Language in Motion:

the 21st century standard model of cognition and its implications for experimental pragmatics

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XPRAG.de 2014

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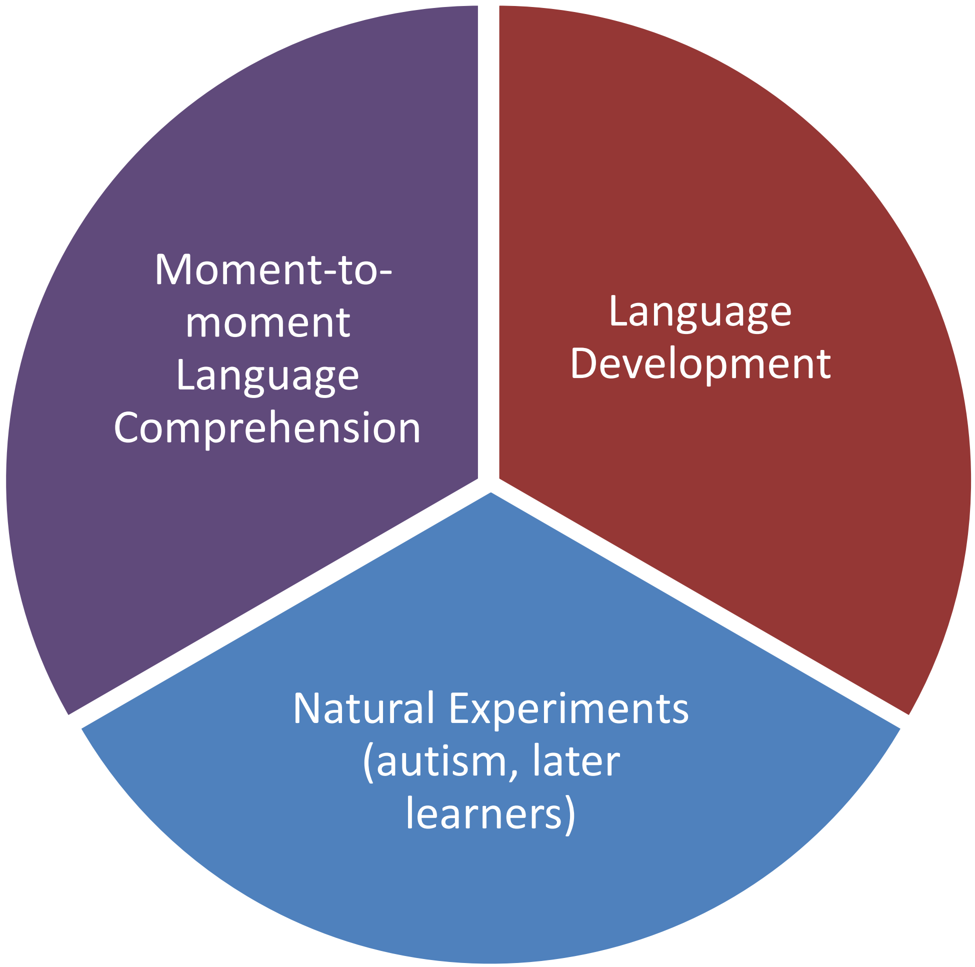
There are two reasons for this. First, it is very easy to say something stupid or confusing when writing in bullet points. Second, I would like to make sure that you have the correct citation for any of the research that I describe, since much of it is currently under review or in preparation.

Who is this person?



Psycholinguist cross-fostered with linguists and developmentalists

If you have a moment

What do you want to learn:

- About development?
  - Language dev
  - Pragmatic dev
  - Dev methods
- About disorders?
  - Which ones?
  - What we know or how to study?
- What did I skip over/miss today

Outline

- 21^{st} century standard model
  - Whirlwind tour of adult language comprehension
- Implications for Experimental Pragmatics
- Nitty-gritty advice on experimental logic and design

The framework

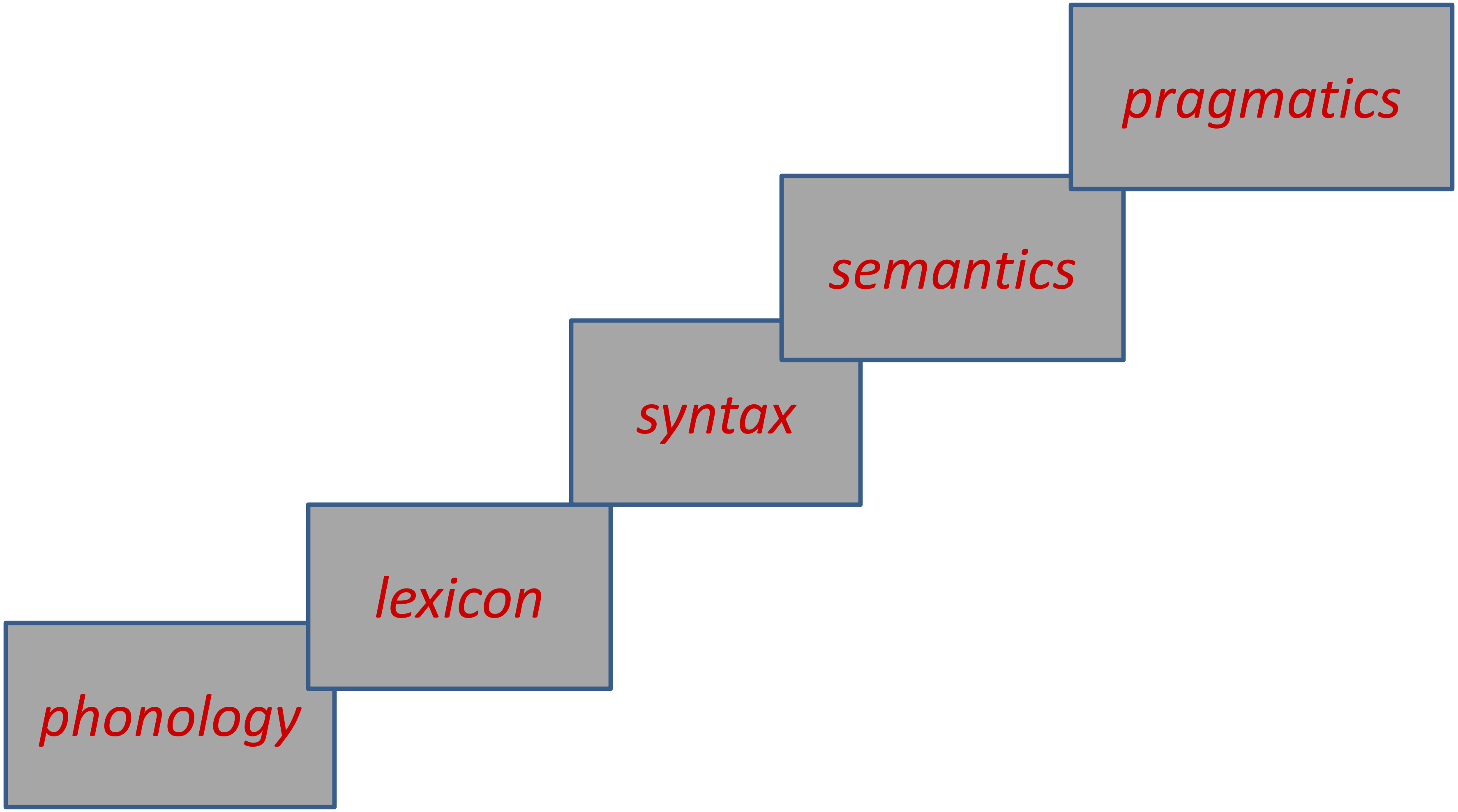
The 21st Century Standard Model

(psycholinguistic version)

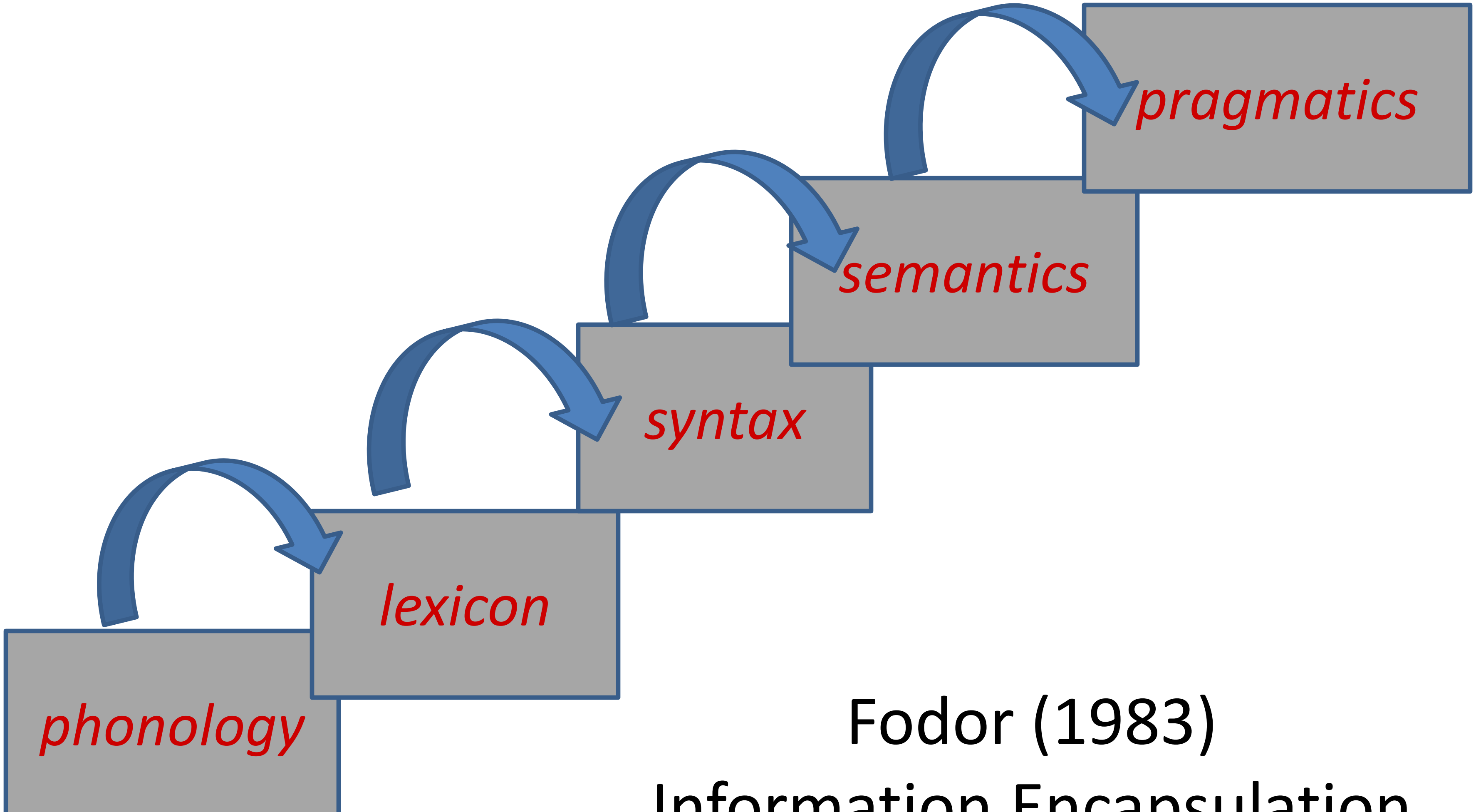
21st century standard model of cognitive processing

1. Processing builds a series of **linked representations**
2. Interpretation is **incremental**
   – Cascaded processing
3. Processes at each level are **interactive**
   – influenced by multiple other levels
4. Incremental, interaction generates **predictions**
5. No walls around language
   – Incremental interaction between linguistic and nonlinguistic processes

1. Comprehension is a series of processes



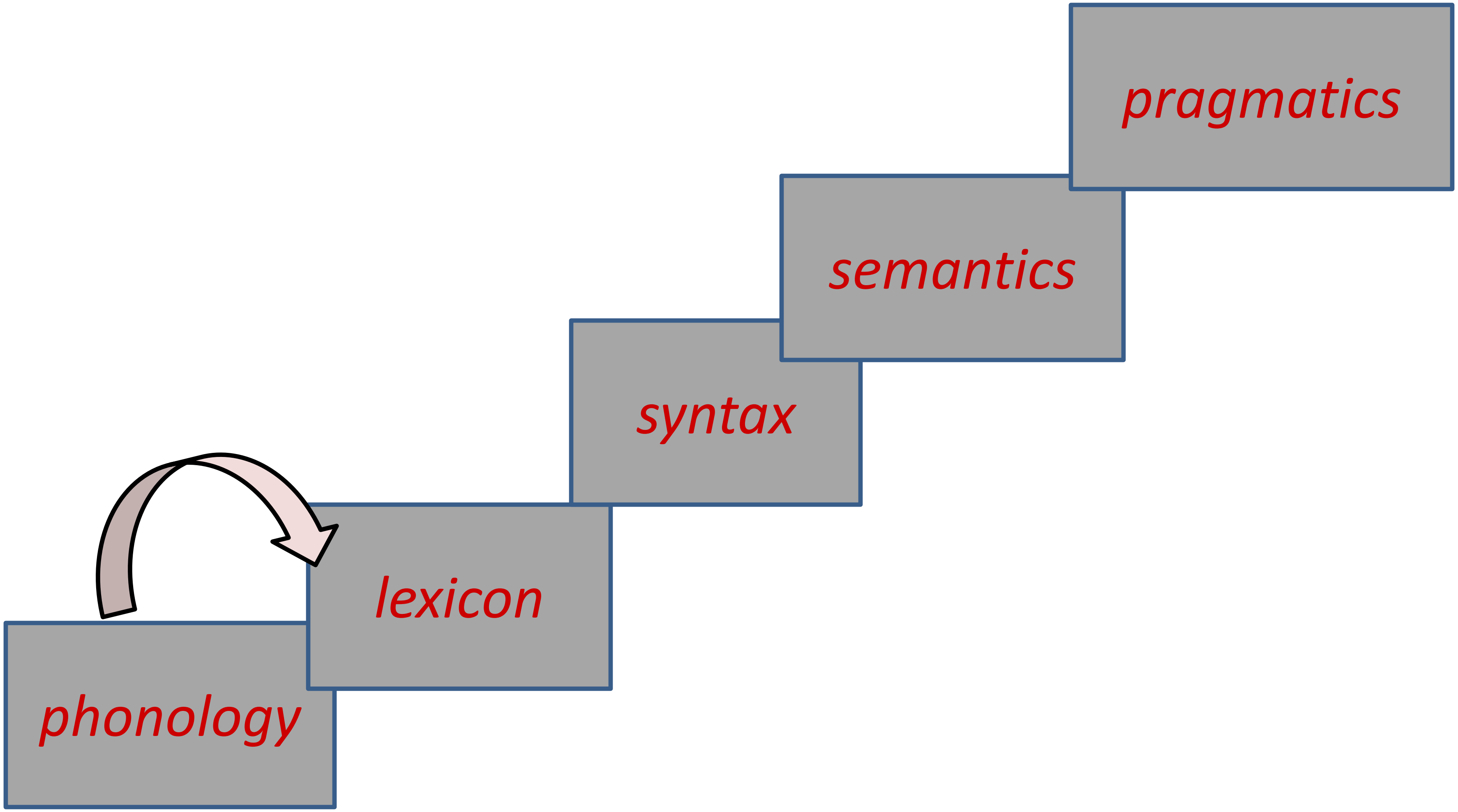
Modularity
Processes sequential & independent



Fodor (1983)
Information Encapsulation

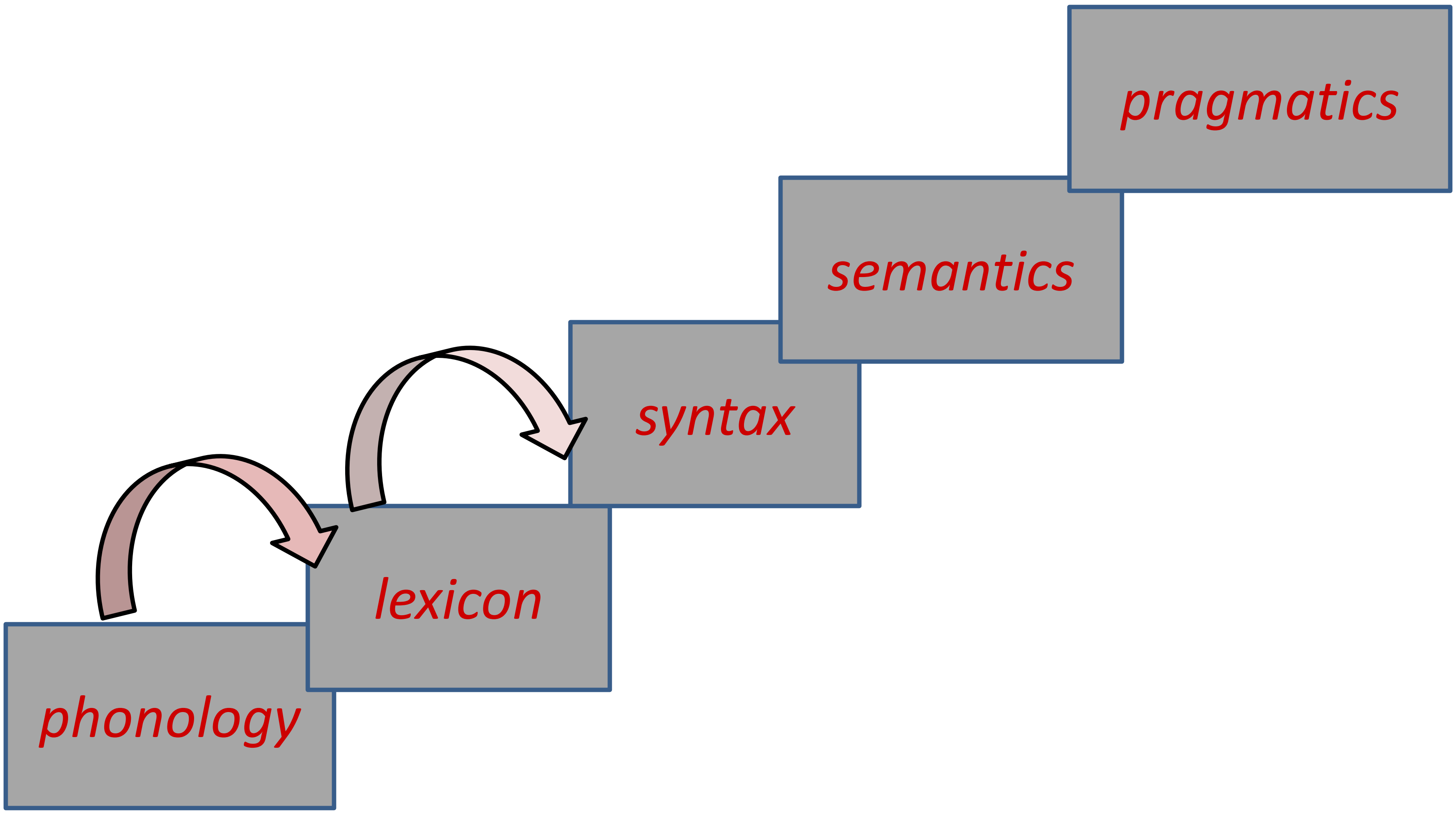
21st Century Standard Model:

2. Cascaded Processing



21st Century Standard Model:

2. Cascaded Processing



21st Century Standard Model:

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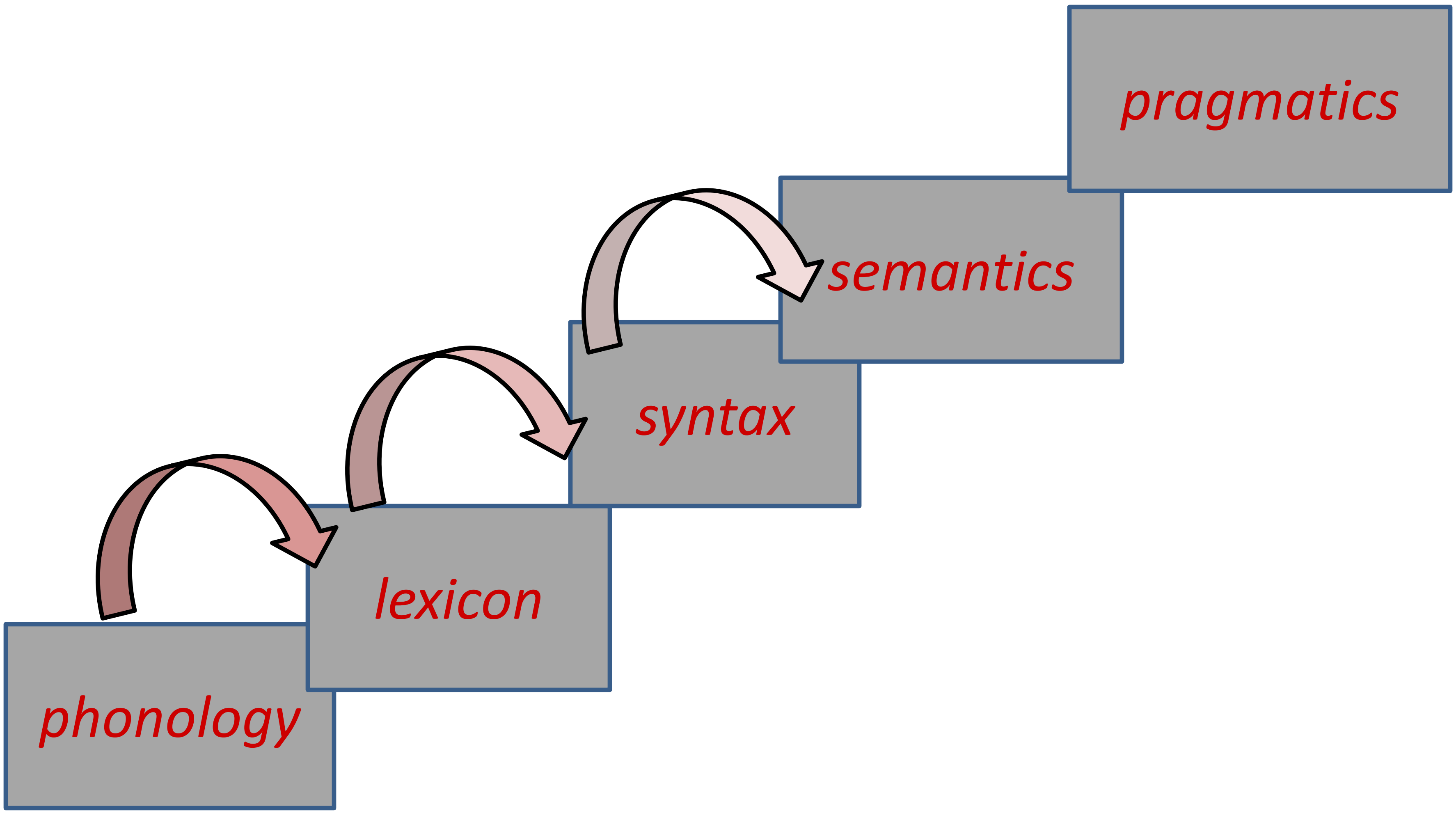

21st Century Standard Model:

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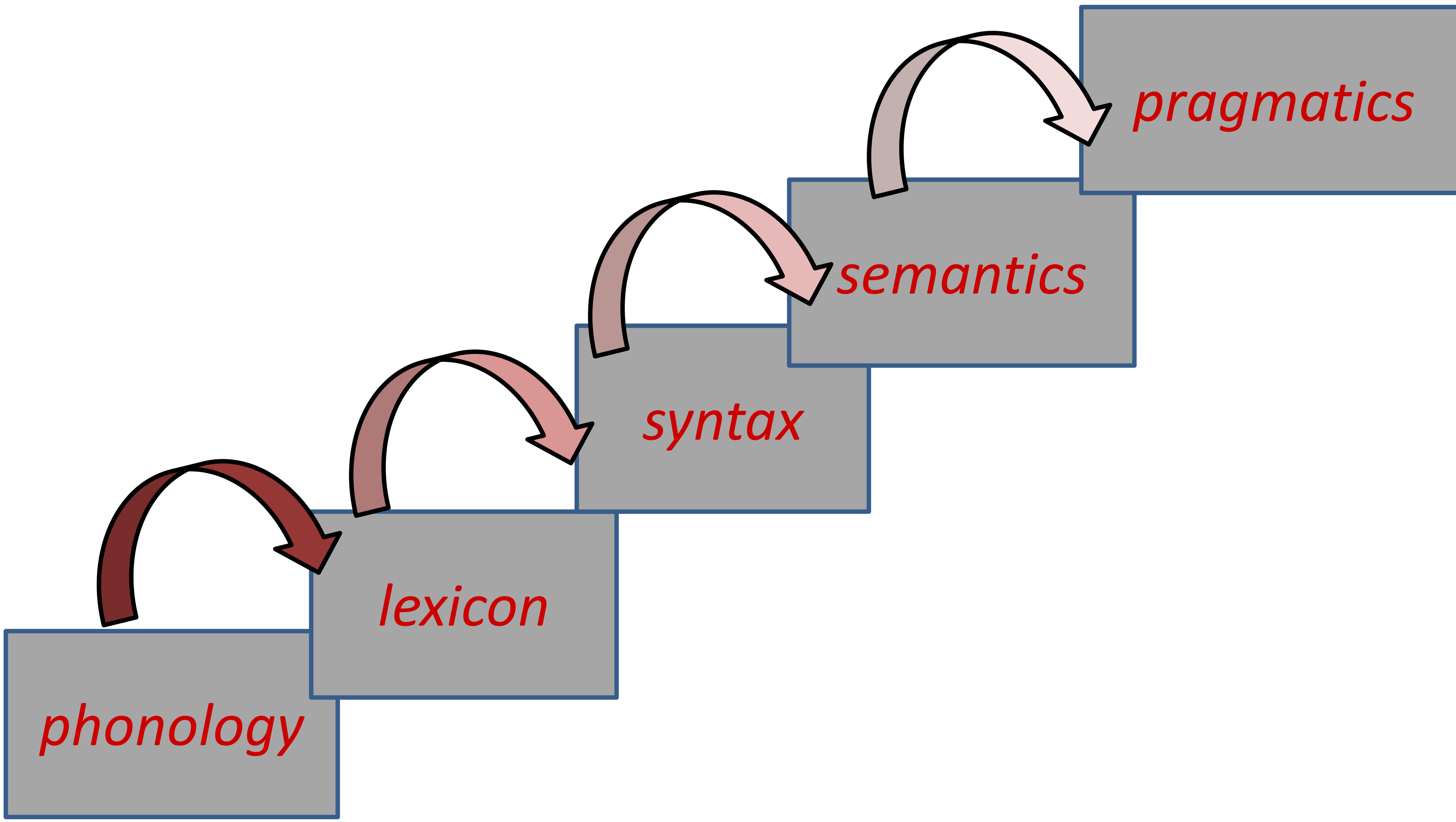
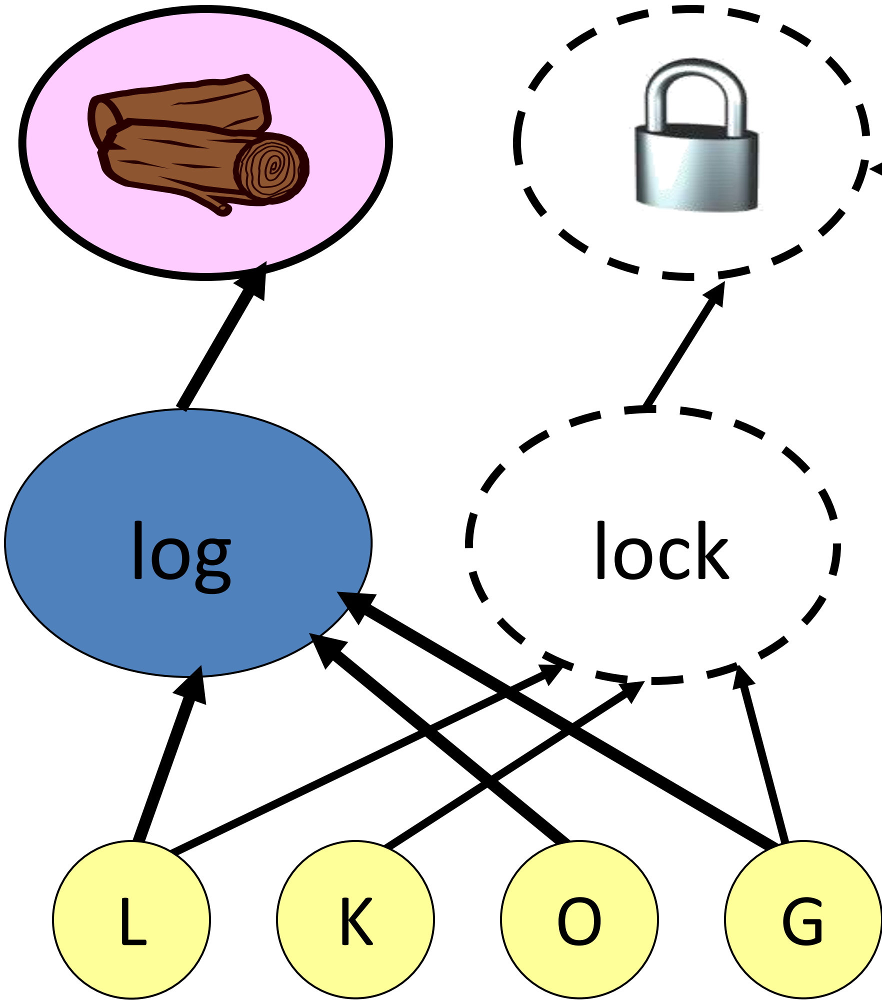


