MORPHOLOGY, SYNTAX, SEMANTICS, PRAGMATICS

COMD570: Introduction to Language Development

Components of language

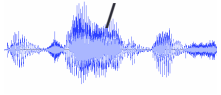
Morphology & Syntax

Abstract combinatorics

Form

Phonetics & Phonology

/ətʃɑɪldits səmtʃɑkələt/



Meaning

Semantics & Pragmatics

Chomsky, 1980; 1995

Morphology

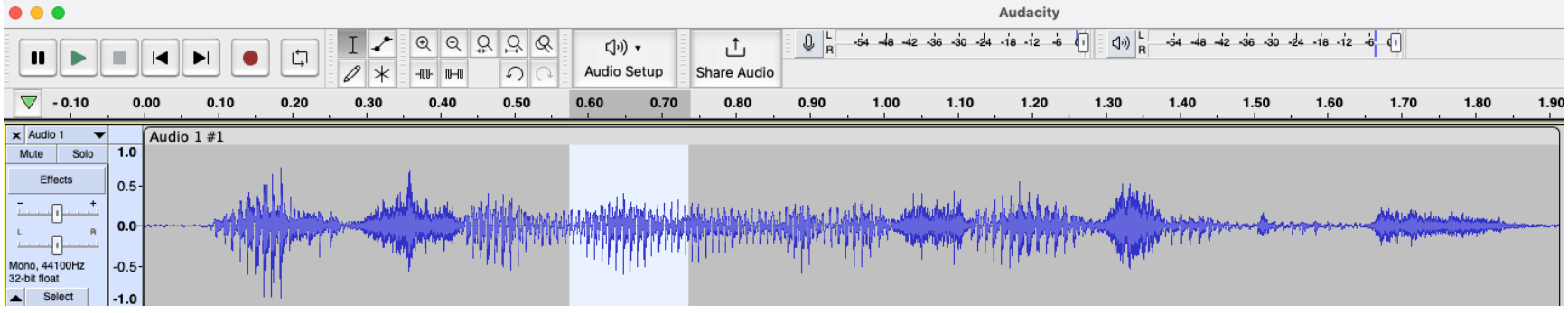
Morphology: word structure

- What are words?
  - Things with spaces in-between them
    - Short words: Cat, dog, me, I, you
    - Long words: antidisestablishmentarianism

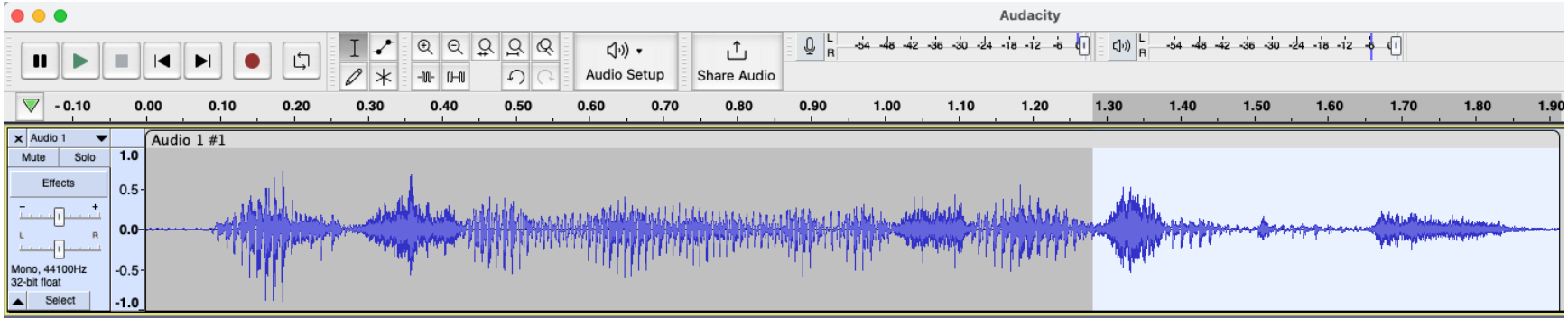
Morphology: word structure

- What are words?
  - Things with spaces in-between them
    - Short words: Cat, dog, me, I, you
    - Long words: antidisestablishmentarianism
- Problems with this definition?
  - Spoken and signed language doesn't have spaces
  - Not all languages have written forms
  - There are spaces in the middle of some words
  - There are cases where word-like things have no spaces in-between

Spoken language doesn’t have spaces



Right, so **now** I’m gonna say a sentence



Right, so now I’m gonna say a **sentence**

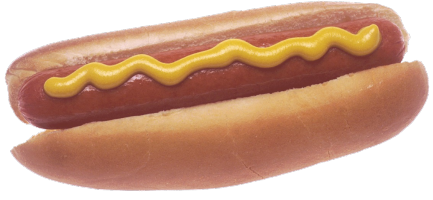
Words with spaces in the middle

- Wet suit, hot dog, bell tower, insurance agent, blood pressure, etc.

Words with spaces in the middle

- Wet suit, hot dog, bell tower, insurance agent, blood pressure, etc.
- There is a big difference between eating a:

- [hot dog]



[hot] [dog]

Words & morphemes

- **Morpheme** = entry in your mental dictionary, or **lexicon**
  - A systematic correspondence between a particular phonological form, a particular meaning, and morphosyntactic features

- **Word**: the smallest unit comprised of one or more morphemes that can be produced in isolation
  - E.g.: *John kicked the ball*
  - Word morphemes: *John, kick, the, ball*
  - Non-word morphemes: -*ed*

Morphemes & phonemes

- Phoneme inventory: small, limited set of phonemes
  - Phoneme inventory is bounded: average language has a few tens of phonemes, extremely difficult (impossible?) to learn/create new ones
- Lexicon: massive, unlimited set of morphemes
  - The lexicon is unbounded: average person knows tens of *thousands* of words/morphemes, constantly learning/creating new ones

DAVID GOEHRING/FLICKR (CC BY 2.0)

An average 20-year-old American knows 42,000 words, depending on how you count them

By Jessica Boddy | Aug. 19, 2016 , 10:00 AM

Open-class vs. Closed-class words/moprhemes

- Open-class: can add new entries to the lexicon (hence, *open*)
  - Also called “content” words/morphemes

- Closed-class: difficult to add new entries to the lexicon (hence, *closed*)
  - Also called “function” words/morphemes

Open-class words/morphemes

- **Nouns:** cat, desk, leisure, pants, Columbia
- **Verbs:** catch, drop, lie, smile, donate
- **Adjectives:** red, hot, happy, sincere, tall

Closed-class words/morphemes

- **Prepositions:** *in, out, over, under, off, on*
- **Pronouns:** *I, you, she, they*
- **Reflexive pronouns:** *myself, yourself, ourselves*
- **Possessive pronouns:** *my, your, her, hers, his*
- **Articles:** *a, the*

