

Research Methods in Experimental linguistics

Outline

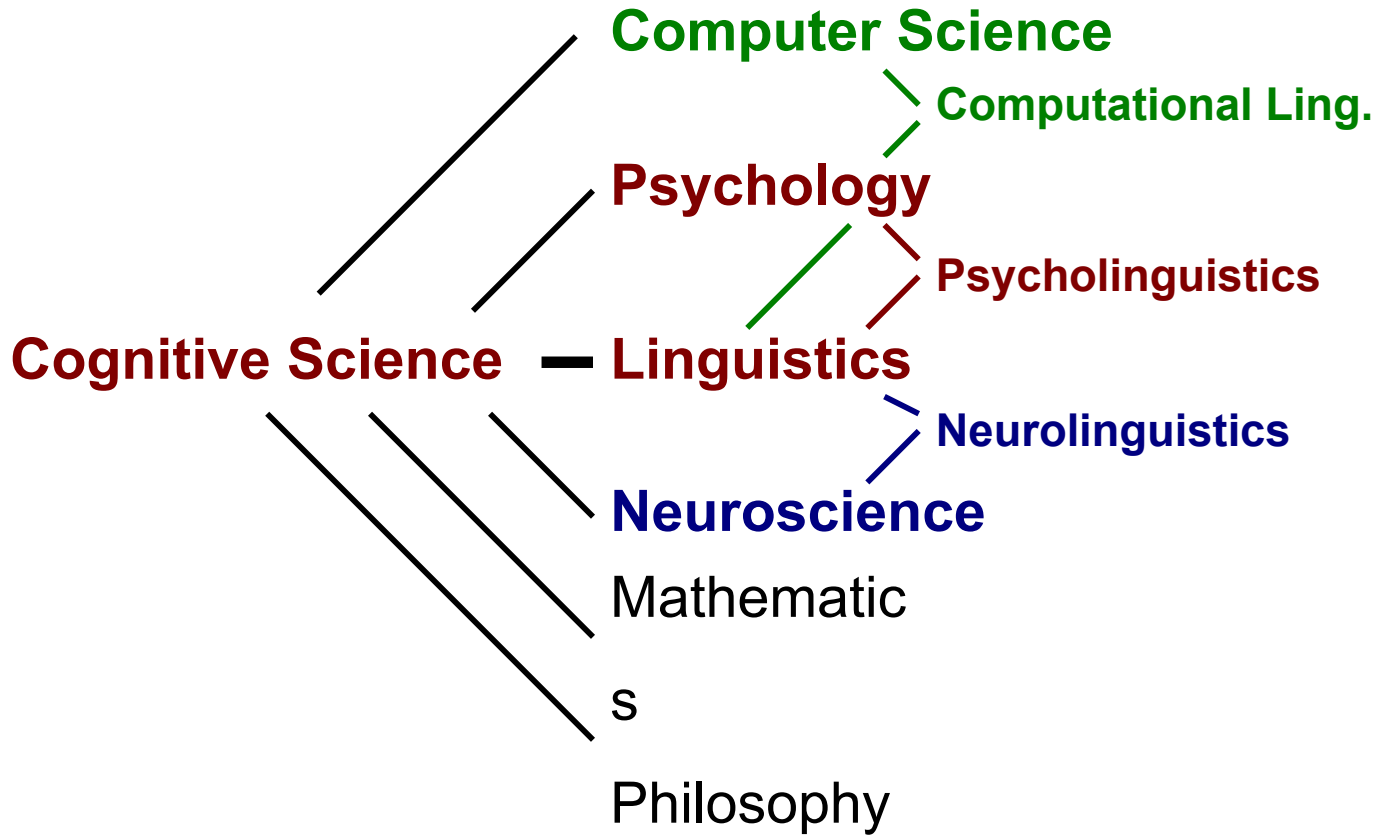
1. Overview
2. Linguistics and Psycholinguistics:
Domains
3. Themes and topics: An overview
4. Research methods in experimental
linguistics

