Linguistics

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Introduction to Cognitive Science, Spring 2017

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Today:

- Linguistics, Language and "Grammar"
- Subfields of Linguistics
  - Phonology
  - Morphology
  - Syntax
  - Semantics
What is Linguistics?

- **Linguistics**: The formal study of language as a system
  - Linguists characterize linguistic knowledge, e.g., phonological, morphological, syntactic knowledge
- **Psycholinguistics**: The study of how people use language and the algorithms that implement linguistic knowledge
  - Psycholinguists study e.g., mental lexicon (representations) and online sentence comprehension (modularity)
- **Neurolinguistics**: The study of the neural mechanisms that realize these algorithms
What do linguists study?

- Linguists study language as a concept
  - How are sounds, words, sentences, and utterances structured in the mind?
  - What are the general principles that all languages tend to follow?
  - How do we relate sound, structure, and meaning?
- Linguistics ≠ Translation
What is Language?

- **Language**: “A shared symbolic system for communication”
Why is language relevant to cognitive science?

- Language is one of our most complex cognitive functions
- Uniquely human and inevitable
- Basic to understanding how mind works: how we communicate and conceptualize
Some Language Universals

- **Productivity**: We can create new words, sentences, and meanings based on a small set of basic units and composition rules.

- **Flexibility**: The sound-meaning mappings can change (including adding new words).

- **Arbitrariness**: Meaning is not predicted or determined by the pronunciation.

- **Displacement**: We can talk about things beyond the here and now.
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Competence vs. Performance

- Linguists generally make a distinction between competence and performance
  - **Competence**: The tacit knowledge all speakers of a language have about the rules of their language.  
    *The student walk tomorrow.*
  - **Performance**: The actual realization of language, including speech errors, memory lapses, etc.  
    *Sally shells sea shells by the sea shore.*

Linguists are (generally) more concerned with competence

Psycholinguists are (generally) more concerned with performance
What is “grammar” to a linguist?

- Don’t end a sentence with a preposition.
- It’s “between you and me,” not “between you and I.”
- Never split infinitives.
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This is not what linguists mean when they talk about “grammar”
Prescriptive vs. Descriptive Grammar

Prescriptive Grammar:
The rules of proper language: tell you how your language ought to be used based on some standard of educated speech/writing. These rules are often arbitrary and irrelevant to the way we actually use language every day.

Descriptive Grammar:
The grammar that we spontaneously use and understand in everyday speech. This is what linguists care about (and what we'll be talking about now).
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Linguistic Subfields — Levels of Analysis

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Phonetics & Phonology: Sounds & Organization

- **Phonetics**: How sounds are produced and perceived

![Phonetics Diagram](image)

- **Phonology**: How sounds are organized and differentiated
Clicker Poll

How many instances of the first consonant in the word *talk* (the ‘t’ sound from that word) are there in the following sentence?

*Hit the water tap three times and then stop.*

a) 8  

b) 5  

c) 4  

d) 2  

e) 0
Phonetics & Phonology

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This ties into the problem of invariance.
Phonemes

- **Phonemes** are the basic units of phonology
  - Phonemes are the abstract representations of contrastive sounds in a language
  - E.g., *hit* [tʰ] vs. *tap* [tʰ] vs. *stop* [t] vs. *water* [r] are all realizations of the phoneme /t/ in English
Phonemic Competence

- The tacit knowledge of which phonemes can occur in which environments is called **phonemic competence**.
- It’s what tells us that *trab* and *glump* are possible words of English, but *rtab* and *puglm* are not.
Word-Sound Pairing

The assignment of certain sounds and combinations of sounds to certain words and meanings is arbitrary. There is no reason why this sound sequence: `[`dog`]` `[dAg]`, or this one `[`perro`]` `[pero]`, should be paired with this meaning:

What about onomatopoeia? `bow-wow` (English) vs. `guau guau` (Spanish) vs. `wan wan` (Japanese)

These are less arbitrary, but still not entirely predictable.
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![Image of a dog]
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![Beagle](image)

- What about onomatopoeia?
  - *bow-wow* (English) vs. *guau guau* (Spanish) vs. *wan wan* (Japanese)
  - These are less arbitrary, but still not entirely predictable.
Clicker Poll

How many words do you know?

a) Under 10,000
b) Between 10,000 and 50,000
c) Between 50,000 and 100,000
d) Between 100,000 and 250,000
e) Over 250,000

The average American knows around 60,000 words!
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Morphology

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- a, an, the
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This is a difficult question. The concept of wordhood is very vague.
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These are the building blocks of words.
Morphology: Words & Units of Meaning

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Units of Meaning: Roots

- Roots/Stems:
  - Primary lexical unit of a word
  - Can stand alone
  - Cannot break into smaller units
  - Carries the most significant aspect of meaning

- Examples:
  - lock (v.), sleep (v.), cat (n.), house (n.), green (adj.), quick (adj.)
Units of Meaning: Affixes

- Affixes:
  - Have predictable patterns of combination with other morphemes
  - Cannot stand alone
  - Usually do not carry the bulk of a word’s meaning
Affixes, continued.

