

Chapter 9 – Language

Review: Where have we been?

- Stimulation reaches our sensory receptors
- Attention determines which stimuli undergo pattern recognition
- Information is transferred into LTM for later use
- Retrieval of information is dependent on a number of factors

Where are we going?

- How people can **use** cognition to perform complex behaviors
 - Language
 - Reasoning & decision making
 - Problem solving
- How can we study these behaviors?
- How does cognition change with age?
Can we apply what we have learned?

Study of Language

- Language: a shared symbolic system for communication
- Linguistics: study of the structure of language
 - “competency”
- Psycholinguistics: study how language is learned & used by people
 - “performance”

Skinner - Chomsky Debate

- Skinner (1957)
 - language is acquired through *conditioning*
 - parents reinforce child’s utterances & associate objects with words
 - grammar is learned thru associations between adjacent words

Skinner - Chomsky cont’d

- Chomsky (1959)
 - innate grammar learning ability
 - productivity

5 Reasons to Study Language

- language is a unique form of **abstraction**, which is at the heart of cognition
- language has a major impact on the **form of representation** of information in memory
- language is the chief form of human **information exchange**
- language provides one means to **think about** external events internally
- language **influences perception**, from which we obtain the basic data for cognition

Linguistic Relativity

Benjamin Whorf (1956)

- The language that is spoken in one's culture affects how one perceives the world.
- Some argue Eskimo's have 40 words for snow - thus see world differently

Problem

Rosch:

- Dani tribe in New Guinea
 - 2 color names: *mola* (bright) *mili* (dark)
 - presented range of colors
 - Found: Dani were able to discriminate different colors on a recognition test

Levels of Language Analysis

- **Phonology**: speech sounds (*phoneme* = a single symbol for a single speech sound; basic unit of spoken language)
- **Syntax**: rules that determine how words are combined
- **Semantics**: meaning from the level of *morphemes* (the smallest unit of meaning) to the word level and beyond

Invariance & Context

- Problem of invariance:
 - different languages use different phonemes
 - gender differences
 - accents
 - coarticulation
- Context:
 - Allows us to overcome problem
 - We process language within context

Grammar

- **Grammar**: the complete set of rules that will generate or produce all of the acceptable sentences in a language, and will not generate any unacceptable, ill-formed sentences

Grammars

Language vs arithmetic:

- both are *productive* - can produce and comprehend an infinite number of expressions
- both are *rule-based* - rules specify correct grammatical expressions

Grammars

- learned rules of arithmetic formally (explicit learning)
 - can state rules
- learned rules of language largely informally (implicit learning)
 - many speakers cannot state rules of grammar

Four Linguistic Intuitions

- 4 aspects of language that users of the language can do implicitly, without being able to formally state rules

Linguistic Intuitions

1. Knowing what is grammatical

- *All politicians kiss babies.*
- *Kiss politicians babies all.*

Note: Knowing what is grammatical does not require meaning:

- *Colourless green ideas sleep furiously.*

Linguistic Intuitions

2. Grammatical Relations

(relations between words in a sentence such as subject, verb & object)

- *John is eager to please.*
 - *John is easy to please.*
- sentences are very similar but relationship between John and please is very different in these two sentences

Linguistic Intuitions

3. Sentence relationships

- *The gorilla chased the monkey.*
- *The monkey was chased by the gorilla.*

-different sentence structures, but same meaning

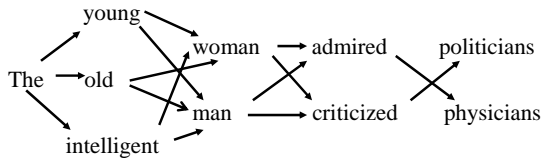
Linguistic Intuitions

4. Identify Ambiguity

- *They are eating apples.*
 - *Visiting relatives can be a nuisance.*
- we understand ambiguous sentences have more than one meaning

Left-to-Right Grammar

Grammar specifies the probability one word can follow another in the language:



Grammatical: The young man criticized politicians.
Not grammatical: The admired woman old physicians.

Left-to-Right Grammar: Problems

1. It would take too long to learn rules (i.e., probabilities of words following each other)

Left-to-Right Grammar: Problems

2. Probability rules not sufficient to explain language:

- “*Was he went to the newspaper is in deep end.*”

Sentence consists of pairs of words that occur with high frequency, but sentence not grammatical.

- “*Colourless green ideas sleep furiously.*”

Sentence consists of words that occur with very low frequency, but sentence is grammatical.

