

## Chapter 8

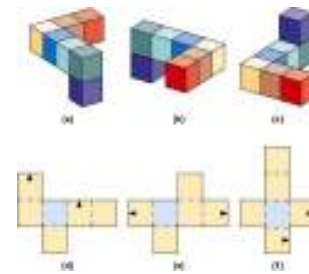
### Cognition, Language, and Creativity

## Cognition: Definition of Terms

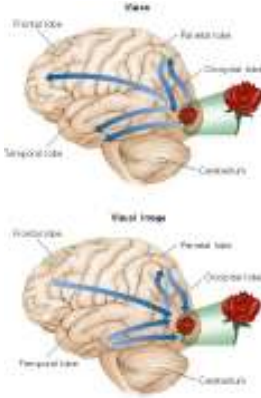
- Cognition: Mentally processing information (images, concepts, etc.); thinking
- Cognitive Psychology: Study of human information processing
- Internal Representation: Mental expression of a problem or situation
- Concept: Generalized idea representing a class of related objects or events
- Language: Words or symbols, and rules for combining them, which are used for thinking and communication

## Types of Mental Images

- Synesthesia: When images cross normal sensory barriers, e.g., listening to music leads to experiencing tastes
- Mental Rotation: Ability to change the position of an image in mental space
- Stored Image: Mental image kept in memory and retrieved when appropriate
- Created Image: Image that has been assembled or invented rather than remembered
- Kinesthetic Image: Created from produced, remembered, or imagined muscular sensations



**Fig. 10.1** Imagery in thinking. (Top) Subjects were shown a drawing similar to (a) and drawings of how (a) would look in other positions, such as (b) and (c). Subjects could recognize (a) after it had been "rotated" from its original position. However, the more (a) was rotated in space, the longer it took to recognize it. This result suggests that subjects actually formed a three-dimensional image of (a) and rotated the image to see if it matched. (Shepard, 1975.) (Bottom) Try your ability to manipulate mental images: Each of these shapes can be folded to make a cube; in which do the arrows meet? (After Kosslyn, 1985.)



**Fig. 10.2** When you see a flower, its image is represented by activity in the primary visual area of the cortex, at the back of the brain. Information about the flower is also relayed to other brain areas. If you form a mental image of a flower, information follows a reverse path. The result, once again, is activation of the primary visual area.

## Concept Formation

- Process of classifying information into meaningful categories
- Positive Instance: Object or event that belongs to the concept class
- Negative Instance: Object or event that does not belong to the concept class
- Conceptual Rule: Guideline for deciding if objects or events belong to concept class

## More Concept Issues and Terms

- Prototypes: Ideal model used as an example of a concept
- Denotative Meaning: Exact definition of a word or concept
- Connotative Meaning: Emotional or personal meaning of a concept
- Prototypes: imaginary "perfect models" you have of something.

## Language and Thought

- Whorf's **linguistic relativity hypothesis** theorizes that language determines our perceptions of reality
- Researchers suggest that language influences thought

## Language and the Brain

- There may be critical periods of language development
- Broca's area is involved in speech and language production
- Supramarginal gyrus combines word meaning with the production of words

## Language: Some Terms to Know

- Symbolic: sounds and words represent stuff
- Encoding: Translating information into symbols that are easy to manipulate
- Semantics: Study of meanings in language. Although the relationship b/w words and "stuff" (symbols) is arbitrary, once accepted by YOU, it does take on meaning

## Language: Some Terms to Know

According to research at Cambridge University, it doesn't matter in what order the letters in a word are, the only important thing is that the first and last letter be at the right place. The rest can be a total mess and you can still read it without problem. This is because the human mind does not read every letter by itself, but the word as a whole.

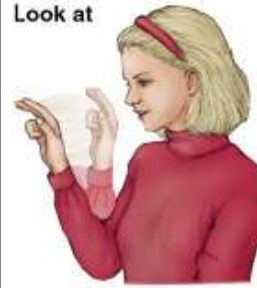
## Language: Some Terms to Know

- Generative: infinite variety of combinations
- Phonemes: Basic speech sounds of a language
- Morpheme: Speech sounds collected into meaningful units, like syllables or words (50,000 English morphemes but over 1,000,000 words).

