Language
Chapter 11

Language

- Language is a complex tool that involves all the processes and theoretical constructs that we’ve discussed so far
- What is it?
  - Universal
  - Generative
- Does language affect the way we think?

Studying Language in Cognitive Psychology

- Psycholinguistics: discover psychological process by which humans acquire and process language
- Comprehension/Perception - how do we understand?
- Speech production - how do we produce?
- Representation - in the brain/mind?
- Acquisition - how do we learn?
What Is Language?: Communication vs. Language

- **Communication**: Transmission of a signal that conveys information
  - Gestures and facial expressions
  - Vervet monkeys’ calls (e.g., snake, leopard, eagle)

- **Language**: A system that has a clear hierarchical structure and allows mutually intelligible communication within a group of speakers
  - Natural languages (e.g., English)
  - American Sign Language (ASL)
  - The emphasis is on *spoken* language

Language in Behaviorist Psychology

- B.F. Skinner (1957) *Verbal Behavior*
  - Language learned through reinforcement
  - i.e., children say words they hear.

Language in Cognitive Psychology

- Noam Chomsky (1957) *Syntactic Structures*
  - Human language coded in the genes
  - Underlying basis of all language is similar
- "Buffalo buffalo Buffalo buffalo buffalo buffalo Buffalo buffalo."
- "(The) Buffalo buffalo [i.e., the buffalo who lives in Buffalo] (that) [other] Buffalo buffalo (often) buffalo (in turn) buffalo other Buffalo buffalo"

- Annie Senghas

Humans are biologically or genetically predisposed for acquiring language

- Pinker's (1994) language instinct hypothesis
  - "Language is a human instinct, wired into our brains by evolution, like web spinning in spiders or sonar in bats"

Evidence for biological/genetic predisposition

- Selective sparing or impairment of language due to biological or genetic factors
- Creation of systematic language by children
- Existence of the "critical period" for language

Evidence: Selective Sparing/Impairment Due to Genetic/Biological Factors

- Genetic disorders selectively impairing language
- Specific Language Impairments (SLI)
  - Show grammatical difficulties (along with other impairments)
    - Her running. He jump everyday. Yesterday he walk to the store.
  - At least some cases of SLI seem hereditary
Selective Sparing/Impairment
Due to Genetic/Biological Factors

• Genetic disorder selectively sparing language
• Williams syndrome (language spared; number and spatial processing severely impaired)

After it stopped hurting, I was told I could go to school again and do whatever I feel like doing. They had to give me ether so I wouldn’t feel the pain.

Creation of Systematic Language by Children

• Generativity

• Invention of “sign language” by isolated deaf children
  • They spontaneously develop “home signs” without any language sample
  • The developmental trajectory of home sign use is similar to that of language use in hearing children (e.g., “two-word” stage)

Generativity

• Noam Chomsky (1959)
  • Children produce sentences they have never heard and that have never been reinforced
  • Language is generative

• Derek Bickerton (1990, Language & Species)
  • Evolution of symbolic thinking
  • The development of formal syntax
  • Pidgins versus Creoles
**Pidgins vs Creoles**

- **Pidgins**
  - Two speakers with no common language create a makeshift language

- **Creoles**
  - Next generation of a pidgin (e.g., their kids speak it as a first language)

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**“Da Jesus Book”: HCE translation of the Bible**

- Hawaii Creole English
- *God, you our Fadda. You stay inside da sky. We like all da peopo know fo shua how you stay, An dat you stay good an spesho, An we like dem give you penny respeck. We like you come King fo everybody now. We like everybody make jalike you like, Ova hea inside da world, Jalike da angel guys up inside da sky make jalike you like. Give us da food we need fo today an every day. Hemmo our shame, an let us go Fo all da kine bad stuff we do to you, Jalike us guys let da odda guys go awready, And we no stay huhuh wit dem Fo all da kine bad stuff dey do to us. No let us get chance fo do bad kine stuff, But take us outs da, so da Bad Guy no can hurt us. Cuz you our King. You get da real power, An you stay awesome foeva. Dass it!*

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**The Universality of Language**

- Deaf children invent sign language
- All cultures have a language
- Language development is similar across cultures
The Same... but Unique.

- All cultures have language, and although there is tremendous diversity in language, they all share similar features.
  - Nouns and verbs
  - Negativity and Positivity
  - Questions
  - Number Concepts
  - Color Concepts
  - Time (past & present)

In English, time metaphorically moves forward and backwards.

In Chinese, time metaphorically moves up and down.

The Hierarchy of Linguistic Units

- **Phoneme (sounds)**
  - A separable unit of sound that serves as a building block of spoken language
  - Some distinctions made in one language may not be present in another (e.g., /r/ vs. /l/)
  - About 200 across all known languages
    - About 47 for English.
    - Infants can discriminate more phonemes than adults.