1. Overview

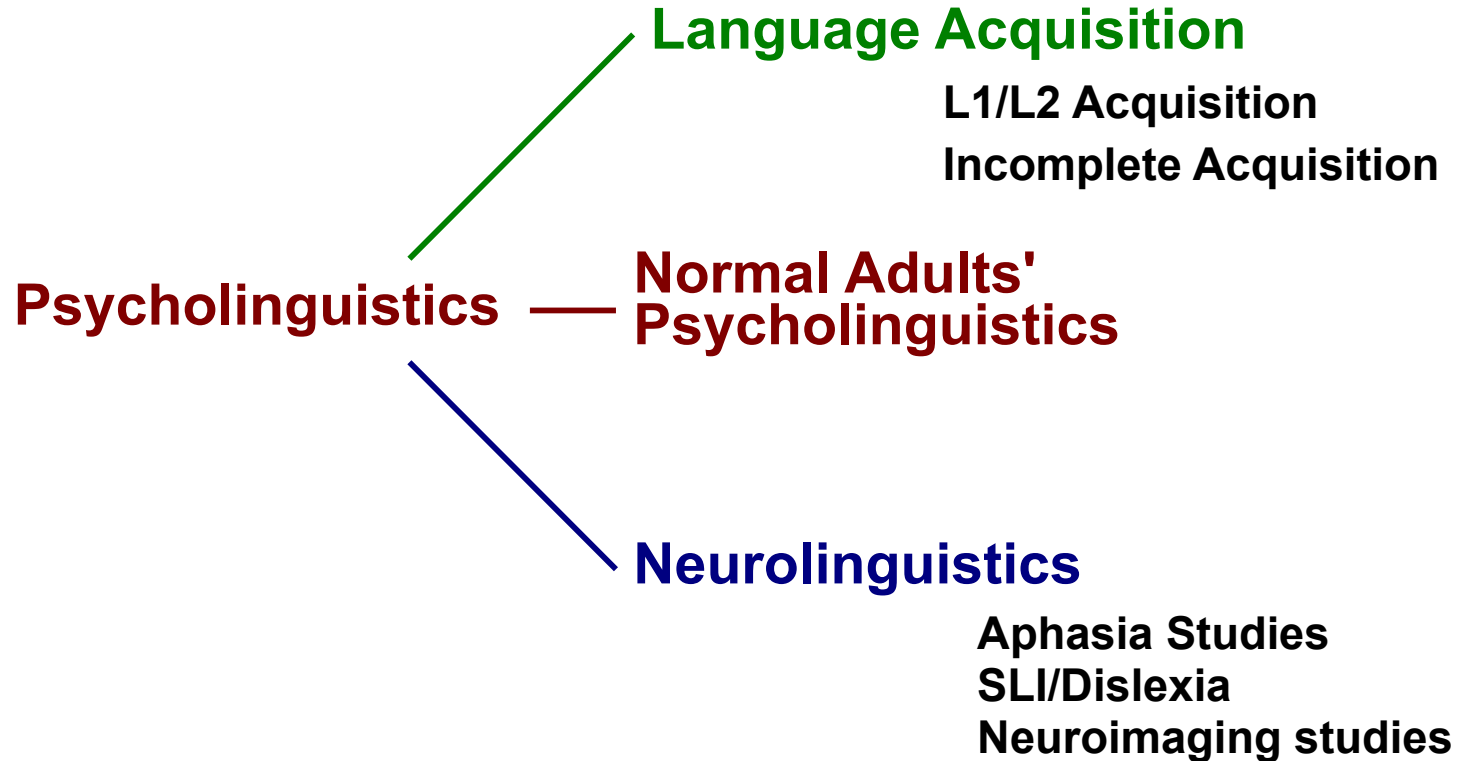
Cognitive Science and Psycholinguistics

- Linguistics + Psychology
 - Psycholinguistics
 - Psycholinguistics in the broad sense
 - Psycholinguistics in the narrow sense

Cognitive Science



Psycholinguistics (broad sense)



What is Psycholinguistics?

Psycholinguistics is an interdisciplinary field of study in which the goals are to understand:

1. How people acquire language
2. How they use it to speak and understand one another *in real time*
3. How it is represented and processed in the brain.
4. Its breakdown and impairments

Psycholinguistics (narrow sense)

Normal Adults' Psycholinguistics

Subfields:

[Production and Comprehension]

Psychophonology

Lexical Processing

Syntactic Processing

Methods:

[Off-Line and On-Line]

Questionnaires

Reading-Time

Decision

Eye Movement Recordings

Cross--modal
priming

Neuroimaging

What is psycholinguistics proper?

