EXPERIMENTAL METHODS IN PSYCHOLINGUISTIC RESEARCH

SUMMER SEMESTER 2015

COURSE INFORMATION

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Course webpage:

piazza.com/uni-saarland.de/summer2015/experimentalmethods/home

- e-mail me your e-mail address so that I can sign you up for the course or sign-up on: piazza.com/uni-saarland.de/summer2015/experimentalmethods

Lectures:	Wednesdays, 14-16	(Room 2.11, C7.2)
Labs:	Mondays, 10-12	(Room 2.11, C7.2)

COURSE INFORMATION

Credits: 6 points

Evaluation

- **40% - Final research report**
  - (Max 3000 words including tables and figures)
- **40% - Experimental work**
  - Experimental design
  - Collection of data
- **20% - Active participation in lectures and labs**

COURSE CONTENT

Lectures:

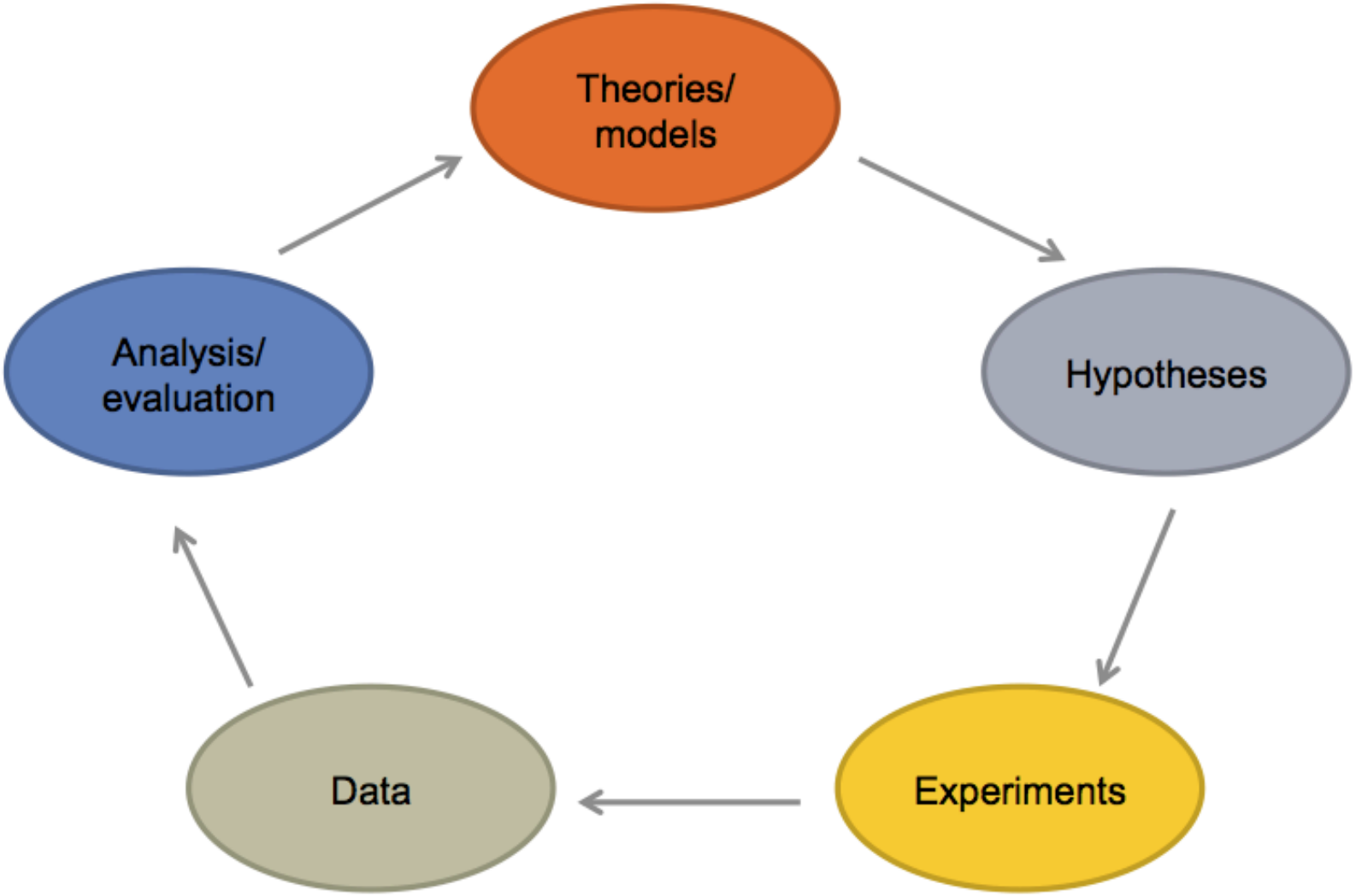
- **Experimental paradigms and techniques**
  - eye-tracking (reading, visual world paradigm), ERPs
- **Experimental design**
  - within vs. between subjects vs. mixed designs
  - controlling extraneous variables
- **Hypothesis testing (Statistics)**
- **Reporting results (APA style)**

