

Psyc 101, Pomerantz  
Section 8: Language & Thinking

Language: what exactly is it (as opposed to other forms of behavior that signals?)

Example: when dogs pant, are they telling you they are hot, or are they just hot?

Language may be the highest form of human cognitive ability, tied in with thought, reasoning, and memory.

No other life forms appear to have *true* language, i.e. with all the components below.

Cf. von Frisch's bees that dance to indicate direction and distance of food; birdsong; parrots' imitation of speech; sonar in dolphins; chimps that fail to display syntax.

Language's two components: sending (production) and receiving (comprehension)

Four defining types of units: phonological, syntactic, semantic, and pragmatic

- Phonology: structure of sounds in a language
  - Phonemes: "cap" has three of them (cf. nap, cup, cat)
    - 45 or so in English
    - 100 or so worldwide
    - generated through combinations of articulatory moves: place, manner of articulation
    - perceived categorically (like colors from the spectrum)
    - e.g., voicing, bah vs. pah
    - cannot be heard individually as speech or spliced
  - Syllables: smallest unit that can be uttered
- Syntax: the internal grammatical structure of a sentence
  - Parts of speech
  - Word order critical ("car hit John" vs. "John hit car")
  - Aphasia – brain damage resulting in language impairment
    - Broca's aphasia: left frontal lobe, disrupts speech production
    - Wernicke's aphasia, left temporal lobe, disrupts comprehension
- Semantics: the meaning of a word or sentence
  - Morphemes: smallest unit with meaning (roots, prefixes, suffixes)
  - Words: the basic unit of meaning
  - 100K+ morphemes in English, combine to form 1M+ words
  - Propositional representations: mental statements that express meaning. Cf. Deep vs. surface structure
- Pragmatics: the way language conveys meaning indirectly
  - "Can you pass me the salt?" is a request, not a question about ability
  - Pragmatics entails knowledge of the world and of language conventions
  - Pragmatics is deeply involved in metaphor: "Love is a rose"

Language is heavily redundant. In theory, English utterances could be cut in half without losing any meaning. Redundancy at multiple levels, from U following Q up to completing missing word in a sentence. Redundancy helps us communicate in the presence of noise.

## Language Development, from babies through adulthood

Behaviorism: B. F. Skinner claimed language is just another behavior shaped through reinforcement

Cognitive/nativistic approach: Noam Chomsky argued that language is

- cognitively driven, based on rules rather than on behaviors
- guided by innate structures in the brain (language acquisition device), as evidenced by universals in development worldwide
- tuned very early by experience, “child-directed speech” (motherese) – short sentences, careful pronunciation, exaggerated intonation
- Infants can hear subtle phonemic distinctions (bah vs. pah categorical perception)
- Universal babbling, even in deaf children

Brain changes during language learning

- Before 20 months, both hemispheres are active
- After 20 months, a concentration of activity in left hemisphere (usually left)

Universal errors in children’s speech

- Overextensions: call all animals “doggie”, all men “daddy”
- Underextensions: calling a dog simply an “animal”
- Overregularization errors: I ranned down the street

Nonverbal and Animal Communication

- Barking dogs, singing birds, etc.
- Gestures, expressions, microexpressions
- Intonation, pitch of speaking
- Example: lying is signaled by micro-expressions, stiff body posture, voice pitch, slow and non-fluent speech, exaggerated facial expressions.
- Although these systems communicate, they are not language because they do not follow the four basic rules.
- Note: sign language is a true language, follows rules and is susceptible to impairment by brain damage in same areas as for spoken language.

Language and Thought

- The Worfian Hypothesis (linguistic relativity hypothesis)
  - More words for snow, colors in some languages than in others
  - But little persuasive evidence that this affects perception or thought

Mental Imagery and Thought

- Seeing with the “mind’s eye”
- Hearing with the “mind’s ear”, etc.
- Objective evidence for visual images
  - Mental rotation studies of Roger Shepard

- Distance and size studies of Kosslyn: does a German shepherd dog have pointed ears?
- fMRI and TMS studies: imagery and perception activate similar brain regions
- Perky's studies on confusion between percepts and images
- Brooks's studies on competition between percepts and images
- Limitations on imagery
  - Which way does George Washington face on the dollar bill?
  - Is San Diego, CA east or west of Reno, NV

#### Abstract representations: Concepts

Note the great efficiency of using abstract concepts in place of millions of detailed, specific instances; but note also the dangers of overgeneralizing and of stereotyping.

- An internal representation of a grouping of object or entities
- Expressible in words or pictures, but deeper than either
- Aristotle: a concept = set of necessary and sufficient features
- Many categories are more complex than that, however
  - E.g., don't need to fly to be a bird
- Eleanor Rosch: some objects are "better" members of their concept or category than are others. E.g., robin is a better bird than parakeet or penguin.
- Thus, a robin is "typical," in fact it is the prototype. It is named and classified more quickly than atypical members.
- Basic level: given a drawing of a tree, people are more likely to call it that, i.e., a "tree" than to call it an "oak" or a "plant". Thus, tree is an entry level description of a category.
- Another example: "apple" is entry level; "fruit" and "McIntosh" are not.

#### Problem Solving

- We do it all the time. The question is how?
- First, we need to represent the problem.
- Then, we need to pick a strategy to solve it (e.g., solving it backwards)
- Fundamental distinction: algorithms vs. heuristics
  - Algorithms: explicit series of steps guaranteed to solve a problem
  - Heuristics: rules of thumb that are not guaranteed but are quick and usually work. More on heuristics later.
- Another method: use of analogies
  - Note: we sometimes fail to recognize problem isomorphs
  - Example of Logo programming language
- Insight: sudden problem solving with no gradual approach.
- Incubation: sometimes we solve a problem best when we walk away from it for a while.