- **Morpheme (meaning)**
  - The smallest units that carry meaning
    - "umpires" = "umpire" + "-s"
Language: Unique to Humans?

- Vervet monkeys’ calls
- Honeybees’ dance
- Chimps’ use of arbitrary signs and symbols

Communication: Transmission of a signal that conveys information
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Key Features of Human Spoken Language

1. Hierarchical structure
2. Arbitrariness
   • No inherent connection between a unit in language and the concept it denotes

3. Productivity (or generativity)
   • Possible to create an infinite number of sentences using a finite number of words and grammatical rules

4. Displacement
   • Possible to refer to things remote in time and space

Comparison Among Different Forms of Communication and Language

<table>
<thead>
<tr>
<th></th>
<th>Vervet Monkeys’ Calls</th>
<th>Honeybees’ Dance</th>
<th>Chimps’ Sign/Symbol Use</th>
<th>Human Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hierarchical Structure</td>
<td>NO</td>
<td>NO</td>
<td>YES (but limited)</td>
<td>YES (but limited)</td>
</tr>
<tr>
<td>Arbitrariness</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
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</table>

"There's glory for you!"

"I don't know what you mean by 'glory,'" Alice said.

Humpty Dumpty smiled contemptuously. "Of course you don't—till I tell you. I meant 'there's a nice knock-down argument for you!'"

"But 'glory' doesn't mean 'a nice knockdown argument for you,'" Alice objected.

"When I use a word," Humpty Dumpty said, in rather a scornful tone, "it means just what I choose it to mean—neither more nor less."

(from Through the Looking Glass by Lewis Carroll)
What Mechanisms Are Available to Facilitate Speech Perception?

1. Support from context (top-down influence)
   - Phonemic restoration effect
   - Context can fill in “gaps” present in speech (e.g., It was found that the *eel was on the axle.)

2. Categorical perception
   - We do not perceive slight differences in phonemes

Phonemic Restoration

Categorical Perception

Voice-onset time (VOT) = time of vocal cord vibration
What Mechanisms Are Available to Facilitate Speech Perception?

3. **Coarticulation**
   - Phonemes in a word are articulated in an overlapping manner
   - Analogous to skilled typing
   - A particular phoneme contains information about the surrounding phonemes

4. **Support from visual input**
   - McGurk effect
   - Auditory input: /ga/
   - Visual input: /ba/
   - Your perception: /da/
Perceiving and Understanding Words

- Speech segmentation
- Understanding of sound and syntactic rules
- Statistical learning
- Understanding of meaning
- Context

Why is speech perception difficult?

1. **Speech is continuous**
   - No clear word boundaries in natural speech

   ![Normal speech (spoken at a natural speed)](image)
   ![Slow speech (each word pronounced separately)](image)

2. **The same phoneme can have different acoustic properties**
   - *pot* vs. *top*
   - *be, bi, bo, ber*

3. **Different phonemes can sound quite similar**
   - *writer* vs. *rider*
Why is speech perception difficult?

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   - \( \text{be}, \text{bi}, \text{bo}, \text{ber} \)

3. **Different phonemes can sound quite similar**
   - \( \text{writer} \) vs. \( \text{rider} \)

4. **There is large variability in pronunciation**
   - Male vs. female
   - Different accents

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Understanding Words

- **Word frequency effect**
  - Respond more rapidly to high-frequency words

- **Eye movements while reading**
  - Look at low-frequency words longer

- **Context effects (Lexical Priming/Ambiguity)**
  - Attempt to figure out what a sentence means as we read it

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Word Frequency Effect

- **Lexical decision task**
  - Read a list of words and non-words silently
  - Say “yes” when you read a word
  - Faster to respond “yes” to high-frequency words like \( \text{home} \) vs low-frequency words like \( \text{hike} \)
  - People look at low-frequency words for longer
Lexical Priming/Ambiguity

- Swinney (1979)
- Priming
  - Stimulus activates a mental representation of the stimulus
  - Respond more rapidly if activation is still present when stimulus is presented again

Lexical Priming/Ambiguity

- “Rumor had it that, for years, the government building had been plagued with problems. The man was not surprised when he found several spiders, roaches and other bugs in the corner of the room.”
- “ANT” or “SPY” or an unrelated word such as “SEW” or non-word, was flashed on the screen when reading “bugs”.
- SPY and ANT were primed equally (faster), SEW and non-words were not (slower).

(Swinney, 1979)
Understanding Sentences

- **Semantics**: meanings of words and sentences
- **Syntax**: rules for combining words into sentences

- Parsing: the grouping of words into the “appropriate” phrases
  - Critical to understanding the intended meaning of the sentence.