Left-to-Right Grammar: Problems

3. Spoonerisms

- after William A. Spooner (famous for frequent “slips of the tongue”)
- these errors demonstrate sentences not generated one word at a time, because slips of the tongue can be between words far apart in a sentence

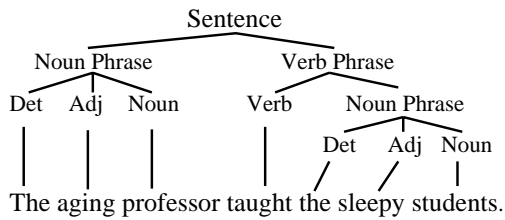
Grammar

- **Grammar:** the complete set of rules that will generate or produce all of the acceptable sentences in a language, and will not generate any unacceptable, ill-formed sentences
- **Phrase structure grammar:** a set of “re-write” rules to break down an utterance into its parts

Phrase Structure Grammar Rules

- Rule 1 S → NP + VP
- Rule 2 NP → DET + (ADJ) + N
- Rule 3 VP → V + NP
- Rule 4 DET → a, an, the ...
- Rule 5 ADJ → aging, sleepy ...
- Rule 6 N → professor, students...
- Rule 7 V → taught, lectured

Phrase Structure



Phrase Structure Grammar: Strengths

1. Rules define grammaticality.
2. Sentences planned hierarchically, not word by word, so can explain spoonerisms.
3. Can account for grammatical relations between words in sentences.

Phrase Structure Grammar:
Problems

1. Cannot account for surface structure ambiguity:
 - ((*The shooting of the hunters*) (*was terrible*))

Phrase Structure Grammar:
Problems

2. Cannot account for sentence relations
 - phrase structure rules do not specify how a sentence can be modified to form a different sentence with same meaning
 - e.g., *The boy took the ball.*
The ball was taken by the boy.
 - if two sentences have different rules, then should have different meanings

Phrase Structure Grammar:
Problems

3. Phrase structure grammar does not take meaning into account:
 - "*The boy took the ball*"
 - "*The ball took the boy*"Both sentences grammatically correct, so should be meaningful

Noam Chomsky

- MIT linguist
- influential book *Aspects of the theory of syntax* (1965)
- emphasis on grammar underlying language
- major critic of US and world government policies

Chomsky's Transformational Grammar

Proposed two modifications to phrase structure grammar:

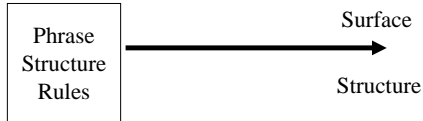
1. Chomsky (1957) proposed a set of transformation rules that specify how to transform sentences based on phrase structure rules (e.g., from active to passive)

Chomsky's Transformational Grammar

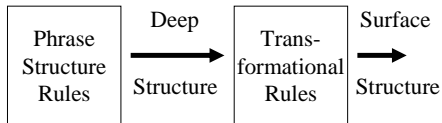
2. Chomsky (1965) modified transformational grammar to consist of two levels:
 - **Surface structure:** the outward appearance of the utterance that can be handled by traditional parsing or phrase structure
 - **Deep structure:** the underlying form, the meaning of the utterance
 - **Transformation rules:** turn one kind of structure into the other
- taken together, these three make up linguistic competence
- underlying ambiguity can be resolved at the deep structure level

Chomsky's Transformational Grammar

Phrase Structure Grammar



Transformational Grammar

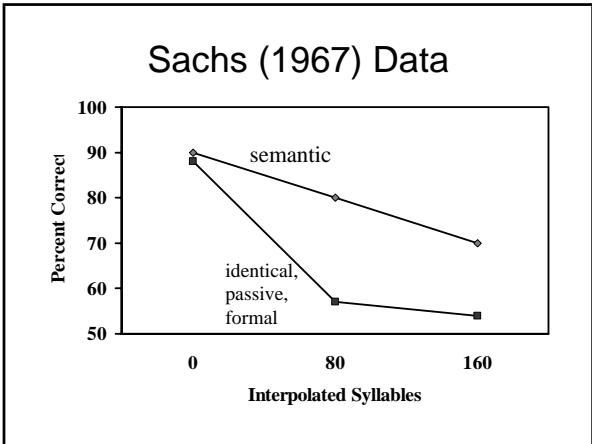


Miller & McKean (1964)

- present a simple sentence:
 - “The professor graded the paper”
- ask subject to transform it:
 - negative: “The professor did not grade the paper”
 - passive + negative: “The paper was not graded by the professor”
- takes longer with more transformations

Sachs (1967)

- *Target:*
 - He sent a letter about it to Galileo, the great Italian scientist. (Identical)
- *Tests:*
 - Galileo, the great Italian scientist, sent him a letter about it. (Semantic change)
 - A letter about it was sent to Galileo, the great Italian scientist. (Passive change)
 - He sent Galileo, the great Italian Scientist, a letter about it. (Formal change)



Case Grammar

- semantic analysis of a sentence involves figuring out what semantic role is being played by each word or concept in the sentence, and computing sentence meaning based on those semantic roles
- encoding of a word provides access to the word's entry in the mental lexicon (mental dictionary of words + meanings)
- assign semantic role (agent, patient, etc.)

Garden Path Sentences

- After the musician played the piano was quickly taken off the stage
- initially assigned case roles are incorrect given the sentence ending and it takes time to recover (fixation duration studies)