COURSE CONTENT

Labs:

- **Topics for the experiment**
- **Experiment implementation:**
  - Stimuli preparation
  - Experiment programming
  - Data collection
- **Data analysis**
- **Reporting results**

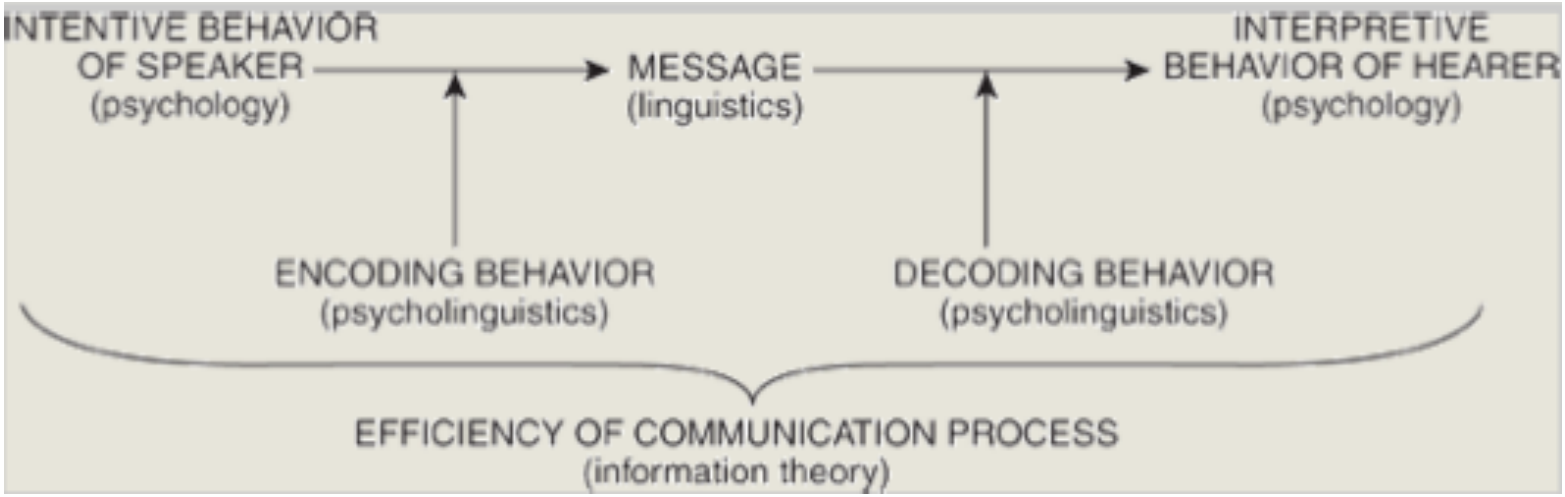
COURSE CONTENT



WHAT IS PSYCHOLINGUISTICS?

A BIT OF HISTORY
LEVELT (2013)

1951:

- **Interdisciplinary Summer Seminar in Psychology and Linguistics at Cornell University**
  - Set out to "*explore the relationships which might exist between the fields of psychology and linguistics*"
  - 

A BIT OF HISTORY
LEVELT (2013)

1951:

Language and Communication

by George Miller

- Covered five decades of empirical investigations

A BIT OF HISTORY LEVELT (2013)

1951:

"The problem of serial order in behavior"

by Karl Lashley

- "*Speech is the only window through which the physiologist can view cerebral life* (Fournié, 1877)"
- Criticized serial order approach to studying brain function and behavior more generally

A BIT OF HISTORY

Early psycholinguists engaged in testing the psychological reality of linguistic rules

- The Derivational Theory of Complexity (DTC)

As the field developed, it became clear that psycholinguistic theories must consider the properties of human mind as well as the structure of language

Psycholinguistics has become its own area of inquiry, informed but not totally dependent on linguistics

WHAT IS PSYCHOLINGUISTICS?