Example: Phonosemantic priming

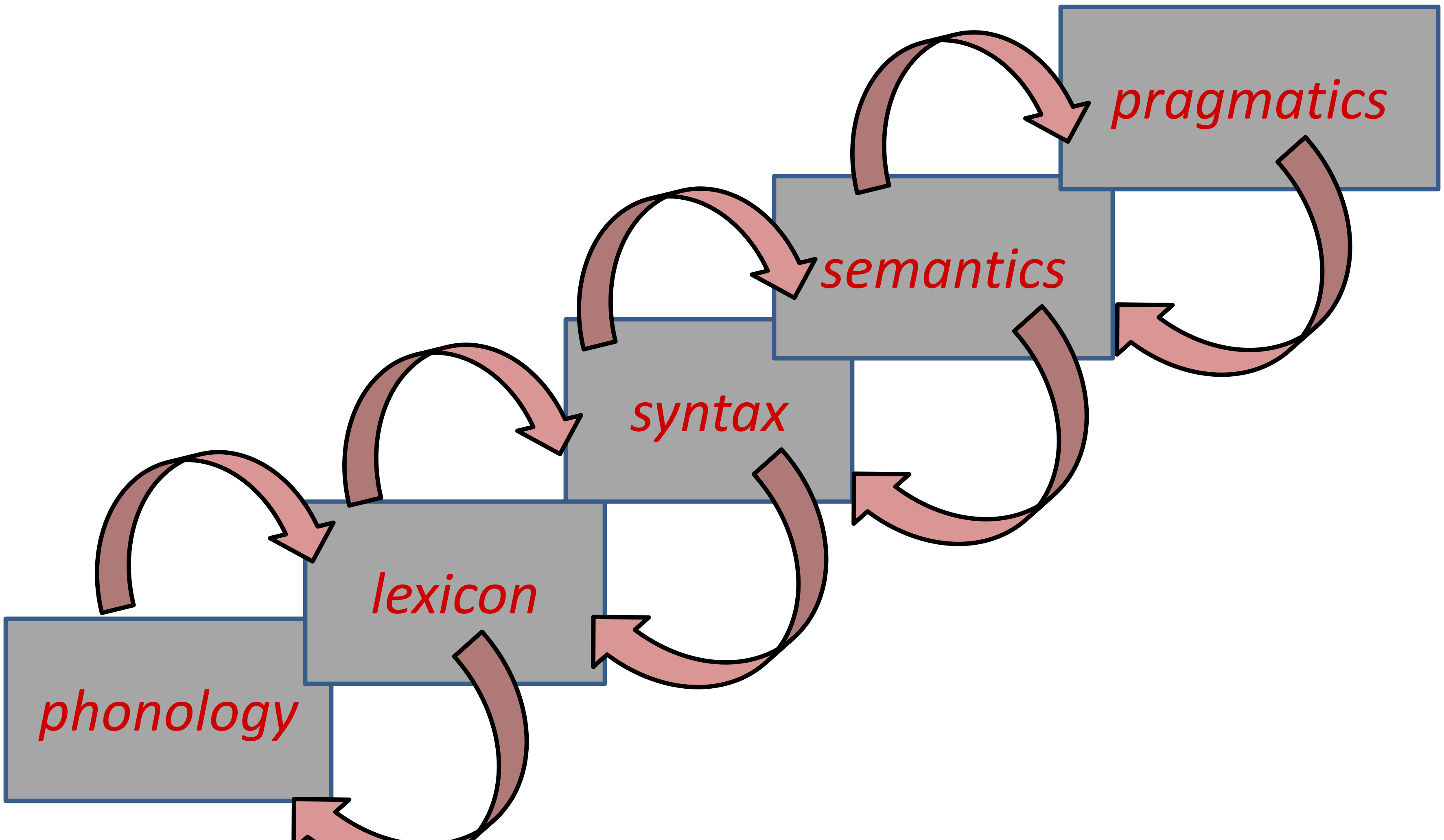


“Pick up the **log**...g”

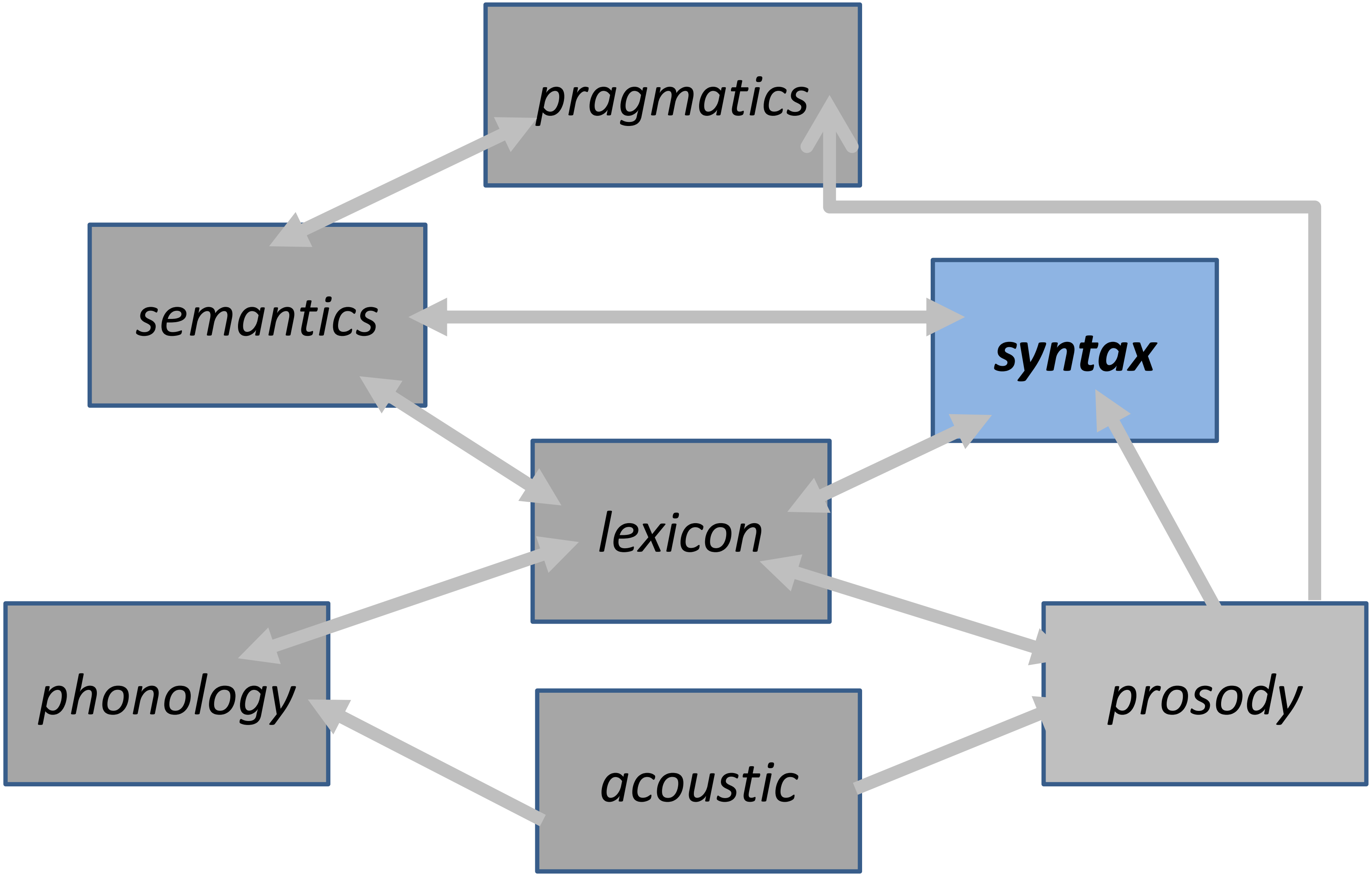
Conceptual priming via phonological associate

Marslen-Wilson & Zwitserlood (1989)
Yee & Sedivy (2006)

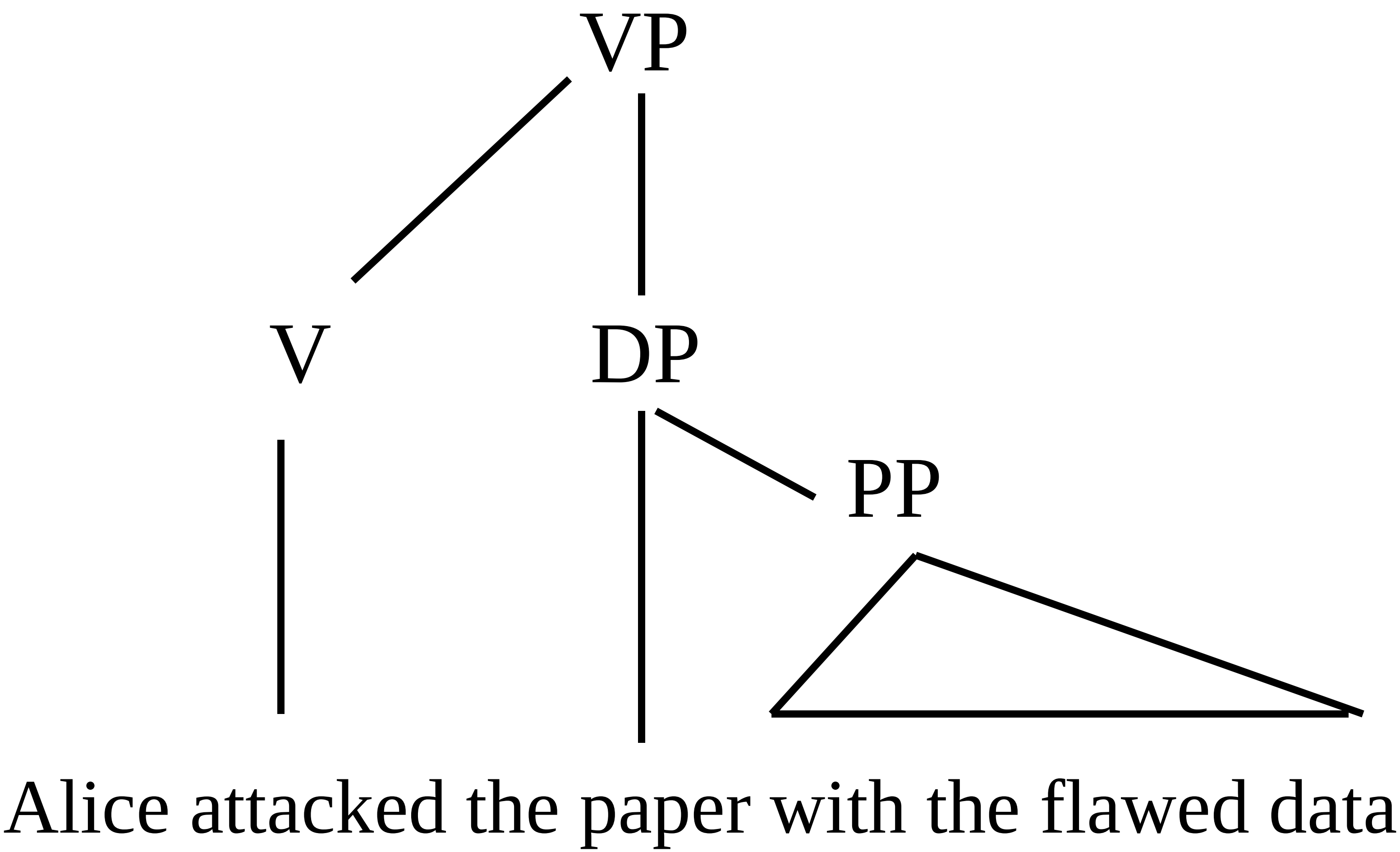
21st Century Standard Model:
3. Interactive Processing



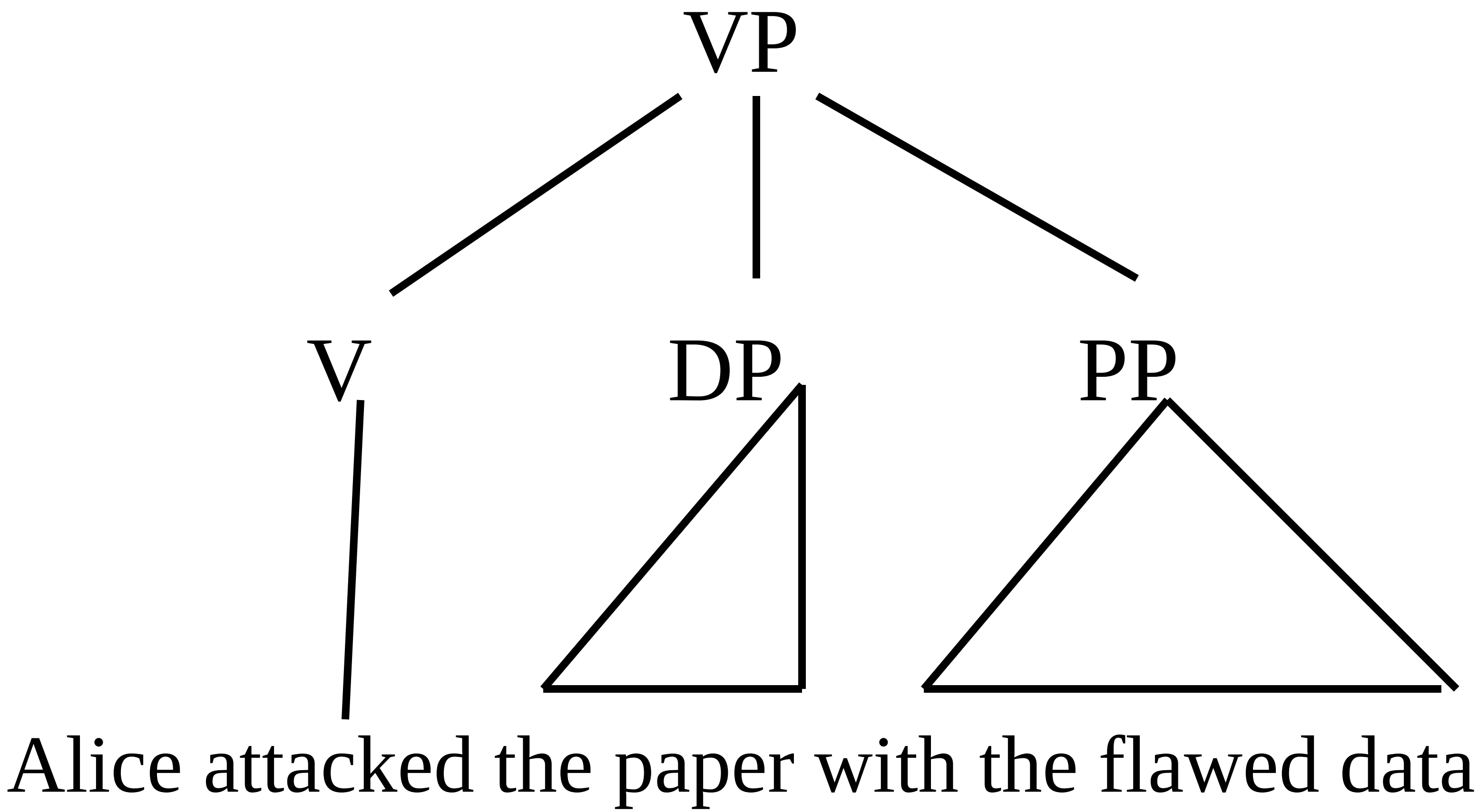
Example: many cues for syntactic parsing



NP-attachment (modifier)



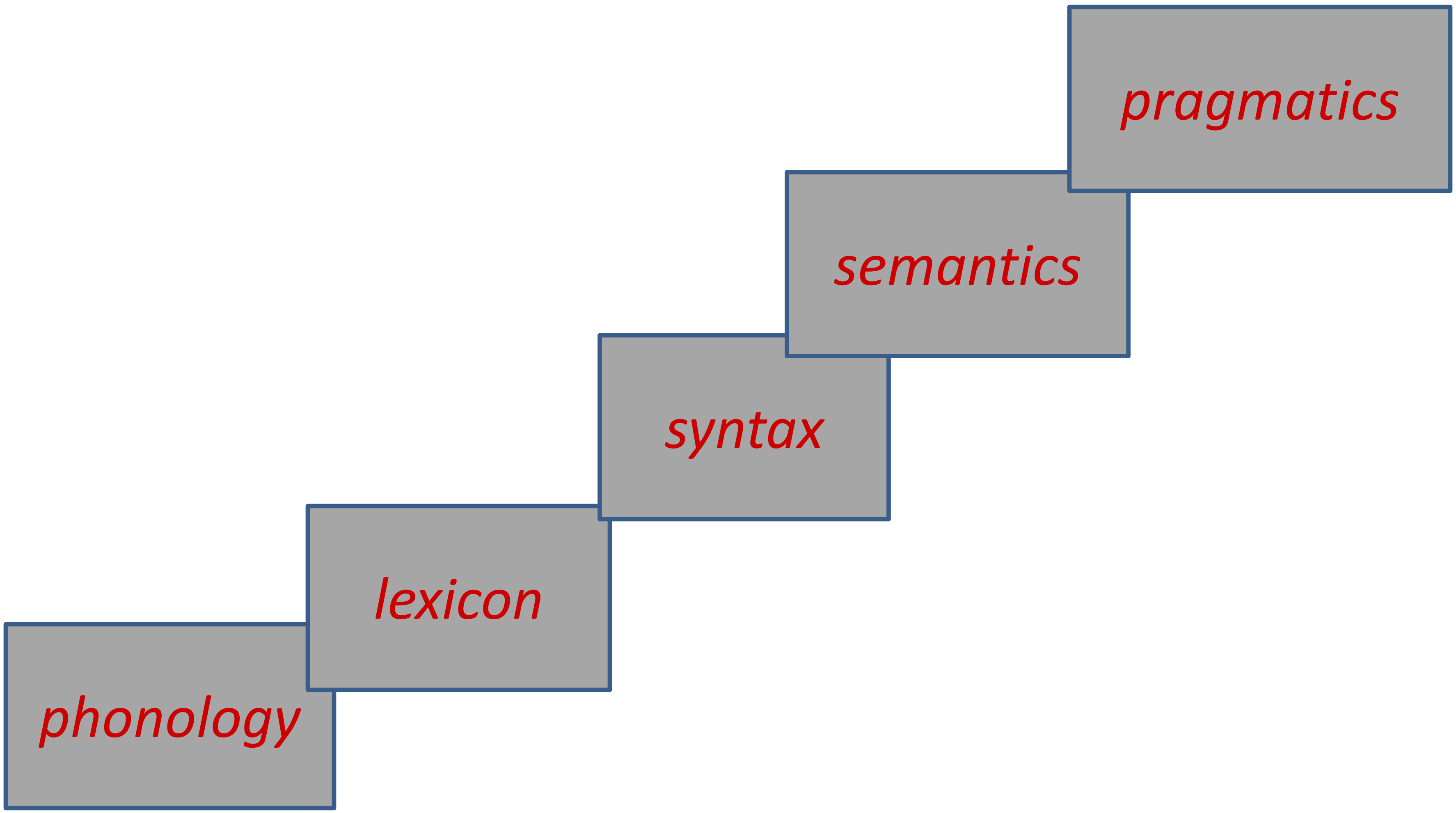
VP-attachment (instrument)



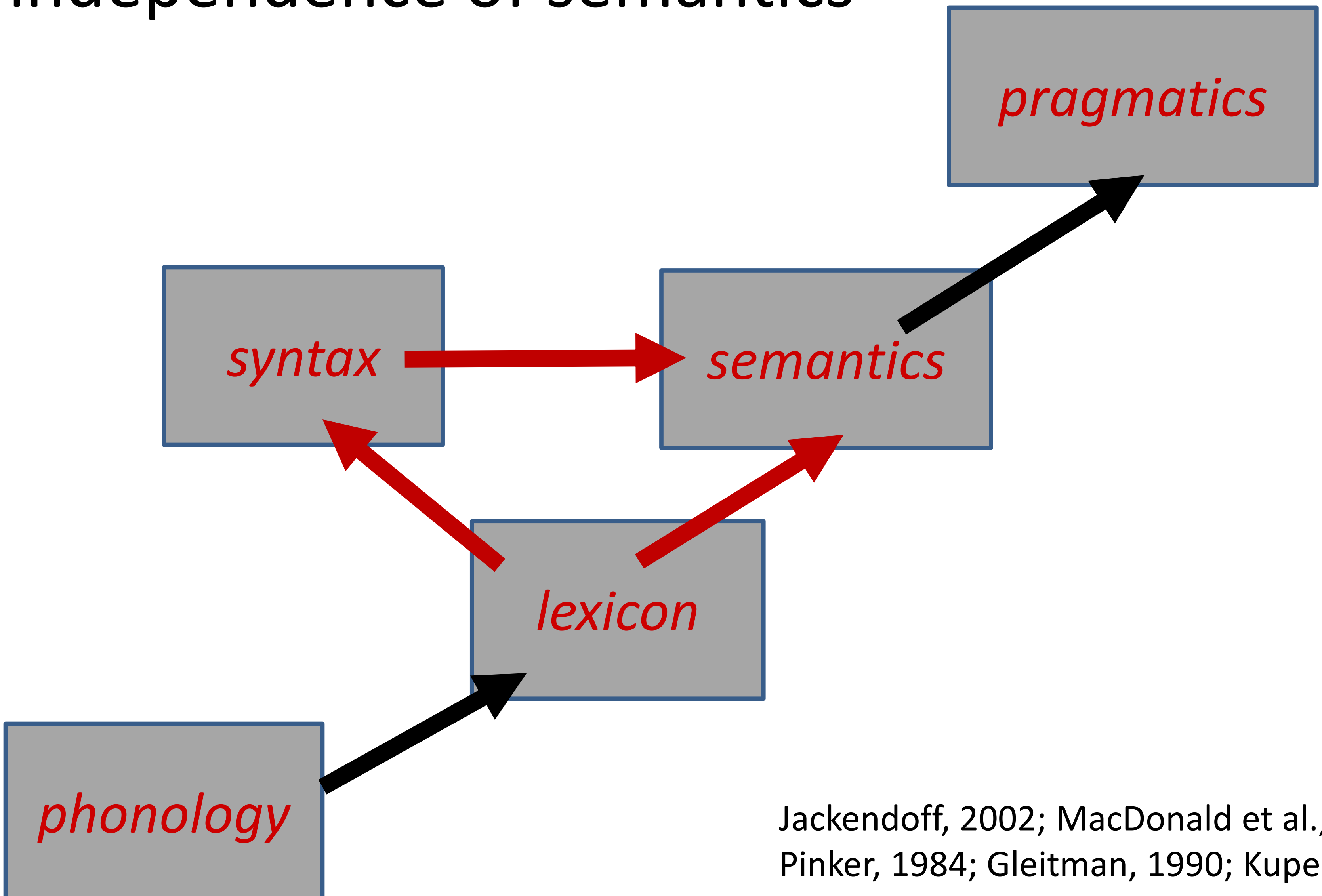
- During parsing adults rapidly integrate information from
  - Lexicon
    - Tickle the pig with the….
    - Choose the pig with the….
  - Prosody
    - You can tickle…the pig with the fan
    - You can tickle the pig…with the fan
  - Pragmatics
    - Are there two pigs? Does the speaker know this?
  - World knowledge
    - Tickle the pig with the feather
    - Tickle the pig with the hat

Altmann & Steedman, 1988; Taraban & McClelland , 1988; Trueswell, Tanenhaus & Kello, 1993; Tanenhaus, Spivey-Knowlton, Eberhard et al. 1995; Pynte & Prieur 1996; Schafer 1997; Garnsey, Pearlmutter, Myers & Lotocky, 1997; Snedeker & Trueswell, 2003

Interactive Processing: allows you to consider other arrangements

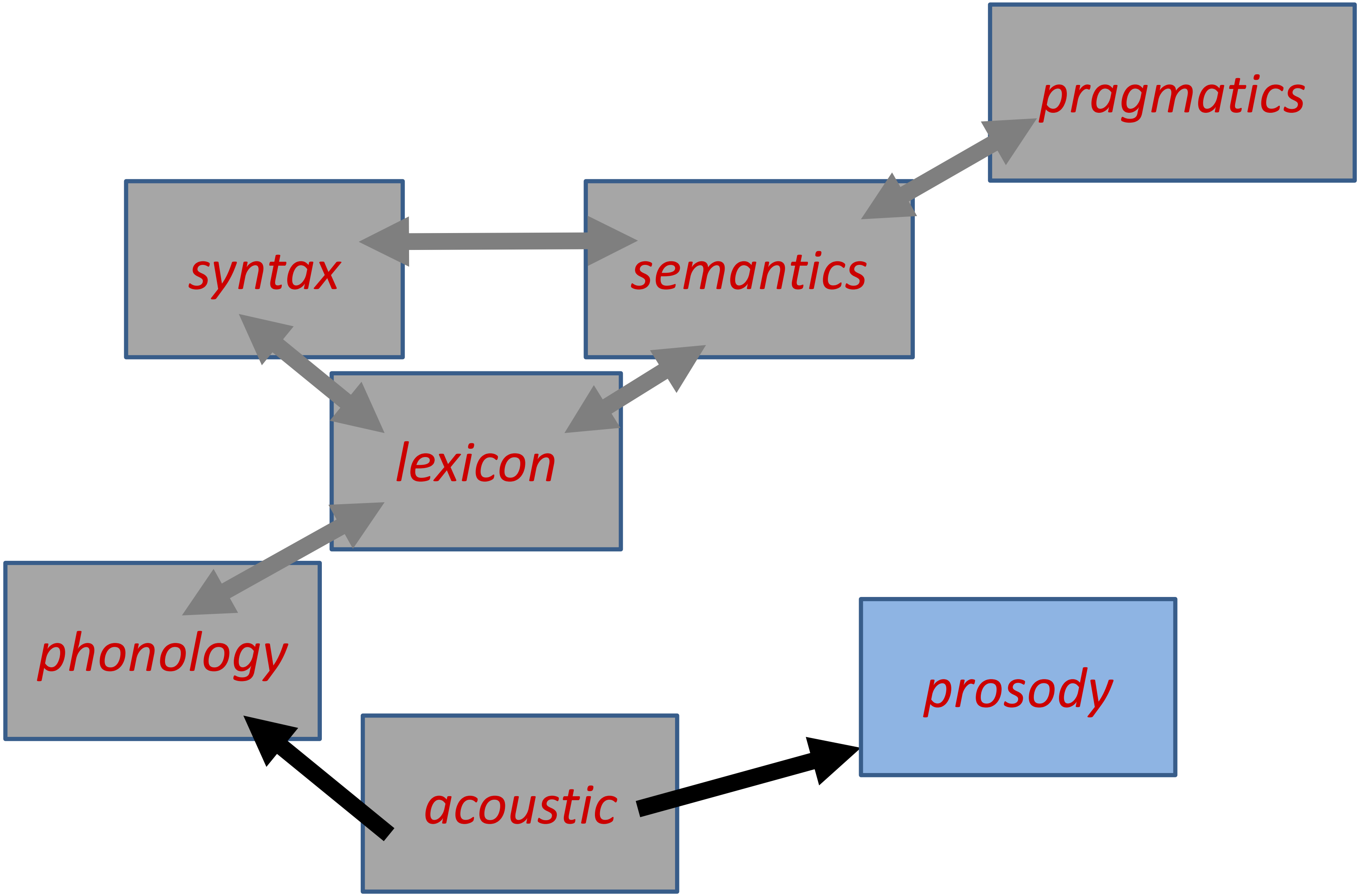


Interactive Processing: allows partial independence of semantics



Jackendoff, 2002; MacDonald et al.,1994; Pinker, 1984; Gleitman, 1990; Kuperberg, 2007 inter alia