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    These last two are often quite common in other languages
Affixes, continued.
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  - Derivational affixes
    - *lock* (v.) + *-able* → *lockable* (adj.)
    - *quick* (adj.) + *-ly* → *quickly* (adv.)
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  - Inflectional affixes
    - *sleep* + Pres.Prog → *sleeping*
    - *cat* + Pl. → *cats*
**Derivation**: A productive way to form new words in a language (here, English)

- Add an affix to a stem \( \Rightarrow \) New meaning (and sometimes new part of speech)

Morphological derivation is **hierarchically organized**

```
carelessness
  /   \
 careless -ness
  /     \
 care   -less
```
Morphological Ambiguities

- `unlockable`
  - `unlock`
  - `-able`

- `unlockable`
  - `un-`
  - `lockable`
  - `lock`
  - `-able`
Morphological Productivity

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    - *anti-anti-aircraft missle missle* 
    - *anti-anti-anti-aircraft missle missle missle missle* 
    - ...
Inflectional Morphology

- Inflection:
  - Add inflectional affix to stem ⇒ express a grammatical category (tense, number, case, gender, etc.)
  - Inflectional morphology doesn’t form a new word or change the part of speech
Inflectional Morphology

- Inflectional morphology is also very productive:
Inflfectional morphology is also very productive:

This is a Wug.

Now there is another one.
There are two of them.
There are two ___.

*Photo courtesy of Jean Berko Gleason*
Inflectional morphology is also very productive:

- **tweet** → **tweets**
- **wug** → **wugs** (*wugen*)
Compounds

- Compounding: a productive way to form new words:
  - green (adj.) + house (n.) → greenhouse (n.)  
    (vs. green house)
  - house (n.) + cat (n.) → house cat (n.)
- New compounds are formed every day!
  - crowdsourcing, Brangelina
Morphology Takeaways

- Morphology studies **the smallest meaningful units of language** (roots/stems and affixes)
- Compounds are made up of more than one root
- Morphemes are combined using generative rules and produce hierarchical structures
- Overall, morphology is **productive**
Syntax: knowledge of how to combine words into sentences

Observation 1: Basic Word Order

- Word order affects meaning:
  - *Dog bites man.* vs. *Man bites dog.*
  - English is an SVO language (subject-verb-object)
- There are grammatical and ungrammatical word orders:
  - *Buffy staked the vampire after midnight.*
  - *Staked midnight Buffy the after vampire.*
Syntax, continued

- Observation 2: Constituents/phrases (groups of words that act as a unit)
  - Sally read about \{mud/the Earth/crispy waffles/the language of her parents/*crispy/*of/*quickly/*laugh\}.
  - \{Mud/The Earth/A crispy waffle/The language of her parents/*Crispy/*Of/*Quickly/*Laugh\} has a few defining features.
Phrase Structure Rules

- Like morphemes in morphology, phrases are the building blocks of syntax.
- Phrases are constructed and combined using phrase structure rules.
- Like morphology, syntax is hierarchically organized and productive.
Nominal (Noun) Phrases

- Noun Phrases: chunks with the same distribution as, say, a proper name
- What can an NP consist of?
- Phrase Structure Rules:
  - NP $\rightarrow$ N (mud, gold, salt)
  - NP $\rightarrow$ Determiner N (the Earth, some people, a cat)
  - NP $\rightarrow$ Adj N (crispy waffles, loud noises)
  - ...
- Where can NPs occur?
  - After a preposition (… about mud)
  - Before a verb (The Earth has …)
  - …
Phrases are also organized hierarchically:

- **NP**
  - **Det**
  - **N**
    - the
    - Earth

- **NP**
  - **Adj**
  - **N**
    - crispy
    - waffles

- **NP**
  - **N**
    - mud
Verb Phrases

- Verb phrases: chunks with the same distribution as say, an intransitive verb
  - *Sally {jumped/ate a pie/put a pie in the oven/*nice/*quickly/*towel}.*

- What can a VP consist of? (Phrase structure rules:)
  - $VP \rightarrow V \ (jumped, \ runs, \ sleeps)$
  - $VP \rightarrow V \ NP \ (ate \ a \ pie)$
  - $VP \rightarrow V \ PP \ (hovered \ in \ the \ sky)$
  - $VP \rightarrow V \ NP \ PP \ (put \ a \ pie \ in \ the \ oven)$
  - ...
Verb Phrase Structure
Sentences

- How do we make a sentence?
  - $S \rightarrow NP \ VP$

```plaintext
S
  / \  \
NP   VP
  / \  / \  \
Det NP V PP
  / \  / \  / \
the Adj N hovered P NP
  / \  / \  / \
shiny ships in Det N
  / \  / \
the sky
```
One of the ways we get productivity in syntax is recursion. Recursion involves an algorithm that is performed on outputs from that same algorithm. E.g., Embedding sentences in other sentences:

- WilLOW loves TARA.
- XANDER knows that WilLOW loves TARA.
- Buy said that XANDER knows that WilLOW loves TARA.
- Giles asked whether Buy said that . . .
- Etc. . . .