The study of the *mental representations and processes* that enable us to acquire, use, and understand language

- **Language acquisition**
  - How do we learn language?
  - What are the stages of acquisition?

- **Language processing**
  - Language production
  - Language comprehension

LANGUAGE PROCESSING

Language production

- Conceptual structure ➔ words and sentences
  - Grammatical and phonological encoding
  - Articulation

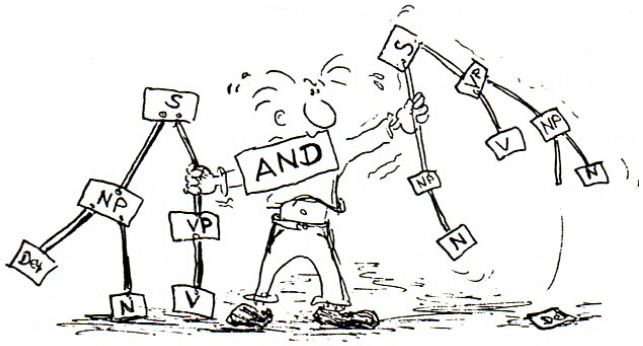
Language comprehension

- Words and sentences ➔ conceptual structure
  - Lexical access
  - Syntactic parsing
  - Semantic interpretation
  - Pragmatic interpretation

LANGUAGE PROCESSING

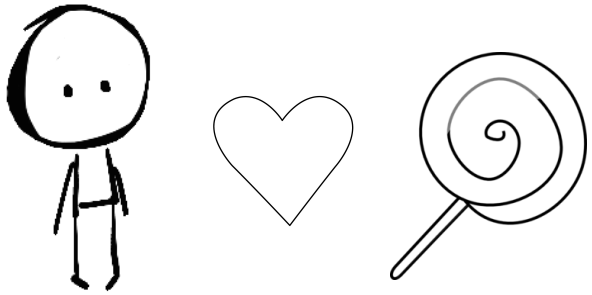
"Mr. Stickman loves candy."

Syntactic



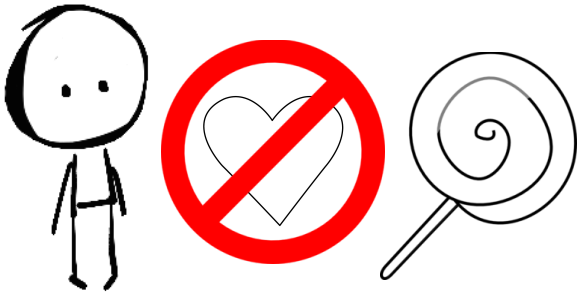
Combining words into phrases (**parsing**) based on formal rules (**syntax**).

Semantic



Extracting the meaning of individual words and their relationships to form the literal meaning of a sentence.