Psycholinguistics in the narrow sense:

- To understand the mental mechanisms supporting our remarkable abilities to produce and to understand language, *apparently with low effort*

What is psycholinguistics proper?

Psycholinguistics in the narrow sense:

- To understand the mental mechanisms supporting our remarkable abilities to produce and to understand language
- More specifically, much current psycholinguistic research concerns itself with how as readers and as listeners we parse input:
 - how we project structure onto the linear string of words (themselves recovered from graphic marks or speech sounds), on the way to the construction of the kinds of meanings achieved in full-blown “language comprehension”

Modularity

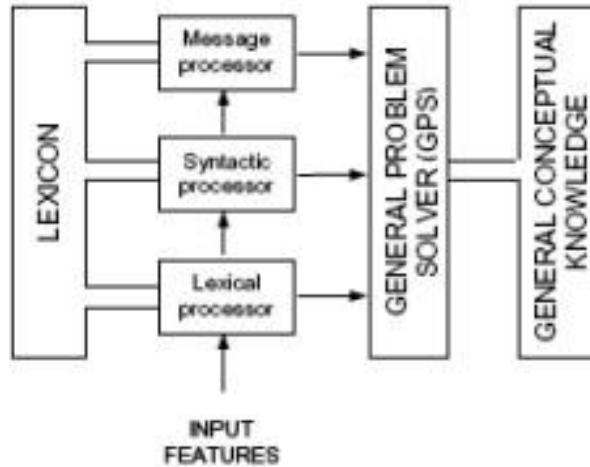


Figure 1 (Autonomy)

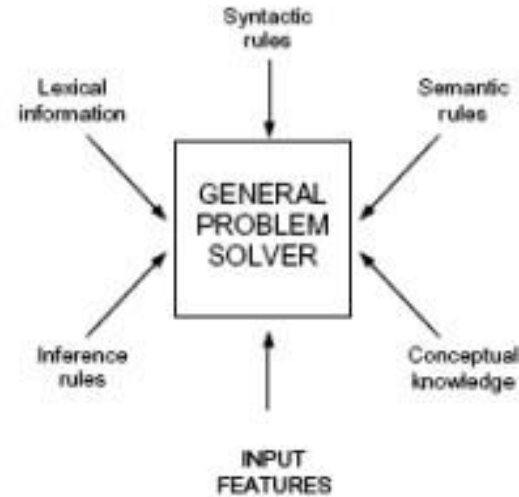


Figure 2 (Interaction)

- “modularity” in mental architecture presupposes that specifically linguistic processes in comprehension operate *independently* of more general cognitive processes.
- These latter are seen as applying to the *outputs* of the language faculty.

Modularity

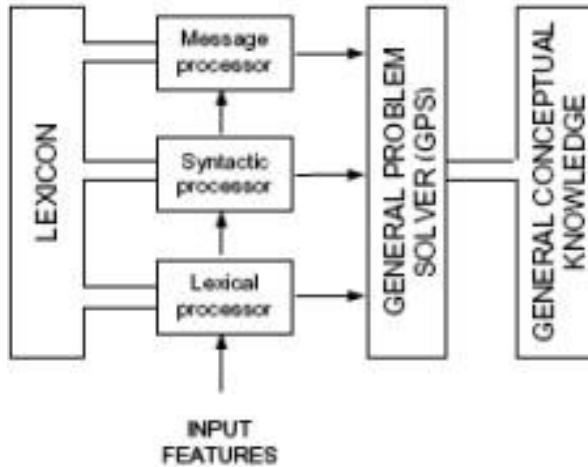


Figure 1 (Autonomy)

