

LANGUAGE:

- Language is a way of communicating.
- Language involves reducing thoughts to an ordering of sounds.
- This leads to an enormous number of arbitrary conventions about how concepts can be translated into words and words should be ordered.
- **Chomsky vs. Skinner:**
 - Skinner's Verbal Behavior (1957) argued that humans learned language via reinforcement or uttered word orders.
 - Chomsky's review (1959) argued that the infinite compositionality and productivity of language make this explanation inadequate.
 - There are an infinite number of legal utterances, created by combining elements together; they can't all be reinforced.
 - Pairwise relations don't suffice: Happy birthday cake.
 - There are syntactic (grammatical) rules governing "acceptability" that go beyond semantics (meaning): Colorless green ideas sleep furiously.
 - All this suggests a complex system of abstract rules for sentence construction: a grammar.
- **Ape Language:**
 - Some researchers have attempted to teach Great Apes human languages.
 - If Skinner is right, this should work, because the basic learning mechanism is the same, and apes are pretty smart.
 - If Chomsky is right, human language involves complex syntactic structures, many of which are innate and specific to humans, so apes will not be able to do it.
 - People are still arguing over what the apes learned and what it means.
 - But while they seem to have learned a fair amount of vocabulary, they learned very little syntax.
- **Universal Grammar:**
 - Despite enormous differences, all-natural languages seem to share some common structures:
 - Same rules and structure.

- All languages have words and sentences.
 - All languages have nouns, verbs, and a few other types.
- Chomsky called this common structure universal grammar and hypothesized that it is innate.
- **Is language innate?:**
 - Humans seem to have a unique ability to learn a language without instruction.
 - Some aspects of language have a critical period.
 - The child's linguistic input, by itself, does not seem to be sufficient for the child to figure out the rules (poverty of the stimulus).
 - Only universal grammar is innate.
 - Details specific to each language have to be learned.
- **Phonology:** Study of sounds of language.
- **Morphology:** Construction of words out of units that carry meaning (morphemes)
 - **EX:** Reviewed = re[again] + view [look at] + ed [past tense] = looked at again.
 - It is about pieces of words that carry meaning (or tense, number, gender, etc).
 - Roots, prefixes, suffixes, affixes.
- **Syntax (grammar):** Ordering of words to form sentences.
 - EX: The dog bit the man vs. The man bit the dog.
- **Semantics:** Meaning and logical form.
- **Pragmatics: Practical aspects of conversation:**
 - What did he/she probably mean by that?
 - What am I supposed to say next?
- **Syntax:**
 - Abstract rules for creating "legal" sentences.
 - A generative grammar is a system for producing all and only legal structures in the given language.
- **Abstract linguistic rules and internal mental symbols:**

- The dog chased the cat.
- The tree chased the cat.
- The pineapple chased the cat.
- The NOUN chased the cat.
- There is an abstract internal representation where different words have certain roles.
- A NOUN is an abstract internal category.
- How do we generalize this idea to encompass more complicated sentence structures?