Pragmatic

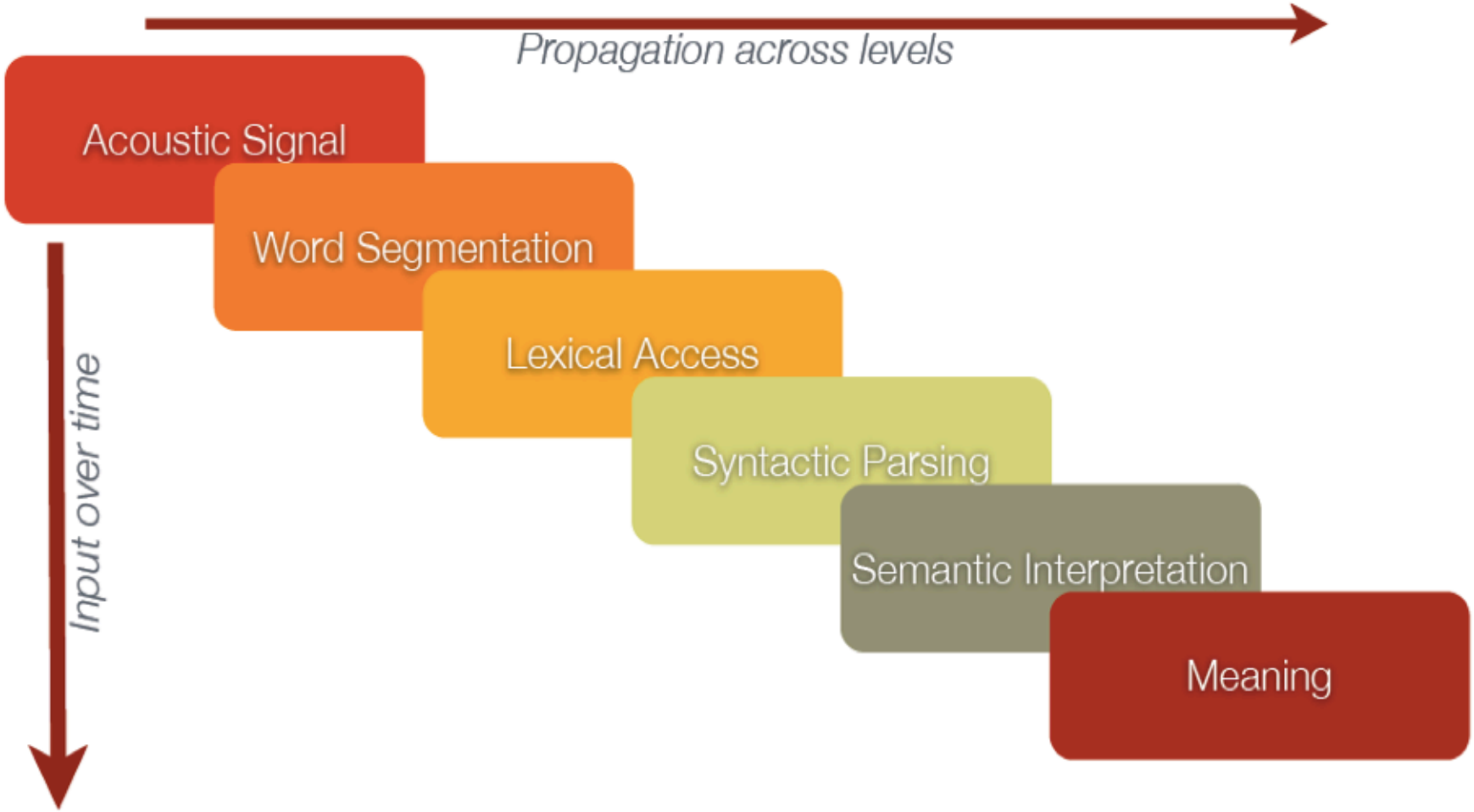


Going beyond the literal meaning depending on the **physical context** of the utterance, any **pre-existing knowledge** about those involved, the **inferred intent** of the speaker…

Pragmatics… irony

Pragmatics… metaphor

LANGUAGE COMPREHENSION



COMPETENCE *VS.* PERFORMANCE

Linguistic competence

- The speaker's (un)conscious knowledge of his native language
  - Knowledge of phonological, morphological, syntactic and semantic rules of a language

Linguistic performance

- The actual use of this (un)conscious knowledge during language comprehension and production

COMPETENCE *VS.* PERFORMANCE

Production: we say things we know are wrong

- Spoonerism: *"The Lord is a shoving leopard"* ("loving shepherd")
- Agreement*: "The friend of the two girls are laughing"*

Comprehension: we can't understand things we know are grammatical

- Center embedding: *"The mouse that the cat that the dog chased bit fled"*

COMPETENCE *VS.* PERFORMANCE

Traditionally, theoretical linguistics deals with language *competence*

Psycholinguistics focuses on linguistic *performance*

- Many of the issues that linguists want to avoid:
  - What makes a sentence ‘hard’ to understand
  - Why we make some errors and not others
  - etc.

WHAT WE KNOW ABOUT LANGUAGE PROCESSING

It is fast: Language is understood at the rate of about 300 words per minute

- lexical retrieval, syntactic parsing, and semantic interpretation occur in a matter of a few hundred milliseconds

It is accurate: We deal with massive ambiguity and indeterminacy without breaking down

It is incremental: We understand language incrementally (word-by-word, sound by sound)

It undergoes some cognitive limitations: Memory, attention, inhibition.

SOME QUESTIONS

Spoken word recognition

- How do we parse an acoustic stream into discrete units and how do we recognize those units as words of our language?