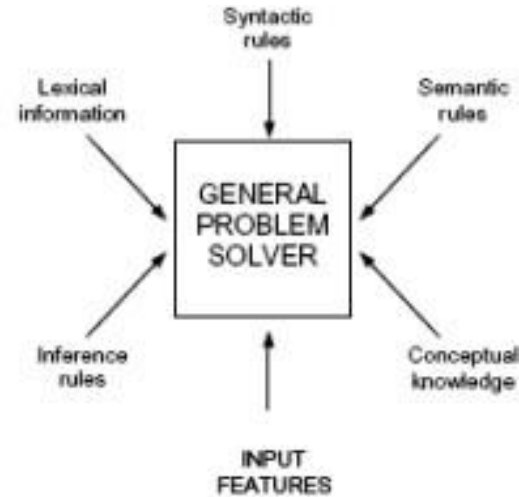


Figure 2 (Interaction)

- Does the human sentence processing mechanism (HSPM) work strictly from the bottom and up or from the top and down?

Incrementality

- Does the parser delay until it has accumulated a substantial amount of information, or does it instead project structure onto an input string *immediately*, i.e. as successive terms are encountered in the input?

Big Q2:

Incrementality

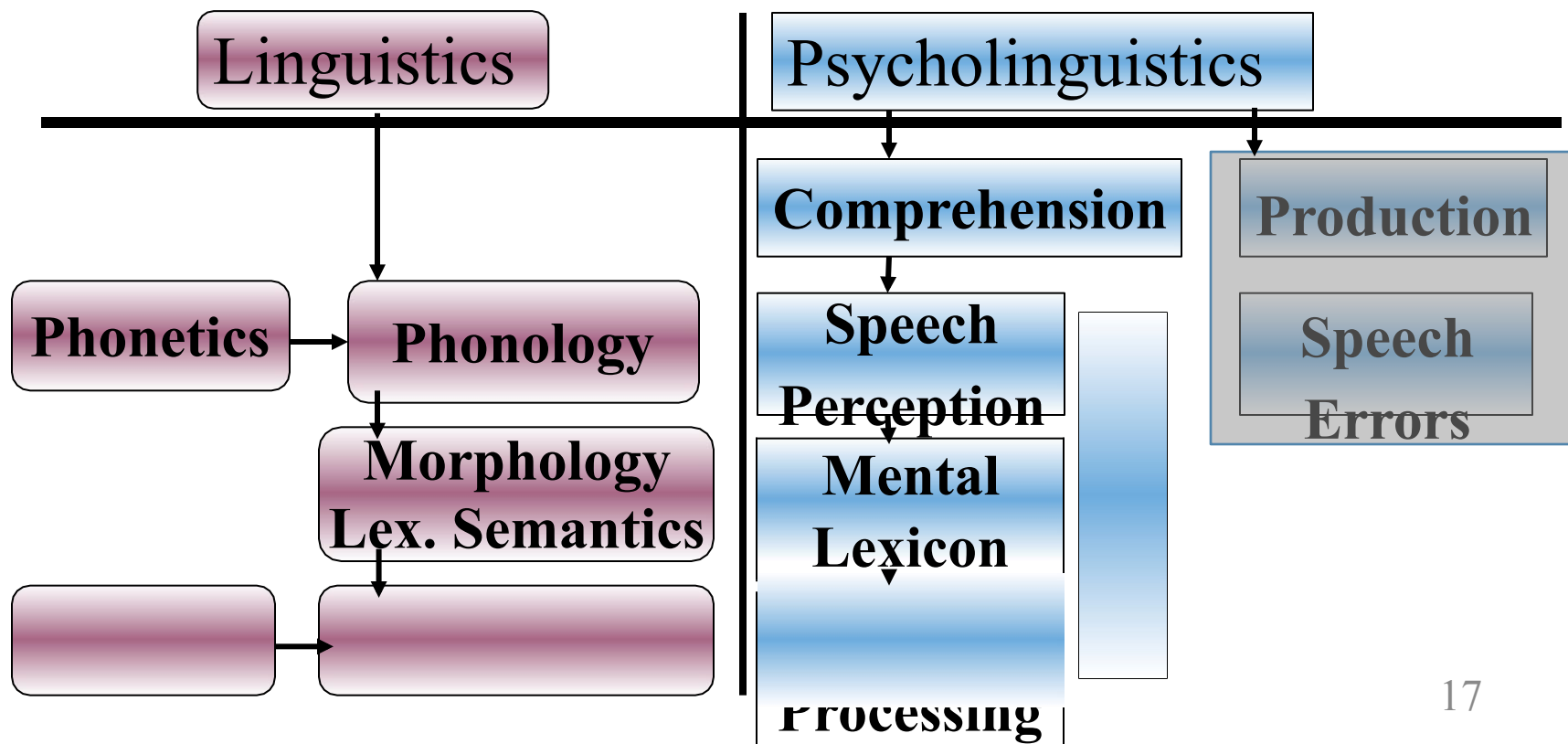
- Does the parser project structure onto an input string *immediately*?
- Consensus: YES
 - input terms are assigned to a parse immediately
 - parsers are impatient...
 - it is easier to make a commitment and revise it later than to wait and see