Closed-class words/morphemes

- **Demonstratives:** *this, that, these, those*
- **Quantifiers:** *some, many, all, few*
- **Copula:** *to be* [noun/adjective (phrase)]
- **Modal Verbs/Auxiliaries:** *will, would, can, could*
- **Auxiliaries:** progressive *be+ing* (e.g. *am, are, is walk-**ing***), perfective *have+en* (e.g. have, has beat-**en,** walk-**ed**)

Morphemes & morphological rules

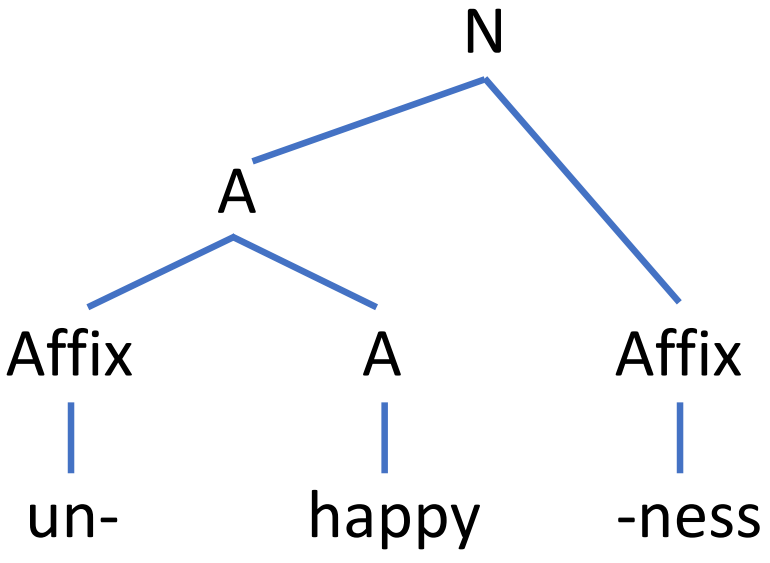
- Two components of morphology:

1. Morphemes
   - Entries in the mental lexicon
2. Morphological rules
   - Processes that modify and/or combine morphemes

- Words: the output of morphological rules

Affixation

- Common type of morphological rule
- Affixation rules attach morphemes together to produce words
  - Creates hierarchical structures that make up words



Roots vs. affixes

- **Root**: the minimal morpheme within a word that has meaning in isolation
  - The “core” of a word’s meaning
- **Affix**: morpheme that cannot stand on its own, attached to a base form to form a new word

Free vs. bound morphemes

- **Free morphemes:** can stand alone and be interpreted
  - E.g.: *erase*, *weather*, *hippopotamus*

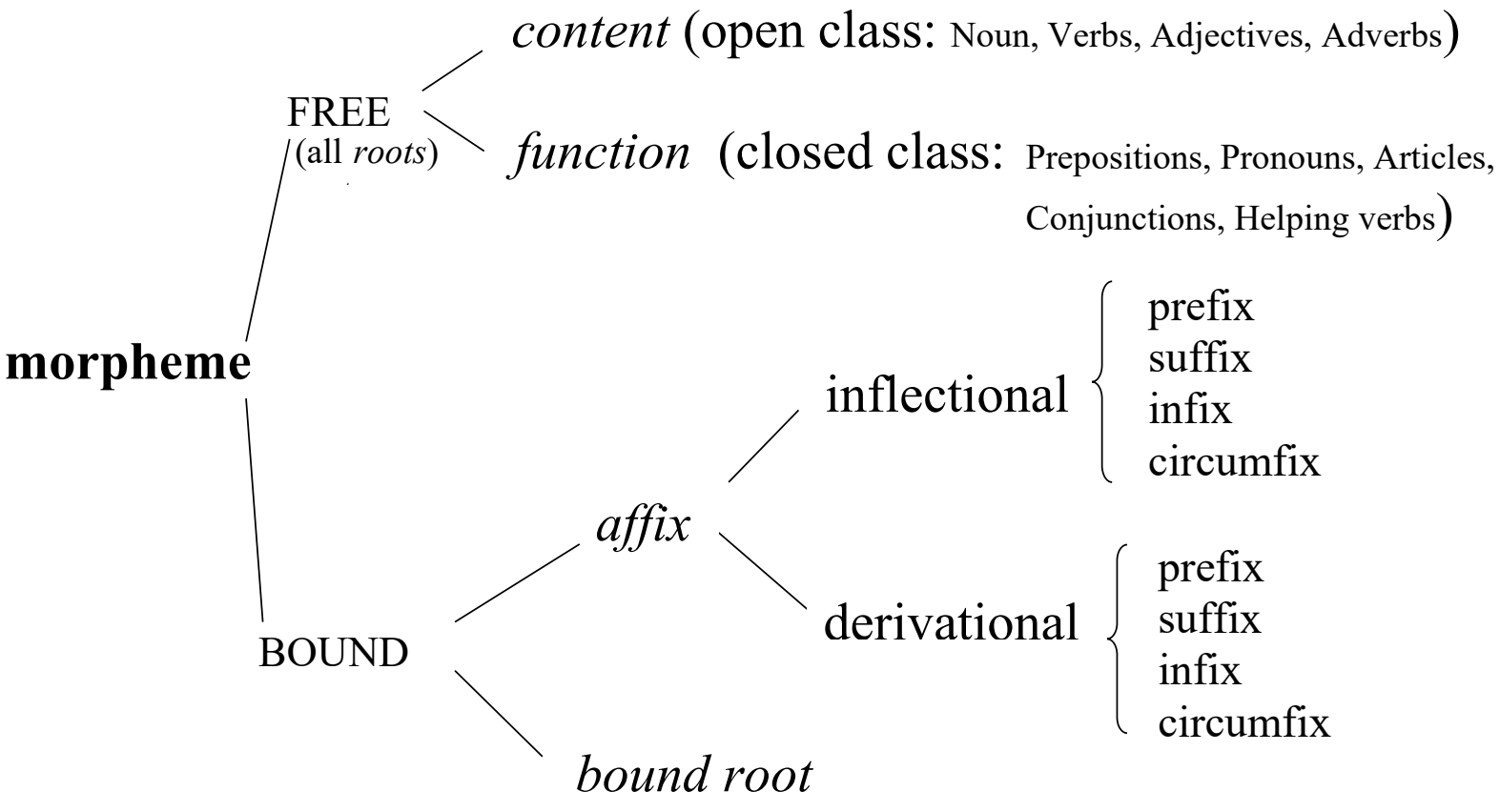
- **Bound morphemes:** must be attached to other morphemes to be interpreted
  - Often, but not always, affixes, e.g.:
    - *-ed*, *re-*, *-er*, and *-s*
  - Bound roots are possible, e.g.: Anx-ious

Affixes

- Four kinds of affixes:

1. **Prefixes**
   - Attach to the front of a base form (e.g., re-, as in **re**do)
2. **Suffixes**
   - Attach to the end of a base form (e.g., -able, as in wash**able**)
3. **Infixes**
   - Attach to the middle of a base form (e.g., -freaking-, as in fan**freaking**tastic)
4. **Circumfix**
   - Attach to the sides of a base form (e.g., en- -en, as in **en**bold**en**, **en**light**en**)