Interactive Processing:
Clarifies the role of prosodic structure



Interactive Processing:
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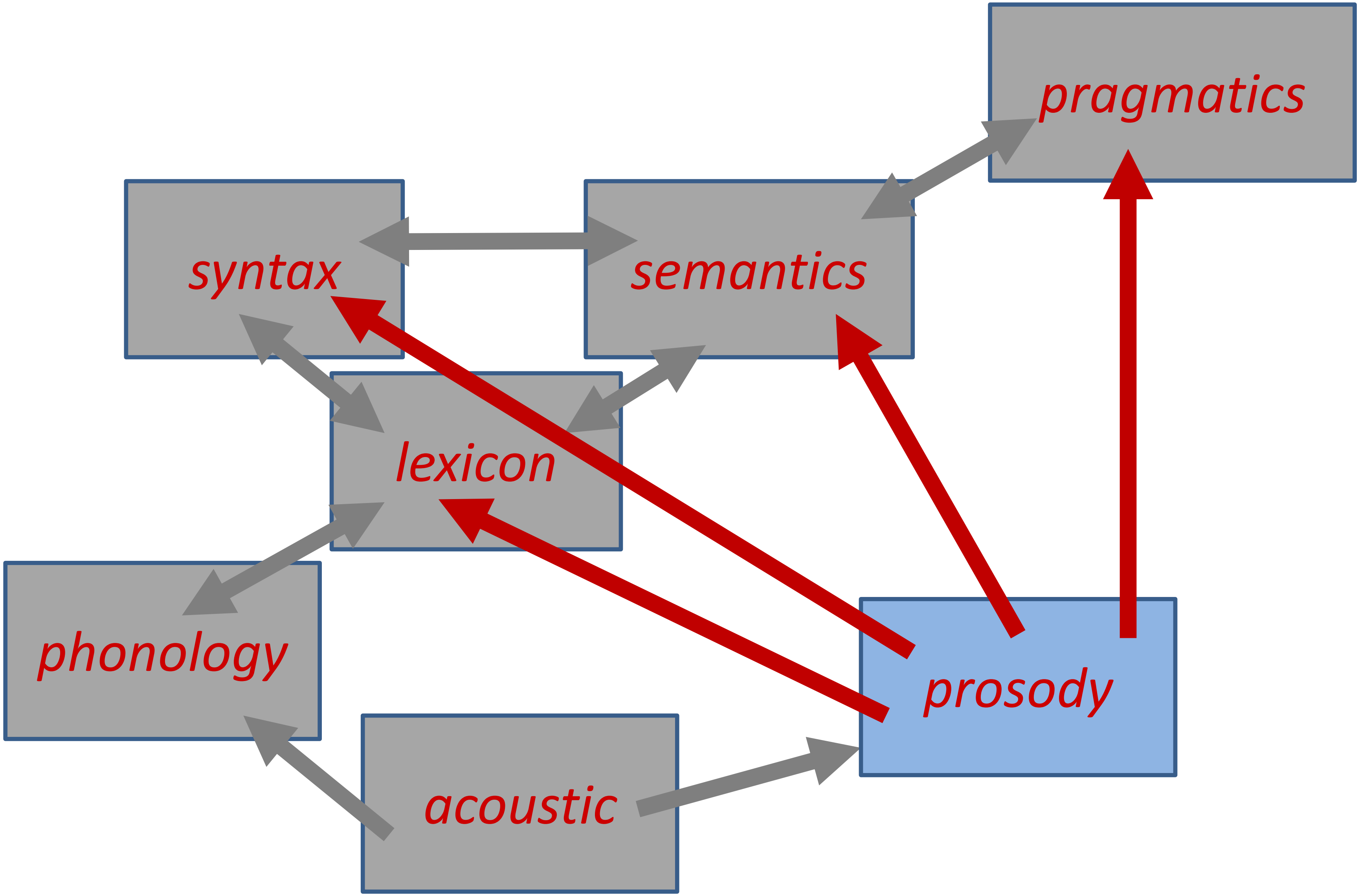
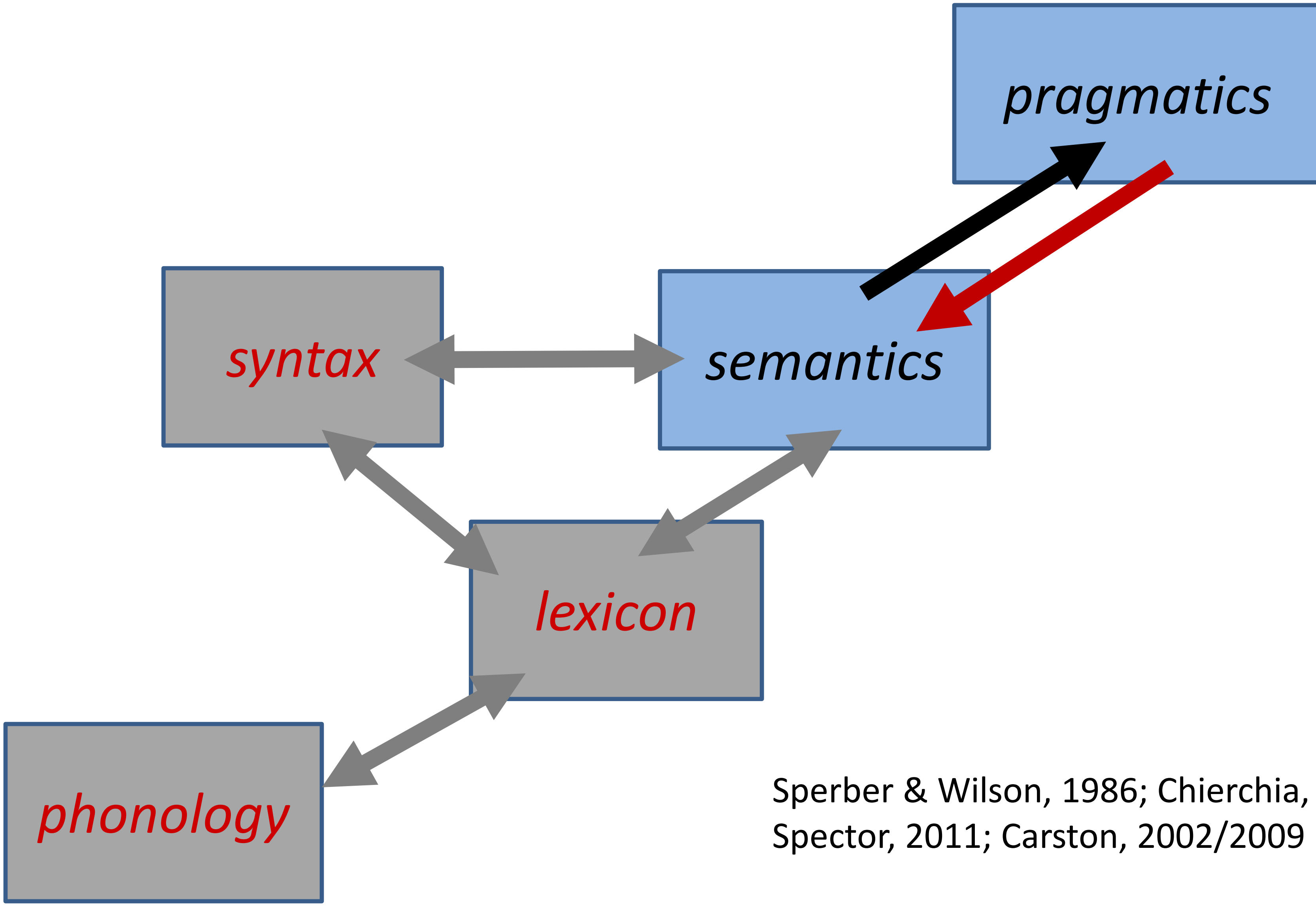


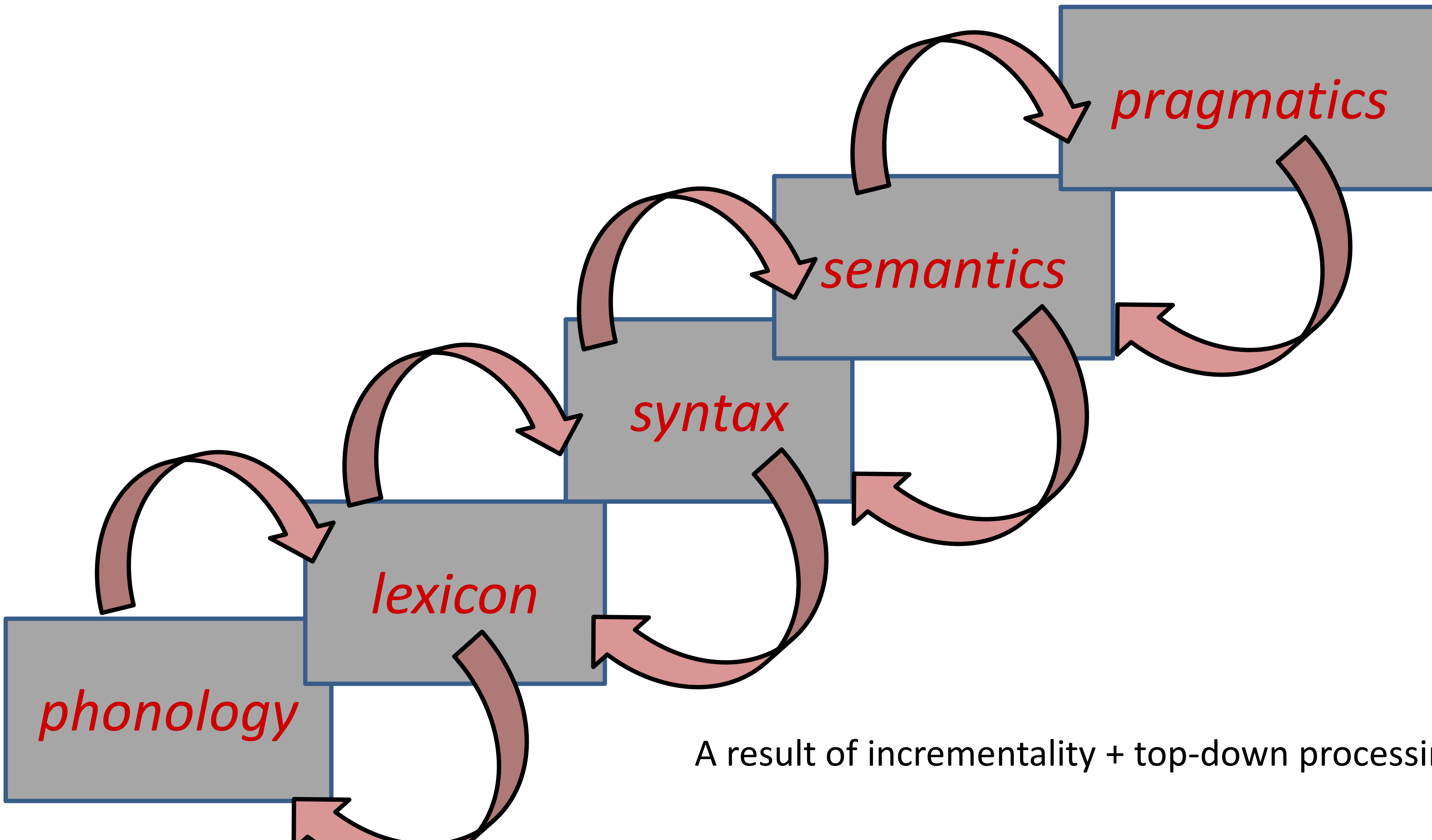
Interactive Processing: allows for pragmatic input to enrich semantic structures



Sperber & Wilson, 1986; Chierchia, Fox & Spector, 2011; Carston, 2002/2009

21st Century Standard Model:

4. Predictive processing



A result of incrementality + top-down processing

4. Predictive Processing

- Prediction: anticipating words or referents that have not yet been spoken
- Incremental, interaction generates inferences about upcoming material

Altmann & Kamide (1999)

- The boy will move the cake
- The boy will eat the cake

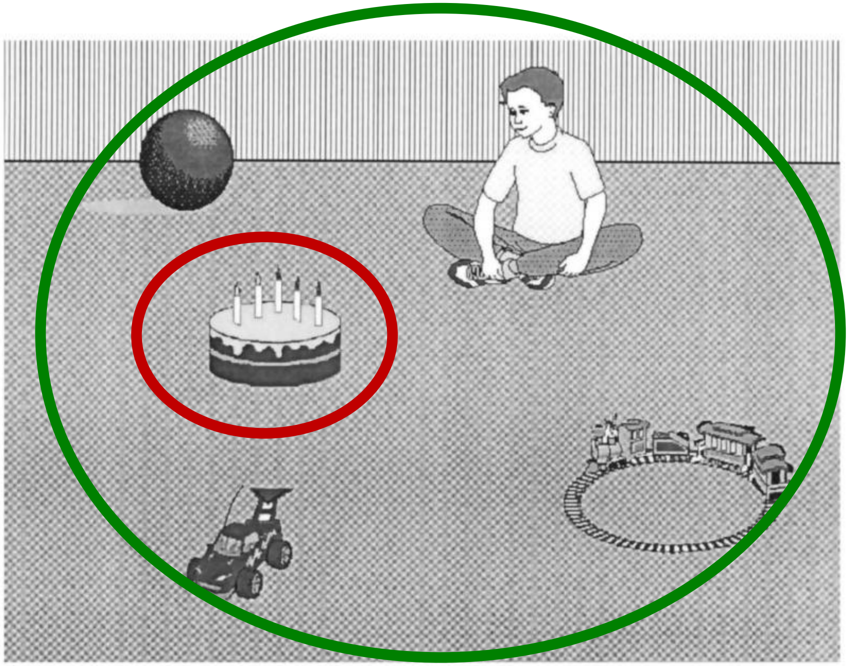
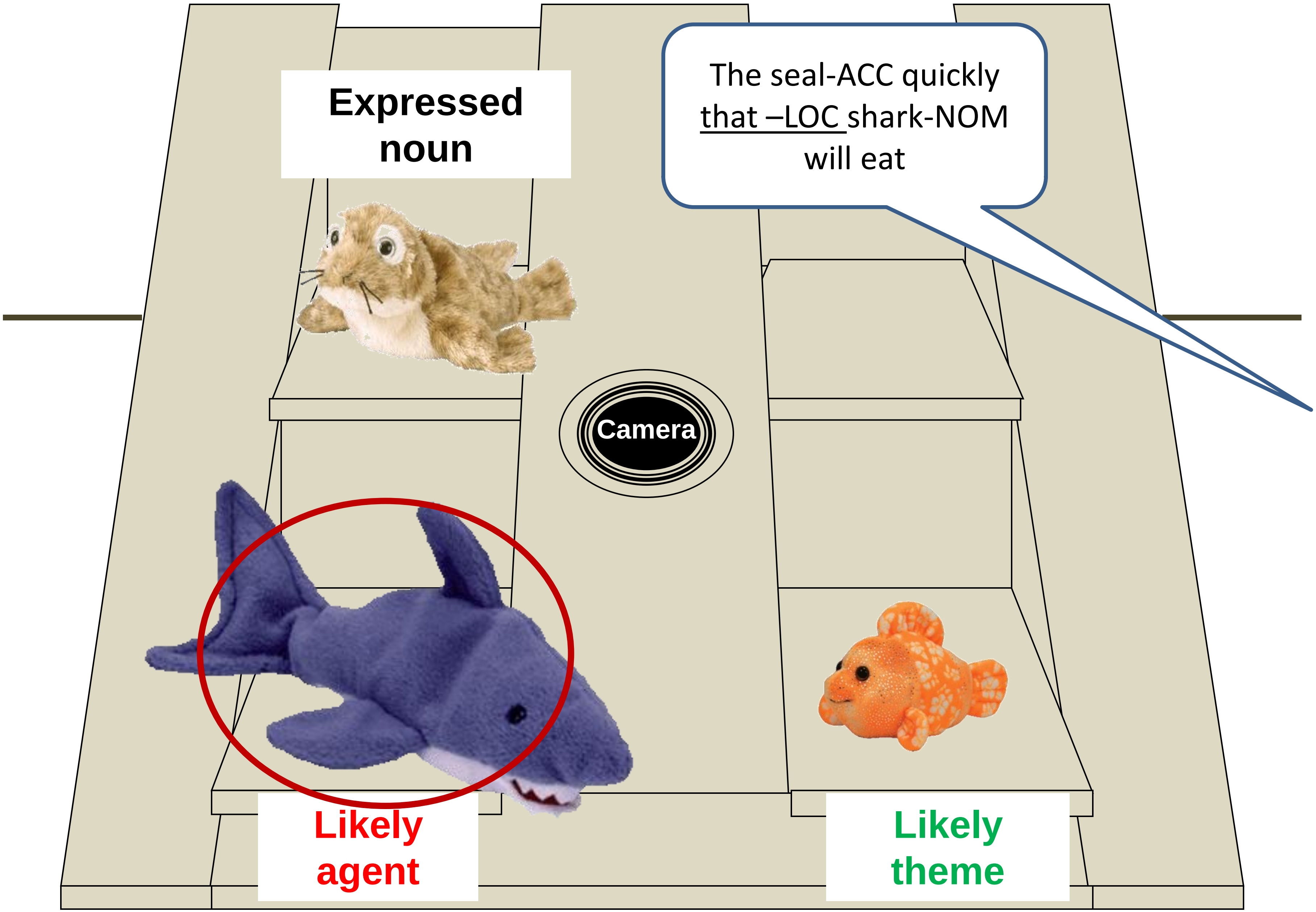


Fig. 1. Example scene used in Experiments 1 and 2 (Sections 2 and 3). Participants heard '*The boy will move the cake*' or '*The boy will eat the cake*' whilst viewing this scene.

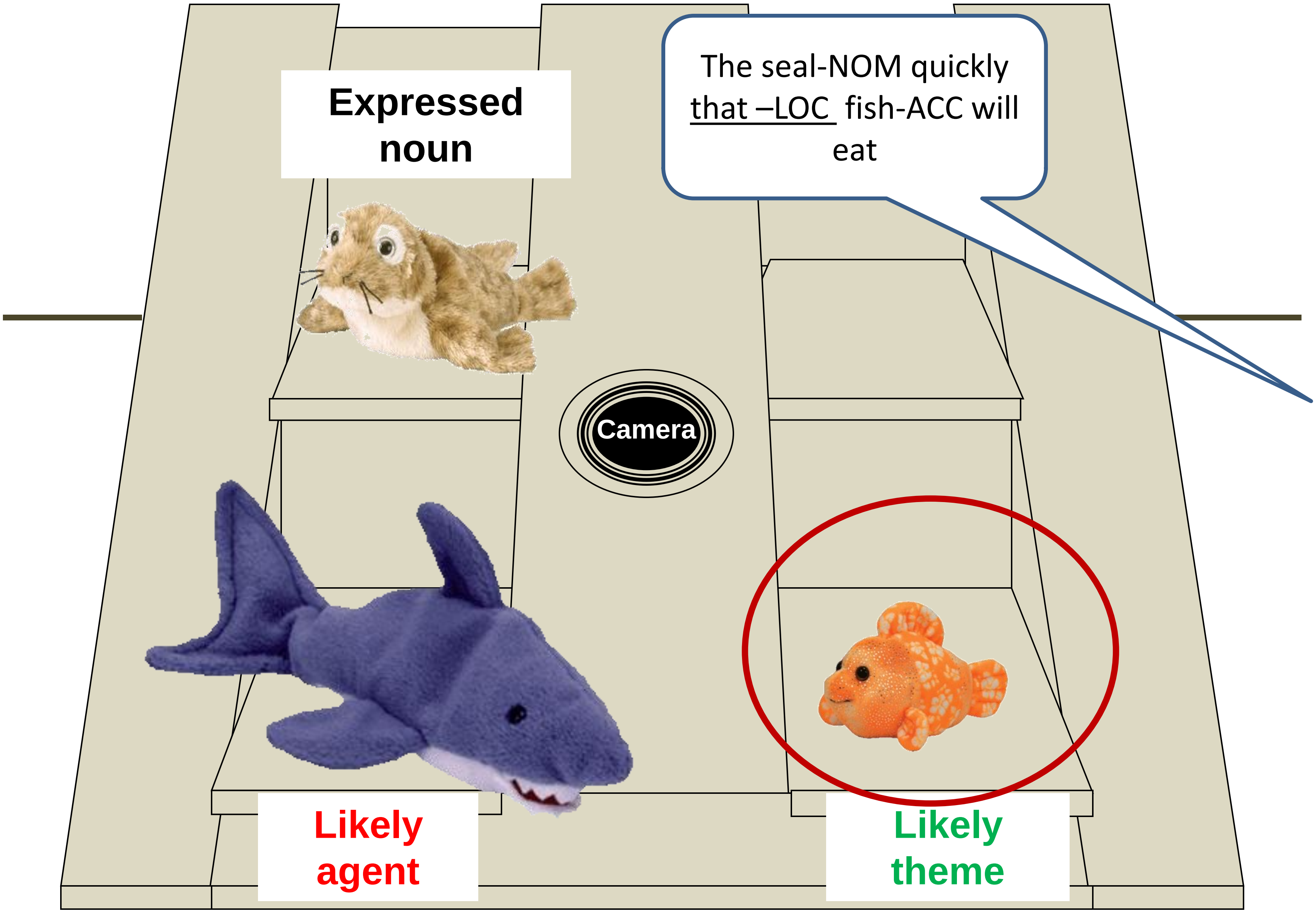
Thematic prediction

- Adults use morphosyntactic cues to determine thematic role of one noun, and predict the upcoming noun
  - Active/passive in English
  - Case marking in Japanese & German (Kamide, Altmann, Haywood, 2003; Kamide, Scheepers & Altmann, 2003)

- 4-5 year old children do too
  - Active/passive constructions in Mandarin (Huang, Zheng, Meng & Snedeker, 2013)
  - Case marking in Turkish (Ozge, Kuntay & Snedeker, in prep)



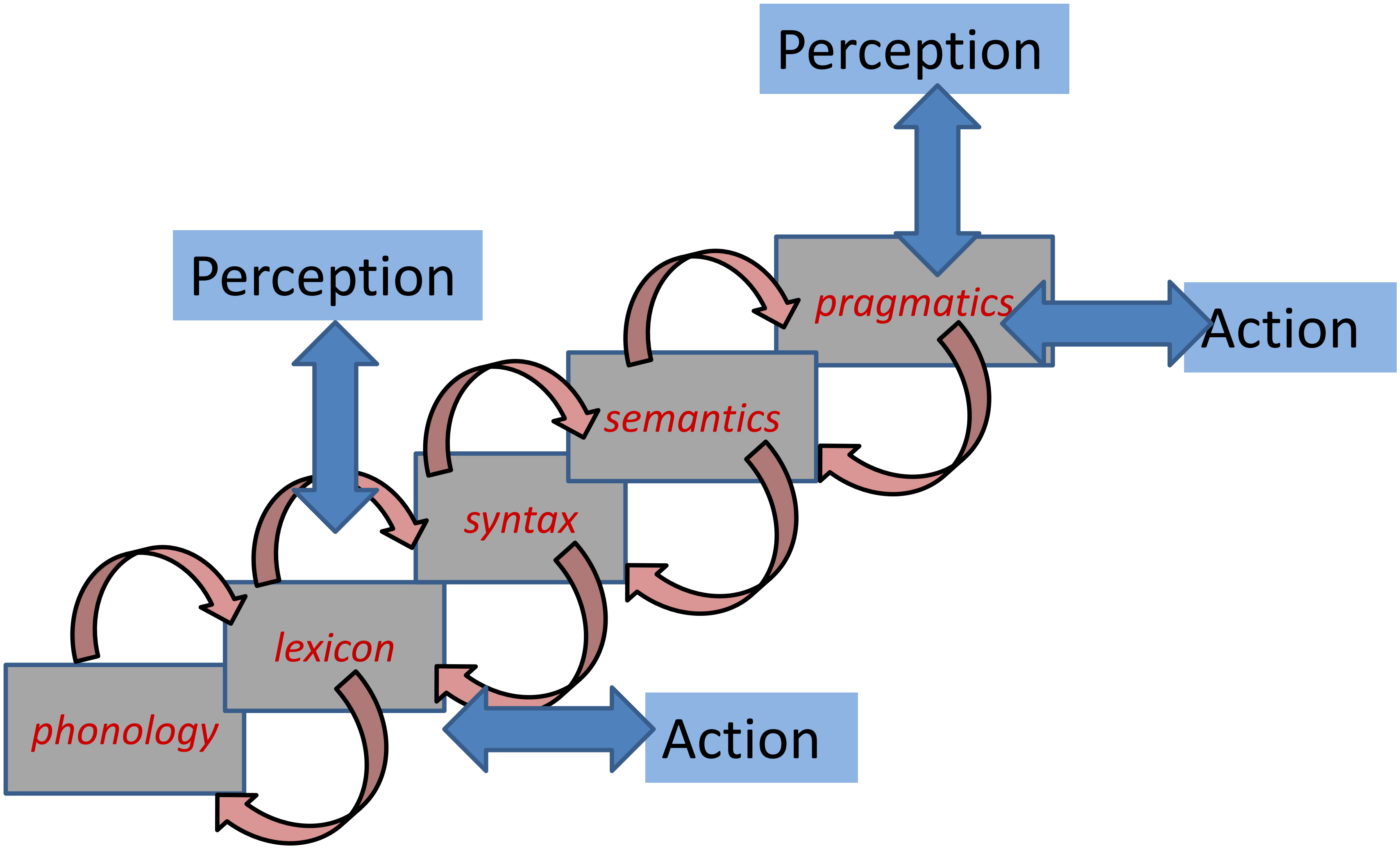
Turkish 4 years olds: Ozge, Kuntay & Snedeker (in prep)



Turkish 4 years olds: Ozge, Kuntay & Snedeker (in prep)

21st century standard model

5. No walls around language



Incremental, interactive processing crosses domains

Crosstalk with other cognitive domains

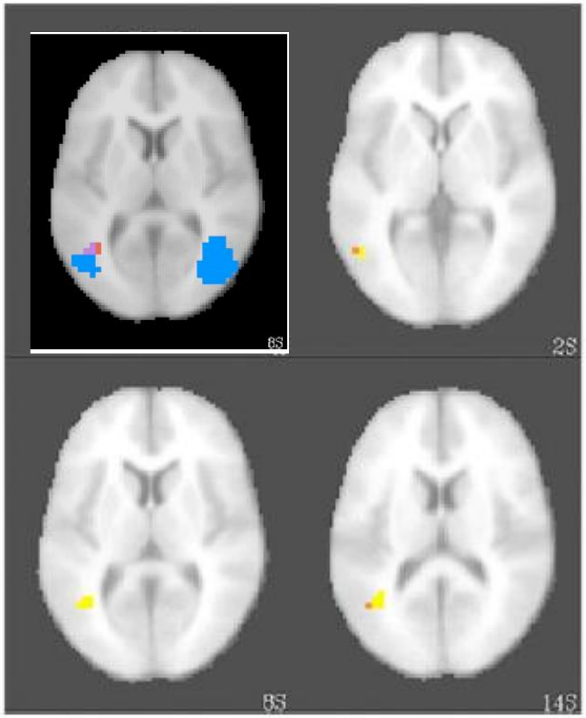
- From language to action
  - Eye movements are actions
  - Language processing at many levels incrementally informs action planning (see above!)
  - One explanation for Action Compatibility Effects (embodied cognition)
- From language to vision
- From vision to language

Incremental visual activation from words

(Pirog Reville, Aslin, Tanenhaus & Bavalier, 2008)

- Ss learn novel motion and state change verbs
- Verbs have phonological cohort members from the same class or from a different class
  - gapito = turn white (state change)
  - gapitu = oscilate vertically (motion)
- fMRI:
  - Find area MT (motion detection) using localizer (blue)
  - Find area that responds to motion verbs (red)
  - In that area: compare non-motion words that have motion cohort member vs. those that do not (orange)
- Hearing a word that overlaps with a motion word activates visual representations of motion

A



Crosstalk with other cognitive domains

- From language to action
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  - One explanation for Action Compatibility Effects (embodied cognition)
- From language to vision
- From vision to language

During object naming, perception must (directly or indirectly) activate linguistic representations.

But does this happen when we are not speaking?