Incrementality

- Incrementality in processing is a guiding principle
- Accounts for significant difference between experimental approaches and theoretical approaches (which do not assume incrementality)

2. Linguistics and Psycholinguistics: Domains

2. Linguistics and Psycholinguistics



Comprehension

Comprehension is what we do with what we hear and read as we:

- identify/recognize the words
- access their meanings
- parse the syntactic structure of the sentence.

Topics and Goals in Speech Perception

- Units of perception: Perceptual processes underlying linguistic feature identification
- Pattern recognition
- Categorical perception
- Theories of speech perception
- Connection to word recognition/lexical access.

2.3 Models of Lexical

~~Access~~

- **Serial Search Model** (Forster, 1975)
- **The Logogen Model** (Morton, 1970)
- **Interactive Activation Models:**
 Connectionism (Rumelhart and McClelland, 1982)
- **Verification Model** (Becker, 1980)
- **Cohort Model** (Marslen-Wilson, 1989)

Topics in Studies of Mental Lexicon

•Semantic Priming:

Word recognition is made easier if a word related in meaning is presented just before it:

“nurse” -- <DOCTOR> vs. *“butter”* -- <DOCTOR>

•Frequency Effect:

•Commonly used words are easier to recognize:

“year” vs. *“hermeneutic”*; *“rain”* vs. *“puddle”*;

•Familiarity and age of acquisition.

•The Cohort Effect: *“candy”* vs. *“candle”*

3. Themes and topics:

An overview

Themes and topics in sentence

- Listeners and readers don't wait until the end of a sentence to interpret things.
- Interpretation goes on “on the fly” while moving through a sentence.
- We constantly make guesses about the intended meaning of words and phrases as we read or hear them.

Complexity

•Hopeless?

SINGLE

EMBEDDING

- *The girl [the man kissed] left.*
- *The girl i[the man [the boy saw] kissed] left.*

DOUBLE

•A bit better?

EMBEDDING

- *The comments that reviewers whom the editor coerced produced were largely ignored.*

•Better yet?

- *The editor that the journalist I knew met was said to be an absolute tyrant.*

Complexity

- Center embedding is not hopeless in head-final languages (Japanese, Korean, Hungarian)
- Georgian, anyone?

Ambiguity

- **Severe**

- *The horse raced past the barn fell.*

- **Less severe**

- *Mary said that John will leave yesterday.*

- **Rather mild**

- *Mary knew the answer was correct.*

Ambiguity is abundant

- ***Time flies like an arrow.***
 - (a) There is a species of flies called *time* that likes an arrow.
 - (b) There is a race and you are referee. Time the flies that look like arrows.
 - (c) There is a race and you are referee. Time the flies as you would time an arrow.
 - (d) There is a race and you are referee. Time the flies the way an arrow would time them.
 - (e) **Time and arrow both move quickly.**

Global Syntactic

~~Ambiguity~~

1. *They are forecasting cyclones.*
2. *They are describing events.*
3. *They are chopping the woods.*
4. *They are eating lunch.*
5. *They are spelling words.*
6. *They are conflicting desires.*

What Does this Exercise

Demonstrate?

- It makes you aware of your ability to parse. Other senses are possible syntactically; you parse by using your mental syntactic parsing operation.
- Syntactic operations work together with semantic operations:
If there is semantic bias for one reading, other structures do not become conscious.