## Language (cont.)

- Grammar: Set of rules for making sounds into words and words into sentences
- Syntax: Rules for word order in sentences
- Transformation Rules: Rules that allow us to change a declarative sentence into other voices (passive, active) or forms
- American Sign Language (ASL): Language used by deaf and hearing-impaired people

Look at



Stare



Fig. 10.9 ASL has only 3,000 root signs, compared with roughly 600,000 words in English. However, variations in signs make ASL a highly expressive language. For example, the sign LOOK-AT can be varied in ways to make it mean look at me, look at her, look at each, stare at, gaze, watch, look for a long time, look at again and again, reminisce, sightsee, look forward to, predict, anticipate, browse, and many more variations.

## Evolution of Language

- Ontogeny recapitulates Phylogeny
- Sarah, a bonobo chimp learned over 600 words. Understood the difference b/w pour the lemonade into the coke, from pour the coke into the lemonade.
- Play Prisoner's dilemma to illustrate importance of language in social animals

## Animal Language

- Animals are capable of limited communication
- Language in animals is not comparable to human language
  - Apes lack appropriate vocal cords for generation of speech
  - Apes can be trained to use non-vocal sign language
    - Washoe acquired American Sign Language
  - Dolphins can be trained to respond to hand signals and to vocal commands
  - Animal language lacks complexity and syntax

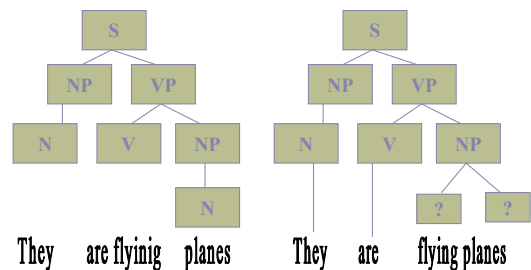


Fig. 10.10 Here is a sample of some of the word-symbols that Sarah the chimpanzee used to communicate with humans. (After Premack & Premack, 1972.)

Would being a better communicator increase one's chance of reproduction? A 1% increase in a biological (inherited) trait would – in 4,000 generations (12,000 years) would go from 1% to 99.9%

LAD (Language Acquisition Program): We can learn very complex language in only 2 years!!!!!!

## Language: Handout Master 8-1



## NATURE VS. NURTURE

- Nurture = B.F. Skinner. Parents shape children's language by REINFORCING successful imitations of proper sounds, words, and syntax. (My brother Wade)
- Nature = Noam Chomsky—LAD
- Interactionist Theory combines both
  - Cognitive Theorists: language is just aspect of cognitive growth
  - Social Communication Theorists: emphasizes the functional aspect of language

## How do children learn

- 3 months: children have use of all phonemes (even ones they never hear)
- 6 months: babbling
- 10 months: 1<sup>st</sup> word
- 12 months: 1<sup>st</sup> sentence (Fast Mapping allows for a MASSIVE increase in vocab.) RECEPTIVE vocab is larger than PRODUCTIVE vocab.
- 2-3 years: longer sentences
- 3+: complex sentences and OVEREXTENSION/ UNDEREXTENSION (word categories problems) OVERREGULARIZATION (grammar problems) **DISAPPEAR.**

## Barriers to Problem Solving

- Types of Problems
  - Inducing Structure (Set game) finding a relationship. **(H.M. 8-5)**
  - Problems of Arrangement (shape puzzle) ex: Vaders
  - Problems with Transformation: you have a large pitcher with 127 oz of water, a medium pitcher with 21 oz. and a small pitcher with 3 oz. How can you get exactly 100 oz.?

