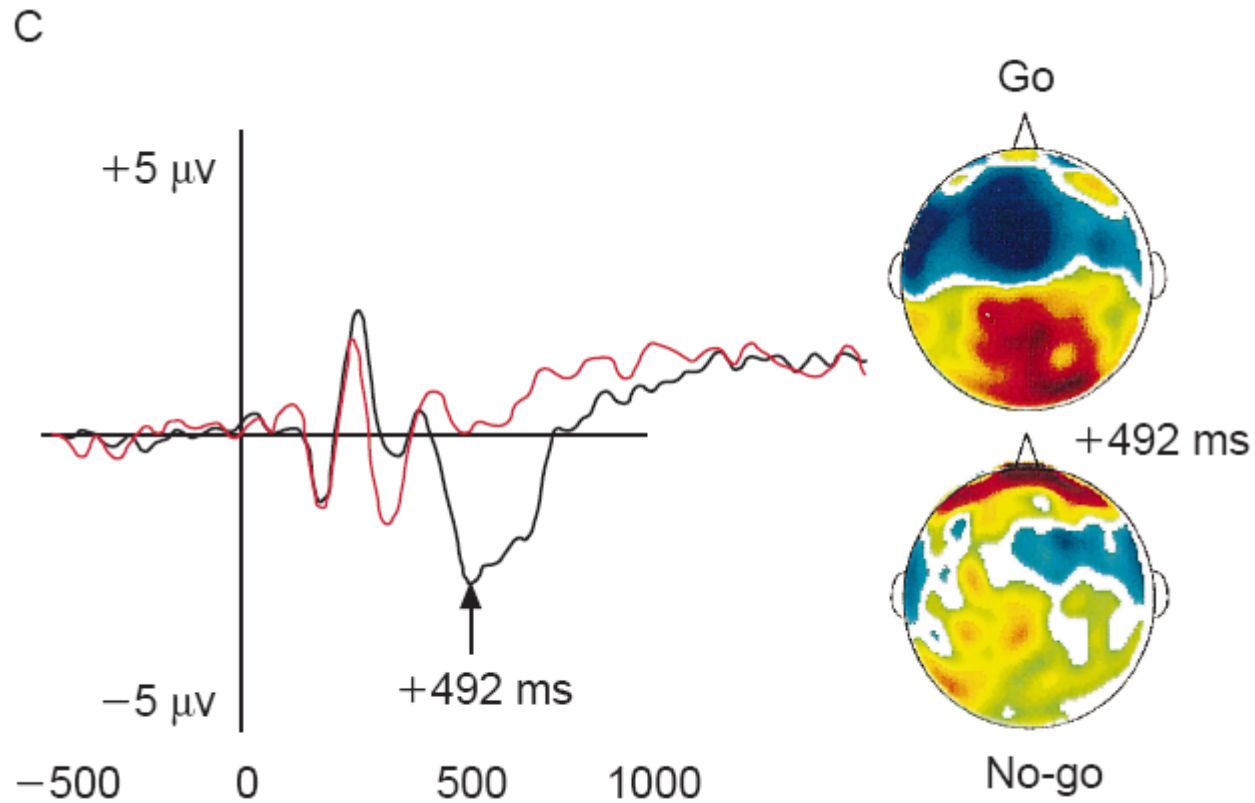
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Second ERP component: N200

- go/nogo paradigm
- enhanced negativity for nogos compared to gos
- maximum at frontal sites
- related to response inhibition
 - Sasaki and Gemba, 1989, 1993
 - Single cell recordings in monkeys

Jackson, Jackson, & Roberts (1999)

- P300 Go/N200 NoGo



Jackson et al. (1999)

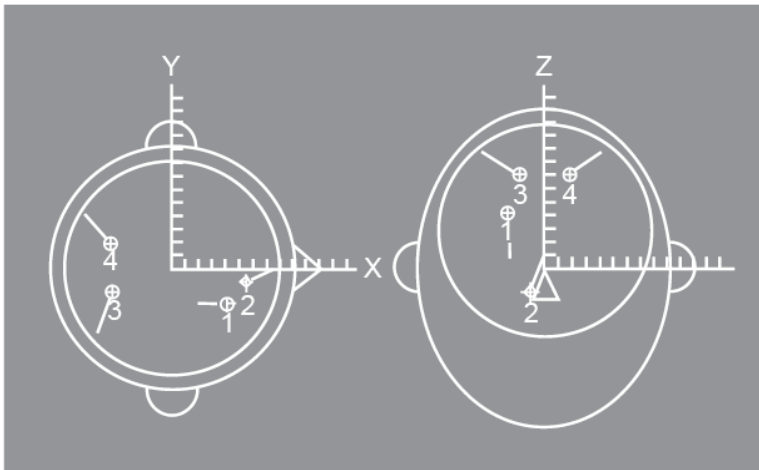


FIG. 3. Dipole locations and orientations resulting from the source analysis carried out on the grand averaged three dimensional no-go condition. Each dipole has a position in a Cartesian frame measured in metres. The tail originating from each dipole indicates the orientation of that dipole (the direction of the tail indicates the direction of the positive end of the dipole). Tick marks within the figure correspond to centimetre divisions.

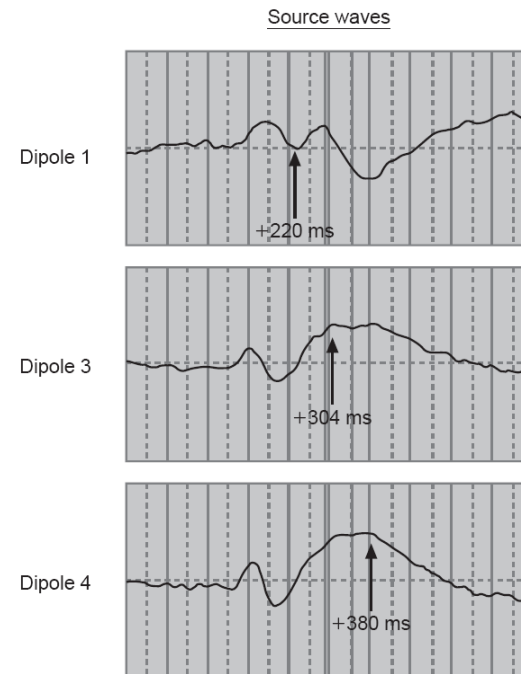


FIG. 4. Estimated source waveforms for dipoles 1, 3 and 4.