Temporary Syntactic Ambiguities

- *The bully hit the girl with the...
...stick.
...wart.*
- *The woman felt the fur...
...and then left.
...was very expensive.*

Temporary Ambiguities and Being “Garden-Pathed” (GP)

• *The bully hit the girl with the...
...stick.*

...wart. *** (GP)

• *The woman felt the
fur...*

*...and they left.
...was very expensive.* *(GP)

Examples of Syntactic

Ambiguity

Want Ads (Personals?)

"FOR SALE: Mixing bowl set designed to please a cook with round bottom for efficient beating."

Caption under their wedding photo:

"Prince Ranier and Princess Grace who later died in a car accident at their wedding."

Recommending an inept employee:

"I most enthusiastically recommend this person with no qualifications whatsoever."

Garden-Path Model of

(Frazier and Fodor, 1978; Frazier and Clifton, 1996)

Processing

- **Pure** (at least initially) syntactic processing;
- **Universal principles:**
 - Minimal Attachment (Minimal Everything)
 - Late Closure (Right Association)
 - Minimal Chain Principle
- **Revision** (backtracking).
- No immediate **semantic and contextual effects**.

Constraint-Based Lexicalist Theory:

(MacDonald et al., 1994; Trueswell & Tanenhaus, 1994)

- **Language Processing System** is:
Fast, interactive, highly tuned to statistical regularities of the language.
- **Recognition of a word** includes:
parallel activation of word meanings
parallel activation of grammatical properties
- **Semantic and contextual cues** allow us to rapidly select an alternative.

4. Types of Methods

Dimensions

- Experimental vs. Correlational
- Comprehension vs. Production
- Spoken vs. Written Language
- Offline vs. Online
 - Adults vs. Children
 - Monolingual vs. Bilingual (multilingual; heritage)
 - Typical vs. Patients and Children with Impairments

Experimental Methods

- Systematic manipulation of variables (=independent variables) in order to measure performance (=dependent variables)
- In psycholinguistic experiments, IVs are linguistic and DVs are linguistically relevant behavior
- The aim: to reveal causal relations between IVs and DVs

Illustration : Referential

Ambiguity

(1) Draco hit Harry. He was really mad.

(2) Draco hit him. He was really mad.

(3) Draco hit Harry. He fell on the ground.