- **Transparency Master 8-9**
- **Transparency Master 9-4**
- **Stop and Play "Stations"**

## Barriers to Problem Solving

- **Mental set** occurs when prior experiences in solving problems lead to an inability to solve future problems (person is stuck using old strategies). Or using the wrong Mental Module. **Tell "Cowboys on a plane" riddle.**
- **Fixations:** Tendency to repeat wrong solutions and to "fixate" on them, or to become blind to alternatives.
- **Functional fixedness** occurs when a person is unable to recognize a new use for a familiar object **Lightbulb Puzzle**
- **Confirmation bias** is the inclination to only use evidence that fits his or her preconceived ideas

## Barriers to Problem Solving

- **Availability heuristic** involves judging the likelihood or probability of events based on how readily available are other instances in our mind.
- **Representativeness heuristic** is the tendency to estimate the probability of something based on how well the circumstances match our previous prototype.
- **Emotional Barriers:** Inhibition and fear of making a fool of oneself or of making a mistake
- **Cultural Barriers:**
  - Field Dependent people: Constrained by "reality". Conformist cultures
  - Field Independent: "outside the box". Individualistic Cultures

### Solve the following

A clan of nomadic desert dwellers is approaching an oasis. The leader says to his followers: "He who's camel arrives last at the oasis will receive a bag of gold". They start for the oasis, going slower and slower until they all dismount and try to outwait the others. A stranger comes by and hears their story. He says 2 words and they race off on the camels for the oasis. What were the 2 words?

### And These?

A man walks into a bar and asks the bartender for a glass of water. The bartender pulls out a shotgun and points it at the man. After several startled seconds the man says "thank you and walks out of the bar. Why did the man say "Thank you"?"

A man is at work and wants to go home. However, whenever he tries a man in a mask is waiting for him and he stops. What does the first man do for a living?

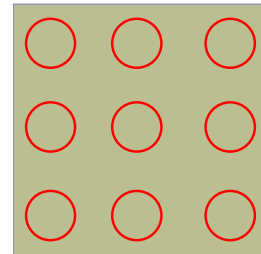
### And these

- A man is found shot to death in room with a table, 4 chairs and 53 bicycles. Why was he shot
- A seal walks into a club. Ha Ha

And now for the hardest one ever.

- There are two doors, each with a guard. 1 door leads to safety, the other to death. 1 guard always lies, and the other always tells the truth. What ONE (1) question can you ask both guards (the SAME question) to make sure you will choose the safety door?

- **Unnecessary Constraints:** connect a 9 dots

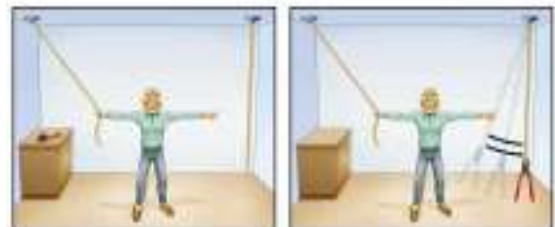


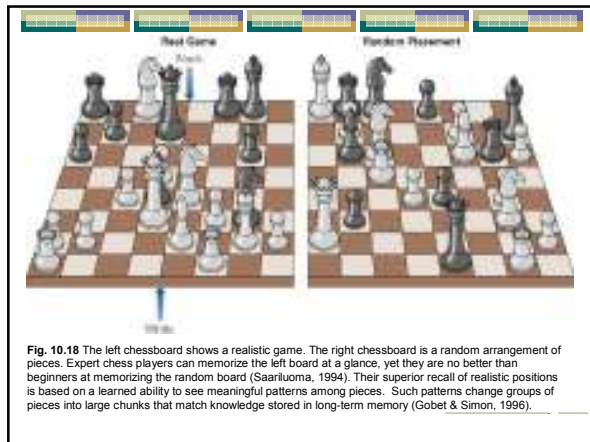
Show Trans 8-9 Again

### Barriers to Problem Solving (cont.)

- Irrelevant information. "If you put .345 cubic milliliters of bacteria into a flask that is EXACTLY 5 cubic liters, and the bacteria doubles every second. At what measurement point (in milliliters) will the flask be 1 second from being full.
- Learned Barriers: Taboos; staying with conventional uses
- Perceptual Barriers: Habits leading to a failure to identify important elements of a problem

### Functional Fixness





## How To Solve Problem

- Mechanical Solution: Achieved by **trial and error** or by rote
- Random Search Strategy: All possibilities are tried, more or less randomly
- Algorithm: Learned set of rules that always leads to the correct solution. Retracing your every footstep till you find your lost keys.
- Heuristic: Strategy for identifying and evaluating problem solutions. "rule of Thumb". Only works if the problem is multi-level. 3 types
  - Forming sub-Goals
  - Working Backwards
  - Analogies

- Forming sub-Goals. Move all 3 rings to the post in the same order. Only a top ring can be moved (ex: red). A larger ring can NOT be placed on a smaller ring.