$S \rightarrow NPVP$

$NP \rightarrow \text{det AdjP N}$

$VP \rightarrow V NP$

$\text{AdjP} \rightarrow \text{Adj AdjP}$

$\text{AdjP} \rightarrow _$

$N \rightarrow \text{cat}$

$N \rightarrow \text{boy}$

$V \rightarrow \text{smelled}$

$V \rightarrow \text{saw}$

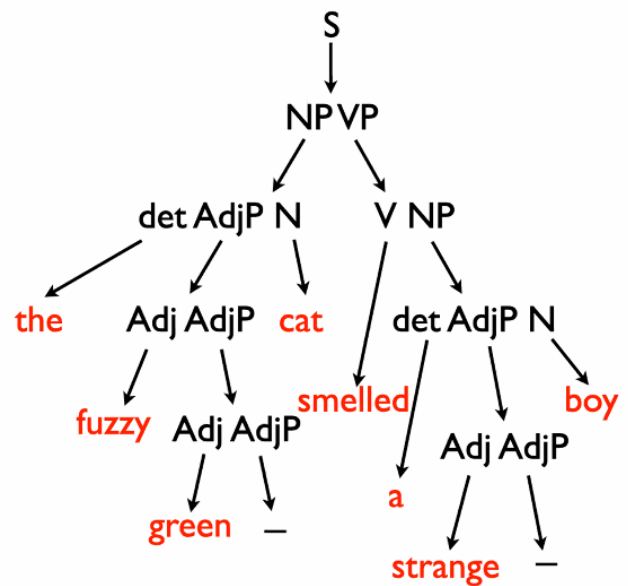
$\text{Adj} \rightarrow \text{fuzzy}$

$\text{Adj} \rightarrow \text{strange}$

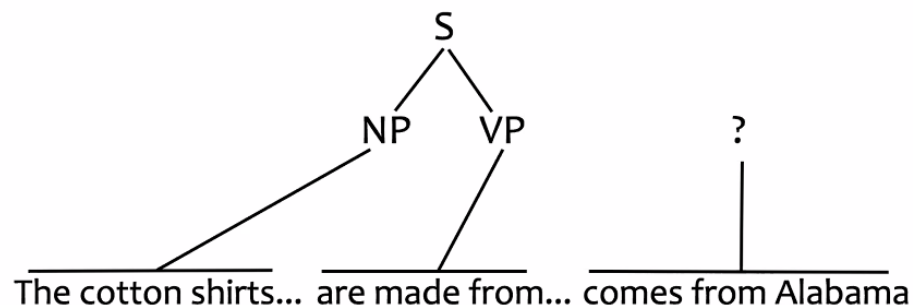
$\text{Adj} \rightarrow \text{green}$

$\text{det} \rightarrow \text{the}$

$\text{det} \rightarrow \text{a}$



- **Syntactic ambiguity:**
 - Syntactic ambiguity occurs when a sentence can be parsed (assigned a tree structure) in two or more different ways.
 - Time flies like a river.
 - I killed a huge lion in my pajamas.
 - The girl hit the dog with the stick.
 - I like chocolate more than my wife.
- **Sentence Processing:**
 - How do you parse a sentence in real-time?
 - **The principle of minimal attachment:**
 - For each new phrase, attach it to the existing tree in the simplest way possible.
 - **Garden path sentences:**
 - Garden path sentences are sentences in which the most natural parse of the sentence makes later words seem ungrammatical.
 - The boy read the book fell asleep immediately.
 - The cotton shirt are made from comes from Alabama.
 - She put the turkey on the counter into the oven.
 - Garden path sentences can be very revealing about progressive parsing processes.
 - **Minimal attachment in a garden-path sentence:**
 - The cotton shirts are made from comes from Alabama.



- **Phonology:**
 - Phonology is about the sounds of language.
 - Individual sound classes are called phonemes.

- **Example:**
 - “Tooth” = /t/ /oo/ /th/

- **Phonological parameters:**
 - Phoneme classes are distinguished by a number of parameters determining how they are physically articulated:
 - Manner of articulation: Stop (p, b, t, d...) vs fricative(f, s, th...) vs various other types.
 - Place of articulation: Bilabial (p,b) vs labiodental (f,v) vs various other types.
 - Voicing characteristics:
 - Voiced/voiceless: f/v, s/z, th/th.

- **Variation among languages:**
 - Different languages use different classes, involving different thresholds along with the same group of parameters.
 - After the critical period for learning, speakers are sensitive to distinctions between categories, but “deaf” to distinctions within their native categories.

- **Semantics:**
 - **Lexical semantics:** accessing the mental lexicon (internal knowledge of the meaning of words).
 - The dog chased the cat.
 - The man gave the woman a hand
 - Time Flies
 - **Phrase semantics:**
 - Brick house/rabbit house
 - **Reference:**
 - The man ate the sandwich that he made.
 - The man and he co-refer
 - The man looked at him in the mirror.
 - **Logical Form:**
 - The boss takes her coffee with sugar =

- She is currently drinking coffee with sugar or
- She habitually drinks coffee with sugar.

- Everybody has a cell phone =
 - All people share one cell phone or
 - Each person has their own cell phone.

- **The war over the past tense:**

- The English past tense rule is a classical morphological rule: add the morpheme -ed.
 - Talk → talked (/t/ sound)
 - Aid → aided (extra syllable)
 - Bug → bugged (/d/ sound)
- However, there are a lot of expectations:

go/went

is/was

bring/brought,

sing/sang [not sought]

seek/sought, but

[but leak/leaked, not lought]

feed/fed

read/read

[but need/needed, not ned]

think/thought

drink/drank

[but blink/blinked, not blought]

bite/bit

light/lit [or lighted], but:

fight/fought

write/wrote

meet/met

[but eat/ate]

- McClelland and Rumelhart proposed to explain the most rule-like and symbolic phenomenon without rules.
 - Thus past tense learning would be an application of a general learning mechanism not specific to language.

- Their network even replicates the U-shaped learning curve.
- Pinker and Prince (now at Rutgers) argued:
 - The network generalized incorrectly.
 - bear/bore/ but bare/ bared
 - stea/stole but steel/steeled.