- Dipoles 3 & 4 localized to parietal cortex (3 in LH and 4 in RH)
 - Contribute to P300
- Dipole 1 localized to inferior frontal lobe in RH
 - Coincident with N2

ACC Generator

Cognitive, Affective, & Behavioral Neuroscience
2003, 3 (1), 17-26

NIEUWENHUIS, YEUNG, VAN DEN WILDENBERG, AND RIDDERINKHOF

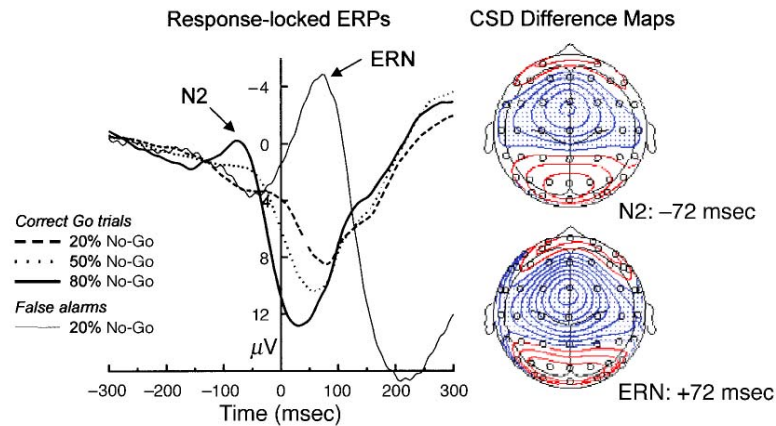


Figure 2. Left panel: response-locked ERPs at electrode FCz for correct go trials for each task condition and for false alarms in the 20% no-go condition. Time = 0 msec indicates the timing of the response. The N2 effect, prior to the response, and the ERN, following the response, are clearly visible. Right panel: current source density (CSD) maps of the response-locked difference waves representing the scalp topography of the N2 effect on correct go trials (80% no-go - 20% no-go) and the ERN in the 20% no-go condition (false alarms - correct go trials). Blue regions indicate negative values; red regions indicate positive values. The decrease/increase in CSD values represented by each isopotential line is $0.07 \mu\text{V}/\text{cm}^2$. The N2 and the ERN are both evident as a focal current sink at FCz.

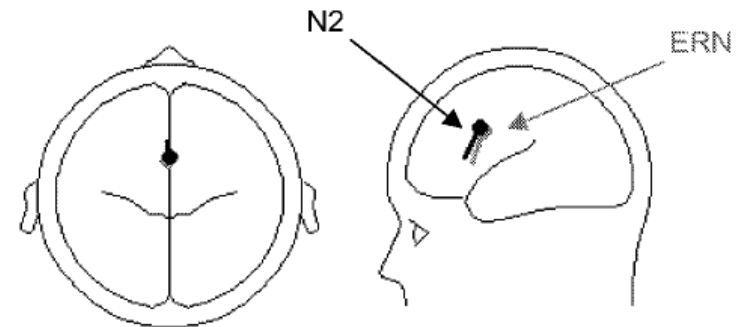


Figure 3. Single-dipole models of the N2 effect and the error-related negativity (ERN) effect in the 20% no-go condition. See the text for further information.

Van Veen & Carter (2005)

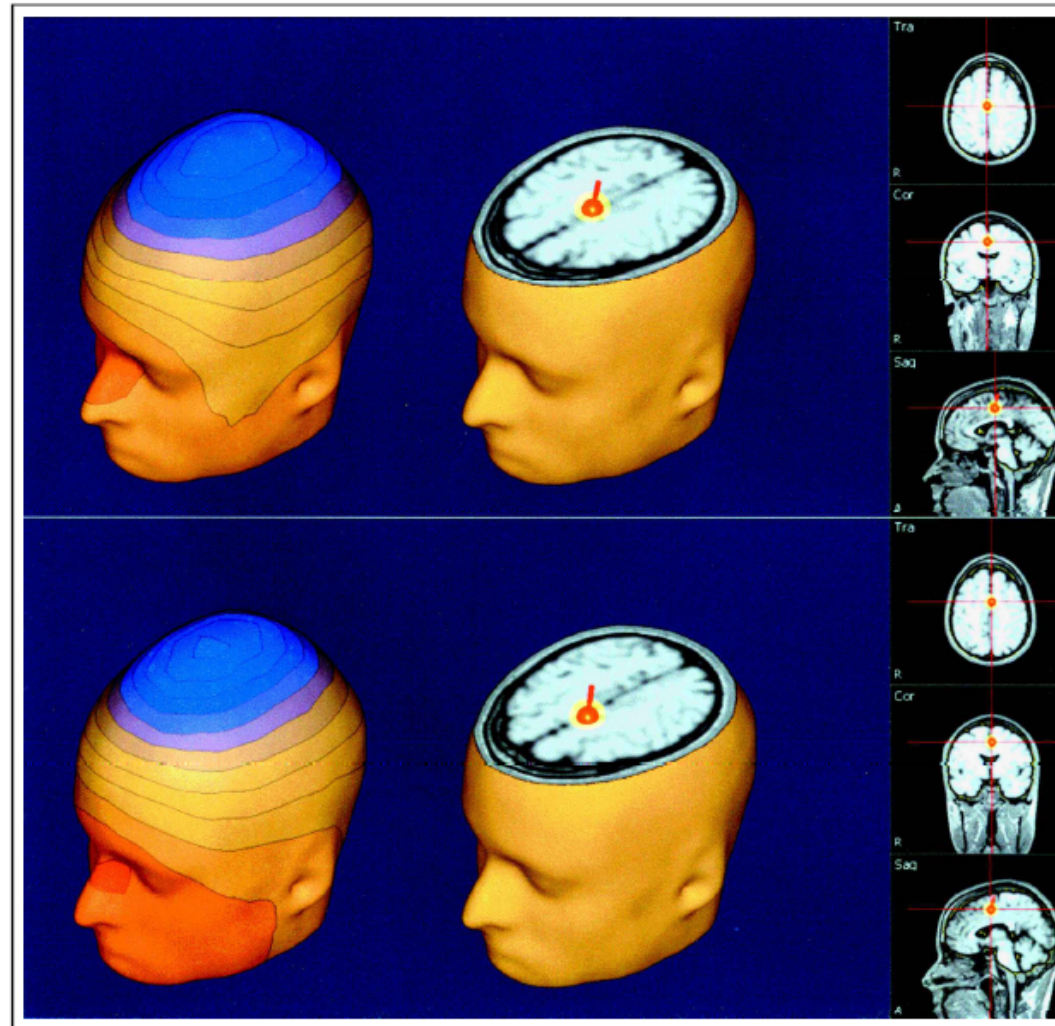


Figure 3. Voltage scalp distribution maps (large, left) and dipole source models (large, right) for the N2 (top) and ERN (bottom), superimposed on a standard realistic, MR-based head model. For each waveform peak, the scalp distribution explained by the dipole model is shown in the small top middle, the residual scalp distribution is shown in the small bottom middle head (blue = more negative; red = more positive). Transversal, coronal, and sagittal views of dipole superimposed on MR-based realistic head model are shown on the right (small). As can be clearly seen from these figures, both dipoles are located in the same region of the ACC.

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N200 in language processing

- nogo - go difference wave
- onset and peak of the effect
- moment in time when specific information is available

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N200 Meaning vs. N200 Sound

- two kinds of information processes
- a meaning process and a sound process
- use pictures to trigger the encoding
- ask participants to decide
 - Is there an animal on the picture or an object?
 - Does the picture's name start with a vowel or a consonant?