Morphological processing

- How do we recognize morphologically complex words and how do we represent relations between related words?

Sentence processing

- How do we understand sentences? How do we resolve ambiguity during real-time processing? How do we detect and repair errors?

EXAMPLES OF RESEARCH QUESTIONS AND MODELS

		Models
Word recognition and mental lexicon		
How are words and their parts stored in and retrieved from the mental lexicon?	➔	Dual-route vs. Cohort Serial search vs. Parallel access
Syntax		
How do people parse sentences? Do they “construct trees”?	➔	Modular vs. interactive Serial vs. parallel processing
Semantics - pragmatics		
How (and when) is meaning represented and accessed in comprehension processes?	➔	Resonance vs. Construction-Integration

THEORIES/MODELS OF SENTENCE PROCESSING

Serial/modular models

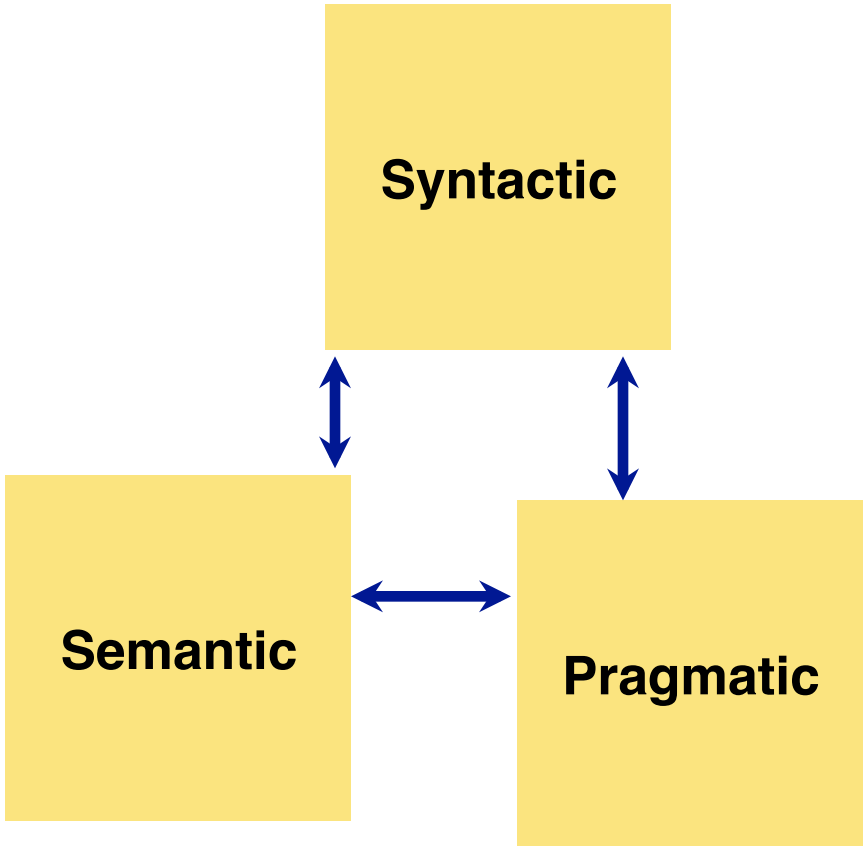
- A single structural analysis is computed and corrected later if needed
- Only syntactic principles are used in initial stages