Our sentence constructing phrase structure rule must allow sentences as part of the input.
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    - *Xander knows that Willow loves Tara.*
    - *Buffy said that Xander knows that Willow loves Tara.*
    - *Giles asked whether Buffy said that . . .
    - Etc. . . .
  - Our sentence constructing phrase structure rule must allow sentences as part of the input
Transformational Grammar

- Chomsky: transformations are a way to relate the surface structures of sentences to their underlying meaning (and the relationships between structures)
  - It seems that there is a unicorn on my patio.
  - A unicorn seems to be on my patio.
  - The girl threw the ball.
  - The ball was thrown by the girl.
  - You can’t take the sky from me.
  - Who can’t you take the sky from?
  - What can’t you take from me?
Syntactic Ambiguity

- Just like morphology, syntactic constructions can exhibit ambiguity
Syntactic Ambiguity

- Just like morphology, syntactic constructions can exhibit ambiguity

*The man saw a mouse in his boxer shorts.*
Syntactic Ambiguity

- Just like morphology, syntactic constructions can exhibit ambiguity
- *The man saw a mouse in his boxer shorts.*
  Who’s wearing the boxer shorts?
Syntactic Ambiguity

- Just like morphology, syntactic constructions can exhibit ambiguity

- *The man saw a mouse in his boxer shorts.*
  Who’s wearing the boxer shorts?

```
  S
   / \  
  NP  VP
     /  
    NP  
       / 
      Det N
       /   
      the man
```

```
  S
   / \  
  NP  VP
     /  
    NP  
       / 
      Det N
       /   
      the mouse
```

```
  S
   / \  
  NP  VP
     /  
    PP  
       / 
      Det N
       /   
      in his boxer shorts
```
Syntactic Ambiguity

- Just like morphology, syntactic constructions can exhibit ambiguity
- *The man saw a mouse in his boxer shorts.*
  Who’s wearing the boxer shorts?

![Syntactic Tree Diagrams]

- S
  - NP
    - Det: the
    - N: man
  - VP
    - V: saw
    - NP
      - Det: the
      - N: mouse
    - PP
      - P: in
      - Det: his
      - N: boxer shorts

- S
  - NP
    - Det: the
    - N: man
  - VP
    - V: saw
    - NP
      - Det: the
      - N: mouse
    - PP
      - P: in
      - Det: his
      - N: boxer shorts
Which of the following is an acceptable continuation of this sentence?

While Mary was mending a sock . . .

a) Bill called
b) fell down
c) Both (a) and (b)
d) None of the above
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called **garden path sentences**, and are described as “temporarily ambiguous”.

The horse raced past the barn fell.

This is evidence of incremental parsing. We get to barn, and think we have one structure, but that structure is incompatible with the following word. So we go back and reanalyze the structure of the sentence:

\[ \text{The horse (that was) raced past the barn} \]
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called *garden path sentences*, and are described as “temporarily ambiguous”.
- *The*
Garden Paths

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- *The horse*
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called *garden path sentences*, and are described as “temporarily ambiguous”.
- *The horse raced*
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called garden path sentences, and are described as “temporarily ambiguous.”
- *The horse raced past*
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called garden path sentences, and are described as “temporarily ambiguous.”
- *The horse raced past the*
Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.

These are often called garden path sentences, and are described as “temporarily ambiguous”.

The horse raced past the barn.
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.
- These are often called garden path sentences, and are described as “temporarily ambiguous.”
- *The horse raced past the barn fell.* ✗
Garden Paths

- Besides genuinely ambiguous sentences, we also have misleading sentences that are difficult to parse.

- These are often called garden path sentences, and are described as “temporarily ambiguous”.