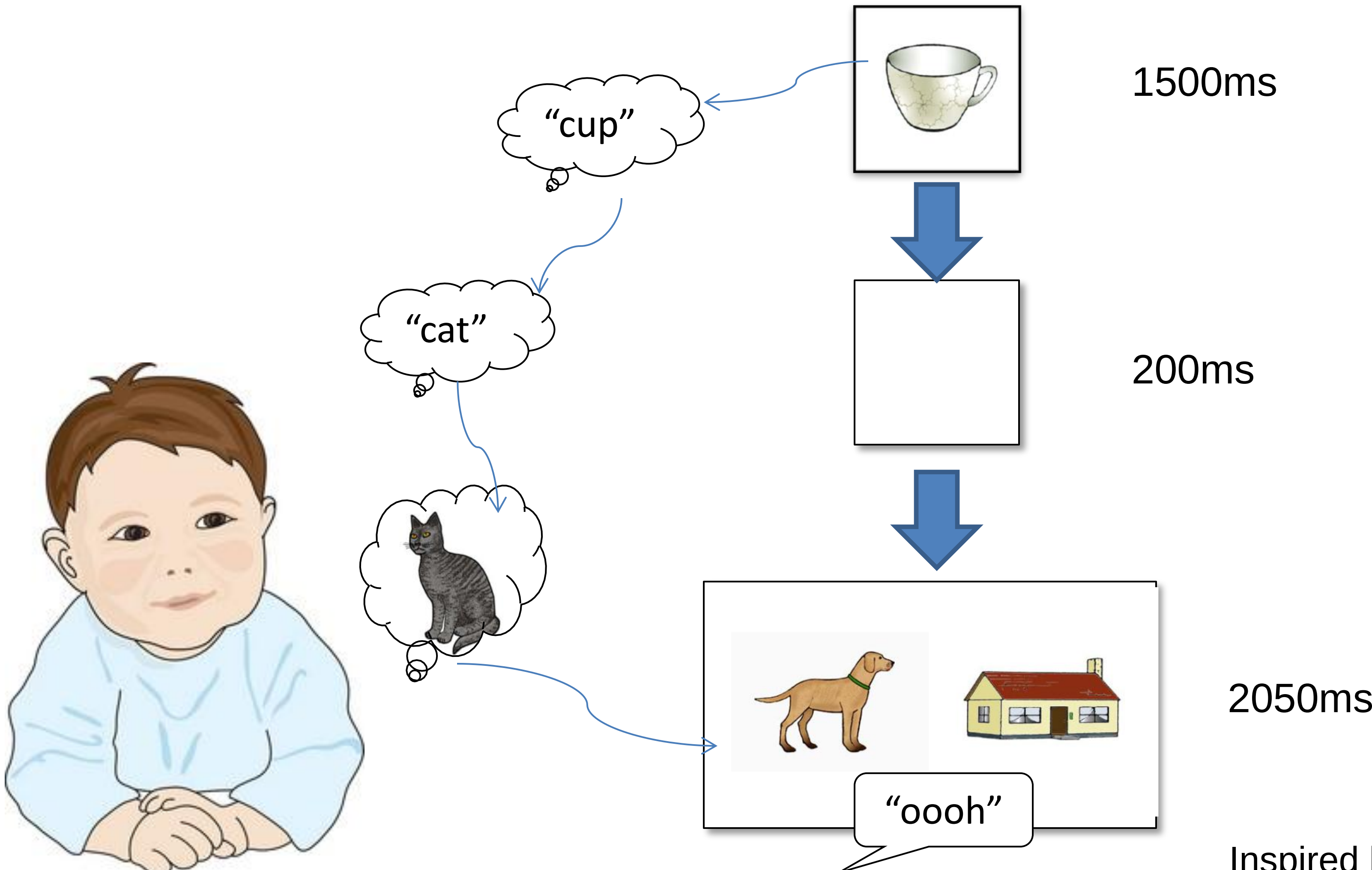
Implicit Naming: the activation of linguistic representations in a non-communicative task

Evidence:

- Phonosemantic activation in infants

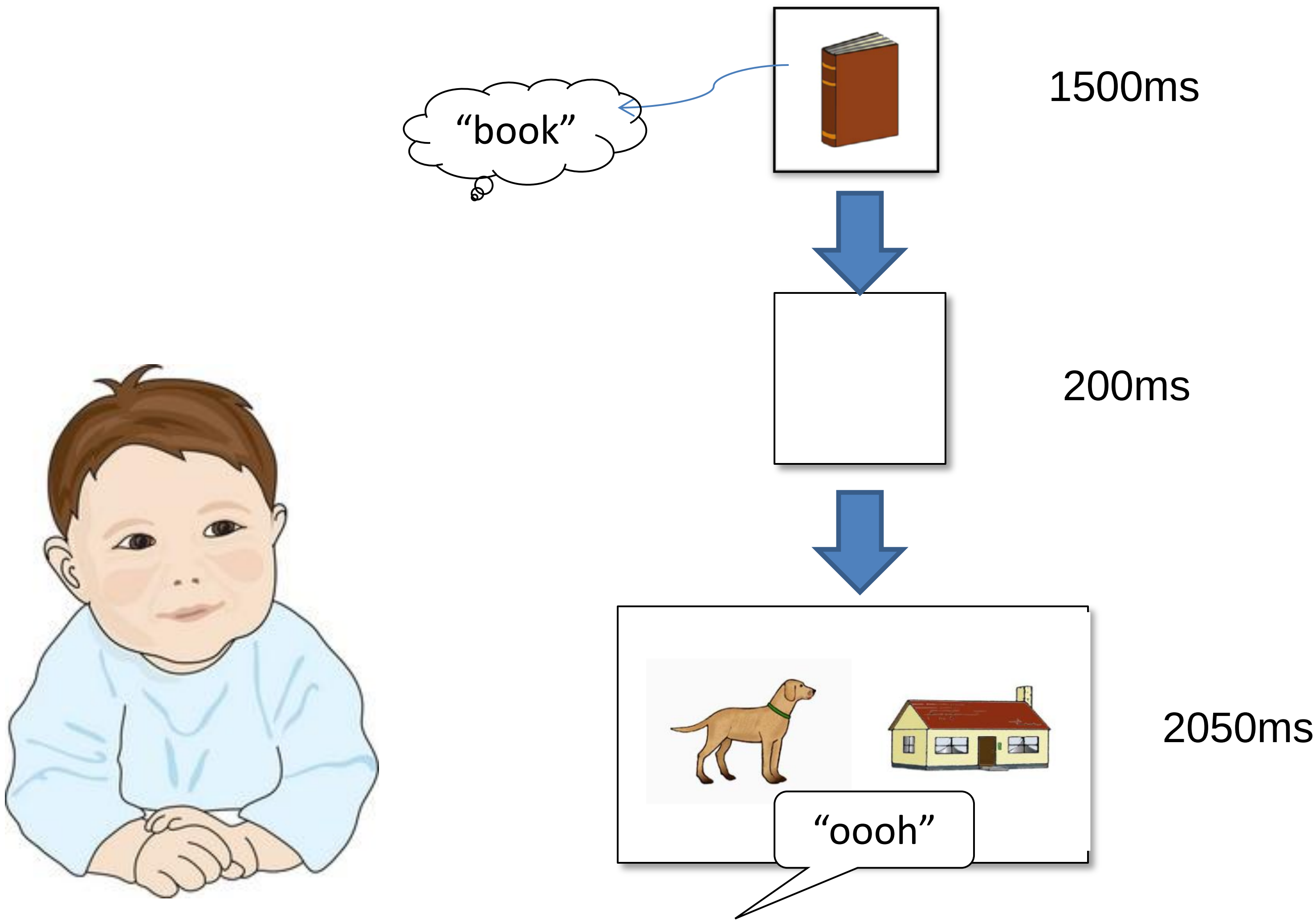
Manizeh Khan

Phonosemantic activation.... without speech

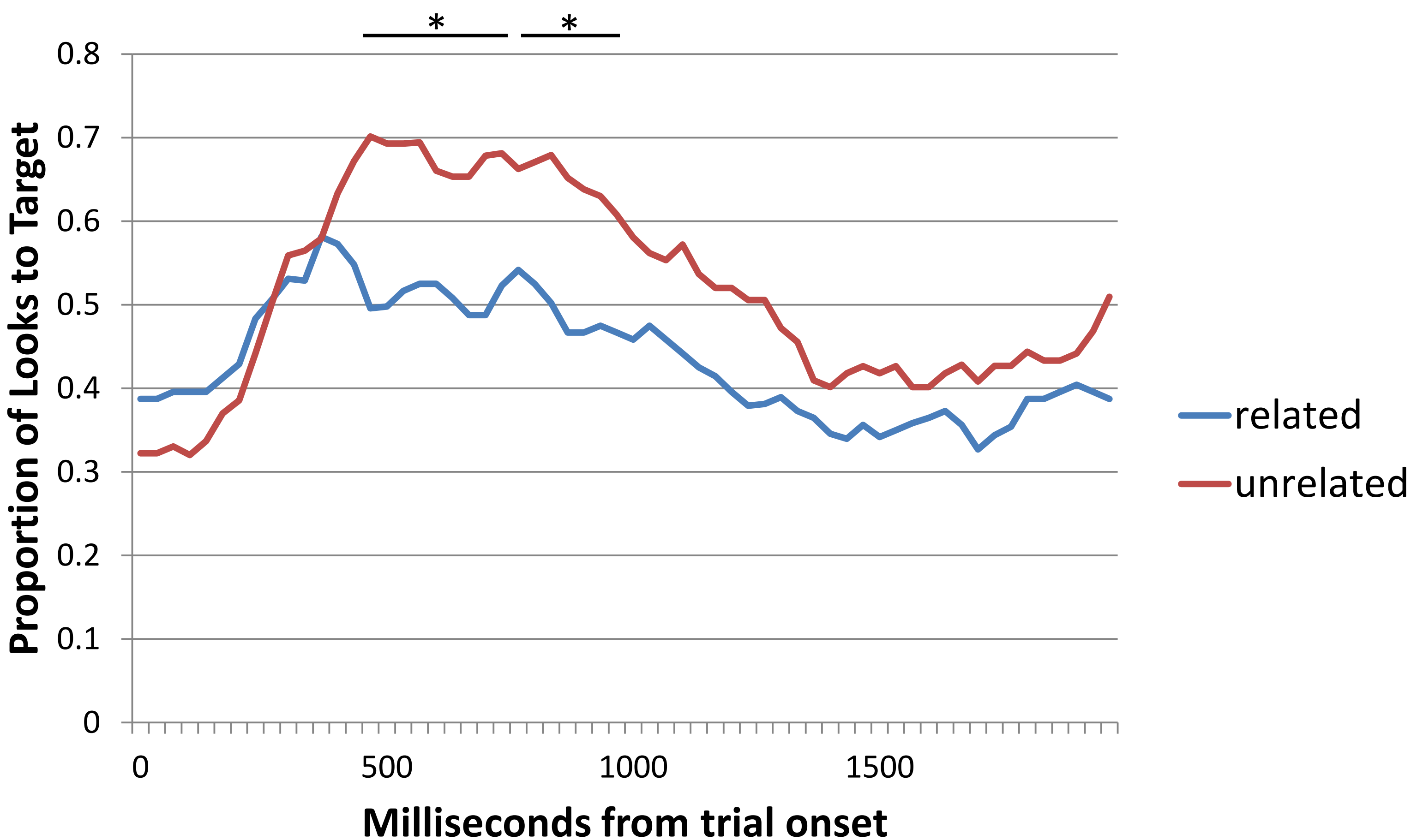


Inspired by
Mani, Durrant & Floccia (2012)

Unrelated Trials



Implicit naming leads to phonosemantic activation in 24 month olds



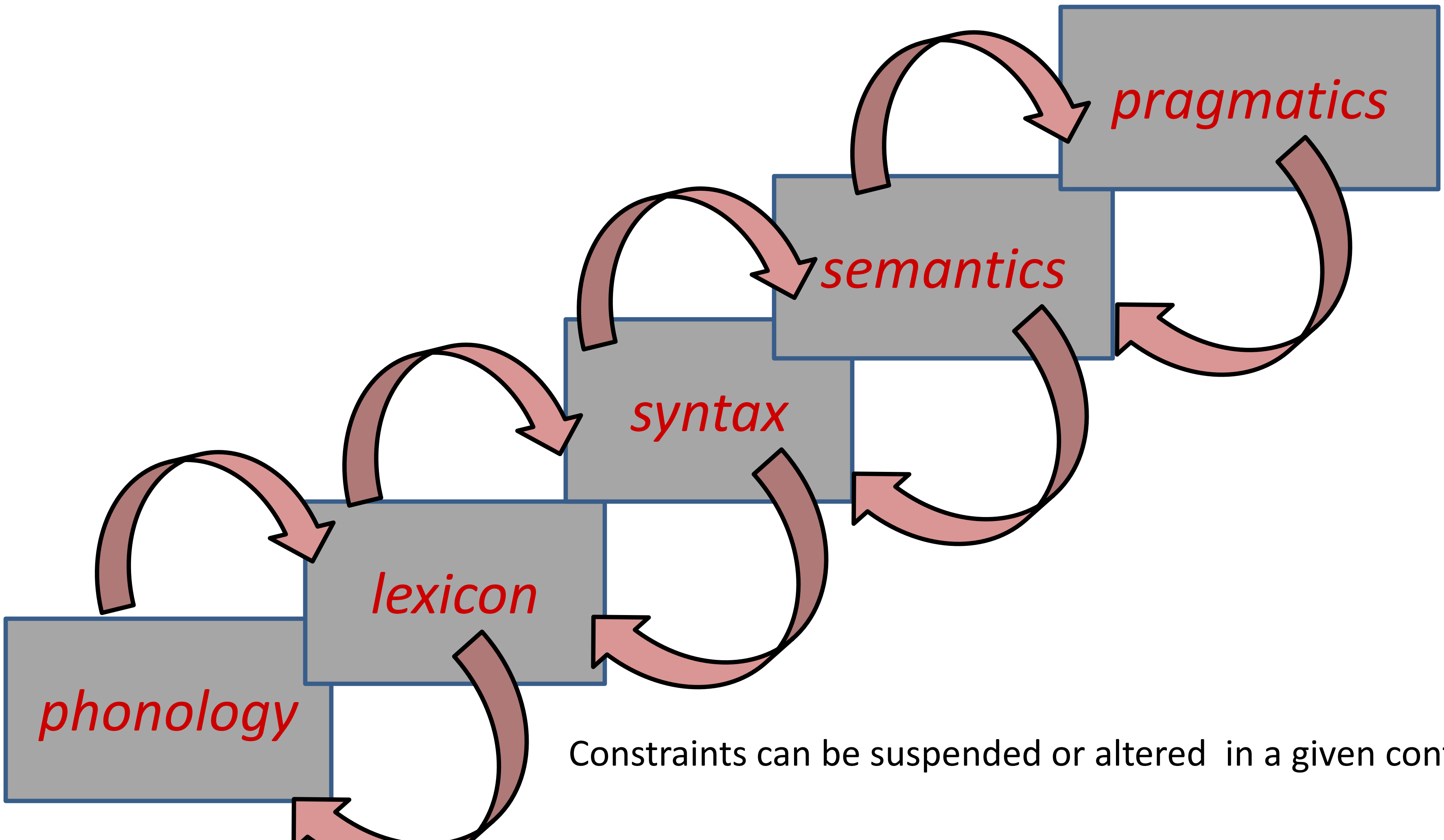
Khan, Geojo, Wang & Snedeker, in prep

In adults, verbal encoding is task dependent

- *Lexical activation* present in nonlinguistic tasks?
  - Homophonous competitors are fixated in visual search (Meyer et al., 2007) and free viewing (Khan, Fitts & Snedeker, in prep)
- *Phonological activation* absent in purely nonlinguistic tasks
  - Visual search (Telling, 2009; Zelinsky & Murphy, 2000) and free viewing (Khan et al., in prep)
- But *phonological activation* present in “optionally” linguistic tasks
  - Working Memory Task (Zelinsky & Murphy, 2000)
  - Free viewing, prime unlabeled but target labeled (Mani, pc 2014)

21st Century Standard Model:

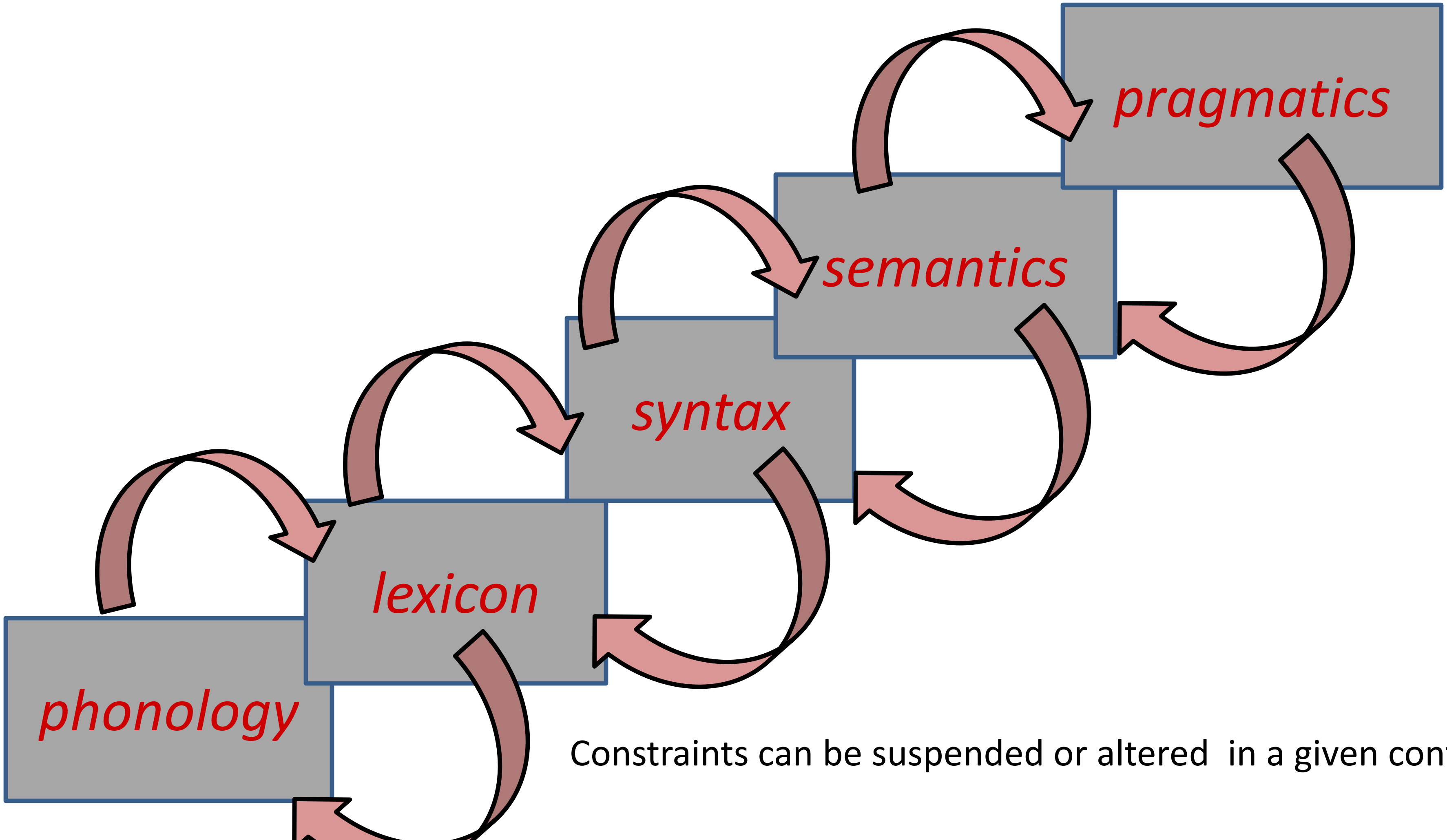
6. Processing is flexible/dynamic



Constraints can be suspended or altered in a given context

21st Century Standard Model:

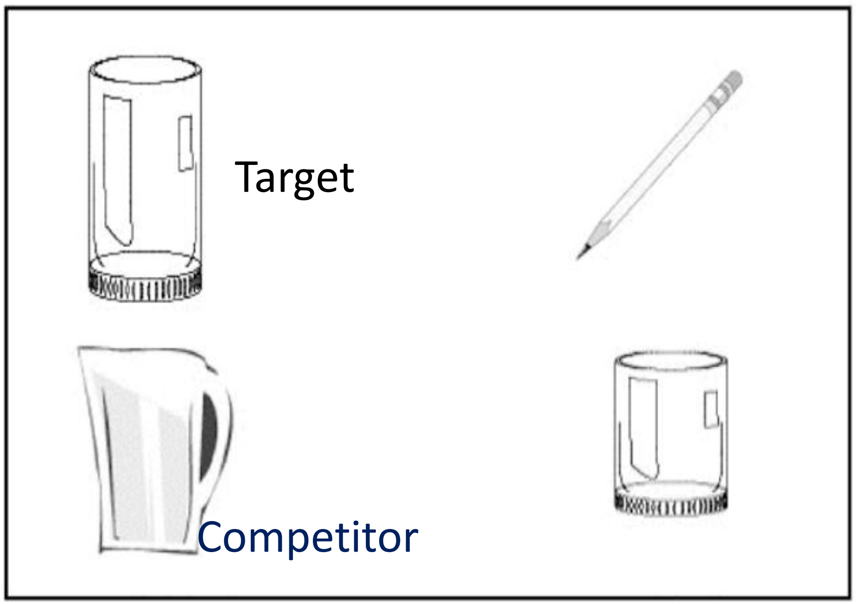
6. Processing is flexible/dynamic



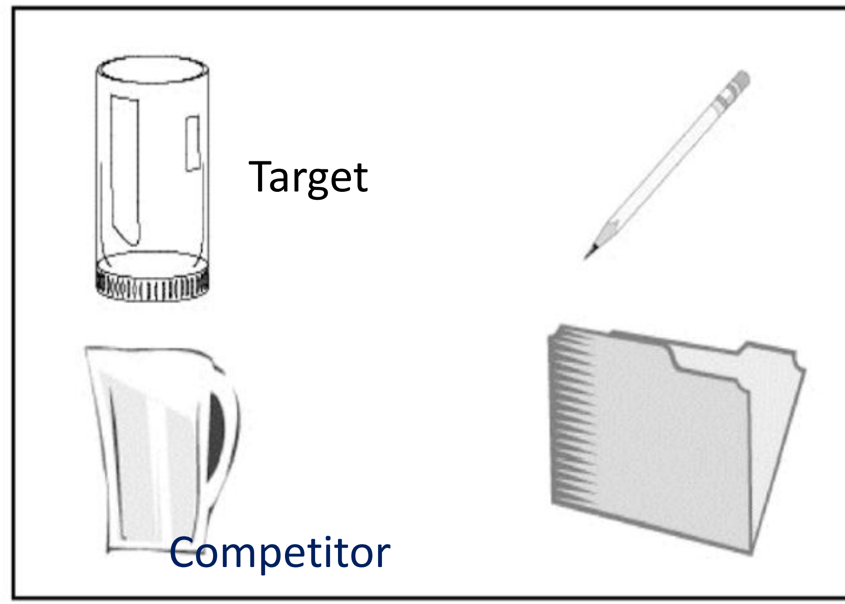
Constraints can be suspended or altered in a given context

Sedivy (1999): adjectives and informativity

"Pick up the tall glass"

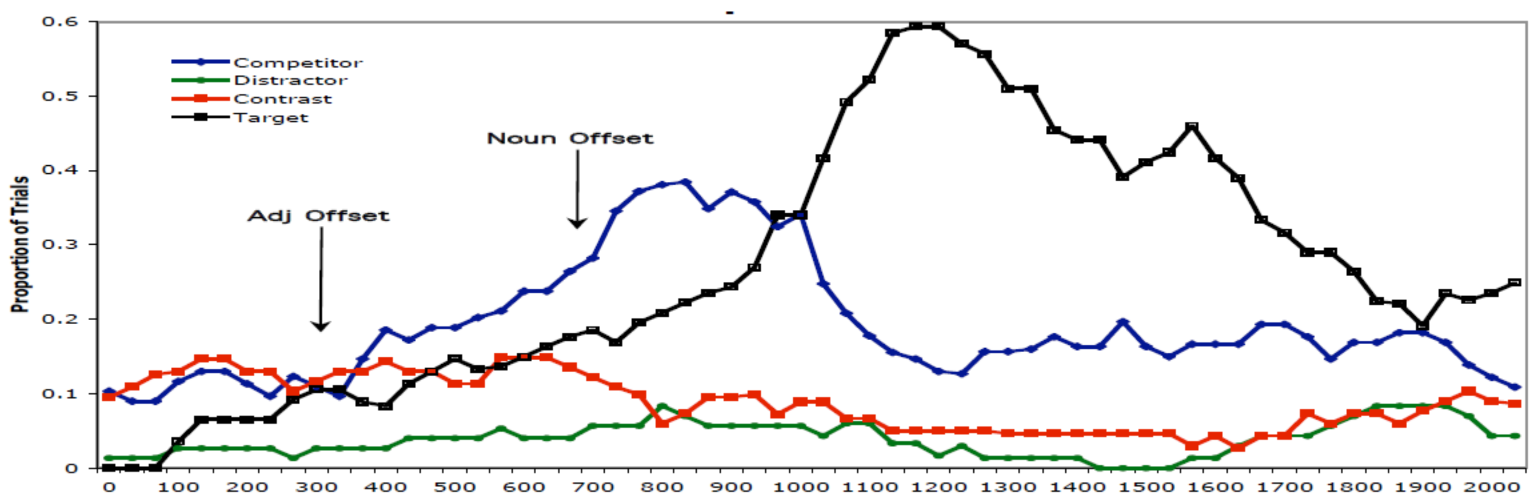


Contrast

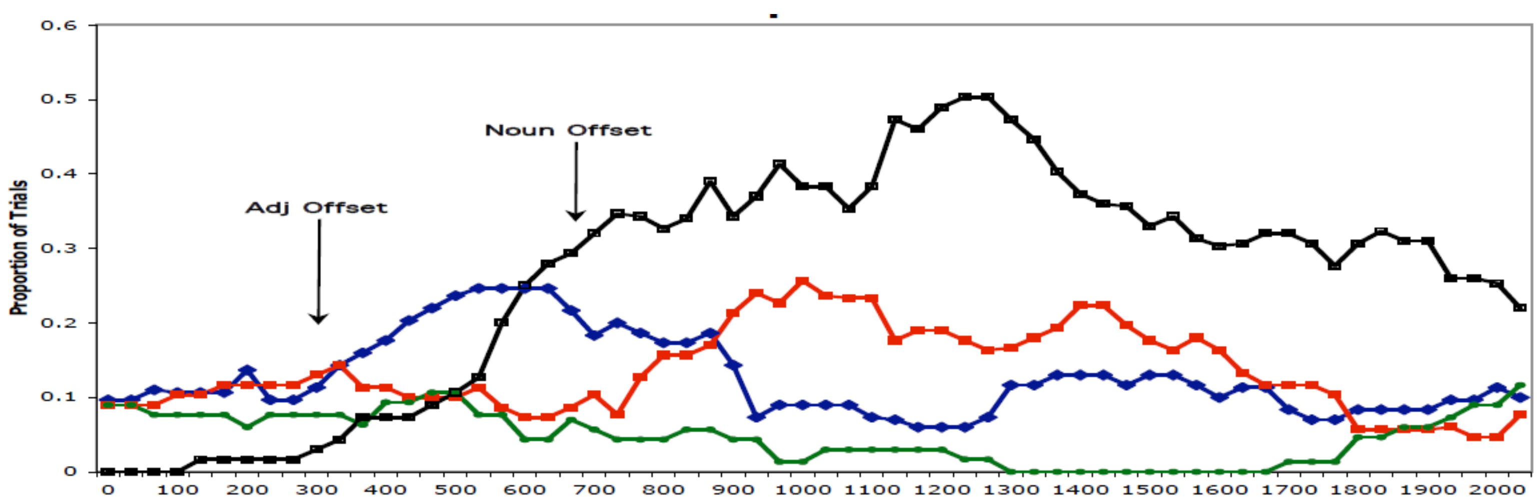


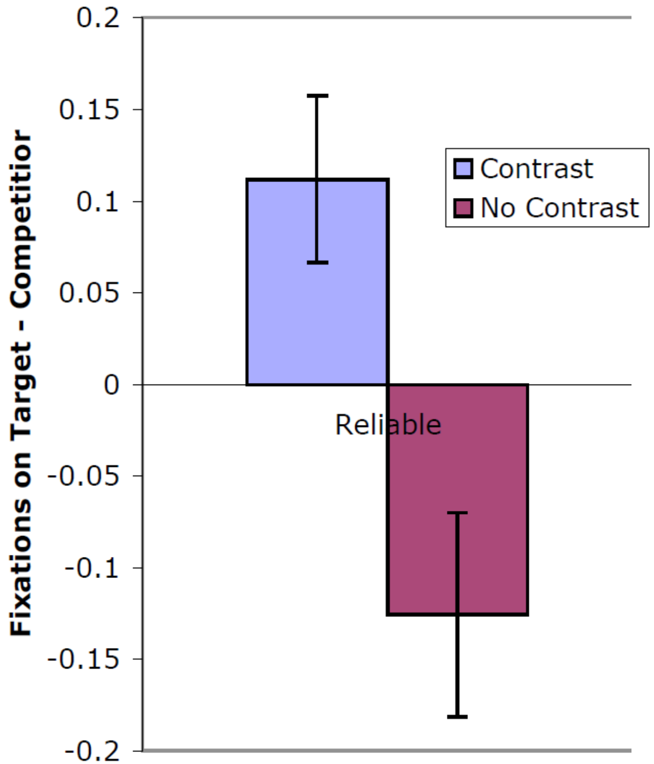
No Contrast

No Contrast: Prolonged Interference



Contrast: More Rapid Target Looks





Contrast Effect

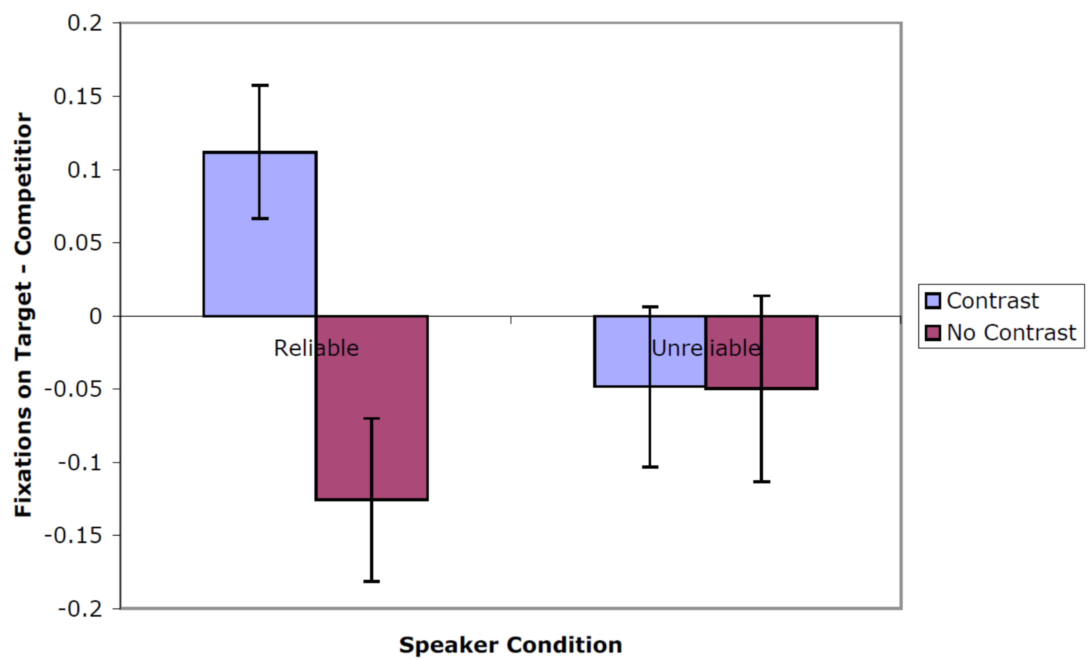
- Similar for Material Adjectives (china)
- Present in questions
  - Is there a tall glass?
- Pattern for color adjectives reflects production patterns