MORPHEME CLASSIFICATION



Productivity

- Morphological rules (like phonological rules) are **productive** –apply to novel forms
  - E.g.: *blick* + -*able* -> *blickable*, *blick* + -*ed* -> *blicked*, *blick* + *re*- -> *reblick*
- **Irregular forms**: words for which certain morphological rules do not apply
  - E.g., eat in the past tense is not *eat* + -*ed* -> *eated*
- Irregular forms need to be memorized (i.e., stored in the lexicon) for individual words
  - Need to block application of regular morphological rules

Derivational & inflectional morphology

- **Derivational morphology:** changes of meaning and/or grammatical category
  - E.g.: -*able* suffixation
- **Inflectional morphology:** express grammatical information, no change of core meaning or grammatical category
  - E.g.: English past tense
  - Verb + -*ed* = verbed

Crosslinguistic differences in Morphology

- **Agglutinative languages**: attach multiple different morphemes to express different grammatical inflections, e.g. Turkish, Swahili

- **Inflectional languages**: express multiple grammatical inflections on the same morphemes, e.g. Spanish, German
  - **Isolating languages:** sub-class of inflectional; little overt inflectional morphology, such as English, Mandarin Chinese, Yoruba

Other Morphological Processes

Conversion

- Sometimes called “zero derivation”

- Process that changes the grammatical category of a word without modifying or adding to phonological form
  - E.g., Noun -> Verb conversion: *mail*, *email*, *salt*, *pepper*, *switch*, *ship*, *lure*, *dress*, *dizzy*, *divorce*, *fool*, *merge*

Compounding

- **Compound**: a word derived from multiple roots rather than one

- Compounds in English are typically right-headed – the rightmost root determines both the core meaning and the syntactic category

- Doghouse, yellowtail, crybaby, afterthought
- Bloodthirsty, red hot, punch-drunk, overprivileged
- Window shop, whitewash, blowdry, underfeed

Iterative compounding

- Like affixation, many roots can be iteratively combined to produce compounds:

[[[[[[[[toe nail] clipper] accident] insurance] company] employee] benefits] **manager**]

- Bracket notation
  - Convenient illustration of internal structure of words/sentences without trees
  - Each bracket represents a constituent

Reduplication

- Walpiri (Australia)
  - Plural marking:
  - [kurdu] *child* — [kurdu**kurdu**] *children*
  - [kamina] *girl* — [kamina**kamina**] *girls*
  - [mardukuja] *woman* — [mardukuja**mardukuja**] *women*

Partial reduplication

- Often serves to intensify or slightly modify meaning
  - Money-schmoney, easy-peasy, okie-dokie

Allomorphy

- Different phonological forms of a morpheme depending on phonological context
  - Underscore the interaction that occurs between morphology and phonology

Allomorphy

- English plural:
  - cat[s] dog[z] horse[əz]
  - plant[s] tree[z] bush[əz]
- English indefinite determiners:
  - an apple a banana
  - an onion a potato
  - an eel a snake
  - an eyeful a mouthful
- Arabic definite determiners:

al-qamr	aʃ-ʃams
the-moon	the-sun
‘the moon’	‘the sun’

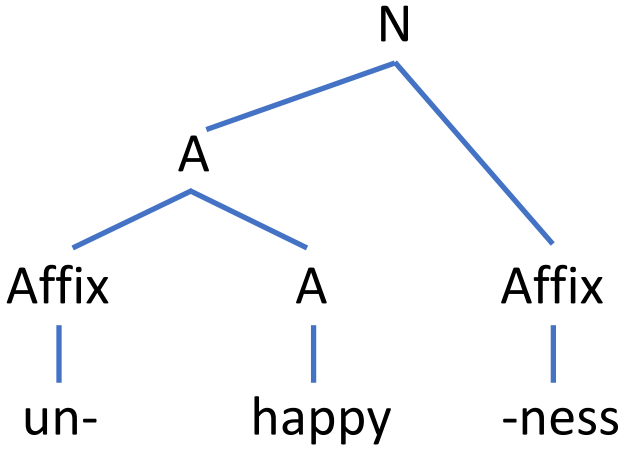
Morphology Recap

Syntax

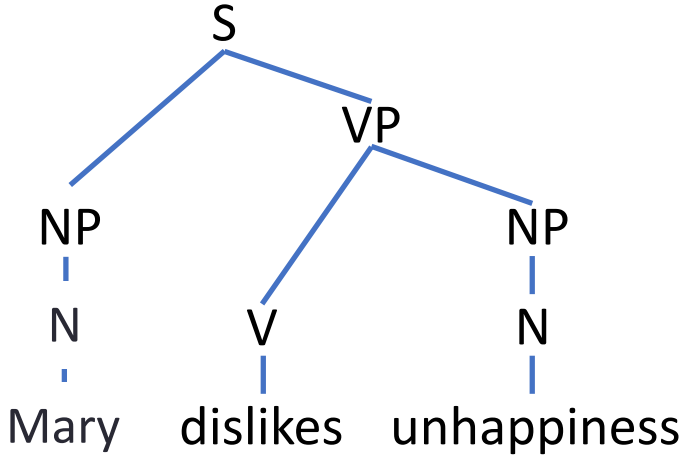
Obligatory Kandinsky painting

From words to sentences

Morphological Word Structure



Syntactic Sentence Structure



Knowledge of sentences: a computational system

- Properties of **syntactic** (sentence) structure:
  - Independent of meaning
  - Possible sequences of words do not reflect probability of word sequences in the environment
  - Creative & infinite

- Part of what you know when you know a language is a **system of rules** for creating sentence structures

Words & grammatical category

- Morpheme: minimal combination of sound and meaning
- Word: output of a combinatorial morphological rules that specify grammatical category
  - Morphemes are inputs to morphology
  - **Words are inputs to syntax**

- Different grammatical categories of words have different syntactic properties

Syntactic distribution

- Different grammatical/syntactic categories have different **syntactic distributions**
  - What kinds of words can occur "next to" each other
  - Both verbs and prepositions can appear before "the clowns"
  - Nouns and adjectives *cannot*

Verb

Envies *the clowns*

Preposition

For *the clowns*

Noun

*The envy *the clowns*

Adjective

*Envious *the clowns*

Syntactic distribution

- Nouns can be preceded by articles and quantifiers

Noun

- {the, some} clowns

Preposition

- *{the, some} over

Verb

- *{the, some} arrives

Adjective

- *{the, some} purple

Syntactic distribution

- Verbs can follow auxiliaries:

Verb

- {will, should} arrive

Preposition

- *{will, should} over

Noun

- *{will, should} clowns

Adjective

- *{will, should} purple

Syntactic distribution

- Within categories, there are also differences in syntactic distribution:
  - The rabbit appeared$_{V}$
  - *The rabbit appeared$_{V}$ a$_{ART}$ garden$_{N}$