N200

design

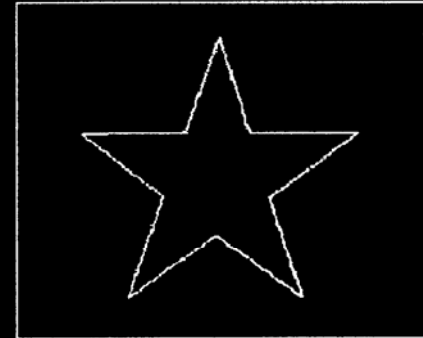
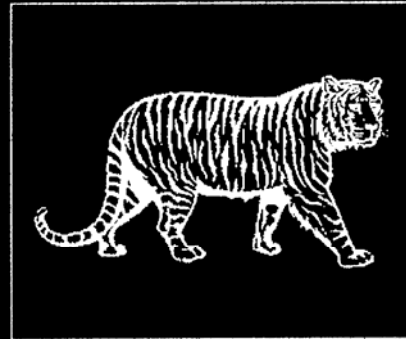
SEMANTICS

left hand
animal

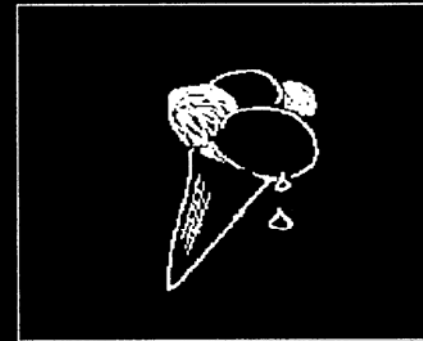
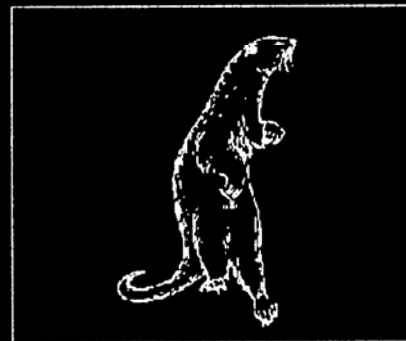
right hand
object

PHONOLOGY

go
word initial
consonant



no go
word initial
vowel

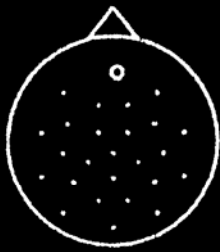


N200 Meaning vs. N200 Sound

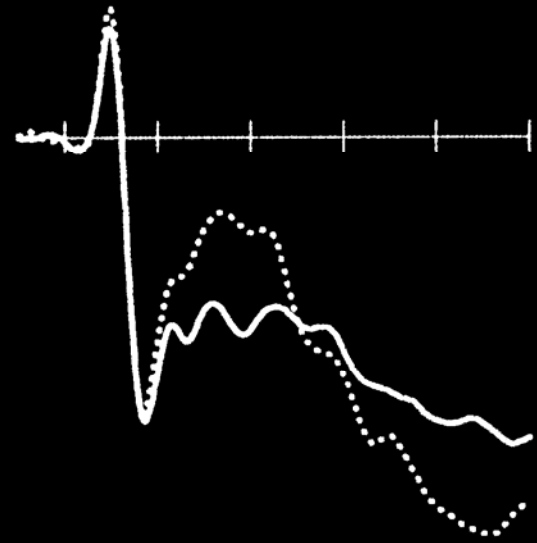
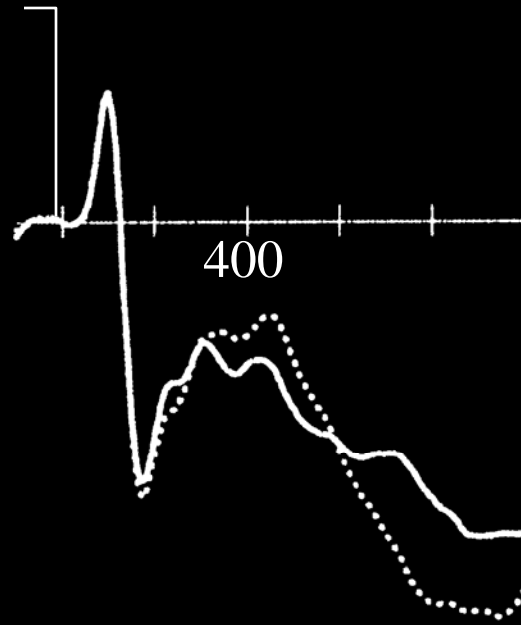
- go and nogo responses based on sound information
- reverse the instruction
- show the same pictures again
- go and nogo responses based on meaning information

GO/NOGO =
PHONOLOGY

GO/NOGO =
SEMANTICS



- 4 μ V

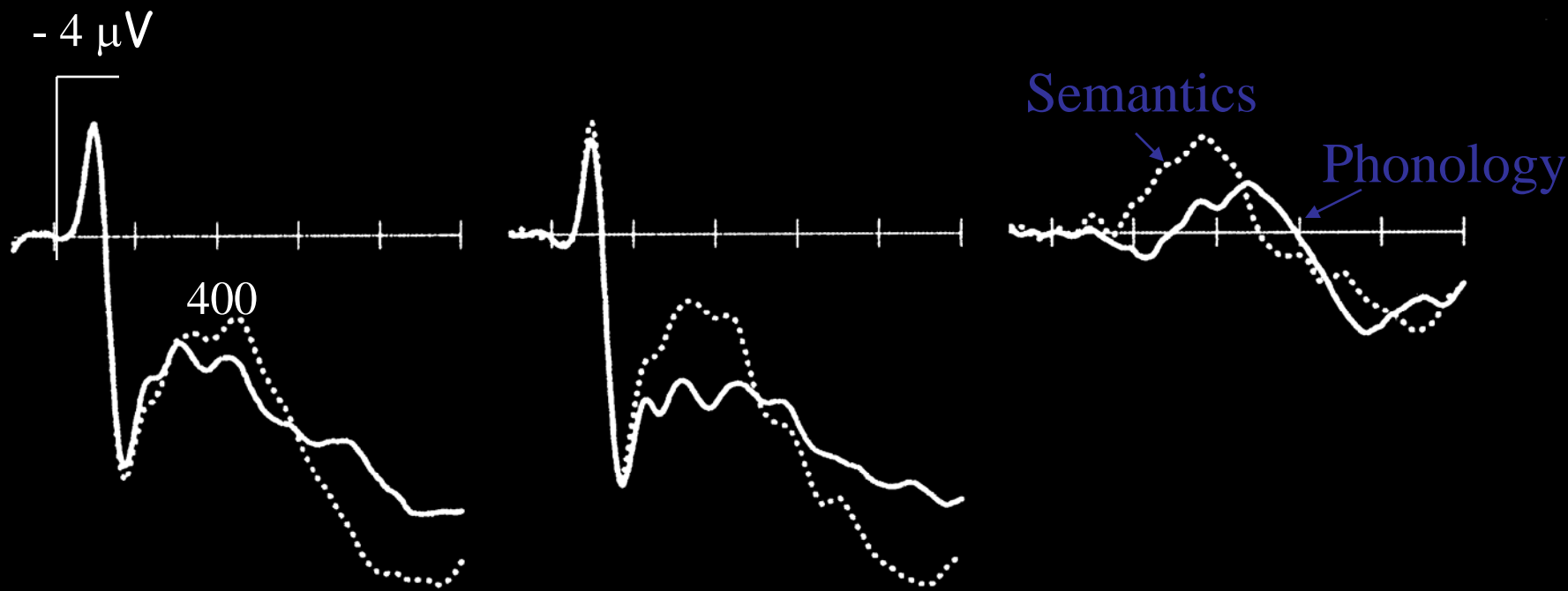


..... NOGO — GO

GO/NOGO =
PHONOLOGY

GO/NOGO =
SEMANTICS

RESPONSE INHIBITION
(NOGO - GO)