Parallel/Interactive models

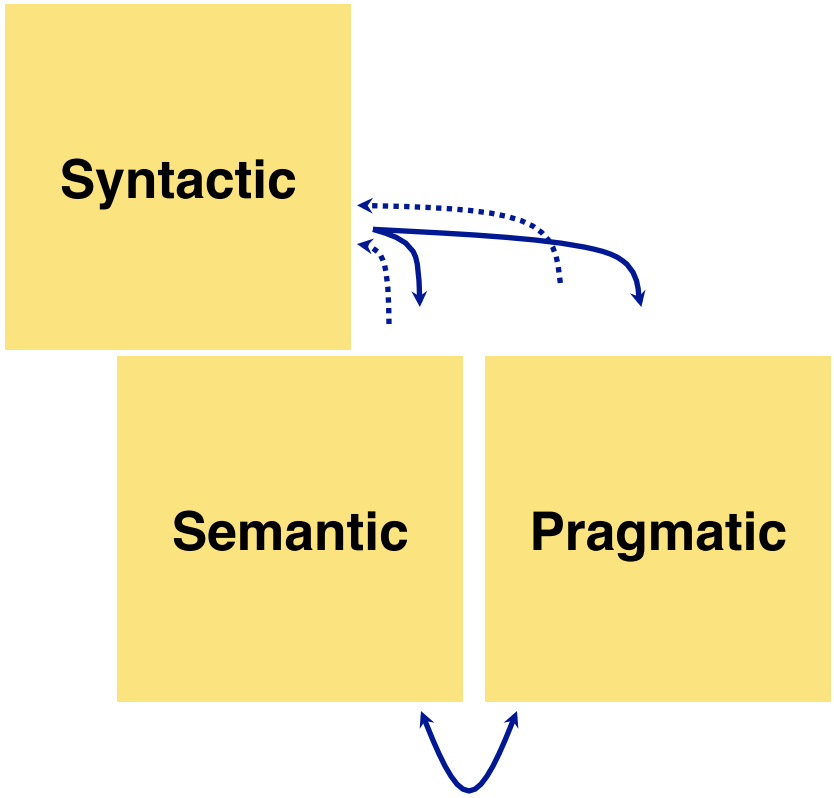
- All possible analyses are computed in parallel
- Candidate analyses are ranked according to frequency in the language or plausibility with the context etc.
- Many different sorts of information (syntactic, semantic, pragmatic, contextual, etc.) play simultaneous roles

THEORIES/MODELS OF SENTENCE PROCESSING

Interactive



Serial



EXPERIMENTAL RESEARCH

EXPERIMENTAL RESEARCH

Goals:

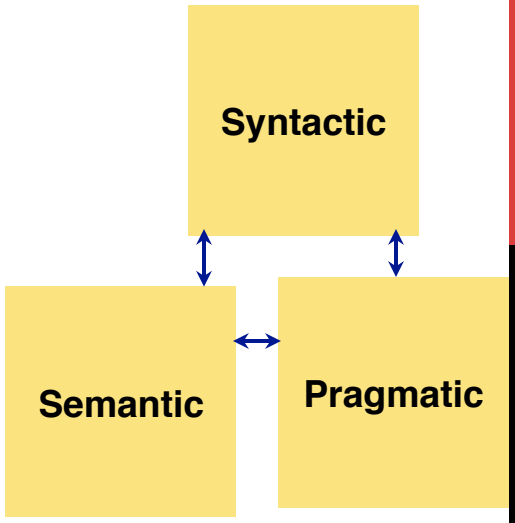
- Test hypotheses (predictions) derived from theories/models
- Establish causal relationships

Suppose you want to test serial/parallel models of sentence processing:

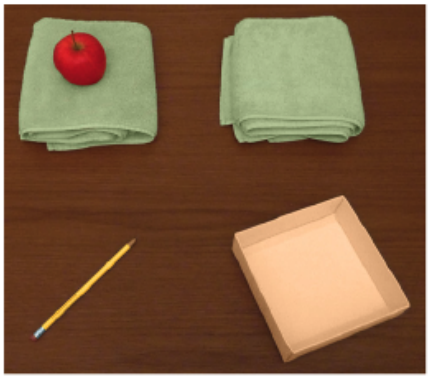
- What kinds of sentences would you use?

Tanenhaus et al., 1995

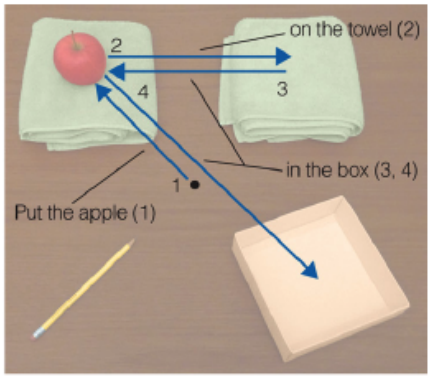
Can **physical context** override syntactic parsing biases?