- Ambiguity:
  - “Cast iron sinks quickly rust.”
  - “The horse raced past the barn fell”
  - *Garden Path Sentences*

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**Syntax-first approach to parsing**

- Grammatical structure of sentence determines parsing
- Late closure: parser assumes new word is part of the current phrase

- Garden-path model:
  - *Cast iron sinks quickly rust.*
  - I*cast iron*!
  - I*cast iron sinks*! (sinks = ambiguous noun/verb)
  - I*cast iron sinks quickly*! (sinks = verb)
  - I*cast iron sinks quickly*! Iquickly rust*! (whoops! sinks = noun)
Understanding Sentences

- Interactionist approach to parsing
  - Semantics influence processing as one reads a sentence
- Consider:
  - The spy saw the man with binoculars
  - The spy saw the man with binoculars
  - The bird saw the man with binoculars

Ambiguous Headlines

- "Kids Make Nutritious Snacks"
- "Miners Refuse to Work After Death"
- "Teacher Strikes Idle Kids"
- "US President Wins on Budget, but More Lies Ahead"
- "Stolen Painting Found by Tree"
- "Red Tape Holds Up New Bridge"
- "Local High School Dropouts Cut in Half"
- "Include Your Children When Baking Cookies"

(cited by Paul Sanderson in Using Newspapers in the Classroom. Cambridge Univ. Press, 1999)

- "Violinist Linked to JAL Crash Blossoms"
- "Academics to Dissect Bob Dylan at NY Conference"
- "Doctor Testifies in Horse Suit"
- "Stud Tires Out"
- "American Ships Head to Libya"
- "Enraged Cow Injures Farmer with Axe"
- "Gadhafi Forces Barrel Into Main Rebel Base"

Understanding Sentences

- Tannenhaus et al. (1995)
  - Eye movements change when information suggests revision of interpretation of sentence is necessary
  - Syntactic and semantic information used simultaneously
Language and the Brain

- **Left Hemisphere:**
  - Detail processing
  - Handles the vast majority of language functions
  - Speech production:
    - Phonology (producing speech sounds)
    - Semantics (producing meaningful speech)
    - Syntax (grammar and sentence structure)
  - Speech comprehension

- **Right Hemisphere:**
  - Global processing
  - Does play a role in language comprehension
  - Prosody: intonation pattern (rising pitch signals a question or emotional tone)
  - Understanding narratives (stories) and non-literal aspects of language (metaphors, jokes)

### Hemisphere Differences

- Comprehension of a joke depends on both hemispheres
- Birhle et al. (1986)
- Patients with LH or RH damage were told the start of a joke:
  - A woman is taking a shower. All of a sudden her doorbell rings. She yells, “who’s there?”, and a man answers, “blind man.” Well, she’s a charitable lady, so she runs out of the shower naked and opens the door.

<table>
<thead>
<tr>
<th></th>
<th>Humorous</th>
<th>Non-humorous</th>
</tr>
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<tbody>
<tr>
<td><strong>Unrelated</strong></td>
<td>Then the blind man throws a pie in her face</td>
<td>The man says, “I really enjoy going to the symphony”</td>
</tr>
<tr>
<td><strong>Related</strong></td>
<td>The man says, “Where should I put these blinds, lady?”</td>
<td>The man says, “Can you spare a little change for a blind man?”</td>
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Hemispheric Differences

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<td>Unrelated</td>
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</tr>
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</table>

- RH Damage: have trouble integrating the punch-line with the joke, so they pick funny but unrelated.
- LH Damage: understand the narrative of the joke, but because they have semantic problems they don’t understand that “blind” can have two meanings.

Language in the Brain

- There is a certain degree of neural separability to semantic and syntactic processing.
- Temporally (ERP): The N400 is sensitive to semantic violations; the P600 is sensitive to syntactic violations.
- Spatially (fMRI): the superior temporal lobe is sensitive to semantic violations; the IT and frontal cortex are sensitive to syntactic conflict.

Understanding Sentences

- Event-related potential (ERP) studies have shown **syntax** and **semantics** are associated with different mechanisms

Semantic Conflict  Syntactic Conflict
Understanding Sentences

- Brain imaging (fMRI) studies have shown syntax and semantics are associated with different mechanisms.

Understanding Text and Stories

- **Coherence**: representation of the text in one’s mind so that information from one part of the text can be related to information in another part of the text.
- **Inference**: readers create information during reading not explicitly stated in the text.
  - **Anaphoric**: connecting objects/people (he/she).
  - **Instrumental**: tools or methods.
  - **Causal**: events in one clause caused by events in previous sentence (cause/effect).