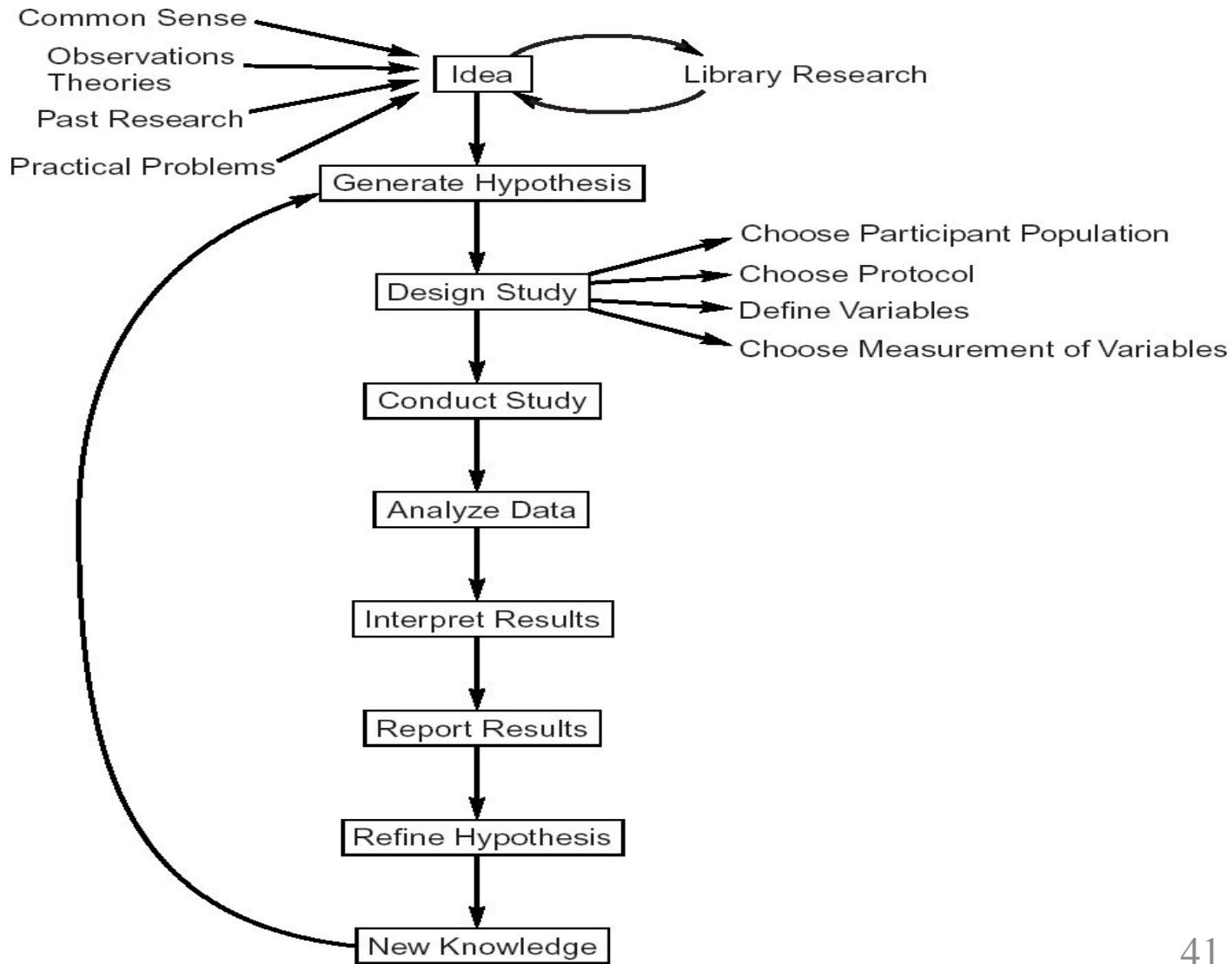
Referential

~~Ambiguity~~

- Factors (=IVs);
 - Gender and number agreement
 - First-mention, recency, subject biases
 - Grammatical role parallelism
 - Prosody
- Linguistic behavior (=DV): Participants' choice of the antecedent (subject vs. object position)
- Control variables

Hypotheses, Predictions, and Theories

- The purpose of psycholinguistic experiments is to test hypotheses about human language processing.
- Examples:
 - For lexically ambiguous words (e.g., “*a bug*”), only contextually appropriate meanings are activated
 - 9-month-old infants are sensitive to phonotactic patterns in their native language
- Hypotheses are derived from theories/models of language processing



Why do we care?

- Functional and mechanistic explanations for particular psycholinguistic phenomena
- Explanations for previous experimental results
- Deriving novel observational predictions and testing them experimentally
- Looking for converging evidence

Spoken vs. Written Language

- **Methods of Studying Spoken Language:**

- In perception, in lexical/syntactic processing

- **Methods of Studying Written Language:**

- Visual word recognition
 - Lexical access and priming
 - Cross-modal priming
 - Self-paced reading (moving window)
 - Eye-tracking (recording of eye movements)
 - Neuroimaging

4.3 Offline vs. Online

OFFLINE: METHODS: METHODS:

Accuracy

Grammatic. judgments

Preferences

Act-out

Sentence-picture matching

Questionnaires

ONLINE:

Reaction times

Fixations and saccades

Brain activity

METHODS:

Self-paced reading and listening; priming; naming;

lexical decision

Eye-tracking

none

TIME SENSITIVITY

msec

Offline Methods

- Some experimental procedures collect responses **offline**, that is, after processing routines have applied.
1. Questionnaires
 2. Act-out
 3. Sentence-picture verification

Questionnaire

- A participant reads or listens to a sentence and answers a comprehension question.
- The measure of interest is how participants respond to:
 1. Complex sentences: There is a correct answer, and error rates can be analyzed
 2. Ambiguous sentences: distribution of responses (preferences) can be analyzed.