"Put the apple on the towel in the box"

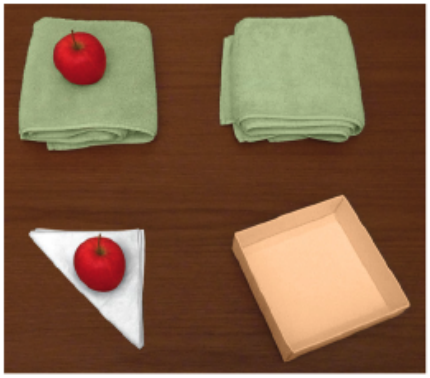


(a) One-apple condition

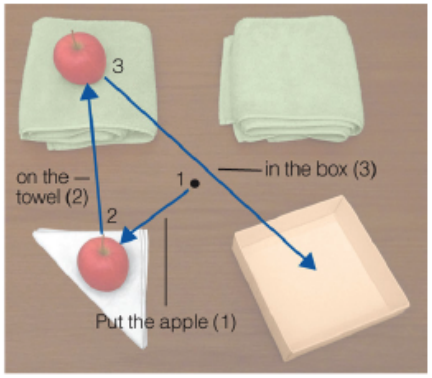


(b) Eye movements

Minimal Attachment bias?!



(a) Two-apple condition



(b) Eye movements

evidence that visual context constrains syntactic parsing biases

GARDEN-PATH SENTENCES

Temporarily ambiguous sentences:

- *Put the apple on the towel in the box*
- *The horse raced past the barn fell.*
- *While Anna was dressing the baby spit up on the bed.*
- *The old man the boat.*

Reveal interpretation preferences

Hard to process (relative to a control)

OFFLINE PARADIGMS

Focus on the outcome of interpretation:

- Grammaticality judgments
- Acceptability judgments
- Comprehension questions
- Completions

Example:

While Anna dressed the baby played in the crib.

- Is the sentence grammatical? Yes 1 – 2 – 3 – 4 – 5 No
- Did Anna dress the baby? ☐Yes ☐No
  - A large number of people give (incorrect) “yes” responses!

ONLINE PARADIGMS

Focus on the time-course of interpretation

Behavioral methods:

- **Written language comprehension:** Self-paced reading, eye-tracking
- **Spoken language comprehension:** Cross-modal priming, visual world paradigm (e.g., Tanenhaus et al., 1995)
- **Spoken language production:** Analysis of speech errors, priming techniques

Neurophysiological methods:

- **ERPs, fMRI, MEG, etc.**

EXPERIMENTAL DESIGN

What do we want to compare?

Garden path sentences
“The elephants squeezed into the booth fainted”

Control sentences
“The elephants that were squeezed into the booth fainted”

Within or between subjects?

CREATING THE MATERIALS

Constructing a set of materials containing the contrast of interest

For example:

- 20 garden path sentences
- 20 control sentences
- 40 filler items

IMPORTANT FACTORS TO TAKE INTO ACCOUNT

When conducting psycholinguistic research, we must take into account not only the linguistic characteristics of the materials (independent variables) but also other (irrelevant) characteristics that might exert an influence (extraneous variables).

- **Extraneous variables:** causal variables in which researcher is not interested, but which, however, influence the dependent variable, are confounded with the independent variable to be studied, and impair a valid causal conclusion.
  - word frequency and length
  - transitional probability of bigram
  - morphological complexity
  - number of words in a sentence
  - etc.

NORMING AND PRESENTING THE MATERIALS

Pre-tests

- Off-line studies designed to check for item characteristics

Obtaining frequencies of occurrence from corpora

Counterbalancing (in particular for within-subjects designs)

- Each participant sees all conditions, but in different items

Randomization

SELF-PACED READING

The elephants

The elephants squeezed

The elephants squeezed into the booth

The elephants squeezed into the booth fainted.

The elephants squeezed into the booth fainted.

354 ms **478 ms** **689 ms** **756 ms**

The elephants squeezed into the booth fainted.

354 ms 478 ms 689 ms 756 ms

The elephants that were squeezed into the booth fainted.