- *The horse raced past the barn fell.*  

- This is evidence of incremental parsing:
  - We get to barn, and think we have one structure, but that structure is incompatible with the following word.
  - So we go back and reanalyze the structure of the sentence:
    
    \[\text{[The horse (that was) raced past the barn]}_{NP} \text{ fell.}\]
Syntax Takeaways

- Phrases in syntax are like morphemes in morphology: they are the building blocks that allow you to make larger phrases, and eventually sentences.
- Syntax is productive too! (recursion)
- You build sentences using nondeclarative memory
Semantics & Pragmatics: Compositional Meaning

- **Semantics**: The meanings attached to words and the rules of composition that derive the meanings of phrases and sentences from those word meanings
  - *All dogs sleep.* ⇒ ∀x[dog(x) → sleep(x)]
  - *Angel doesn’t like Spike* ⇒ ¬like(Spike)(Angel)

- **Pragmatics**: How context interacts with the semantic meaning to produce discourse and social meaning
  - *Can you pass the salt?* ⇒ request to pass the salt
  - *Buffy is under the impression that Dawn is safe.* ⇒ The speaker believes that Dawn is not safe
  - Q: How’s your day been?
    A: #Yes!
Semantic Ambiguity

- There is also ambiguity at the semantic level!
Semantic Ambiguity

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- Scope Ambiguity:
Semantic Ambiguity

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- Scope Ambiguity:
  - *A boy climbed every tree.*
Semantic Ambiguity

- There is also ambiguity at the semantic level!
- Scope Ambiguity:
  - *A boy climbed every tree.*
    - → There is a single boy who climbed all the trees.
Semantic Ambiguity

- There is also ambiguity at the semantic level!
- Scope Ambiguity:
  - A boy climbed every tree.
    → There is a single boy who climbed all the trees.
    OR
    → For each tree, at least one boy climbed it. (Need not be the same boy)
There is also ambiguity at the semantic level!

Scope Ambiguity:

- A boy climbed every tree.
  → There is a single boy who climbed all the trees.
  OR
  → For each tree, at least one boy climbed it. (Need not be the same boy)

Lexical Ambiguity:
Semantic Ambiguity

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    - There is a single boy who climbed all the trees.
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- Lexical Ambiguity:
  - *I saw a bat over there.*
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    → I saw a flying mammal
Semantic Ambiguity

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    - For each tree, at least one boy climbed it. (Need not be the same boy)
- Lexical Ambiguity:
  - *I saw a bat over there.*
    - I saw a flying mammal
    - OR
    - I saw a tool for hitting baseballs
How the Levels Interact

- We’ve already seen that:
  - Phonology feeds into morphology (words are made of sounds)
  - Morphology feeds into syntax (sentences and phrases are made of words)
  - Syntax feeds into semantics (meaning is derived from structure)
Focus Semantics

- But other levels interact as well:
Focus Semantics

- But other levels interact as well:
  - The pronunciation can give us insight into semantic meaning:
Focus Semantics

- But other levels interact as well:
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    Bill only introduced Bob to Sue.
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    Bill only introduced Bob to Sue.
    Could this be true if Bill introduced Bob to Mary?
Focus Semantics

- But other levels interact as well:
  - The pronunciation can give us insight into semantic meaning:
    *Bill only introduced Bob to Sue.*
    Could this be true if Bill introduced Bob to Mary?
    What if he introduced John to Sue?
Focus Semantics

But other levels interact as well:

- The pronunciation can give us insight into semantic meaning:

  *Bill only introduced Bob to Sue.*

  Could this be true if Bill introduced Bob to Mary?
  What if he introduced John to Sue?

- Which element is focused/stressed tells us!
Focus Semantics

- But other levels interact as well:
  - The pronunciation can give us insight into semantic meaning:
    
    *Bill only introduced Bob to Sue.*
    
    Could this be true if Bill introduced Bob to Mary? What if he introduced John to Sue?
  - Which element is focused/stressed tells us!
    
    *Bill only introduced BOB to Sue.*
    
    ⇒ Bill didn’t introduce anyone other than Bob to Sue (but he could have introduced Bob to other people)
Focus Semantics

- But other levels interact as well:
  - The pronunciation can give us insight into semantic meaning:
    
    *Bill only introduced Bob to Sue.*

    Could this be true if Bill introduced Bob to Mary?
    What if he introduced John to Sue?

  - Which element is focused/stressed tells us:
    
    *Bill only introduced BOB to Sue.*
    
    ⇒ Bill didn’t introduce anyone other than Bob to Sue (but he could have introduced Bob to other people)
    
    *Bill only introduced Bob to SUE.*
    
    ⇒ Bill didn’t introduce Bob to anyone other than Sue (but he could have introduced other people to Sue)
Wrap Up

- Language is inevitable and human
- Linguists are interested in descriptive grammar to characterize the language knowledge that speakers have
  - Phonological knowledge
  - Morphological knowledge
  - Syntactic knowledge
  - Lexical, semantic, and pragmatic knowledge
- Language is productive, hierarchical, and compositional
Thanks!

I don’t mean to go all language nerd on you, but I just legit adverbed “legit,” verbed “adverb,” and adjectived “language nerd.”

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