Syntactic distribution

- Within categories, there are also differences in syntactic distribution:
  - *I planted$_{V}$
  - I planted$_{V}$ a$_{ART}$ garden$_{N}$

Syntactic distribution

- Within categories, there are also differences in syntactic distribution:
  - *The dude resides_{V}
  - *The dude resides_{V} a_{ART} house_{N}
  - The dude resides_{V} in_{P} a_{ART} house_{N}

Syntactic distribution: linear order

- Need a more precise definition of what we mean by “next to” each other
  - *Brutus stabbed$_V$
  - Brutus stabbed$_V$ Caesar$_N$
  - *Brutus stabbed$_V$ happy$_A$

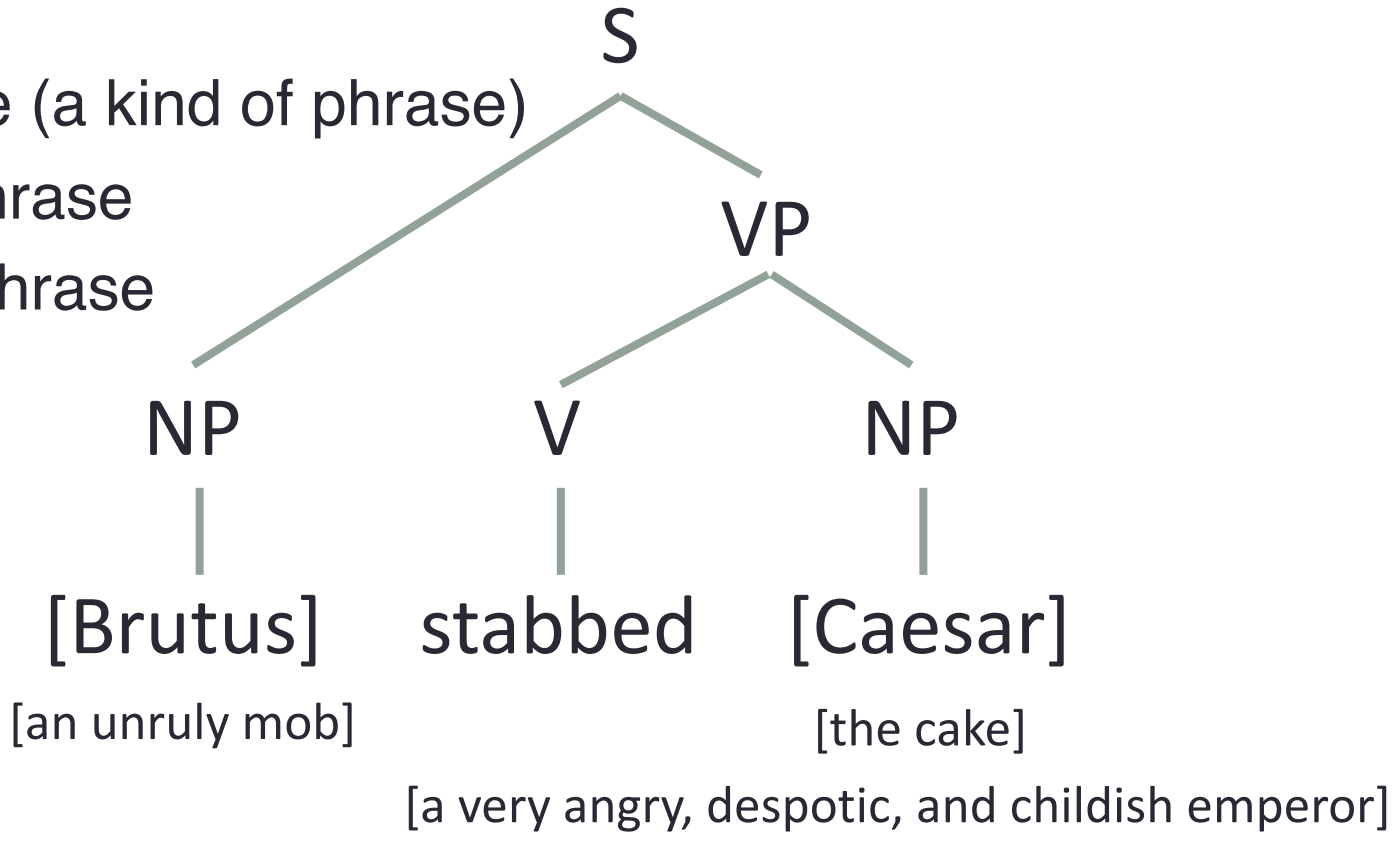
Phrase structure

- **Phrases:** groups of words (i.e., syntactic units)
- ‘stab’: needs to be next to a **Noun Phrase**

- Brutus stabbed [Caesar]$_{NP}$
- Brutus stabbed [the cake]$_{NP}$
- Brutus stabbed [angry senators]$_{NP}$
- Brutus stabbed [a very angry, despotic, and childish emperor]$_{NP}$

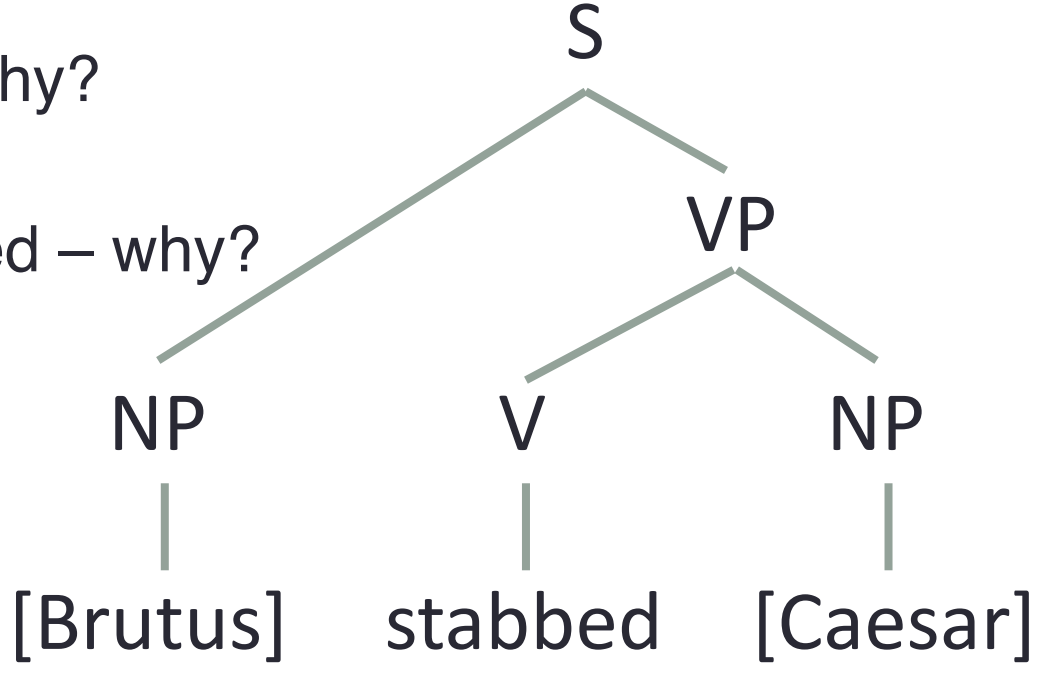
Syntactic trees

- S: sentence (a kind of phrase)
- VP: verb phrase
- NP: noun phrase



Syntactic trees

- Structure determines meaning:
- Brutus is the killer – why?
  - Subject position
- Caesar is the one killed – why?
  - Object position