..... NOGO — GO

Difference

N200 Conclusions

- N200 peak in go/nogo = semantics around 380 ms
- N200 peak in go/nogo = phonology around 470 ms
- 90 ms head start for semantics
- semantic information available earlier than phonological information during encoding
- N200 data go hand in hand with LRP results

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Semantic vs. Syntactic Info

- **WEAVER++**
 - semantic info available prior to syntactic info during word production
- **Alternatively**
 - semantic and syntactic info available simultaneously during word production

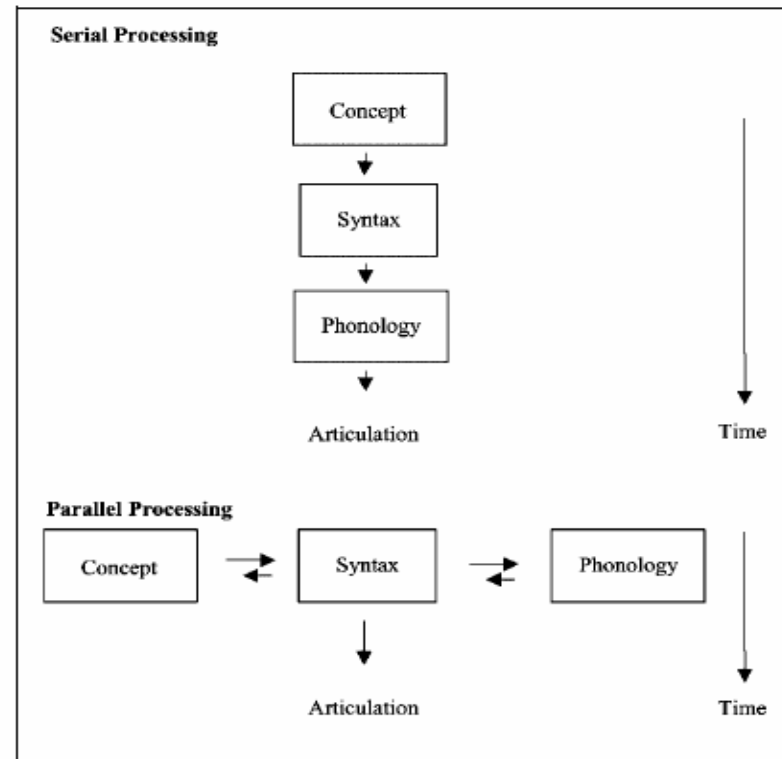


Figure 1. An illustration of parallel processing (after Jackendoff, 1999) and serial processing (after Bock & Levelt, 1994) of conceptual, syntactic, and phonological processing. Arrows indicate information flow.

Schmitt et al. (2001)

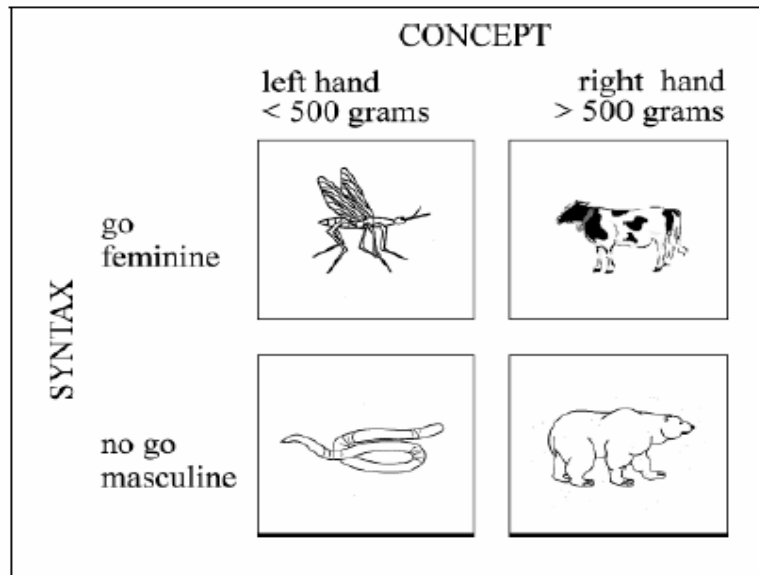
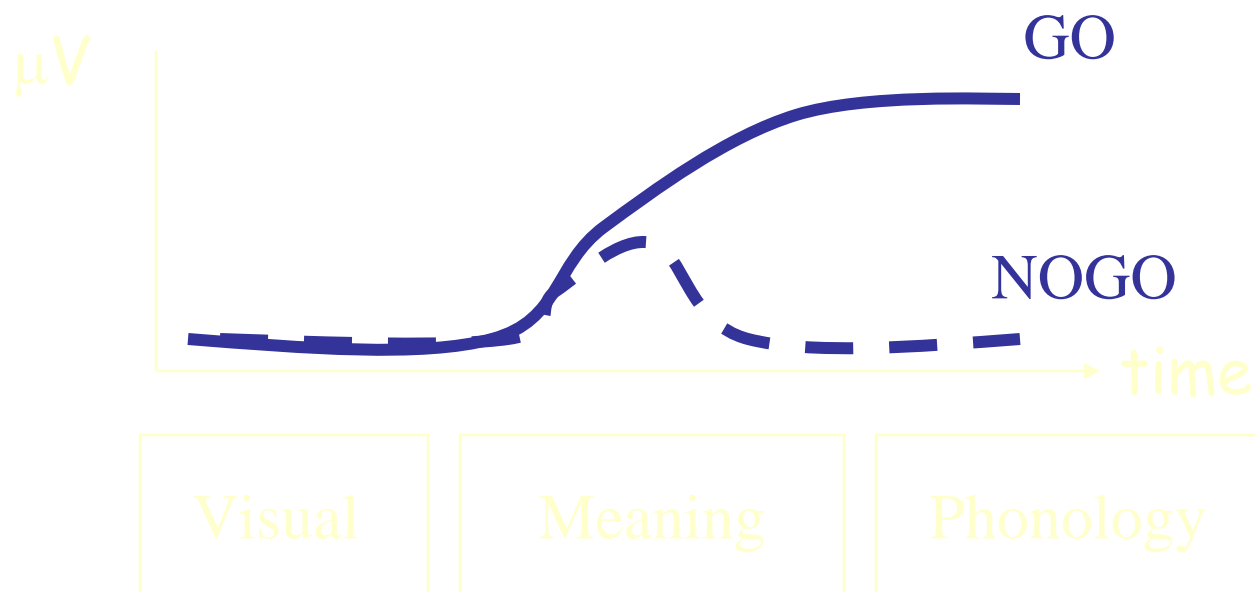


Figure 2. This illustration of the experimental design shows an example from the hand = concept condition. The response hand is contingent on conceptual information. The go/no-go response is contingent on syntactic information. In the hand = syntax condition, the pictures were the same but the response contingencies were reversed: in that case, the response hand would be contingent on syntactic information, and the go/no-go response would be contingent on conceptual information (see also Appendix B for a detailed example).