Suggests that its inference based on speaker model (pragmatic)

Sedivy et al., 1999; Sedivy, 2003

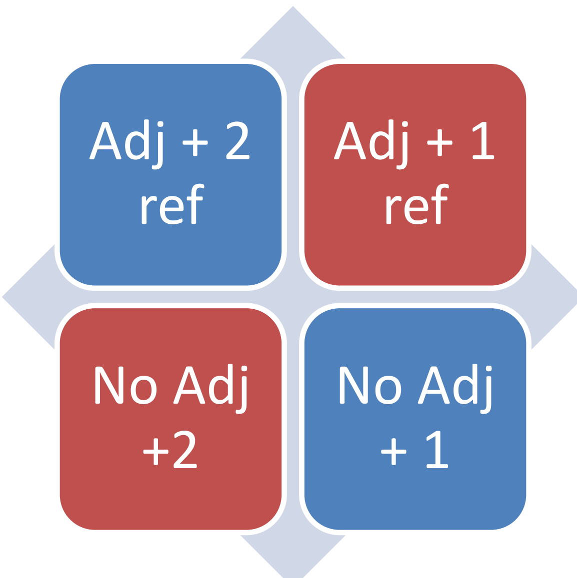
Strange Speaker Manipulation (Grodner & Sedivy, 2011)

- Reliable Condition: Speaker is subject in study, initially produces optimally informative utterances
- Unreliable Condition: Speaker has social/language disorder, gives impossible instructions on filler trials, consistently over-informative



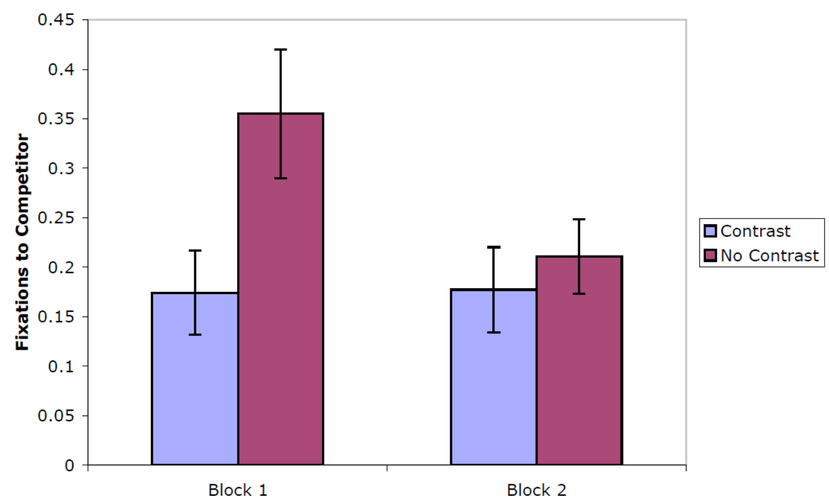
Issue for experimental design

- Most common design: cue pitting



- Results in infelicitous utterances

- Participants adjust quickly

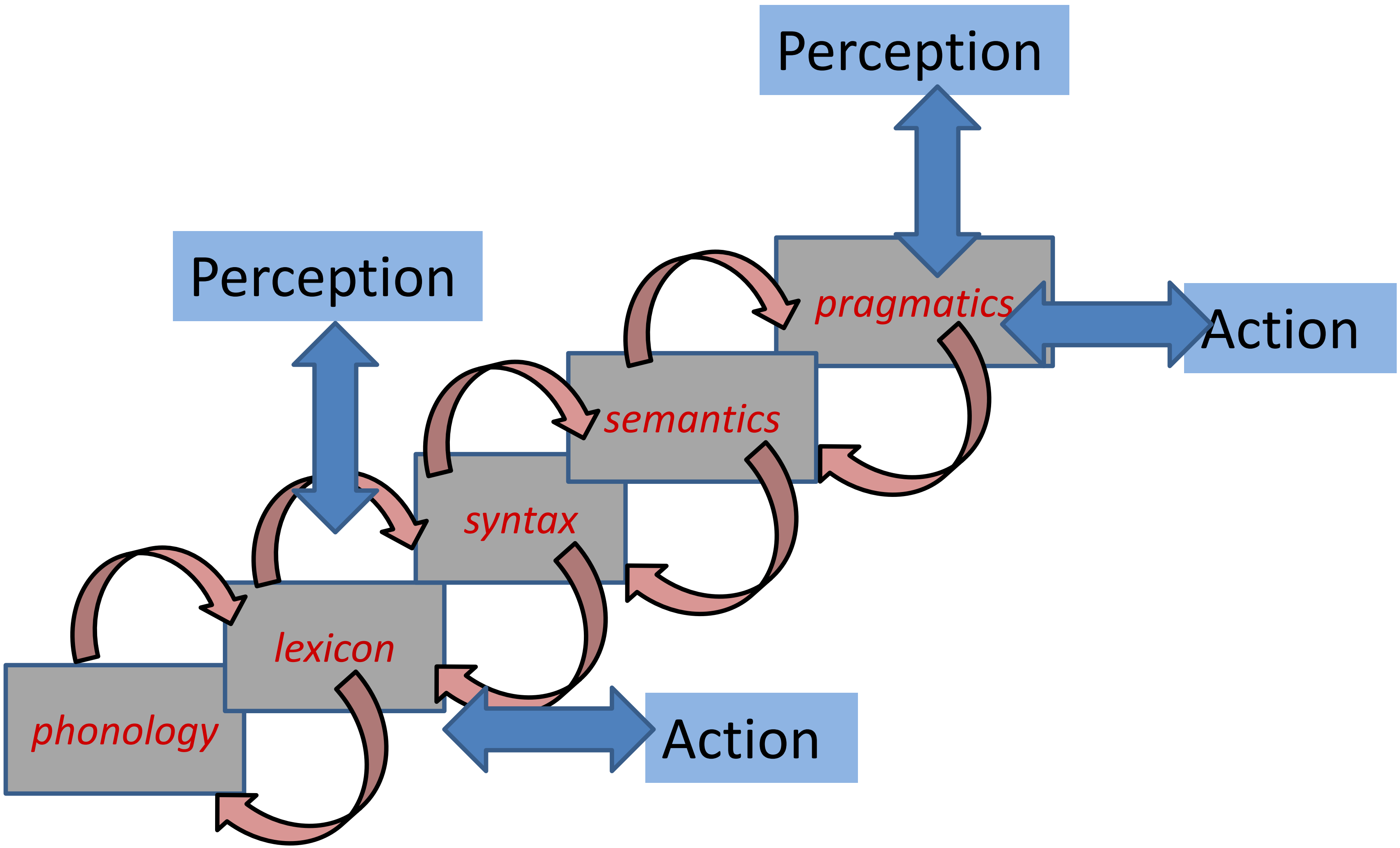


Reliable Speaker: 35 min, 20 critical trials

Processing system is highly dynamic

- Strange speaker manipulation eliminates expectation that disfluent nouns refer to unusual objects (Arnold & Tanenhaus, 2011)
- Semantic priming depends on the proportion of primes in the stimuli (Bodner & Masson, 2003)
- Use of a given syntactic or semantic structures primes subsequent use
  - Syntax: double object vs. prepositional dative (Bock)
  - Scope ambiguity (Raffery & Pickering)

21st century standard model is pervasive



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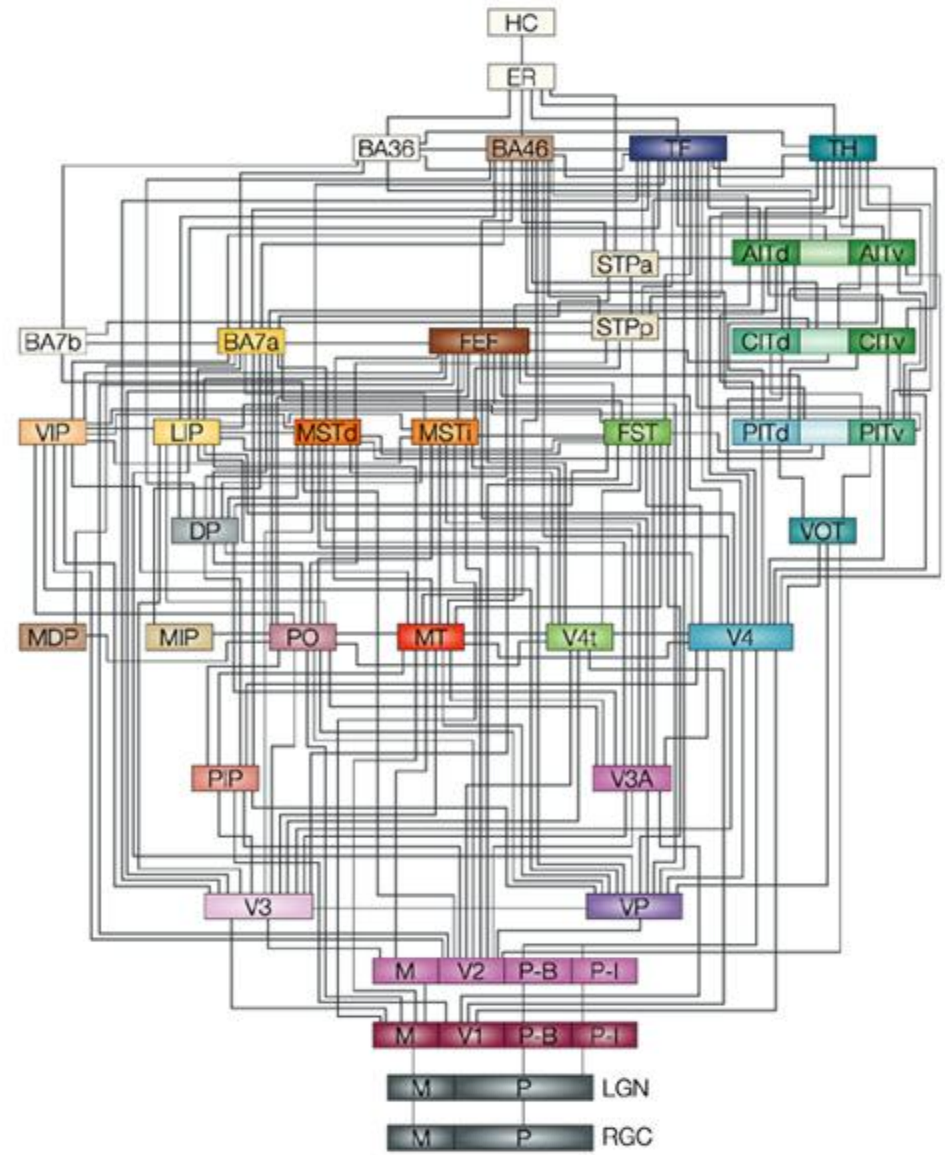
21^{st} century standard model is pervasive

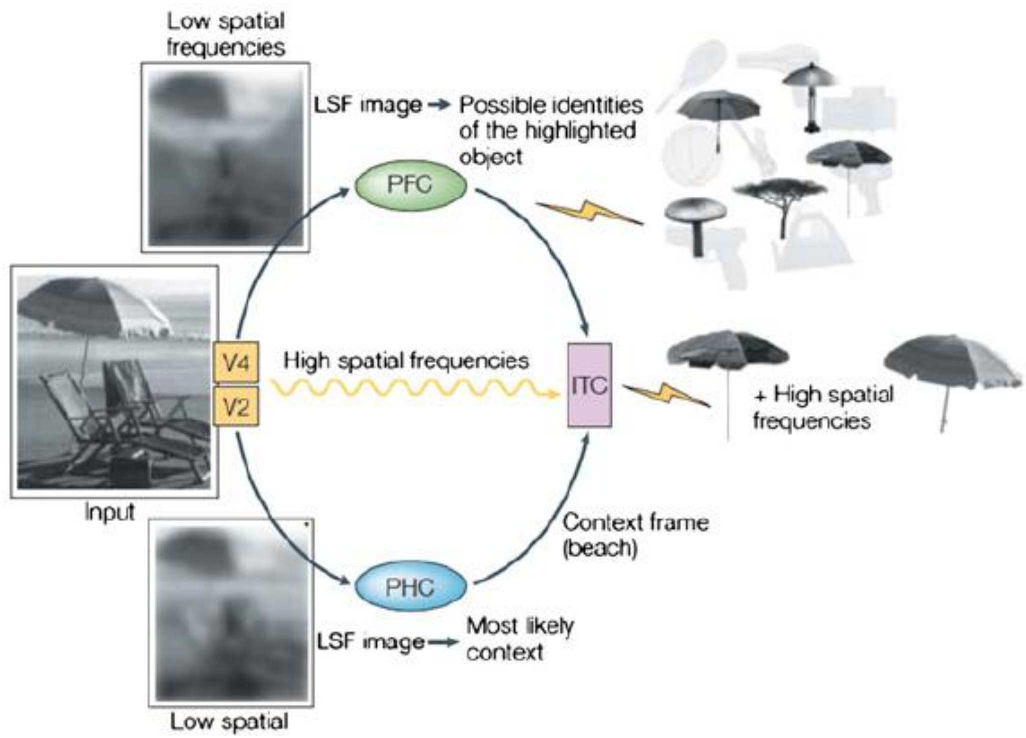
Example: visual areas in macaque



Rees, Kreiman & Koch (2002)

21^{st} century standard model is pervasive

Example:
Barr's model of context in visual perception



Cheung & Barr (2011)

Modularity is dead but linguistics need not mourn

- <u>Information encapsulation </u>can only be saved by becoming vacuous
- But <u>domain-specificity</u> is alive and well
  - Uncontroversial forms (levels)
  - Controversial forms (distinct processes, divergent characteristics of each of level)
- Nativism does not depend on either

Implications for Experimental Pragmatics

Lesson 1:
Need to consider multiple time scales

Four time scales in any experiment

- Time since the trigger word (ms)
  - N400, gaze shift 200-1200 after word onset….
- Time since the cue appeared (ms to min)
  - Between-subjects design: earlier in sentence
  - Within-subjects design: earlier in study
- Time in experiment (sec to days)
  - Over short time scales processing adapts
- Developmental time (years)
  - What is the history of participants experience with this information

Four time scales in any experiment

- Time since the trigger word (ms)
  - N400, gaze shift 200-1200 after word onset….
  - Temptation to think of this as "processing time"
- Time since the cue appeared (ms to min)

Sometimes these are the same, and sometimes they are different….

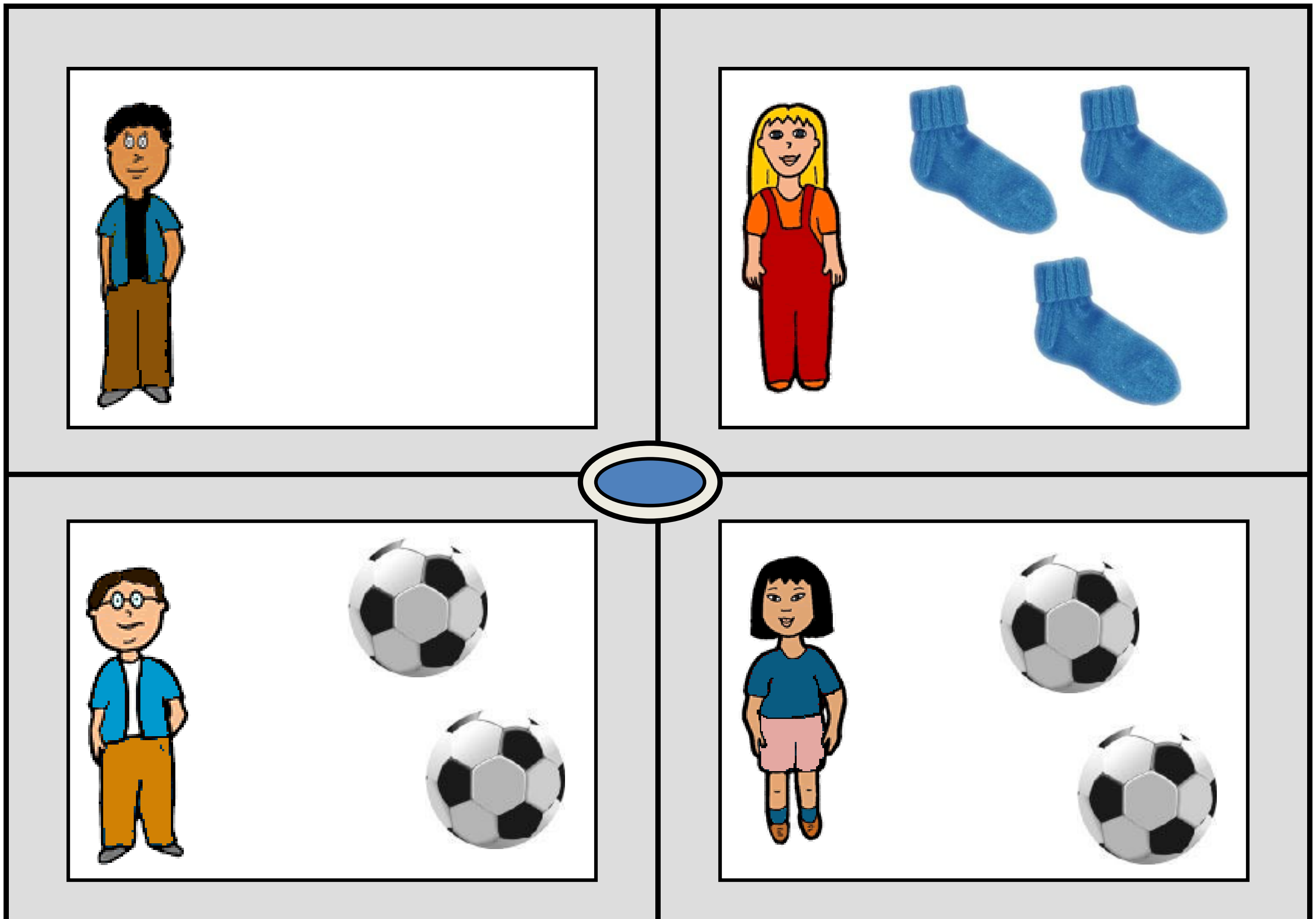
Cue is the trigger (Huang & Snedeker, 2009; 2011)

Design real time SI processing task simple enough for a child

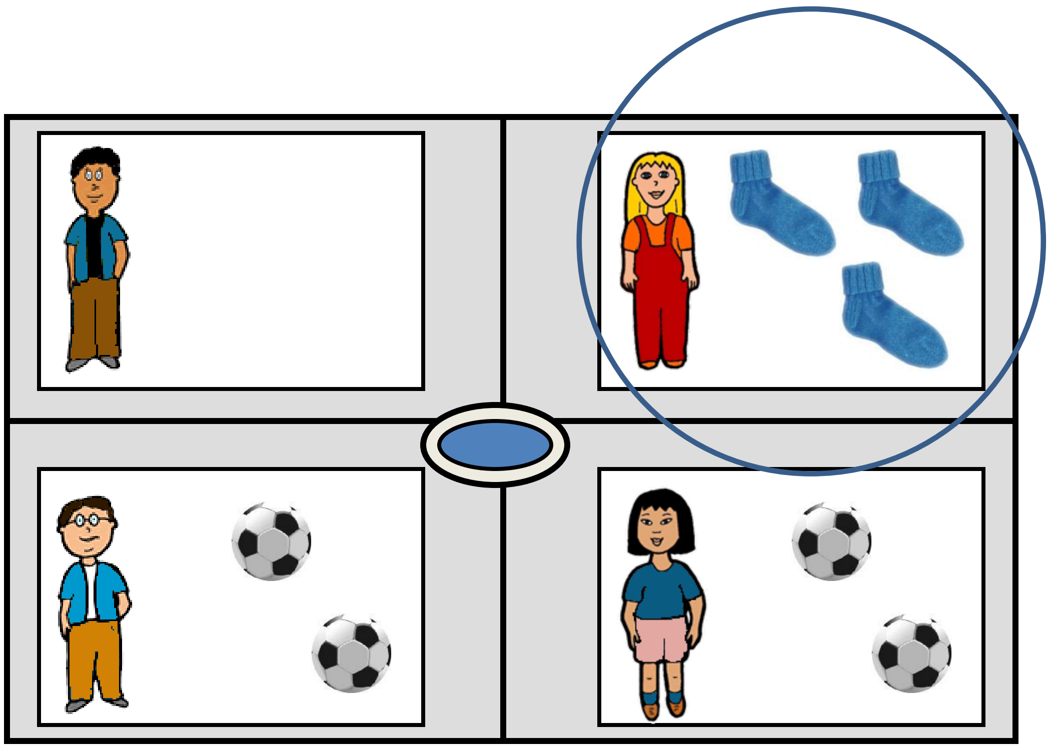
Is the lower-bounded meaning of "some" available before the SI?

When are SI's made?

Yi Ting Huang

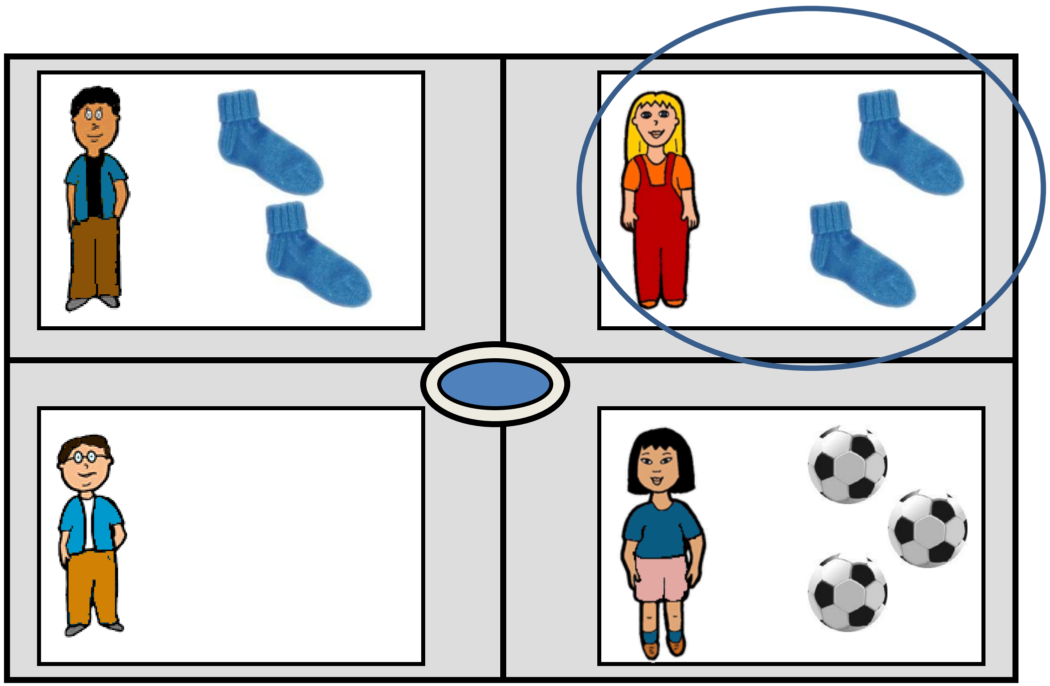


“Point to the girl that has <u>all/three</u> of the socks.”

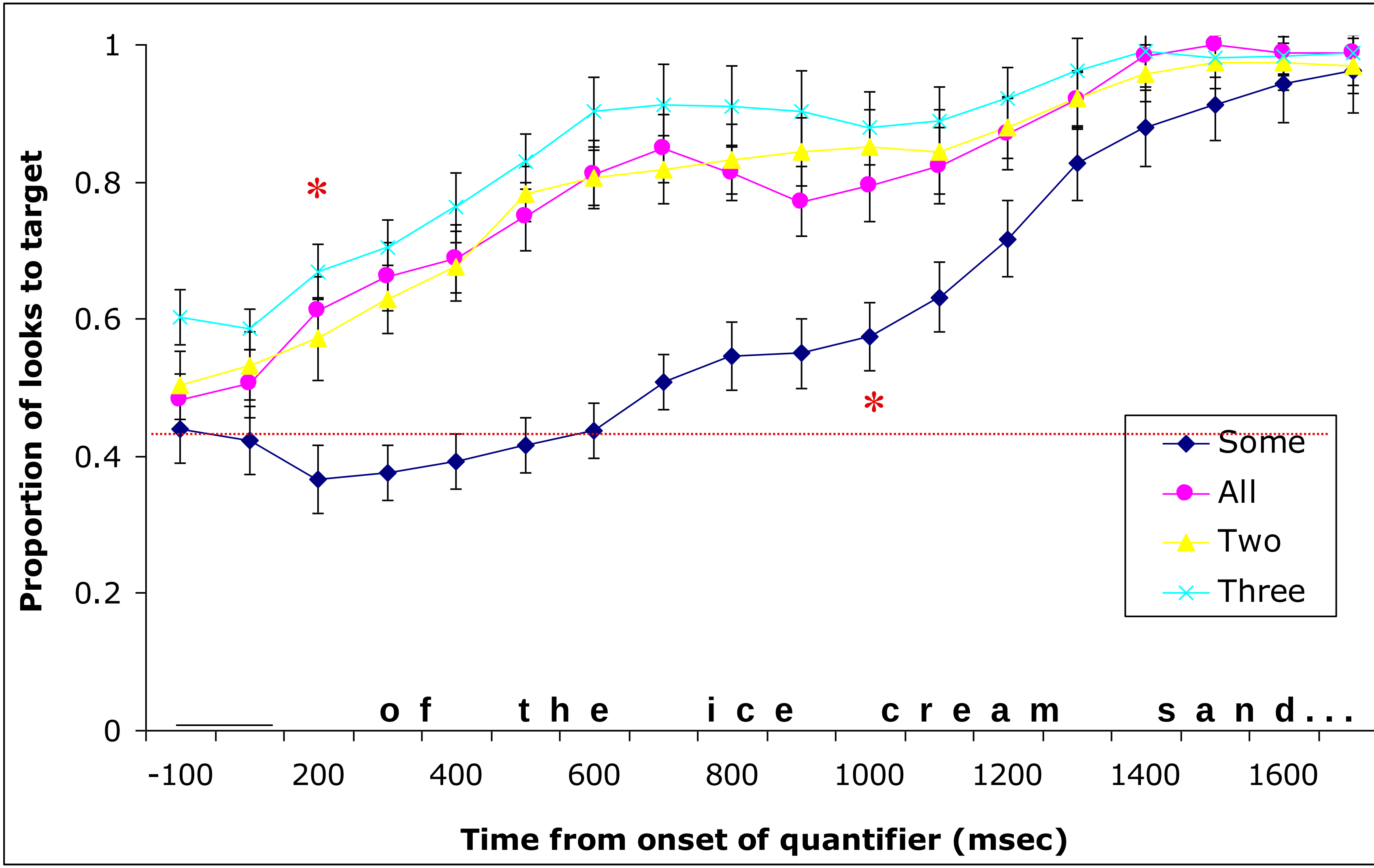


Quantifier is both the cue and trigger

"Point to the girl that has <u>some/two</u> of the socks."



~800ms delay in looks to target

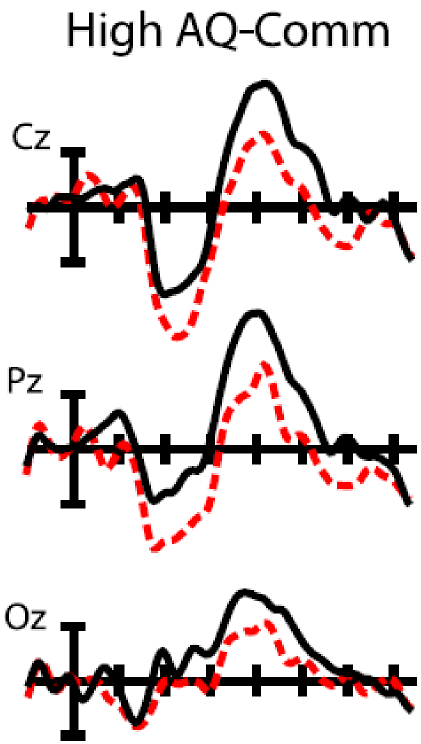


Huang & Snedeker, 2011

Cue before trigger: Nieuwland et al., 2010

Some people have lungs/pets, which require good care

N400 greater for "lungs"



Underinformative — Some people have **lungs**, ...

Informative — Some people have **pets**, ...