## Heuristics Cont.

- Working Backwards
  - Bridge puzzle: four people at midnight approach a bridge.
    - They only have one lantern,
    - Man "1" always takes 10 minutes
    - Man "2" always takes 5 minutes
    - Man "3" always takes 2 minutes
    - Man "4" always takes 1 minutes
    - They MUST go cross in pairs
    - One of them MUST return with the lantern
    - They MUST cross in pairs again, etc.
    - Get all 4 across in the less than 18 minutes.
  - Chicken, fox, Grain puzzle

## Heuristics Cont.

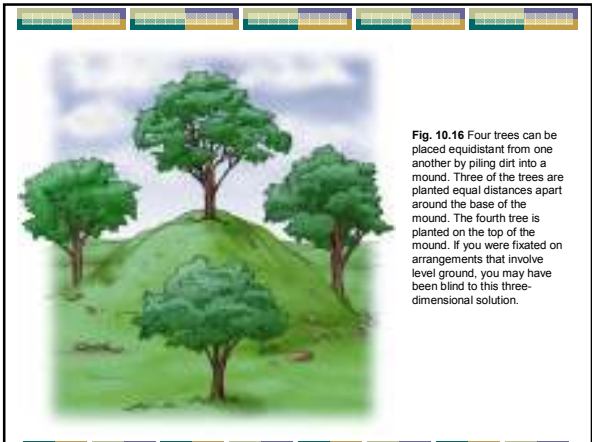
- Analogies: Tying NEW problems to same TYPE of problem you solved in the past. Send ½ of class into the hall and tell the "the generals dilemma" story to the remaining ½ of the class. Bring outside ½ back in and have them all read the next slide. See who can solve it better: outside ½ or inside ½

## Heuristics Cont.

Your patient has a stomach tumor. He is too weak to survive any type of surgical removal. If you don't remove it he will die. You could use a red laser to kill it at a very high intensity level, but it would also kill all the tissue it passes through at that level. How do you kill the tumor w/o killing the patient.

## Problem Solving

- **Preparation** lays the groundwork
  - Identify given facts
  - Distinguish relevant from irrelevant facts
  - Define the ultimate goal
- **Production** involves generating hypotheses
  - **Algorithms** will generate a solution (ALL possible choices)
  - **Heuristics** are educated guesses
    - Means-ends analysis
    - Working backwards
    - Creation of subgoals
  - **Random Search Strategy:** All possibilities are tried, more or less randomly
- **Evaluation** asks whether the generated solutions satisfy the problem



**Fig. 10.16** Four trees can be placed equidistant from one another by piling dirt into a mound. Three of the trees are planted equal distances apart around the base of the mound. The fourth tree is planted on the top of the mound. If you were fixated on arrangements that involve level ground, you may have been blind to this three-dimensional solution.

## Decision Making

• Theory of Bounded Rationality (Simon): states that most people decide issues using simplistic strategies that result in irrational decisions.

• Additive Strategy:

Free 100 test grade	+12
Feel good abt self	+2
Miss out on _____	-5
Every quiz is a grade	+3
Hasn't helped in past	-4
Lose sleep	-3
Have to miss work/\$	-3
So DECIDE	?

## Decision Making (cont.)

• Subtractive: make a list of needed aspects, and then eliminate choices by the most important aspect first. Say you are offered 3 jobs

	Job 1	Job 2	Job 3
	\$7.00	\$10.00	\$12.00
1 mile away	5 miles away	20 miles away	
weekends	M, W, Fr 6:00-9:00	T. Th. 8:00-2:00	
Friendly boss	Neutral boss	Demanding boss	