- Picture naming task
- Go/nogo Decisions
- Semantic
 - Heavier or lighter than 500 grams?
- Syntactic
 - Male or Female Gender (in German)

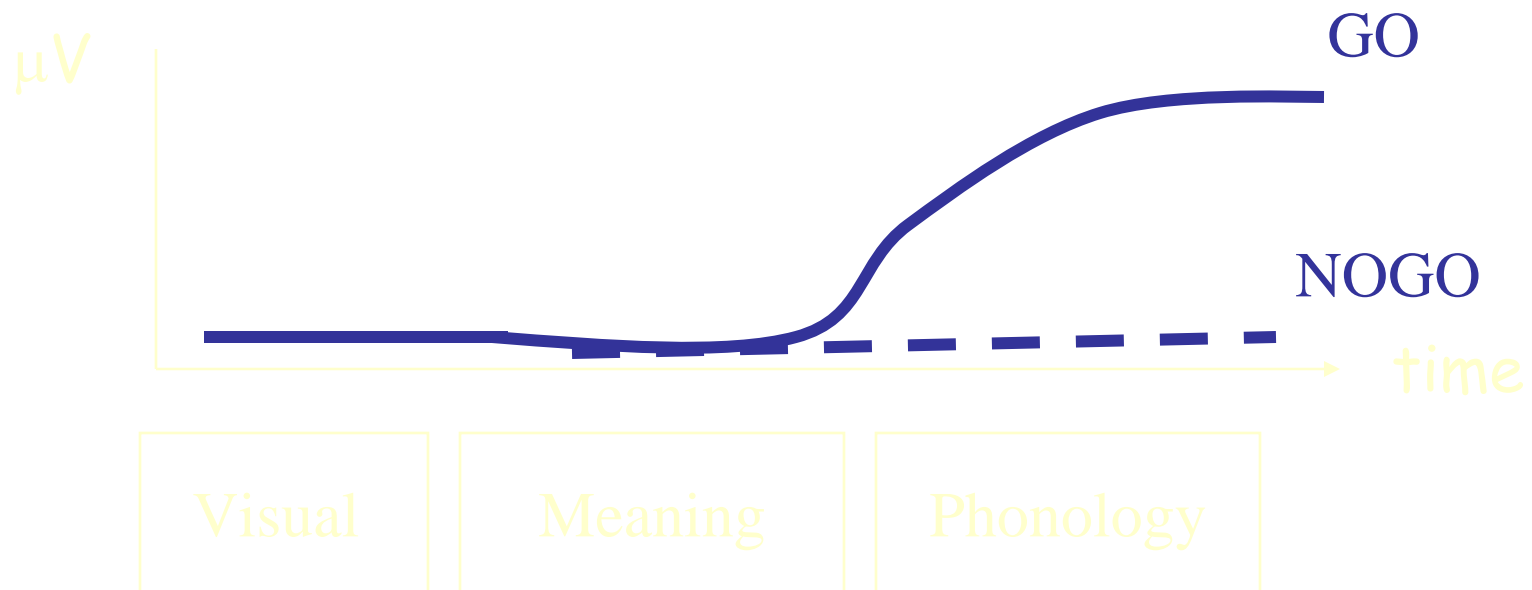
LRP Hypothesis

- hand = semantics
- if semantics precedes syntax LRP even on nogo trials



LRP Hypothesis

- hand = syntax
- if semantics precedes syntax LRP *only* on go trials



N200 Hypothesis

- Semantics = hand
 - NoGo – Go = SemanticsN2
 - Response inhibition due to availability of semantic info
- Syntax = hand
 - NoGo – Go = SyntaxN2
 - Response inhibition due to availability of syntactic info

$$\text{PKL}(\text{SemanticsN2}) < \text{PKL}(\text{SyntaxN2})$$

LRP

- Concept=Hand
 - Teeny weeny NoGo effect
- Syntax=Hand
 - No detectable NoGo effect

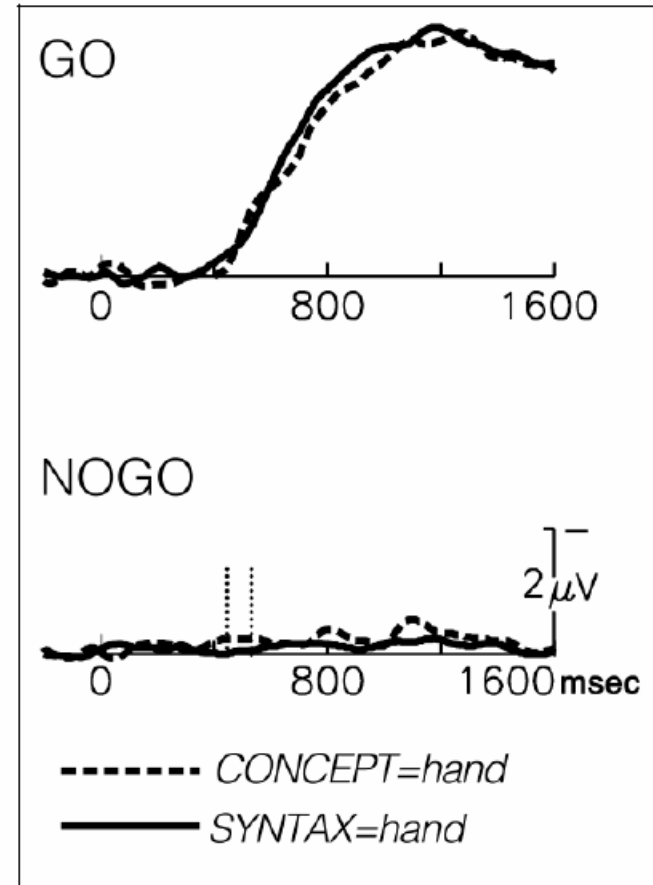


Figure 5. Grand average LRP on go trials (top panel) and no-go trails (bottom panel) in the two dual-choice tasks, involving hand preparation contingent on conceptual or on syntactic information (20 participants, 100 trials per condition, minus rejected trials). The LRP is time-locked to picture onset. The two dashed vertical lines surround the no-go effect in the hand = concept condition.