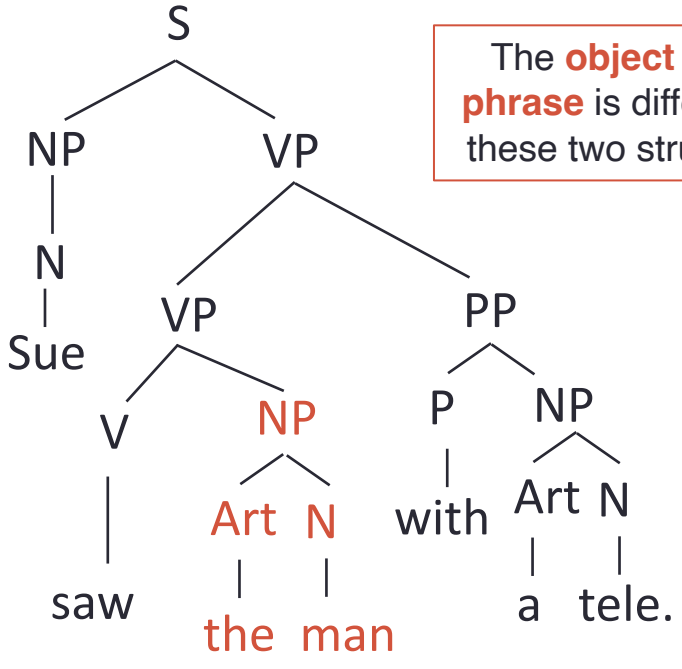


Constituency

- **Constituent:** a group of words that functions as a single syntactic unit
  - Phrases are constituents that have a grammatical category label determined by a particular word inside the phrase
- **Ambiguity:** multiple possible structures for the same sequence of words
- Sue saw the man with a telescope
  - What are the possible meanings of this sentence?

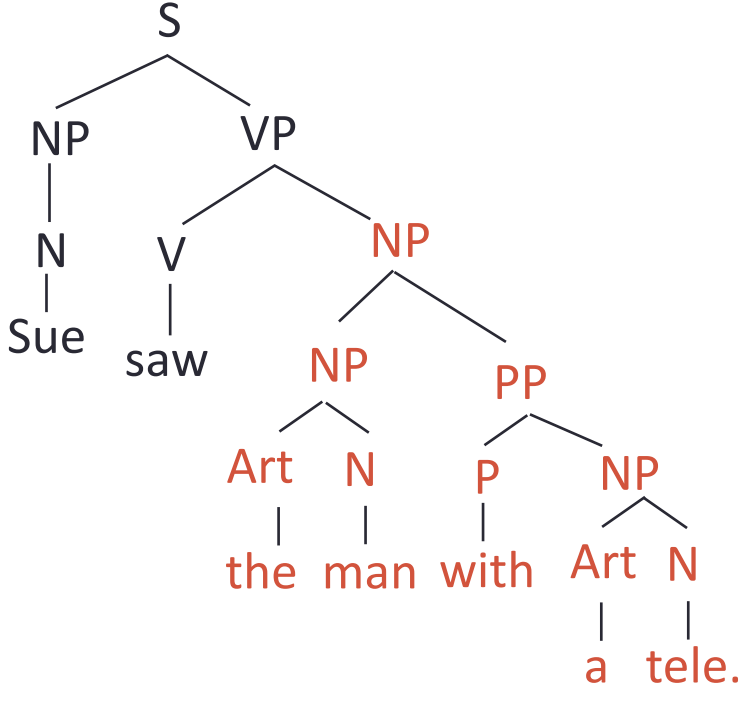
Ambiguity

- Sue saw [the man] with a telescope
  - Using a telescope to see the man



The **object noun phrase** is different in these two structures

- Sue saw [the man with a telescope]
  - Seeing a man who had a telescope



Phrase structure

- **Phrase:** constituent centered around a **head** word
  - The head *determines* the grammatical category label of the constituent

- Brutus stabbed [the $\text{cake}_{N}]_{NP}$
  - Grammatical category of entire phrase: NP
  - Head: cake (category N)

Different kinds of phrases

- **Noun phrases**
- Verb phrases
- Prepositional phrases
- Adjective phrases

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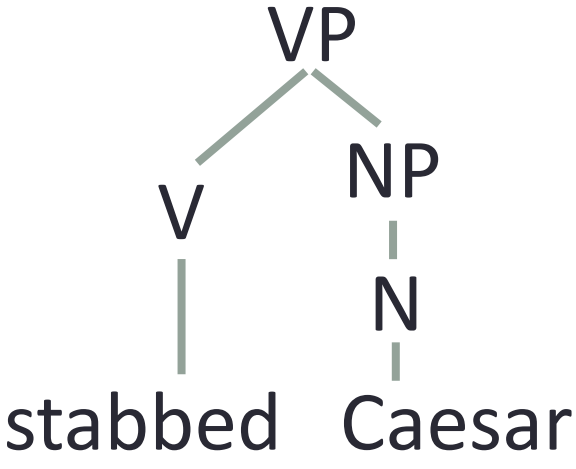

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- **Prepositional phrases**
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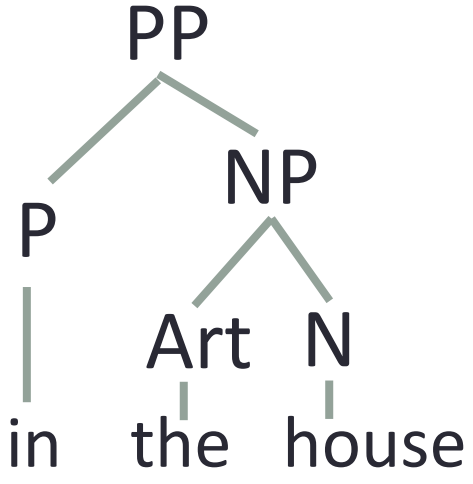
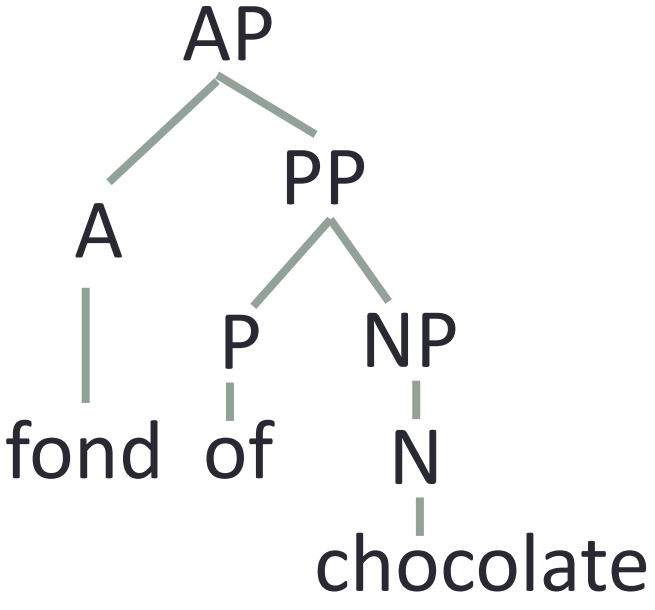