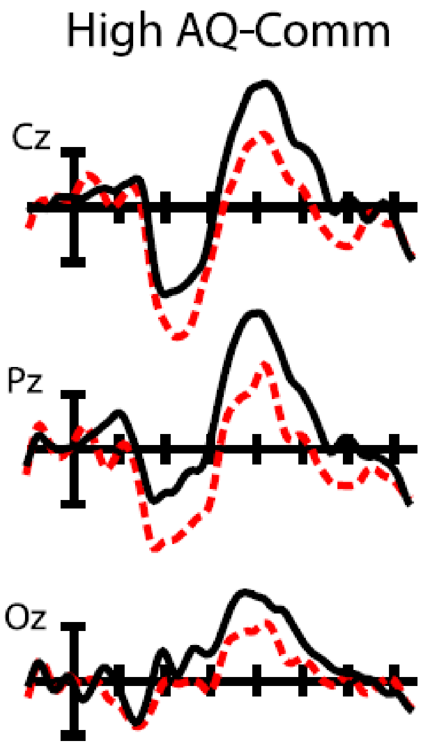
Cue before trigger: Nieuwland et al., 2010

Some people have <u>lungs/pets</u>, which require good care

Scalar Implicature within 400 ms?

No. Cue came ~1300ms earlier

SI by <u>1700ms</u>



Underinformative: Some people have **lungs**, ...

Informative: Some people have **pets**, ...

Four time scales in any experiment

- Time since the trigger word (ms)
  - N400, gaze shift 200-1200 after word onset….
  - Temptation to think of this as “processing time”
- Time since the cue appeared (ms to min)
  - Well controlled between-subjects design: earlier in the sentence or paragraph
  - Within-subjects design or a confounded design (see below)

Four time scales in any experiment

- Time since the trigger word (ms)
  - N400, gaze shift 200-1200 after word onset….
- Time since the cue appeared (ms to min)
  - Between-subjects design: earlier in sentence
- Time in experiment (sec to days)
  - Learning: subjects may learn what to attend to
  - Unlearning: design may make some cues invalid
  - Priming: low frequency structures become more accessible

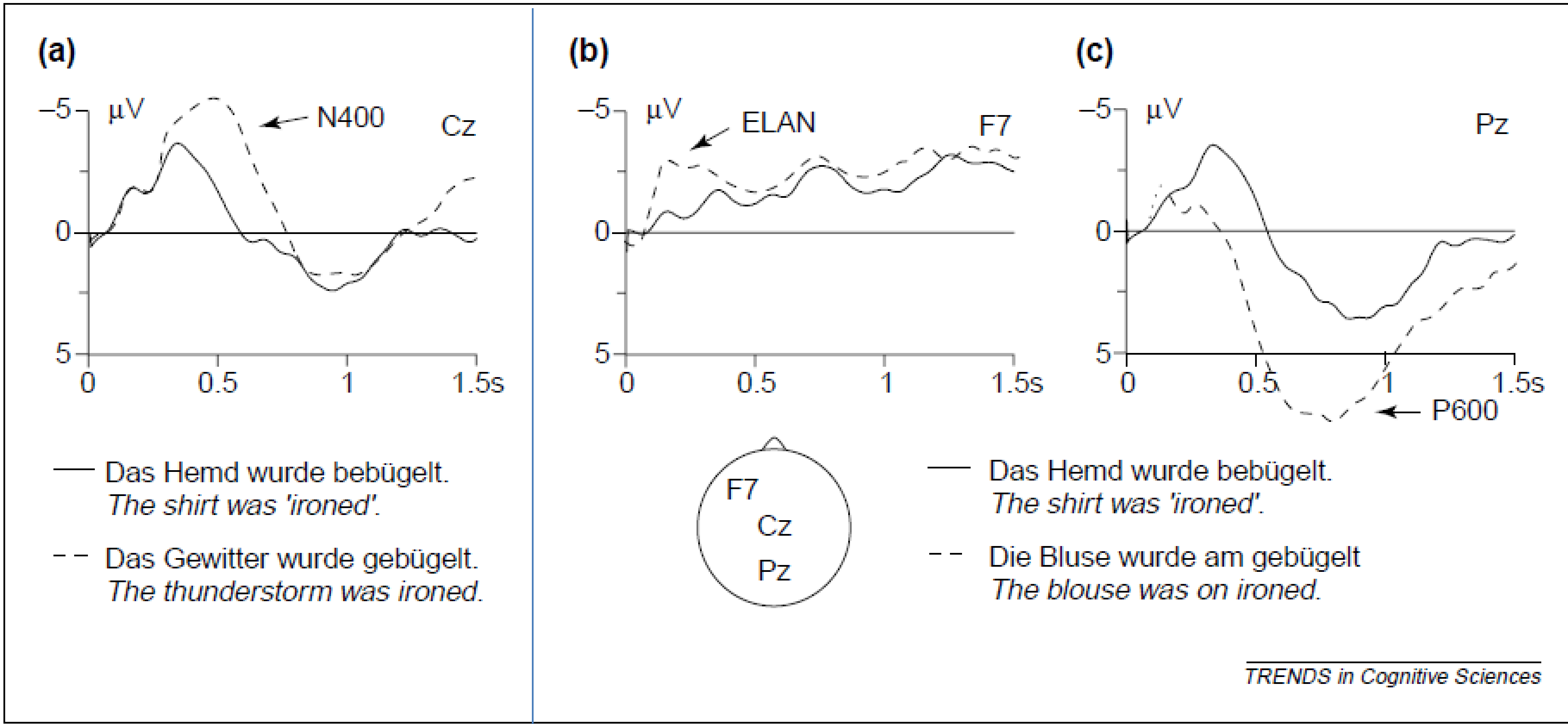
Four time scales in any experiment

- Time since the trigger word (ms)
  - N400, gaze shift 200-1200 after word onset….
- Time since the cue appeared (ms to min)
  - Between-subjects design: earlier in sentence
- Time in experiment (sec to days)
  - Learning: subjects may learn what to attend to
- Developmental time (years)
  - What is the history of participants experience with this information?
  - Begin with corpus studies

Lesson 2:
Determining the representational locus of an effect got harder

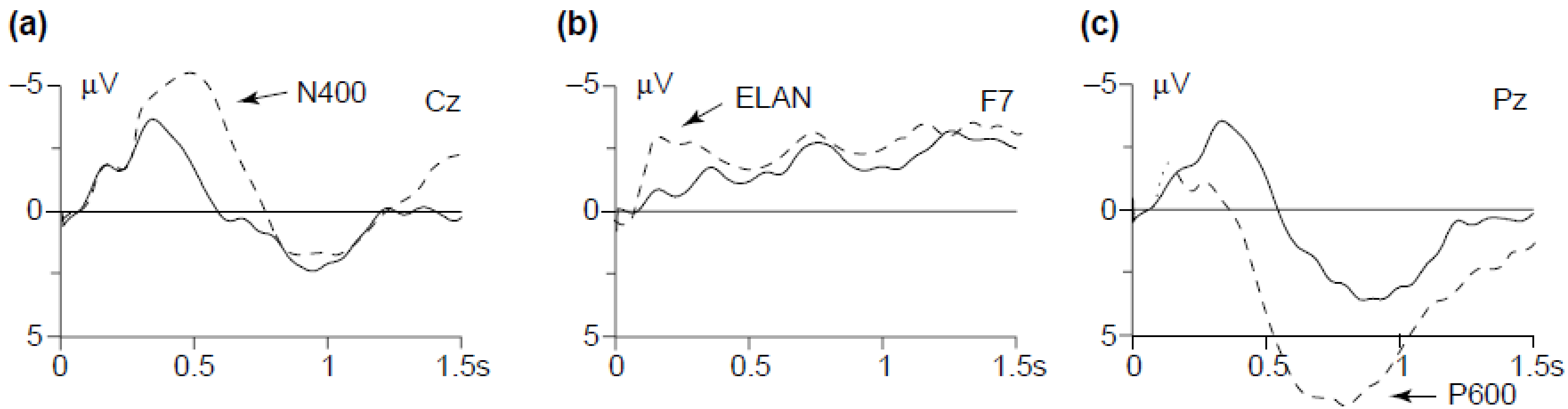
"The component formerly known as the ELAN"

The component formerly known as ELAN



Friederici (2002)

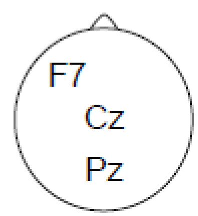
The component formerly known as ELAN



N400

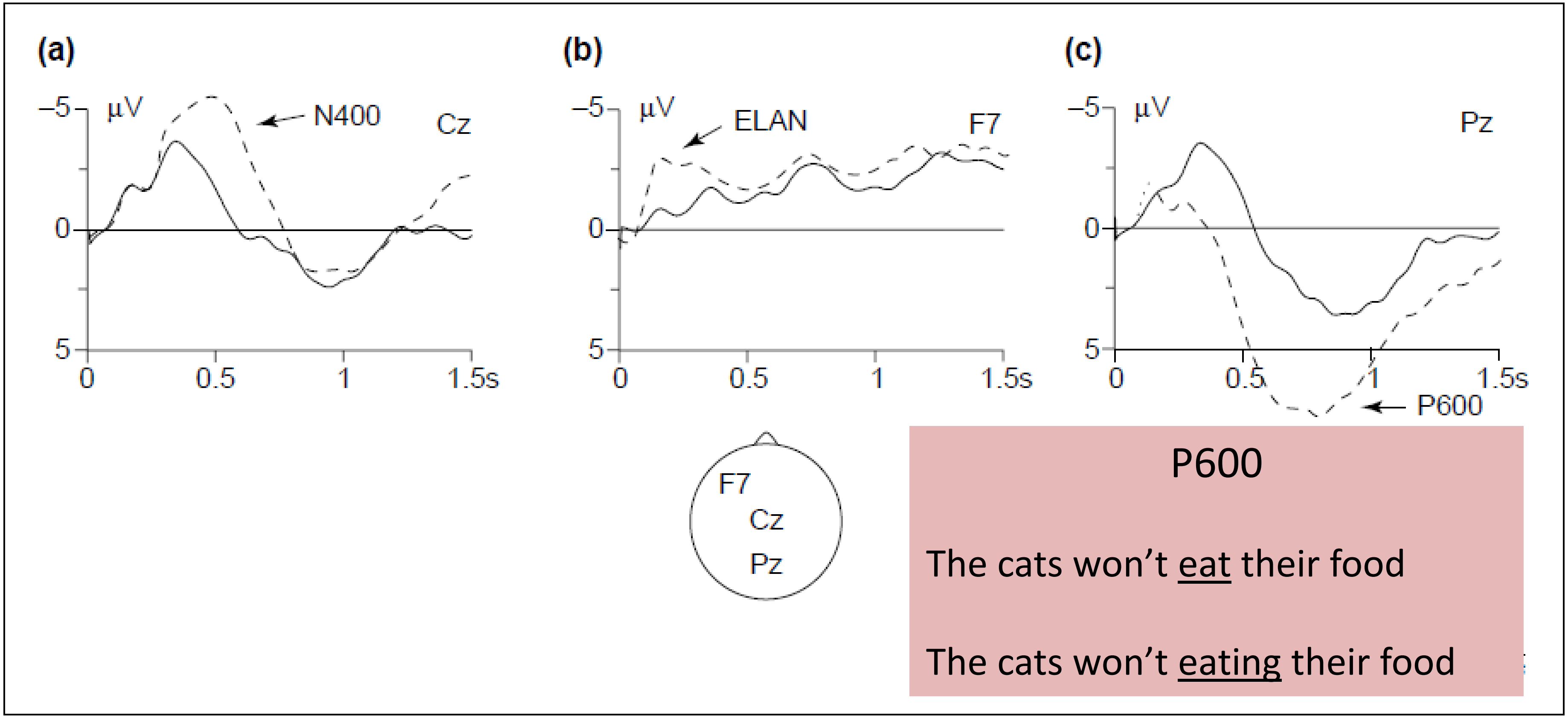
The man ate the delicious <u>apple</u>

The man ate the delicious <u>cart</u>



Friederici (2002)

The component formerly known as ELAN



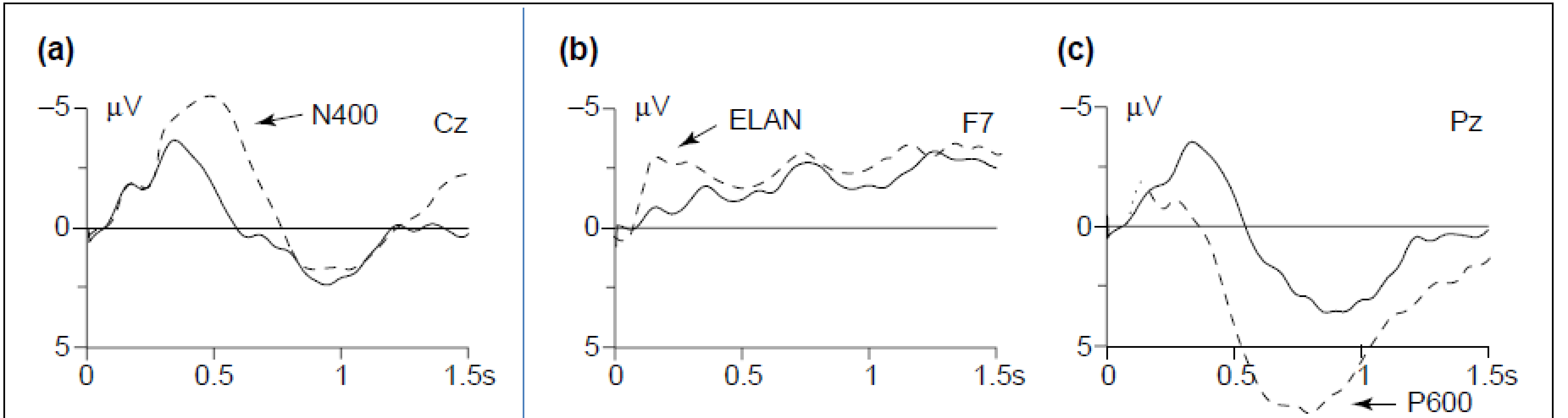
P600

The cats won’t <u>eat</u> their food

The cats won’t <u>eating</u> their food

Friederici (2002)

The component formerly known as ELAN

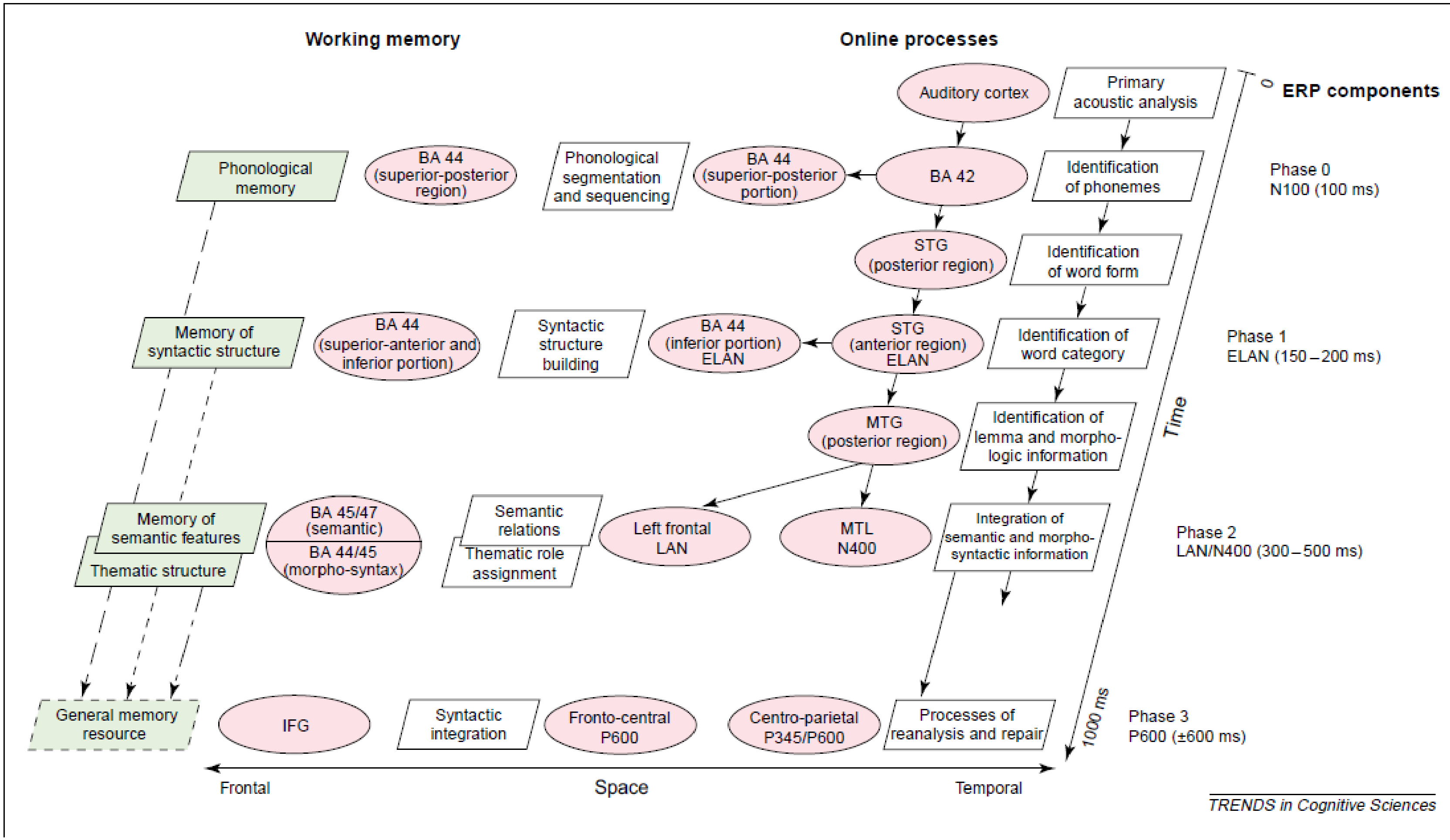


ELAN

(2) a. Das Baby wurde *gefüttert*
The baby was fed
b. * Das Baby wurde <u>im</u> *gefüttert*
The baby was in the fed

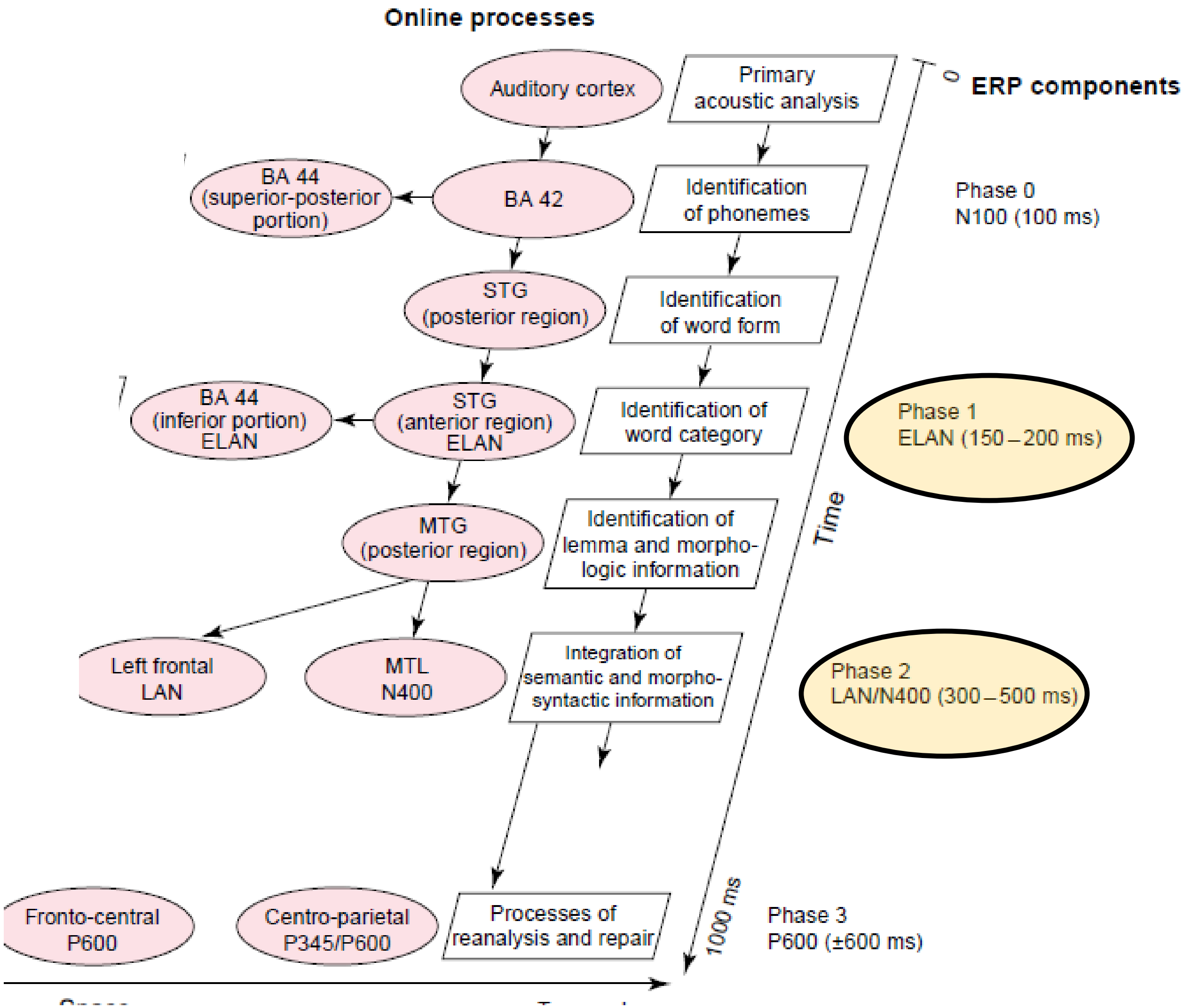
Friederici (2002)

The component formerly known as ELAN



Friederici (2002)

The component formerly known as ELAN

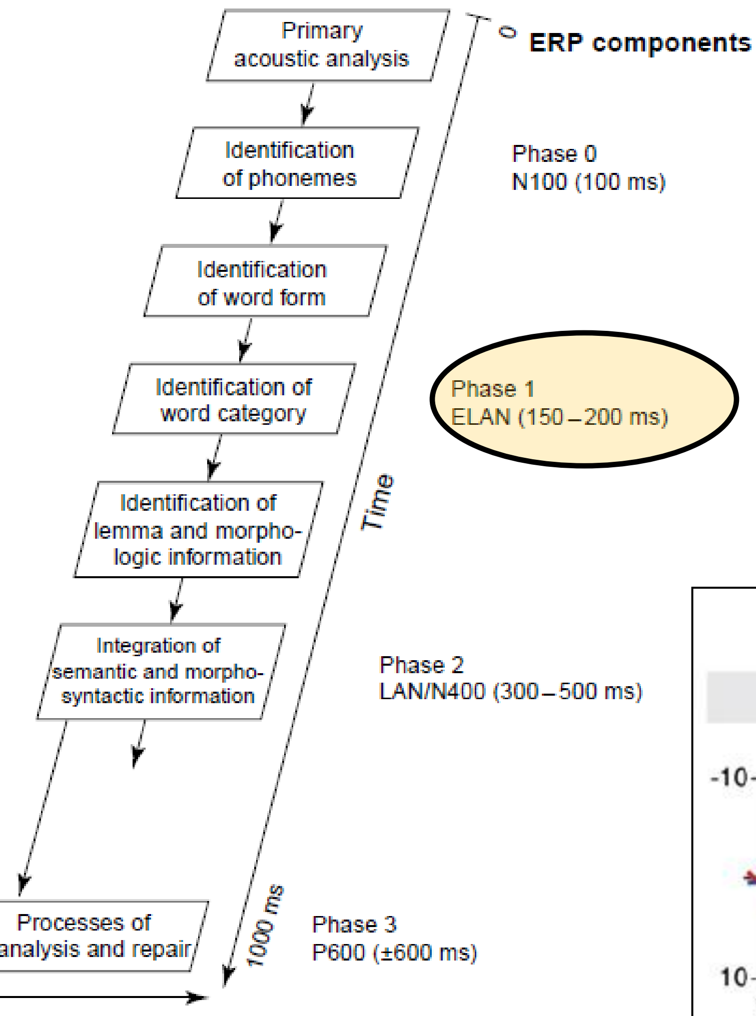


Used to support syntax first

Hard to reconcile with evidence that N400 is linked lexical retrieval

Friederici (2002)

The component formerly known as ELAN

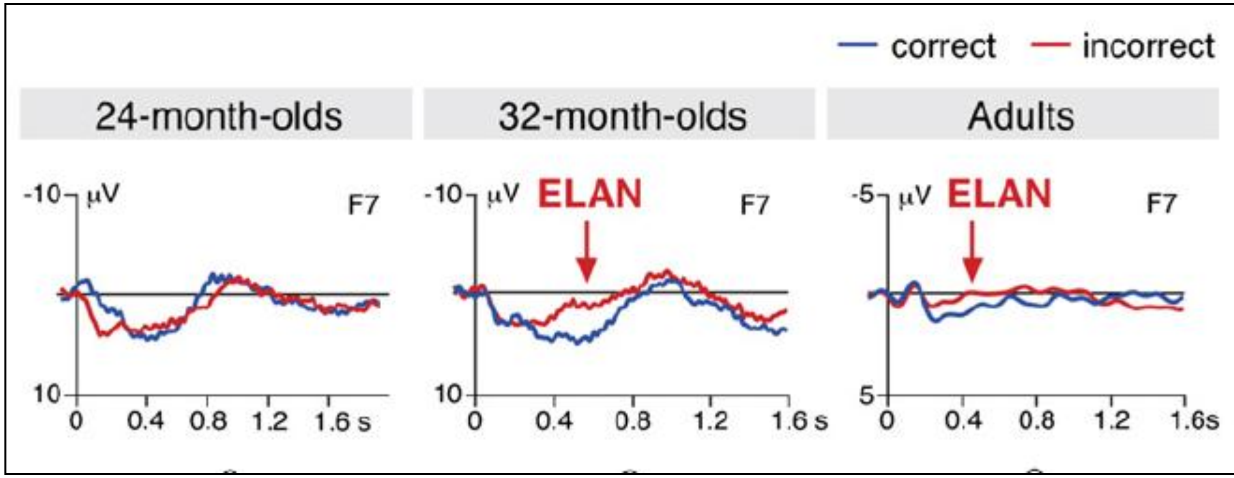


Syntax /ELAN early in processing stream

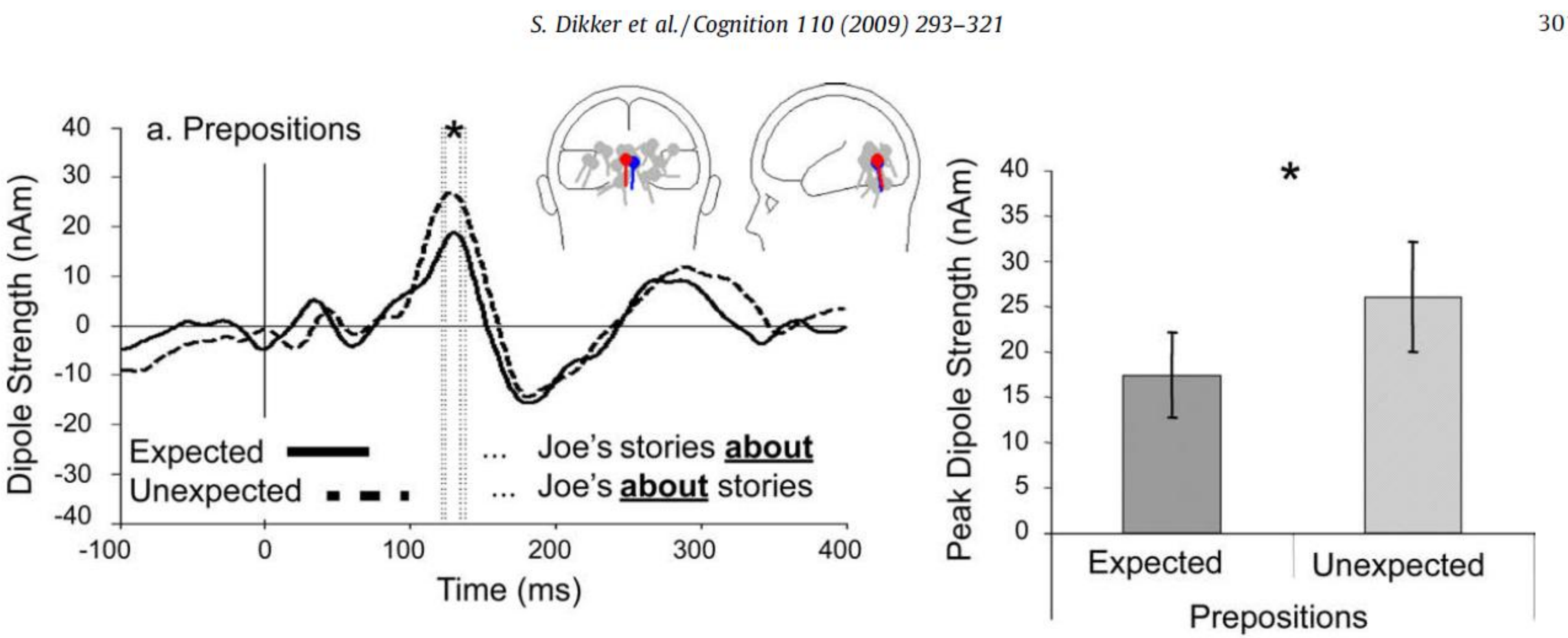
But late in development

How do children interpret sentences? How does it change?