Understanding Text and Stories

- **Situation model**: mental representation of what a text is about.
  - Represent events as if experiencing the situation.
  - Point of view of protagonist.
Stanfield and Zwaan (2001); Zwaan et al. (2002)

- Participants responded “yes” more rapidly for the orientation (nail) and the shape (eagle) that was more consistent with the sentence.

Producing Language: Conversations

- Two or more people talking together
- Dynamic and rapid
- **Semantic coordination**
  - Conversations go more smoothly if participants have shared knowledge
- **Given-new contract**: speaker constructs sentences so they include:
  - Given information
  - New information
  - New can then become given information
Producing Language: Conversations

- **Syntactic coordination**
  - Using similar grammatical constructions (syntax)
- **Syntactic priming**
  - Production of a specific grammatical construction by one person increases chances other person will use that construction
  - Reduces computational load in conversation

Syntactic Priming

Recap: 2 types of priming

- **Syntactic priming**
  - Production of a specific grammatical construction by one person increases chances other person will use that construction
  - Reduces computational load in conversation
- **Lexical (Semantic) priming**
  - Stimulus activates a representation of the stimulus
  - Respond more rapidly if activation is still present when stimulus is presented again
Recap: 2 types of conversation coordination

- **Syntactic coordination**
  - Using similar grammatical constructions

- **Semantic coordination**
  - Shared meaning
  - Given-new contract: speaker constructs sentences so they include
  - Given information
  - New information
  - New can then become given information

Understanding Text and Stories

- **Neurophysiology of simulations**
  - Approximately the same areas of the cortex are activated by actual movements and by reading related action words
  - The activation is more extensive for actual movements

Hauk et al. (2004) results. Colored areas indicate the area of the brain activated by:
- (a) foot, finger, and tongue movements
- (b) leg, arm, and face words.
Embodied Cognition

- **Embodiment**: the nature of the human mind is largely determined by the form of the human body.

Embodied Cognition

- Conceptual Metaphor: we can understand abstract concepts through progressive metaphors based on physical experience.
  - Physical Gestalts:
    - *Light is good; Dark is bad*
    - *Knowledge is seeing; Information is light*
  - Experiential Gestalts:
    - *Roll up our sleeves and get to work...*
    - *Ideas as balls... (bounce an idea off you; toss an idea around)*

Culture, Language, & Cognition

- **Sapir-Whorf hypothesis**: language influences thought. (Linguistic Relativity)
  - Strong version: language determines how we think.
  - Weak version: language can influence how we think.
Culture, Language, & Cognition

- Imagine color perception in a language with only three color terms. (Berlin & Kay, 1969)
- The most ubiquitous color terms are dark (black, grey, navy), light (white, cream, yellow), and red.
- As color terms increase in a language, they come in a systematic order: greens/yellows, then blues.
- All languages containing six colors have terms for: black, white, red, green, yellow, and blue.

Irish uses two words for green: glas denotes the green color of plants, while uaidhe describes artificial greens of dyes, paints, etc., even if two shades are identical!!!

Remember Auditory Categorical Perception...

Voice-onset time (VOT) = time of vocal cord vibration

Categorical Perception with Colors

- Categorical Perception: Items (or colors) in the same category are harder to discriminate between than items in different categories
  
  ![Diagram]

- Which two are the most similar?
  
  British: B and C - both fall under “green” category
Linguistic Determinism, Relativity, or Neither?

- Color Perception (Roberson et al., 2000)
- British participants used eight color names (blue, green, yellow, pink, red, brown, orange, purple)
- Berinmo (culture from New Guinea) participants used five color names (wap, wor, mehi, kel, nol)

Categorical Perception with Colors

- British- B and C in same category so B and C will be “same”
- Berinmo- A and B in same category so A and B will be “same”
- Therefore: How colors are named affects how people perceive them
- Supports the Sapir-Whorf Hypothesis
Culture, Language, & Cognition

- Language can affect color perception
- There are limits to the effects of language
- Reiger et al. (2005)
  - Different languages have similar choice for “best” color examples

Beyond color terms…

- Changing the framing of an argument significantly influences a person's decision making.
- Metaphors provided participants with a structured framework for understanding crime, influenced the inferences that they made about the crime problem, and suggested different causal interventions for solving the problem.

(Thibodeau & Boroditsky, PLoS, 2011)
Political Rhetoric

- Linguistic relativity within a language:
  - “Tax relief”: reinforces the metaphor that taxes are a burden.
  - Why “pro-choice” and not “pro-abortion rights”; “pro-life” preferred over “anti-abortion”.
  - Consider the difference between “citizens killed in air strike” versus “citizens die in air strike”.
  - Palestinians – “Terrorists” vs. “Refugees”
  - We will discuss decision making in a future chapter...