Different kinds of phrases

- Noun phrases
- Verb phrases
- Prepositional phrases
- **Adjective phrases**



Heads & complements

- Some phrases are comprised of just a head:
  - $[\text{Brutus}]_{NP}$, $[\text{Caesar}]_{NP}$
- Some phrases are comprised of a head & another phrase:
  - $[\text{Stabbed}_{V}\ [\text{the cake}]_{NP}]_{VP}$
- Often this “other phrase” serves as a **complement**
  - Completes the meaning of the head

Complement Selection

- Different kinds of heads have different **selection requirements** for complements:
  - Appear
    - A rabbit appeared
    - *A rabbit appeared [the garden]
  - Plant
    - I planted [a garden]
    - *I planted
  - Reside
    - *The dude resides
    - *The dude resides [a house]
    - The dude resides [in a house]

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What are the selection requirements for each of these verbs?

Complement Selection

- Appear:
  - Nothing — **Intransitive** (does not take complement)
- Plant:
  - NP — **Transitive** (takes 1 complement)
- Reside:
  - PP — **Transitive** (takes 1 complement)

The lexicon and lexical entries

- Lexicon: repository of morphemes connecting form & meaning
- Specifies:
  - Phonological form
  - Meaning
  - Grammatical category
  - Complement selection

The lexicon and lexical entries

- Lexical entry for ‘cat’:
  - Pronounced: /kæt/
  - Means: CAT
  - Category: N
- Lexical entry for ‘stab’:
  - Pronounced: /stæb/
  - Means: STAB
  - Category: V
  - Selection: __ NP
- Lexical entry for ‘reside’:
  - Pronounced: /ɹəzɑɪd/
  - Means: RESIDE
  - Category: V
  - Selection: __ PP
- Lexical entry for ‘appear’:
  - Pronounced: /əpiɹ/
  - Means: APPEAR
  - Category: V
  - Selection: __ ∅

Some other things about syntax

Agreement

- The value of some grammatical feature (e.g., number, gender) in one phrase is dependent on the value of the same feature in a different phrase

Agreement

- Subject-verb :
  - In English: **person + number** of subject marked on the verb
    - *she*[3rd sing.] *loves*[3rd sing.] *linguistics; they*[3rd plural] *are*[3rd plural] *intelligent*
- Anaphoric (pronoun/reflexive):
  - In English: pronoun or reflexive agrees in **number + (grammatical) gender** of its antecedent (the noun phrase it refers to)
    - *Bob*[masc. sing.] *loves Mary because he*[masc. sing.] *is enlightened*
- Noun phrases:
  - In English: **number** agreement with quantifiers
    - *Three*[plural] *cats*[plural]
  - In Spanish: number + gender agreement with adjectives
    - *galletas*[fem. plur.] *deliciosas*[fem. plur.]*; delicioso*[masc. sing.] *burrito*[masc. sing.]

Movement/Transformations

- Rules that take a completed phrase structure and transform it
  - Add/delete/move elements of a tree around
  - Often used for forming questions and sentences with non-canonical (i.e. non-standard) word order, such as passives, e.g. *Bob was stabbed*

Movement/Transformations

- Yes/No questions (i.e., the answer is “yes” or “no”) involve movement of the auxiliary of the main clause to the front of the sentence

[Susan]$_{NP}$ **must** leave
Must [Susan]$_{NP}$ leave?

[Mary]$_{NP}$ **has** been sleeping
Has [Mary]$_{NP}$ been sleeping?

[Bill]$_{NP}$ **is** sleeping
Is [Bill]$_{NP}$ sleeping?

[The man who is tall]$_{NP}$ **is** happy
Is [the man who is tall]$_{NP}$ happy?

Hierarchical structure cross-linguistically

- Latin: free word order language with **case marking**
  - Mark syntactic positions using an inflectional affix
  - Subject position: nominative case
  - Object position (complement of VP): accusative case
- Marc**us** ferit Cornelia**m**: Marcus hits Cornelia (subject–verb–object)
- Marc**us** Cornelia**m** ferit: Marcus Cornelia hits (subject–object–verb)
- Case marking found in many other languages, e.g. German, Japanese, Russian, Turkish)

Syntax Recap

- Syntax
  - Structure of sentences (analogous to morphology, or word structure)
- Lexicon & lexical entries
- Constituents
- Ambiguity
- Phrases
- Agreement
- Movement/transformations

Semantics

Semantics vs. pragmatics

- Semantics: the meaning of a linguistic expression
- Pragmatics: how language is used in social context

Structure in meaning

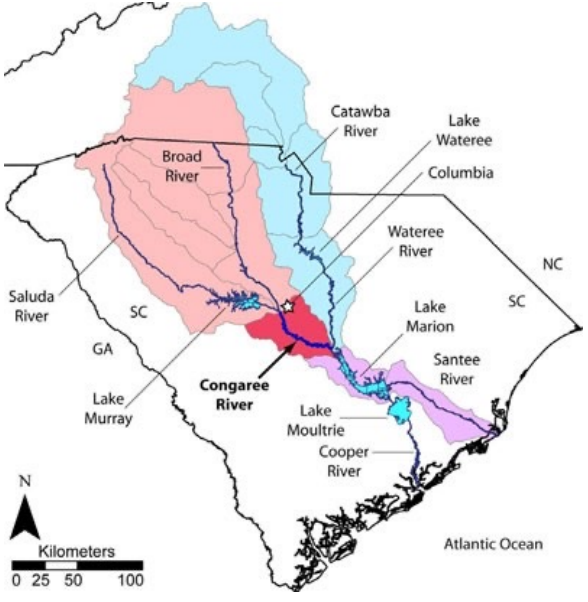
- Meanings are structured in at least two ways:
  1. Concepts are highly organized with respect to each other
  2. The semantic interpretation of sentences depends on the syntactic structure of the sentence