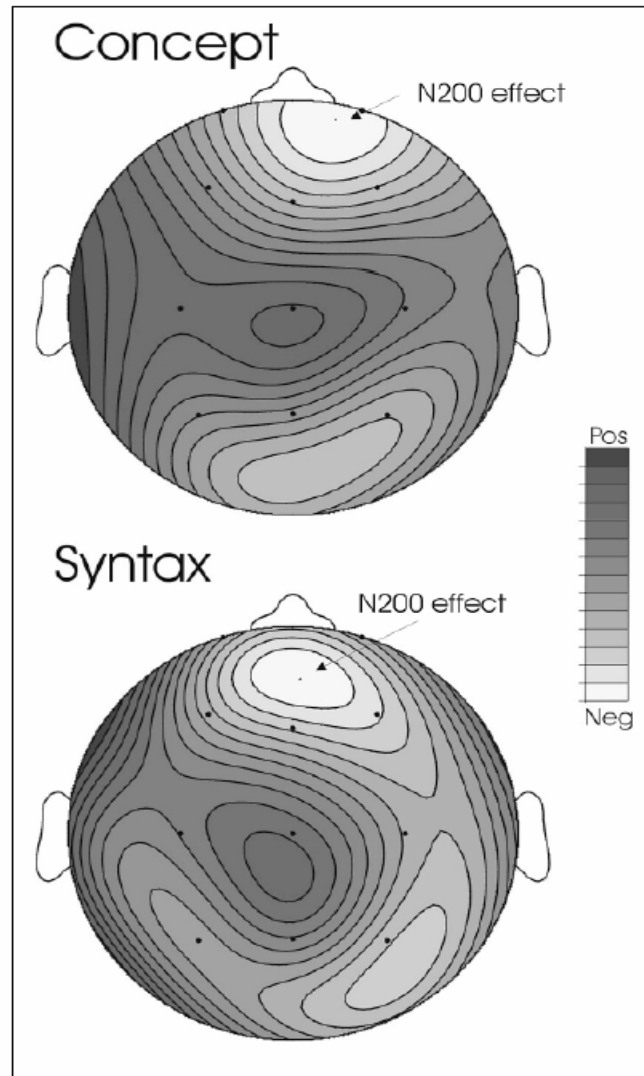
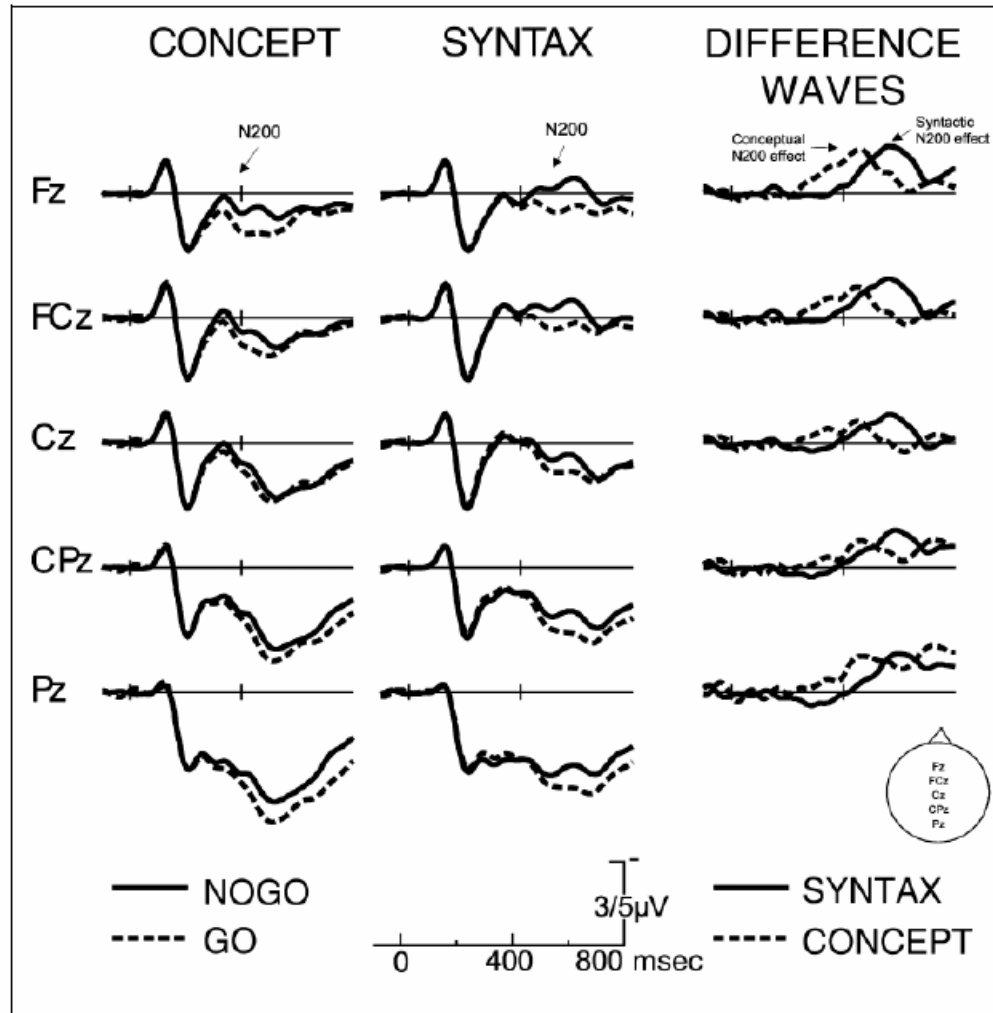


Figure 4. Scalp distribution of normalized mean voltage amplitudes of the two N200 effects. The upper panel shows the N200 effect for the go/no-go = concept condition (mean amplitudes of the time window 420–500 msec after stimulus onset). The lower panel shows the N200 effect for the go/no-go = syntax condition (mean amplitudes of the time window 520–600 msec after stimulus onset). Lighter shades indicate regions of negative voltage amplitudes in the “no-go minus go” difference wave (i.e., the N200 effect). Darker shades indicate regions of positive voltage amplitudes. The electrode locations are marked by black dots. The view is from the top of the head, the triangle (nose) indicates the front of the head.

Figure 3. Grand average ERPs ($n = 20$) on go and no-go trials in the hand = concept condition (left column) and the hand = syntax condition (middle column). The ERPs were time-locked to picture onset. Both conditions are associated with a frontal negativity (N200) that is more negative for no-go than for go trials. In the right column, the “no-go minus go” difference waves (i.e., the N200 effects, interpreted as response inhibition) for the two conditions are shown superimposed. Displayed are data from 20 participants (200 trials per condition per subject, minus rejected trials) over five midline electrodes (from the front [Fz] to the back [Pz] of the head, see head icon for electrode positions). Note that the calibration bar shows $5 \mu\text{V}$ for the left and middle column and $3 \mu\text{V}$ for the difference waves in the right column. Negative voltage is plotted up in this and all subsequent figures.



Plan

- Speech Errors (Review)
- Issues in Lexicalization
- LRP in Language Production (Review)
- N200 (N2b)
- N200 in Language Production
- Semantic vs. Phonological Information
- Semantic vs. Syntactic Information
- **Syntactic vs. Phonological Information**
- Time Course of Word Production in Picture Naming

Van Turenhout, Hagoort, & Brown (1998)

- Is lemma retrieval strictly separated from phonological encoding
- One syntactic feature represented at the lemma level is gender
- So...