#### Artificial Intelligence

#### Barriers to Problem Solving

Mental set, functional fixedness

Duncker: mount a candle on a wall given box, tacks, candle

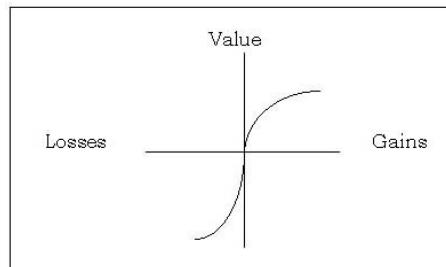
Logic, Reasoning, and Decision Making: Are people logical?

- Logic: applying principles of correct reasoning to reach a decision or evaluate the truth of a claim
- Deductive reasoning: from the general to the particular (Sherlock Holmes)
- Deductive reasoning in humans is susceptible to error, e.g., of affirming the consequent (assuming that a specific cause is at work because a certain result has occurred)
- Another example: confirmation bias (covered previously)
- Anchoring: \$2.00 gallon for cash vs. \$2.20 for credit: a discount for cash vs. a surcharge for credit?
  - Or, \$500 for a suit in a store that also carries \$2000 suits: seems like a bargain!
  - Helps explain why many stores seem to have most things on sale most of the time: creates the impression of a bargain
- Framing decisions: Losses versus Gains

Imagine you are a physician working in an Asian village and 600 people have come down with a life-threatening disease. Two possible treatments exist. If you choose Treatment A, you will **save** 200 people. If you choose B, there is a 1/3 chance you will **save** all 600 people, and a 2/3 chance you will **save** no one. Which do you choose, A or B. [Formally the two choices are equivalent but in experiments, the vast majority pick A – they prefer saving a definite number of lives over the chance they will save no one.]

Imagine you are a physician working in an Asian village and 600 people have come down with a life-threatening disease. Two possible treatments exist. If you choose Treatment A, 400 people will **die**. If you choose B, there is a 1/3 chance no one will **die**, and a 2/3 chance everyone will **die**. Which do you choose, A or B. [This is the identical dilemma to the one above, only framed differently, in terms of lives lost rather than lives saved. So formally the two choices are again equivalent but in experiments, the now the vast majority pick B – they would rather risk losing everyone than settle for the certain death of 400.]

- Prospect Theory (Tversky and Kahneman)
  - Utility function for humans is non-linear
    - “Diminishing marginal utility” - \$200 doesn’t make you twice as happy as \$100 (it’s closer to x 1.7 than 2.0)
    - Similarly, losing your second \$100 doesn’t hurt as much as losing your first \$100.
    - The loss portion of the graph is steeper than the gain portion.



Note: Abscissa is objective value (e.g., dollars)

Ordinate is subjective value (e.g., pleasure or happiness)

A rational being would show a straight line with slope 1.0

Note the law of diminishing marginal utility at work here.

- So, which would you prefer: a sure \$100, or a 50/50 shot at \$250? **Risk aversion** describes human behavior here.
- Losses: would you prefer a \$100 sure loss or a 50/50 shot at escaping a \$200 loss? **Risk seeking** describes human behavior here.
- **Loss aversion**: A \$200 loss produces a feeling of negativity that is more intense than the feeling of elation at a \$200 gain.
- **Endowment effect**: the moment you take position of something, its worth to you rises. People rarely trade objects for other objects of equal worth. This may help explain the use of money-back guarantees: people rarely exercise this option.
- **Sunk costs**: should you drive through a storm to a concert for which you've paid large sums to attend?

### Mental Accounts

Imagine you have decided to attend a concert costing \$20 per ticket. You arrive at the concert hall to discover you have lost a \$20 bill. Will you still buy a \$20 ticket with your remaining funds? [almost 90% say yes.]

Imagine you have decided to attend a concert costing \$20 per ticket. You arrive at the concert hall to discover you have lost your ticket. Will you buy another \$20 ticket with your remaining funds? [fewer than 50% say yes].

### Decision Making under uncertainty, Choice and Heuristics

- Estimating frequency via the **availability** heuristic: ease of recall serves as a proxy for frequency of occurrence.
  - Salient items drive frequency estimates:
    - What's more common, words beginning with K or having K as their third letter?
    - Mundane diseases vs. vivid accidents as causes of death: what's more common, death by homicide or death by stroke (latter x11 more common).

- Another mortality example: disease causes 16x more deaths than accidents, but people believe the two are equally frequent, because accidents are more salient in memory (more available).
- Famous people and illnesses
- Another example: anecdotes about Saabs vs. Consumer Reports surveys. Your neighbor's experience with a car can affect you more than the reports of 1000's of consumers responding to a survey.
- Elimination by aspects and the transitivity of choice

#### Additional characteristics of human decision making and cognition

Hindsight bias: believing that once an event has ended, it could not have ended otherwise, with a different outcome. "Hindsight (a.k.a. Monday morning quarterbacking) is usually 20-20."

Poor calibration of confidence: when people are fully confident they are correct, they are nonetheless wrong some of the time; when they are fully confident they know nothing and are guessing, they are nonetheless correct more often than you would expect by chance. Thus, people are poorly calibrated – their understanding of their own knowledge and its limitation is far from perfect.

The psychology of regret: people show greater regret at near-misses than far-misses, e.g., missing an airplane by 5 minutes vs. 5 hours.