How to design a questionnaire

- An interesting (important) linguistic phenomenon in the area of sentence processing
- A theory that attempts to explain it/ competing theories
- Factors/characteristics that may affect people's accuracy/acceptance/preferences

4.4.2 Sentence

~~Acceptability~~

- Materials consist of paradigm-like token sets:
 - Why did the Duchess sell a portrait of Max?*
 - Who did the Duchess sell a portrait of?*
 - Who did the Duchess sell the portrait of?*
 - Who did the Duchess sell Max's portrait of?*

Details

- Within token set, sentences should as nearly as possibly identical to each other.
- Item power: number of token sets
- Counterbalancing schema: each informant judges exactly 1 member of each token set
- Fillers
- Rating scale.

Instructions

- ***We would like you to imagine that your job is to teach English to speakers of other languages. For each sentence listed below, we would like you to do the following. Read the sentence, then ask yourself if the sentence seems English-sounding or not. Suppose one of your students were to use it. ... Your task is to tell us how English-sounding each sentence is using a scale.***
- ***Let the FIRST sentence be your reference. Assign a score for it that seems appropriate to you. Assign a score for each new sentence so that the score shows how much better or worse that sentence is compared to the first sentence. The better the sentence seems, the higher the score you should use.***

The Sentences

11. This is a painful movie to watch.

①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦

12. His brother believe they have are on the brink of a breakthrough to the really big time.

①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦

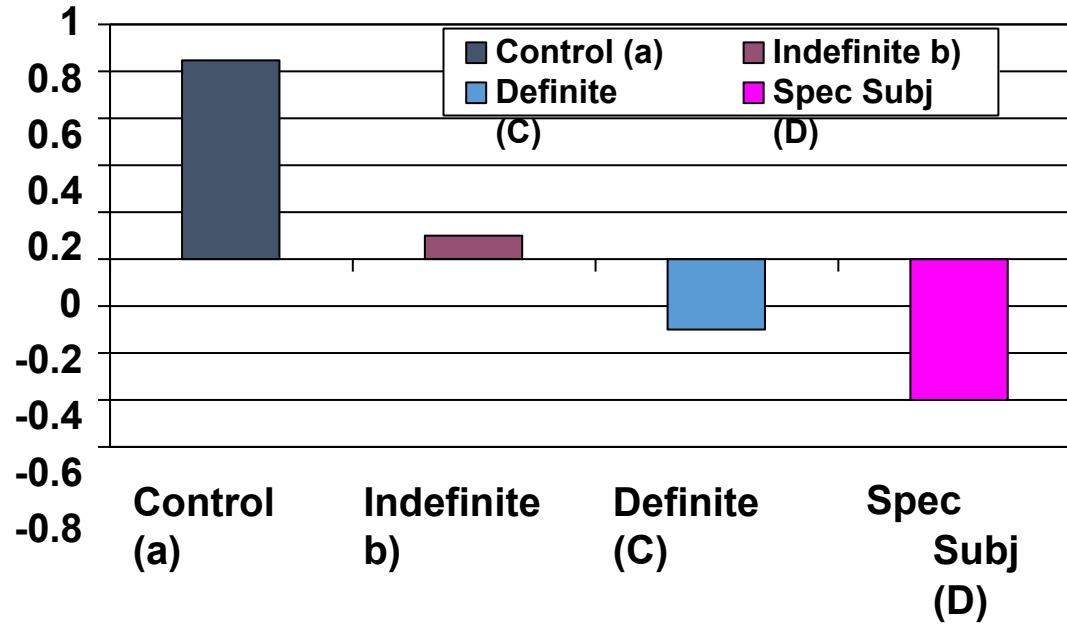
13. Who did the Duchess sell a portrait of?

①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦

16. Who did the reporter present the picture of?

①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦

The Results



Act-Out Task

- Instead of reading sentences, participants enact spoken instructions using toys and props.
- The measure of interest is how participants respond to:
 1. Complex sentences: There is a correct answer, and error rates can be analyzed
 2. Ambiguous sentences: distribution of responses (preferences) can be analyzed.

Pros and Cons of Offline

~~Methods~~

- Cheap, easy, fast; could be used with various populations (with spoken materials); no special equipment required; good for establishing an issue

- Not sensitive enough; subject to interpretation; no connection to what really happens in real time

THANK YOU