352 ms 432 ms 475 ms 567 ms 643 ms

DATA

Reading time for the disambiguating region

- Garden-path sentences: 756 ms
- Control: 643 ms

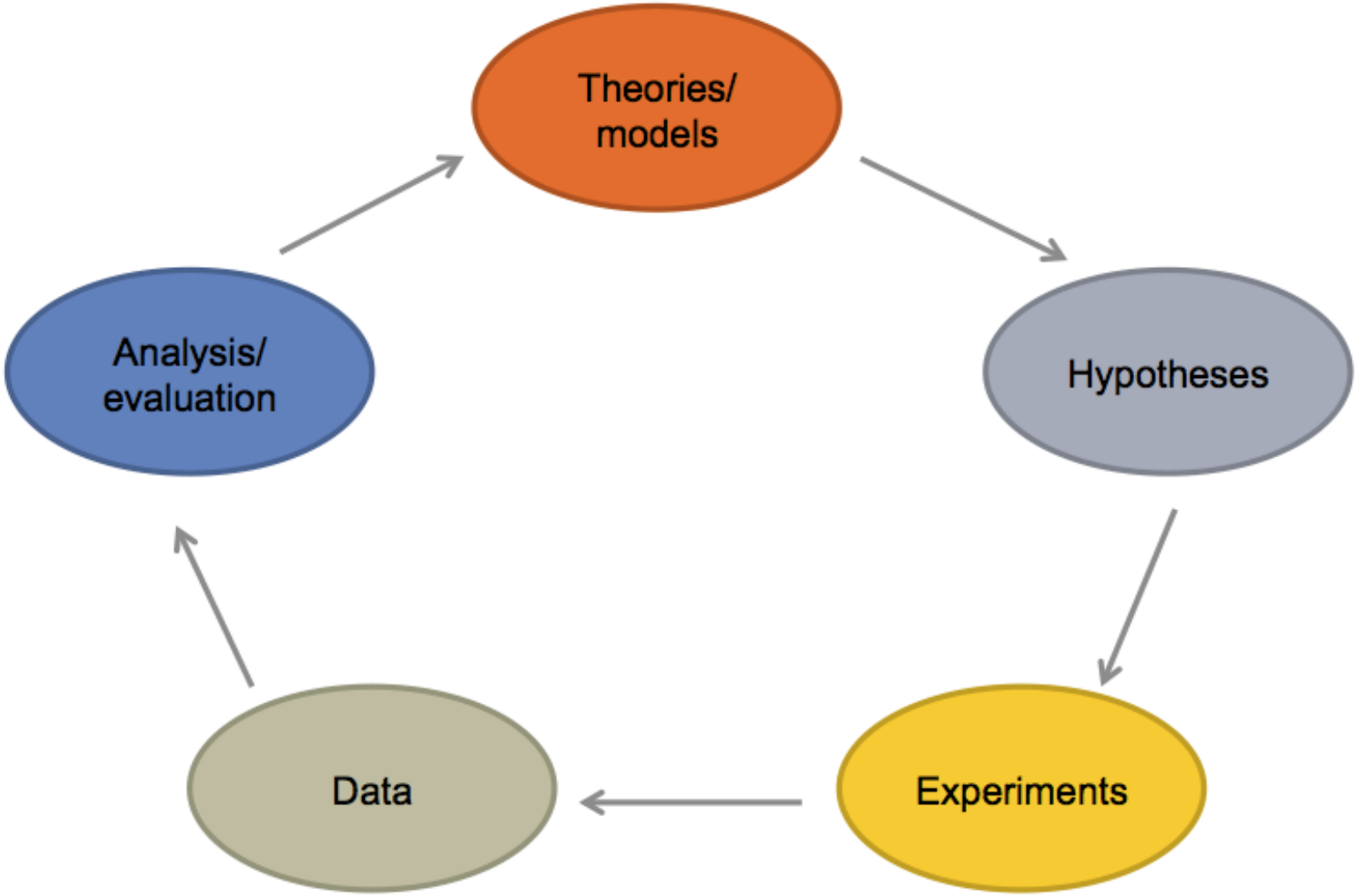
What can we conclude?

Nothing without statistics!

ANALYZING DATA

- Applying probability theory to make an educated guess whether observed differences are likely to occur in other sentences and other people (not only in study participants)
- In psycholinguistics, statistical analyses are usually performed “by participants” (generalizing to other people) and “by items” (generalizing to other sentences, words, etc.)
- A statistically null result (difference being not significant) is not interpretable

REPORTING RESULTS: COMPLETING THE CYCLE



CLASS EXPERIMENT

EXPERIMENT TOPIC

Please read the following article for the next Monday:

Mem Cogn (2012) 40:297–310
DOI 10.3758/s13421-011-0153-5

Psychological essentialist reasoning and perspective taking during reading: A donkey is not a zebra, but a plate can be a clock

Steven Frisson · Mary Wakefield

Focus on the perspective taking aspect of it.