Lexical vs. compositional semantics

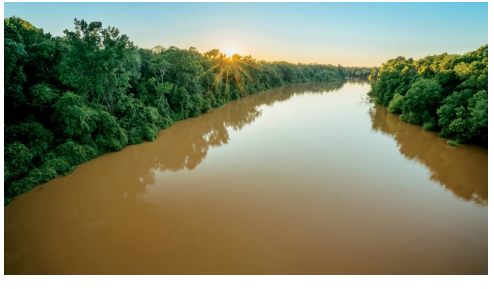
- **Lexical semantics**: the meanings of particular concepts denoted by words and their relations to other concepts
  - Concepts contain semantic features or properties of meaning
  - E.g., the meaning of *cat*: CAT (the furry 4-legged creature with a tail that goes meow, likes to hunt mice, known for being uppity and not getting along with dogs, etc.)
- **Compositional semantics**: the meaning of combinations of morphemes/words
  - E.g. the meaning of *the troll messily devoured the elf* (vs. *the elf messily devoured the troll*)

Words and Concepts

- What is the meaning of a word, e.g. *Congaree?*
  - Traditional answer: the word picks out something in the world (or a set of things, e.g. in the context of *river*)
  - Problems: can radically alter or replace the physical nature of something, yet the meaning does not change



- Alternative:
  - Concepts/meanings of words are mental objects which *can be used* to refer to "the real world" but are independent of it



Meaning relations among words

- **Synonyms:** (roughly) same meaning, different phonological form
  - Sofa – couch
  - Sick – ill
  - Buy – purchase

Meaning relations among words

- **Homonyms** (or homophones): different meaning, same phonological form
  - Bank (financial institution) – bank (side of the river)
  - Left (political orientation) – left (past tense of leave)

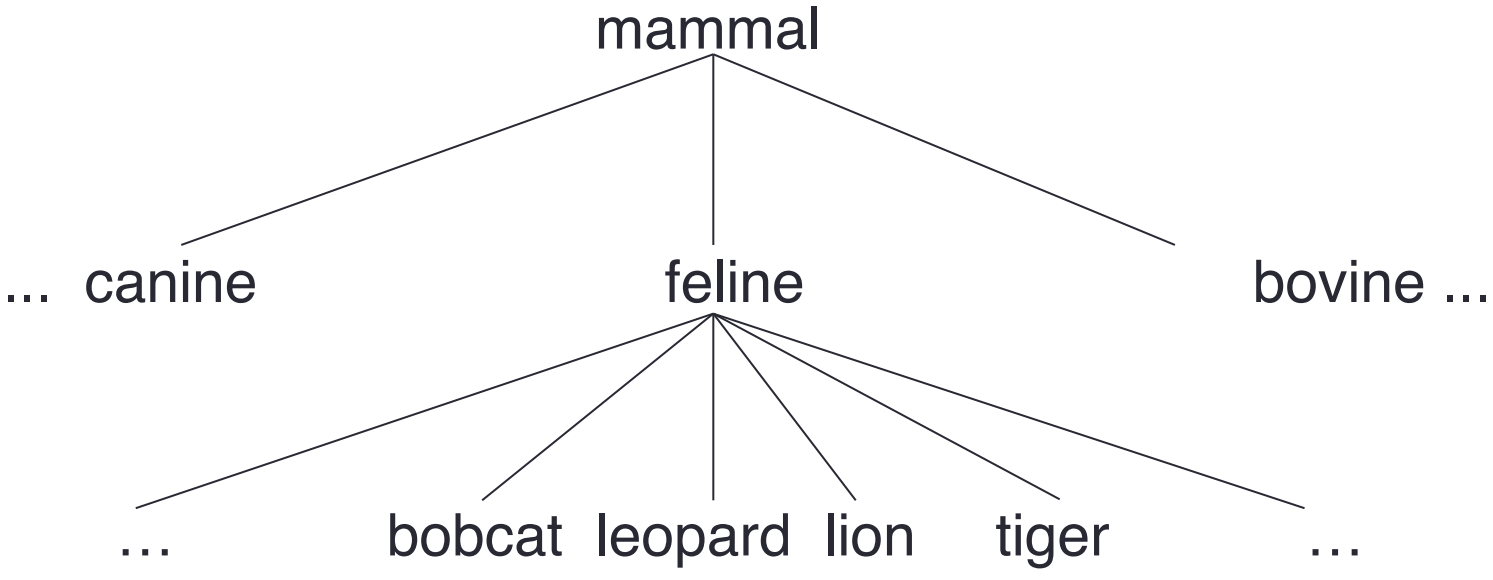
Meaning relations among words

- **Antonyms:** opposite or nearly opposite meanings
  - Dead – alive
  - Increase – decrease
  - Do – undo

Meaning relations among words

- **Hyponyms:** words whose meanings are specific instances of the meaning of a more general word
  - *Scarlet* –> hyponym of red
  - *Red* –> hyponym of color

Taxonomic relations among concepts



Compositionality

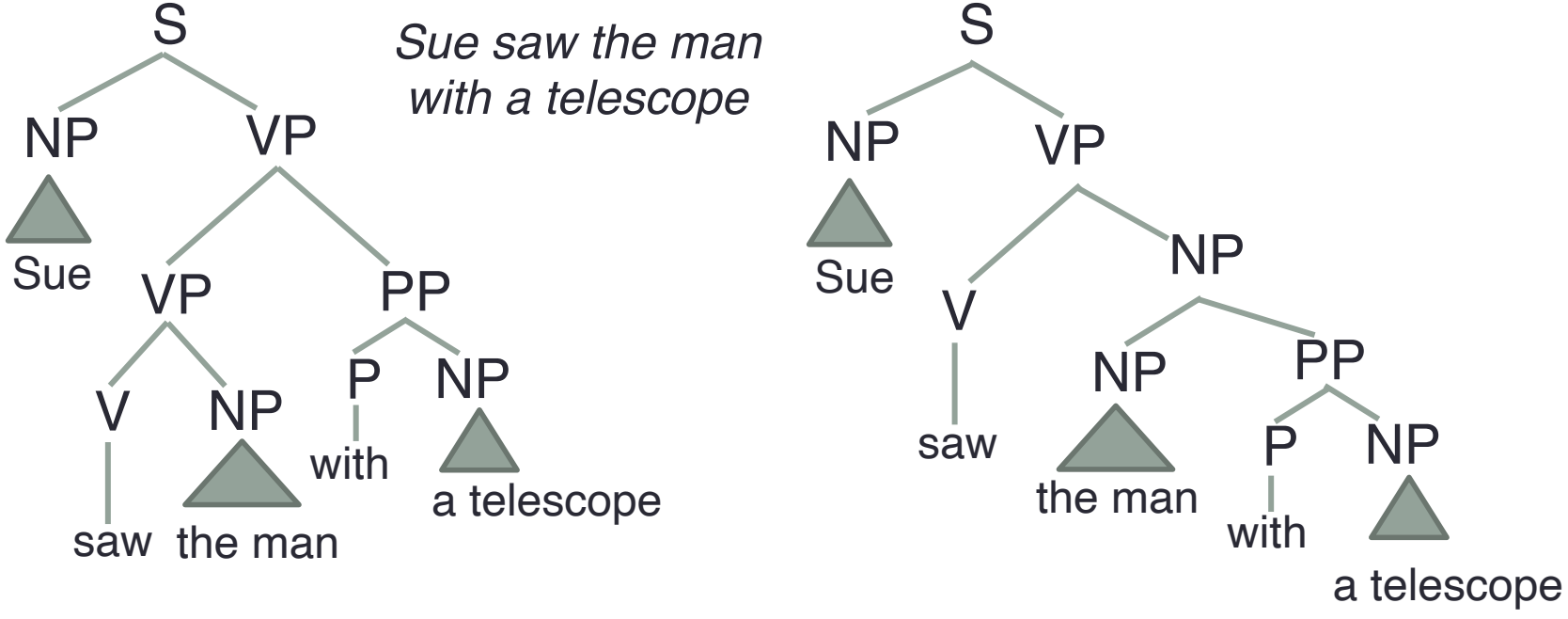
- Linguistic expressions (i.e., sentences) have complex internal structure built up out of parts (morphemes & words)
- The complexity of a linguistic expression has a corresponding complexity of meaning, i.e. the semantics of language is **compositional**
- Propositions formed by compositional semantics can be judged as true or false of the world