Predictions

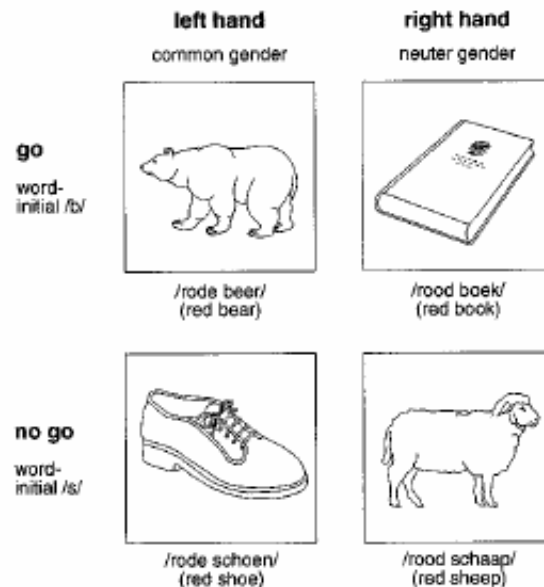


Fig. 1. Examples of the pictures used in the syntactic-phonological categorization task in experiment 1. In the figure, the Dutch picture names are shown below the pictures. The pictures were presented in color, and naming responses included the color adjective, the correct adjectival inflection, and the picture name. The four pictures depicted here represent separate trials for the four experimental conditions. In this example, a common gender word cues a left-hand response, and a neuter gender word cues a right-hand response. The response is executed if the picture name starts with a /b/ (go trials), and it is withheld if the picture name starts with an /s/ (no-go trials).

- Syntax precedes Phonology
- NoGo LRP?
 - Hand=Gender
 - Go/NoGo=Initial Phoneme
- NoGo LRP?
 - Hand=Initial Phoneme
 - Go/NoGo=Gender

Data

Hand=Gender

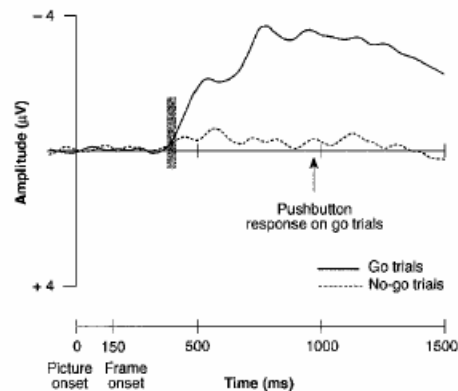


Fig. 3. Grand average ($N = 16$ participants) LRPs on go trials and no-go trials in experiment 1. The syntactic gender decision determined the response hand; the word-initial phoneme decision determined whether a trial was a go or a no-go trial. Significant lateralization of the readiness potential was obtained both on go and on no-go trials from 370 ms after picture onset. The shaded area shows the time interval in which the go and the no-go LRPs were significantly different from the base line, but not from each other. The presence of an LRP for no-go trials means that preparation of a syntactic response has started before phonological information is available to inform the motor system that a response should be withheld. The right border of the shaded area marks the moment (410 ms) at which phonological information leads to the termination of the syntactic response preparation on no-go trials.

Hand=Initial Phoneme

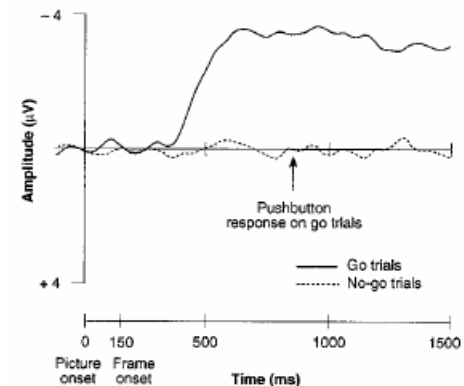
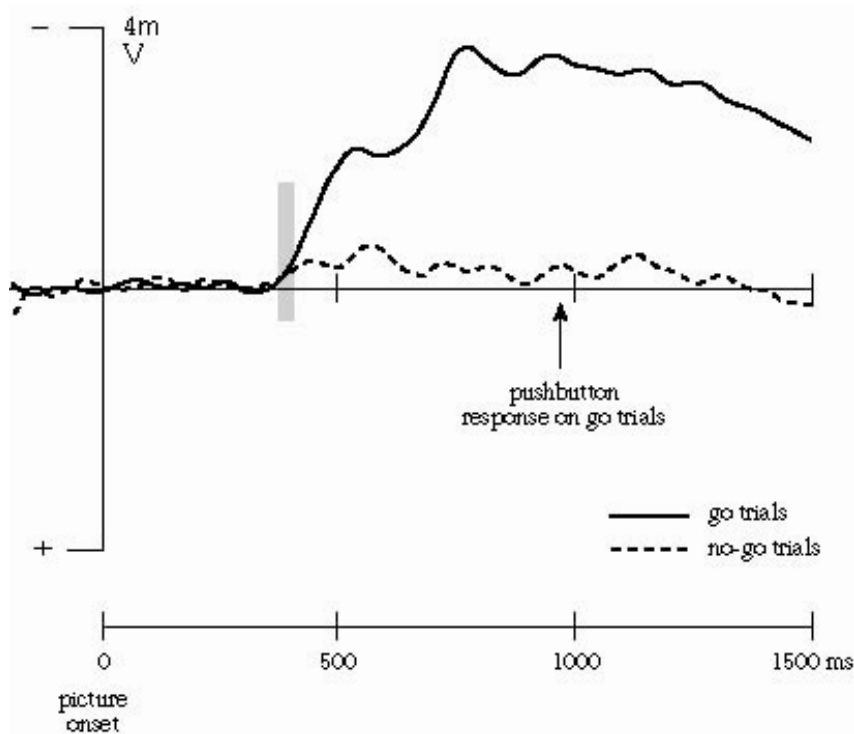


Fig. 4. Grand average ($N = 16$ participants) LRPs on go and no-go trials of experiment 2. The syntactic gender decision determined whether a trial was a go or a no-go trial, and the word-initial phoneme decision determined the response hand. No significant lateralization of the readiness potential was obtained on no-go trials.

