Cognition, problem solving, & language

• Represent a broad range of higher mental functions
• These include thinking, gaining knowledge, and using that knowledge
• Originate in the cerebral cortex
• Are supported by many subcortical or lower level functions including
  – Attention
  – Alertness
Higher Mental Functions

- Perception
- Pattern recognition
- Language
- Thinking and problem solving
- Attention
- Memory
- Human intelligence
- Imagery
Prototypes and Conceptualization

- All concepts are built on a best example of that grouping (a prototype)
- Conceptualization occurs with the development of the brain and, in a sense, is the layering of simple concepts and prototypes
- Conceptual networks emerge when we “link” concepts together and we develop a complex neuronal architecture
The “cup” prototype
Spreading activation

IDEAS

Jazz

Famous

First astronaut

Famous sayings

Louis Armstrong

Neil Armstrong

Louis Armstrong

Armstrong

Neil

SOUNDS

"One small step for a..."
Attention and Pre-attention Process

• These psychological/physiological functions underlie all of the higher mental functions
• Pre-attention skills help extract information automatically and simultaneously across a large portion of the visual and non-visual fields
• Attention processes consider only a portion of the visual/non-visual field at a time
• Consider the Stroop Effect
The Stroop Effect
Problem Solving Skills

- The ability to solve problems using or synthesizing information or knowledge from a variety of different areas is critical for survival and for complex behaviors.
- **Expertise** or being an expert at solving problems arises from practice and through a person’s genetic makeup.
  - Some experts believe that it takes about 10 years of intensive work in a field to develop what is considered expertise.
- **Insight** appears to be making predictions about an area of expertise that may be outside of actual experience, i.e., “thinking outside the box.”
- **Creativity** is characterized as using elements of novelty as well as having some social value.
The problem-solving process

- The simplest form includes:

  Current State → Future State

  Strategies/Hypotheses
to achieve the solution
Additional problem solving strategies

- **Quasi-scientific method**
  - Generate hypotheses to test
  - Test the hypotheses
  - Understand the problem
  - Check the results

- **Algorithmic strategies** (every possible solution)
- **Heuristic Strategies** (common/experienced sense solution)

Errors in Problems solving result from
- Over-confidence/premature commitment to a solution
- Functional fixedness
- Mental set errors
Problem Solving

Problem Presented

Encode Problem Information

Identify Goal

Generate Possible Solution

Does Solution Lead to Goal?

Yes

Is Goal Complete Solution?

Yes

Problem Solved

No

Does Solution Lead to Goal?
Language

• The use of arbitrary symbols by a group of people for the purposes of communication and the transmission of culture, that have specific rules of combination, and significance for those peoples using it.

• It gives humans the ability to express new ideas

• Chomsky called this “transformational grammar” in that we can convert deep structures into surface structures (“hunger” is expressed through the use of words and gestures)

• Language may or may not involve speech

• Humans are the only creatures to have speech because humans have a vocal apparatus for speech and specific areas in the brain devoted to it (Broca’s Area: expressive language; Wernicke’s Area: receptive language.

• Strokes to someone who uses sign language affects their use of sign language as if it were a speech area (overlap of functions)
Wernicke’s area:
Brain damage leading to Wernicke’s aphasia usually includes this area.

Broca’s area:
Brain damage leading to Broca’s aphasia usually includes this area.
Language in Apes and Monkeys

- Consists primarily of gestures and grunts
- Bonobos/Chimpanzees can use nonverbal language to produce about 50 words
- Gorillas, like Koko, can produce over 1000 words!
- Most communication in apes is related to survival and the foraging of food (especially by the females who lead the groups)
Language in Humans

- **Psycholinguists** concern themselves with all aspects of language including its structure and function.
- **Phonemes** – the smallest units of sound (“a”)
- **Morphemes** – the smallest units of meaning (“re”)
- **Semantics** – the study of the meaning of words and sentences (lawyers)
- **Syntax** – the rules that govern how morphemes of language are to be combined in order to form meaningful utterances (English vs. Spanish)
- **Pragmatics** – involves the study of social contexts and how these affect the meaning of linguistic events (jokes)
- **Context** – involves how meanings of words change with the context of the utterance (political correctness)
Language acquisition

• Occurs primarily through “imitation” of adult models
• Predictable stages occur in human language including:
  – **Babbling** – speech phonemes occurring in rhythmic and repetitive patterns
  – **Holophrastic speech** – the use of words to communicate several different meanings (asking for milk)
  – **Telegraphic speech** – utterances characterized by the use of nouns, verbs, and adjectives, and a few functioning words (“Jimmy draw picture” and by 2 ½ the utterance is “Jimmy’s picture”)
<table>
<thead>
<tr>
<th>AGE</th>
<th>TYPICAL LANGUAGE ABILITIES (MUCH INDIVIDUAL VARIATION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months</td>
<td>Random vocalizations.</td>
</tr>
<tr>
<td>6 months</td>
<td>More distinct babbling.</td>
</tr>
<tr>
<td>1 year</td>
<td>Babbling that resembles the typical sounds of the family’s language; probably one more words including “mama”; language comprehension much better than production.</td>
</tr>
<tr>
<td>1 1/2 years</td>
<td>Can say some words (mean about 50), mostly nouns; no phrases.</td>
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<tr>
<td>2 years</td>
<td>Speaks in two-word phrases.</td>
</tr>
<tr>
<td>2 1/2 years</td>
<td>Longer phrases and short sentences, with some errors and unusual construction; can understand much more.</td>
</tr>
<tr>
<td>3 years</td>
<td>Vocabulary of about 1,000 words; longer sentences with fewer errors.</td>
</tr>
<tr>
<td>4 years</td>
<td>Close to adult speech competence.</td>
</tr>
</tbody>
</table>
* Stages of Language emerge more or less along these milestones
  * Can be affected by the presence of absence of adult models
  * Feral children (like Genie) are raised without models and have deficits in
    * Language
    * Emotional development
    * Intellectual deficits
  * Sometimes children, especially twins invent their own language
  * Bilingual skills increases the efficiency of the brain and individuals have greater cognitive flexibility
  * Reading is an important and extremely complex higher mental function
Reading

• Is a skill like any other that takes practice and effort
• Eye movements are called **saccades**
• Eye stops are called **fixations**
• Good readers have about 11 letters per fixation
• Speed reading does not increase comprehension of the information being read
• Some read quickly (hare/Jefferson) and some read very slowly (tortoise/Lincoln)