Ambiguity

- Multiple interpretations given the same string of words
- **Lexical ambiguity**: homonyms give rise to lexical ambiguity
  - Let's meet at the bank
  - I hate lemons
- Different lexical entries that happen to have the same pronunciation

Ambiguity

- **Syntactic ambiguity**: multiple possible structural analyses of the same string of words



World knowledge

- Need to distinguish **linguistic semantics** (including word knowledge) from **world knowledge**

World knowledge

- **World knowledge**: autobiographical and experiential understanding of the world
  - Can assess the extent to which events are likely to occur in specific contexts
  - E.g., it is likely that a professor will give students an exam in a classroom, possible that angry aliens will vaporize a starship, but unlikely that a dinner party will be held in the waves of the ocean
- Includes memories of particular events in your life
  - Sometimes called **episodic memory**

Pragmatics

Discourse

- Extended use of language, beyond isolated sentences
  - Most of language use is discourse!
  - Conversations, story-telling, joke-telling

- Pragmatics is the system by which we can understand language in the context of discourse

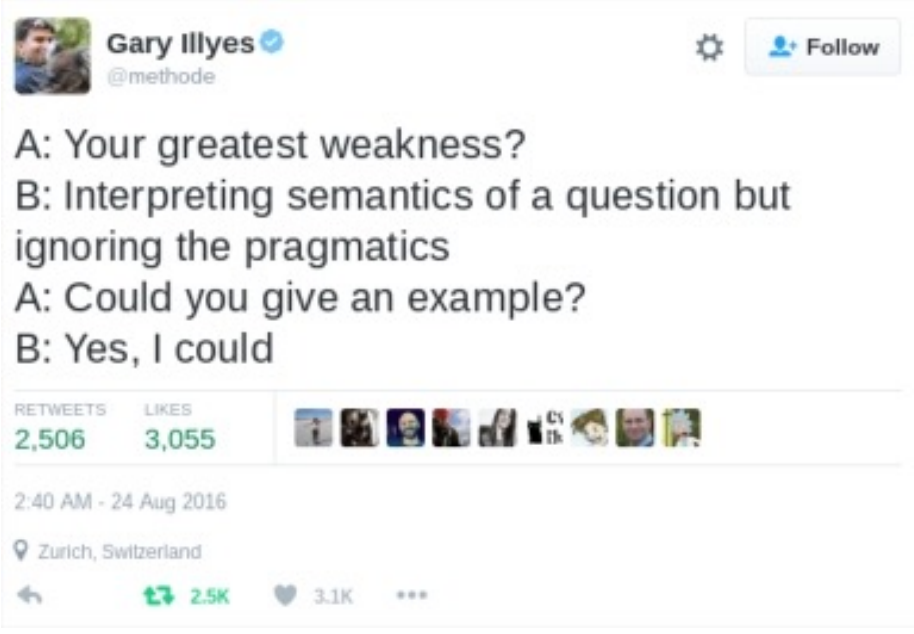
Pragmatic rules

- There are certain “rules” you assume people are following in conversation

- When these rules are violated, it can be surprising or upsetting (or sometimes funny!)

Pragmatic rules

- These rules are not part of the literal meaning of the sentence (semantics)
- They have to do with the nonliteral, unspoken meaning



Pragmatic rules

- Rules provide a set of **expectations** for how people will speak

- Allow you to make certain **inferences** about what they must have meant by what they said

Pragmatic rules: Gricean Maxims

- **Quality**: Don’t lie or say things you don’t have evidence for
- **Quantity**: Don’t say too much or too little
- **Relevance**: Don’t say irrelevant things
- **Manner:** Don’t ramble on or speak unclearly

Gricean Maxims: Flouting the Rules

- What are some ways each maxim can be broken cooperatively?
  - **Quality:** Don't lie or say things you don't have evidence for
    - Sarcasm: "Do you like ice cream?" "No, ice cream is the worst and nobody could ever like it".
  - **Relevance:** Don't say irrelevant things
    - "Do you want ice cream?" "Is the Pope Catholic?"
  - **Manner:** Don't ramble on or speak unclearly
    - "That's total bull *cough*"

Gricean Maxims: Violating the Rules

- What are some ways each maxim can be broken *uncooperatively*?
  - **Quality**: Don't lie or say things you don't have evidence for
    - A homeless person asks if you have a dollar, you reply "no"
  - **Quantity**: Don't say too much or too little
    - "Hey, sorry, but I really can't make our date tomorrow." "Fine."
  - **Relevance**: Don't say irrelevant things
    - Polonius: "What matter do you read, my lord?" Hamlet: "Words, words, words"
  - **Manner:** Don't ramble on or speak unclearly
    - E.g. mumbling

Conversational Repair

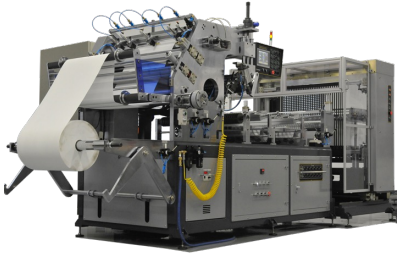
- Conversational repair is a way to give feedback: affirmation, correcting errors, expressing confusion or lack of understanding
  - Verbal or nonverbal
  - E.g. nodding along (affirmation)
  - Quizzical expression on face (expressing confusion)

Semantics and Pragmatics Recap

- Semantics: meanings are abstract, highly organized mental representations
  - Cannot be defined solely based on physical properties of things “in the world”
- Pragmatics: communication with language has certain “rules” that define what kind of information we are expected to contribute to the discussion

Components of language

Morphology & Syntax



Abstract combinatorics

Form

Phonetics & Phonology

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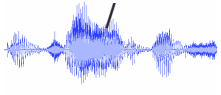

Meaning

Semantics & Pragmatics

Chomsky, 1980; 1995