## Why we make such BAD decisions

- Risky Decisions:
  - We don't weigh the probability and decide logically
  - We let "Subjective Probability" push us into bad decisions: Buying a lottery ticket.
- Using Heuristic devices:
  - Availability Heuristic: Estimating the probability based on what comes to mind. If you know a lot of divorced people you will rate US divorce rates too high.
  - Representative Heuristic: Estimating the probability based on how similar the result would be to typical PROTOTYPES. Ex. Which coin flip scenario is more likely?
    - TTTTTT
    - HTTHHT

H.M 8-6. Answer question and say if it is Availability or Representative

## Why we make such BAD decisions

- We ignore Base Rates: People ignore statistics when making decisions, especially when it affects THEM. Ex: smoking
- The Conjunction Fallacy: "You meet a man who knows a lot about construction, but he also stumbles and slurs his words." Is he more likely a carpenter, or a drunk carpenter.

## Or DO we really make such bad decisions?

- Most research on decision making is NOT done in SOCIAL situations. Remember the “D,F3,7 vs drinking” scenario.
- Researchers who put people into social decision situations find that they are very good at recognizing cheaters.

## Artificial Intelligence (AI)

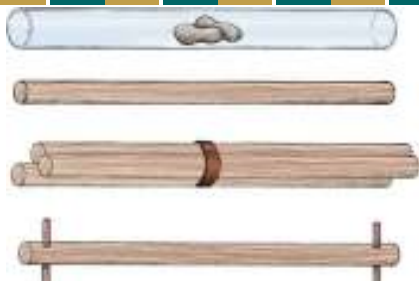
- Computers (and their programs) that perform human-like problem solving or intelligent responding (Deep Blue, the chess-playing supercomputer)
- Computer Simulations: Programs that attempt to duplicate human behavior, especially thinking, problem solving, or decision making

## Artificial Intelligence (AI) (cont.)

- Expert Systems: Computer programs that respond as an expert human would
  - Responding like a chess Grand Master
- Organized Knowledge: Systematic information
- Acquired Strategies: Learned tactics

## Do Animals Think?

- Delayed Response Problems: Tasks in which an animal must remember the solution to a problem before responding
- Multiple-Stick Problem: Several sticks of increasing length are arranged between the cage and the desired goal or object
- Conclusion: Animals are capable of delayed responding, planning future actions, tool use, and simple problem solving that imply a basic level of thinking capacity



**Fig. 10.25** Researchers found that chimpanzees, bonobos, and orangutans can solve problems that appear to require both things and comprehension. A transparent plastic tube was baited with a food treat (such as peanuts), and the apes were given one of three tools to use, a straight stick, a bundle of sticks, or a stick with crossbars. Successful use of the latter two tools required greater comprehension of the problem (Visalberghi, Fragaszy, & Savage-Rumbaugh, 1995).



**Fig. 10.24** Psychologist Wolfgang Köhler believed that the solution of a multi-stick problem revealed a capacity for insight in Chimpanzees.

## Creative Personality

- There is a weak correlation b/w smart people and higher levels of creative
- Creative people usually have a greater than average range of knowledge and interests
- Creative people have openness to experience

## Creative Thinking uses ALL of:

- Inductive Thought: Going from specific facts or observations to general principles
- Deductive Thought: Going from general principles to specific situations
- Logical Thought: Going from given information to new conclusions based on explicit rules
- Illogical Thought: Thought that is intuitive, associative, or personal

## How to “Rate” Creative Thoughts

- Fluency: Total number of suggestions you can make
- Flexibility: Number of times you shift from one class of possible uses to another
- Originality: How novel or unusual your suggestions are
- Convergent Thinking: Lines of thought converge on an answer; conventional thinking
- Divergent Thinking: Many possibilities developing from one starting point

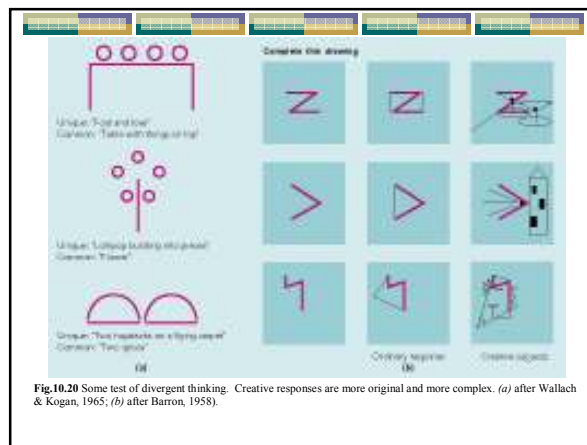


Fig.10.20 Some test of divergent thinking. Creative responses are more original and more complex. (a) after Wallach & Kogan, 1965; (b) after Barron, 1958).