Time Course

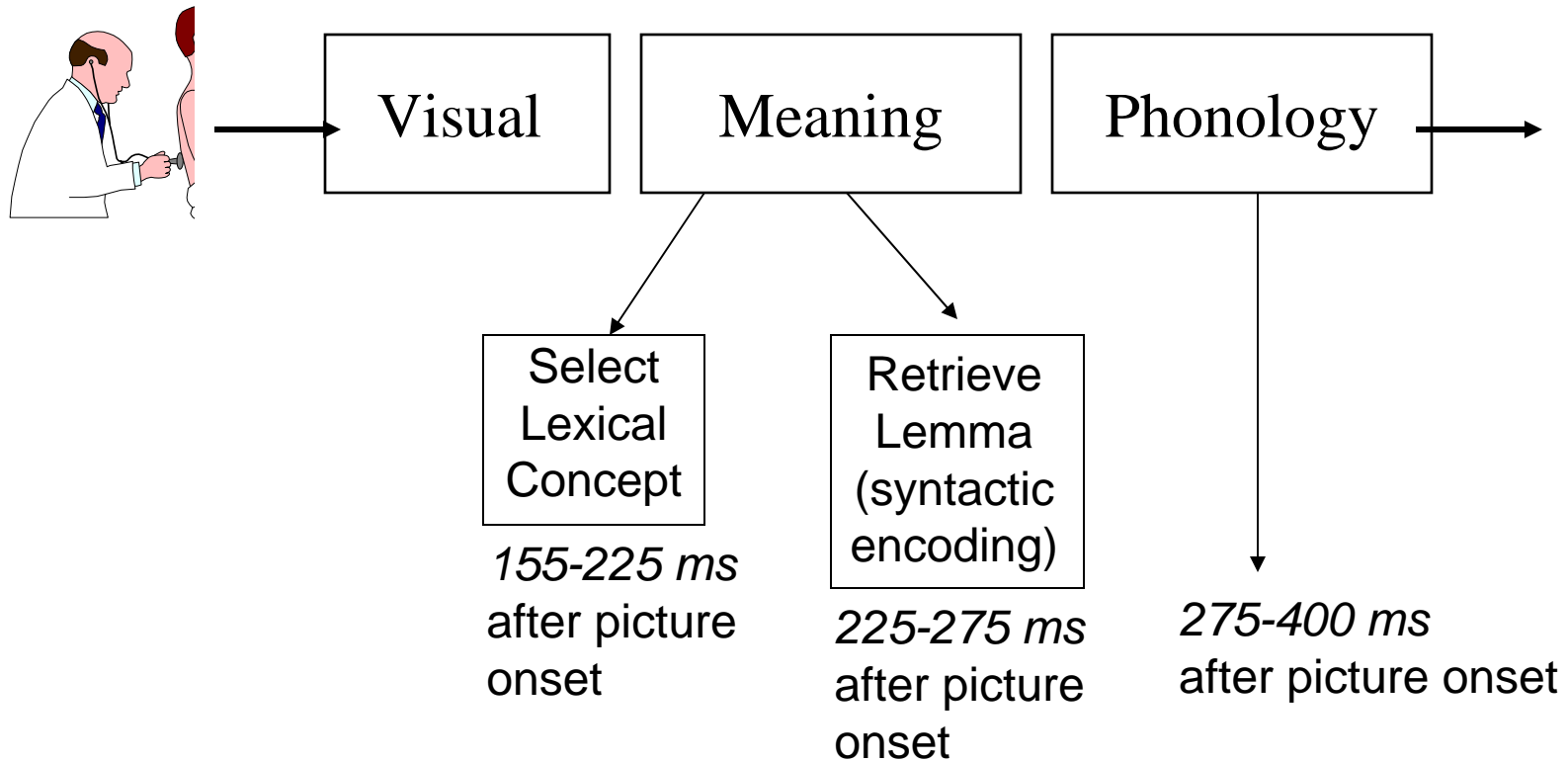


- Both Go & NoGo LRPs begin 370 ms after picture onset
- 410 ms after picture onset go & nogo LRPs diverge
- Once syntactic gender has been retrieved, only 40 ms needed to retrieve word's initial phoneme

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Time course of Word Production



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- Time Course of Word Production in Picture Naming
- **Problem Set**

Dell's Model

- Dell
 - Semantic Level
 - Syntactic Level
 - Morphological Level
 - Phonological Level
 - Garrett
 - Message Level
 - Functional Level
 - Positional Level
- 

Dell's Model

- Representations
- Categorical Rules
- Lexicon
- Insertion Rules

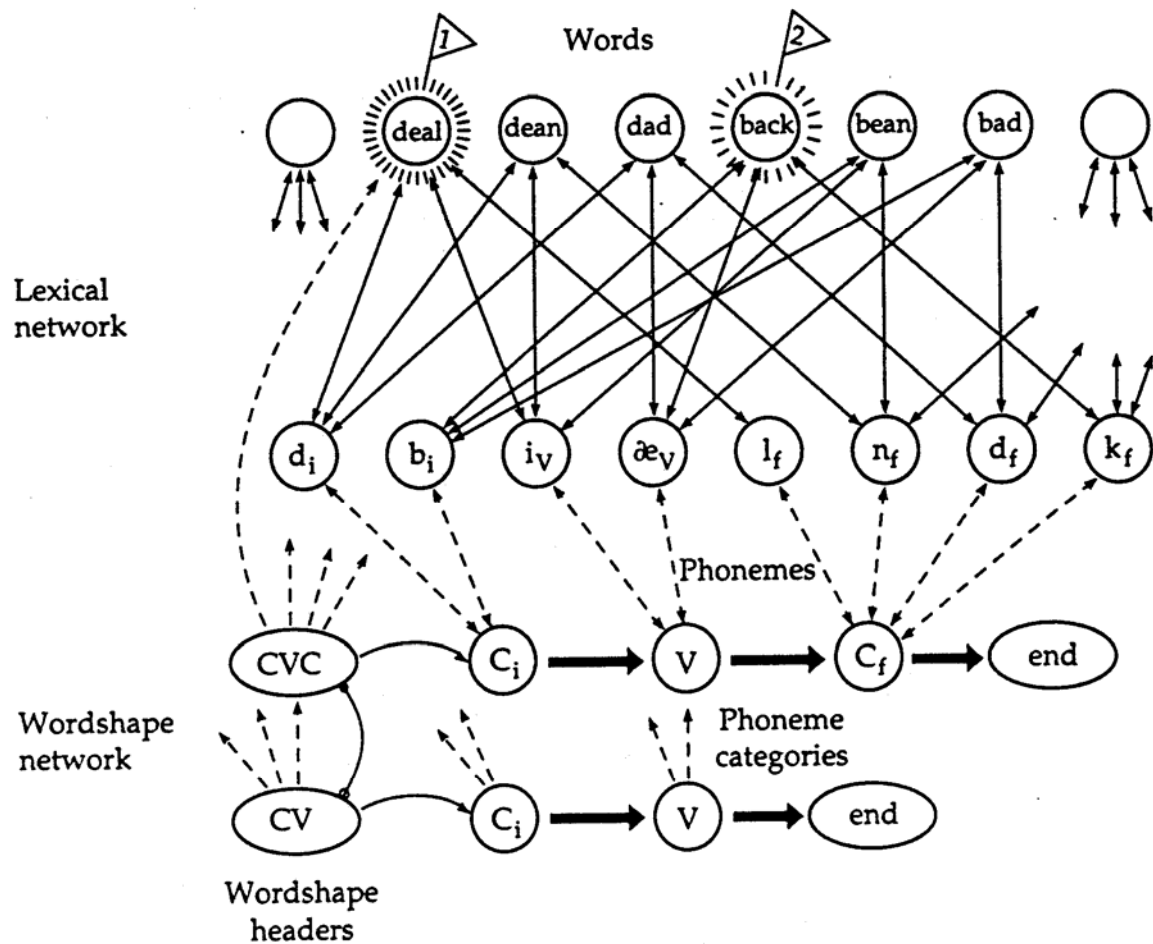


Figure 9.5

The lexical and wordshape networks in Dell's model. The intended phrase is *deal back* indicated by numbered flags on the word nodes. The word *deal* is the current word. All connections between nodes in the lexical network are excitatory and two-way. The dotted lines indicate connections between the lexical and wordshape networks. The arrows between phoneme category nodes in the wordshape network indicate their sequence of activation. Source: Dell, G. S., 1988.

Garrett & Dell on Error Data

- Spoonerisms
 - Garrett reports 93% of spoonerisms within clause
 - Garrett – positional level
 - Dell – phonological level
 - Word Exchange Errors
 - I must let the house out of the cat.
 - Garrett – functional level
 - Dell – syntactic level
 - Morpheme Exchange Errors
 - He has already trunked two packs.
 - Garrett – positional level
 - Dell – morphological level
- Important**
- 