Friederici (2006)



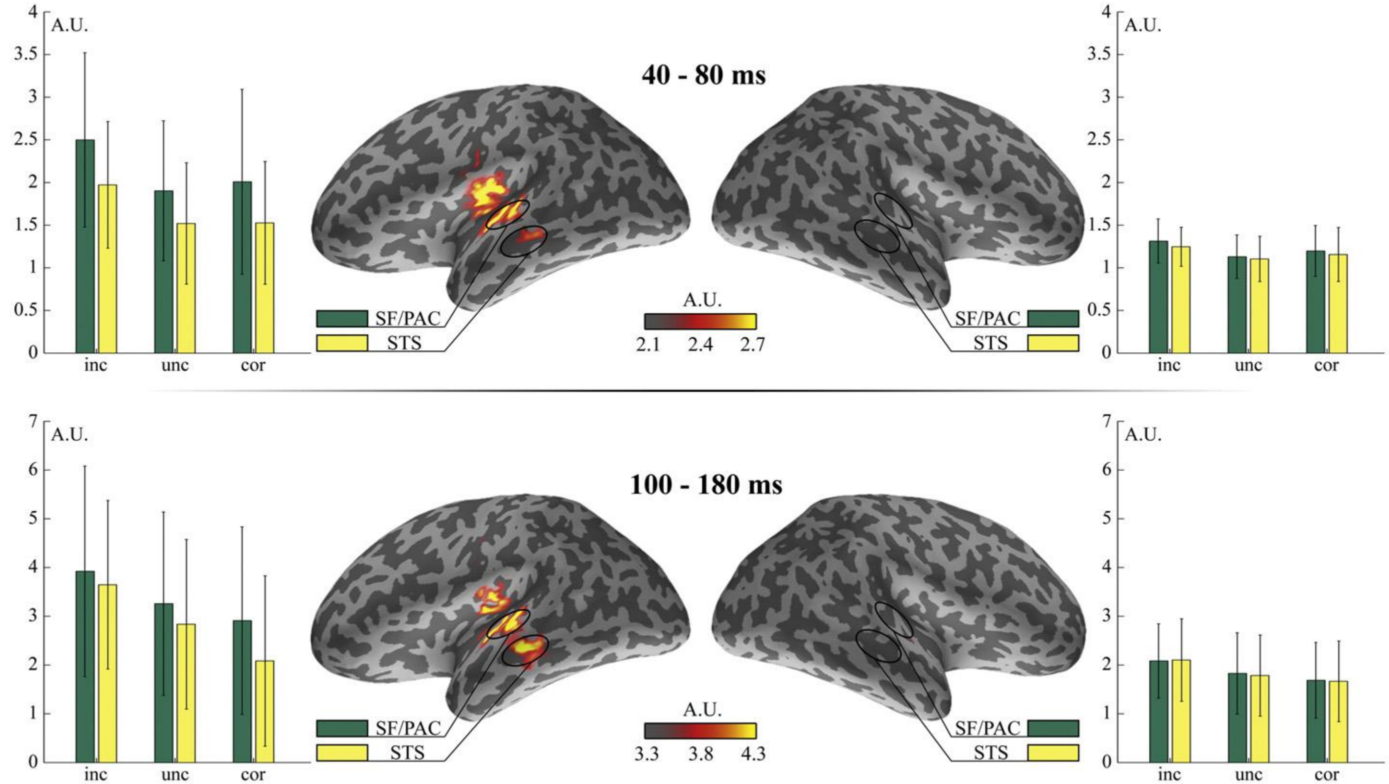
In reading ELAN localizes to visual cortex
(Dikker, Rabagliati & Pylkkänen, 2009)



United with prior sensory components: M100, MMN, N100 or P200….

During spoken language ELAN effects are generated in auditory cortex

B. Herrmann et al. / NeuroImage 48 (2009)



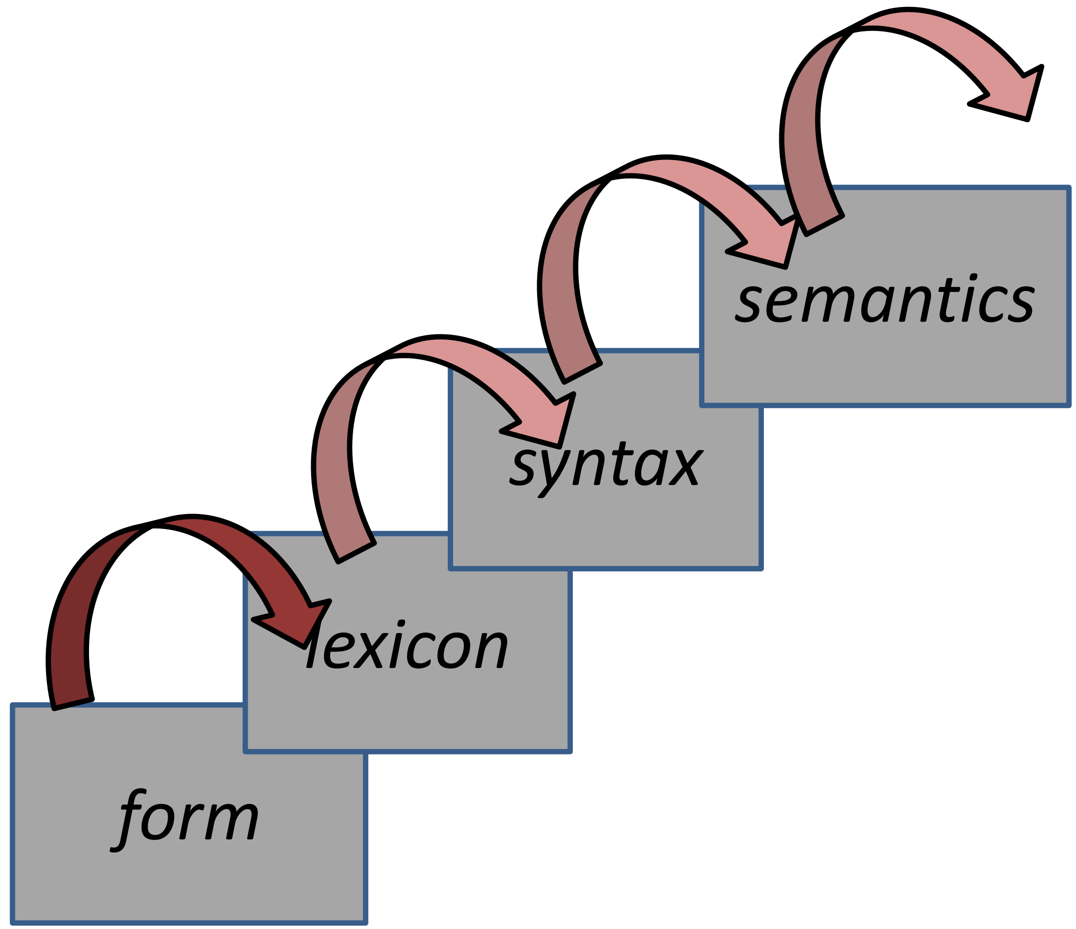
What is happening?

1. Prior words are processed generating syntactic structure (semantics etc)

The

discovery

was



What is happening?

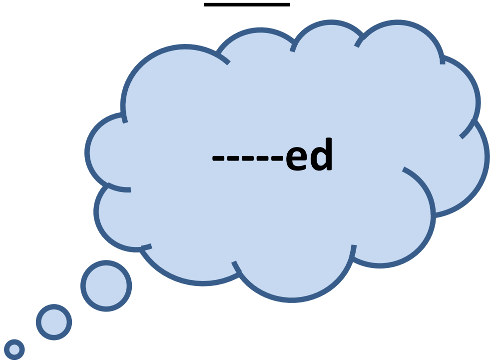
2. Syntactic constraints generate prediction about perceptual form

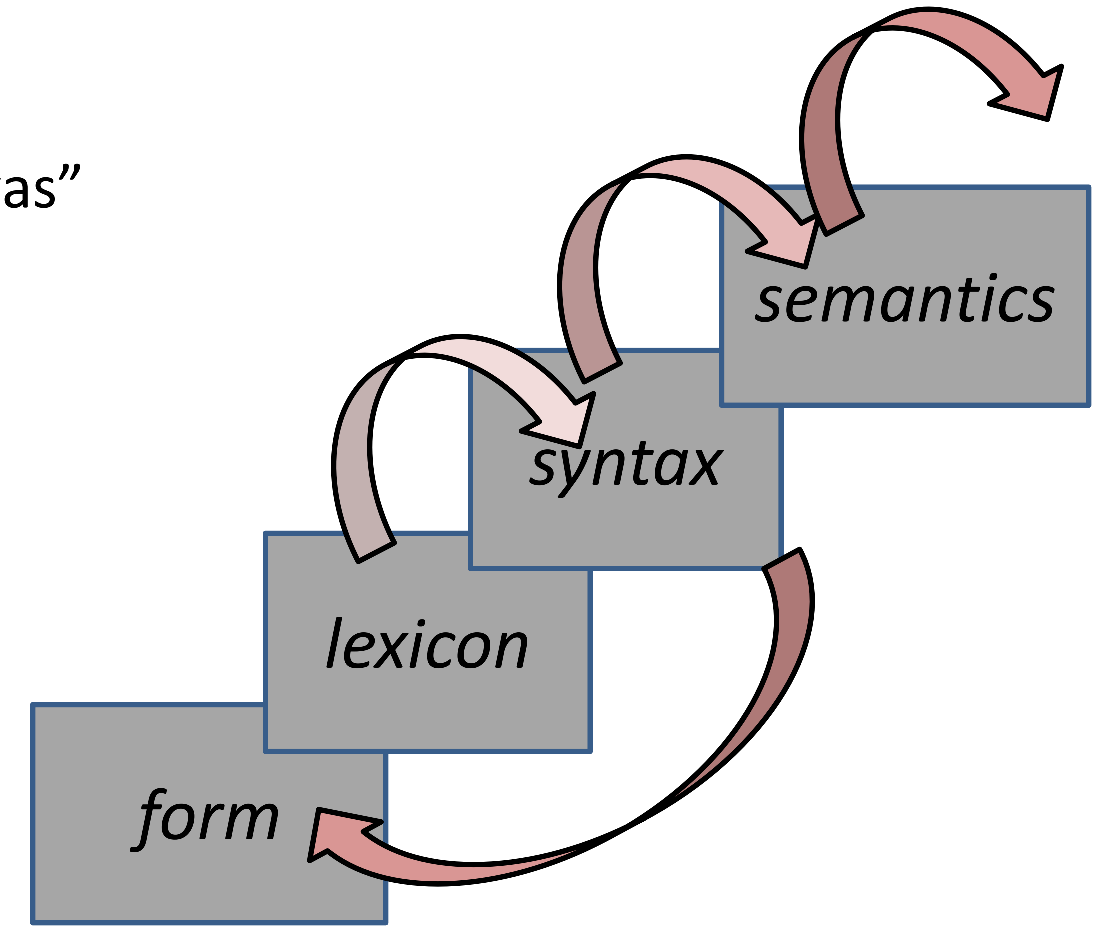
By 600 - 1200ms after “was” appears (cue word)

The

discovery

<u>was</u>





What is happening?

3. This prediction is confirmed (less N100) or disconfirmed (more N100)

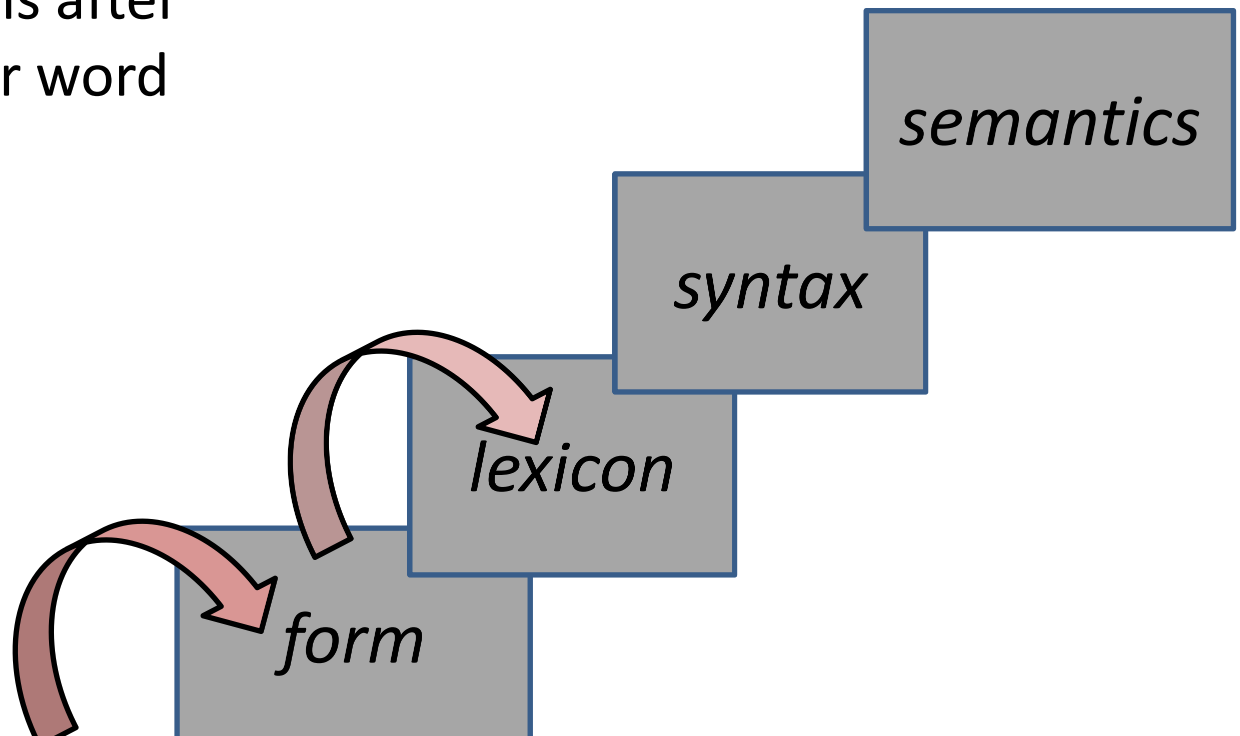
In the first 40-150 ms after encountering trigger word

The

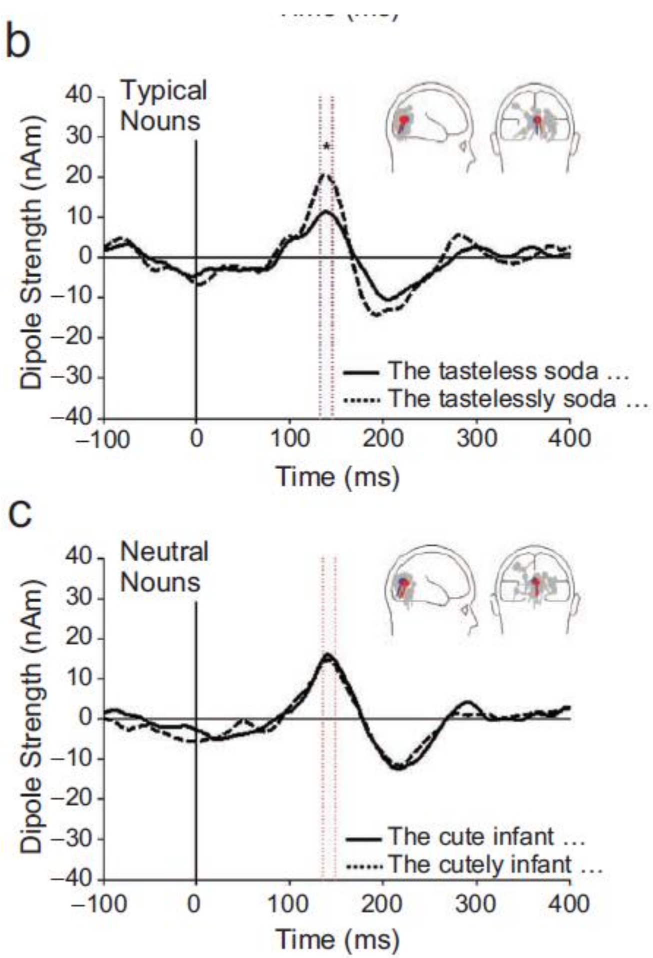
discovery

was

reported



Further evidence



- *Effects depend on typicality of form for class*
- *ELAN-like effects may appear in infants if __prediction__ is made easy enough* (my interpretation of Bernal et al., 2010)

Dikker et al 2010

Lesson 3:
Pragmatic effects clearly vary in their loci

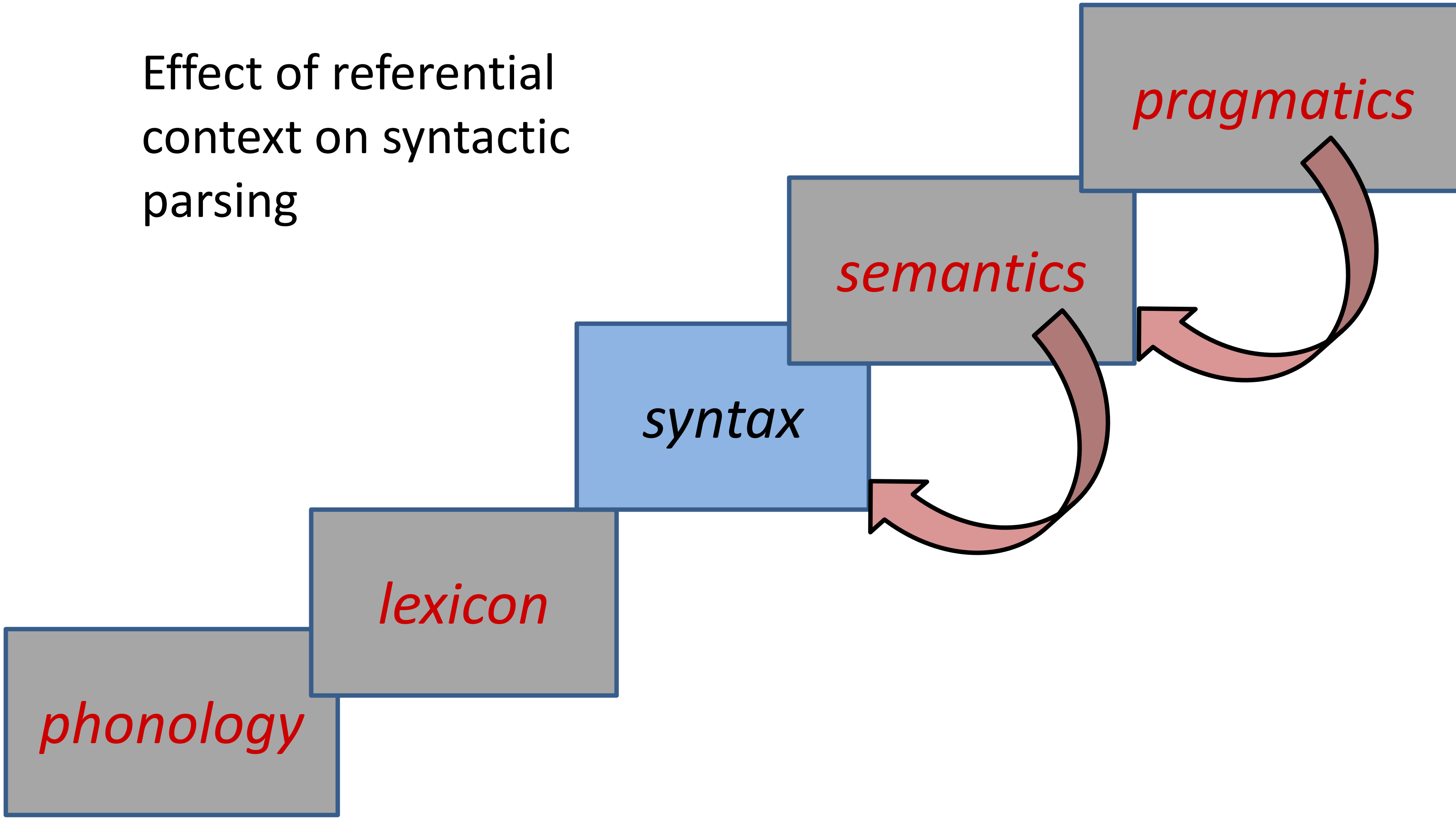
And ambiguity abounds

5 broad kinds of *pragmatic* effects

1. Top-down, pragmatic constraints on pre-semantic processes
    - Lexical and syntactic disambiguation
2. Top-down processes that fill-in semantic structure
    - Scalar implicature? Pronoun resolution?
3. Processing of utterance at a higher linguistic level
    - Pragmatic level? Discourse model?
4. Inferential chains within some conceptual level of representation
    - Irony? Relevance Implicatures? Disjunctive Syllogism?
5. Processing in other cognitive domains triggered by language
    - Affiliation, mirroring, emotional reactions, ACE…..

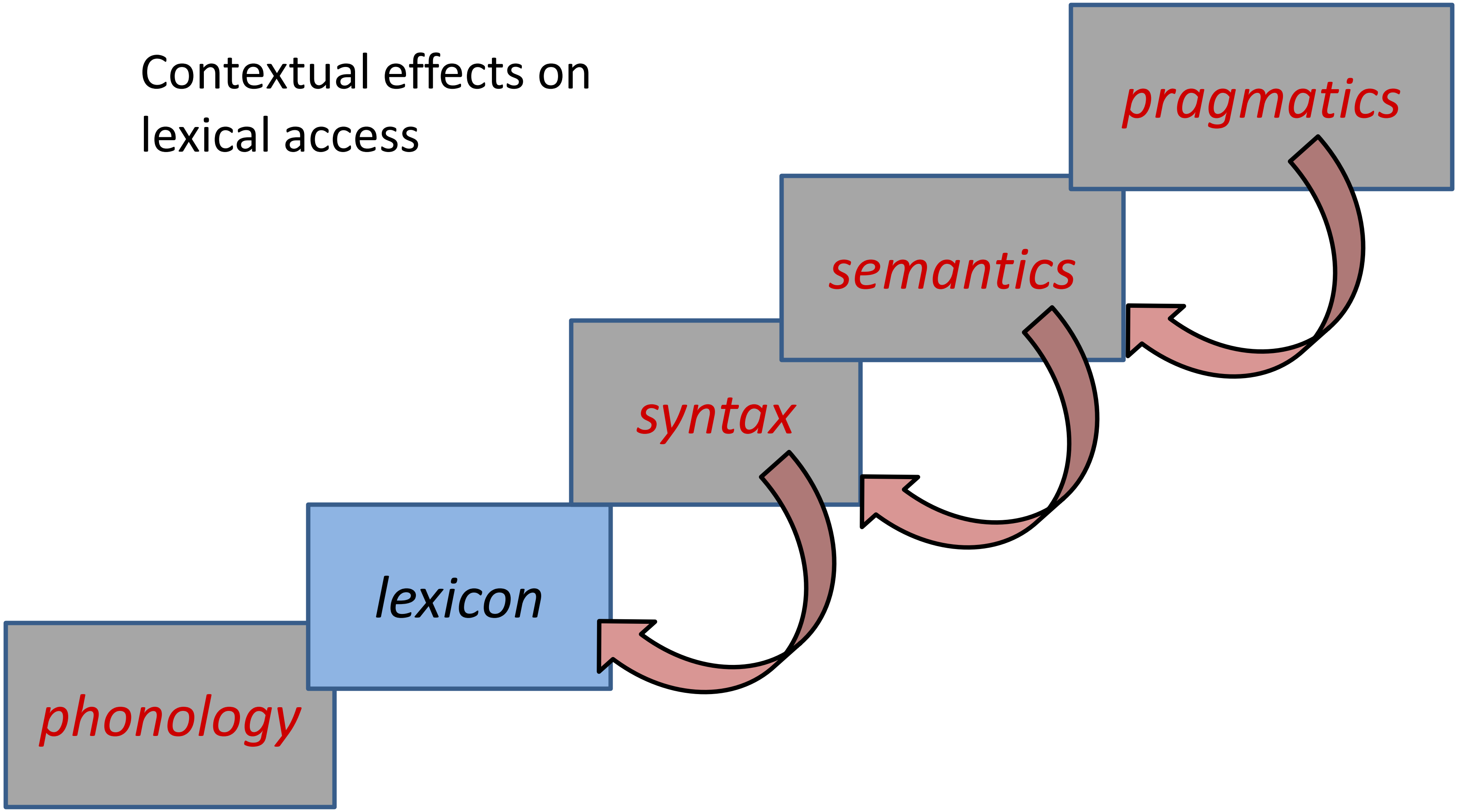
Kind 1: Top-down constraints on lower level processes

Effect of referential context on syntactic parsing



Kind 1: Top-down constraints on lower level processes

Contextual effects on lexical access

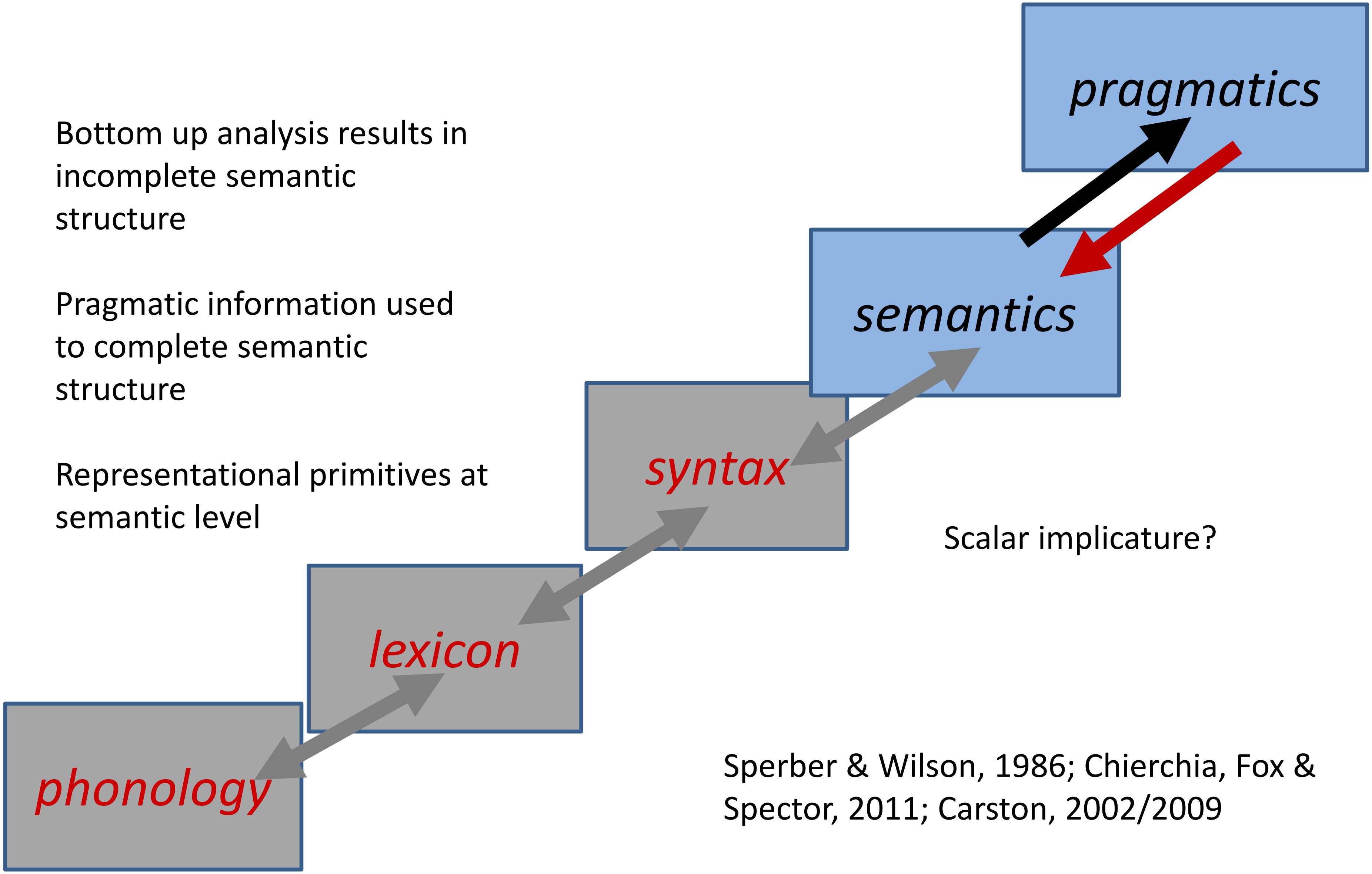


Kind 2: Top-down pragmatic input fills-in semantic structures

Bottom up analysis results in incomplete semantic structure

Pragmatic information used to complete semantic structure

Representational primitives at semantic level



Scalar implicature?