## Daydreams, Fantasy, and Creativity

- Daydream: Vivid waking fantasy
- Two Most Common Plots:
  - Conquering Hero Fantasy: Daydreamer is the star as a famous, rich, or powerful person
    - May reflect need for mastery and desire to escape frustrations of life
  - Suffering Martyrdom: Others regret their past actions and realize what a great person the daydreamer always was

## Tests of Creativity

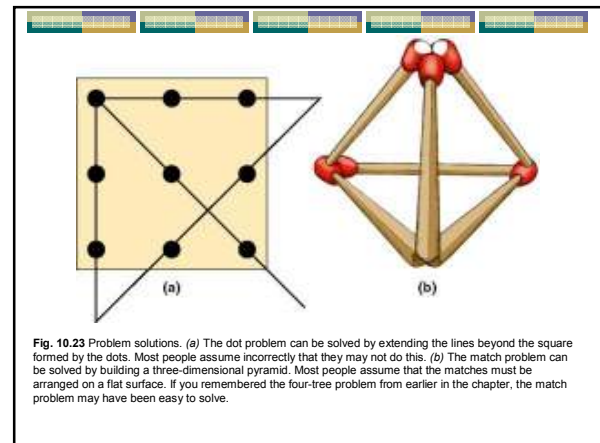
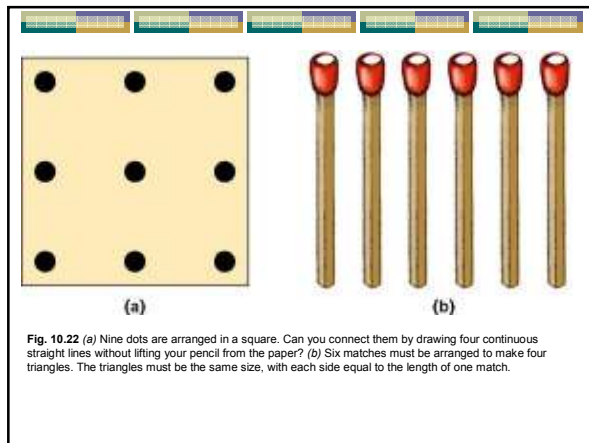
- Unusual Uses Test: Find as many uses for an object as possible (Tell me all the things you can do with this pencil.)
- Consequences Test: List all the consequences that would follow if a basic change were made in the world (What would happen if we were able to read everyone's thoughts?)
- Anagrams Test: Make as many new words as possible from the letters in a given word
  - Often seen on puzzle pages in newspapers.

## Stages of Creative Thought

- Orientation: Defining the problem
- Preparation: Gaining as much information as possible
- Incubation: The problem, while not appearing to be actively worked on, is still “cooking” in the background
- Verification: Testing and critically evaluating the solution
- Insight: The “a-ha” experience; rapid insight into the solution

## Insight

- Definition: Sudden mental reorganization of a problem that makes solution obvious
- Involves three abilities
  - Selective Encoding: Selecting information that is relevant to a problem while ignoring distractions
  - Selective Combination: Connecting seemingly unrelated bits of useful information
  - Selective Comparison: Comparing new problems with old information or with problems already solved (Sternberg & Davidson, 1982)



## How to Enhance Creativity

- Break mental sets and challenge assumptions
  - Mental Set: Predisposition to perceive or respond in a certain way that blinds us to possible solutions
- Define problems broadly
- Restate the problem in different ways
- Allow time for incubation
- Take sensible risks
- Look for analogies
- Seek varied input
- Brainstorm

## Brainstorming

- Keeping the production of ideas separate from the evaluation of them; producing ideas with no criticism
- Cross-Stimulation Effect: When one participant’s ideas in a group problem solving session trigger ideas from others