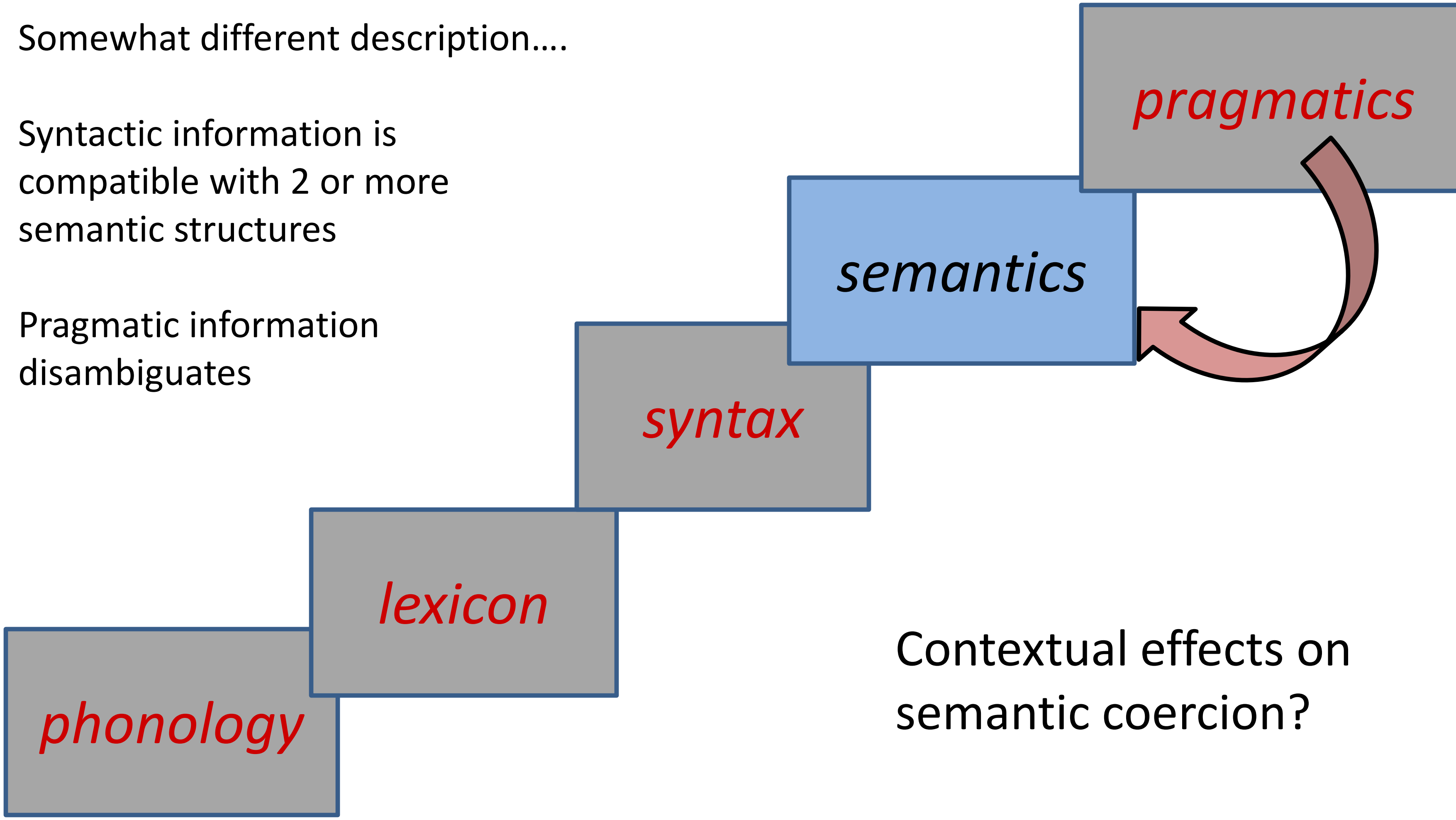
Sperber & Wilson, 1986; Chierchia, Fox & Spector, 2011; Carston, 2002/2009

Kind 2: Top-down pragmatic input <u>disambiguates</u> semantic structures

Somewhat different description….

Syntactic information is compatible with 2 or more semantic structures

Pragmatic information disambiguates

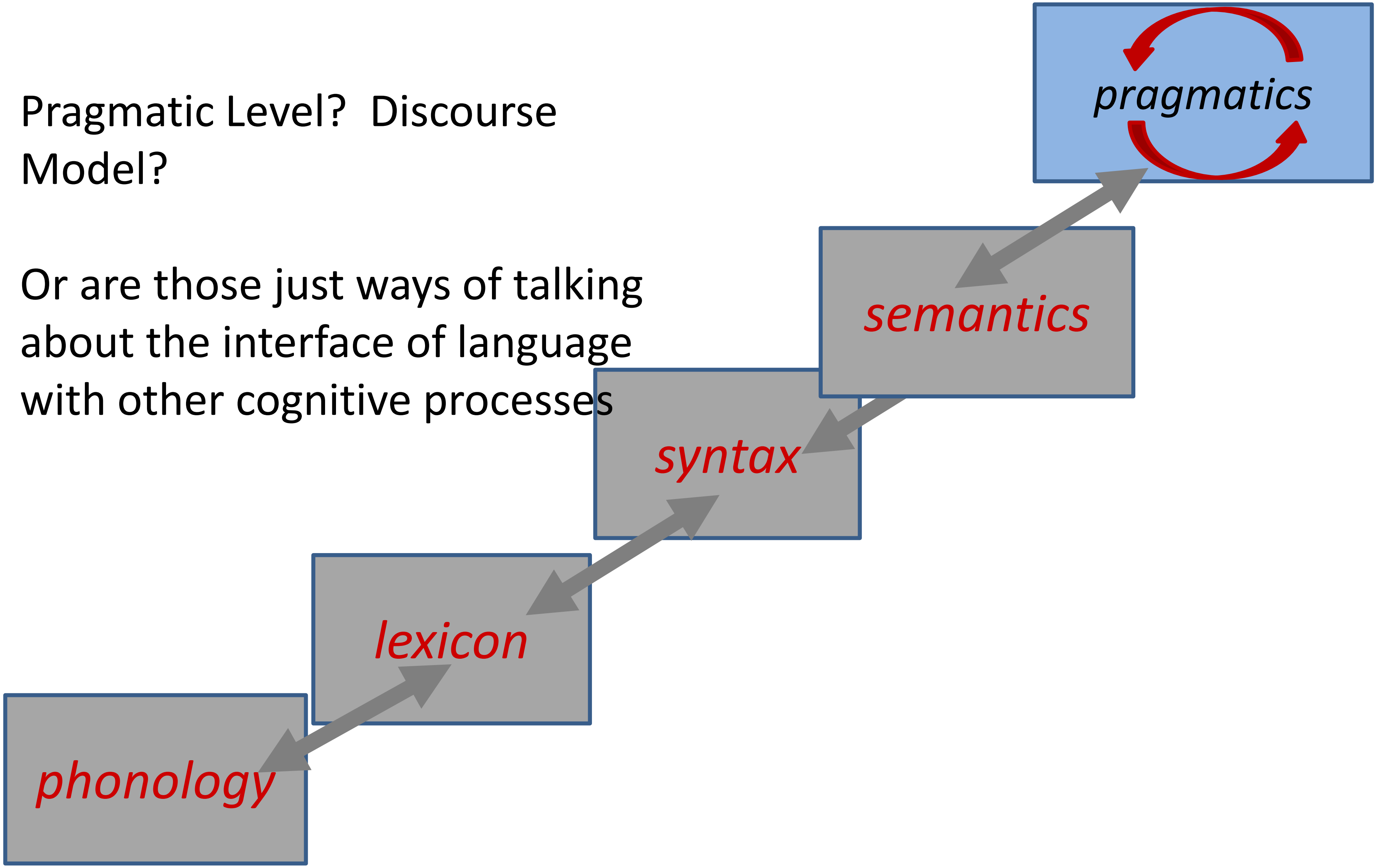


Contextual effects on semantic coercion?

Kind 3: Processing of utterance at higher linguistic level

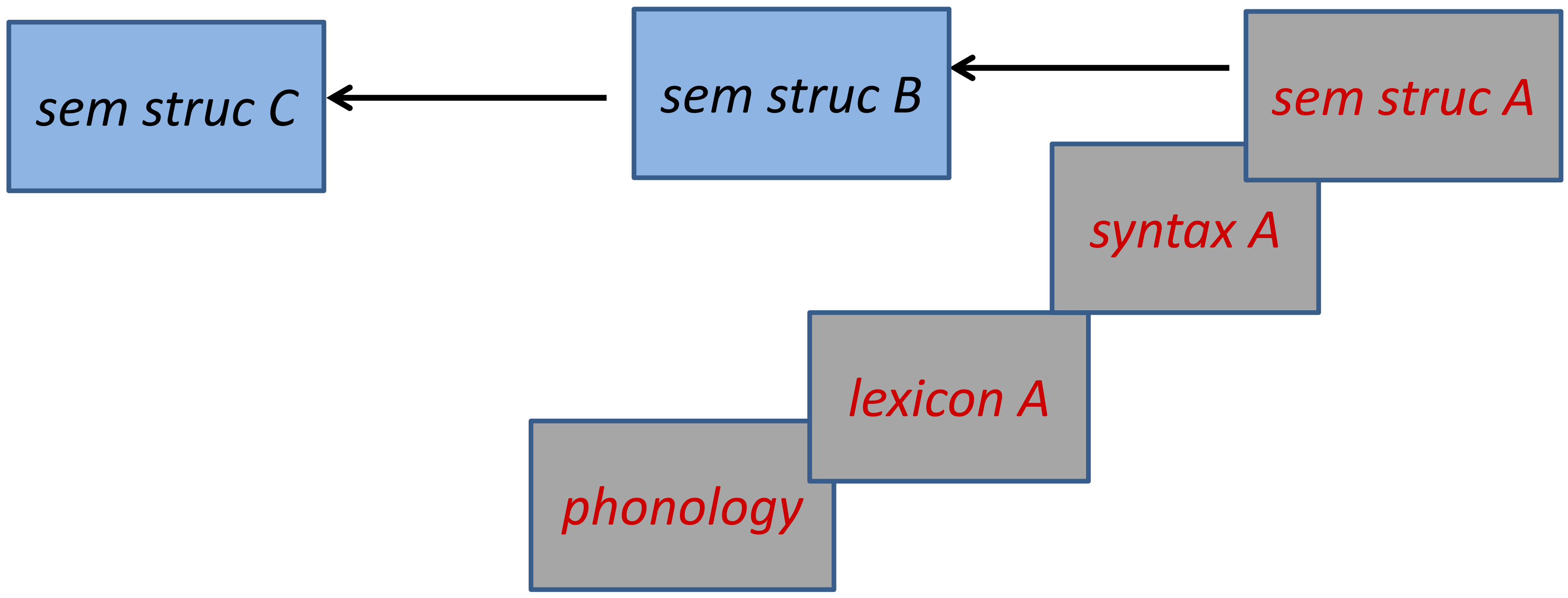
Pragmatic Level? Discourse Model?

Or are those just ways of talking about the interface of language with other cognitive processes



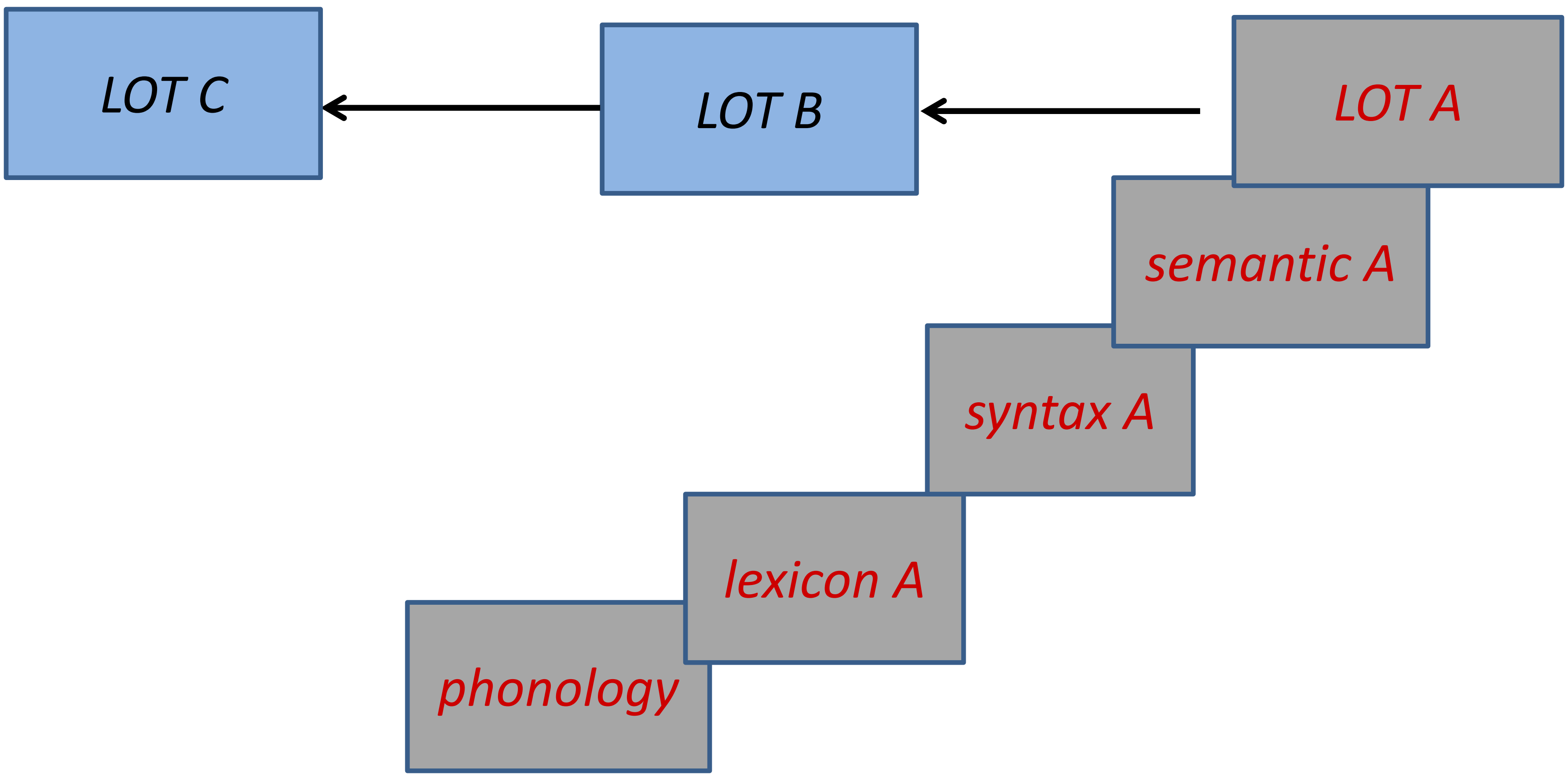
Kind 4: Chains of inferences

Language as Thought Version



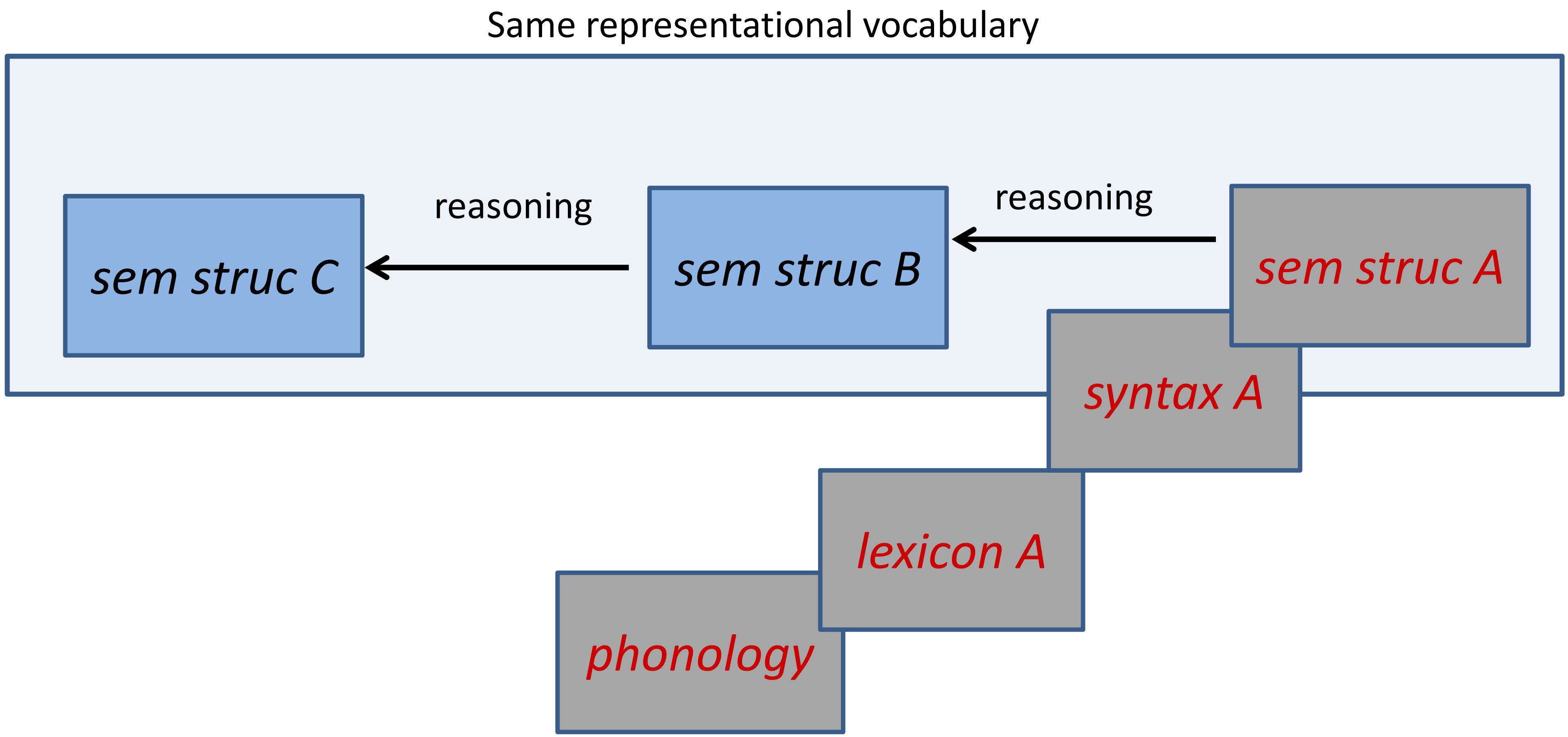
Kind 4: Chains of inferences

Language of Thought Version

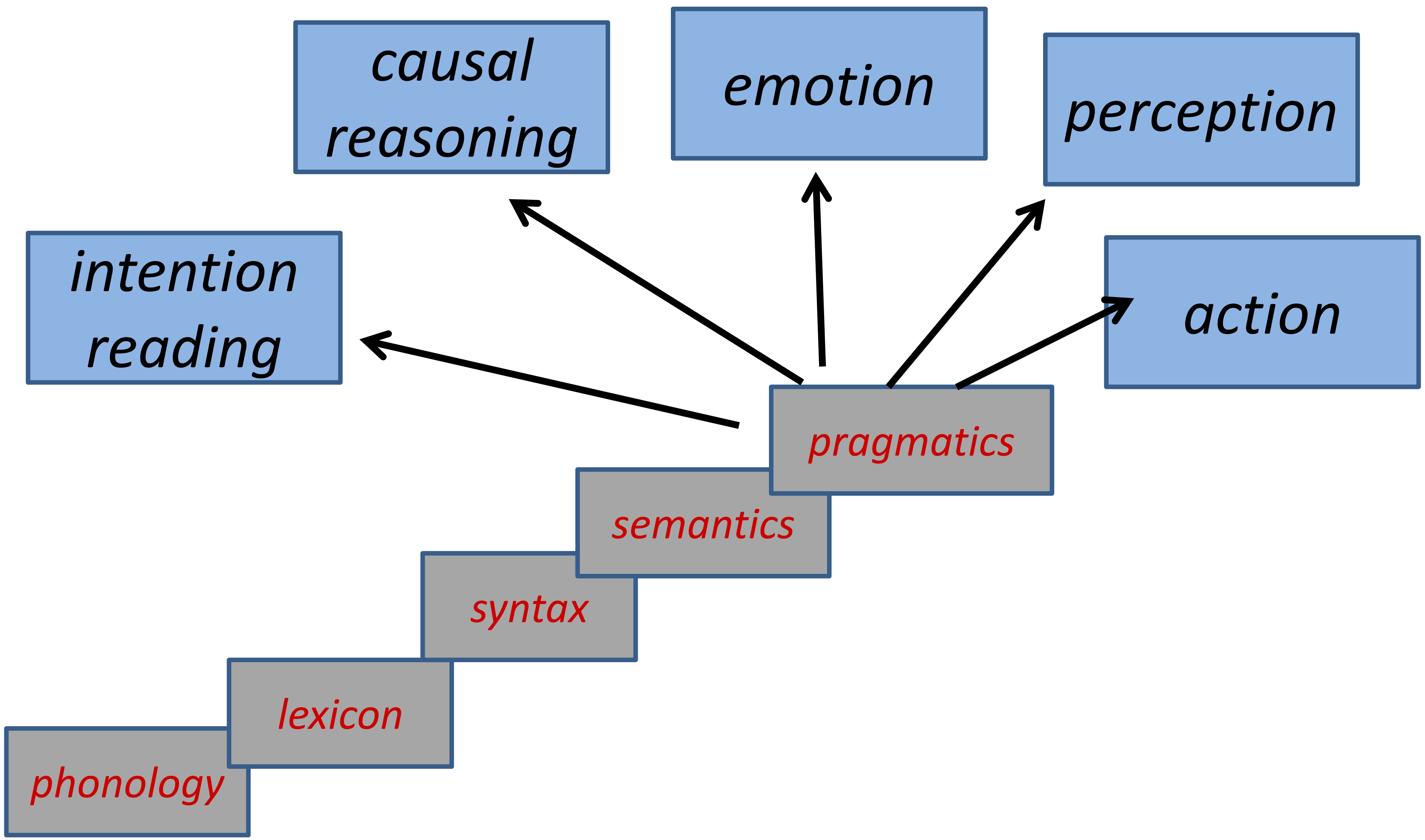


Kind 4: Chains of inferences

Language as Thought Version



Kind 5: Processing in other domains triggered by language



5 broad kinds of *pragmatic* effects

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Lesson 4:
Interaction unfolds over time

Morals from slips of the tongue

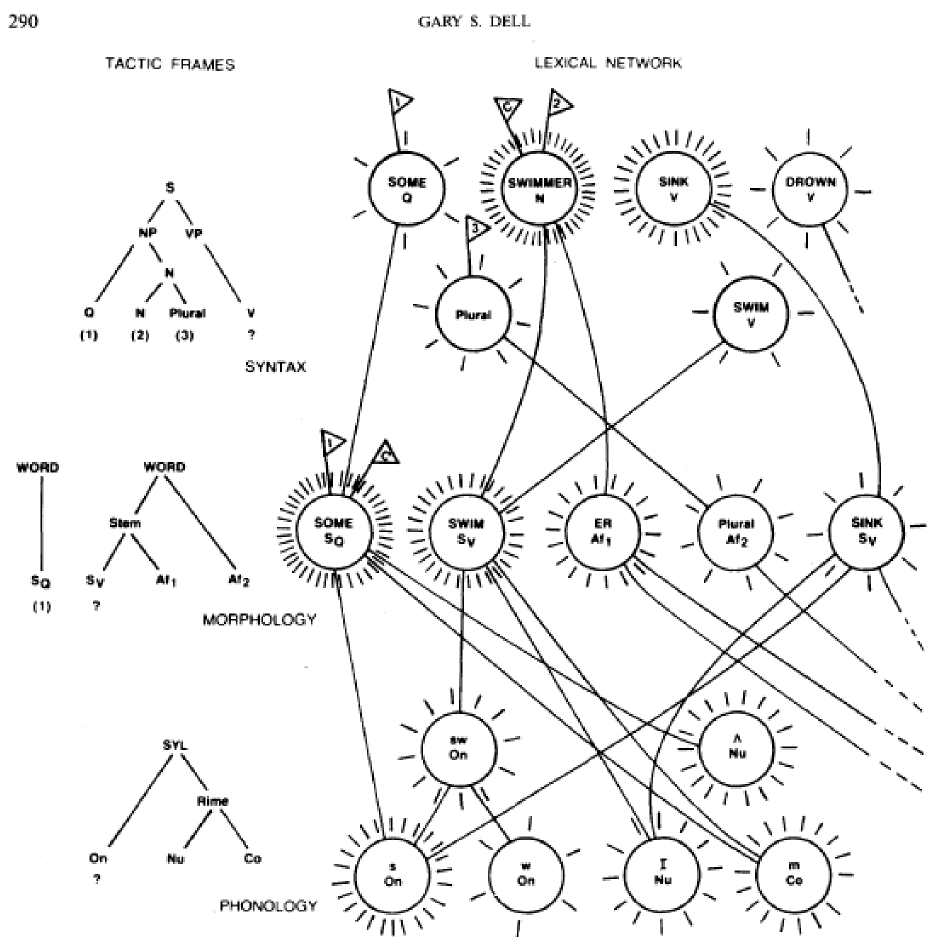
Does incremental activation mean that everything happens instantly?

No, this is computation not magic

It still involves transformations of information over time.

7-10 ms to travel over one synapse (who knows how many synapses are involved)

Interaction unfolds over time



Sound exchange errors are more common if the error will form a word

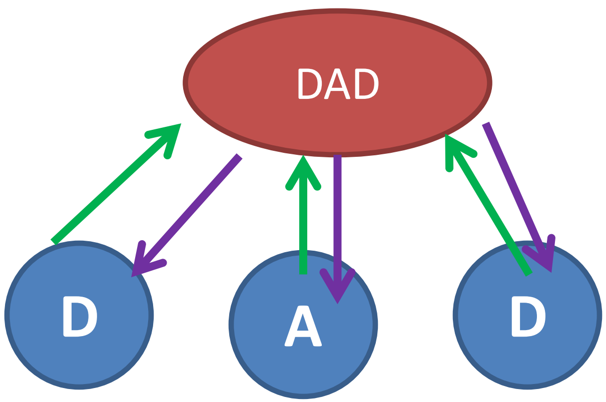
Why?

Baars & Motley (1974) slip paradigm

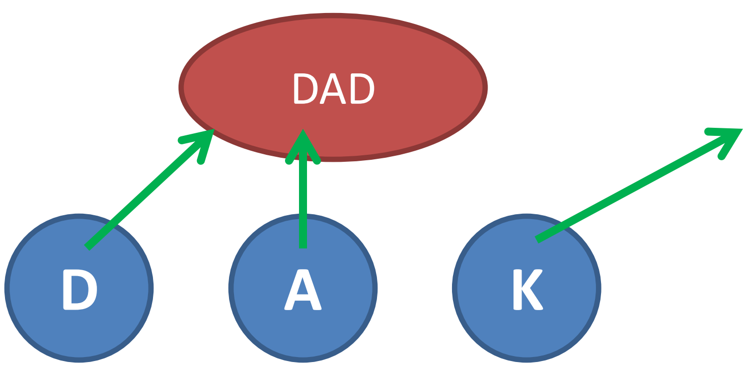
	Target	Error
Word Condition	Bad Dean	Dad Bean
Nonword Condition	Back Deal	Dack Beal

Interaction unfolds over time

Dell (1986) Errors in phonological encoding



Feedback loops influence phonological selection



	Target	Error
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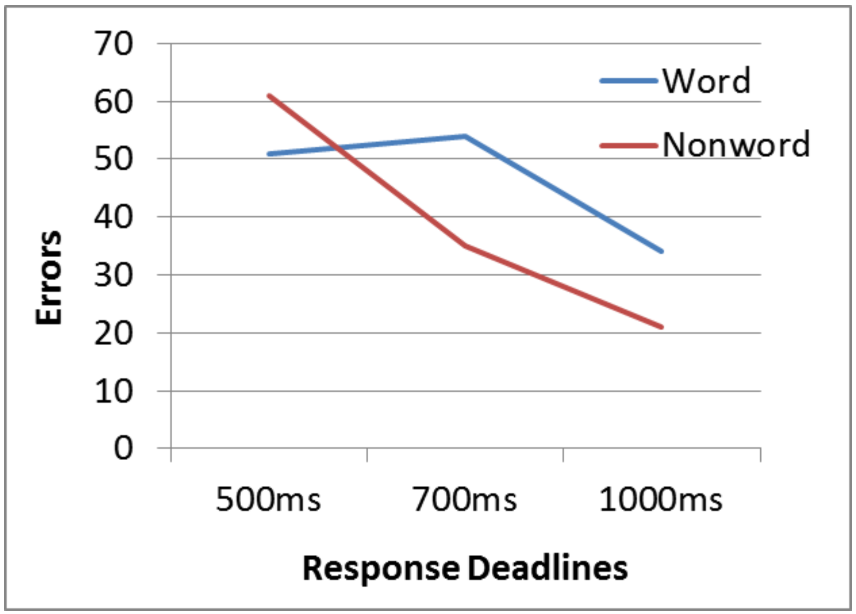
Dell (1986) Errors in phonological encoding



Bias for words in phonological errors emerge with more processing time

	Target	Error
Word Condition	Bad Dean	Dad Bean
Nonword Condition	Back Deal	Dack Beal

Collaborators, conversation and other debts

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